A Brief Review of RB336:

The University of Nebraska Cooperative Extension Publication *Socioeconomic Impacts of Expanding Pork Production* By John C. Allen and David J. Drozd

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Introduction

The question of how large, concentrated pork production influences the economic and social life of a region in which it is located has been of considerable interest in both the economics and sociology communities--not to mention the intense debate this issue has caused among the residents of regions that host these operations.

The general impact of large swine production has been increasingly well-defined over the last ten years by studies from many different sources. Extensive research in this area, much of it peer reviewed, has often shown that large swine production operations are likely to have a number of unfavorable economic and social consequences for the regions in which they are located (see the sources listed in Appendix I for a list of some of the research and thought on both sides of this subject). The unfavorable consequences, many of which are related to the waste, odor and medical problems associated with swine concentrated animal feeding operations, are both obvious and logical from an economic development perspective.

For this reason, the recent release of "Socioeconomic Impacts of Expanding Pork Production" by John C. Allen, a professor in the Rural Sociology Department at the University of Nebraska and David J. Drozd, a student in the Department of Agricultural Economics at the University of Nebraska, [hereafter referred to as the Nebraska Swine Impact Study] which purports to show that increased hog production does not negatively affect regions in which it is located was the subject of much interest in the press.

Unfortunately, the Nebraska Swine Impact Study suffers from a number of serious problems. This review will only discuss two of the most critical of these problems--the classic statistical error of selection bias and the failure of the authors to properly use regression analysis to model the data in the report. Either of these problems renders meaningless the statistics presented in the Nebraska Swine Impact Study and unsupportable any conclusions reached by the authors regarding the relative impact of large swine operations on regional economies.

I. Selection Bias in the Nebraska Swine Impact Study

The Nebraska Swine Impact Study chose six counties with increased swine production (called subject counties) in each of six states (Colorado, Illinois, Iowa, Missouri, Nebraska and North Carolina). It then attempted to find a control county in the same state that was matched to each of the subject counties. The authors tried to find the same number of control counties as subject counties so they could work with matched pairs--even though this was not necessary to construct an adequate statistical experiment.

It was the selection of control counties that fatally biased this study, and the author's own description of the selection process shows exactly how this happened:
(1) the control county was to be "similar in most aspects to the subject county, except that the control county had not seen a shift in pork production." (p. 4) and
(2) "the matched subject and control county pair were to have close proximity and similar population numbers" (p. 4) and
(3) "the control county needed to have no more than a small increase in total hog inventory and inventory controlled by larger (1000+ head) farms." (p. 4)

This initial selection bias was further increased by the next step undertaken by the authors:

> After matching counties by these initial criteria, key informants were contacted to obtain information about the counties and if they were matched appropriately...key informants included rural sociologists, agricultural economists, agricultural extension educators, and swine specialists at land grant universities and state agencies.(p. 4)

Thus, a group of people with agricultural credentials of various types was allowed to further filter the control groups by adding additional selective factors. Note that each of the selection requirements (more properly called selective factors in statistics) severely and increasingly limited the choice of a control county as the selection process proceeded. The general issue of this kind of selection bias has been well understood for well over fifty years. Croxton and Cowden, writing in 1953, stressed that "The avoidance of bias involves, first, that there shall be no selective factor present in the drawing of the sample..."[1]

As a result of this process, the Nebraska Swine Impact Study was left with nothing that remotely resembled a statistical control group. Throughout this process, as the study's authors explain,

> [t]he control county selection process posed problems. Often key informants had a potential problem with a matched pair or an externality to consider so control counties had to be adjusted. (p. 5)

These "adjustments' resulted in some unusual matches of subject and control counties. (See the Nebraska Swine Impact Study's maps of subject and control counties, p. 19-21) For example, counties were included if they had similar soil types, but the were excluded if they had "a substantial tourism industry" or "urbanization," (p. 6) although "substantial" and the degree of urbanization were not defined.

Taking the most charitable view of this process, control counties were selected in a non-random process so they were identical to the subject counties in every way except that they did not have large hog farms. Then "adjustments" were made by unnamed "key informants" that apparently removed many other things (such as tourism or urbanization) that could have contributed to regional economic development. As a result, the authors created a situation where counties with large, consolidated hog farms were compared with counties whose more conventional agriculture was being decimated by the market effects of consolidation in the hog industry. Further, these counties, in order to remain as a control group, had no other important means of economic growth.

The economies and social structure of the control counties are, to some degree, dependent on the health of their smaller, conventional hog farms. But these same hog farms were being put out of business by large hog facilities similar to those in the subject counties. Thus, the control counties were not independent of the subject counties. In fact, given the relatively constant level of hog output for the nation, for a subject county to show increases in large hog production (one of the selection criteria for a subject county) counties similar to the control counties across the United States would have to show a decrease in conventional hog production. The authors of the Nebraska Swine Impact Study found that their data showed that this was exactly what happened in the control counties they studied. (p. 6)

For those who are confused by the problems this situation creates, consider the following analogy. Assume one wanted to look at the economic growth in Germany under the NAZI regime in

[1] Croxton, Fredrick, E., and Cowden, Dudley J., Applied General Statistics, Prentice-Hall, Inc., New York, 1955, pp. 33-34.

Europe over the period 1939 to 1943. Assume further that one also chose a group of control countries in Europe based on proximity and similarity to Germany (countries such as Belgium, the Netherlands, or Poland) and compared how these control countries fared compared to the subject country, Germany, in retail sales, employment, population loss, number of retail establishments and other measures of economic growth.

One would clearly find that economic growth in Germany outstripped growth in Belgium, the Netherlands, or Poland and one could then claim that the NAZI method of economic growth was superior--until someone pointed out that growth in the other European countries was depressed because they had all been reduced to rubble by Germany. Clearly, what happened in the control countries was not independent of what was happening in Germany. An identical situation applies to the control and subject counties in the Nebraska Swine Impact Study. Thus, it is not surprising that counties with large hog farms came out better in some comparisons, but it is surprising that they are only marginally better in most areas and worse in other areas given the bias in the study. However, selection bias has so polluted the construction of the Nebraska Swine Impact Study experiment that no real conclusions can be reached regarding the performance of any county, region, collection of counties or states.

II. Failure to Properly Model Data in the Nebraska Swine Impact Study

While the problems in section I are more than sufficient to invalidate the entire Nebraska Swine Impact Study, a problem of similar significance also occurred in the modeling of the data used in the study. Given that the authors chose to use a regression model to determine the relationship between each of the economic and social variables and the increase in swine production in the counties, it is curious that the only model statistics presented by the study are the R values--which are generally regarded by statisticians as the poorest indicator of model relationships.

As Figure 11 on page 14 of the Swine Impact Study shows, the vast majority of R values in the study are too low to indicate any significant relationships between any of the variables. In fact, when the overall statistics are considered, only Farm Job Change at -.865 is large enough to merit either comment or analysis. And in another section of the thesis that led to the Nebraska Swine Impact Study, only the retail data showed significant R values. The obvious reasons for this are either that the models show nothing or that the models would show nothing if properly constructed. In the case of the Nebraska Swine Impact Study, the latter situation appears to apply.

The reader's attention is directed to Appendix 2 of this paper which presents a collection of the models used in the study. Even a cursory inspection of these models shows that each suffers from the same problem--a large number of more-or-less random data points gathered around the left axis and two prominent outliers on the right axis. The inclusion of these outliers violates the fundamental rules of regression modeling that require no structural differences in the data modeled. The two outlier points, which appear at the right axis in each of the Nebraska Swine Impact Study models, are the only significant determinants of each regression line. If these are valid data points they should be handled in their own model or with a dummy variable. As used by the Nebraska Swine Impact Study's authors, this regression analysis is similar to plotting a straight line between two points—each of which represents a structurally different set of data. Such a line (model) represents nothing, and it renders worthless any statistical results discussed in the study--including all of the R values on which the conclusions in the Nebraska Swine Impact Study are based.

Appendix I

Partial Bibliography of Studies of the Various Aspects of Large, Confined Swine Operations

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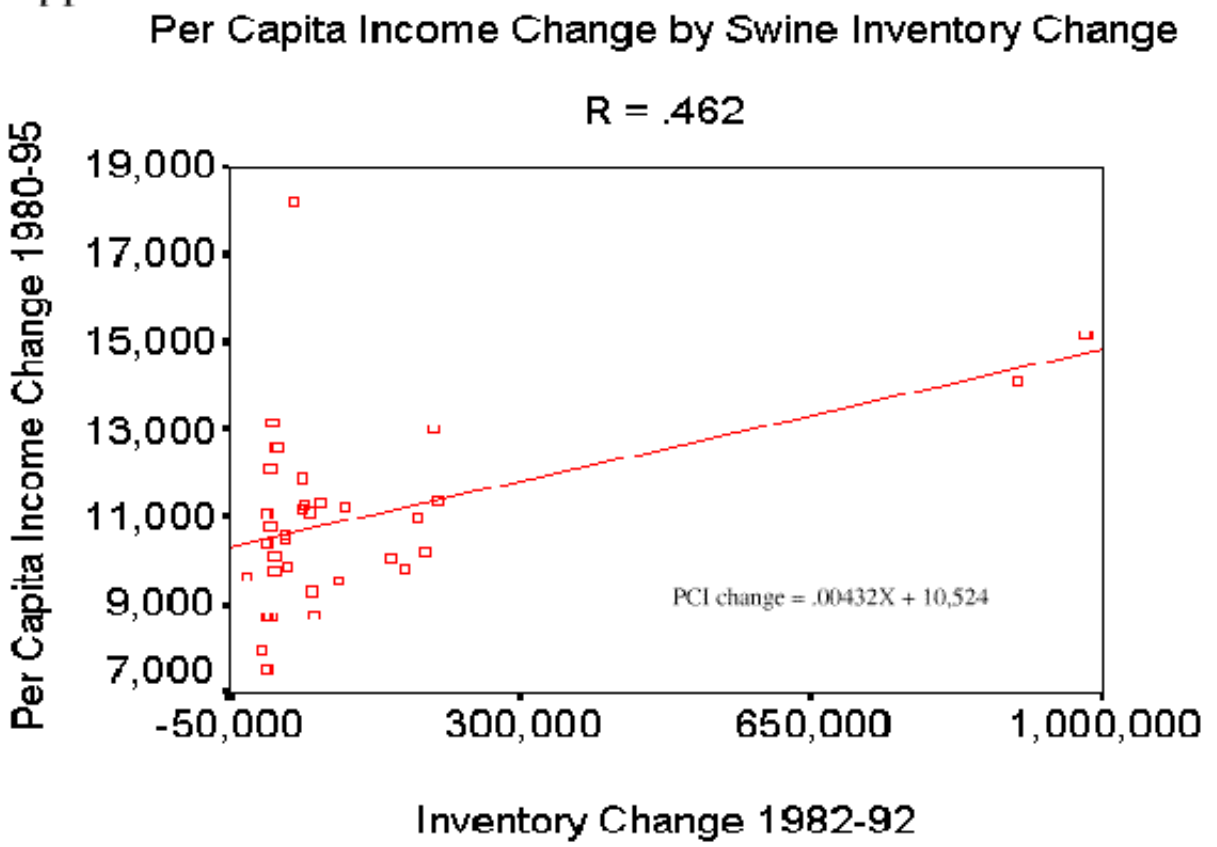
Appendix 2

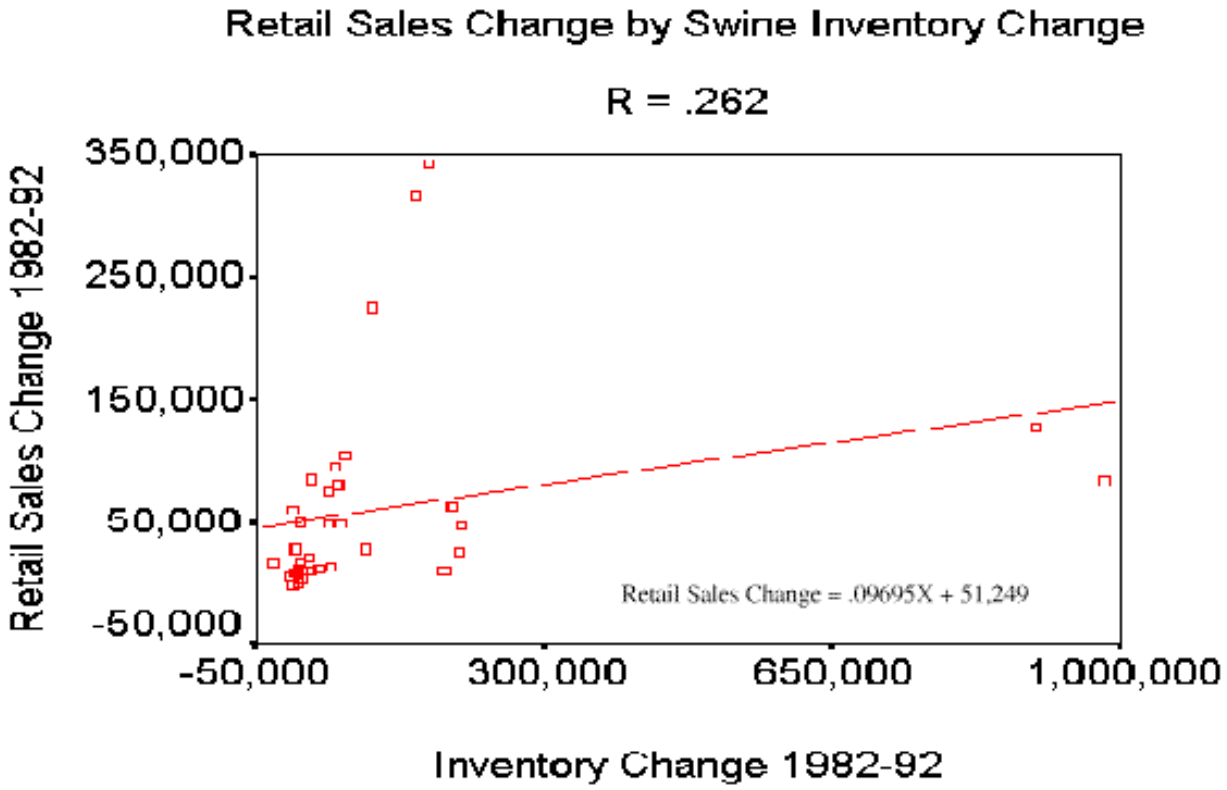
Model Runs From Appendix D of the Nebraska Swine Impact Study

Appendix D



34 Counties; SOURCES: Ag Census, US Department of Commerce

Appendix D - cont.



34 Counties; SOURCES: Ag Census, USA Counties 1996

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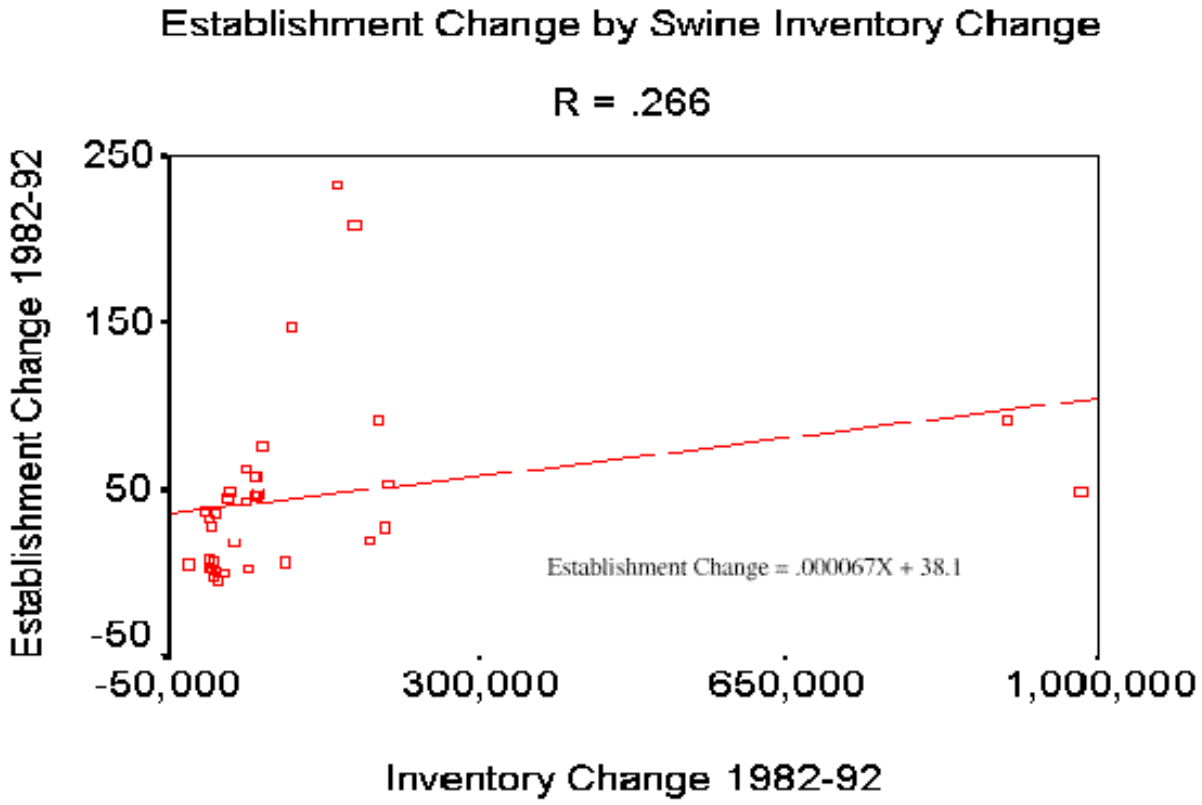

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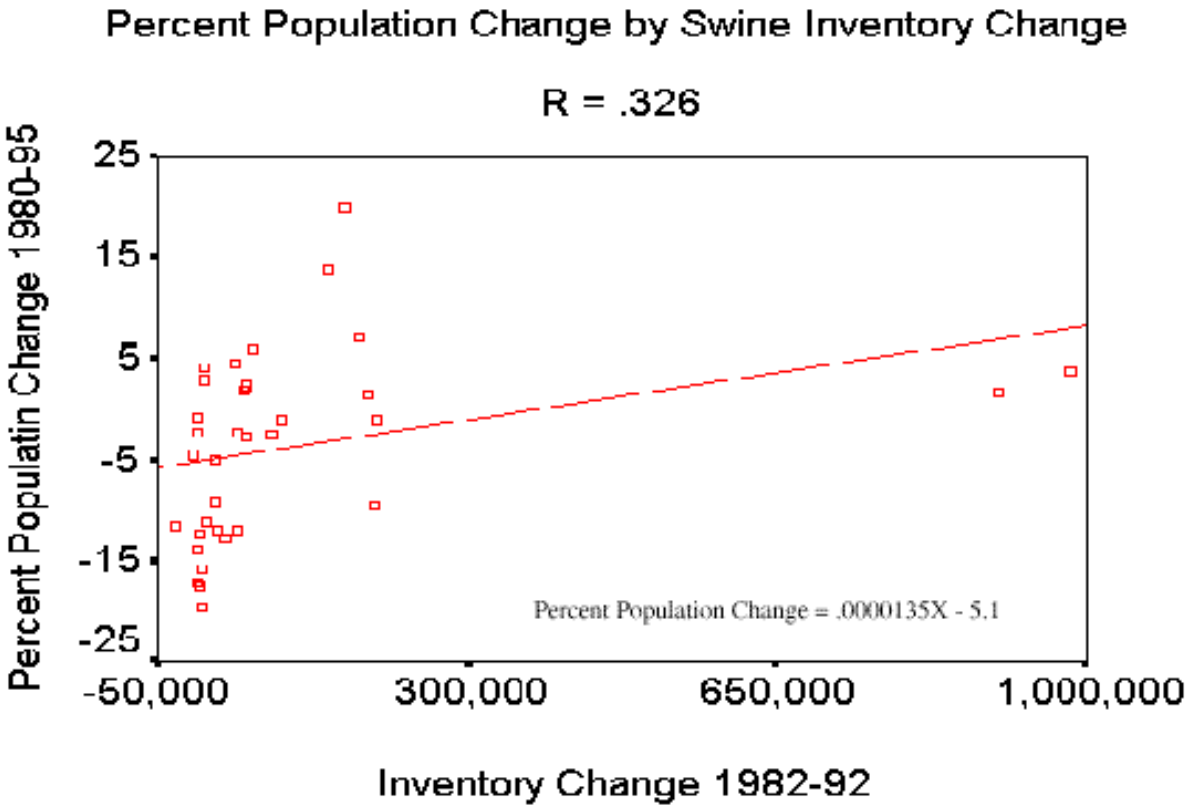

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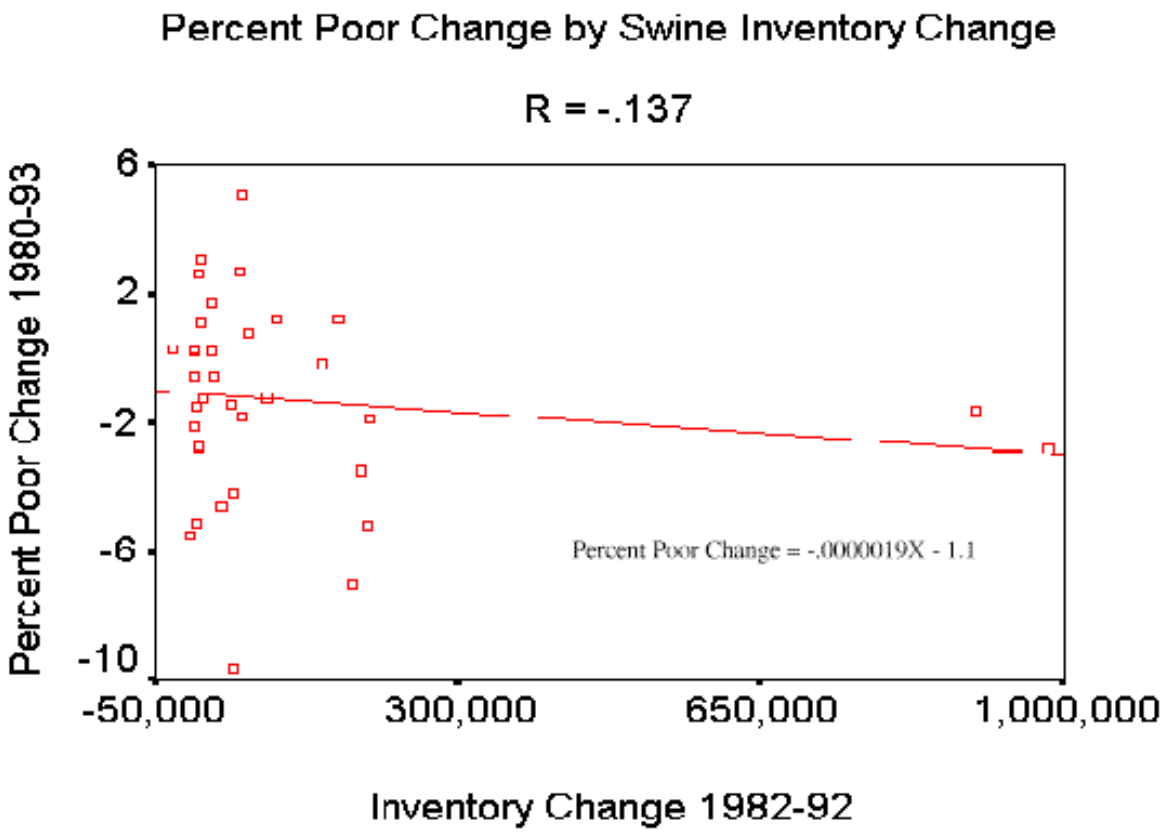

34 Counties; SOURCES: Ag Census, Census Bureau

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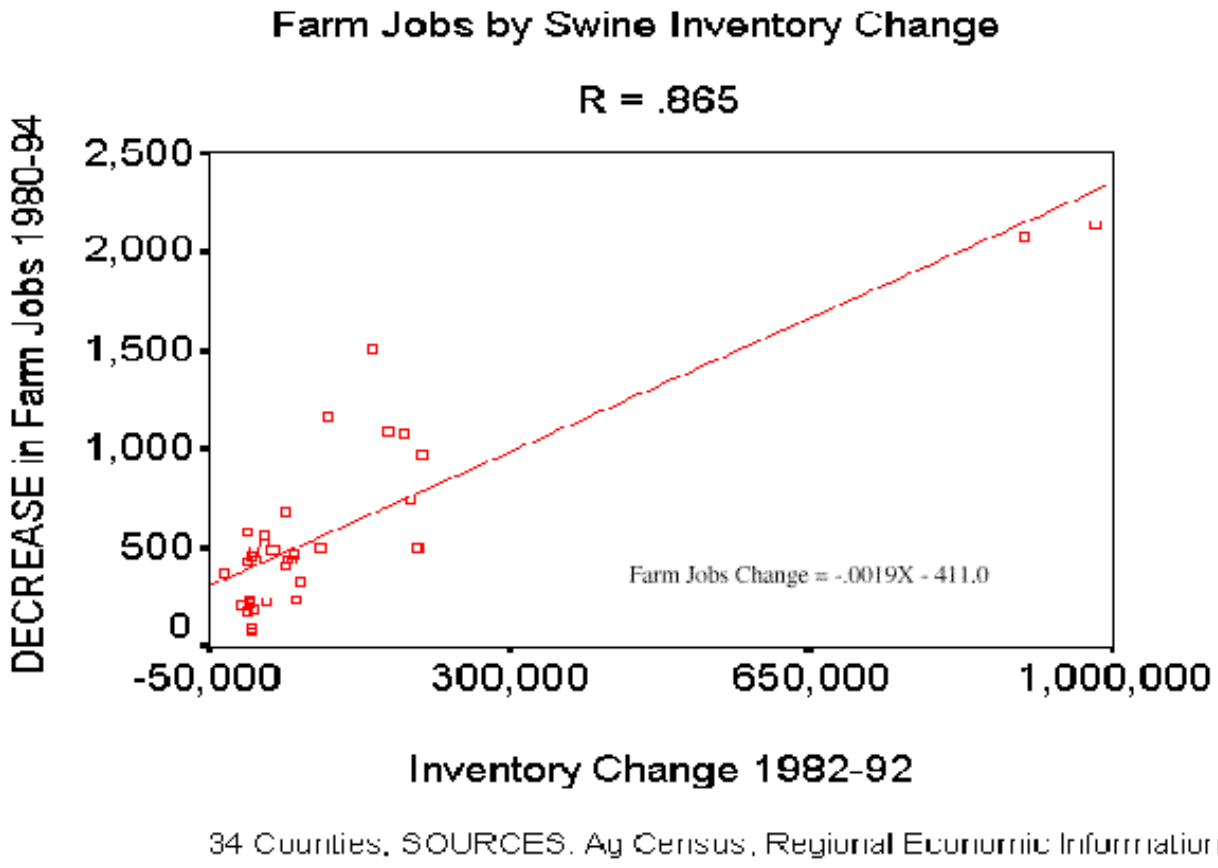
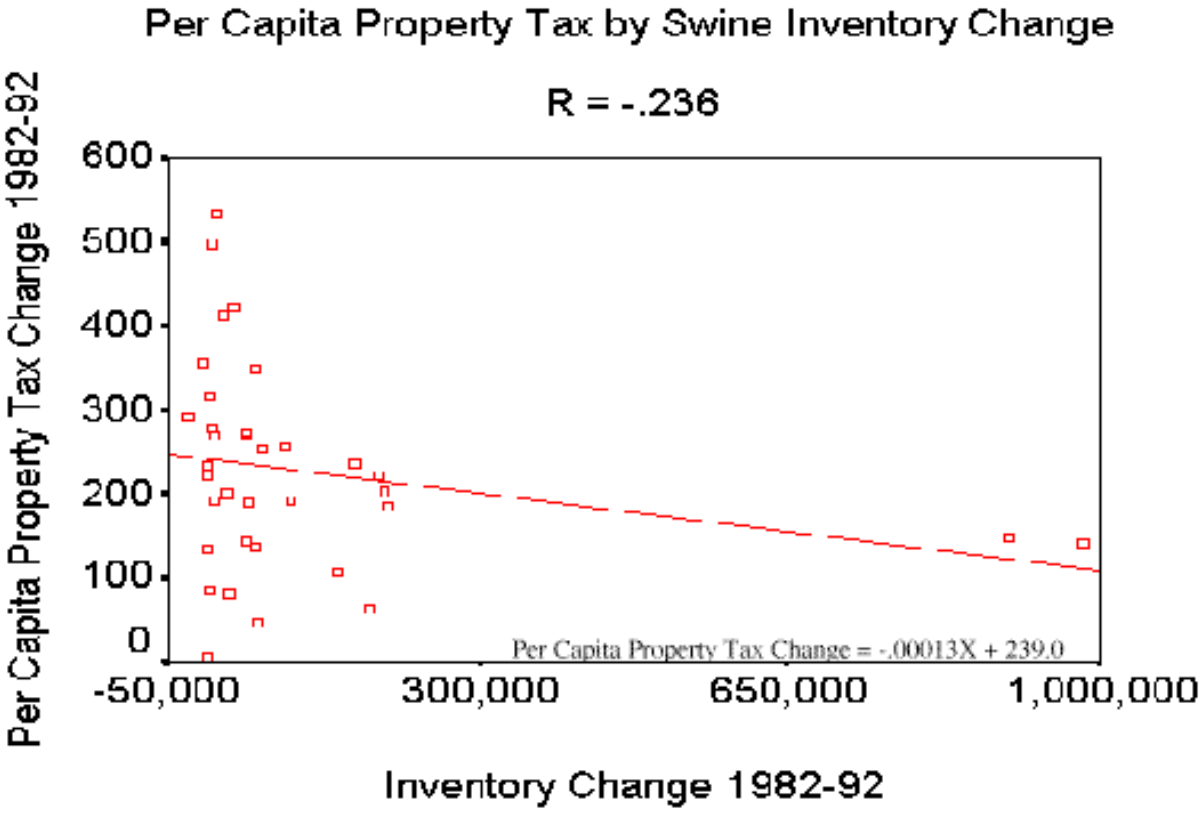


34 Counties, SOURCES. Ag Census, Regional Economic Information

Appendix D - cont.



34 Counties, SOURCES. Ag Census, USA Counties 1996