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A STUDY OF KENTUCKY'S AGRICULTURAL PERFORMANCE USING SHIFT-SHARE ANALYSIS

A Thesis

Presented to

the Faculty of the Department of Economics

Western Kentucky University

Bowling Green, Kentucky

In Partial Fulfillment

of the Requirements for the Degree

Masters of Arts

David Neal Cundiff

August 1992

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A STUDY OF KENTUCKY'S AGRICULTURAL PERFORMANCE

USING SHIFT-SHARE ANALYSIS

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A STUDY OF KENTUCKY'S AGRICULTURAL PERFORMANCE USING SHIFT-SHARE ANALYSIS

Davin N. Cundiff August 1992 26 Pages

Directed by: Daniel Myers, Thomas Wisley, and John Wassom

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In this paper the theory that Kentucky has a comparative advantage in agricultural employment, when compared to the United States, is examined. In order to test this hypothesis, a dynamic shift-share analysis was conducted using the thirteen major economic sectors of Kentucky over the period 1970 to 1989. The resulting regional shift components, or competitive components, give support to the theory that a comparative advantage for Kentucky in agriculture does exist. Annual regional shift components, as well as their dynamic counterpart, possess predominately positive values, indicating outperformance by Kentucky's agricultural sector when compared to the United States economy as a whole.

Over the past few decades, the United States, as well as most other industrial nations, has experienced a dramatic decrease in employment in the agricultural sector of the economy. This employment shift has been accompanied by increased employment in the other sectors, such as manufacturing and services. The purpose of this thesis is to determine whether Kentucky has followed the same developmental trends as the United States, or has followed its own trends. If Kentucky has, indeed, followed its own trends, then what implications could this have on future development, as well as state developmental policy?

In this paper, Kentucky's developmental trends will be examined using dynamic shift-share analysis as a means of comparison. The first section provides a review of the relevant literature to support and explain the theory. Section two contains a discussion of the methodology and mechanics of shift-share analysis. The third section presents the data used, as well as a discussion of the methodology utilized in the analysis. Both the raw results and interpretations of these results are presented in section four. Finally, section five offers a summary and conclusions based on the empirical work.

I. BACKGROUND INFORMATION.

The underlying question of this analysis is whether or not the Kentucky agricultural employment situation, when compared to the nation as a whole, has behaved typically or atypically. The intent of this thesis is to show, utilizing the following aspects of economic theory, that Kentucky has out performed the nation in agriculture over the past twenty years.

The Law Of Comparative Advantage

Ricardo's Law of Comparative Cost Advantage, according to Mark Blaug (1968), states that a nation should produce those goods in which they have an advantage when compared to other countries. These goods are those which require the least amount of labor or other resource input as compared to other products this nation can produce. Ricardo (1974) says that a country need not require the least amount of labor to produce a certain good, but merely be the nation which must give up the least production in order to produce the good. When nations engage in trade, where each offers the good or goods in which they have a comparative advantage in producing, the result will be the consumption of as many goods as if trade had not taken place, plus some amount of extra production.

This extra production can be attributed to the excess labor or resources created by not producing those goods which the nation is comparatively inefficient in producing (Ricardo, 1974).

To better explain comparative advantage, the presentation of Ricardo's original example may be useful. Ricardo (1974) gives the example of two countries, England and Portugal, which produce two goods, wine and cloth. Ricardo says that in England, cloth can be produced for 100 units of labor and wine for 120 units. Portugal can produce similar cloth and wine for 90 and 80 units of labor respectively. Blaug (1968) notes that Portugal can, in this case, produce both goods utilizing fewer resources than England. However, when comparing the ratio of the cost of wine to the cost of cloth, we see that England must give up producing 1.2 units of cloth to produce one unit of wine. Portugal must only give up 0.88 units of cloth to produce one unit of wine.

Each nation, by decreasing production of the more resource intensive good, therefore creating unused labor, can produce more units of its specialized good. The resulting increase in production of the latter good will be greater than the value of the decreased output of the more resource intensive good. This, according to Ricardo (1974), clearly shows that England would be far better off to produce cloth only, and trade the excess supply to Portugal in exchange for the comparatively cheaper Portuguese wine.

Kentucky's Geography and Climate

In order for Kentucky to possess a comparative advantage in agriculture, suitable soil and weather conditions must be present. Robert C. Lay (1992) describes Kentucky as being comprised of many soil types which are excellent for agricultural purposes. Tommy Yankey (1992), who is the Casey County Extension Agent for Agriculture, adds that Kentucky's south-central and western regions are quite fertile, with lesser soil conditions existing primarily in the eastern region where farming is less concentrated.

Yankey (1992) says Kentucky possesses weather which is very suitable for raising many types of vegetables, tobacco, and cattle. Lay (1992) adds that the climatic and rainfall conditions in Kentucky are well suited to the production of row crops, such as corn, soybeans, produce, and foliage.

Alone, either Kentucky's soil conditions or its climate would be ample reason to make Kentucky an agricultural force. However, Kentucky's combination of these two factors could very well be the key to a possible comparative advantage in the agricultural sector.

Opportunity Costs

The opportunity cost of any use of a resource is defined as the highest value of any alternative use of the resource not taken. This can be associated with the cost of producing one good as opposed to another, or utilizing one resource instead of another. In the agricultural sector, the choice to

use land for farming bears the opportunity cost of the highest value of all alternative uses of the land, other than for agricultural purposes. Instead of farming, a land owner could decide to erect buildings, or lease to others, thus giving up the income that would have been received by farming.

A farmer may also be faced with the choice of which crop or crops should be grown. Those crops which require a climate which is more tropical than Kentucky's, such as citrus fruits, would be unsuitable for Kentucky farmers. The additional cost of providing the required amount of heating and sunlight would make them far too expensive to be grown for a profit. The farmer must, therefore, examine the opportunity cost of producing one crop instead of any other.

The agriculture supporting climate and soil conditions of Kentucky lend support to the idea of a comparative advantage for Kentucky in agriculture. If Kentucky does have this advantage, then the opportunity cost of utilizing labor in the other sectors would certainly be large enough to prevent Kentuckians from abandoning agriculture for other sectors of the economy where no such comparative advantage exists.

Each of the theoretical topics above can be used to support the idea that Kentucky should be better than average, when compared to the nation, at producing agricultural products. Better production should then, logically, lead to increases in the employment of agriculturally oriented persons in Kentucky.

II. METHODOLOGY.

The primary analytic tool used in this study will be shift-share analysis. The purpose of shift-share is to determine growth differences in an industry based on the rate of change in that industry for a specified base region. Shift-share analysis, according to Park and Lewis (1991), is a data accounting method which disaggregates employment changes into three separate components. These components are the national share effect, the industry mix effect, and the regional shift effect. The national share effect defines the regional change in employment in each industry attributed to the national rate of growth for all industries combined. The industry mix effect describes the change in employment a region would expect if each industry grew at its national rate. The third component, the regional shift effect, indicates the extent to which industries, when compared to the national average for that industry, either outperform or underperform the nation in employment growth (Park and Lewis, 1991). The regional shift effect is sometimes referred to as the competetive effect. Barff and Knight (1988) note that the regional shift effect is simply the residual, or the difference between actual employment and the expected level of

employment based on the national average of growth in that particular industry.

Shift-share analysis can be performed in two general forms, the static and the dynamic models. Static shift-share analysis has, until recently, been the most common method. Static shift-share models, according to Barff and Knight (1988), compare employment levels for each sector of the economy at the first and final years of the study period. Dynamic shift-share analysis involves computing each of the components from year to year over the entire range of the sampling period. The final results can then be examined as annual changes, as well as combined by adding the yearly changes in the variables to compute the components for the overall sampling period.

The components for both methods of shift-share analysis, according to Blair (1991), are computed in the following manner:

$$dEi = Ei[(US^*/US)-1] + Ei[(US^*i/USi) - (US^*/US)] + Ei[(Ei^*/Ei) - (USi^*/US^*)]$$

where dEi = The change in local employment in industry i,

Ei = The local level of employment in industry i in the beginning period,

Ei* = The local level of employment in industry i during the final period,

US* = The level of total U.S. employment during the final period,

US = The level of total U.S. employment during the first period,

USi* = The level of U.S. employment in industry i during the final period, and

USi = The level of U.S. employment in industry i during the first period.

In the above equation, the national share effect is indicated by the term Ei[(US*/US) - 1)]. The industry mix component is expressed as Ei[(USi*/USi) - (US*/US)]. The final term, Ei[(Ei*/Ei) - (USi*/USi)], represents the regional shift component, or the competetive component. The regional shift component describes the competitiveness of a particular industry. Although the above equation represents the static version of shift-share analysis, the dynamic model can be obtained by computing year to year components, and then taking the summation of each yearly component over the sample period.

A dynamic shift-share model is the method of analysis chosen for this study. This is because the dynamic version utilizes more information than does the static, and can generate more accurate competitive components. Barff and Knight (1988) describe how the static method of shift-share analysis fails to take into account all changes which have occurred during the study period. This approach can be somewhat problematic because the industrial mix component is forced to remain constant, even though the actual value may have changed. Another possible problem with the static method is that annual changes in the regional employment base are not taken into account (Barff and Knight, 1988). This generally leads to an underestimation of the national growth effect when local growth is greater than the national rate, and

overestimation when it is greater. Both of these problems could possibly lead to significantly misleading results. Unlike the static version, the dynamic shift-share model does account for a variable mix component and a changing regional employment base, and therefore adds to the accuracy and validity of the results.

III. PRESENTATION OF THE DATA AND METHODOLOGY.

Data.

The data used in this analysis consist of 26 series of employment figures for both Kentucky and the United States. The series are annual, and cover the period of 1970 to 1989. All of the data were acquired from a data base from the Kentucky Economic Information System.

Thirteen of the data series cover the levels of employment in each of Kentucky's basic economic sectors, while the other thirteen describe the same sectors of the United States economy. These sectors include: farming; agricultural services, forestries, and fisheries; mining; contract construction; manufacturing; transportation, communication, and public utilities; wholesale trade; retail trade; finance, insurance, and real estate; services; federal civilian; federal military; and state and local. While agriculture is the primary focus of this analysis, the other sectors are included in order to produce a better overall picture of what has been, and continues to be, the direction of the Kentucky economy.

Table 1 presents the number of persons employed in agriculture for both Kentucky and the United States over the

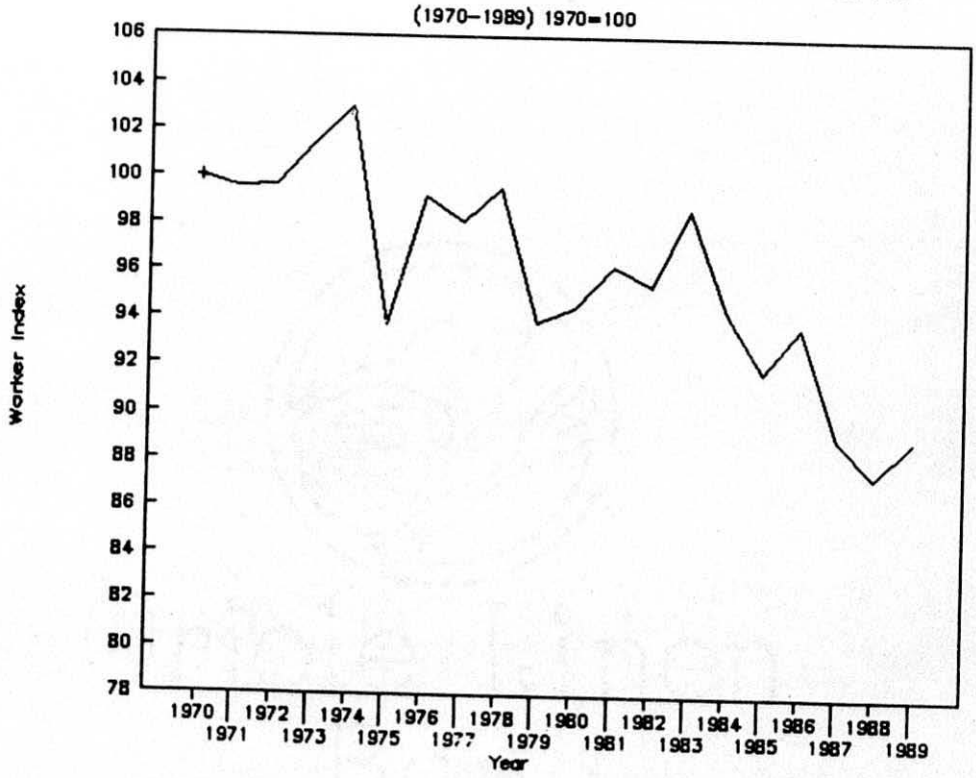
TABLE 1. AGRICULTURAL EMPLOYMENT FOR KENTUCKY AND THE UNITED STATES FROM 1970-1989.

YEAR	KENTUCKY	UNITED STATES
1970	145,426	3,962,000
1971	144,814	3,915,000
1972	144,860	3,870,000
1973	147,450	3,897,000
1974	149,769	3,968,000
1975	136,359	3,948,000
1976	144,240	3,973,000
1977	142,736	3,853,000
1978	144,835	3,758,000
1979	136,521	3,848,000
1980	137,427	3,819,000
1981	139,995	3,690,000
1982	138,765	3,621,000
1983	143,506	3,710,000
1984	137,220	3,580,000
1985	133,549	3,456,000
1986	136,300	3,332,000
1987	129,471	3,275,000
1988	127,155	3,272,000
1989	129,440	3,168,000

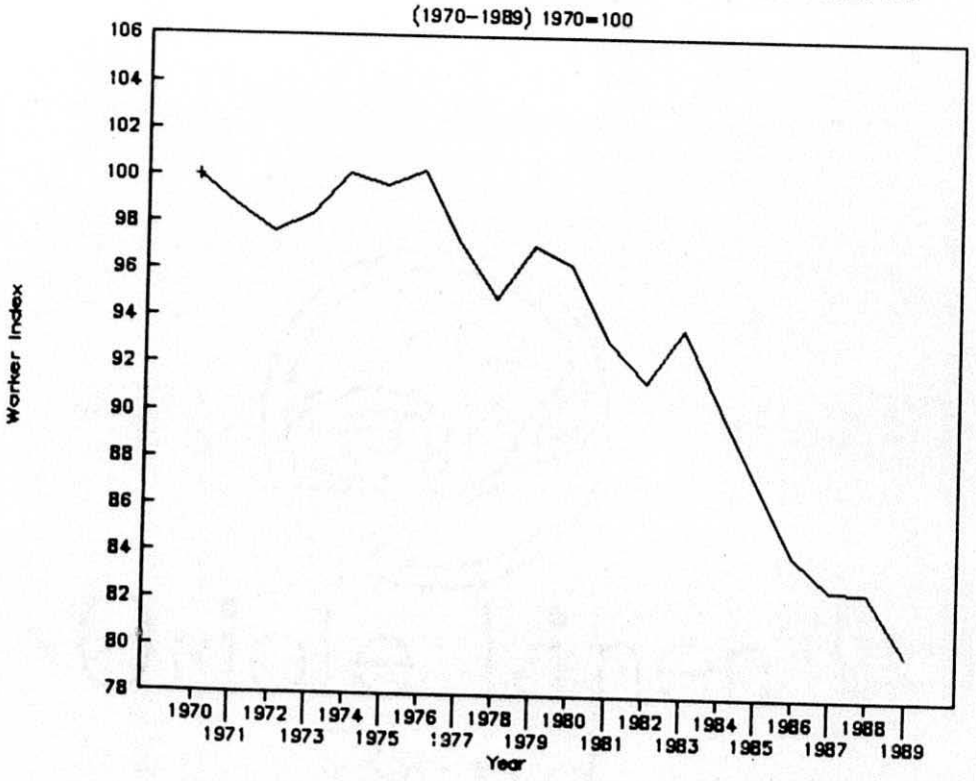
study period. In both sets of data, there is an obvious downward trend in agricultural employment. Graphs 1 and 2 present the levels of agricultural employment for both Kentucky and the United States respectively. The use of the graph format helps to give a clearer picture of the actual paths of the numbers over the sample period. These employment values are presented in the form of indices with a base year of 1970. Each index value is the result of dividing each observation by the first observation in the series, and then multiplying the quotient by 100. The conversion of the series to indices was utilized in order to compensate for differences in scale between the Kentucky and the United States values.

The graphs clearly show a downward trend for the data. However, there does not appear to be a similar path for both Kentucky and the United States. The Kentucky employment in the agricultural sector appears to possess a much less dramatic decline over the sample period than does that of the United States. The means for the two series indices are 95.92 for Kentucky employment and 93.28 for the United States. These means are accompanied by standard deviations of 19.09 and 44.11 respectively. These statistics indicate that the agricultural employment for the United States has greater variance from its mean than does Kentucky. Along with the visual information from the graphs, this larger variance around a smaller mean indicates that the United States has decreased its employment of agricultural workers at a faster rate than has Kentucky over the past twenty years.

GRAPH 1: KY AGRICULTURAL EMPLOYMENT.



GRAPH 2: U.S. AGRICULTURAL EMPLOYMENT.



Methodology.

In order to determine the evolution of Kentucky's economy, shift-share analysis was utilized. The shift-share analysis of Kentucky uses the United States as the basis for comparison. All three shift-share components for each sector of the economy were computed on a year-to-year, static basis. The annual components of each period were then combined to create the dynamic components for each of the thirteen sectors of the economy. Both the yearly static, and the dynamic shift-share components will be useful in the understanding of the Kentucky economy, and in explaining the validity of the thesis statement.

IV. PRESENTATION AND INTERPRETATION OF THE RESULTS.

Over the study period, Kentucky's total employment increased from 1,314,649 jobs in 1970 to 1,902,164 jobs in 1989. This is an increase of over 578,000 additional jobs which was spread over Kentucky's thirteen economic sectors. In fact, Kentucky experienced actual job growth in every sector except agriculture and the federal military. For the twenty-year period, Kentucky has a competitive component of 14,056, which indicates Kentucky has, on average, outperformed similar economies in the nation by 14,000 jobs for all sectors combined.

The results of the dynamic shift-share analysis can be seen in Table 2. The competitive components show that Kentucky has outperformed the United States in many areas of the economy. The sectors of manufacturing and retail trade greatly outperformed the national growth rate, with 30,364 and 9,574 more persons than would be expected, based on the national rate of growth, respectively. Kentucky also gained 6,508 more federal military jobs than the national average would predict. Other industries that did better than the nation as a whole include: agriculture, forestry, and

TABLE 2. DYNAMIC SHIFT-SHARE COMPONENTS FOR THE KENTUCKY ECONOMY(1970-1989).

Source	1970	Share	Mix	Actual Change	1989	Competitive
Farm	145,426	52,482	-82,416	-15,986	129,444	13,948
Nonfarm						
Private						
Agricultural services, forestries, and fisheries	4,375	3,541	5,678	11,751	16,126	2,531
Mining	30,384	16,401	-628	8,807	39,191	-6,966
Contract construction	69,643	30,407	11,547	32,074	101,717	-9,880
Manufacturing	256,236	100,563	-96,035	34,892	291,128	30,364
Transportation, communication, and public utilities	67,872	28,778	-6,875	24,922	92,794	3,019
Wholesale trade	45,511	22,725	6,251	29,246	74,757	270
Retail trade	189,517	91,336	33,273	134,183	323,700	9,574
Finance, insurance and real estate	52,000	28,774	28,648	51,751	103,751	-5,671
Services	214,792	112,545	131,316	217,168	431,960	-26,693
Government						
Federal civilian	40,815	15,193	-11,233	2,699	43,514	-1,261
Federal military	63,087	22,270	-31,044	-2,266	60,821	6,509
State and local	134,991	61,614	-1,617	58,274	193,265	-1,724
Total	1,314,649	568,629	-13,136	587,515	1,902,164	14,056

fisheries; transportation, communication, and public utilities; and wholesale trade.

Kentucky also has many industries which have fallen below the national average in employment growth. Mining, contract construction, and services were the sectors with the biggest underperformances in Kentucky. Over the past twenty years, these sectors have underperformed the United States by 6,966, 9,880, and 26,692 jobs respectively. Finance, Insurance, and Real Estate has a competitive component of -5,670, and federal civilian has one of -1,261, indicating lower than average growth in these sectors as well.

Agriculture, which is the sector of focus in this analysis, greatly outperformed the nation over the period 1970 to 1989. Agriculture possesses a competitive component of 13,948, which indicates the presence of almost 14,000 more jobs than would have occurred if Kentucky were following the same trend as the United States. Agriculture is also the second strongest sector (manufacturing is the first) that outperformed the United States.

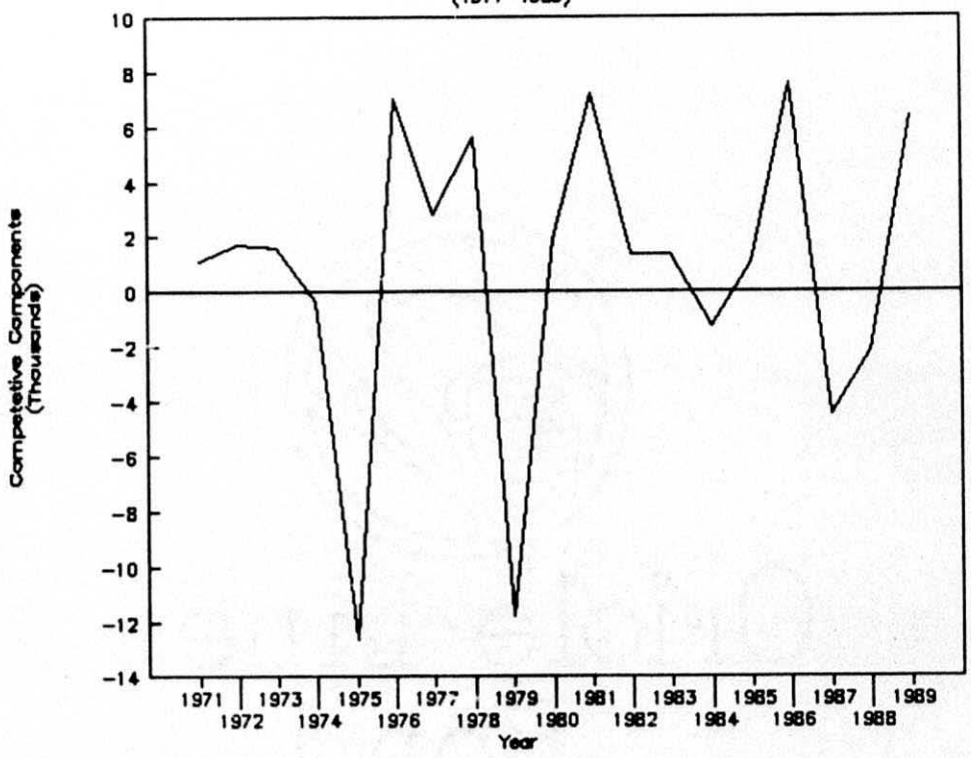
Although Kentucky performed quite well in agriculture over the range of the study period, its success was not as apparent on a year-to-year basis. Both Table 3 and Graph 3 present the competitive components of Kentucky's agricultural sector over each of the one year intervals. These data show Kentucky underperformed, when compared to the United States, during six of the nineteen years. From 1970 to 1973, Kentucky experienced positive growth, compared to the nation.

TABLE 3. STATIC SHIFT-SHARE COMPETITIVE COMPONENTS OF KENTUCKY AGRICULTURE(1970-1989).

YEAR	COMPETITIVE COMPONENT
1970-71	1,113
1971-72	1,711
1972-73	1,579
1973-74	-367
1974-75	-12,655
1975-76	7,018
1976-77	2,853
1977-78	5,618
1978-79	-11,783
1979-80	1,935
1980-81	7,210
1981-82	1,388
1982-83	1,330
1983-84	-1,257
1984-85	1,082
1985-86	7,543
1986-87	-4,497
1987-88	-2,198
1988-89	6,327
DYNAMIC	13,948

GRAPH 3: KY AG. COMPETETIVE COMPONENTS

(1971-1989)



Agriculture then began to decrease against the nation from 1973 to 1975 with a major underperformance of 12,655 jobs during the 1974-1975 period. Kentucky then resumed its above average performance until 1978-1979, where an underperformance of 11,782 jobs was experienced. After 1979, Kentucky's performance is mostly positive, except for 1983 to 1984, and 1986 to 1987.

Irregular weather appears to be one of the major causes of Kentucky's underperformances during the study period. The underperformance of about 13,000 jobs in 1974 coincides with above average rainfall, and heavy flooding during the spring growing season (Kentucky Department of Agriculture, 1976). The 1979 underperformance of 12,000 jobs could be partially linked to excessive rainfall of 13.11 inches in Kentucky during the April to September growing season of that year (Kentucky Department of Agriculture, 1980). Along with the periods of excess rain, drought could be a factor in some of these periods of underperformance. Kentucky received 5.58 inches of rain below average from April to September of 1987 (Kentucky Department of Agriculture, 1988). This was accompanied by a similar drought throughout much of the southeast. Likewise, a rainfall of 4.48 inches below average was experienced in Kentucky, during the growing season of 1988 (Kentucky Department of Agriculture, 1989). Both periods of drought were accompanied by crop damage and early harvest. Either of these weather patterns, drought or excess rain, lead to decreased production and profitability in farming. Such

decreases could easily explain lower than average employment in agriculture for Kentucky.

One noteworthy aspect of these annual competitive components is that underperformances, though more seldom, tend to be more drastic than do years of overperformance. The 1975 and 1979 competitive components could possibly reflect the oil shocks of the 1970s. Higher prices in gasoline and petroleum based fertilizers could cause farmers to face higher input costs and therefore lead to decreases in employment. However, there is no apparent reason to believe that farmers in other areas would not be similarly affected, and therefore cause Kentucky to maintain its natural competitive position.

Overall, Kentucky has outperformed the United States. Also, even though the United States has outperformed Kentucky in agricultural employment during a few years, on average, Kentucky appears to have a stronger tendency towards the agricultural sector.

V. SUMMARY AND CONCLUSION.

The Kentucky agricultural employment level has, although fluctuating often, decreased by 15,986 jobs since 1970. This has been accompanied by a decrease of 794,000 jobs in U.S. agricultural employment. This analysis has looked at the question of Kentucky's employment decrease, and how it has compared to the values that the national average would have predicted.

The results of the analysis do lend some support to the thesis statement that Kentucky should outperform the United States in the level of agricultural employment it attains. Over the past twenty years, Kentucky has possessed almost 14,000 more agriculture jobs than the national average would predict.

One aspect of the results which tend to refute the thesis statement is the negative values of some of the competitive statistics for agricultural employment. Although Kentucky outperforms the United States in most of the static components, there are some periods of extreme underperformance by Kentucky. During the 1974-1975 and the 1978-1979 periods, Kentucky underperformed by 12,655 and 11,782 jobs respectively. Another such underperformance by Kentucky could

completely negate the exceptional performances of the other periods. The positive side to these findings could be that Kentucky did outperform the U.S., even with these tremendous obstacles.

Overall, the results of this study provide plenty of evidence to support the idea that Kentucky should have a comparative advantage in agriculture, and therefore outperform the United States in employment in that sector. However, some questions could still receive better answers. Future analysis of the subject could increase the range of the data sample in order to lessen the effects of any large positive or negative outlying terms. However, a larger sample may add additional problems which could lead to less accurate results. Also, the agricultural sector could be further disaggregated into more specific components, to see what types of crops Kentucky is best suited to produce. A third way to expand this study might be for Kentucky to be compared to those states with similar climates, or similar geographic location, in order to determine exactly how suited to agriculture Kentucky really is.

In spite of the possible problems, Kentucky does appear to have an advantage in agricultural production and employment. This knowledge can be utilized by Kentucky's policy makers in order to improve the Kentucky economy as a whole. The use of state grants and incentives for agricultural development could lead to increases in the number of persons employed in Kentucky. Also, trade policy could be

further shifted toward the area of agricultural products. Another policy move could be to create additional laws which protect Kentucky's environment, but not harm agricultural profitability, and therefore protect one of the state's strongest sectors. The success of these policy moves is somewhat unpredictable, but it does seem obvious that Kentucky would be greatly benefitted by continuing its emphasis on agricultural production.

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