A CIRCLE OF PROSPERITY: EDUCATIONAL PERFORMANCE AND PER-CAPITA INCOME IN CENTRAL INDIANA COUNTIES·

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ABSTRACT

Central Indiana, a region of 44 counties, has enjoyed economic prosperity throughout most of the 1990s but when it comes to education the region has, like the rest of Indiana, lagged behind most of the United States. An empirical model, using a panel of data from 1990 to 1999, is developed to measure the effects of educational attainment, financial support and student performance on a county's per capita income. Simultaneity between per-capita income and educational performance is estimated with two stage least squares and preliminary findings indicate that higher levels of income promote higher levels of student performance and vice versa.

INTRODUCTION

This paper undertakes empirical research on the relationship between various measures of educational attainment, support and performance on the economic well being, over the course of several years, of counties in Central Indiana. Dodge (2003) provides a preliminary investigation of these issues, but the focus of that paper was only a cross section in 1998. The results of that research imply that metropolitan counties with high performing schools, a relatively high number of "new economy" jobs, and strong labor demand, experience greater economic prosperity. Somewhat surprisingly, per capita incomes are not significantly affected in counties that have a relatively strong manufacturing sector or a population with relatively high levels of educational attainment. Dodge (2003) also provides support for the assertion that high performing county schools may be the product of high performing county economies and those counties with households that have higher average levels of education have a positive affect on test scores. Counties in which spending per student is high, actually exhibit lower overall test scores, which may be seen as a sign that lower levels of spending, if wisely targeted, may be more effective. Smaller average class sizes also appear to improve test scores, testament perhaps to the benefits of more one on one instruction and assistance. The current research broadens the scope of that paper by building a panel of data, from 1990-1999, for 44 Central Indiana counties. A simultaneous equations model of per capita income and academic performance as functions of each other and other economic and education variables is estimated. Preliminary results indicate that there is a positive relationship between academic performance and economic prosperity at the county level. Counties in which greater fractions of graduating high school seniors plan to attend college also seem to enjoy more economic prosperity. Interestingly, counties in MSA's have per-capita incomes that are significantly higher than non MSA counties, yet students in MSA counties exhibit significantly lower overall academic performance than their more rural counterparts.

Background

A substantial body of research supports the assertion that, for an individual worker, there is a positive return to increased amounts of education.[1] Table 1 presents median incomes for U.S. workers in 1998 and illustrates the positive relationship between income and an individual's educational attainment. These returns are potentially justified by two hypotheses. The first is that schooling fundamentally changes the person, making them a more productive unit of labor and thus able to command a higher wage. The second is that the student, without improving their inherent productivity, endures education. By completing the education employers receive a signal that the student is productive.

While it is widely assumed that more and better education improves the earnings of an individual, studies at the county level are becoming more prevalent. Madden (1996) provides a useful review of the literature surrounding changes in urban and suburban poverty rates and finds that the median level of education of the over age 25 population has no significant effect on the rate of growth in poverty rates, but that variables designed to capture economic growth and local labor market conditions do influence the growth of poverty in MSAs. Levernier, *et al* (2000) examine differences in 1990 family poverty rates for all U.S. counties and independent cities in the lower 48 states. With regard to education they find that greater educational attainment reduces poverty, but that these effects are stronger with high school attainment, and are about twice as effective as college attainment in lifting a family out of poverty. This makes sense since college attainment "more likely lifts families into the middle and upper classes" (p. 487). Domazlicky, *et al* (1996) estimate that a one-percentage point increase in a county's high school noncompletion rate is associated with a drop in per capita personal income by over $50. Every one-percentage point

[1] See Hanushek (1986) and Filer, Hammermesh, and Rees (1996) for a review of this literature.

increase in a county's college degree rate increases per capita personal income by over $200.

	High School 9th-11th grade	High School graduate only	Some College no degree	Bachelor's Degree
All workers 18 years and older[2]	$10,563	$17,143	$19,006	$32,022
Men[3]	$22,996	$30,035	$33,833	$47,399
Women	$16,195	$21,405	$24,826	$34,668

Table 1 : Income by Educational Attainment

While stronger educational attainment is likely to increase an individual's income and many studies have found the same effect for decreasing poverty and/or increasing per capita income at the county level, there are likely simultaneity issues. Strong education variables may be included as independent variables with per capita income as the dependent variable, but education may simultaneously be dependent upon local economic conditions. For example a poor school system may be a function of a poor county, and this poor school system fails to produce strong students who fail to attain high-income jobs. A model that incorporates simultaneous effects is desirable. Borland and Howsen (1996) construct a model of educational performance (mathematics scores) and educational support (average teacher salaries), each as a function of one another and other explanatory variables. They find, with 2SLS estimation, that in the teacher salary equation, student performance in mathematics significantly increases teacher salaries. They also find that higher teacher salaries decrease math performance, a seemingly puzzling result. However Hanushek's (1986) survey of the literature finds that only nine of sixty studies find a positive and significant impact between these two variables. Of the fifty studies for which there is no significant impact, eleven report a negative sign. Dodge (2003) also uses a simultaneous model to estimate the relationship between per-capita income at the county level as a function of economic and demographic variables, and also as a function of countywide performance on the ISTEP (Indiana State Test for Economic Progress) exam.[4] Student performance on the ISTEP is then modeled as a relationship between measures of educational quality and per-capita income. This work indicates that higher levels of income, a more educated household and smaller classes promote higher levels of student performance at the county level. Dodge also finds that higher levels of spending per student are associated with lower countywide exam performance.

Model

In this study I incorporate many of the above techniques and models to estimate a two-equation system of county per-capita income and student academic performance (as measured by total battery ISTEP scores) in that county. The specific model to be estimated is

$$Realy = f(ISTEP, urate, msa, manuf\_ratio, college\_attend)$$

and

$$ISTEP = f(Realy, attend\_rate, teach\_sals, cogskill, pupil\_ratio, msa)$$

where *Realy* represents the inflation adjusted[5] per capita income in the county, *ISTEP* is the total battery score for the county, *urate* is the annual average unemployment rate, *msa* is a dummy variable identifying a county located in a MSA area, *manuf_ratio* is the ratio of manufacturing jobs, and *college_attend* is the fraction of high school graduates who intend to attend a two or four-year college. The second equation in the simultaneous model is a model for ISTEP performance as a function of *Realy*, *attend_rate* is the average attendance rate in county schools, *teach_sals* is the inflation adjusted average salary of teachers in the county, *cogskill* is the average score students received on a cognitive skills test administered with the ISTEP, and *pupil_ratio* is the average pupil to teacher ratio in the county. Panel data has been collected from 1990-1999 for the 44 counties that fall within the BEA's definition of Central Indiana.

It is expected that *ISTEP*, *manuf_ratio*, *msa*, and *college_attend*[6] will have positive effects on the per-capita income of the county and that *urate* will have a negative effect. ISTEP is included as a reflection of school and student quality and *college_attend* is a measure of the quality of the labor force in the county. The proportion of seniors who express an interest in college is also measuring household

[2] These figures are for all workers 18 years and over who are receiving some sort of income. Source: Bureau of Labor Statistics, March 1998 Current Population Survey.

[3] The male and female wage figures in Table 1 represent median incomes for year-round, full-time workers 18 years and older. Source: March 1998 Current Population Survey.

[4] A more thorough background of Indiana's testing procedures, including current design of the ISTEP+ exam can be found in the "ISTEP+ Program Manual 2002-2003" at hyyp://doe.state.in.us/publications/istep.html

[5] Nominal incomes were deflated by the annual average of the Midwest urban CPI (1982-84 = 100).

[6] Data for the percentage of county residents who have already attained a college degree would be more desirable, but this data is collected only during the decennial census. The percentage of high school seniors who intend to pursue higher education is collected annually.

effects as students are more likely to attend college if their parents attended college. Of course this specification cannot account for inter-county migration or for citizens who work in one county but reside in another. It is also noteworthy that the model does not incorporate a lag structure between the educational quality or attainment and per-capita income. For example one could argue that a large percentage of a class of graduating students attend college and the county does not feel the impact of their educational attainment for several years. My decision to omit a lagged variable should not imply that I disagree with this argument; it's simply that including a lagged independent variable would tend to be arbitrary. Would it be appropriate to lag *college_attend* by two, four, five, or six years? It's difficult to provide theoretical justification. Therefore the empirical estimates should not be interpreted as directly causal from year t to year t (or t+4), but rather an overall reflection of the aggregate influence of the independent variable on per capita income.

It is expected that *Realy*, *attend_rate*, *teach_sals*, and *cogskills* should have a positive effect on countywide ISTEP battery scores. With better-paid teachers[7], more intelligent students who attend more frequently, and in strong economic counties, students should perform better on the standardized exam. The pupil to teacher ratio has an ambiguous theoretical influence on test scores. Arguments can be made that smaller classes allow the teacher to provide more one on one contact with the student, thus quickly identifying weaknesses in testable subject matter and helping to remedy those weaknesses. It could also be argued that larger classrooms provide a situation where a teacher can specialize instruction on testable subjects and thus produce well-drilled students who perform well on the ISTEP.

Data

As previously mentioned, a panel of data has been constructed over ten years and over the 44 counties that make up Central Indiana. Thus each variable contains 440 observations. Exceptions are made for four missing years of teacher experience data.[8] One last exception is the missing pupil-teacher ratio data for every county in 1990. The Department of Education reclassified teaching categories in 1991 and thus data earlier than 1991 is not comparable to data since 1991. Table 2 below reports some summary statistics for the remaining 396 complete observations.

Variable	Mean	Maximum	Minimum	Standard Deviation
Real Per capita Income[a]	$13,608	$24,852	$9451	$2352
Unemployment Rate[b]	4.99%	14.40%	1.20%	2.40%
Percentage who intend to pursue higher education[c]	62.19%	87.14%	31.63%	11.73%
ISTEP Total Battery Score[c]	61.55	72.60	53.90	3.30
Pupil/Teacher Ratio[c]	25.64	30.58	21.58	1.61
Average Teacher Salary[c]	$23,711	$28,150	$20,389	$1368
Student Attendance Rate[c]	95.72%	97.60%	94.36%	.52%
Dummy for MSA counties[a]	.41	1	0	.49
Ratio of Jobs in Manufacturing[a]	.199	.392	.021	.089

Table 2: Summary Statistics
Data Sources: [a] U.S. Bureau of Economic Analysis. [b] U.S. Bureau of Labor Statistics. [c] Indiana Department of Education, School Finance and Educational Information.

Empirical Results

The above model was estimated with two stage least squares[9] and the results are reported in the following Table 3. All results are corrected for heteroskedasticity using White's (1980) consistent estimator and t-statistics are reported in parentheses.

Within the first equation, the coefficients on ISTEP, the metropolitan county identifier and intention to attend college are positive and significant at the 99% level of confidence. The coefficient on the unemployment rate is negative and significant with 99% confidence. The ratio of manufacturing jobs in the county has a positive, but statistically insignificant, impact on the per capita income. This implies that metropolitan counties that include schools that produce students who excel on the ISTEP test of academic performance, and who are encouraged to pursue higher education, where jobs are relatively plentiful, experience greater economic prosperity.

If one of the contributing factors in a county's prosperity is the quality of the students produced in the county school systems, the second equation attempts to identify the factors that produce higher ISTEP scores. The issue of simultaneity arises again because of the possibility that the citizens of counties of relative wealth will demand better schools and better teachers and will be willing to support those

[7] With the extent of union representation, salary is probably a function of tenure in the profession. This experience may also contribute to stronger test scores, though this is not universally found in the literature.
[8] The counties of Decatur, Fountain, Parke and Union did not report the average years of experience for their teachers in 1993 so I replaced this missing data with the mean experience during the 1990s.
[9] The software used for all estimations is Limdep 7.0.

efforts. Thus it is argued that prosperous counties will produce better students, as measured by the ISTEP. The coefficient on per capita income is indeed positive and statistically significant with 99% confidence, as is the variable for performance on the test of cognitive skills. The metro/urban dummy variable is significantly negative at the 95% confidence level, indicating that schools located in more urban counties may be falling behind in test performance. The variables measuring pupil to teacher ratio (positive coefficient), attendance rate (positive) and average teacher salary (negative) in the county are statistically insignificant. These latter results do not support the common assertion that smaller class sizes improve academic performance, nor do they support the argument that student performance will improve if teacher salaries are raised, either by conscious decision at the local level or by more experienced teachers. As mentioned earlier in this paper, the insignificant result of educational inputs like teacher salaries on student achievement is not surprising given the results of Hanushek's (1986, 1989) survey of the literature. In fact Hanushek, Rivkin and Taylor (1996) argue that the aggregation of school data tends to inflate the coefficients on school resources, so it may be the case that the actual effects are actually even smaller than reported here.

Summary and Implications

The decade of the 1990s gave an economic boost to most of the United States and Central Indiana was no exception. However economic prosperity has not been uniformly distributed across Central Indiana's 44 counties. Educational attainment and academic performance in Indiana has sometimes been used as an explanation for why per-capita income in some counties has outgrown those in other counties. This paper has attempted to model and quantify some of the factors that have differentiated counties in Central Indiana, both economically and educationally. Following Borland and Howsen (1996) I construct a two-equation model of per-capita income and student performance on the ISTEP exam. The argument that there is a simultaneous relationship between income and ISTEP is supported by the positive and significant coefficients in each equation. Strong local economies foster strong students and strong students contribute to a stronger local economy. This circular relationship may provide support for arguments that the rich keep getting richer and provide justification for fundamental changes in policy so that relatively poorer counties may break the cycle. The results of this paper also indicate that the citizens of counties in which relatively larger proportions of high school seniors are attempting to pursue higher education are enjoying higher incomes. And while citizens of more urban counties are enjoying higher per-capita incomes, the students in those counties are not performing well on the ISTEP. This factor may be an indication that school districts in more urban counties may have fallen behind more rural counties during the 1990s. Two findings with possible policy implications are that smaller classrooms and higher-paid teachers do not significantly increase student performance on ISTEP exams. This is not to say that spending public funds in these two areas is wasteful, it just may not show up in exam scores.

Variable	**Real per-capita Income**	**Total Battery ISTEP score**
Intercept	-1414.36 (-.583)	-43.24 (-2.099)
Total Battery ISTEP score (ISTEP)	202.44 (5.751)	
Unemployment Rate (urate)	-281.06 (-7.563)	
Ratio of Manufacturing jobs (manuf_ratio)	586.09 (.671)	
Percentage of seniors intending to pursue higher education (college_attend)	52.16 (5.849)	
Dummy variable for counties in MSA's (msa)	1343.13 (8.308)	-.44 (-2.026)
Real per-capita Income (Realy)		.0005 (7.817)
Cognitive Skills Test (cogskill)		.713 (22.720)
Attendance Rate (attend_rate)		26.81 (1.367)
Real Average Teacher Salary (teach_sals)		-.0002 (-.945)
Pupil to Teacher Ratio (pupil_ratio)		.044 (.660)

Table 3: Estimated 2SLS Coefficients

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