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POLICY IMPLICATIONS OF CHANGES IN ILLINOIS HOG PRODUCTION

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POLICY IMPLICATIONS OF CHANGES IN ILLINOIS HOG PRODUCTION

by

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A.A.S. Lakeland College, 2007
B.S. Southern Illinois University, 2009

A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Masters of Science

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RESEARCH PAPER APPROVAL

POLICY IMPLICATIONS OF CHANGES IN ILLINOIS HOG PRODUCTION

By

Neil Probst

A Research Paper Submitted in Partial

Fulfillment of the Requirements

for the Degree of

Masters of Science
in the field of Agribusiness Economics

Approved by:

Charles Matthew Rendleman –Chair

Graduate School
Southern Illinois University Carbondale
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AN ABSTRACT OF THE RESEARCH PAPER OF

Neil Probst, For the Masters of Science in Agribusiness Economics, Presented on November 4, 2010 at Southern Illinois University Carbondale.

TITLE: POLICY IMPLICATIONS OF CHANGES IN ILLINOIS HOG PRODUCTION

MAJOR PROFESSOR: Dr. Charles Matthew Rendleman

This paper analyzes the rapid changes of the hog industry in the state of Illinois, with a focus on the impact of increasing scale on local communities and environments. Theory on externalities, regional economics, and efficiencies is explored. A literature review looks at past studies on effects to local environments, health, land values, and economic vitality and explores potential solutions. A regression model is used to determine the impact of increased hog concentration on local Illinois employment rates to see if local economies are strengthened or weakened by large hog operations. Results show Illinois counties that had hog farm loss between 1997 and 2007 saw an increase in unemployment rates. We discuss the various policy options to deal with potential externalities, along with their advantages and disadvantages. My final recommendation is a compensation system through a mandated insurance policy.

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INTRODUCTION

In recent years, the hog industry in Illinois has experienced rapid changes in terms of increasing scale, concentration and specialization in hog production. There has been an undeniable trend in both horizontal and vertical integration, with strong evidence that Illinois hog farmers felt the need to expand their operations or go out of business. The possible reasons for this sudden trend in larger scale operations are many: increased availability of farm credit, lower risk environments or higher risk tolerance by producers, higher fixed costs due to technology or government policies, as well as trends in prices related to farming, including low grain prices and moderate pork prices. But when farmers expand their size, it does not mean that the hog industry in Illinois has grown. The evidence shows to contrary; as some operations increase their scale, smaller operations go out of business and horizontal integration occurs.

According to the USDA National Agriculture Statistics Service, the number of hog operations in Illinois fell from 62000 in 1965 to 2900 in 2007(see figure 1). Also the percentage of hog farms that had over 2000 head, which is considered by the USDA to be a large farm, skyrocketed from 3% in 1992 to 20% in 2007 (see figure 2, USDA did not start classifying farms by size until 1992). This overall integration had led to an overall decrease in total hog inventory (see figure 3). These trends are prevalent in Illinois and across America, causing the hog industry to be concentrated in certain areas of the country, particularly the Midwest and North Carolina.

However, as the size of farms increases, they can become bigger point source polluters due to the large amounts of animal waste that accumulates on the property, implying that the hog industry is a greater pollution risk today more than ever even

though there are fewer hogs. Starmer and Wise explain that in the past, when farms were spread out among a bigger area, there was plenty of land to spread the waste over, decreasing the negative effects. But now as the industry is becoming more concentrated, the waste accumulates in a smaller area as it too costly to transport. If the waste is not managed effectively, the larger farms can have a serious environmental impact on the local rural communities. The negative impacts come in two forms, odors and pollution. The odors, caused by air pollutants in the hog waste are often the subject of public nuisance complaints and are associated with lowering the property value of surrounding residential areas. "The major air pollutants of concern from hog producers include hydrogen sulfide (H25) and ammonia (NH4)" and are linked to worsened public health (Sneeringer, Jan 2009). Water pollution occurs when waste escapes the farm premises because it was not managed properly by the farmer or there was a catastrophic event such as a flood. All of this leads to damages that are external to the farmer.

Because of these trends, there has been increasing pressure on regulators to prevent or reverse these negative externalities. However, many hog producers feel they are overregulated, and the environmental polices enforced on their farms are too costly and keep them from being profitable. "While all livestock farmers are under increasing scrutiny to reduce the level of residuals associated with the raising of animals, the pressures are greatest for hog farmers" (de Vos, et al., 2003). According to a survey of Illinois hog farmers by Reisner and Taheripour, farmers are more likely to emphasize the benefits of large scale livestock production than the lower property values of the residents who live near them. Many farmers claim their operations help the local economy by providing jobs to the area, offsetting the negative externalities. This idea is often

unchallenged. "[I]f a community believes that the CAFO will improve its economy, it is likely to support such activities to the detriment of the residents in the agriculture area around it" (Weida, 2002).

This leads to three basic questions that I wish to address in this paper. 1) Does increasing scale of hog farms lead to a greater negative impact on local communities? 2) If so, is there an optimal level of government regulation that can correct the externalities? And 3) is there any truth to the claim that large farms help the economic vitality of local communities? I will explore these issues by analyzing economic theory regarding economies of scale, externalities, and policy implications, as well as a review of existing literature on the topic applied to Illinois and the other regions. Finally, I will use a model of my own to test the effect of hog scale on local economies in Illinois by analyzing changes in industry and local economic factors.

ECONOMIC THEORY ANALYSIS

A) Economies of Scale

The concept of economies of scale attempts to explain why firms operate at certain capacities as opposed to larger or smaller levels of output. The theory suggests that as the fixed cost of a firm increase, there is more incentive for a firm to increase its output in order to spread the costs among more units. For example, if a new technology emerged that fed hogs automatically, a large farmer would be more likely to adopt it, as the high initial costs of the technology could be offset by lower labor cost. For a small farmer, however, the technology would not be worth the expense because he could feed the hogs himself. Therefore, the large farmer has become more efficient by lowering his labor costs, and the small farmer has incentive to increase the size of his farm to take advantage of the new technology.

Economies of scale does not always mean bigger is better, however. Every operation will eventually reach a point of diminishing returns where increasing scale leads to lower total revenue. Overcrowding barns or spreading resources too thin can cost the farmer money. When a farmer researches this point, they are experiencing diseconomies of scale. Therefore, economy of scale implies that every farm has an optimal level of scale contingent on factors related to the specific industry and firm. Factors like credit availability and risk utility can also effect a farmer's decision to change scale. The benefits of taking advantage of economies of scale- increasing efficiency and specialization which ultimately lead to higher profits- are often greater than any disadvantage of scale increases (pollution) from the perspective of the farmer.

Therefore, government policies are often used to counter the effect of increasing scale if the perception of negative externalities exists, as is the case with hog operations.

B) Externalities

Tietenberg describes as externality as situation where "the welfare of one agent, either a firm or household, depends on the actions of another agent" (Tietenberg, 2006, 613). In other words, it is when a market activity affects a bystander. In the case of large hog farms, pollution and nuisance are two most common types of externalities. If waste from a farm pollutes a water supply or causes bad odor, surrounding property owners are powerless to stop the activity, which is why many would justify regulations on hog farms even if they cost efficiency. Externalities are considered market failures and are often used to justify government intervention in the free market. In this case, the market fails because the costs incurred by the owners of the hog operations do not include the total social costs- the cost of pollution and nuisance are external to the operation. Social optimization only occurs when output reflects total costs, so current hog production levels may not be efficient.

C. Regional Economics

Because this paper examines the relationship between hog farms and communities in close proximity, it is important to understand how spatial factors can effect economic decisions. Since it costs money to physically transport goods and people, there is incentive for local businesses to use local inputs and hire local people. Therefore, many communities welcome new businesses, not only for the immediate creation of new customers and jobs, but also for their induced effects. For example, if a large hog farm comes to the area, it may buy its corn and hire its workers from the local community,

increasing the income of all involved. With higher incomes, these people now have more money to hire local labor and spend on local services, strengthening other economic sectors, and a positive feedback loop is created. This is called the multiplier effect. Shaffer, et al. defines an employment multiplier as a measurement of "the total change in employment due to $1.00 change in final demand of a specific sector" (Shaffer, et al., 2004)

However, factors determining the strength of the multiplier effect are different for every industry and region, so many are skeptical of the idea that large hog farms actually benefit the region in which they are located. Some claim the multiplier effects become lower as the scale increases (Sneeringer and Hertz, 2010). This is based on the idea that operations become more concentrated, they become more technology intensive and rely less on labor. Therefore, when several small farms combine into one large one, less labor is needed per head and there is a net job loss. Also, large farms are more likely to be vertically integrated (Starmer and Wise, 2007). In other words, the operation is not owned by farmer, but rather by a large corporation that contracts the services of the farmer. By controlling more stages of the supply chain, the corporation can lower transportation and transaction costs, making farms more likely to buy inputs outside the local economy.

D. Optimization Methods

In order to determine the appropriate degree of regulation one must compare the cost of the externalities to the cost of the lost efficiency. However, negative externalities are hard to quantify, especially in this case. If you don't like the smell of your neighbor's farm, how much money does that cost you? If manure build-up leads to water pollution

which leads to the poor health of a community, can a price be put on their suffering? These are challenging issues surrounding the hog industry, but there are economic methods to deal with externalities to determine the optimal actions to be taken.

When external damages can be defined and quantified, the Coase Theorem can be applied, which states that the existence of property rights can help solve problems regarding externalities. Tietenberg explains "the Coase Theorem shows that the very existence of an inefficiency triggers pressures for improvements" as long as property rights are well defined and transition costs are low. In the case of hog farms, a case could be made that if farmers were mandated to pay all costs associated with their operation, both social and internal, then the externality would become internalized and socially optimal output would be produced. This solution is simple and requires no direct regulations or prior restraint. But often it is unrealistic as it is often hard to define which property owners are affected by air and groundwater pollution.

When target policies such as standards for waste management are preferred, a popular method for policy makers is the cost-benefit analysis. Using this method, all potential costs and benefits of a proposed policy would be calculated and expressed in dollar terms. If benefits exceed costs, then the policy should be implemented. These often serve as a good guide for policy makers but are often imperfect because they contain a great deal of researcher subjectivity, especially in regards to valuing benefits. Also, some criticize that it relies too heavily on the philosophy of utilitarianism- maximizing pleasure and minimizing pain- which is not a universally accepted ethical principle as it does not address the moral distribution of benefits and costs (Stavins, 2000, 355-365).

The general economic model to solve this problem is summarized by de Vos, et al.: “The optimal social level of a good such as livestock manure occurs where its marginal social costs are equated with the marginal social benefits of an additional unit of product.” So when choosing a corrective action, one must consider all parties involved to determine a socially optimal outcome. As stated earlier, determining who is affected by negative externalities and to what extent can be a very complex task, which means attempts to correct the market failure could make things much worse, especially if decision-makers have a poor understanding of economic principles.

REVIEW OF LITERATURE

Many studies seek to discover the true impact of the increase in scale of hog operations. These studies focused on various regions around the country and looked as the different effects including change in local land values, effects on local communities, and profitability changes. Also, some of the strategies to manage hog farm externalities, such as mediation, regulation, and internalization are also explored. Since this issue is very complex, it is helpful to examine the existing knowledge on the numerous factors that contribute and potentially resolve the problem.

A) Measuring externalities

Several studies look at the direct impact of hog operations on land values. Two studies, one by Palmquist, et al. and another study by Goldsmith and Thomas, show the effect of large hog operations on local land values in North Carolina, a large hog producing state. Goldsmith's article concludes that large farms do not lower property values, whereas Palmquist finds a significant negative relationship. A similar study was done in Iowa by Herriges, et al. and concluded that hog operations lowered local property values, but suggested farm management practices was a greater factor than farm size. Huang, et al. did a study in Illinois and found that the number of hog farms in an area negatively affects value while scale has a weak positive effect. "[O]ur results suggest that fewer operations are associated with increases in farmland values." All of these studies used hedonic models that included physical variables such as the size and amenities of the property, and location variables such as average income and distance to schools.

Sneeringer performed two studies looking at the effects of CAFOs on public health due to air and water pollution. A national study (Feb 2009) looks at the cost of

worsened infant health caused by CAFO pollution. She concludes there is "a strong positive relationship between livestock farming and infant mortality." Although she does not attempt to put the cost of infant deaths in dollar terms, she does state "offsetting the 2.3% increase [in infant mortality] associated with livestock would require 0.11% of GDP." The second study (Jan 2009) looks specifically at the state of North Carolina and the effects of hog expansion and concentration on air pollution levels. She shows that the rapid expansion, partially caused by favorable legislation, increased pollution levels significantly. She did attempt to put a dollar figure on the cost of pollution in this study, concluding "an externality cost of $2.45 million per county per year attributable to hog production."

Three studies looked at the socio-economic impacts of large swine operations on local areas. The first was performed by Edwards and Ladd, and it explores the rate of farms loss on low income and minority citizens. The authors imply that the rate of farm loss is an indicator of environmental impact, and that large hog operations negatively affect disadvantaged groups in a larger proportion. Sneeringer and Hertz look at the effects of increasing scale across the country and compare them to local economic changes. They conclude that large farms are less likely to buy local inputs than smaller operations, and are less likely to spend their returns in the local economy, implying that increasing hog scale has lower "multiplier effects" and thus weakens local economies. "…[W]e would expect the full employment impact of hog farming to be falling over time, on a per hog basis." Weida did a study to look at how CAFOs affect rural depopulation and determined that because communities have started to offer more local service, "…agriculture is no longer the primary economic engine of rural America"

(Gale, qtd in Weida, 2002). He also concludes that as the size of livestock farms increase, the population of surrounding areas decreases, which is desirable for the CAFO because there are less people to complain. He also confirms the low multipliers effect discussed earlier.

B) Solutions

Next, we will look at the various studies offering solutions to the externality problem. De Vos, et al. explore the "economic-environmental tradeoff" faced by many farm managers and conclude that large farms can reduce environmental damage at a fairly low cost if they consider alternative waste management practices. A major advantage of this study is getting around the problem of placing an economic value on environmental damages (a practice to which many environmentalists object) and presents a tradeoff frontier with the economic benefits in "monetary terms" and the environmental costs in "physical terms." A study by Bazen and Fleming showed that legislation in Kentucky which mandated large hog farms to a certain distance from residential properties where economically justified, as the costs to farmers were less then what the diminished property values would have been.

> Livestock production firms are worse off under the longer setback lengths (by as much as \$300 m^{-1}), but the losses to surrounding home owners far exceed the firm gains at the legislated setbacks. This result implies that Kentucky's legislated setback lengths are contributing to odor damages to surrounding property (Bazen and Fleming, 2004).

Reisner and Taheripour conducted a survey in Illinois to analyze the relationship between hog farmers, their residential neighbors, and local environmental activists. The

study shows there is an advantage when farmers are willing to cooperate with local interests, as most activist and rural residents have farm backgrounds and understand the the realities of raising livestock. Starmer and Wise, in a comprehensive review of the problem, suggest the competitiveness of the large operation is not the result of economies of scale but of current government policies, including artificially cheap feed caused by corn subsidies and unenforced pollution externalities, implying that some large operation might under free market conditions be experiencing diseconomies of scale. They conclude that the efficiency/externality tradeoff is really nonexistent, and it may be economically efficient to place more stringent regulations on hog operations.

Gramig, et al. try to get around the problem of non-market valuation of externalities, which are often highly subjective and vary across cases, by providing a market-based solution. "…[A]ny difference between the social costs and private costs of the firm likely cannot be determined by government regulators" (Gaming, et al., 2004). They propose a solution where all farmers are required to purchase insurance to cover liability claims by individuals affected by the pollution and odors caused by the operation. The insurance companies determine insurance premiums for individual farms, assuming they will equal the expected value of external cost, thus internalizing the externality. The cost of the premium will incentivize the operation to downscale or to invest heavily in environmentally friendly waste management practices. More extensive review of existing literature should be done to see any of these potential solutions has had success in the real world.

RESEARCH QUESTION

One of the principle arguments used by farmers to justify large-scale industrial hog operations is that they bring jobs and economic well-being to rural communities. If this is true, it may not be in the best interest of community members to demand strict regulations on these large farms, as such regulations are costly to enforce and could cost local communities employment. There are numerous ways to measure the economic impact of hog farms on local communities, but I am interested in whether or not the rapid hog farm loss in Illinois contributes to economic well-being, particularly higher employment. My question is: do changes in the number of hogs and hog operations in Illinois effect local unemployment rates? The results of my model do little to answer the question of optimal regulation, but it does help settle the argument as to how the rapid changes in the Illinois hog industry impact local economies

DATA AND METHODS

To answer this question, I used a simplified version of the model used by Sneeringer and Hertz to test the relationship between changes in unemployment and changes in the Illinois hog industry. My model can be expressed as:

$\Delta UNEMPLOY = \beta_0 + \beta_1 \Delta FARMNUM + \beta_2 \Delta HOGSNUM + \beta_3 \Delta HHINCOME + \beta_4 \Delta POPCHN$

Where:

- ΔUNEMPLOY is the 2007 unemployment rate minus the 1997 unemployment rate
- ΔFARMNUM is the 2007 number of hog operations minus the 1997 number of hog operations
- ΔHOGSNUM is the 2007 total hog inventory minus the 1997 total hog inventory
- ΔHHINCOME is the 2007 per capita household income minus the per capita household income
- Δ POPDEN is the percent change in population from 1997 to 2007

All the data is at the county level for every county in Illinois, making a total sample size of 102 (* see appendix). All the variables are on an annual basis and show the changes between the years 1997 and 2007. I chose these years because the hog farm data at the county level is estimated only during Census of Agriculture years, and I feel this time period captures the bulk of the structural changes in the Illinois hog industry. All data comes from public sources and is based on government estimates. Data on the number of hog operation and the total hog inventory per county came from USDA-NASS census data. Unemployment data come from the

U.S. Department of Labor- Bureau of Labor Statistics, while population and income data came from the U.S. Department of Commerce- Bureau of Economic Analysis. The purpose is to test the significance of farm numbers and hog inventory (β_1 and β_2). I also used per capita income as a predictor variable as well as rate of population change (2007 county population – 1997 county population divided by 2007 population) to represent the percent population gain/loss in each county.

RESULTS

The overall regression relationship is week, with an R^2 value equal to 0.187. However, three of the four predictor variables are significant at the .05 alpha level (see Table 1 in appendix). The change in the number of hog farms in Illinois counties has a significant, negative relationship with the change in that counties unemployment rates. In other words, if a county experienced a negative change in hog farms (farm loss) from 1997 to 2007, it unemployment rate increased. Change in hog inventory was not a significant factor in employment changes. Change in per capita income was significant with a positive relationship, which was expected. Percent change in population had a significant, positive relationship, meaning if a county gained population, its unemployment rate increased. This may best be explained by fact that counties who lose population do not necessarily loose the economic base, and there are more jobs for the people who stay.

The results of the regression are not sufficient to conclude that large hog farms hurt local economies. The model only shows the effects of a ten year period and does not forecast the possible lagging effects of the changes. For example, a large hog operation may attract a large feed mill or slaughter house to the area which would provide long term jobs. But operations like these require intensive planning so the developments do not occur immediately. Also, job loss due to efficiency should not necessarily be viewed as a bad thing. Even if large hog operations do cause short term unemployment, increasing efficiency and productivity improve the viability of the county in the long run. We can conclude, however, that when large hog operations claim they bring immediate jobs to an area, local communities should attempt to validate the claims.

DISCUSSION

Through the review of existing literature we can conclude that significant externalities exist with increasing hog scale and local residents are likely to experience more costs than benefits, despite claims that the operation will bring jobs to the area. Corrective action by government body or community organization may be justifiable, whether to prevent or compensate for damages, or to provide symmetric information to the community about the effects of the hog operation. There is a menu of policy options available to deal with the large hog farm problem. Most of them fall into three broad categories: command-and-control, government incentives, and compensation strategies.

The intuitive option to deal with the problem is direct regulation- using specific rules to enforce prior restraint on operations to ensure pollution and odor are controlled. This is often called "command and control" policy, and generally favored by regulators because it goal is usually to prevent the externality from happening in the first place. This can be done by requiring the operation to adopt "best management practices," which are procedures determined by experts to be the best at preventing odor and pollution, or to require producers to adopt specific reduction standards. However, these policies are often costly to the farmer and will probably not generate the socially optimal outcome because of bad or insufficient information. Tietenberg says of command and control pollution regulations in general: "control costs are often several times higher than necessary." Since policy makers often reject the idea of an "optimal" pollution level, they overestimate the true cost of the externalities. Also, while de Vos, et al. show that larger farms can reduce their pollution risk at a lower cost than smaller farms, regulators often apply a one-size-fits-all regulation to operations of all sizes, and smaller operations often

end up sharing a large portion of the burden. Farmers are also less likely to cooperate with these kinds of policies. "Command and control regulation creates an adversarial relationship between the regulator and those being regulated" (Gaming, et al., 2004).

Another option is incentives- using taxes and subsides to change behavior of firms. An example is giving a tax break or subsidy to operators who adopt environmentally friendly practices. Removing existing policies can also mitigate the problem, such as eliminating the corn subsidies and reducing taxes on small scale farms, both of which would discourage scale and therefore externalities (Starmer and Wise, 2007). This is often preferred by economists because it gives the firms more flexibility which makes them more likely to choose an efficient output. However, affected parties often reject his method and claim their losses are more important than economic efficiency. It also can be difficult to determine the level of incentive that would optimize efficiency.

The traditional approach to dealing with the problem is compensation. This requires no direct regulation on the operation, but requires them to financially compensate anyone who had their property or well-being negatively affected by the operation. This is advantageous because it has the benefits of prior restraint (the cost of compensation will highly motivate a farmer to limit external damages) without using inflexible command and control regulations. The goal is to internalize pollution costs, allowing individual firms to bear their optimal level of risk. It also cuts down on regulation costs, although Graming, et al. point out the cost of litigation would be significant, especially if there is a contentious relationship between the operation and

surrounding property owners. It also can be difficult to value and assign damages if property rights are not clearly defined.

In my opinion, the best solution is the one proposed by Gaming, et al. that uses private insurance companies to determine proper risk premiums. It also allows private third party to quantify externalities on a case by case basis to get an accurate value, as opposed to a broad cost-benefit analysis sanctioned by a regulatory body, which increases the likelihood of an efficient outcome. There are disadvantages. There is potential adverse selection (total premiums lower than the true expected risk) because their strong incentive for the operator to not reveal all potential risks to the insurance assessor in order to lower the premium. There is also moral hazard, as some operator may engage in more risky behavior knowing the insurance company will pay for the damage. Regulations can help alleviate some of these problems, such as requiring all operations to publicly submit a waste management plan (Gaming).

More research needs to be done to determine the policy for correcting the problem, as well as measuring the true effects of hog farms on local communities and economies. The rapid change is hog scale may be nothing more than an industry reaping the benefits of scale and specialization, but special attention by the public is needed to ensure the interest of all affected parties.

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APPENDICES

APPENDIX

*for 2007 total hog data, the number of total hogs for five counties (Alexander, Cook, DuPage, Lake, and Union) were combined and lump value, 5250, was reported. In order to include these counties in the sample, I evenly distributed the hogs among them, assigning 1050 hogs to every county. In 1997, four counties (Alexander, Cook, Du Page, and Pulaski) were combined at a total of 1200, so 300 hogs were assigned to each county. For number of hog operations, three counties, Cook, Du Page, and Hardin, were reported as having no value, implying that the number of operations was very small and was not reported for confidentiality reasons. A value of 1 was given to these counties.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.43284874
R Square	**0.18735803**
Adjusted R Square	0.15384702
Standard Error	1.29226883
Observations	**102**

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	37.34655339	9.336638	5.59094	**0.000430398**
Residual	97	161.9859956	1.669959		
Total	101	199.332549			

y= change in unemployment	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	-1.8606762	0.600097497	-3.10062	0.002528
Change in number of farms	-0.0108414	0.00410938	-2.63822	**0.009709**
Change in hog inventory	-9.192E-07	6.47166E-06	-0.14203	0.887349
Change in per capita income	0.00013545	5.698E-05	2.377187	**0.019407**
Percent change in population	4.15551235	1.300609378	3.19505	**0.001887**

Table 1: Regrsssion Output

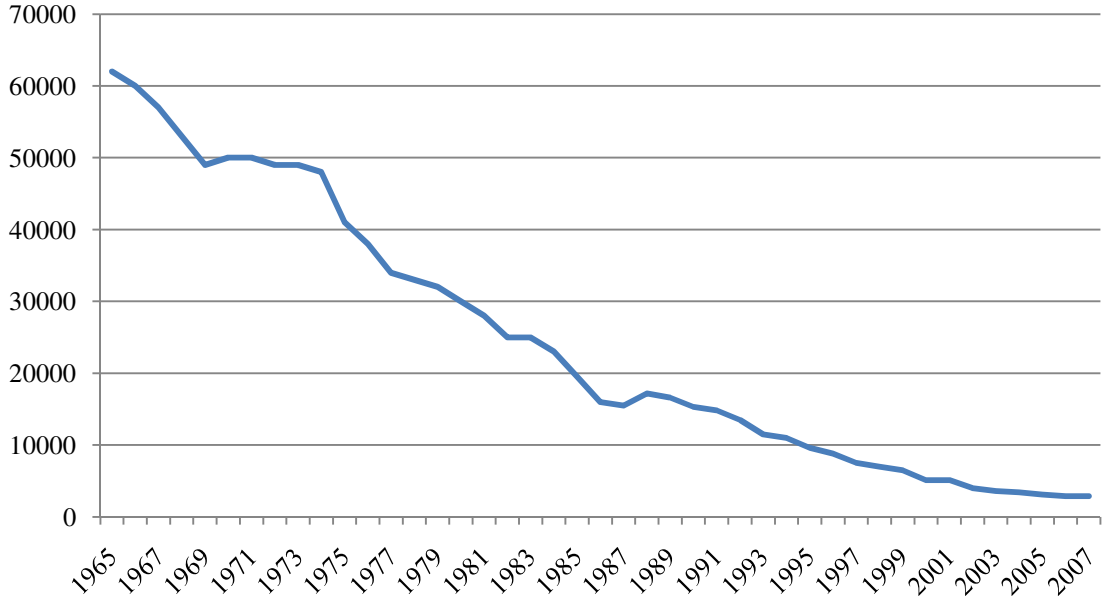

Figure 1: Number of Hog Farms in Illinois (Data from USDA-NASS)

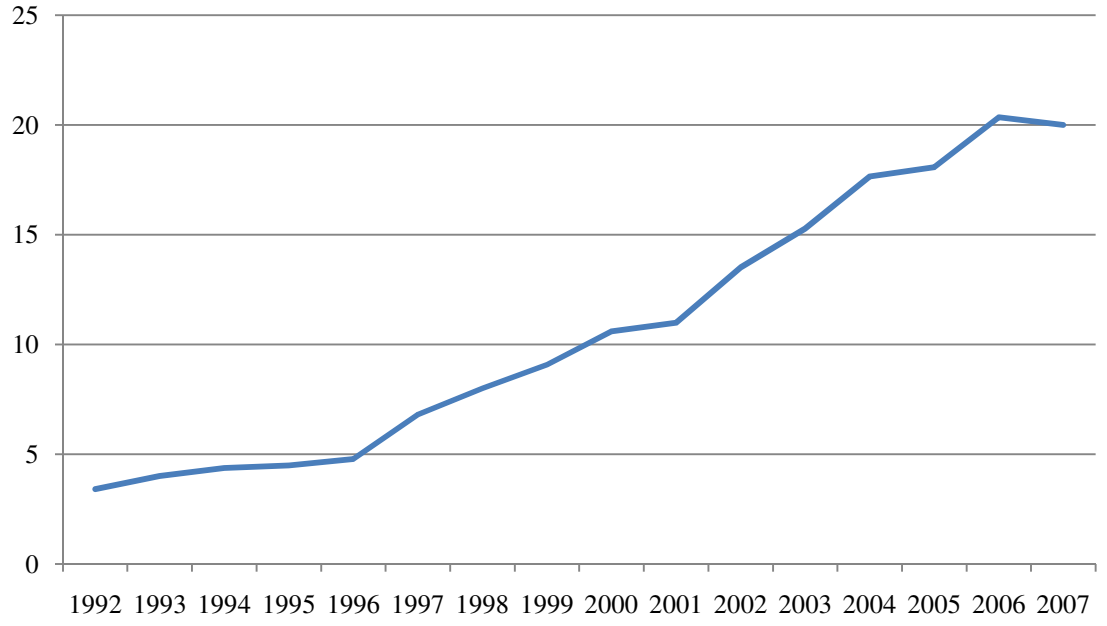

Figure 2: Percent of Operations Considered Large (Data from USDA-NASS)

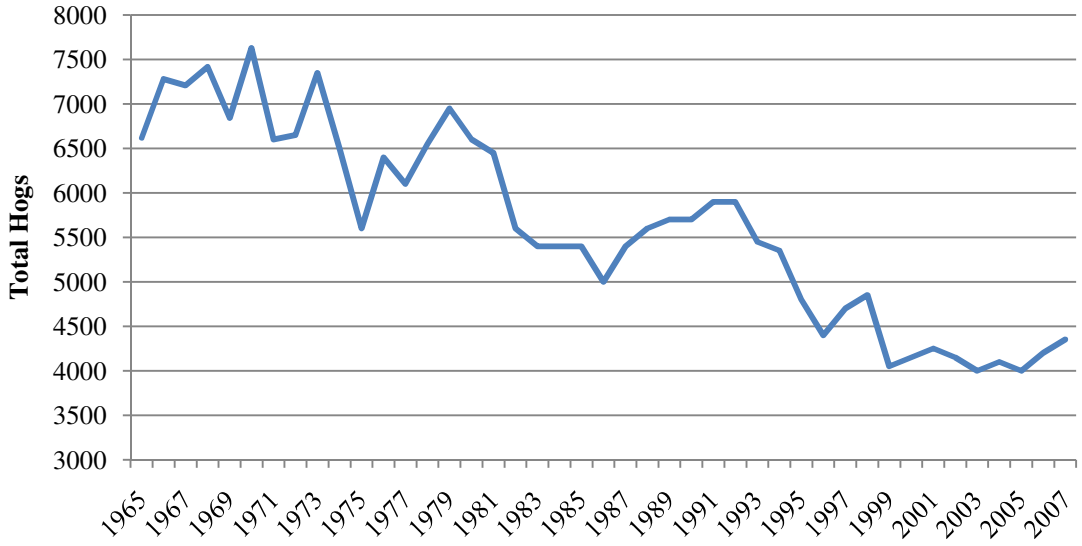

Figure 3 Total Illinois Hog Inventory (Data from USDA-NASS)

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