CORPORATE FARM LAWS AND FARM SIZE:
A CASE STUDY

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Introduction

Whether or not farmers should be allowed to incorporate their business operations would appear, on the surface, to be a rather simple legal issue. In the Great Plains area of the United States, however, a heated debate on this subject has persisted for almost half a century. A major concern of those who oppose allowing incorporation has been the threat to the "small family farm." They contend that allowing incorporation could result in having family farms replaced by giant entities with largely non-local ownership [3, pp. 8-10]. The proponents argue that the main beneficiaries will be these same family farmers, who can more easily transfer their farms from generation to generation in the corporate farm. They would expect incorporation to permit a change in the form of farm ownership without causing unusual changes in the size of farms or in the residence of their owners [4, p. 9]. In this paper an attempt is made to inject some objectivity into one aspect of the debate. Does the opportunity to incorporate farming operations influence the size of farms?

To answer this question most easily, one would prefer to view a homogeneous farming region with corporate farming allowed in one portion and not allowed in the other. While no region is completely uniform in physical characteristics, the border counties of North Dakota and Montana come very close to an ideal setting for such a study. The region is very similar across boundary lines in those physical attributes which are likely to influence farm size, and corporate farming is freely permitted in Montana but illegal in North Dakota. Many states have laws restricting corporate farming in various ways, but all lie somewhere between the extremes of North Dakota's prohibition against incorporation and Montana's total absence of restructions.

While the inspiration for the study was the possible effect of corporate farming laws, an added dimension is the necessity to identify other determinants of farm size. The economic and physical forces which cause farm size to differ between regions are interesting in their own right. The study also serves as an example of a somewhat unique methodological approach. In addition to the commonplace application of stepwise regression analysis, path analysis based upon standardized regression coefficients is also used. This technique, widely used in sociology, is very useful in examining the relative importance of independent variables in the presence of multicollinearity and in explaining situations involving stepwise causality.

The Study Area

The study area consists of thirteen counties, seven in North Dakota and six in Montana (see Figure 1). While the area is divided in an east-west manner politically, it is more distinct physically from north to south. The four northern counties are characterized by glaciated level land and good soils, while the remaining nine counties contain large areas of land dissected by rivers with steeper sloping,

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lower quality land. The area was one of the last in the United States to be settled by European immigrant farmers, when access to markets via railroad transportation was gained in the 1880's and 1890's.

Historically, the pattern of farm size in the region shows the typical growth in acreage, but with a more rapid growth in Montana than in North Dakota (see Figure 2). The gap clearly widens more rapidly after 1940. The law prohibiting corporations from engaging in farming was passed in North Dakota in 1932. Existing corporate farms, however, had until 1942 to divest themselves of their farm holdings.[1] This may explain why the difference in farm size between North Dakota and Montana is more evident after 1940 rather than immediately after the law was passed.

FIGURE 1. Counties and Average Farm Size (in acres - 1974)
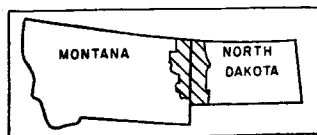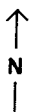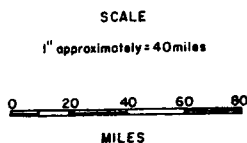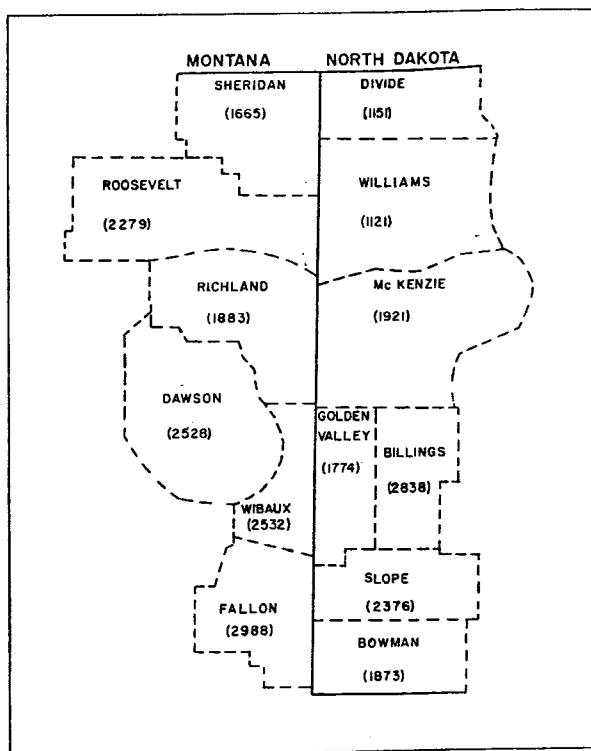
[1] North Dakota Corporate Farm Law, Section 10-06-03.

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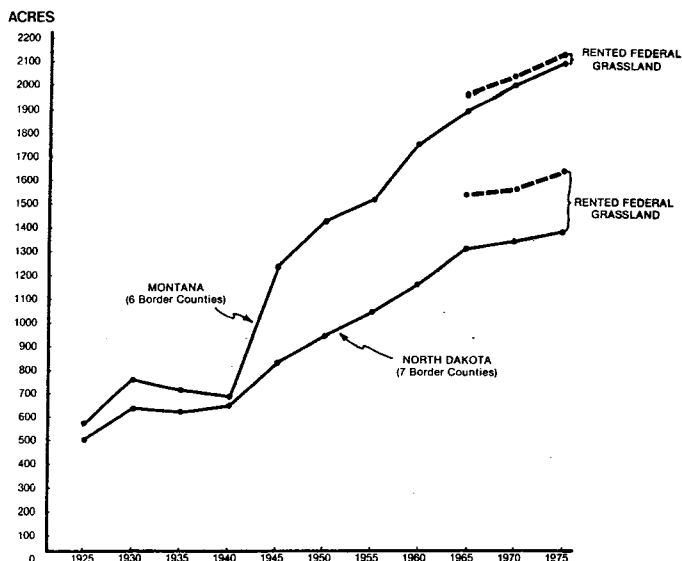
Sources:

U.S. Dept. of Commerce, *Census of Agriculture,* for appropriate years.

S. W. Voelker and J. E. Johnson, "Adjustment of County Statistics in the 1964 Census of Agriculture for Changed Definitions of Farms Operated by Grazing Associations in North Dakota," *Agricultural Economics Miscellaneous Report No. 1,* North Dakota State University, March 1968.

Other elements may have influenced this historical trend, namely the depression of the early 1930's and the drought of the late 1930's. While the depression lowered farm prices drastically, which should encourage farm abandonment, the accompanying high unemployment rates in urban places had a greater impact and discouraged off-farm migration. The drought encouraged off-farm migration, but in turn, discouraged farm purchases. Both phenomena, in different ways, probably had an impact upon the extent and timing of land consolidation in the study area. These forces, however, influenced farm size in both states. Better prices and better weather came to the entire study area at the same time. As indicated in Figure 2, however, the combination of circumstances produced a much steeper increase in farm size between 1940 and 1945 in Montana border counties than was true for those in North Dakota.[2]

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[2] In some regions farm size is distorted by the presence of numerous small "hobby farms." This is not the case in the study area because there are so few opportunities for off farm work in the small trade centers which characterize the region. Only 5 percent of the farms in the North Dakota counties were under 100 acres in 1969 and 1974, and 7 percent in Montana (U.S. Census of Agric., County Data, 1974). The number of small farms, then, is not only small but uniform along the border between the two states.

With this brief geographic and historical perspective, the question raised here is whether or not the ability to incorporate a farm has an impact upon farm size in this study area today. To make such a judgment requires identifying as many variables as possible which may influence the size of farms, and determining whether or not corporate farming is among them.

The General Model and the Variables

The problem of relating farm size to a number of variables at a given time lends itself to the now rather typical cross section multiple regression analysis technique. The size of farms becomes the dependent variable and in this case, the value of sales per acre, the percentage of land in wheat, the percentage of land in other crops, the percentage of level land, the percentage of good soils, average annual precipitation, and the percentage of land in corporate farms, become the independent variables. The model takes the usual form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \ldots \beta_7 X_7 + e_i$$

Where

Y = Average size of farms in each of thirteen counties

β_1 to β_7 = Regression coefficients

X_1 to X_7 = Average value for dependent variables in each of the thirteen counties.

Before describing the more refined regression model actually used, or the subsequent path model, each of the explanatory variables will be discussed to demonstrate how they were measured and their expected effect upon the dependent variable.

Value of Sales Per Acre

In selecting independent variables related to farm size, the basic guideline was to consider a farm as a single unit of business and to consider those forces which would affect the number of acres required for a viable business entity (or family farm). In this context, the most obvious economic force would be the amount of sales which can be generated from an acre of land. Because of the presence of economies of scale, albeit at a low level for farming, a certain gross income is essential to reach the break-even point.

The value of sales per acre was determined by dividing total farm sales in each county by the acreage in farms.[3] On the assumption that a change in farm size is a long-run rather than short-run decision, and would be made in response to cumulative experience, average sales per acre for the census periods from 1944 to

[3] A data problem occurred in connection with this variable which influenced others as well. In some census periods the national grasslands were included as part of acres in farms, while in other years they were not. It was necessary to settle on a consistent treatment of these lands, and it was decided to include them because, while they are rented from the federal government rather than owned, they are an integral part of the operating units in several counties of the study area. For a discussion of this problem, see S. W. Voelker and J. E. Johnson, "Adjustment of County Statistics in the 1964 Census of Agriculture for Changed Definitions of Farms operated by Grazing Associations in North Dakota," *Agricultural Economics Miscellaneous Report No. 1,* North Dakota State Univ., March 1968.

1969 and 1944 to 1974 were used to identify this variable (see Table 1). Because larger sales per acre make it possible to have a viable business on fewer acres, this variable was expected to be inversely related to farm size.

TABLE 1. Economic, Physical, & Political Variables Associated with Farm Size. North Dakota and Montana Border Counties

	Average Farm[1] Size (Acres) 1969 1974		Percent[1] Farmland Corp. Fms. 1969 1974		Ave. Sales[1] Per Acre 1944- 1944- 1969 1974 (Census Yrs)		Percent[1] Farmland in Wheat 1969 1974		Percent[1] Farmland in Other Cps. 1969 1974		Percent[2] Level Land	Percent[3] Good Soils	Average[4] Annual Precip. 1931-60
North Dakota													
Divide	1072	1151	0	0	$9.24	$13.39	24%	31%	10%	7%	63%	95%	13.36
Williams	1115	1121	0	0	9.56	12.95	21	27	9	8	61	85	13.70
McKenzie	1876	1921	0	0	6.61	8.38	8	9	8	9	39	35	15.71
Golden Valley	1710	1774	0	0	7.37	10.05	10	15	11	9	42	50	13.68
Billings	2689	2838	0	0	3.42	3.98	3	4	6	6	30	30	15.77
Slope	2240	2376	0	0	5.49	7.39	10	13	8	8	57	55	14.48
Bowman	1789	1873	0	0	6.06	8.24	11	16	12	11	56	70	12.38
Montana													
Sheridan	1491	1665	6.3%	11.5%	8.73	11.20	21	26	9	6	62	100	13.19
Roosevelt	2002	2279	5.0	6.2	7.08	9.05	16	20	9	5	58	100	12.55
Richland	1741	1883	2.8	8.7	8.89	12.94	10	12	9	9	43	90	15.20
Wibaux	2477	2532	2.6	17.1	4.99	6.72	6	10	6	6	37	40	13.16
Fallon	2993	2988	13.8	19.9	4.12	5.54	6	8	6	6	39	15	14.09
Dawson	2548	2528	8.3	22.5	5.09	7.09	8	12	6	5	39	50	12.49

SOURCES:

[1] U.S. Dept. of Commerce, *Census of Agriculture,* for appropriate years.

[2] U.S. Geological Survey, Topographic Maps, 1/250,000 Series.

[3] A. R. Southard, *Soils of Montana,* Montana State University, 1969; and H. W. Omodt, G. A. Johngard, D. D. Patterson, and O. P. Olson, *The Major Soils of North Dakota,* North Dakota State University, 1968.

[4] R. A. Dightman, National Weather Service, Helena, Montana; and Cooperative Extension Service, North Dakota State University.

Corporate Farms

Several variables were considered in measuring the extent and magnitude of corporate farms. The number of corporate farms, the acreage in corporate farms, and the percentage of the total farmland in corporate farms were examined. In an earlier version of the model, the number of corporate farms in each county proved significant. While most corporate farms are large, however, the number does not adequately allow for variations in size. The total acreage in corporate farms considers size but does not adjust for differences in the size of counties. It was determined, therefore, that the percentage of land in corporate farms within each county would be the best measure of this variable (see Table 1). In this form the variable is expected to have a positive relationship with the dependent variable.

While North Dakota law does not permit corporations to own and operate farm land, it does allow cooperatives to do so. The Census of Agriculture lists a few corporate farms in North Dakota in both 1969 and 1974. These are, however, cooperatives. While cooperatives can operate in a manner similar to corporations, those cooperatives in North Dakota were organized to handle vertically integrated operations such as feed lots, rather than the large grain or cattle farms typical of

the region. These units are, therefore, excluded from the analysis, and North Dakota is assumed to have no corporate farming acreage.

Land in Wheat and Other Crops

The two basic types of agriculture in the study area are livestock raising and cropland farming, with wheat the dominant cash crop. While wheat farms in the Great Plains tend to be much larger than crop farms in other parts of the country, they tend to be smaller than livestock operations in the same area. As a result, the percentage of farmland in wheat in each county is expected to have a negative effect upon average farm size.

The other crops grown in the study area are largely feed crops, with hay being dominant. Hay tends to be raised on the river bottom land in conjunction with livestock operations. This variable, therefore, could have either a positive or negative effect upon the dependent variable. A positive effect would suggest that it is associated with the larger livestock operations, while a negative effect would result if larger amounts of hay land permit livestock operations to function with fewer acres. The model should indicate which force is strongest.

Soils

The soil groups found in the study area include chestnut, solonetz, regosols, and lithosols. Of these, the chestnut group is best suited to farming. These are well drained, highly productive soils with parent materials ranging from loamy sand to silty clay in texture and including glacial till, outwash, wind blown sands, loess, alluvium, and materials derived from weathered sedimentary beds of the tertiary formation. The second best soil group is the solonetz which occurs in association with the chestnut soils. Solonetz are characterized by poor physical condition, limited rooting depth, very slow permeability, and high alkalinity. They are, however, used for cropland as well as pasture in the study area.

The soils variable is measured by the percentage of chestnut and solonetz soils contained in each county because both are used in crop farming. The regosols and lithosols groups are relegated almost entirely to pasture for livestock grazing. In this form the soils variable is expected to have a negative impact on farm size, because better soils produce higher yields per acre.

Precipitation

The western counties of North Dakota receive slightly more precipitation than the eastern counties of Montana (see Table 1). This trend would be even more evident if the average annual precipitation was followed from west to east through all of North Dakota and Montana.

Air masses rise and cool as they progress eastward over the Rocky Mountains. The air masses condense, form clouds, and subsequently lose most of their moisture by the time they get to the leeward or eastward side of the mountains. There is very little moisture available until air masses pass through most of Montana and into North Dakota. Moisture can then be picked up from other sources such as air masses pushing up from the Gulf of Mexico. Hence, the increase in rainfall as one moves from eastern Montana through western North Dakota.

Adjustments in farm size in response to precipitation are clearly a very long-run phenomenon. For this reason, the precipitation variable reflects the average annual precipitation in each county over the period from 1931 to 1960. In this form, the variable is expected to be inversely related to farm size as higher precipitation contributes to higher yields per acre.

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Topography

The percentage of level land in a region can influence the size of farms in two ways. To the extent that level land increases mechanization, the grain farms will tend to be larger. Dissected land, however, is usually devoted to livestock operations which tend to be larger than crop farms. In the study area, both phenomena are at work and the relationship between this variable and the size of farms may be reduced because of these counteracting forces. The model will tell us which force prevails, but it cannot separate the impact of the two.

This variable reflects the percentage of the land in each county which has a slope of less than eight percent. The data base was developed by using contour maps on a scale of one to 250,000. Each quarter township was examined and level land was defined as sizable tracts with a slope of less than eight percent. Thus, very small, level parcels, not suited to mechanized farming, were excluded.

The Specific Models

The models used to examine and explain the results of this study include a forward and backward stepwise regression model and a path model using standardized regression coefficients. Both models are applied to data based upon the 1969 and 1974 Census of Agriculture.

The reason for including both models, rather than choosing between them, is that the regression model shows interesting results at several different steps and provides the basis for an estimating equation, while the path analysis is a better basis for demonstrating the interrelationships between the variables and their relative importance. The reason for using two time periods is to add credibility to the findings and to demonstrate some interesting changes which occurred between these two periods.

The results of the regression model are summarized in Table 2. The forward solutions are obtained by stepwise building and represent, in each year, the point at which any new variable added would not be statistically significant. The backward solutions are obtained by stepwise reduction, and represent the point at which all variables remaining in the model are significant. The "best" solution for each year represents that equation which maximizes the R^2 while incorporating only variables which are significant or suspiciously close to significant.

The percentage of land in corporate farms proved to be significant in all forms of the models except the backward step in 1974 (see Table 2). The sign associated with the variable is positive, as expected, and the results strongly suggest that the opportunity to incorporate tends to increase the size of farms in the study area. The variable proved to have a greater impact on the dependent variable, and to be more significant, in 1969 than in 1974.

The value of sales per acre also proved significant in five of the six models presented in Table 2. Like the corporate farm variable, however, its impact and significance declined in 1974 from 1969.

The percentage of acreage in wheat proved significant in all three models in 1969 and in the "best" and backstep models in 1974. The sign of the coefficient for wheat acreage is negative, as expected, suggesting that this variable is tending to reduce the size of farms in the study area because crop farming tends to yield higher money returns per acre than livestock raising. Indeed, what the model suggests is that sharp increases in wheat prices between 1969 and 1974 caused wheat acreage to become more important in keeping down the size of farms than

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TABLE 2. Summary Statistics from Stepwise Regression Models Relating Farm Size to Selected Variables (n = 13)

Variables	1969			1974		
	Forward	"Best"	Backward	Forward	"Best"	Backward
Level Land (%)					22.8* (2.89)	29.0* (3.23)
Good Soils (%)		3.7* (2.37)				
Precipitation (Ave. Ann. Inches 1931-60)						
Land in Wheat (% of Farmland)	-27.1* (2.93)	-33.7** (4.59)	-27.1* (2.93)		-67.9** (4.31)	-95.8** (7.64)
Land in Other Crops (% of Farmland)		-44.9* (2.77)			-100.2* (3.20)	-163.3** (6.46)
Value of Sales Per Acre ($; 1944-69 or 1944-74)	-169.5** (5.42)	-171.2** (7.07)	-169.5** (5.42)	-162.3** (7.78)	-59.6' (2.26)	
Land in Corporate Farms (%)	41.6** (5.41)	35.5** (5.99)	41.6** (5.41)	18.0* (2.61)	10.0' (1.84)	
Intercept	3307	3561	3307	3407	3329	3365
R^2	97.3	99.0	97.3	92.3	97.4	94.7

NOTE:** Significant at .01   * Significant at .05   'Significant at .10
Values in parentheses are t-values for significance testing.

historical experience with value of sales per acre. It should be noted that the regression program reveals a simple correlation coefficient of .80 between value of sales per acre and wheat acreage. This could explain why value per acre drops out in the backward stepping, as the model selects from two highly correlated independent variables on the basis of which one makes the greatest contribution to the explanation of the dependent variables at a different stage of the fitting process.

The above events suggest why corporate farming became a less important variable in 1974. If high prices for wheat were causing wheat acreage to become the dominant variable then there would be less impact from any variable which would tend to increase the size of farms. It is significant to note, however, that the percentage of land in corporate farms did rise substantially in all Montana counties in the study area between 1969 and 1974. The rapid increases in the prices of grains and farm land which were occurring during this period were probably motivating people to incorporate to protect their increased wealth, rather than as a vehicle to expand the size of their farms.

The percentage of acreage in other crops also proved significant in the "best" of the 1969 models and in the "best" and backstep models for 1974 (see Table 2).

The sign of this variable is consistently negative suggesting that the opportunity to grow hay and other feed crops reduces the land requirement for a viable livestock operation.

Up to this point, the economic variables have dominated the models. The physical variables are included in only a few of the models and have signs which are the opposite of those expected. These variables are certainly important in determining farm size in the study area, but their effect occurs through the economic variables, contributing to the multicollinearity and leading to their elimination from the equation.

A problem with multiple regression is that when the independent variables are highly correlated, the selection of variables for inclusion in the equation can be quite arbitrary. That variable will be selected which most increases the regression sums of squares, but once selected will exclude related variables. The choice of which variable to include is a purely mechanical one, and the decision can hinge on minor quirks in the data. In some circumstances, path analysis can provide a way out of this dilemma. Instead of machine sorting of independent variables, a model is postulated based on the innate structure of the data and the hypothesis to be tested [2, p. 81]. Unlike multiple regression, more than one causal step is allowed. Subsequently, multiple regression and correlation enables coefficients to be attached to each step in the model (usually correlation coefficients or standardized regression coefficients), the size of which indicates the strength of relationship. Regression coefficients are used when a causal effect can be inferred, indicated by a single directional arrow; correlation coefficients are used otherwise, indicated by a double headed arrow. Path models for 1969 and 1974 are shown in Figure 3.

While two of the three physical variables continue to have an insignificant impact upon the economic variables, the impact of level land is seen in a more logical context. The percentage of level land (X_6) has a significant positive effect upon the percentage of land in wheat (X_4) which, in turn, positively influences the value of sales per acre (X_2) which has a negative effect upon the size of farms. In this form the positive sign of the coefficient for level land is logical because it is positively associated with the amount of land in wheat. In 1969, the land-in-wheat variable impacts through the value of sales variable, as well as directly on the dependent variable.

The fact that the level land variable does not significantly influence the percentage of land in other crops reflects the earlier observations about the areas in ·which hay is grown for livestock. The small river bottom areas in otherwise dissected land areas would not be included in the level land variable.

The relative size of the standardized regression coefficients in Figure 3 indicates the relative importance of the variables. Level land, wheat acreage, and value of sales per acre are all more important than corporate farming as influences on farm size in both 1969 and 1974. Nevertheless, the percentage of land in corporate farming is significant and of the same order of magnitude in both years.

Conclusions

the evidence from this study strongly suggests that if North Dakota allows corporate farming, this action alone would tend to increase the size of farms in that state. Using regression models, it is possible to estimate the impact upon farm size in North Dakota's seven western border counties.

FIGURE 3. Path Models Showing Interrelationships of Physical, Economic &
Political Variables and Farm Size
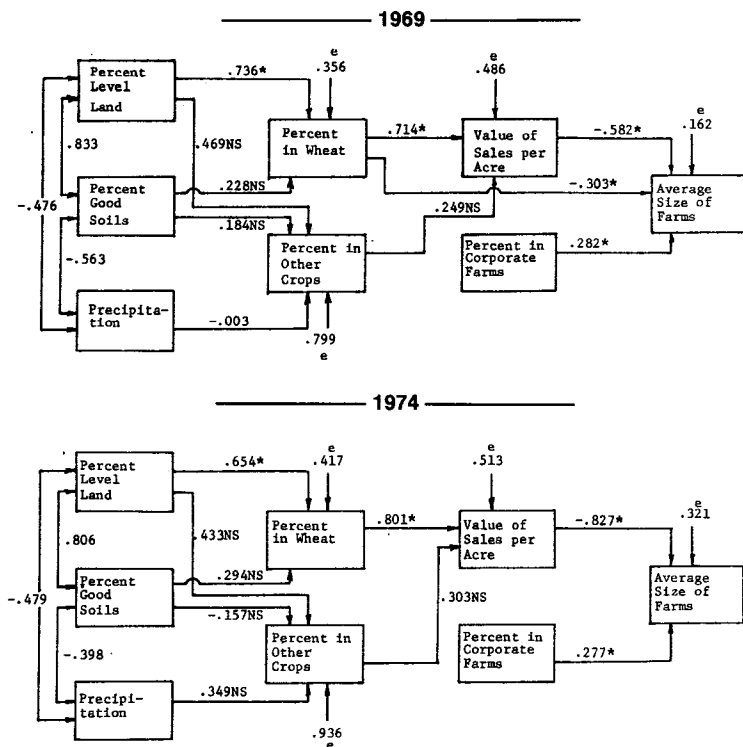
* Significant .05 level   NS — Not Significant
e — Unexplained Sums of Squares

The lack of influence on farm size of physical variables in the models supports the observation that the physical environment across boundary lines from east to west between North Dakota and Montana is quite similar. This suggests that if North Dakota would eliminate all restrictions on incorporation for farming operations, it is reasonable to expect that the extent of incorporation in North Dakota border counties would soon approximate that in eastern Montana. In Montana's six eastern border counties, 6.5 percent of the farmland was under incorporation in 1969, and 14 percent in 1974. The regression model for 1969 indicates that for every increase of one percent in land in corporate farms, farm size tends to increase by about 40 acres. If, therefore, farms including 10 percent of the land in North Dakota's border counties were to be incorporated, it would increase farm size by about 400 acres, an increase of about 25 percent from 1974 levels.

The 1974 regression models do not reflect as strong an influence for corporate farming. Because of rapid increases in wheat prices between 1969 and 1974, the acreage in wheat becomes very significant in 1974 and tends to overwhelm the value of sales per acre and corporate farming variables in at least one version of

the regression model. Insofar as the path model tends to sort out these problems, however, it suggests that corporate farming was just as important in influencing farm size in 1974 as was true in 1969. What the 1974 regression results do suggest is that if North Dakota removes its restrictions on corporate farming in years of high grain and beef prices, the impact upon farm size will probably be smaller, or slower in coming, than if the change is made in years of lower farm prices.

It is not clear how long the adjustment in farm size would take, but judging from historical experience with the original restrictions on corporate farming in North Dakota, the results would probably be evident within a five-year period.

An increase of 400 acres in average farm size would result in a decrease of about 770 in the number of farms (and farm families) in North Dakota's seven border counties. The remaining farm families would be operating larger farms and, therefore, presumably have higher incomes, but spending patterns in the region would obviously be affected. It is reasonable to assume that a similar impact, albeit of a different magnitude, would occur in other North Dakota counties.

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