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Testing the Impact of Corporate Farming Restrictions on the Nebraska Hog Industry

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Abstract

This paper evaluates the implications of corporate restrictions on production agriculture using the case of the Nebraska hog industry. Corporate farming restrictions prohibit the acquisition or operation of agricultural land by nonfamily farm or ranch corporations. A partial adjustment model with a variable coefficient of adjustment is used to study the policy change. The results of the study support the hypothesis that the corporate farming restrictions in Nebraska have reduced the Nebraska hog industry's ability to adjust its inventory to target levels. A significant shift in inventory adjustment behavior is shown to coincide with the enactment of the corporate restrictions.

Key words: corporate restrictions, hog industry, partial adjustment, Nebraska

TESTING THE IMPACT OF CORPORATE FARMING RESTRICTIONS ON THE NEBRASKA HOG INDUSTRY

Corporate farming has been debated in Nebraska since the 1960s, when corporations started to engage in production agriculture. Many people saw this as a threat to the family farm and, as a result, sought restrictions on corporate activities in agriculture (Knoeber 1997). Krause (1983) states that corporate farming laws intend to "preserve and protect the family farm as the basic unit of production" and to "stem the influx" of investments in agriculture by "nonfarm outsiders." The failure of the Nebraska legislature to pass corporate restrictions resulted in an initiative petition (Initiative 300) to enact regulations through the referendum process. In 1982, the time of the enactment of the restrictions, about 3,000 of Nebraska's 60,000 farms were organized as corporations. These operations averaged annual sales of more than $1 million each, while the average family farm had sales of only $73,600. About 6.8 percent of the hog sales were made by nonfamily farm corporations. Their annual sales averaged 18 times the sales of family hog farms.

Over the past two decades, American hog farming has experienced a fundamental realignment. In 1982, before the farm crisis, there were nearly 330,000 farms producing hogs and pigs; in the decade that followed, the number of hog farmers declined by 42 percent while the number of hogs sold grew by 17 percent, from 94,780,000 to 111,330,000. The number of operations continued to decline, decreasing from 309,700 in 1989 to 138,690 in 1997. Traditional family farms represent the majority of those who gave up hog production. For every 50,000 -sow unit added, about 1,000 fifty-sow operations closed down (Southard and Reed 1995). Diversified hog and grain farms, typical of the Midwest, gave way to specialized pork producers. The decline in family pork production was most significant in traditional pork-producing states such as Iowa, Illinois, and Indiana, in contrast to the sharp increase in production from an emerging hog-producing state such as North Carolina. Some states, including Nebraska, attempted to fight this decline of the family hog farm by enacting anticorporate farming regulations.

Figure 1 illustrates the situation in Nebraska, which is characterized by divergent behavior of the Nebraska share of hog inventory and hog farms. The figure shows that the share of operations started to rise two years after the corporate restrictions were enacted. That means the transition from small to large operations progressed faster nationally than it did in Nebraska. Many of these large units around the country are organized as corporations. The Nebraska inventory share was still rising after 1982 but at a slower rate than in previous years. The beginning of a strong increase in the share of hog operations and the diminishing growth of the inventory share both coincide with the enactment of corporate restrictions in 1982.

The purpose of this study is to analyze how the exclusion of nonfamily farm corporations from the Nebraska hog industry has influenced the industry's development. Larger operations in particular may need to operate as corporations to acquire adequate amounts of capital. Without this option in Nebraska, the hog industry's response to market signals may have been impeded. In the framework of a partial adjustment model with a variable speed of adjustment, we hypothesize that the speed at which the hog inventory of Nebraska farms adjusts toward a desired level has decreased after the enactment of corporate farming restrictions.

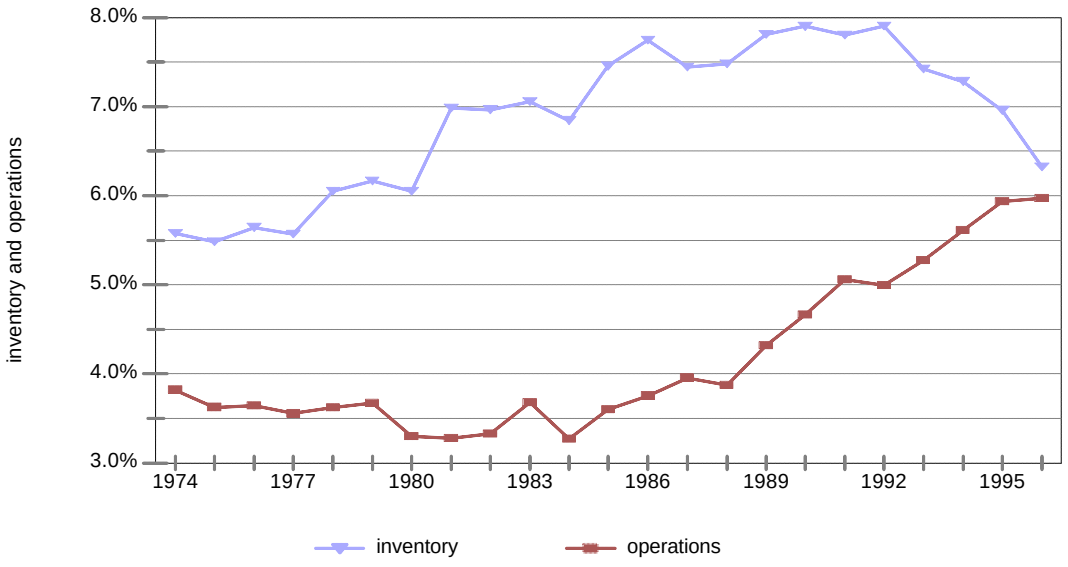

FIGURE 1. Nebraska share of U.S. hog inventory and operations from 1974 to 1996

The paper starts with a summary of the corporate farming laws in Nebraska, Missouri, and Iowa. The next section reviews the pertinent literature on corporate farming restrictions and partial adjustment models. A single-equation partial adjustment model is then used to analyze the Nebraska hog industry. The results strongly suggest a significant reduction in the adjustment speed of the hog industry at the time the corporate farming restrictions were enacted. However, the analysis does not tell us if this structural change is unique to Nebraska, or how much of that change is the result of the impact of corporate farming restrictions. We then estimate two multistate models, which test the findings for Nebraska against a control group of other states. The control group is made up of states with and without corporate restrictions to isolate the impact of corporate farming restrictions from other economic and political influences common to the entire U.S. hog industry. We find that states with corporate restrictions differ from states that do not restrict corporate farming. The combined results of the two approaches are consistent with the hypothesis that corporate farming restrictions impeded the development of the Nebraska hog industry.

Corporate Farming Restrictions

Currently, nine states have enacted laws regulating corporate agricultural land ownership and the production of agricultural commodities.[1] The nine states—Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Wisconsin—form a contiguous land mass in the northern Great Plains, lying, for the most part, between the Mississippi River and the Rocky Mountains.

Nebraska Constitution Article XII, §8 prohibits acquisition or operation of agricultural land by nonfamily farm or ranch corporations and by nonfamily farm or ranch syndicates, including limited partnerships. To qualify as a family farm corporation, the firm has to be engaged in farming or ranching or in the ownership of agricultural land. A majority of the voting stock has to be owned by family members.

Missouri has had a ban on corporate farming since 1975 (Mo. Ann. Stat. §350.15). The statute provides that “After September 28, 1975, no corporation not already engaged in farming shall engage in farming; nor shall any corporation, directly or indirectly,

acquire, or otherwise obtain an interest, whether legal, beneficial or otherwise, in any title to agricultural land in this state." In 1992, Missouri relaxed its anticorporate restrictions by giving Premium Standard Farms (PSF) the ability to go to Wall Street for bond financing of mega expansions. Within a short time, Tyson Foods, Continental Grain, and Murphy Family Farms followed PSF into Missouri. In 1993, the Missouri state legislature passed an amendment to the anticorporate farming law exempting the three counties where PSF operated from the corporate restrictions. By 1996, PSF had 105,000 sows and produced more than 2.5 million hogs per year in Missouri.

Iowa did not prohibit any corporate ownership of livestock until 1987, when the law was amended to prohibit a pork processor from owning hogs or contracting for their feeding and care (Iowa Code §172C.2). The statute provides that "In order to preserve free and private enterprise, prevent monopoly, and protect consumers, it is unlawful for any processor of beef or pork or limited partnership in which a processor holds partnership shares as a general partner or partnership shares as a limited partner, to own, control or operate a feedlot in Iowa in which hogs or cattle are fed for slaughter." A processor can still contract for the feeding of hogs as long as they are processed outside the state of Iowa. A corporation that is not a processor may own livestock within Iowa, or enter into contracts for the care and feeding of animals. Murphy Family Farms and others have been taking advantage of these possibilities. Additionally, Iowa allows "authorized farm corporations" to engage in pork production (Iowa Code §172C.1[9], 1987). The ownership of these corporations is limited to 25 stockholders. These conditions have led to a stronger concentration process of the Iowa hog industry in recent years and have strengthened Iowa's ability to adjust its inventory to the changes in market conditions (Lawrence and Wang 1998).[2]

Previous Research

The literature on issues of corporate farming and anticorporate farming laws can be divided along the lines of proponents and opponents of anticorporate farming laws. The main argument of the proponents of these laws is the need to protect the family farm as the main production unit of American agriculture. This view is supported by economic and

agrarian views (Comstock 1987, Kirkendall 1987, Barry 1987, Hightower 1987). Anticorporate advocates argue that the family farm emerges as the efficient means of production, if all externalities of agricultural production are taken into account. They claim that the lower cost of production of corporate farms can be achieved only because of environmental externalities that are transferred to the public or private entities such as neighboring farmers and landowners (Center for Rural Affairs 1999). The exertion of market power by integrated agribusinesses against independent family farmers is cited as the second justification for corporate restrictions in agriculture. In the hog industry, family farmers are said to receive lower prices unfairly because of competition from captive supplies of pork processors (Center for Rural Affairs 1999).

Opponents of such restrictions argue that from an economic point of view there is little evidence that the family farm is the most cost-effective structural framework in which to produce agricultural commodities. The family farm may be shown to be more economically efficient, but this is only because the owner-operator is not fully compensated for his or her managerial contribution. When the full cost for management compensation is factored in, the family farm form of operation ends up on a more equal footing with other forms of operation. The family farm has not been shown to be more financially stable than the nonfamily operation. There is also little evidence that the family farm holds any distinct advantage in the area of resource conservation. Finally, there is no evidence to substantiate the family farmer's claim to an ability to quickly adapt to a new technology (Boehlje 1987).

Opponents of such restrictions also contend that corporate farming restrictions prevent certain types of economic development and expansion desirable to the state. They claim that the impact of restrictions such as Initiative 300 goes beyond the immediate provisions. The existence of corporate restrictions signals to large producers a business climate that opposes large-scale hog production in the state. This business climate may impact the hog industry directly and may also influence the location decisions of feed suppliers and pork processors (Johnson et al. 1988).

The impact of Initiative 300 on the Nebraska agriculture is analyzed in a study by Johnson et al. (1988). The study concludes that perceptions of the impact of the corporate

restrictions were quite mixed, with no clear consensus. In 1988, only one-third of Nebraskans felt that Initiative 300 had helped maintain the family farm and rural communities. Also, only about the same percentage thought that Initiative 300 had been advantageous to Nebraska. The impact of corporate farming laws on the hog industry is not specifically addressed in this study. We know of no other research that quantitatively evaluates the impact of these restrictions upon the Nebraska hog industry.

Model of the Nebraska Hog Industry

We use a partial adjustment model with a variable speed of adjustment applied to on-farm hog inventories. There is a long tradition in agricultural economics of using these types of models (Tryfos 1974, Azzam and Turner 1991, Wahl, Hayes, and Johnson 1992, Bierlein et al. 1998). The conceptual foundation of these models is well known and not repeated here (Koyck 1954, Nerlove 1958).

Our research attempts to determine the change in the speed of adjustment caused by an institutional constraint; hence, the coefficient of adjustment ? has to be variable over time. This is accomplished by postulating the following function for the adjustment coefficient ?:

$$? \; ' \; a_0 \; \% \; a_1 D_1 . \qquad (1)$$

The coefficient or speed of adjustment becomes a function of two parameters (a_0, a_1) and a shift variable D_1. The constant a_0 is comparable to the constant coefficient in the original model. The parameter a_1 represents the change in the adjustment speed. It takes effect when the shift variable takes a value of one. The resulting adjustment speed ? is the sum of the two coefficients.

The first empirical model, hereafter referred to as the Nebraska model, analyzes the Nebraska hog industry. The dependent variable in this model is the total on-farm hog inventory INE_t. The desired inventory INE_t^* is calculated as a function of the price of hogs received by farmers P_{t-2}, the cost of feed C_{t-2}, and the technology variable TNE_{t-2}:

$$INE_t^{*} = \beta_0 + \beta_1 P_{t-2} + \beta_2 C_{t-2} + \beta_3 TNE_{t-2} + u_t. \tag{2}$$

The adjustment of inventory (INE_t - INE_{t-1}) is the fraction ? of the adjustment toward the desired level (INE_t^* - INE_{t-1}):

$$INE_t - INE_{t-1} = (\alpha_0 + \alpha_1 D_1) \cdot (INE_t^{*} - INE_{t-1}). \tag{3}$$

The corporate form of business offers the advantages of continuity, centralized management, ease of transferability of ownership, limited liability, and flexibility in financing. Of these advantages, the last two, limited liability and flexibility in financing, are the principal nontax advantages of the corporate form. And, of these two, the flexibility in financing that a corporation may enjoy is a significant reason why anticorporate farming statutes exist (Hayes 1985). The institutional constraint, generated by Initiative 300, which limits the ability of the Nebraska hog industry to exploit these advantages, is simulated by shift variable D_1. Equation (2) is substituted into equation (3) and is solved for the inventory variable INE_t:

$$\begin{aligned} INE_t &= (\alpha_0 + \alpha_1 D_1) \\ &\quad \cdot (\beta_0 + \beta_1 P_{t-2} + \beta_2 C_{t-2} + \beta_3 TNE_{t-2} - INE_{t-1}) + INE_{t-1} + v_t, \end{aligned} \tag{4}$$

where $v_t = (\alpha_0 + \alpha_1 D_1) u_t$. This variable speed of adjustment model is intrinsically nonlinear. Consequently, the task of estimation is carried out by the nonlinear procedures of SHAZAM.

A partial adjustment model with constant speed of adjustment is used as a linear simplification of a model with variable adjustment speed. This model is estimated to obtain good starting values for the nonlinear estimation. The desired inventory function is identical to the one in the nonlinear model.

Data

The model uses semiannual observations from June 1974 to June 1996. The inventory data are taken from the "Hogs and Pigs Report," published by the National Agricultural Statistics Service (USDA Various). All models use the total number of hogs and pigs as published for June 1 and December 1 from 1974 to 1996 for each state in the sample. The Omaha market is selected as the representative market for all price data (Wellman 1998). The prices used in the econometric models are deflated semiannual averages of monthly observations, of cash prices from January to June, corresponding to the June 1 inventory observations, and from July to December, corresponding to the December 1 inventory data. The cost variables cover the main components of the feed rations plus an interest component. The rations are calculated according to the recommendations given by the University of Nebraska Extension staff (Nebraska Cooperative Extension 1991). The technology variable is the percentage of total hog inventory held in operations over 500 head. The price, cost, and technology variables are lagged two periods because of the approximately one-year lag between the breeding decision and the marketing of the finished hogs. The second four-state model for Nebraska, Ohio, Indiana, and Illinois uses the number of hogs per farm to approximate industry structure and technology in a state.

The shift variable D_1 has the value of one for all observations after December 1983 and zero otherwise. Initiative 300 was enacted in November 1982; because of the lag in production, we assume that its impact on the hog inventory in Nebraska was first seen in the December 1983 figures.

The price series are first subjected to a Dickey-Fuller test (Fuller 1976; Dickey and Fuller 1981). This procedure tests the time series for a unit root. Additional tests are performed to confirm that the elements of the price time series are random. A test for white noise processes is given by the Ljung-Box-Pierce (Box and Pierce 1970; Ljung and Box 1978) portmanteau test statistic. The combined results of the Dickey-Fuller and Ljung-Box-Pierce portmanteau tests provide statistical support for our decision to lag the independent variables two periods in the partial adjustment models. It is reasonable to assume that the decisionmakers use the price information at the time of the production decision. The available information does not allow us to form credible predictions about future values of output prices and input costs.

Results of the Nebraska Model

The results of the Nebraska model (Equation [4]) are presented in Table 1. The coefficients of all parameters have the expected signs. The quasi-R^2 of the model is 0.87.[3] The coefficients are significant at the 5 percent level, except for the finished hog price, which is only significant at the 10 percent level. The aggregation of monthly prices into a semiannual average is thought to have caused the relative explanatory weakness of this variable. Additionally, the price series is a random walk with no statistical structure. This causes decisionmakers to hold arbitrary conjectures about the development of prices during the time from the production decision until marketing of the finished hogs. In this study, a constant conjecture is assumed, which may not accurately model the behavior of all decisionmakers in the industry.

The speed of adjustment from 1974 to 1983 is found to be ? = a_0 = 0.58181. This means that, per six-month period, the total hog inventory adjusts about 58 percent toward the desired level. The desired inventory is controlled by finished hog price, cost of feed, and the structure of the state hog industry. Rearranging the adjustment mechanism as $INE_t = 0.58181 INE_t^* + 0.41819 INE_{t-1} + e_t$ illustrates how these factors influence the actual inventory through the desired inventory specification. The influence of the market forces outweighs the lagged inventory. The regression results show that from 1974 to 1982 the Nebraska hog industry reacted substantially to revenue and cost signals and was strongly influenced by industry structure and technology.

TABLE 1. Regression results of Nebraska model (equation [4])

Variable	Parameter	Estimated Value	T-Ratio
Fixed adjustment	a_0	0.58181	4.1639
Adjustment shift	a_1	-0.57401	-4.0708
Intercept	$ß_0$	2023.1	7.1712
Hog price	$ß_1$	40.005	1.7105
Feed cost	$ß_2$	-5.8229	-3.5901
Technology	$ß_3$	7993.0	3.7899

The adjustment coefficient depends on the ratio of the marginal out-of-equilibrium and adjustment costs (Grilliches 1967). The marginal out-of-equilibrium cost is the marginal loss in profits of keeping a nonoptimal inventory. The marginal adjustment cost is the cost of marginal hog inventory changes. Following Grilliches's decomposition of the adjustment speed, ? = 0.58 means that the ratio of marginal adjustment to out-of-equilibrium costs is about 1:1.5. The marginal adjustment cost is relatively low compared to the marginal out-of-equilibrium cost during that time.

This situation changes fundamentally after the corporate restrictions became effective in 1983. The effective adjustment coefficient, calculated as ? = $a_0 + a_1$, is reduced to 0.0078. The ratio between marginal adjustment and out-of-equilibrium costs in now about 1:0.01. The cost of adjusting hog inventory by a unit far outweighs the lost profit from keeping a unit of nonoptimal inventory. Looking at the adjustment mechanism as $INE_t = 0.0078INE_t^* + 0.9922INE_{t-1} + e_t$ illustrates that the influence of the desired inventory is almost eliminated after 1983. The actual hog inventory can hardly respond to price, cost, and technology signals. Lagged hog inventory becomes the dominant determinant of current inventory.

To further analyze whether Initiative 300 has any impact on the adjustment pattern of the hog industry, two questions need to be answered. First, is the structural break unique to the point in time defined by the enactment of Initiative 300? Second, is the structural change at this particular time unique to the hog industry of Nebraska? Negative answers to these questions would eliminate corporate farming restrictions as being a substantial force behind the hog industry's development in our analysis. If the structural change is unique neither to 1983 nor to Nebraska, it is likely that the restrictions have no impact or only an insignificant impact on the hog industry's speed of adjustment. Alternative explanations for the results of the Nebraska model are technological changes, commodity prices, environmental regulations (Metcalfe 1999), export conditions, credit conditions, and other economic or political factors.

To answer the first question and to establish a link between the regression results and corporate farming restrictions, we systematically test for significant changes in the adjustment speed around the time of the enactment of Initiative 300. We run the model repeatedly with a modified shift variable D_1, which simulates structural breaks between June 1981 and 1986. The values of the parameter a_1, their t-ratios, and the R^2 values of

the respective shift variable specifications are shown in Table 2. The configuration of the shift variable D_1 used in the original Nebraska model results in the best-fitting model. Before 1983, no significant change in the adjustment speed is detected. After December 1983, all shift variable configurations result in negative changes of the adjustment speed coefficients, which means reductions in the adjustment coefficient. This effect is expected because the corporate farming laws are permanent. These results support our hypothesis that the restrictions have an impact on the behavior of the hog industry, by permanently impeding its ability to adjust to a desired inventory level.

Figure 2a illustrates the results. This diagram helps to demonstrate the estimated change in industry behavior. The chart depicts the estimated inventories using constant and variable adjustment processes. In the constant adjustment estimate, the on-farm hog inventory is estimated assuming ? = a_0 for the entire study period. The variable adjustment model uses ? = $a_0 + a_1$. Naturally, both lines run concurrently from 1974 to 1982, as D_1 = 0 during that period. A noticeable, permanent gap opens up in 1983. Maintaining a constant speed of adjustment after 1982 results in an inventory estimate well above the variable adjustment line.

TABLE 2. Comparison of various shift variable configurations

D_1	a_1	T-Ratio	R^2
June 81	0.12261	0.48546	0.833
Dec 81	0.23441	1.0588	0.836
June 82	0.36524	1.3765	0.842
Dec 82	0.03981	0.16118	0.832
June 83	0.04130	0.15479	0.832
Dec 83	**- 0.57401**	**- 4.0708**	**0.871**
June 84	- 0.56496	- 3.5699	0.851
Dec 84	- 0.52340	- 3.1500	0.844
June 85	- 0.52143	- 3.4661	0.844
Dec 85	- 0.10663	- 0.57203	0.833
June 86	- 0.49115	- 3.4718	0.845

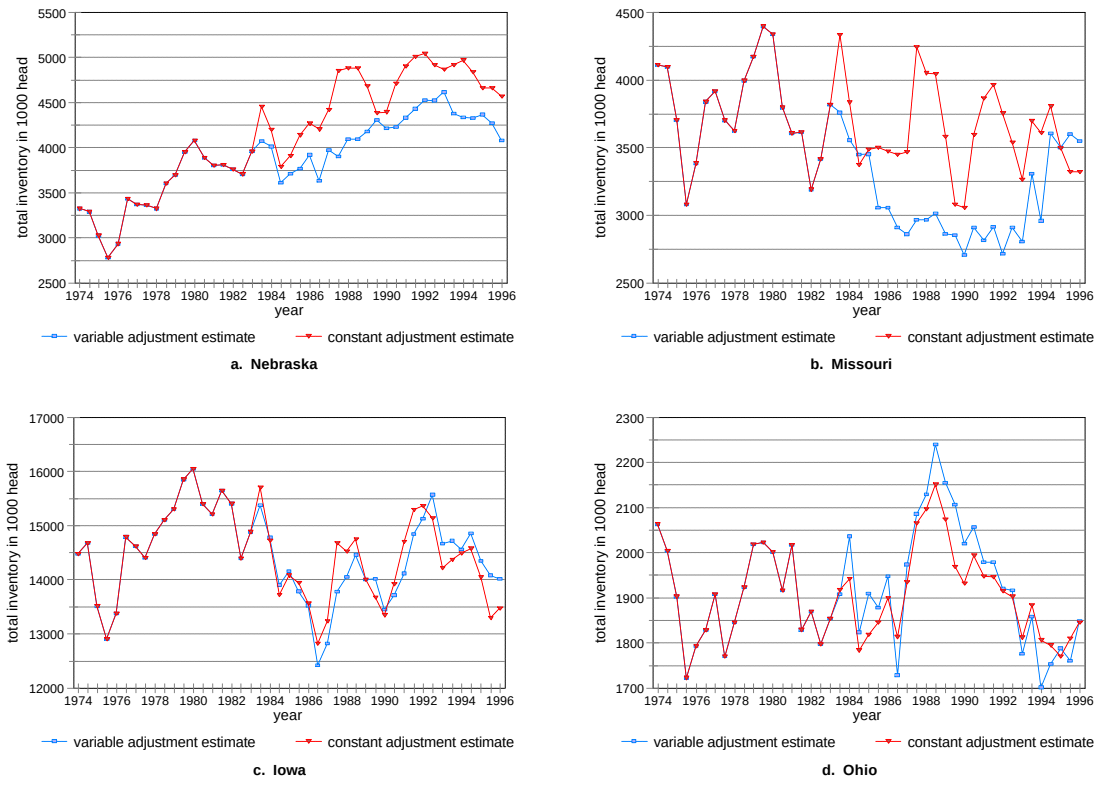

FIGURE 2. Variable and constant inventory adjustment estimates

The results of the Nebraska model support the research hypothesis of this study that the elimination of the corporate organizational option in Nebraska has reduced the ability of the hog industry to adapt its inventory to changes in market conditions.

It is important to note that several other financial and economic factors contributed to the development of the hog industry in the 1980s. In the early 1980s, agriculture experienced a financial crisis. Following years of aggressive expansion of production capacities using cheap bank financing, interest rate increases and subsequent appreciation of the dollar led to a collapse of agricultural exports by 1985. U.S. agriculture slipped into a state of depression. The 1985 farm bill initiated a then unprecedented rescue effort for the American farm sector. Government subsidies accounted for as much as half of total farm income. This assistance to corn and soybean producers diminished the incentive for diversified producers to engage in labor-intensive livestock production. These factors exerted similar forces on the hog industry; their impact cannot be completely separated from the impact of corporate restrictions.

Multistate Analysis

In this section, we use two seemingly unrelated regression models that compare the hog industry in Nebraska to the hog industries of Missouri, Ohio, Iowa, Indiana, and Illinois. These states were selected because of their geographical proximity to Nebraska, their comparable hog industry histories, and their similar makeup of large family hog farms. The hog industries in these states face common economic shocks but they vary in their corporate farming regulations. Our research hypothesis implies that state hog industry behavior corresponds to the prevalent degree of corporate farming restrictions in a state. Missouri and Iowa, states that restrict corporate farming, are expected to show significant reductions in the adjustment speed. Ohio, Indiana, and Illinois, states that do not have corporate farming restrictions, are expected to show a constant speed of adjustment over the entire study period.

If the reduction in adjustment speed were driven by forces common to the national hog industry, we would expect to see a common pattern in the behavior of the hog industries in all states covered by the analysis. This means that corporate farming restrictions cannot be singled out as a main cause to explain the behavior of the Nebraska hog industry.

Because of a lack of data availability, not all six states can be estimated in one model. The first model, which is discussed in detail in this paper, compares Nebraska to Missouri, Iowa, and Ohio. In this setting, only Ohio represents the states without corporate farming restrictions. To broaden the base, in a second model, Nebraska is compared to three states without corporate farming restrictions: Ohio, Indiana, and Illinois. The structure of the second model is similar to the first one. Only the technology variable is altered. The second model uses the number of hogs per farm to approximate the prevailing technology and industry structure.

In the first multistate model, the structures of the individual state equations are very similar to the Nebraska model. The price and cost variables are shared by all four equations, but each state has a separate technology variable. Combining the desired inventory equations for all four states with the adjustment mechanisms yields the following nonlinear seemingly unrelated regression model:

$$
\begin{aligned}
INE_t &= (a_{01} + a_{11}D_1) + (ß_{01} + ß_{11}P_{t-2} + ß_{21}C_{t-2} \\
&\quad + ß_{31}TNE_{t-2} - INE_{t-1}) + INE_{t-1} + v_{1t} \\
IOH_t &= (a_{02} + a_{12}D_1) + (ß_{02} + ß_{12}P_{t-2} + ß_{22}C_{t-2} \\
&\quad + ß_{32}TOH_{t-2} - IOH_{t-1}) + IOH_{t-1} + v_{2t} \\
IMO_t &= (a_{03} + a_{13}D_1) + (ß_{03} + ß_{13}P_{t-2} + ß_{23}C_{t-2} \\
&\quad + ß_{33}TMO_{t-2} - IMO_{t-1}) + IMO_{t-1} + v_{3t} \\
IIA_t &= (a_{04} + a_{14}D_1) + (ß_{04} + ß_{14}P_{t-2} + ß_{24}C_{t-2} \\
&\quad + ß_{34}TIA_{t-2} - IIA_{t-1}) + IIA_{t-1} + v_{4t} \quad .
\end{aligned}
\tag{5}
$$

This model is estimated using the nonlinear capabilities for seemingly unrelated regressions of the SHAZAM software package.

Results of the Multistate Models

The nonlinear estimation of the first seemingly unrelated regression model (equation [5]) produced the parameter estimates shown in Table 3. The main result of this estimation is that parameters a_{11}, a_{13}, and a_{14}, representing the change in the adjustment speed after 1983, are all negative and significant. This means that Nebraska, Missouri, and Iowa experience a significant reduction in the adjustment speed of their hog inventories while Ohio does not. The ability of the first three states' hog industries to adjust their inventory from period to period to a desired level has shifted in 1983. The same cannot be said about Ohio's hog industry because a fixed speed of adjustment over the whole sampling period is observed.

Additional tests are performed to further evaluate these parameters. The first hypothesis tested is H_0: $a_{11} = a_{12} = a_{13} = a_{14}$. This hypothesis states that the reduction in the speed of adjustment is jointly equal for all four states. The χ^2 statistic of this test is 2.74, which means we fail to reject the null hypothesis. This test contradicts the results of

TABLE 3. Regression results of the multistate model

Variable	Parameter	Estimate	T-Ratio
Nebraska (R2= 0.861)			
Fixed adjustment	a_{01}	0.49098	3.60
Adjustment shift	a_{11}	-0.46783	-3.29
Intercept	$ß_{01}$	2299.8	7.74
Hog price	$ß_{11}$	51.185	1.90
Feed cost	$ß_{21}$	-4.2652	-2.63
Technology	$ß_{31}$	4753.6	1.89
Ohio (R^2 = 0.378)			
Fixed adjustment	a_{02}	0.63475	3.59
Adjustment shift	a_{12}	-0.37681	-1.47
Intercept	$ß_{02}$	1930.6	12.80
Hog price	$ß_{12}$	2.3106	0.21
Feed cost	$ß_{22}$	-0.97268	-1.10
Technology	$ß_{32}$	727.59	0.57
Missouri (R^2 = 0.804)			
Fixed adjustment	a_{03}	0.44172	4.29
Adjustment shift	a_{13}	-0.43587	-4.31
Intercept	$ß_{03}$	3506.2	8.73
Hog price	$ß_{13}$	113.27	5.06
Feed cost	$ß_{23}$	-4.7850	-2.19
Technology	$ß_{33}$	-2787.4	-0.80
Iowa (R^2 = 0.685)			
Fixed adjustment	a_{04}	0.40241	3.49
Adjustment shift	a_{14}	-0.26228	-2.16
Intercept	$ß_{04}$	13393	12.84
Hog price	$ß_{14}$	246.74	2.82
Feed cost	$ß_{24}$	-2.1321	-0.47
Technology	$ß_{34}$	-13283	-2.45

the individual t-tests of the parameters, because parameters different from zero test equal to a parameter not different from zero.

Single linear hypothesis tests are used to gain additional insights into the properties of the parameters. The following hypotheses are tested: H_{01}: $a_{11} = a_{12}$, H_{02}: $a_{11} = a_{13}$, and H_{03}: $a_{11} = a_{14}$. The test statistics result in a failure to reject any of these hypotheses. The tests confirm the result of the joint hypothesis test.

Figure 2 illustrates the results of the multistate model. The graphical illustrations reveal that Nebraska and Missouri's hog industries behave differently from the way Iowa and Ohio's do. The estimates of the Nebraska equation are very close to the results of the previous Nebraska model. Therefore, the graphical illustration is not repeated. Figure 2a and its results apply to the multistate model. The graphical result of the Missouri equation (Figure 2b) is comparable to the Nebraska result. The behavior of the Missouri hog industry is similar to that of Nebraska until the relaxation of the corporate farming restrictions in 1992. The model estimates a higher hog inventory by using a constant speed of adjustment until 1992. This is an indication that Missouri's hog industry has been constrained in its development similarly to Nebraska's. This is consistent with the impact of corporate restrictions—imposed in 1975—that have permanently restricted capital availability.

Figure 2d shows that the Ohio equation of the multistate model does not predict a clear difference in hog inventory dependent on a structural break in the development of the industry. Allowing for a reduction in adjustment speed in 1983 versus the use of a constant adjustment coefficient does not result in a visible difference in the estimated inventory. This is consistent with the hypothesis that a state without corporate restrictions should not display the same distinct gap between the constant and variable estimate seen in the Nebraska (Figure 2a) and Missouri (Figure 2b) models.

The results for Iowa (Figure 2c) fall in between Nebraska and Missouri on one side and Ohio on the other. The parameter estimated for the reduction of adjustment speed is weakly significant. The resulting effective speed of adjustment ? is 0.4, which lies in between the values for Nebraska and Missouri, which are almost identical, and the value for Ohio. The graph of the estimated inventories for Iowa (Figure 2c) shows that this

parameter value results in a behavior of the industry that is similar to Ohio's. We do not see the wide gap between constant and variable adjustment estimates of inventory exhibited by Nebraska and Missouri. Iowa has had corporate farming laws since 1975. However, the reduction in number of hog operations since then has been much more severe than in either Nebraska or Missouri. Compared to Nebraska or Missouri, a larger part of the total hog inventory in Iowa consists of market hogs. Missouri in particular has been concentrating on hog farrowing. A sizable portion of hogs that are finished in Iowa have been farrowed in Missouri. Market inventory adjusts faster than does breeding inventory, so an industry with a higher percentage of market inventory is expected to have a higher total adjustment speed (Matthey 2000). Assuming that the Iowa hog industry exhibits a ratio of adjustment coefficients between the breeding and market sectors that is similar to the Nebraska hog industry, the emphasis on hog finishing contributes to a higher adjustment coefficient of the total inventory. The sum of the structural differences between Nebraska and Iowa is believed to be responsible for the different response the Iowa hog industry shows to the price and cost changes after 1983.

The econometric results of the multistate model suggest that factors common to the national hog industry affect states with corporate farming laws differently from the way they do states without them. The industries of Nebraska and Missouri behave in a similar fashion. Both states have corporate farming laws, while Ohio does not.

The complete results of the second multistate model are omitted here.[4] The estimated parameters verify the results of the multistate model discussed above. Because of the difference in independent variables, the absolute parameter values differ, but the findings point in the same direction. For Nebraska we find a significant reduction in the speed of adjustment in 1983, even though the coefficient is not as strong as in the first two models. The result for Ohio shows a weakly significant coefficient for the speed reduction variable. Indiana and Illinois are included in the analysis to provide an additional control group of states without corporate farming laws. The results for these two states confirm the Ohio results in the first multistate model. Both Indiana and Illinois have insignificant a_1 parameters. Their inventory adjustment speed does not decrease in 1983—it is constant over time. These findings indicate that the hog industries in states without corporate

farming laws behave differently from Nebraska's hog industry. Their ability to adjust inventory stays on a fixed and higher level over the entire period, while Nebraska's is diminished in 1983.

Summary and Conclusions

The results of the Nebraska model support the initial research hypothesis of this study that the corporate farming restrictions in Nebraska have reduced the Nebraska hog industry's ability to adjust its inventory to target levels. We find a difference in the behavior of the hog industry before and after the restrictions become effective. The Nebraska hog industry responds less to market signals after 1983. The adjustment pattern is altered permanently after 1983. Because a single state analysis does not eliminate factors common to the national hog industry, the Nebraska hog industry is compared to its counterparts in other states. The equations for Nebraska and Missouri on one side estimate a gap between the constant and variable adjustment estimates after 1983, while the models for Ohio, Indiana, Illinois, and Iowa do not show such a gap. Structural differences between these industries, induced by anticorporate farming laws, are believed to lead to these findings.

The combined results of all models are consistent with the expected impact of corporate restrictions on the Nebraska hog industry. Even though no causal relationships can be shown, the analysis provides convincing evidence that points to corporate restrictions as an important influence on the development of the Nebraska hog industry. A significant shift in inventory adjustment behavior is shown to coincide with the enactment of the corporate restrictions. States allowing nonfamily corporate agriculture exhibit different adjustment patterns than do states prohibiting this type of enterprise.

Endnotes

1. The forms of business organization targeted by these regulations include the corporation, corporate partnership, limited partnership, limited corporate partnership, syndicate, and joint stock company or association.
2. We introduce here only the parts of the regulations relevant to our results. For a comprehensive treatment of these laws, see the complete legal texts.
3. The quasi-R^2 is calculated as the squared correlation between the actual and predicted dependent variable.
4. The complete estimation results are available from the authors upon request.

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