EDUCATION, INFRASTRUCTURE, AND REGIONAL INCOME PERFORMANCE IN ARKANSAS

Thomas FULLERTON, Jr.*
Enedina LICERIO
Phuntsho WANGMO

Abstract
Although education and infrastructure investments are widely recognized as key ingredients for regional economic development, there are many areas for which empirical estimates of the potential gains associated with these steps do not exist. Arkansas is one such regional economy in the United States. Parameter estimates for the education variables are similar in magnitude to those reported for other regions. Coefficient estimates for the infrastructure variable are not all as hypothesized, but the presence of a commercial airport is confirmed as positively correlated with per capita incomes. Model simulations indicate that raising educational attainment in counties below the respective state averages can generate substantial income gains in Arkansas.

Key Words: Education, Physical Infrastructure, Regional Income Performance, Regional Econometrics
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1. Introduction

Education and infrastructure are critical components of economic development. Education helps increase human capital stocks. Infrastructure investment expands public capital stocks. Together, education and infrastructure help increase productivity and personal income. Other variables also influence regional economic performance. They include institutions, policies, geographic area, resource endowments, and population density. Rauch (1993) indicates that productivity also benefits from the geographic concentration of human capital.

Income performance in Arkansas is below the national average. This is at least partially due to educational attainment. For example, Arkansas ranks last among the 50 states in the percentage of adults age 25 or older who hold bachelor degrees. Investment in public infrastructure for Arkansas may also lag behind the rest of the nation, although this is more difficult to ascertain.

* Thomas Fullerton, Jr., Enedina Licerio, Phuntsho Wangmo, Department of Economics & Finance University of Texas at El Paso, 500 West University Avenue, El Paso, TX 79968-0543, USA. Email tomf @utep.edu
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The objective of this study is to analyze regional income performance in Arkansas. The model will utilize a series of explanatory variables that have been shown to affect regional economic development in other areas of the nation. These include educational attainment measures as well as several demographic variables. The framework will also attempt to incorporate at least some infrastructure variables as public capital stock measures.

Section 2 provides a summary of prior studies. Section 3 discusses data and methodology. Empirical results are presented in Section 4. Section 5 includes a conclusion and suggestions for future research. A data appendix tabulates all of the statistical information employed in the econometric analysis.

2. Literature Review

A number of empirical studies document positive relationships between education and income performance. Rauch (1993) indicates education is a local public good with positive externalities that increase overall economic efficiency. Metropolitan data from the United States are used to estimate hedonic wage and rent equations. Results confirm the central role of education in productivity and regional economic development.

Empirical research also indicates that high school non-completion is a burden to government and is a social concern. Rickman (1995) finds high school non-completion to lower county per capita incomes in southeastern Georgia. Domanzlicky et al. (1996) report similar earnings losses for secondary school dropout rates in southeastern Missouri. Over all, for every percentage point increase in a county's high school non-completion rate, per capita personal income falls by $52. That estimate is consistent with the Rickman (1995) estimate for Georgia.

Educational attainment is very important in metropolitan areas. As noted by Rauch (1993) firms pay higher wages for educated workers because they possess more knowledge and help increase productivity. A highly educated city will tend to have better communication links, and create, transmit, and exchange knowledge and skills more efficiently. Simon (1998) finds that cities with more educated individuals are more productive and attract population at a faster rate than cities with lower levels of learning.

Fullerton (2001) employs a cross section data sample for Texas counties. Empirical outcomes in that study confirm positive linkages between various education attainment measures and regional income performance. Jones (2001) examines the relation between education and productivity in Ghanaian manufacturing. Results indicate that educated workers in Ghana earn higher wages than uneducated workers because of higher productivity. Tertiary educated workers are found to exhibit higher output rates than those with secondary and primary schooling.

Gottlieb and Fogarty (2003) analyze the importance of an undergraduate college degree in metropolitan areas. A bachelor degree is viewed as separating professionally educated workers from manual workers. Among 75 large metropolitan areas in United States, a significant relationship between education, the rate of per capita income growth, and employment growth from 1980 until 1997 is documented. A significant difference in the incomes of more educated places and less educated places is observed. The most educated metropolitan areas exhibit real per capita incomes that are 20 percent above the national average. Likewise, the least educated metropolitan areas have real per capita incomes 12 percent below the national average. More rapid employment growth is also observed among more highly educated regional economies.

Infrastructure development, along with education, can potentially help eradicate poverty via increased productivity. Fan and Zhang (2004) provide evidence on how infrastructure affects regional economic development in rural China. Nonfarm productivity is found to benefit more than agricultural productivity from increased investments in both education and infrastructure.

Partridge and Rickman (2005) utilize logistic regression analysis and find that higher poverty rates in the previous decade naturally increase the probability of remaining in poverty. Every 1 percent increase in the initial poverty rate increases the probability of remaining in poverty by 2.3 percent. The results suggest that counties in high poverty regions can emerge from poverty by increasing educational attainment and investing in physical infrastructure.

Arellano and Fullerton (2005) use 2000 census data to analyze regional income performance in Mexico. A strong correlation between education and per capita gross state product across Mexico is reported. To account for agglomeration spillovers, population density in each state is utilized as an explanatory variable. Results indicate that increases in formal years of schooling will improve regional economic performance.

Destefanis and Sena (2005) find that public capital has a significant impact on total factor productivity across regional economies of Italy. Public capital is categorized into core infrastructure, non-core infrastructure, and total stocks. Core infrastructure includes roads, airports, harbors, railroads, and water systems. Non-core infrastructures include education, public buildings, and hospitals. Investment in core infrastructure is found to strongly increase total factor productivity.

Almada et al. (2006) utilize pooled cross section and time series data set for the years 1990 and 2000 to examine the relationship between education and income performance in Texas counties. Parameter heterogeneity indicates that the data should not be pooled, potentially due to structural changes in the Texas economy. Results obtained using 2000 data point to a positive correlation between income and education in Texas. The intensity of that linkage is found to be stronger than what existed in 1990.

Bronzini and Piselli (2009) examine regional economic growth between 1980 and 2001 across the Italy. Regional productivity is found to be affected by human capital, research and development activity, infrastructure, and geographical spillovers. Infrastructure such as roads and motorways are found to exercise stronger impacts on regional productivity than those for railways, water systems, and electricity. Empirical results indicate that a 1 percent increase in human capital increases total productivity by 0.3 percent. Increases in public capital stocks, and in research and development, also lead to increases in total productivity of 0.11 percent and 0.03 percent, respectively.

Empirical economic literature in this general area is expanding, but access to infrastructure data is problematic for many regions. Arkansas is one such regional economy. To examine the importance of education in Arkansas, income data are analyzed for all 75 of its counties. A small set of infrastructure data are also assembled to aid in this task. Various specifications are employed in order to allow for the possibility of diminishing returns. The model is discussed in detail in the next chapter.

3. Data and Methodology

A variety of studies have analyzed education, income, and demographic variables in order to clarify the nature of sub-state regional income performance (Rickman1995; Domazlicky et al., 1996; Sloboda, 1999). The incorporation of infrastructure into these frameworks is difficult to achieve due to data constraints among counties. This study attempts to do so for Arkansas. A cross section data set for all 75 counties is assembled for purposes of carrying out the analysis.

Arkansas is still a largely rural state, with nearly half of its population living in non- metropolitan areas. Given that, surface transportation links may play important roles for county income performance. Population density per square mile is included in the analysis as an explanatory variable. This variable is employed to capture agglomeration effects associated with greater interaction (Arellano and Fullerton, 2005).

Seven educational variables are employed in the analysis. The state government has taken initiatives to promote education in Arkansas, especially at community colleges, technical colleges, and two year colleges that are a part of the statewide university system (Watts, 2002). Those efforts have been spurred, in part, because census data indicate that Arkansas lags behind most, if not all, of the 50 states for the percentage of adults over the age of 25 who hold bachelors degrees.

Table 1. Variable Names and Definitions

Mnemonic	Definition
PCINC	County per capita personal income, thousands of U.S. dollars
HSGR25	Percentage of adults 25 and over who graduated from high school
COLSOM25	Percentage of adults 25 and over who attended some college
BACH25	Percentage of adults 25 and over with bachelors degree
GRAD25	Percentage of adults 25 and over with graduate degrees
POPDENSITY	Numbers of persons per square mile.
AIRPT	Commercial airport qualitative variable (Dummy = 1 if commercial airport in county; 0 otherwise)
AIRMILES	Distance to the nearest commercial airport, miles
ISHW	Interstate Highway qualitative variable (Dummy = 1 if interstate highway traverses county; 0 otherwise)
OHW	Other Highways, miles of lanes

Data collected for this study are analyzed in a manner similar to what is done in previous studies. The dependent variable in the model is per capita personal income (PCINC) for the 75 counties in Arkansas. The explanatory variables include seven measures of educational attainment for adults over the age of 25 in each county: percentages with less than 9th grade studies (LT9GRADE25), no diploma (NODIP25), high school graduates (HSGR25), some college (COLSOM25), associate degrees (ASSODDR25), bachelor degrees (BACHDR25), and graduate or professional degrees (GRADGR25). Also included as explanatory variables are the numbers of persons per square mile (POPDENSITY), non interstate highway miles or other highway lane miles (OHWS), and distance to the nearest airport (AIRMILES). These are all numeric variables.

Physical infrastructure investment has been shown to improve regional economic performance and increase incomes (Fan and Zhang, 2004), but only four infrastructure variables are employed in the analysis due to data constraints. AIRPT is a dummy variable utilized to indicate the locations of the six largest commercial airports in Arkansas. AIRMILES measures distance to the nearest major commercial airport for each county. ISHW is a qualitative variable used to indicate whether a county is traversed by an interstate highway.

Table 2 and Table 3 report summary statistics for the variables in the sample for the years 1990 and 2000. The standard deviations and ranges for the different variables included in the sample exhibit relatively good variability. In Table 2, average per capita income (PCINC) in 1990 was $9,281. The percentage of high school graduates over the age 25 (HSGR25) is approximately 36.6 percent, while that for some college studies (COLSOM25) is 18.5 percent. The averages for bachelor degree (BACH25) and graduate degrees (GRAD25) in Arkansas are 6.7 percent and 3.2 percent, respectively. The standard deviations for these two variables indicate that they are widely dispersed across the 75 counties. The population density varies from 9.3 to 454 persons per square mile.

The majority of the counties do not have commercial airports and distance to the nearest airport (AIRMILES) varies widely. Other highway miles (OHW) in each county range from 129.9 to 397.3, with a mean of 210.3. For potential data pooling, the income numbers are deflated using the consumer prices index. Median values are used as the measures of central tendency for the qualitative variables in both tables.

Table 2. Numeric Variable Summary for 1990 Data

Variables	Mean	Media	Maximum	Minimu	Std. Dev.	Observations
PCINC Nominal	$9,281	$9,101	$13,760	$6,582	$1,341	75
PCINC Real	$7,100	$6,963	$10,528	$5,036	$1,026	75
HSGR25	34.1	34.3	42.3	22.4	3.6	75
COLSOM25	14.1	13.9	22.1	8.7	3	75
BACHDR25	6.7	6.2	15.3	3.2	2.2	75
GRADGR25	3.2	2.9	8.2	1.3	1.7	75
POPDENSITY	43.9	26.4	454	9.3	57.3	75
AIRMILES	57.1	57.1	132	1	28.8	75
AIRPT	NC	1	1	0	NC	75
ISHW	NC	1	1	0	NC	75
OHW	210.3	207.5	397.3	129.9	53	75

In Table 3, average per capita income for 2000 is $15,276. The range is from $10,983 to $21,466. Percentages of adults over the age of 25 who graduated from high school (HSGR25) and who attended some college (COLSOM25) are 36.6 percent and 18.5 percentage, respectively. The percentages of the population over 25 who holds bachelor degrees (BACH25) or advanced degrees (GRAD25) is 8.3 percent and 4.1

percent, respectively. Population density is 50 persons per square mile in 2000, a moderate increase relative to 1990. Infrastructure variables exhibit the same values as those reported in Table 2.

Table 3. Numeric Variable Summary for 2000 Data

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
PCINC Nominal	$15,276	$15,216	$21,466	$10,983	$1,786	75
PCINC Real	$8,871	$8,836	$12,466	$6,378	$1,0371	75
HSGR25	36.6	36.8	43.6	26.5	3.4	75
COLSOM25	18.5	18	24.5	12.9	2.8	75
BACHDR25	8.3	7.6	18	4.2	2.7	75
GRADGR25	4.1	3.7	10.1	1.8	1.6	75
POPDENSITY	50	28.3	469	9.1	63.7	75
AIRMILES	57.1	57.1	132	1	28.8	75
AIRPTOLN	NC	1	1	0	NC	75
ISHWSLN	NC	1	1	0	NC	75
OHWS	210.3	207.5	397.3	129.9	53	75

Parameter heterogeneity testing is used to see whether the sample data can be pooled for modeling purposes (Almada et al., 2006). This is carried out using a Chow (1960) F-test. The model specification for the study in hand is similar to those employed by Rickman (1995) and Sloboda (1999). Parameter estimation is completed using least squares regression analysis. Because of the cross section of counties in the sample, heteroscedasticity tests are also completed (Fullerton, 2001; Almada et al., 2006).

Beyond parameter estimation, simulations are carried out to examine the potential impacts of different public policy efforts. Personal income gains associated with greater educational attainment are first simulated (Sloboda, 1999; Almada et al. 2006). Depending on model estimation diagnostics, the gains associated with greater infrastructure investment may also be calculated.

For the education variables, the expected signs for the no diploma and less than 9^{th} grade education coefficients are negative because higher dropout rates will generally reduce worker productivity. All other schooling attainment variables are expected to be positively related to per capita income. Although most of the variables in the sample are expected to increase county per capita incomes in Arkansas, diminishing marginal returns are likely to be observed. To allow for diminishing returns, logarithmic transformations are applied to the data prior to estimation.

The basic specification for PCINC takes the form shown in Equation 1. Per capita income is expressed as a function of the various regressors. Data sources include the University of Arkansas at Little Rock Institute for Economic Advancement, U.S Bureaus of the Census, U.S Bureau of Economic Analysis, Federal Aviation Administration, Arkansas State Highway and Transportation Department, and the U.S. Bureau of Transportation Statistics. Coefficients for all of the regressors except AIRMILES are hypothesized to be greater zero. To avoid perfect collinearity, at least one of category of county education attainment or non-attainment must be excluded prior to estimation. Exclusion of the high school non-completion percentage aggregates for each county follows Almada et al. (2006). Estimation results are discussed in the next section.

$$\begin{aligned} \text{Log PCINC}_i = {} & \beta_0 + \beta_1 \text{ Log HSGR25}_i + \beta_2 \text{ Log COLSOM25}_i + \beta_3 \text{ Log BACH25}_i + \\ & \beta_4 \text{ Log GRAD25}_i + \beta_5 \text{ Log POPDENSITY}_i + \beta_6 \text{ Log AIRPT}_i + \\ & \beta_7 \text{ Log AIRMILES}_i + \beta_8 \text{ Log ISHW}_i + \beta_9 \text{ Log OHW}_i + e_i \end{aligned} \qquad (1)$$

4. Empirical Results

Table 4 reports the F-test for parameter heterogeneity (Chow, 1960). The data are logathrimically transformed prior to estimation. Results for Equation 1 are generally as hypothesized, but it is not clear whether the data from 1990 and 2000 should be pooled. Accordingly, an F-test for parameter heterogeneity is carried out (Pindyck and Rubinfeld, 1998). Because the calculated F-statistics is greater than the critical value at the 5-percent level of significance, the model rejects the null hypothesis of coefficient homogeneity. This implies that the data should not be pooled for estimation purposes.

Table 4. F-Test for Parameter Heterogeneity

ESS Unrestricted –1990	0.466184
ESS Unrestricted – 2000	0.241546
Restricted Pooled ESS	0.882582

$ESSur = ESS_1 + ESS_2 = 0.466184 + 0.241546 = 0.70773$

$\hat{F} = [(ESSr - ESSur) / (k + 1)] \,/\, [ESSur / (n - 2k - 2)]$

$\hat{F} = [(0.882582 - 0.70773) / 6] \,/\, [0.70773 / (150 - 2(9)) - 2)] = 5.353$

Note: $\hat{F}$ is larger than $F_{6, 130, 0,05}$ and the null hypothesis of parameter homogeneity is rejected.

Table 5 reports a chi-squared test for heteroscedasticity (White, 1980) performed using the 2000 data. Unlike what frequently occurs in cross sectional data samples, the chi-squared test fails to reject the null hypothesis of homoscedasticity. Given that, heteroscedasticity correction for the covariance matrix is not employed.

Table 5. Chi-Squared Heteroscedasticity Test

F-statistic	0.6486	Prob. F(47, 27)	0.9049
Obs*R-squared	39.77341	Prob. Chi-Squared(47)	0.7635
Scaled explained SS	25.01156	Prob. Chi-Squared(47)	0.9965

Note: The estimated statistics are less than their respective critical values and the null hypothesis of homoscedasticity fails to be rejected.

The central hypothesis tested is that Arkansas county incomes are affected by educational attainment and infrastructure variables in a manner similar to that of other regions of the United States. Estimation results for Equation 1 using data from 2000 are shown in Table 6. The coefficients for HSGR25, COLSOM25, BACH25, GRAD25, POPDENSITY and AIRPT are statistically significant at the 5-percent level. As in neighboring Missouri, this implies that acquiring education beyond secondary school level yields positive returns (Domazlicky et al., 1996). For every one percent increase in the high school graduation rate, per capita income increases by \$2.03. The AIRPT coefficient is 0.10, indicating that the presence of a commercial airport increases county per capita by $1.11. The t-statistics for AIRMILES, ISHW and OHWS fall below the 5-percent significance level. Overall the model exhibits good economic traits, but the signs for the ISHW and OHWS coefficients are counter-intuitive.

Table 6. Estimation Results using 2000 Data

Dependent Variable: LOG(PCINC). Method: Least Squares. Number of Observations 75				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Constant	6.1583	0.4467	13.7873	0.0000
LOG(HSGR25)	0.7064	0.0875	8.0739	0.0000
LOG(COLSOM25)	0.1344	0.0671	2.0046	0.0492
LOG(BACH25)	0.1549	0.0395	3.9234	0.0002
LOG(GRAD25)	0.0780	0.0327	2.3841	0.0201
LOG(POPDENSITY)	0.0533	0.0177	3.0099	0.0037
LOG(AIRPT)	0.1056	0.0454	2.3255	0.0232
LOG(AIRMILES)	-0.0027	0.0096	-0.2822	0.7787
LOG(ISHW)	-0.0236	0.0162	-1.4557	0.1503
LOG(OHWS)	-0.0117	0.0354	-0.3308	0.7419
R-squared	0.7946	Mean Dependent Variable		9.6275
Adjusted R-squared	0.7662	Std. Dev. Dep. Variable	0.1151	
Std. Error Regression	0.0557	Sum Squared Residuals	0.2013	
F-statistic	27.9414	F-statistic Probability	0.0000	
Log likelihood	115.5914			

Table 7. Estimation Results using 2000 Data

Dependent Variable: LOG(PCINC). Method: Least Squares. Number of Observations 75				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Constant	6.1309	0.3737	16.4081	0.0000
LOG(HSGR25)	0.6977	0.0874	7.9837	0.0000
LOG(COLSOM25)	0.1455	0.0615	2.3662	0.0209
LOG(BACH25)	0.1560	0.0392	3.9799	0.0002
LOG(GRAD25)	0.0714	0.0321	2.2211	0.0297
LOG(POPDENSITY)	0.0445	0.0164	2.7160	0.0084
LOG(AIRPT)	0.0943	0.0449	2.1028	0.0392
LOG(AIRMILES)	-0.0042	0.0096	-0.4329	0.6665
R-squared	0.7873	Mean Dependent Variable	9.6275	
Adjusted R-squared	0.7651	Std. Dev. Dependent Var.	0.1151	
Std. Error Regression	0.0558	Sum Squared Residuals		0.2085
F-statistic	35.4312	F-statistic Probability		0.0000
Log likelihood	114.2822			

Given that, Table 7 excludes the ISHW and OHW variables. All of the coefficients for the numerical explanatory variables exhibit the hypothesized signs. The magnitude of the parameter estimates are more in line with earlier studies. The coefficient of determination is 0.79, adjusted for degrees of freedom it is 0.77, fairly high values for cross sectional data. The t-statistics for all the variables except AIRMILES are significant at the 5-percent level. Additional estimation results for alternative specifications are included in the appendix. As above, the null hypothesis of homoscedasticity fails to be rejected for this more limited specification.

Table 8. Chi-Squared Heteroscedasticity Test

F-statistic	0.9693	Prob. F(31, 43)	0.5298
Obs*R-squared	30.8507	Prob. Chi-Squared(31)	0.4738
Scaled explained SS	17.5352	Prob. Chi-Square(d31)	0.9750

Note: The estimated statistics are less than their respective critical values and the null hypothesis of homoscedasticity fails to be rejected.

The parameter estimates shown in Table 7 can be used to calculate potential gains associated with improved educational achievement for Arkansas counties. All of the calculations are summarized in Tables 9, 10, 11, and 12. For counties with educational achievement rates that exceed the corresponding state averages, no calculations are performed. For the other counties, the impacts of raising county educational attainment to the state averages are calculated. Aggregate income impacts are tallied by multiplying per capita gains by each county's population. Table 9 summarizes the potential impacts from raising Arkansas county high school graduation rates to the state average. Such steps lead to substantial income improvements.

Table 9. Income Gains from Increased High School Graduation Rates

County	Per Capita Impact	Aggregate Impact
Arkansas	NC	NC
Ashley	NC	NC
Baxter	NC	NC
Benton	$445.48	$68,338,859
Boone	NC	NC
Bradley	NC	NC
Calhoun	NC	NC
Carroll	$23.79	$603,264
Chicot	NC	NC
Clark	$605.71	$14,261,934
Clay	NC	NC
Cleburne	NC	NC
Cleveland	NC	NC
Columbia	NC	NC
Conway	NC	NC
Craighead	$476.94	$39,179,444
Crawford	NC	NC
Crittenden	$288.09	$14,653,732
Cross	NC	NC
Dallas	NC	NC
Desha	NC	NC
Drew	NC	NC
Faulkner	$1,072.19	$92,223,278
Franklin	NC	NC
Fulton	NC	NC
Garland	$461.38	$40,633,181
Grant	NC	NC
Greene	NC	NC

Hempstead	NC	NC
Hot Spring	NC	NC
Howard	NC	NC
Independence	NC	NC
Izard	NC	NC
Jackson	NC	NC
Jefferson	NC	NC
Johnson	NC	NC
Lafayette	NC	NC
Lawrence	NC	NC
Lee	$1,096.96	$13,799,804
Lincoln	NC	NC
Little River	NC	NC
Logan	NC	NC
Lonoke	NC	NC
Madison	NC	NC
Marion	NC	NC
Miller	NC	NC
Mississippi	$564.38	$29,335,710
Monroe	NC	NC
Montgomery	NC	NC
Nevada	NC	NC
Newton	NC	NC
Ouachita	NC	NC
Perry	NC	NC
Phillips	$2,310.10	$61,090,594
Pike	NC	NC
Poinsett	NC	NC
Polk	NC	NC
Pope	$195.43	$10,644,738
Prairie	NC	NC
Pulaski	$2,873.69	$1,038,765,902
Randolph	NC	NC
Saint Francis	$366.98	$10,763,100
Saline	NC	NC
Scott	NC	NC
Searcy	NC	NC
Sebastian	$980.90	$112,873,008
Sevier	$74.70	$1,177,114
Sharp	NC	NC
Stone	NC	NC
Union	NC	NC
Van Buren	NC	NC
Washington	$1,368.01	$215,755,227
White	NC	NC
Woodruff	NC	NC
Yell	NC	NC
Statewide	**$1,322.19**	**$1,764,098,889**

Note**:** All impacts are calculated in 2000 dollars for 2000 schooling rates relative to the Arkansas state average**.**

Pulaski County is expected to generate the largest estimated per capita gain of $2,874. Similarly the largest aggregate income increase is also realized by Pulaski County, $1 billion. The second largest income per capita gains is experienced by Phillips County at $2,310. On average, the weighted per capita gain of each county is $1,322. The state aggregate income gain exceeds $1.76 billion.

Table 10 reports, the impact of increasing the percentage of adults 25 and over who attend at least some college. Dallas County exhibits the largest per capita gain, $912, followed closely by Clay County with $873. The aggregate income gains for White County exceed $22 million, while Poinsett County obtains the second largest total increase of $17 million. The average state per capita gain is $309, while the state aggregate income gain is approximately $369 million.

Table 10. Income Gains from Increased Some College Attendance Rates

County	Per Capita Impact	Aggregate Impact
Arkansas	$396.12	$8,219,070
Ashley	$517.19	$12,520,694
Baxter	NC	NC
Benton	NC	NC
Boone	NC	NC
Bradley	$604.47	$7,616,308
Calhoun	$733.74	$4,214,590
Carroll	$46.66	$1,183,205
Chicot	$658.32	$9,293,557
Clark	$79.49	$1,871,679
Clay	$872.50	$15,363,809
Cleburne	NC	NC
Cleveland	$512.49	$4,392,592
Columbia	$232.90	$5,962,821
Conway	$400.35	$8,141,584
Craighead	$55.16	$4,531,414
Crawford	$13.62	$725,323
Crittenden	$47.19	$2,400,307
Cross	$382.78	$7,474,105
Dallas	$912.23	$8,401,621
Desha	$522.18	$8,010,836
Drew	$223.57	$4,185,892
Faulkner	NC	NC
Franklin	$37.67	$669,381
Fulton	$69.30	$806,818
Garland	NC	NC
Grant	NC	NC
Greene	$328.54	$12,264,619
Hempstead	$458.59	$10,816,653
Hot Spring	$244.64	$7,425,581
Howard	$300.57	$4,298,147
Independence	$170.03	$5,820,684
Izard	NC	NC
Jackson	$759.36	$13,985,914

Jefferson	NC	NC
Johnson	$575.04	$13,099,933
Lafayette	$429.19	$3,673,450
Lawrence	$569.91	$10,129,499
Lee	$490.63	$6,172,179
Lincoln	$437.63	$6,342,193
Little River	NC	NC
Logan	$273.55	$6,151,089
Lonoke	NC	NC
Madison	$472.49	$6,729,729
Marion	NC	NC
Miller	NC	NC
Mississippi	$327.67	$17,031,723
Monroe	$765.92	$7,853,775
Montgomery	$310.01	$2,866,049
Nevada	$449.18	$4,471,601
Newton	$389.30	$3,351,123
Ouachita	NC	NC
Perry	$230.95	$2,357,790
Phillips	$185.14	$4,896,096
Pike	$383.49	$4,334,596
Poinsett	$702.72	$17,999,594
Polk	NC	NC
Pope	NC	NC
Prairie	$360.61	$3,439,861
Pulaski	NC	NC
Randolph	$403.38	$7,339,488
Saint Francis	$225.13	$6,602,919
Saline	NC	NC
Scott	$464.52	$5,107,897
Searcy	$610.34	$5,042,037
Sebastian	NC	NC
Sevier	$269.12	$4,240,517
Sharp	NC	NC
Stone	$363.20	$4,176,396
Union	$66.83	$3,049,242
Van Buren	$35.93	$581,739
Washington	NC	NC
White	$341.37	$22,928,041
Woodruff	$720.12	$6,294,603
Yell	$551.11	$11,650,007
State	**$309.00**	**$368,510,371**

Note: All impacts are calculated in 2000 dollars for 2000 schooling rates relative to the Arkansas state average**.**

Table 11 examines the impact of increased bachelor degree rates for Arkansas counties. The largest per capita gain is $2,016 for Poinsett County, while the largest aggregate income gain is $64 million for Crawford County. The statewide weighted average per capita income gain is $756 and the state aggregate gain is roughly $1.16 billion.

Table 11. Income Gains from Increased Bachelor Degree Rates

County	Per Capita Impact	Aggregate Impact
Arkansas	$649.37	$13,473,842
Ashley	$1,106.08	$26,777,099
Baxter	$624.87	$23,986,376
Benton	NC	NC
Boone	$555.39	$18,854,253
Bradley	$829.98	$10,457,688
Calhoun	$1,913.32	$10,990,112
Carroll	$414.09	$10,500,041
Chicot	$475.16	$6,707,872
Clark	NC	NC
Clay	$1,612.52	$28,394,836
Cleburne	$507.88	$12,212,475
Cleveland	$862.28	$7,390,575
Columbia	NC	NC
Conway	$1,186.22	$24,122,990
Craighead	NC	NC
Crawford	$1,204.12	$64,115,709
Crittenden	$456.87	$23,238,986
Cross	$1,303.51	$25,452,346
Dallas	$729.53	$6,718,992
Desha	$567.28	$8,702,615
Drew	NC	NC
Faulkner	NC	NC
Franklin	$848.34	$15,075,782
Fulton	$1,372.66	$15,980,509
Garland	NC	NC
Grant	$1,091.71	$17,973,960
Greene	$968.69	$36,162,155
Hempstead	$1,007.58	$23,765,857
Hot Spring	$803.24	$24,380,895
Howard	$732.20	$10,470,447
Independence	$640.35	$21,921,223
Izard	$914.64	$12,118,000
Jackson	$1,072.11	$19,746,156
Jefferson	$42.00	$3,539,407
Johnson	$587.44	$13,382,397
Lafayette	$1,141.57	$9,770,738
Lawrence	$1,973.35	$35,074,338
Lee	$1,357.46	$17,076,785
Lincoln	$1,364.40	$19,772,871
Little River	$890.72	$12,138,710
Logan	$1,175.41	$26,430,249
Lonoke	$232.15	$12,264,217
Madison	$1,054.43	$15,018,312
Marion	$1,031.41	$16,646,982

Miller	$655.28	$26,501,572
Mississippi	$744.75	$38,711,350
Monroe	$1,546.00	$15,852,709
Montgomery	$1,767.45	$16,340,096
Nevada	$978.05	$9,736,448
Newton	$740.76	$6,376,425
Ouachita	$521.02	$15,000,190
Perry	$938.16	$9,577,630
Phillips	$496.36	$13,126,303
Pike	$1,279.76	$14,465,126
Poinsett	$2,016.18	$51,642,379
Polk	$1,232.06	$24,923,442
Pope	NC	NC
Prairie	$1,264.45	$12,061,592
Pulaski	NC	NC
Randolph	$1,322.64	$24,065,478
Saint Francis	$1,182.49	$34,681,307
Saline	NC	NC
Scott	$1,531.34	$16,838,609
Searcy	$1,667.46	$13,774,877
Sebastian	$46.76	$5,380,873
Sevier	$1,137.99	$17,931,266
Sharp	$1,053.24	$18,030,421
Stone	$1,413.12	$16,249,503
Union	$80.54	$3,674,923
Van Buren	$749.72	$12,139,464
Washington	NC	NC
White	$212.96	$14,303,610
Woodruff	$1,143.57	$9,995,932
Yell	$960.36	$20,300,957
State	**$755.50**	**$1,162,489,278**

Note**:** All impacts are calculated in 2000 dollars for 2000 schooling rates relative to the Arkansas state average**.**

The impact of increasing the percentage of adults 25 and over who complete graduate degrees in Arkansas counties is reported in Table 12. The largest estimated per capita gain is for Dallas County, $2,682. Poinsett County experiences the largest aggregate income gain of $51 million. The weighted per capita gain for the entire state is $938 and the state aggregate income increase exceeds $1.45 billion.

Table 12. Income Gains from Increased Graduate School Completion Rates

County	Per Capita Impact	Aggregate Impact
Arkansas	$1,058.44	$21,961,623
Ashley	$1,597.24	$38,667,481
Baxter	$763.94	$29,324,761
Benton	NC	NC
Boone	$881.74	$29,933,364
Bradley	$692.95	$8,731,218

Calhoun	$1,907.01	$10,953,848
Carroll	$494.15	$12,530,050
Chicot	$1,522.75	$21,496,730
Clark	NC	NC
Clay	$1,797.96	$31,660,217
Cleburne	$359.31	$8,639,890
Cleveland	$2,265.68	$19,419,170
Columbia	$353.81	$9,058,621
Conway	$545.46	$11,092,508
Craighead	NC	NC
Crawford	$1,279.11	$68,108,882
Crittenden	$915.83	$46,584,763
Cross	$1,070.78	$20,908,122
Dallas	$2,682.45	$24,705,397
Desha	$1,741.31	$26,713,464
Drew	$394.30	$7,382,420
Faulkner	NC	NC
Franklin	$1,157.40	$20,568,148
Fulton	$757.88	$8,823,186
Garland	NC	NC
Grant	$1,071.77	$17,645,554
Greene	$1,226.88	$45,800,666
Hempstead	$968.58	$22,845,894
Hot Spring	$1,355.45	$41,142,102
Howard	$1,134.52	$16,223,694
Independence	$275.50	$9,431,175
Izard	$755.45	$10,008,987
Jackson	$1,152.08	$21,218,941
Jefferson	$376.77	$31,753,043
Johnson	$531.91	$12,117,424
Lafayette	$1,380.72	$11,817,620
Lawrence	$757.48	$13,463,416
Lee	$1,673.23	$21,049,233
Lincoln	$2,300.54	$33,339,461
Little River	$2,025.94	$27,609,462
Logan	$1,628.72	$36,623,368
Lonoke	$554.60	$29,298,599
Madison	$1,430.54	$20,375,241
Marion	$1,367.12	$22,065,391
Miller	$772.17	$31,228,996
Mississippi	$982.00	$51,043,334
Monroe	$1,369.16	$14,039,358
Montgomery	$1,033.56	$9,555,297
Nevada	$1,220.89	$12,153,994
Newton	$991.88	$8,538,104
Ouachita	$881.60	$25,381,263
Perry	$1,240.73	$12,666,626
Phillips	$718.28	$18,994,949
Pike	$1,062.36	$12,007,851
Poinsett	$2,023.63	$51,833,298
Polk	$624.52	$12,633,413

Pope	NC	NC
Prairie	$1,677.46	$16,001,318
Pulaski	NC	NC
Randolph	$681.08	$12,392,201
Saint Francis	$1,100.65	$32,280,841
Saline	$347.41	$29,019,226
Scott	$1,416.35	$15,574,139
Searcy	$1,428.96	$11,804,652
Sebastian	NC	NC
Sevier	$1,450.57	$22,856,690
Sharp	$1,391.62	$23,823,112
Stone	$986.10	$11,339,188
Union	$708.45	$32,325,779
Van Buren	$1,172.91	$18,991,816
Washington	NC	NC
White	$106.75	$7,170,175
Woodruff	$2,319.76	$20,277,050
Yell	$927.64	$19,609,464
State	**$937.57**	**$1,454,635,266**

Note: All impacts are calculated in 2000 dollars for 2000 schooling rates relative to the Arkansas state average.

As shown in the above tables, raising educational attainment can improve county income performance noticeably in many regions of the state. The coefficients of HSGR25, COLSOM25, BACH25, and GRAD25 are statistically significant at the 5-percent level. Results for the infrastructure variables are somewhat ambiguous. The coefficients for the highway variable are statistically indistinguishable from zero, but the airport coefficients are more in line with expectations. Estimation and simulation results underscore the importance of educational attainment in Arkansas. State and county policies designed to increase enrollments will likely meet with success. Counties in which commercial airports are located should invest in both maintenance and expansion programs. Additional research is needed, however, to better assess the impact of infrastructure investment on regional economic performance in this state.

5. Conclusion

The objective of this paper is to quantify the contributions of education, infrastructure, and demographics on regional per capita income in Arkansas. A pooled cross section data set for all 75 counties in Arkansas is utilized for the analysis. An F-test for parameter heterogeneity indicates that the data should not be pooled. The empirical results detailed above are consistent with prior studies for other regions of the United States. Empirical results indicate that regional income and educational attainment are closely linked in Arkansas.

In spite of data constraints, the results are potentially useful to policy analysts. In particular, there are several counties that may benefit from raising educational achievement up to the state averages across several categories. Statewide income gains potentially exceed $4.74 billion. Those gains would undoubtedly exceed the additional instructional resources required to achieve them.

Infrastructure data constraints are fairly binding, but the presence of commercial airports helps raise per capita incomes. More data regarding county level physical infrastructure would be useful. Data regarding private capital stocks might also be helpful in terms of more completely describing regional income behavior in Arkansas and other regions.

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