Economic Growth with Limited Agglomeration Economies

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Abstract

This study examined how various inputs including employment agglomeration in different industries affected economic growth of Arkansas during 1986-1999. Analysis showed locations that are able to successfully substitute infrastructure, human capital, and amenities, are more likely to see increased incomes.

Keywords: employment agglomeration, input potentials, input utilization, personal income.

Introduction

According to the 1990 U.S. Census nearly half (45.6%) of all Arkansans lived in rural areas, compared to 24.8% of the total U.S. population. Arkansas was ranked eleventh in the nation in percentage of rural population. There was a steady increase in population in most Arkansas counties during last two decades. Between 1986 and 1999, population in Lonoke and Washington counties has increased by 38%, Faulkner County by 51%, Benton County by 58%. Within the same time period real per capita personal income increased significantly in the following counties: Benton county by 22.5%, Saline 24%, Sebastian 25.2%, Lonoke 26.8%, Faulkner 28.6% and Pulaski 29.1%.

The counties that exhibited significant growth in population and per capita income are the counties that constitute three major metropolitan statistical areas (MSA) of Arkansas: Fayetteville-Springdale-Rogers MSA, Fort Smith MSA, and Little Rock-North Little Rock MSA. Benton and Washington counties form Fayetteville-Springdale-Rogers MSA and are the home to Wal-Mart, Tyson Foods, and J.B. Hunt Transportation. In 2001, not only is it the fastest growing MSA in the state of Arkansas, but it also was the eighth fastest growing MSA nationally (Fineberg, 2001). Fort Smith MSA contains Sebastian County. Little Rock-North Little Rock MSA includes Faulkner, Lonoke, Pulaski, and Saline counties. In 1997 out of all 273 MSAs in the United States Little Rock-North Little Rock MSA was ranked number 72 based on population and number 117 based on average annual pay, Fayetteville-Springdale-Rogers MSA was ranked number 134 based on population and number 204 based on average annual pay, and Fort Smith MSA was number 166 based on population and number 232 based on pay (US Bureau of Census).

This research was sparked by the interest to examine how counties are developing when confronted with limited agglomeration economies. Socio-political and amenity factors are studied for their contribution to this development.

Literature Review

There have been many studies in the past that focused on the economic development of the United States. Most of them put emphasis on infrastructure, business climate, taxation, cost and availability of raw materials, labor, and capital, access to markets, and climate in explaining economic growth of the region.

Plaut and Pluta in their state level analysis used labor and energy cost, availability and productivity variables, land and raw materials, environment, business climate, taxes and government expenditures as explanatory variables (Plaut and Pluta, 1983). They found market accessibility, labor variables, land, environment, business climate, and property taxes to be highly significant in explaining production, employment and capital stock growth.

Carlino and Mills looked at the determinants of county growth (Carlino & Mills, 1987). County level data were used to analyze what variables had an impact on the growth of population and employment during the 1970s and 1980s. Structural equations were estimated using two-stage least-squares technique for total employment and population, and for manufacturing employment and population, since manufacturing sector appeared to influence regional economic growth. Eight regional dummies were used to identify association of a county to a particular region. Population density, interstate-highway density, and family income showed to contribute significantly to the employment density growth, whereas employment, interstate-highway density, family income, and central city dummy contributed to the population density growth.

Deller, Tsai, Marcouiller and English looked at how amenities influence rural economic growth (Deller et al., 2001). Economic growth was represented in their study by three types of growth: growth in population, growth in employment, and growth in per capita income. Results of their analysis showed that higher levels of income inequality are associated with lower levels of growth in terms of population. Property taxes had a negative effect on population and income growth, population over age sixty-five was negatively related with economic growth, climate strongly influenced growth levels of population, all amenity attributes, such as levels of water amenities, developed recreational infrastructure, winter recreational activities, were statistically significant and positively related to economic growth.

Government policies can have an impact on the firm's decision-making process, particularly taxation and incentive policies. Corporate income and property tax rates can affect a firm's profits either directly or indirectly (Gerking and Morgan). It is obvious that a firm's profits will decrease if the burden of an increase in taxes is borne directly by the firm. However, it may not be so clear that a firm's profits will decrease if the increase in taxes is passed forward to the consumer. By passing the tax to the consumer through higher prices, the firm's market will decline, thus indirectly reducing profit.

On the other hand, Newman and Sullivan argue that business taxes should not be viewed strictly as another cost to the firm. They perceive business taxes in part as benefit taxes. "Firms derive some benefit from local or state expenditures on fire, public safety, transportation, and perhaps education" (Newman and Sullivan, p. 216). The relevant question for the firm now would not be which location would minimize the tax burden to the firm, but what location would provide the firm with the most desirable overall fiscal package.

Agglomeration economies represent the cost savings that accrue to firms that locate in communities with a relatively large concentration of manufacturing/commercial business activity (Henry and Drabenstott; Johnson; McNamara, Kriesel, and Rainey). The concentration of activity tends to provide broader access to markets, business services, and technological expertise. In addition, agglomeration forces are generally associated with an abundant supply of skilled labor. Thus, communities in or near large Metropolitan Statistical Areas (MSAs) have location advantages over smaller and/or more remote communities.

This study will examine how rural and small metro locations expand when limited agglomeration economies exist. In particular, the study will examine to what extent other factors can be substituted for manufacturing agglomeration and increase local incomes.

Data

Panel data were collected for 75 counties of the Arkansas state for the years from 1986 through 1999. Average per capita personal income variable was used as an indicator of the economic growth. It was possible to collect following independent variables:

a) agglomeration of employment in agriculture, construction, and manufacturing, wholesale and retail industries, and in service;
b) population density;
c) percent of population over 25 years of age with high school diploma;
d) all roads in miles;
e) total traveled person-trips;
f) sales and use tax rates and property tax rates.

Property taxes are based on two kinds of property: real property and personal property. Real property tax ratea are used in this research. Real property accounts for 64% of property

value and revenue in the state. Real property tax rates include all tangible real estate: land and all improvements on that land, such as: buildings, homes and barns. Property taxes operate as a proxy for local service provisions.[1]

Data on employment agglomeration for different industries were found using REIS web site, other data were taken from Arkansas Annual Statistical Abstracts and data for missing years were inquired from Arkansas Departments of Transportation, Education and Tourism.

Data statistics are given in table 1.

Model and the Concept of Input Potentials

Blum's definition of an input potential is applied in this study to an input factor. Input potential is an input factor, characterized by spatial immobility (Blum, 1982).

Cobb-Douglas production function represents the following model, used in this study:

$$\text{Ln } P(\hat{o}_{it}) = \ln a_{0t} + \sum_{j=1}^{16} a \ln \hat{o}_{it} + \omega = \beta_0 + \sum_{j=1}^{16} \beta_{it} c_{it} + \upsilon,$$

where:

P – personal per capita income;

o_{it} – i-th independent variable for the t-th year;

c_{it} – natural log of the i-th independent variable for the t-th year;

ω and υ – are the error terms.

When trying to identify the bottlenecks or excess capacity definition of substitutional and nonsubstitutional effects should be given. Blum defined that two inputs c_{jit} and c_{kit} are substitutional, if sign of β_{jt} equals sign of β_{kt} with the marginal rate of substitution of:

$$MRS_{jkit} = - \partial c_{jit} / \partial c_{kit} = \beta_{kt} c_{kit}^{-1} / \beta_{jt} c_{jit}^{-1} > 0,$$

where

[1] Ideally we would have included revenue amounts but that data was not available for the entire time period.

j = 1, 2, . . .,m,

k = 1, 2, . . ., m,

$j \neq k$,

t = 1, 2, . . ., T,

i = 1, 2, . . ., n.

Two inputs are nonsubstitutional when the sign of β_{jt} does not equal to the sign of β_{kt}.

Average marginal rate of substitution needed for Blum's definition of a bottleneck:

$$\overline{MRS}_{jkt} = \beta_{kt} \cdot (1/n \sum_{i=1}^{m} c_{kit})^{-1} / \beta_{jt} \cdot (1/n \sum_{i=1}^{m} c_{jit})^{-1}$$

Then a bottleneck of an input potential was determined by comparing MRS to average MRS:

$$MRS_{jkit} > c \cdot \overline{MRS}_{jkt},$$

where $c \geq 1$, it is an arbitrarily chosen factor based on political or statistical considerations.

Results

Cobb-Douglas production function was estimated using SAS statistical package. Results are summarized in table 2. Agricultural employment agglomeration came out to be highly significant and negative, thus showing that agricultural employment inversely related to county per capita personal income. Similarly, Blum found that concentration of agricultural activities reduces personal per capita income (Blum, 1982). Manufacturing and retail employment agglomerations were found to be significant and contributed to the increase in personal per capita income. New manufacturing plants recruit larger workforces and offer higher wages than agriculture or service. Wages in retail sector tend to be low, but retail activity tends to follow income so it could be that the positive relationship is more of correlation instead of causation.

Construction and service employment agglomerations were negative and insignificant, thus not influencing county personal per capita income. Wholesale agglomeration had negative

effect on personal per capita income. Wholesale industry employs only few workers and benefits only those few, average personal per capita income suffers from an increase in wholesale activities.

Transportation variable was represented in this study by the number of miles in all roads. This variable was highly significant and positively related to personal per capita income. Previous research showed that rural amenities contribute to the increase in tourism and economic growth in the county.

Visits to the national and state parks were measured in this study by the number of trips to these parks. This variable was significant and positively related to the personal per capita income.

Another outcome of this research is that economic development was positively related to population density. As a rule county with high population density has higher concentration of industrial activities then less densely populated county, thus county offers a better choice of employment and a greater variety of products and services.

Education was represented by one variable – percent of population over 25 years of age with high school diploma. This segment of population is still growing providing educated work force and improving personal per capita income.

Since taxes are the important source of the revenues for local government, two tax variables were used in this analysis: sales tax rates and property tax rates. These two variables were hypothesized to be positively related to personal per capita income. Sales tax rates and property tax rates variables came out to be positive and highly significant. Sales and use taxes and property taxes are an important source of revenue for local government. In 1996 sales and use taxes constituted 47.8% of Arkansas local tax revenues and property taxes constituted 15.5%

of Arkansas and local tax revenues. Most of the revenue generated by property tax is spent for education. In 1999 over 77% of property tax revenue was spent for local primary and secondary schools and community colleges (Miller, 2001). The rest of the property tax revenue goes for general county operations, roads, libraries, hospitals, and pensions. Strong positive relationship between property taxes and personal per capita income can be explained by the fact that greater revenue should lead to more and/or better services improving the quality of life and productivity of private capital in the area.

Natural amenity index developed in 1993 by ERS USDA was considered as one of the substitutes for employment agglomeration. This index was developed with the consideration of rural-urban code of 1993, mean temperatures for January and June for the years 1940-1970, and topography of 1970. Incorporation of this index in the model showed that natural amenity index did not influence significantly per capita personal income in the state. Therefore, we decided not to include this index in the model. Some other potentially influencing variables, such as median housing price, were not included in the model due to unavailability of data.

Theoretical County Incomes in Factor Production

Actual Cobb-Douglass production function can be written as follows, using estimated coefficients:

$$\hat{y}_{it} = 7.112 \cdot \hat{o}_{1it}^{-0.009} \cdot \hat{o}_{2\,it}^{-0.004} \cdot \hat{o}_{3\,it}^{0.015} \cdot \hat{o}_{4\,it}^{-0.006} \cdot \hat{o}_{5\,it}^{0.019} \cdot \hat{o}_{6\,it}^{0.0001} \cdot \hat{o}_{7\,it}^{0.201} \cdot$$

$$\hat{o}_{8it}^{0.016} \cdot \hat{o}_{9\,it}^{0.055} \cdot \hat{o}_{10\,it}^{0.166} \cdot \hat{o}_{11\,it}^{0.009} \cdot \hat{o}_{12\,it}^{0.088}$$

where:

i – 1,2,3,…,75;

t – 1986, 1987, 1988, …, 1999;

$\hat{y}_{it}$ – is the theoretical average per capita income if total capacity of input potentials were used for production in region i under the assumption of efficient price systems;

$\hat{o}_{it}$ – independent variables used in estimation of per capita incomes.

Comparison of actual and theoretical income for all counties in Arkansas is given in table 3. This table shows how some counties over-utilized and others under-utilized resources that were considered in this research. A negative difference between theoretical and actual income or ratio of actual income over theoretical income greater than 1 tells about over-utilization of considered inputs. This table shows that all counties of Fayetteville-Springdale-Rogers MSA and Little Rock-North Little Rock MSA over-utilized considered resources with the exception of Washington county, whereas majority of other counties, for example Clark, Fulton, Lee, and White counties were not using resources efficiently.

Regression analysis has shown that manufacturing agglomerations significantly influenced per capita personal incomes in the state of Arkansas. Further analysis investigates how other inputs were utilized in relation to these two types of agglomeration. Utilization of inputs against manufacturing employment agglomeration is shown in table 4. Only following inputs were substitutional against manufacturing employment agglomeration: retail employment agglomeration, service employment agglomeration, roads as infrastructure variable, amenity variable, population density, and education variable. If table 3 gives comparison of theoretical and actual income among the counties for the state of Arkansas, table 4 demonstrates which inputs were used efficiently and which were not, when comparing against manufacturing agglomeration. For example, Benton County has an actual income higher than theoretical income, thus implying that Benton County over-utilizes some of its resources. Which resources are over-utilized can be determined from table 4. Benton county over-utilizes it's roads,

amenities and population density, when compared against manufacturing agglomeration. Another example, Clark County has an actual income lower than the theoretical income. From resource utilization table 4 it can be seen that this county has excess capacity in roads, population density, and education variables substitutable against manufacturing agglomeration. Table 4 shows over or under utilization of inputs for each county substitutable against manufacturing agglomeration.

Table 5 provides ratios of the individual county MRS to the state's average MRS. This table shows how county utilizes its resources while substituting for manufacturing. For example, actual income in Benton County is higher than theoretical income. Table 5 shows that roads, amenities and population density are over-utilized in this county substituting for manufacturing agglomeration.

Productivity of Input Potentials

To see a static productivity change with this 14-year period, two identical Cobb-Douglas production models were used. One was for the starting year of the analysis 1986 and another model was for the final year – 1999. Results of these analyses are summarized in table 6. Productivity results have shown that productivity of agricultural and wholesale employment agglomerations have increased and became significant and positive in 1999, whereas on average during 1986-1999 these agglomerations were negative and significant. Productivities of construction and manufacturing agglomerations have decreased between 1986 and 1999, and retail and service employment agglomeration became more productive.

Productivity results on the transportation variable showed that scarcity of the all roads has decreased. Population density variable has shown that population density is still contributing to the increase of the personal per capita income but at a slower rate than in 1986 and that higher

percentage of population over 25-years of age contributes to the increase of personal per capita income.

When comparing tax rates, their productivities have decreased with this 14-year period and made them insignificant. Thus, in 1999 sales and use tax rates, personal property tax rates and by implication services contributed less to the increase of the personal per capita income, than tax rates used in 1986.

Conclusion

The study examined how other local resources could used to substitute for limited agglomeration economies. The results indicate that communities can increase their incomes by substituting human capital, infrastructure, and localization/population agglomeration for a lack of concentration in local manufacturing activity.

This study found that infrastructure (all roads), amenities (visits to state park in this case), education, and population density have a positive impact on personal per capita income. The static analysis indicates an increase in productivity of population density/agglomeration and in productivity of human capital (population of 25-years of age with high school diploma).

The study also found that manufacturing agglomeration decreased in its influence in raising per capita incomes from the mid 1980s to the late 1990s. The ability of communities to make improvements in these other substitutable areas to a large extent will determine how well local incomes will grow in the future.

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Table 1. Summary statistics of the data used in the study of the role of quality of life in Arkansas economic development for the period 1986-1999

Variable	Mean	Std. Dev.	Min	Max
Average per capita personal income	14744.20	3575.09	6831.00	30124.00
Agglomeration of employment in agriculture	0.68	12.36	0.00	239.95
Agglomeration of employment in construction	2.99	61.44	0.00	1453.33
Agglomeration of employment in manufacturing	21.79	404.78	0.00	8220.00
Agglomeration of employment in wholesale industry	1.81	37.03	0.00	848.00
Agglomeration of employment in retail industry	9.55	190.69	0.00	4288.00
Agglomeration of employment in service	14.69	296.86	0.00	6702.67
Population density	44.12	55.86	8.94	437.73
Population over 25 with high school diploma	46.88	14.49	3.60	96.20
All roads in miles	1146.09	456.99	624.30	8316.00
Total traveled person-trips	227523.90	468566.00	0.00	4098817.00
Sales and use tax rates	0.78	0.51	0.00	2.00
Property tax rates	1.49	16.81	0.00	414.40

Table 2. Coefficients of the Cobb-Douglass production function estimating effects of the employment agglomeration, education, amenity variables and tax rates on the county growth for the years 1986-1999

Variables	Coefficients
Intercept	7.112***
	(40.98)
Agricultural employment agglomeration	-0.009***
	(-7.30)
Construction employment agglomeration	-0.004*
	(-1.78)
Manufacturing employment agglomeration	0.015**
	(3.16)
Wholesale employment agglomeration	-0.006**
	(-2.25)
Retail employment agglomeration	0.019**
	(2.63)
Service employment agglomeration	0.0001
	(0.03)
All roads in miles	0.201***
	(7.39)
Visitors to the state parks	0.016**
	(3.53)
Population density	0.055***
	(4.42)
Percent of population 25 years of age with high school diploma	0.166***
	(9.85)
Sales and use tax rates	0.009***
	(7.91)
Property tax rates	0.088***
	(5.72)
F-value	56.95
Adj. R^2	39.72

* indicates significance at the 10% level,
** indicates significance at the5% level,
*** indicates significance at the 10% level.

Table 3. Actual and theoretical incomes of all counties of the state of Arkansas for the period 1986-1999

County name	Theoretical income	Actual income	Difference	Ratio
Arkansas County	14776.3	17238.36	-2462.06	1.17
Ashley County	15456.73	15908.57	-451.84	1.03
Baxter County	15978.19	17495.14	-1516.95	1.09
Benton County	17850.74	19404.79	-1554.05	1.09
Boone County	16152.01	16183.00	-30.99	1.00
Bradley County	14126.39	16008.07	-1881.68	1.13
Calhoun County	13373.09	13006.43	366.66	0.97
Carroll County	13576.15	15871.50	-2295.35	1.17
Chicot County	12632.14	12404.00	228.14	0.98
Clark County	15798.96	14834.79	964.17	0.94
Clay County	12954.51	13953.50	-998.99	1.08
Cleburne County	14457.95	15185.50	-727.55	1.05
Cleveland County	12771.86	14066.07	-1294.21	1.10
Columbia County	14939.74	16052.21	-1112.47	1.07
Conway County	14005.28	15374.07	-1368.79	1.10
Craighead County	17242.49	16443.43	799.06	0.95
Crawford County	13863.29	13736.00	127.29	0.99
Crittenden County	14490.23	15260.86	-770.63	1.05
Cross County	13722.14	13744.21	-22.07	1.00
Dallas County	12410.25	15597.57	-3187.32	1.26
Desha County	12791.29	13456.43	-665.14	1.05
Drew County	14143.35	14466.86	-323.51	1.02
Faulkner County	15867.05	17323.36	-1456.31	1.09
Franklin County	13279.8	14177.50	-897.70	1.07
Fulton County	13311.71	11310.50	2001.21	0.85
Garland County	17012.44	18881.29	-1868.85	1.11
Grant County	12901.51	15670.43	-2768.92	1.21
Greene County	14697.02	14126.71	570.31	0.96
Hempstead County	14787.96	14482.57	305.39	0.98
Hot Spring County	14227.04	13544.43	682.61	0.95
Howard County	12764.2	16932.57	-4168.37	1.33
Independence County	14941.53	15608.21	-666.68	1.04
Izard County	13622.33	13392.57	229.76	0.98
Jackson County	14782.51	14761.86	20.65	1.00
Jefferson County	16620.63	15588.86	1031.77	0.94
Johnson County	14112.27	13895.86	216.41	0.98
Lafayette County	11782.85	12869.43	-1086.58	1.09
Lawrence County	13762.32	13439.43	322.89	0.98
Lee County	14235.44	11075.79	3159.65	0.78

Lincoln County	13633.43	10902.14	2731.29	0.80
Little River County	12193.52	15990.57	-3797.05	1.31
Logan County	14804.99	14584.57	220.42	0.99
Lonoke County	15965.25	16446.00	-480.75	1.03
Madison County	12886.04	14288.00	-1401.96	1.11
Marion County	14546.42	13643.29	903.13	0.94
Miller County	12629.62	14772.71	-2143.09	1.17
Mississippi County	16241.09	15134.57	1106.52	0.93
Monroe County	12283.35	13265.57	-982.22	1.08
Montgomery County	13113.53	13231.14	-117.61	1.01
Nevada County	13704.51	13604.79	99.72	0.99
Newton County	12510.21	10738.86	1771.35	0.86
Ouachita County	14105.22	14884.14	-778.92	1.06
Perry County	11938.21	13150.93	-1212.72	1.10
Phillips County	14950.49	12386.57	2563.92	0.83
Pike County	13699.29	14996.86	-1297.57	1.09
Poinsett County	14446.39	14035.93	410.46	0.97
Polk County	14755.93	14015.50	740.43	0.95
Pope County	16705.62	15896.14	809.48	0.95
Prairie County	12598.08	13745.36	-1147.28	1.09
Pulaski County	22011.05	21568.86	442.19	0.98
Randolph County	13499.39	13245.50	253.89	0.98
St. Francis County	13864.68	13003.29	861.39	0.94
Saline County	15943.39	16492.07	-548.68	1.03
Scott County	12202.55	14184.07	-1981.52	1.16
Searcy County	13044.21	12192.64	851.57	0.93
Sebastian County	16610.66	18932.21	-2321.55	1.14
Sevier County	13651.43	15590.14	-1938.71	1.14
Sharp County	14657.09	13334.07	1323.02	0.91
Stone County	13006.44	12881.50	124.94	0.99
Union County	16376.45	18427.00	-2050.55	1.13
Van Buren County	13889.08	13531.86	357.22	0.97
Washington County	18969.73	17196.43	1773.30	0.91
White County	16278.49	14315.21	1963.28	0.88
Woodruff County	11909.59	13748.93	-1839.34	1.15
Yell County	13519.65	14758.71	-1239.06	1.09

Table 4. Bottlenecks (-) and Excess Capacity (+) of an Input Potentials Against Manufacturing Agglomeration for 75 counties of Arkansas State for the Years 1986-1999

		Retail agglom.	Service agglom.	All roads	Visitors to the parks	Population density	Population with HS diplomas
Arkansas County	+	+	+	+	+	+	
Ashley County	+	+	+	+	+	+	
Baxter County	-	-	+	-	-	+	
Benton County	+	+	-	-	-	+	
Boone County	-	+	-	-	-	-	
Bradley County	+	-	+	+	+	+	
Calhoun County	+	+	+	+	+	+	
Carroll County	-	-	-	-	-	-	
Chicot County	+	-	+	+	+	+	
Clark County	-	-	+	-	+	+	
Clay County	+	+	+	+	+	+	
Cleburne County	-	-	+	-	-	+	
Cleveland County	-	-	-	-	-	-	
Columbia County	+	-	+	+	+	+	
Conway County	+	-	+	+	+	-	
Craighead County	+	-	-	-	-	+	
Crawford County	+	-	+	+	-	+	
Crittenden County	-	-	-	-	-	-	
Cross County	+	-	+	+	+	+	
Dallas County	+	-	+	+	+	+	
Desha County	-	-	-	-	-	-	
Drew County	+	+	+	+	+	+	
Faulkner County	-	-	+	-	-	-	
Franklin County	+	-	+	+	+	+	
Fulton County	+	-	-	-	+	-	
Garland County	-	-	-	-	-	-	
Grant County	+	+	+	+	+	+	
Greene County	+	-	+	+	+	+	
Hempstead County	+	-	+	+	+	+	
Hot Spring County	+	-	+	+	-	+	
Howard County	+	+	+	+	+	+	
Independence County	+	-	+	+	+	+	
Izard County	+	-	-	-	+	-	
Jackson County	-	-	-	+	+	-	
Jefferson County	-	-	-	-	-	-	
Johnson County	+	+	+	+	+	+	
Lafayette County	+	-	+	-	+	-	
Lawrence County	+	-	+	+	+	+	

Lee County	-	-	-	-	-	-
Lincoln County	+	-	+	+	+	-
Little River County	+	+	+	+	+	+
Logan County	+	+	+	+	+	+
Lonoke County	-	-	-	-	-	-
Madison County	+	-	-	+	+	+
Marion County	+	-	+	+	+	+
Miller County	-	-	-	-	-	+
Mississippi County	+	+	+	+	-	+
Monroe County	-	-	-	-	+	-
Montgomery County	+	-	-	-	+	-
Nevada County	+	-	+	+	+	+
Newton County	-	-	-	-	+	-
Ouachita County	-	-	+	+	-	+
Perry County	-	-	-	-	-	-
Phillips County	-	-	-	-	-	-
Pike County	-	-	+	+	+	-
Poinsett County	+	+	+	+	+	+
Polk County	+	-	+	+	+	+
Pope County	-	-	-	-	-	-
Prairie County	-	-	-	+	+	-
Pulaski County	-	-	-	-	-	-
Randolph County	+	-	+	+	+	+
St. Francis County	-	-	-	+	-	-
Saline County	-	-	-	-	-	+
Scott County	+	+	+	+	+	+
Searcy County	+	-	-	+	+	-
Sebastian County	+	-	+	-	-	+
Sevier County	+	+	+	+	+	+
Sharp County	-	-	-	-	-	-
Stone County	-	-	-	-	+	-
Union County	+	-	+	-	-	+
Van Buren County	-	-	-	-	-	-
Washington County	-	-	-	-	-	+
White County	-	-	-	-	-	-
Woodruff County	+	-	+	+	+	-
Yell County	+	+	+	+	+	+

Table 5. Ratio of the individual county's MRS to the state's average MRS

MRS against manufacturing agglomeration	Retail agglom.	Service agglom.	All roads	Visitors to the parks	Population density	Population with HS diploma
Average Arkansas County	0.95	-2.89	0.99	0.97	0.84	0.96
Average Ashley County	0.77	0.92	0.84	0.81	0.77	0.80
Baxter County	1.02	1.28	0.95	1.10	1.10	0.89
Benton County	0.75	0.73	1.05	1.08	1.31	0.88
Boone County	1.06	-2.59	1.02	1.10	1.15	1.05
Bradley County	0.82	1.03	0.85	0.79	0.74	0.89
Calhoun County	0.34	0.55	0.71	0.55	0.47	0.72
Carroll County	2.72	3.21	2.57	3.04	2.55	2.52
Chicot County	0.95	1.13	0.97	0.95	0.92	0.96
Clark County	1.02	1.20	0.96	1.02	0.88	1.04
Clay County	0.81	0.89	0.86	0.80	0.83	0.82
Cleburne County	1.07	1.28	0.99	1.12	1.03	0.99
Cleveland County	1.46	1.98	1.64	1.39	1.31	1.86
Columbia County	0.94	1.09	0.92	0.92	0.92	0.96
Conway County	1.00	1.19	0.94	0.96	0.99	1.02
Craighead County	0.71	1.38	1.08	1.14	1.37	1.08
Crawford County	0.98	1.15	0.93	0.99	1.18	0.95
Crittenden County	1.37	1.60	1.20	1.39	1.51	1.07
Cross County	1.00	1.08	0.94	0.92	0.96	0.97
Dallas County	0.85	1.02	0.82	0.75	0.64	0.80
Desha County	3.48	3.81	3.17	3.29	2.87	3.23
Drew County	0.89	0.98	0.85	0.85	0.77	0.91
Faulkner County	1.01	1.26	0.99	1.06	1.29	1.01
Franklin County	0.99	1.18	1.00	0.95	0.96	0.98
Fulton County	1.11	1.39	1.15	1.14	0.95	1.14
Garland County	1.47	1.85	1.39	1.63	1.74	1.36
Grant County	0.86	0.95	0.85	0.74	0.79	0.77
Greene County	0.89	1.05	0.85	0.81	1.00	0.82
Hempstead County	0.86	1.07	0.88	0.92	0.87	0.90
Hot Spring County	0.97	1.11	0.94	0.93	1.03	0.94
Howard County	0.73	0.89	0.65	0.56	0.59	0.65
Independence County	0.95	1.16	0.57	0.59	0.61	0.55
Izard County	1.00	1.30	1.03	1.01	0.93	1.09
Jackson County	1.07	1.31	1.00	0.98	0.99	1.05
Jefferson County	1.09	1.36	1.09	1.17	1.36	1.08
Johnson County	0.92	0.97	0.84	0.85	0.83	0.84
Lafayette County	0.89	1.21	0.99	1.04	0.89	1.07
Lawrence County	0.98	1.10	0.93	0.95	0.94	0.92
Lee County	1.19	1.47	1.25	1.02	1.11	1.37

Lincoln County	0.83	1.15	0.99	0.86	0.97	1.08
Little River County	0.83	0.88	0.83	0.85	0.80	0.68
Logan County	0.88	1.00	0.89	0.81	0.87	0.94
Lonoke County	1.15	1.35	1.13	1.11	1.26	1.14
Madison County	0.89	1.11	1.02	0.88	0.79	0.94
Marion County	0.81	1.09	0.86	0.92	0.77	0.86
Miller County	1.16	1.46	1.05	1.20	1.27	0.78
Mississippi County	0.86	0.98	0.92	0.99	1.04	0.83
Monroe County	1.31	1.40	1.09	1.23	0.97	1.21
Montgomery County	0.95	1.26	1.05	1.07	0.72	1.11
Nevada County	0.93	1.14	0.94	0.92	0.79	0.98
Newton County	1.07	1.59	1.28	1.21	0.86	1.32
Ouachita County	1.04	1.15	0.93	0.98	1.01	0.95
Perry County	2.47	3.55	2.78	2.67	2.28	2.66
Phillips County	1.20	1.51	1.13	1.17	1.23	1.23
Pike County	1.04	1.12	0.98	0.96	0.82	1.06
Poinsett County	0.90	0.97	0.95	0.88	0.93	0.84
Polk County	0.92	1.08	0.93	0.90	0.81	0.98
Pope County	1.07	1.28	1.03	1.13	1.18	1.08
Prairie County	1.19	1.41	1.17	0.97	0.93	1.24
Pulaski County	1.43	1.89	1.54	1.81	2.41	1.44
Randolph County	0.87	1.01	0.86	0.84	0.83	0.87
St. Francis County	1.10	1.29	1.03	0.78	1.15	1.07
Saline County	1.30	1.51	1.20	1.18	1.52	1.19
Scott County	0.80	0.87	0.83	0.74	0.60	0.89
Searcy County	0.98	1.26	1.04	0.99	0.77	1.13
Sebastian County	0.91	1.19	0.90	1.05	1.34	0.89
Sevier County	0.84	0.98	0.84	0.82	0.80	0.82
Sharp County	1.82	2.13	1.64	1.68	1.54	1.66
Stone County	1.17	1.36	1.03	1.20	0.89	1.10
Union County	0.95	1.19	0.97	1.04	1.03	0.96
Van Buren County	1.28	1.53	1.19	1.29	1.04	1.19
Washington County	1.07	1.26	1.09	1.20	1.41	1.01
White County	1.19	1.33	1.11	1.08	1.21	1.04
Woodruff County	0.88	1.08	0.95	0.85	0.82	1.04
Yell County	0.71	0.89	0.85	0.75	0.72	0.86

Table 6. Productivities for the comparative static analysis for the years 1986 and 1999

Variable	Coefficients of productivity analysis for the year 1986	Coefficients of productivity analysis for the year 1999
Intercept	7.375***	9.191***
	(15.05)	(25.78)
Agricultural agglomeration	-0.014	0.008***
	(-1.64)	(2.74)
Construction agglomeration	0.060	0.008*
	(0.224)	(1.82)
Manufacturing agglomeration	0.007	-0.001
	(0.82)	(-0.08)
Wholesale agglomeration	-0.018	0.013**
	(-1.47)	(2.38)
Retail agglomeration	0.032	0.036
	(0.49)	(0.63)
Service agglomeration	-0.080	-0.063
	(-0.82)	(-1.10)
All roads in miles	0.255**	0.043
	(3.99)	(0.73)
Visitors to the state parks	0.023	0.006
	(1.42)	(1.58)
Population density	0.014	0.093**
	(0.41)	(3.65)
Population 25-years of age	-0.040	0.024
with high school diploma	(-0.77)	(1.30)
Sales and use tax rates	0.0004	-0.005
	(0.16)	(-1.34)
Property tax rates	0.185**	0.026
	(2.18)	(1.63)
F-value	8.31***	8.61***
Adj. R^2	54.23	55.25

* indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.