A DISCRIMINANT ANALYSIS OF GRAIN MARKET STRUCTURE IN SELECTED STATES OF THE SOUTH AND CORNBELT

E. Dean Baldwin, Cameron S. Thraen and Donald W. Larson

Abstract

Scherer's industrial organization model is modified to characterize the grain marketing system. The modified model identifies the important relationships between economic characteristics and the type of grain facilities found in three states; Alabama, Illinois, and Ohio. Multivariate linear discriminant analysis is used to identify the important basic supply, demand, and transportation variables within and among these states. It is concluded that the structural differences among selected grain marketing regions can be explained by regional differences in basic supply, demand, and transportation variables. The findings suggest that Scherer's industrial organization model can be adapted to explain the diverse structure of the grain marketing system in selected states.

Key words: industrial organization model, grain market structure, discriminant analysis.

INTRODUCTION

The grain marketing system in the United States has evolved from a simple process of transporting relatively small grain surpluses directly from farms to the final consumer in its early stages, to a highly complex system involving many physical and service oriented functions. Today's grain marketing system is comprised of transportation, processing, merchandising, and service activities conducted by managers of a highly diverse set of grain facilities. This diversity exists both within and among major grain producing regions of the United States. With substantial regional diversity and specialization in grain and livestock production patterns, transportation alternatives, shipping rates, and final market outlets, it is common knowledge that the evolutionary process has resulted in a unique set of plant or facility types within specific grain producing regions. What is not as well understood is the relationship between specific economic characteristics of a region and the type of grain facility to be found operating in that region.

Past research on this subject has investigated the structural characteristics of various grain producing regions, focusing on the number, type, size, and extent of services offered by those grain handling facilities (Hennen et al., Baldwin and Bateman, and Schnake and Driscoll). Because of an inadequate data base, these studies have been primarily descriptive in nature, identifying what exists in the region in question but not attempting to statistically relate the economic characteristics of the region to the type of facilities found there (Caves).

The purpose of this paper is to identify significant economic variables which are associated with the type and mix of grain facilities for selected states in three United States regions: the South, Eastern Cornbelt, and the Western Cornbelt.[1] Individual grain facility data for the states of Alabama, Illinois, and Ohio for the year 1977 are used in this analysis.[2] Multivariate linear discriminant analysis (MLDA) is the methodology employed.

In the first section of this paper, a modification of Scherer's industrial organization model is applied to the grain marketing system to identify sets of economic variables which influence grain market structure. Section two reviews the basic properties of the MLDA technique which is used to identify the significant economic variables

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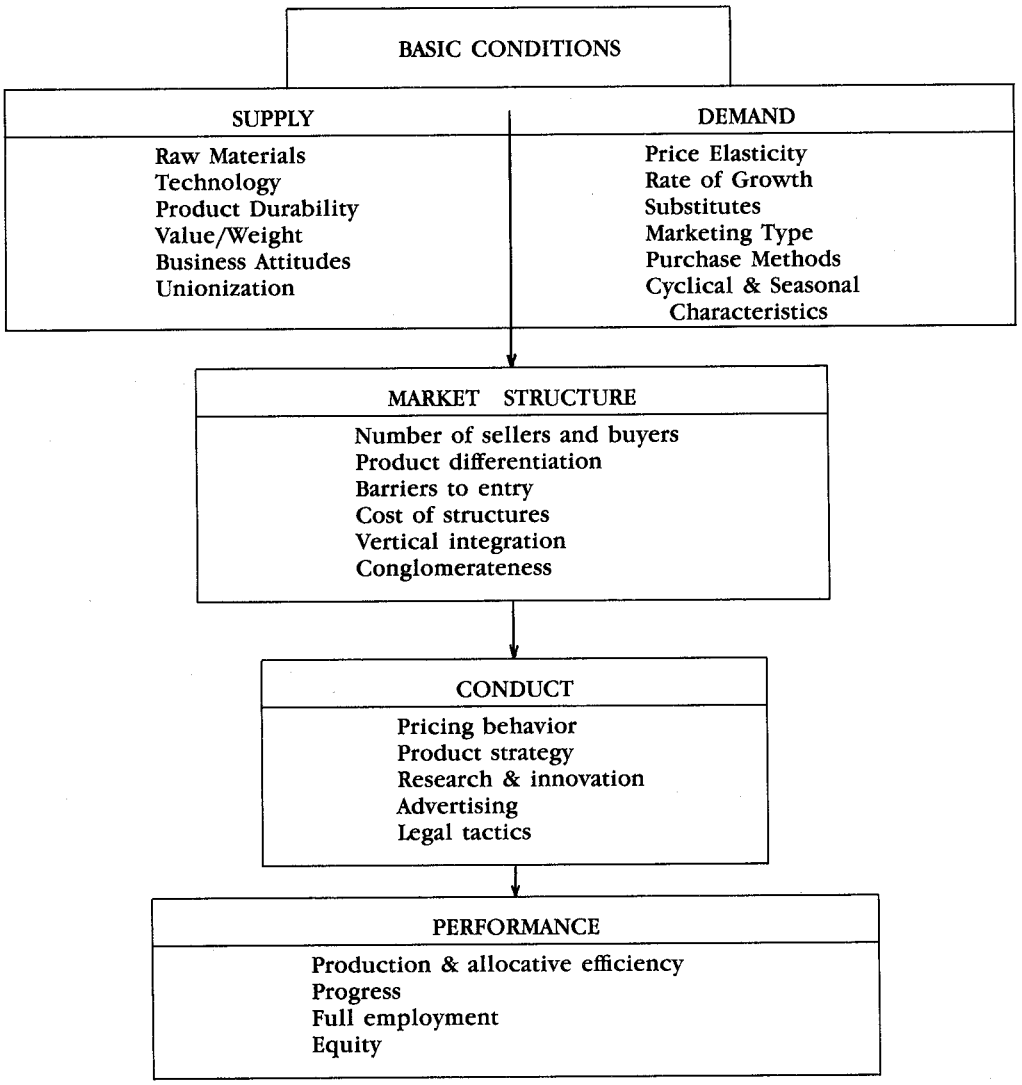
This research contributes to two regional research committees, the Southern Regional Grain Marketing Research Project S-115 entitled, "Alternative Structures for Increasing Efficiency in Inter- and Intra-Regional Grain Marketing Systems, and the North Central Regional Project NC-137 entitled, "Alternative Rural Freight Transportation, Storage and Distribution Systems."

The authors thank Professors Lowell D. Hill, University of Illinois and James L. Stallings, Auburn University, who provided the individual firm data from those states for use in this study.

[1] The South is a grain deficit region while the Eastern and Western Cornbelt regions are grain surplus areas (Lazarus et al.). A grain deficit area is defined as one in which the intra-regional disappearance of grain exceeds the intra-regional production of grain and a grain surplus region is defined as one in which the production of grain exceeds the disappearance of grain.

[2] These data were collected by two regional grain marketing committees and are the most current source of information.



Source: (Scherer)

Figure 1. Generalized Industrial Organization Model.

associated with the type and mix of grain facilities for the selected states. The next section presents the results and interpretations of the analysis and the last section includes conclusions and implications.

GRAIN MARKETING SYSTEM

The structure of the grain marketing system is delineated from a conceptual model frequently used in industrial organization studies to identify sets of variables which influence market structure, conduct and performance (Scherer). The grain marketing system can be studied as a subset of Scherer's generalized model for industrial organization analysis, Figure 1. Only one aspect of market structure as defined by Scherer is examined; that is, the relationships between basic conditions and the type and mix of grain facilities. Implications for conduct and performance are not examined. Furthermore, other characteristics of market structure such as product differentiation, barriers to entry, cost, vertical integration, and degree of conglomeration are not examined.

Because of the importance of the transportation industry to the grain marketing system, a third dimension, transportation, is added to Scherer's basic conditions. Transportation can be considered as one of Scherer's other *"germane basic conditions."* The supply, demand and transportation variables presented in Figure 2 and defined in Table 1 are the key variables which are hypothesized to be closely associated

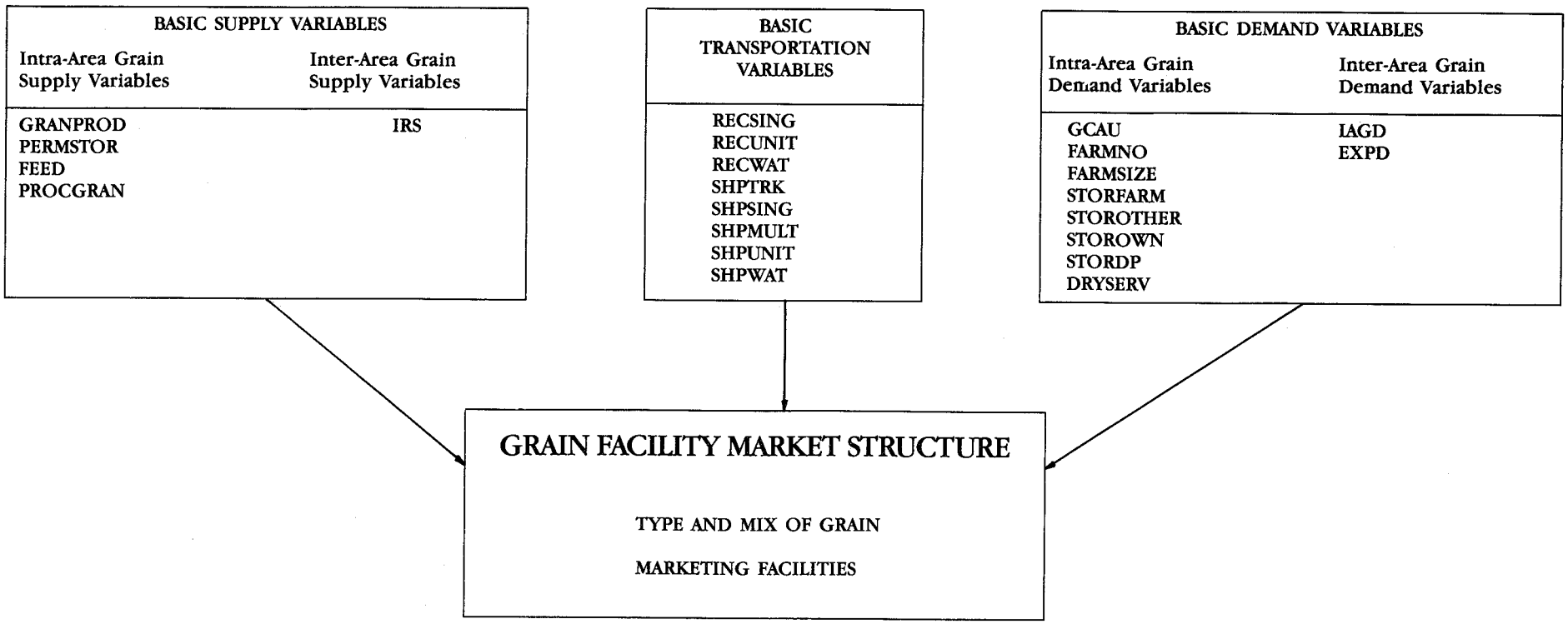


Figure 2. A Modified Industrial Organization Model for the Grain Marketing System.

TABLE 1. SPECIFIED STRUCTURAL GRAIN MARKET VARIABLES, DEFINITIONS AND RELATIONSHIPS TO THE STRUCTURAL ORGANIZATION MODEL

Variable name	Relationship in model	Definition
PLANTTYPE[a]	Grain facility type	Type of grain facility.
PERMSTOR	Intra-area supply	Total bushels of grain[b] (corn, soybeans, wheat) actually stored by facility, 1977.
FEED	Intra-area supply	Total tons of feed produced by facility, 1977.
PROCGRAN	Intra-area supply	Total bushels of grain processed as non-feed by facility, 1977.
GRANPROD	Intra-area supply	Total number of bushels of grain produced in the crop reporting district in which the grain facility was located, 1977.[c]
IRS	Intra-area supply	Percentage of grain facility's total grain receipts acquired from interstate origins, 1977.
FARMNO	Intra-area demand	Number of farms in the crop reporting district in which the facility was located, 1977.
FARMSIZE	Intra-area demand	The average number of acres per farm in the crop reporting district in which the grain facility was located, 1977.
GCAU[d]	Intra-area demand	Number of grain consuming animal units in the crop reporting district in which the grain facility was located, 1977.
STORFARM	Intra-area demand	Percent of grain facility's permanent grain storage capacity used to store farmer owned grain.
STOROTHER	Intra-area demand	Percent of grain facility's permanent grain storage capacity used to store non-farmer owned grain (i.e., government owned or other firm grain) on November 30, 1977.
STOROWN	Intra-area demand	Percent of grain facility's permanent storage capacity used to store grain owned directly by the facility on November 30, 1977.
STORDP[e]	Intra-area demand	Percent of grain facility's grain storage capacity used to store grain held by the facility on delayed price contracts, November 30, 1977.
DRYSERV	Intra-area demand	Availability of grain drying services at the facility in 1977. Dummy variable represented as 1 = yes and 0 = no. November 30, 1977.
IAGD	Inter-area demand	Percent of grain facility's total grain shipments moved to inter-area destinations, 1977.
EXPD	Inter-area demand	Percent of grain facility's total grain shipments moved to export destinations, 1977.
RECSING	Transportation	Percent of grain facility's total grain receipts moved under single-car rail rates, 1977.
RECUNIT	Transportation	Percent of grain facility's total grain receipts moved under unit train (65 or 100 cars) rail rates in 1977.
RECWAT	Transportation	Percent of grain facility's total grain receipts moved by water (barge or ship) in 1977.
SHPTRK	Transportation	Percent of grain facility's total grain shipments moved by truck in 1977.
SHPSING	Transportation	Percent of grain facility's total grain shipments moved under single-car rail rates in 1977.
SHPMULT	Transportation	Percent of grain facility's total grain shipments moved under milti-car (2-50 cars) rail rates in 1977.
SHPUNIT	Transportation	Percent of grain facility's total grain shipments moved under unit trains (65 or 100 cars) rail rates in 1977.
SHPWAT	Transportation	Percent of grain facility's total grain shipments moved by water (barge or ship), 1977.

[a]Represents the dependent variable.
[b]Hereafter, grain is defined as corn, soybeans and wheat.
[c]Crop reporting district: a geographical area used by the State Crop and Livestock Reporting Service for the purpose of recording agricultural information.
[d]Grain consuming animal units: represents a weighted measure of the livestock (cattle, hogs, sheep, and poultry) produced by a crop reporting district, based on the average quantity of grain and other concentrates, and expressed in feed units, consumed annually by each type in relation to the consumption rate of the average milk cow in the U.S. from 1969 to 1971.
[e]Delayed (deferred) priced grain: title of the grain transfers at the time of delivery with the seller having the right to set the price at a later date.

with the type and mix of grain facilities within and across regions.[3]

Type and mix of grain facilities include country elevators, terminals, river and export elevators, feed processors, feed mills, soybean processors, corn processors, and flour mills. (See Lower for a definition of facility types.) Type of facility is the dependent variable in

[3] These variables were selected based on an adaptation of Scherer's industrial organization model and the availability of individual grain facility data.

this analysis. The independent variables are the basic supply, demand and transportation conditions. The supply variables include inter-area and intra-area grain supplies and volume of grain stored by facility and volume of grain processed into feed, flour, meal, and oil by facility. The inter-area grain supply (IRS) represents the volume of grain received from grain surplus producing regions outside of the area while intra-area farmers provide the intra-area grain supply (GRANPROD), Table 1. Since these variables identify the volume and location of available grain to the facilities, they are closely related to Scherer's "raw materials" basic conditions, Figure 1.

The volumes of grain stored and processed (PERMSTOR, FEED AND PROCGRAN) represent the size of the facility and the intensity of the use of the facility (turnover rate). Differences in volume of grain stored or processed by facilities indirectly identify different long run cost curves for the respective facilities. As such, these variables represent Scherer's "technology" basic condition. Other basic supply conditions such as product durability, value/weight, unionization and business attitudes are judged to be inappropriate or can not be included because of the unavailability of data.

The basic demand conditions include the demands of intra-area, inter-area and export buyers for grain and marketing services. Most of the intra-area demand for grain originates from the livestock industry (cattle, hogs, sheep, and poultry) and is represented by the GCAU variable, Table 1. Grain facilities provide services to different numbers (FARMNO) and sizes (FARMSIZE) of grain and livestock farms. The inter-area demand (IAGD) represents the demand for grain and marketing services of non-export facilities outside the area. Export demand (EXPD) is the foreign purchase of grain and services. While exports may or may not be possible from a particular intra-area location given the need for port facilities, the influence of export markets is transmitted throughout grain marketing channels. The demand variables for grain described above are most synonymous with Scherer's marketing type basic condition.

The demand for services (STORFARM, STOROTHER, STOROWN, AND DRYSERV) represent the substitutes basic condition while STORDP represents both the substitutes and purchase method basic conditions. For example, the storage function performed by grain facilities is a substitute for farm storage. The STORDP variable also substitutes the farm storage and represents an alternative grain purchasing method. The remaining basic demand conditions are judged to be inappropriate variables or cannot be analyzed because of data limitations. Rate of growth in demand, price elasticities and cyclical and seasonal characteristics, for example, cannot be analyzed with the available data.

The basic transportation conditions include the type, availability and relative importance of alternative transportation modes (rail, truck, and barge) and rates used to ship grain among sectors and areas. The transportation variables influence the type and mix of grain facilities as well as the size and intensity of the use of facilities (turnover rates). Variables include the percent of total grain receipts (RECSING, RECUNIT, RECWAT) and shipments (SHPTRK, SHPSING, SHPMULT, SHPUNIT, SHPWAT) transported by each mode, Table 1.

METHODOLOGY

The methodology selected to investigate the relationship between sets of economic variables and specific facility types is multivariate linear discriminant analysis (MLDA), (Klecka, Dhrymes). This descriptive technique belongs to the family of multivariate statistical techniques related to factor analysis. Given a vector of dicotomous and continuous variables (represented by variables defined as basic conditions) observed on a set of individuals or objects known to belong to a certain number of different populations (represented by grain facility types), MLDA can aid in discovering whether or not a subset of these variables discriminates well among these populations. Other methodologies such as linear regression analysis were not selected because the nature of the hypotheses and the characteristics of the data are more suitable for MLDA. In this analysis, MLDA is used as a descriptive tool to help identify the existence of specific subsets of economic variables which can be used to discriminate among specific grain facility types.

MLDA requires the existence of several groups or populations to which each grain facility type observation is assumed to belong.[4] Inclusion into a specific group is denoted by a qualitative variable (Falgon). The objective of MLDA is to identify a unique set of axes, i.e., linear combinations of variables, which discriminate well between the different classes of individuals or groups. In application to the problem at hand, succeeding linear discriminant functions are calculated up to the point where the last linear function does not add significantly to the total explained variance as evidenced by the χ^2

[4] MLDA is presented in this analysis as a descriptive multivariant statistical method useful in providing insight into a complex mass of data. This method is presented independently of specific distribution assumptions, although under strict normality and equal covariance assumptions, this is equivalent to maximum likelihood estimation of the linear discriminant function.

statistic. This occurred normally within three to four calculations in this analysis.

DATA

Two regional grain marketing committees completed a national survey of grain facilities for 1977. Committee representatives from the states of Alabama, Illinois, and Ohio provided individual facility data to support this research. These are the most current individual facility data that are available. Lack of additional individual facility data prevents the extension of this analysis to other states.

It was hypothesized that the Alabama data would be representative of the market structure of the South; Illinois data would be representative of the market structure of the Western Cornbelt; and Ohio data would be representative of the market structure of the Eastern Cornbelt. The Southern Region is defined as Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia. The Western Cornbelt is defined as Illinois, Iowa, and Missouri, and the Eastern Cornbelt is defined as Indiana and Ohio. On the basis of Chi-square tests, no significant differences were found in mean levels of grain production, distribution of grain facilities by type, and facility size as measured by total permanent storage capacity between Alabama, Illinois, and Ohio and their respective regions.[5]

The individual facility data are supplemented with secondary data on grain and livestock production, consumption, processing, and transportation taken from the Crop and Livestock Reporting Services of Alabama, Illinois, and Ohio. All secondary data are acquired on a crop reporting district basis for each of the states.

STATISTICAL RESULTS

Results of the analysis are presented in tables 2 and 3. Table 2 contains the MLDA parameter estimates for three canonical discriminant functions (CDFs) for Alabama (South) and Illinois (Western Cornbelt) and four canonical CDFs for Ohio (Eastern Cornbelt). For Alabama, approximately 99 percent of the variance in facility types is explained by the first three functions, Table 3. For Illinois, 99 percent of the total variance is explained by the basic economic variables in the first three functions. With respect to Ohio, nearly 98 percent of the variance in facility types is explained by the basic economic variables in the first four functions. Each of the estimated orthogonal functions for each state are significant at the 97 percent level or better as demonstrated by Chi-square testing, Table 3. Significance of each estimated discriminant function lies in the magnitude of the linear weights (parameters) associated with each economic variable. While these weights may be positive or negative, their relative contribution centers on the absolute value, which indicates whether or not that particular economic variable can be used to discern one grain facility type from another.[6] Comparing across states, the presence or absence of a parameter and its relative absolute size is indicative of the association of that economic variable and grain facility structure. For ex-

TABLE 2. PARAMETER ESTIMATES FOR SIGNIFICANT CANONICAL DISCRIMINANT FUNCTIONS FOR CLASSIFYING FACILITY TYPE MODELS IN ALABAMA, ILLINOIS AND OHIO, 1977

Basic variables	ALABAMA			ILLINOIS			OHIO			
	Function 1	Function 2	Function 3	Function 1	Function 2	Function 3	Function 1	Function 2	Function 3	Function 4
Supply										
IRS	−0.185	−0.570	0.029	0.182	−0.193	0.346	0.062	0.408	−1.049	0.627
GRANPROD	a	a	a	0.060	0.161	0.250	a	a	a	a
PERMSTOR	1.205	−0.506	1.953	0.101	−0.081	0.616	−0.526	0.425	0.411	−0.182
FEED	−0.680	0.376	−0.420	−0.041	−0.386	−0.253	0.137	0.191	−0.421	0.468
PROCGRAN	−1.337	0.043	−2.483	−0.120	−0.192	-0.026	0.004	−0.813	−0.186	0.514
Demand										
GCAU	a	a	a	0.059	−0.185	−0.229	a	a	a	a
FARMNO	a	a	a	a	a	a	0.153	0.070	0.351	−0.152
FARMSIZE	a	a	a	0.057	−0.210	−0.186	a	a	a	a
IAGD	0.552	−0.071	−0.479	−0.326	−0.283	−0.359	−0.096	0.583	−0.261	0.582
EXPD	−0.339	−0.346	0.325	−0.012	−0.008	−0.590	a	a	a	a
STORFARM	a	a	a	0.012	0.202	−0.232	0.039	0.435	0.245	0.359
STOROTHER	a	a	a	−0.233	0.093	−0.111	0.159	0.108	0.596	−0.142
STOROWN	0.215	0.409	0.381	0.006	0.211	−0.212	−0.155	0.233	0.385	−0.170
STORDP	0.669	−0.006	−0.145	a	a	a	−0.095	−0.614	0.156	0.447
DRYSERV	0.253	−0.278	−0.319	a	a	a	−0.136	−0.203	−0.045	0.384
Transportation										
RECSING	a	a	a	−0.339	−0.190	0.022	−0.059	−0.101	0.534	−0.156
RECUNIT	a	a	a	0.019	0.016	0.302	a	a	a	a
RECWAT	0.418	−0.625	0.388	a	a	a	a	a	a	a
SHPTRK	a	a	a	0.204	1.633	0.463	0.171	0.753	0.158	−0.485
SHPSING	a	a	a	−0.294	0.744	0.235	0.169	−0.227	0.444	−0.530
SHPMULT	a	a	a	0.413	1.304	0.413	−0.097	0.337	0.298	0.219
SHPUNIT	a	a	a	0.313	1.161	−0.149	0.164	−0.188	−0.670	−0.366
SHPWAT	0.112	−0.502	−0.502	−0.114	0.401	0.149	1.411	0.028	0.149	−0.301

[a]Denotes variables identified as having little discriminating power in the analysis.
Source: Lower.

[5] More extensive testing of this hypothesis was not possible because of limitations in the data.

[6] The sign of a parameter indicates whether or not the associated variable increases or decreases the linear discriminant score which is the basis for identifying specific facility types in each state. However, when comparing across states, the relative contribution based on absolute values is the important point.

TABLE 3. DISCRIMINANT FUNCTION STATISTICS FOR THE FACILITY TYPE MODELS: ALABAMA, ILLINOIS AND OHIO, 1977

Function measurements	ALABAMA			ILLINOIS			OHIO			
	Function 1	Function 2	Function 3	Function 1	Function 2	Function 3	Function 1	Function 2	Function 3	Function 4
Percent of variance	61.81	20.58	16.51	86.34	10.05	2.22	78.02	10.13	5.69	3.85
Canonical correlation	0.89	0.75	0.71	0.99	0.92	0.75	0.98	0.86	0.78	0.72
Wilk's lambda	0.03	0.19	0.45	0.01	0.03	0.21	0.01	0.03	0.11	0.29
Chi-square	195.62	98.83	47.88	1,940.30	904.90	396.67	627.38	332.77	205.99	116.06
Degree of freedom	44.00	30.00	18.00	95.00	72.00	51.00	90.00	68.00	48.00	30.00
Chi-square significance	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Source:Lower.

ample, comparing intra-area grain production (GRANPROD) across the three states indicates that for Alabama and Ohio, this variable does not help in effective discrimination among facility types. However, for Illinois, the presence of this variable in all three functions indicates significant discriminatory power among facility types, Table 2.

INTERPRETATION OF RESULTS

Supply and demand basic variables are important distinguishing characteristics in Alabama (representing the grain deficit South Region) while the supply, demand and transportation variables are important distinguishing characteristics for Illinois (representing the grain surplus Western Cornbelt), Table 2. Alabama's grain facilities are relatively specialized in grain and feed services, which are required to meet the livestock driven demand for deficit grain. For this reason, processing grain (PROCGRAN), permanent storage (PERMSTOR), feed produced (FEED) and interstate grain receipts (IRS) are identified as key supply variables for the first function in discriminating among grain facility types in Alabama, Table 2. These supply variables also explained additional variance in facility types in functions two and three.

Of lesser importance are the demand variables. Delayed priced grain (STORDP), grain drying services (DRYSERV), and grain stored by elevators (STOROWN), are important demand variables in all three discriminant functions. Since farm storage (STORFARM) is unimportant, commercial drying and storage services are provided by the elevator facilities as a substitute for farm storage. Delayed pricing can be used as either a substitute for farm storage or as an alternative grain buying method. Further, most of the interstate grain receipts are stored in commercial facilities for transshipments and/or for processing into feed, flour, meals, and oils.

Grain shipments to inter-regions (IAGD) and to exports (EXPD) are also important demand variables for all three functions. Although Alabama is a grain deficit state, grain is shipped by terminal elevators to inter-regional destinations and by export elevators to export points at harvest. Further, some grain is transshipped from grain surplus producing regions through Alabama to export points. To facilitate these grain movements, two important transportation variables, receipts by water (RECWAT) and grain shipments by water (SHPWAT), emerge, Table 2.

Relative to Alabama, the basic supply conditions are less important for determining variance in facility types than for either Illinois or Ohio (grain surplus producing regions). For Illinois, the supply basic condition, interstate receipts (IRS), processing of grain (PROCGRAN) and intra-regional grain produced (GRANPROD) indicates the relative importance of internal grain supply factors over external ones.

The set of basic demand conditions for Illinois is different than for Alabama. The relative importance of type and size of farm as measured by grain consuming animal units (GCAU), acres per farm (FARMSIZE), and bushels of grain stored on farm (STORFARM) emerge, Table 2. Not surprising, grain shipments to inter-regions (IAGD) and to exports (EXPD) are also important demand variables. Finally, basic transportation conditions are important economic variables as modes of transportation are used to ship grain to deficit grain regions and export points.

The same set of supply variables emerge for Ohio as for Alabama; however, the parameter estimates are smaller for Ohio, Table 2. The demand variables demonstrate the importance of farm structure (FARMNO and STORFARM), commercial storage (STOROTHER, STOROWN, STORDP and DRYSERV), grain purchasing method (STORDP) and the importance of grain shipments to other inter-regional areas (IAGD). Commercial storage is important because of the central role country elevators play in storing farmer-owned grain; whereas, export elevators and processors store primarily their own grain. Shipments to export points (EXPD) are unimportant as a discriminator because terminal and export elevators all ship grain to export points. Not surprising, basic transportation conditions are also important explanatory variables.

CONCLUSIONS

The findings of this study indicate that the

structural differences among selected grain marketing regions can be characterized by regional differences in basic supply, demand and transportation variables. Taken as a whole, the structure of the grain marketing industry is characterized by the number, size, and types of farms, marketing functions performed by the farm and commercial facility sectors, volume of inter-regional grain receipts, volume of inter-regional domestic grain shipments and exports and by available transportation facilities.

Basic supply and demand variables characterize the grain market structure of Alabama, which represents the grain deficit Southern Region. The importance of supply variables, feed produced, volume of inter-regional grain receipts and volume of processed grain, suggest that the grain marketing structure in Alabama can be explained in part by the existence of the livestock industry and its need to import grain from surplus producing regions. In addition, the competitive advantage enjoyed by the Southern region in manufacturing semifinished grain products for export markets also contributes to the importance of grain processing.

The basic demand conditions, commercial storage variables, delayed price, grain drying and grain shipments to inter-regional destinations and export points, also influence the grain market structure. The importance of the commercial storage variables and delayed pricing implies that commercial storage is being substituted for farm storage and that inter-regional receipts are stored in commercial facilities for additional processing into grain products. Because of transshipments, grain shipments to inter-regional destinations and export points are important. Of lesser importance for explaining Alabama's market structure are the transportation variables.

In contrast to Alabama, demand and transportation are the key variables influencing the grain marketing structure for Illinois and Ohio. Grain facilities in these surplus producing areas take advantage of intra-regional and inter-regional and export opportunities. For Illinois, the transportation variables employed to ship grain to deficit regions and to export points are the most important explanatory variables. Further, the volume of grain shipped to inter-regional destinations and to export points and the type and size of farms are important explanatory demand variables. Of lesser importance for explaining the market structure in Illinois are the supply variables.

These findings are not surprising since Illinois farmers produce relatively large volumes of grain, relatively large grain surpluses exist and grain is shipped relatively long distances to market. Further, country elevators provide nearly the same marketing functions as terminals; that is, they receive grain from farmers and ship directly to domestic demand centers and to export points. Grain processors differentiate themselves from elevators by primarily providing the grain processing function.

For Ohio, a grain surplus producing region characterized by lower production, smaller grain surplus, and closer proximity to major markets than Illinois, the services of country and terminal elevators are more differentiated. That is, many country elevators in Ohio are relatively small and therefore move grain in relatively small shipments from farmers directly to Great Lakes export points, to Ohio River facilities, and to processors. Terminals, on the other hand, accumulate grain from farmers and other grain facilities to take advantage of economical transportation options to East Coast and Gulf export points.

Based on these differences between Illinois and Ohio, it is concluded that basic transportation conditions are important explanatory variables for the Ohio grain marketing structure. However, the importance of the transportation variables is less for Ohio than for Illinois. Further, a somewhat different set of demand variables emerge for Ohio relative to Illinois. For example, commercial storage, delayed pricing and drying services are relatively more important explanatory variables for Ohio. On the other hand, shipments to grain deficit regions and to export points are more important explanatory variables for Illinois.

The set of supply variables for Ohio, volume of feed and grain processed, permanent storage, bushels of grain received and number of farms is nearly consistent to the set of supply variables for Illinois and is an exact match relative to Alabama. However, the supply variables are relatively more important for explaining the market structure in Alabama than in Ohio.

The above findings suggest that Scherer's industrial organization model can be adapted to explain the structure of the grain marketing system. For example, *"raw materials"* or the location and volume of grain, *"substitution conditions"* or the importance of commercial drying and storage services relative to farm services and the *"marketing type conditions"* explain, in part, the market structure for Alabama. Transportation variables or the *"other germane conditions,"* and the *"market type conditions"* primarily explain the market structure for Illinois and *"other germane conditions," "substitute basic conditions,"* and *"market type conditions"* explain, in part, the market structure for Ohio.

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