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STAFF PAPER

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June 1988

No. 88-11

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This paper was prepared for presentation at a Selected Papers Session of the Northeastern Agricultural and Resource Economics Association Annual Meetings, Orono, Maine, June 20-22, 1988.

Rail Regulatory Reform and Changing Interregional Competitiveness in the Feed Grain Industry

With a significant animal production industry but a low degree of self-sufficiency in feed grain production, Northeast agriculture has traditionally been highly dependent on feed inshipments from the Midwestern U.S. Since the vast majority of regional feed imports are by rail, the changing regulatory environment surrounding rail transportation in the 1980's and its implications for feed prices and availability are extremely important to animal production agriculture in the Northeast and the industry's interregional competitiveness.

One of the specific issues which arises in considering the changing interregional competitiveness of Northeastern agriculture as a result of regulatory reform is how the region has fared relative to the Southeastern U.S. The movement of much of Northeast's poultry industry to the Southeast over the last several decades was expedited by feed transportation cost differentials which enhanced the competitiveness of the Southeast relative to the Northeast. This fact was noted by Seaver and Hanekamp in the 1970's and Skinner, et. al. in the early 1980's. Recently, however, as a result of rail deregulation, there have been some indications that these rate differentials have lessened and that the competitive position of the Northeast may have improved relative to the Southeast (Randolph and Lee).

This paper addresses this competitiveness issue by constructing a spatial equilibrium model of the Eastern feed industry. This model incorporates regional supply, demand, storage and transportation components for both Northeastern and Southeastern sub-regions and Midwestern supply areas. A base model, based on the pre-deregulation year of 1980, is estimated and simulations incorporating changing interregional transportation costs in years following deregulation are run. The results permit useful insights into the changing interregional competitiveness of the Northeast's feed industry and allied animal production industries as a result of regulatory reform.

Northeast Agriculture and Rail Regulatory Reform

Animal production agriculture - principally, dairy, broiler and egg production - accounts for nearly 60% of the value of Northeastern agriculture. Despite this fact, the region has traditionally been a deficit producer of feedstuffs to sustain that production. In 1981, for example, the region produced about 9.6 million tons of feed grains (mostly corn) while consuming nearly 12.2 million tons, a deficit of 21% of consumption (Randolph and Lee). The deficit for the main high-protein feed, soybean meal, was considerably larger, 79% of consumption in 1981.

Northeastern feed grain deficits have historically been met through inshipments of feeds from the northern Midwestern states, principally Michigan, Illinois, Indiana and Ohio. While some shipments move short distances by truck, the vast majority of interregional feed transportation occurs by rail.

To understand the importance to Northeastern agriculture of rail regulatory reform in the 1980's - principally under the Staggers Act of 1980 - it is necessary to briefly review the status of rail freight transportation in earlier years. The period of roughly 40 years preceding 1980 was characterized by pervasive regulatory control over U.S. rail transportation. The Interstate Commerce Commission, in an ongoing response to rate and service discrimination abuses extending back to the 19th century, regulated railroads' abilities to change rates in response to economic and cost changes, to drop unprofitable lines, and to take full advantage of increased operational efficiencies. In large part as a result of these factors, the railroads' share of U.S. intercity freight volume fell from 70 percent in 1945 to 38 percent in 1981. Real net investment in railroads fell from 45 billion dollars to 15 billion dollars. These developments culminated in a rash of railroad bankruptcies in the 1960's and 1970's, including the Penn Central bankruptcy, which seriously affected freight transportation in the Northeast.

Among other things, rail regulation influenced the Northeast's competitiveness in feed grains and allied animal production industries. Beginning in the early 1960's, the ICC approved low hopper car rates for grain shipments to Southern states so that traffic would not be diverted to highly competitive barge transportation. These rate differentials later widened as barge competition continued to limit rail rate increases to the Southeast more than to the Northeast, and as ICC proportionate rate increases - applied to the initially higher Northeastern rates - caused rates to Northeast destinations to rise in greater absolute terms (Seaver and Hanekamp). Over the 1960's and 1970's, gradually increasing rail rate differentials adversely affected the competitiveness of Northeast animal production, particularly for eggs and broilers, for which feed costs comprise nearly two-thirds of unit production costs and thus for which production is highly sensitive to even small relative changes in feed transportation costs.

Beginning with the Railroad Revitalization and Regulatory Reform Act of 1976 and culminating with the Staggers Rail Act of 1980, the regulatory environment surrounding rail transportation changed dramatically. The Staggers Act greatly increased rate-making flexibility for railroads, permitting negotiated contracts with individual shippers, joint rate cancellation on through routes, surcharges on light density lines, and simplifying rail abandonment procedures. While the resulting effects of Staggers on the agricultural transportation system have been profound, most evaluations of these effects have been positive. Sorenson found important cost reductions in grain logistics systems had been achieved without a significant reduction in pricing efficiency. A March, 1987 report by the Association of American Railroads states that grain rates have fallen an average 28 percent since Staggers was passed. An evaluation of the effects of Staggers on the Northeastern feed industry found significant short-run and long-run reductions in grain rates and costs for Northeastern grain consumers (Randolph and Lee). The interregional issues discussed above, however, remain largely unresolved.

Model and Data Requirements

To examine the changing competitive position of the Northeast feed industry relative to the Southeast in light of regulatory reform, a spatial equilibrium (quadratic programming) model of the Eastern U.S. feed economy was constructed. This model minimizes the transportation costs of moving feedstuffs from excess supply regions to excess demand regions given a number of constraints defining demand, supply, storage and price equilibria for each region incorporated into the model. The GAMS/MINOS optimization package was used to solve the programming model and conduct simulations of the effects of rail rate changes. Spatial equilibrium models of the type estimated here have been used extensively in interregional competition studies for agricultural products; recent examples relevant to the Northeastern U.S. include Dunn and Garfola (apples), Wu, Jack and Colyer (broilers), and Randolph and Lee (feed grains).

The interregional competition model estimated here incorporates several components which are described briefly below. Models were estimated for corn and - in a reduced form - for soybean meal, these two comprising the large majority of feedstuffs consumed in the Northeast. Further details concerning model construction are available in Schmeltz.

Regions

In order to examine the competitiveness issue in some detail - both inter-regionally (Northeast vs. Southeast) and intra-regionally (within each region) - individual regions within the Northeast, Southeast and Midwestern supply region were defined at the state level (in some cases, at the multi-state level). Base points for each region representing the major producing or consuming point and/or the primary rail transportation node in each region were also defined. These are given in table 1. Six major ports of export were also defined as individual demand regions. The 1977 grain transportation survey by Hill, Leath and Fuller, along with grain flow information reported in Randolph and updated transportation data collected by the authors were used in specifying the four Midwestern supply regions.

Regional Demands

Feed demand equations must be specified and estimated for each region in the model. In general, aggregate feed demand for a given region may be estimated as a function of own price, prices of substitute feeds, output price, etc. However, estimation of aggregate feed demand functions abstracts from the considerable variation which may exist in the composition of livestock production across regions and over time (Richardson and Ray).

Accordingly, an alternative approach, introduced by Richardson and Ray and adapted by Randolph and Lee is used. This approach involves several steps. First, feed conversion equations which explain concentrate feeding intensity per animal unit are estimated for all major animal production activities in each region. Feed conversion is estimated in each case as a function of own price, substitute (or feed complement) price, output price, and a time trend in each region. Together with USDA estimates of grain consuming animal units (GCAU's), this gives an estimate of total feed demand for any given region. Second, the proportions of specific feed components (feed grains and high protein feed) relative to total feed concentrate consumption are estimated on a national basis for each animal category. These equations produce elasticity estimates which explain the responsiveness of feed concentrate composition to changes in relative feed prices, output prices, etc.

Finally, the elasticities from each of the preceding two steps are weighted and combined in generating composite estimates of feed demand. For example, the aggregate regional demand elasticity for corn (Randolph and Lee, p. 94) can be shown to be equal to:

$$\eta_c = \frac{\partial Z}{\partial PC} * \frac{PC}{Z} + \frac{\partial (FG/R)}{\partial PC} * \frac{PC}{FG/R}$$

where Z = feed conversion rate, PC = price of corn, and FG/R is the proportion of feed grains in the nation. The elasticity estimates derived in this manner for each livestock category were then weighted by their appropriate shares of regional concentrate consumption in deriving the composite regional demand elasticities for inclusion in the interregional model. These estimates are reported in table 2. In setting the levels of feed consumption for each region, it was also necessary to estimate commercial disappearance and export quantities where applicable. Given the focus in this analysis on domestically consumed agricultural feedstuffs, commercial and export price responsiveness to changing transportation rates and feed prices was ignored, although base levels of commercial utilization and exports were used in estimating total feed demand.

Regional Supplies

For the first year immediately following Staggers, 1981, regional corn supplies were considered to be perfectly inelastic. For years 1982-1985, regional supply elasticities for all regions in the corn model were borrowed from Langley's 1980 supply response study. Langley's short run estimates were used for 1982 and long-run estimates were used for 1983-85. Midwestern excess supplies were assumed to be perfectly elastic for all years. This is consistent with the observation that the total usage of Midwestern corn in the Eastern U.S. market accounts for only a small proportion of total production in any given year.

Estimated soybean meal supplies are regionally specific. For regions north of Maryland/Delaware, no soybean meal processing occurs, so all demand is satisfied by inshipments from the Midwest, at costs based on a Decatur, Illinois price plus net margin and transportation costs. For all other regions (except Florida), soybean processing capacity exceeds regional demand and thus is considered to be the factor limiting availability.

Storage

Due to the fact that corn is harvested at one time of the year but consumed year round, two-period models were estimated for corn, encompassing harvest and post-harvest periods. Corn storage in each region was constrained by available storage space, both on-farm (from USDA Grain Storage Capacity Survey) and off-farm (from Leath, et al.). Available port storage capacity is also incorporated into the model for the export regions (minus grain stocks other than corn). Storage cost and grain stocks data were available from Leath, et al., Randolph, and USDA data.

Transportation Rates

One of the results of rail deregulation has been that most grain transported by rail now moves under confidential contract rates at discounts - often significant - from published tariff rates. The use of tariff rates in a study like this would thus seriously underestimate rail rate decreases caused by deregulation. For example, spot comparisons of discounts below tariff rates for routes incorporated in this study ranged from one to 56 percent, and averaged in the 25 to 40 percent range.

An alternative, used in this study, is to use sample rail rate data taken from the Carload Waybill Statistics collected by the Association of American Railroads for the ICC. These samples include contract rate information and information on changes in shipment sizes. Their use suffers from some limitations (inconsistent reporting of rebating; changes in waybill sampling procedures) but these data were judged to be far more representative of actual freight rates than more easily available tariff rates. Tariff rates were used in estimating the pre-deregulation base model when these rates were operative. Additional adjustments in waybill rate estimates were made in selected cases to adjust for rebating (if not previously incorporated in waybill rates) and for changes in average shipment sizes over time.

The rail transportation rate data are far too voluminous to be discussed in detail here but are reported in Schmeltz. In general, decreases in rail rates characterize the great majority of routes examined in this study with proportionate declines somewhat higher for Midwest to Northeast destinations compared to Midwest to Southeast destinations.

Empirical Results

Base model results for the corn model for 1980 are reported in table 3. The model explains regional prices to within one to four percentage points, with the exception of Maryland-Delaware region (9% deviation) and Florida (14% deviation). Consumption estimates are all within two percentage points of actual levels; this result is not unexpected given highly inelastic regional demands. The model also does a reasonable job in simulating interegional corn shipments; route origins for routes in solution are generally consistent with those given in the 1977 corn flow survey, before deregulation.

Based on rail rate changes following Staggers, simulations were run for 1981-85 to estimate the resulting changes in prices, consumption, and shipments. To illustrate the results obtained, the corn price simulations are reported here (table 4). The results shown small but consistent decreases in corn prices for Northeastern regions over the five-year period and rough stability or small increases in Southeastern prices over the same period. The results clearly show that - pricewise - the Northeast overall has benefitted more than the Southeast as a result of rail deregulation, ceteris paribus. Over the study period the corn price differential is estimated to decrease by an average 39 cents per bushel in favor of the Northeast.

Simulated corn shipments over the study period mirror the estimated changes in price. Shipments to Northeast destinations increase as quantity supplied decreases, while shipments to Southeast destinations decrease as quantities supplied increase. Michigan and Ohio are estimated to be the primary source of shipments to the Northeast, while Ohio, Indiana and Illinois are the primary sources for Southeastern shipments. Georgia is the primary source for Florida.

Since the soybean meal model is limited to one surplus supply point, quadratic programming is not needed to solve it. Transportation costs and net marketing margins are added to the Decatur price to arrive at regional prices. Once calculated, the demand schedules previously estimated are used to generate quantities demanded. Although incomplete data prohibit estimation of soybean meal price and consumption for two of the regions (NC and SC), the estimates are generally consistent with those for corn. Of the fifty observations on price changes over the 1981-85 period, only five are increases, four of which are in the Southeast. Northeastern feed consumers are estimated to fare relatively better than those in the Southeast as soybean meal prices fall slightly more (in proportionate terms) and feed consumption rises modestly.

Conclusions

The overall effects of rail deregulation in the Northeastern and Southeastern feed markets can be gauged by estimating total regional feed costs after regulatory reform (table 5). In all regions except one Southeastern region, total feed costs are estimated to fall following deregulation. The proportionate changes are greater in the Northeast, although the total cost savings are still significant in the Southeast. The proportionate cost decreases are especially great in the New York and Pennsylvania - New Jersey regions. In some regions, corn and soybean meal costs move in opposite directions, but on net, all regions (except one) are shown to benefit from rail cost declines. It must be borne in mind, however, that while price declines mean gains to grain consumers, they imply costs to grain producers who now receive a lower price for their crops, ceteris paribus. Thus the apparent gains reported here are moderated when considering the entire agricultural sector of each region. Nonetheless, rail deregulation is estimated to have decreased feed costs for animal production agriculture from levels that otherwise would have prevailed in most of the East, and the competitive position of the Northeast is estimated to have improved relative to the Southeast, reversing pre-deregulation trends.

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Table 1

Regions and Base Points

Demand Only Regions	Base Point
Maine	Augusta
Vermont-New Hampshire	St. Albans, VT
Massachusetts-Connecticut-Rhode Island	N. Franklin, CT
Supply/Demand Regions	
New York	Batavia*
Pennsylvania-New Jersey	Lancaster, PA*
Maryland-Delaware	Salisbury, MD
Virginia-West Virginia	Harrisonburg, VA
North Carolina	Salisbury
South Carolina	Newberry
Georgia	Gainesville
Alabama	Guntersville
Florida	Tampa*
Export Demand	
Albany Port	Albany, NY**
Philadelphia Port	Philadelphia, PA
Baltimore Port	Baltimore, MD
Norfolk Port	Norfolk, VA+
Charleston Port	Charleston, SC+
Mobile Port	Mobile, AL

Supply Only Region

Corn

Ohio	A-Toledo	B-Columbus	C-Cincinnati
Indiana	A-Fort Wayne	B-Indianapolis	C-Evansville
Illinois		A-Moline #	B-Danville
Michigan			Saginaw

Soybean Meal

C-Decatur**

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* supply region for corn only
** soybean meal only
+ corn only
# barge only

Table 2

Composite Demand Elasticities

	Corn	Soybean Meal
MAINE	-.20	-.20
VT-NH	-.37	-.23
CT-MA-RI	-.25	-.21
NEW YORK	-.19	-.21
PA-NJ	-.18	-.22
MD-DE	-.18	-.15
VA-WV	-.22	-.24
N. CAROLINA	-.19	-.25
S. CAROLINA	-.17	-.25
GEORGIA	-.18	-.21
FLORIDA	-.15	-.32
ALABAMA	-.18	-.21

Table 3

Corn Model Validation Results, 1980

	Prices ($/Ton)			Consumption (1000 tons)		
Region	Model	Actual	Percent Deviation	Model	Actual	Percent Deviation
MAINE	144.1	140.0	+ 3	433.1	435.6	-0.6
VT-NH	140.3	140.0	+ 0	518.8	519.1	-0.1
CT-MA-RI	142.1	139.3	+ 2	623.2	626.5	-0.5
NEW YORK	130.2	125.0	+ 4	2446.2	2463.0	-0.7
PA-NJ	138.3	136.8	+ 1	3845.2	3852.0	-0.2
MD-DE	142.0	130.7	+ 9	2168.7	2172.1	-0.2
VA-WV	130.2	125.7	+ 4	2184.3	2201.1	-0.8
N. CAROLINA	129.2	130.4	- 1	4566.1	4556.3	+0.2
S. CAROLINA	130.0	125.0	+ 4	1022.5	1029.0	-0.6
GEORGIA	129.0	125.0	+ 3	4252.4	4276.3	-0.6
FLORIDA	138.0	121.4	+14	1759.3	1795.8	-2.0
ALABAMA	126.7	130.4	- 3	3428.8	3413.7	+0.4

Table 4

Base Year Price and Simulated Changes from Base Corn Model

Domestic Regions	1980	1981	1982	1983	1984	1985
	$/ton	- - - - - - - percent - - - - - - - - - -				
MAINE	144.07	-3.7	-3.9	-6.6	-7.4	-3.9
VT-NH	140.27	-3.4	-6.4	-7.6	-4.5	-4.9
CT-MA-RI	142.07	+0.7	-4.5	-7.7	-2.5	-3.5
NEW YORK	130.15	-1.7	-2.3	-3.9	-4.4	-5.7
PA-NJ	138.31	-7.8	-8.0	-7.5	-8.3	-6.5
MD-DE	142.01	-9.7	-10.7	-10.8	-8.9	-11.9
VA-WV	130.16	-1.2	-2.2	-0	-0.3	-0.9
N.CAROLINA	129.23	+1.2	+2.0	+3.0	+1.4	+0.8
S.CAROLINA	130.02	+0.1	+0.9	+1.3	+3.4	+4.8
GEORGIA	129.03	+1.2	+0.5	+1.4	+1.4	+6.2
FLORIDA	137.99	+1.1	+0.1	+1.6	+0.8	+5.8
ALABAMA	126.70	-0.3	-3.1	-1.9	-3.1	-2.6
Export Regions						
Phil.	120.42	+1.1	+1.2	+0.6	+0.3	+3.5
Baltimore	122.19	-0.9	-2.3	-2.8	-1.3	-3.9
Norfolk	121.74	-1.2	-1.4	+1.0	-0.2	-3.1
Charleston	130.87	+1.1	+2.4	+1.4	5.4	+1.2
Mobile	124.45	-3.1	-4.9	-2.8	-4.7	-4.7

Table 5

Total Base Year Feed Costs and Percentage Changes from Base

	1980	1981	1982	1983	1984	1985
	($ million)	- - - - percent change from 1980 - - - - -				
MAINE	94.53	-1.8	-2.2	-3.6	-5.9	-3.7
Vt-NH	94.38	-2.1	-3.5	-4.4	-2.8	-4.1
CT-MA-RI	123.93	-0.5	-2.9	-5.0	-1.8	-2.5
NEW YORK	409.25	-1.2	-1.7	-2.6	-3.2	-4.7
PA-NJ	720.87	-5.2	5.3	-5.3	-6.0	-5.0
MD-DE	495.73	-5.6	-	-	-4.6	-
VA-WV	405.17	-1.3	-2.1	-0.8	-0.8	-1.1
GEORGIA	841.56	0.9	-	1.5	0.5	2.7
FLORIDA	364.11	-	-	-0.1	-1.3	-
ALABAMA	664.48	-0.0	-1.3	-1.1	-2.7	-