Why Have Some Pennsylvania Counties Grown Fast and Others Slowly?

by

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Abstract

A substantial number of variables are partially correlated with the growth of Pennsylvania county per capita income in at least one regression. The problem is that variable x_1 is significant when the regression includes variables x_2 and x_3 but becomes insignificant when x_4 rather than x_3 is included. This paper adopts the methodology of Sala-i-Martin (1997a; 1997b) to identify which of 22 variables are strongly correlated with county growth rates by examining the whole distribution of the estimates of the coefficient of variable x_i. A small number of variables are found to be strongly correlated with county economic growth.

I. Introduction

Many variables are potentially correlated with local area economic growth. A typical study like that of Carlino and Mills (1987), Mills and Price (1984), or Steinnes (1977) regresses a set of variables such as taxes, crime, natural amenities, and highway density on some measure of growth. The problem is that often variable x_1 is significant when the regression includes variables x_2 and x_3 but becomes insignificant when x_4 rather than x_3 is included and economic theory is not specific enough about which variables belong in the regression. Sala-i-Martin (1997a, 1997b) suggests examining the entire distribution of the estimates of the coefficient of variable x_i in order to determine which variables are strongly correlated with economic growth. I adopt his methodology to explore the correlates of county-level economic growth in Pennsylvania.

II. Methodology

Sala-i-Martin's (1997a, 1997b) method looks at the entire distribution of the estimators of β_z to decide whether variable z is robustly correlated with growth.

> "In particular, one might be interested in the fraction of the density function lying on each side of zero: if 95 percent of the density function for β_1 lies to the right of zero and only 52 percent of the density function for β_2 lies to the right of zero, one will probably think of variable 1 as being more likely to be correlated with growth than variable 2" (Sala-i-Martin 1997a, p. 179).

I estimate regressions of the form:

$$Y = \alpha_i + \beta_{zi} z + \beta_{xi} X_i + \varepsilon \qquad (1)$$

where Y is a measure of economic growth, z is the variable of interest, and X_i is a vector of three variables taken from the pool of N variables thought to be related to county growth. This

regression is estimated for all the M possible combinations of X_i. For each regression, an estimate of β_{zi} and a corresponding standard deviation, σ_{zi}, is obtained. I also calculate the likelihood function, L_i, for each regression.

If the estimates of β_z are normally distributed its mean and standard deviation determine the cumulative density function. The mean estimates of β_z and σ_z are weighted averages of the individual point estimates:

$$\beta_z = \Sigma\omega_{zi}\beta_{zi} \text{ and } \sigma_z = \Sigma\omega_{zi}\sigma_{zi}. \quad (2)$$

The weights are designed to give greater weight to those regressions that are more likely to be "right" and are calculated by

$$\omega_{zi} = L_i/\Sigma L_i, \quad (3)$$

regression i's proportion of the sum of the likelihood functions of the M regressions for variable z.

If the estimates of β_z are not normally distributed, the aggregate cumulative density function is the weighted average of the individual cumulative density functions for each of the M regressions, where the weights are given by equation (3). I also compute the aggregate cumulative density function using an unweighted average of all the regressions.

III. Data

I want to explain the growth of county income per capita in Pennsylvania between 1970 and 1996. The appropriate income measure is not available: a county-level version of gross domestic product. Personal income data is available on a county basis. But use of personal income is problematic if people work in one county and live in another or if people tend to own capital in other counties because the personal income accounts reported by the Bureau of

Economic Analysis assign income to the county in which the owner of the inputs resides not to the county in which the income was earned. Also, the personal income measure includes transfer payments. So, personal income is not a good measure of county economic activity because it includes both unearned income and income earned outside the county.

I use "total earnings by place of work" as the measure of county income because it attributes income to the county in which it was earned. Total earnings includes wages and salaries, other labor income, contributions for social insurance, and proprietors' income. It excludes dividends, interest, rent, and transfer payments. I divide total earnings by total population for each county. Data for total earnings and population are taken from the Regional Economic Information System web page.[1] The dependent variable is the difference in the log of real total earnings per capita for 1996 and 1970. Table 1 provides the average annual rate of real per capita total earnings growth for Pennsylvania counties over the study period.

I calculate the aggregate cumulative density function for 22 variables.

(a) Political Variables: fraction of the total number of voters registered Democratic, total number of municipalities levying taxes per square mile of county land area, and total taxes collected by the county government as a percentage of total earnings .

(b) Economic Variables: log of 1970 real total earnings per capita, fraction of total earnings invested in manufacturing capital goods, agricultural income as a percentage of total earnings, fraction of total employment in manufacturing, manufacturing exports divided by total earnings, highway density, and bank deposits as a percentage of personal income.

(c) Location Variables: distance from the county seat to Philadelphia and distance from the county seat to Pittsburgh.

[1] <http://fisher.lib.virginia.edu/reis>

(d) Demographic Variables: population growth rate, percent of total year-round housing renter occupied, population density, percent urban population, liquor sales per capita, and public assistance expenditures as a percentage of total earnings.

(e) Human Capital Variables: proportion of the county population of persons 25 years and over with a bachelor's degree or higher and per pupil public school expenditures.

(f) Scale Variables: land area in square miles and total employment in 1970.

If income growth influences the independent variables, then estimates of equation (1) using OLS are potentially inconsistent. To reduce the simultaneity problem, I take the values of the explanatory variables from the beginning of the sample period, 1970. The sources of the independent variables are the 1971 and 1973 *Pennsylvania Statistical Abstract*.

Each regression contains four independent variables: the variable of interest and all the possible groups of three of the other 21 independent variables. 1330 regressions were run for each variable.

IV. Results

Table 2 reports the main results from the regressions. Only one variable, the fraction of adults with college degree, is significantly different from zero at the 0.05 level in all regressions. Several variables were not significant in any regression. The correlation between the column reporting the cumulative density function under the assumption that the distribution of the estimates of β_z is normal and the column reporting the CDF assuming non-normality is 0.986, indicating that the density function of the estimates of β_z is nearly normal.

Focusing on the weighted non-normal CDF's and taking 0.95 as the usual level of significance, three variables can be described as strongly correlated with county-level growth in

Pennsylvania: the fraction of adults with a college degree (positively related to growth), the growth rate of county population (negatively related to growth), and the fraction of total earnings in agriculture (positively related to growth). Two additional variables have a CDF greater than 0.90 and may be considered weakly correlated with county-level growth: the fraction of voters registered Democratic (negatively related to growth) and the percentage of the county population living in urban areas (positively related to growth).

The college education, a proxy for human capital, and population growth variables have a standard neoclassical growth model interpretation. I am not sure how to explain the strong correlation between agriculture and growth as it seems to contradict the finding that urban counties grew relatively rapidly. Manufacturing, on the other hand, did not contribute positively to county growth. Nor can I offer an adequate explanation of why having a largely Democratic electorate was bad for growth.

V. Conclusions

A county in Pennsylvania has probably grown rapidly since 1970 if

- it had a college educated work force
- agriculture was a large share of total earnings
- its population was largely urban

Since 1970, a Pennsylvania county probably grew slowly, if at all, if

- its population grew relatively rapidly
- voters were mostly registered Democrats

Table 1 – Average Annual Growth Rate of Total Earnings per Capita of Pennsylvania Counties, 1970-1996

	Average Annual Growth Rate of Total Earnings per Capita
Fulton	2.73%
Cumberland	2.29%
Montour	2.13%
Chester	2.09%
Montgomery	2.03%
Potter	1.89%
Delaware	1.84%
Bucks	1.60%
Lehigh	1.57%
Centre	1.55%
Somerset	1.47%
Allegheny	1.38%
Union	1.26%
Dauphin	1.26%
Elk	1.21%
Lackawanna	1.14%
Bradford	1.08%
Indiana	1.07%
Luzerne	1.00%
Clearfield	0.93%
Berks	0.92%
Tioga	0.74%
Washington	0.74%
Lancaster	0.70%
Blair	0.70%
Bedford	0.68%
Sullivan	0.68%
Juniata	0.67%
McKean	0.66%
Butler	0.63%
Westmoreland	0.62%
Erie	0.61%
Adams	0.55%
Clarion	0.51%
Fayette	0.51%
Schuykill	0.46%
Snyder	0.44%
Jefferson	0.44%
Lawrence	0.43%
Philadelphia	0.41%
Crawford	0.40%
Lycoming	0.38%
Columbia	0.33%
Warren	0.33%
Armstrong	0.26%
Greene	0.22%
Huntingdon	0.20%
Wyoming	0.20%

	Average Annual Growth Rate of Total Earnings per Capita
Perry	0.16%
Cambria	0.14%
Clinton	0.13%
York	0.12%
Susquehanna	-0.05%
Northumberland	-0.07%
Mifflin	-0.11%
Lebanon	-0.12%
Cameron	-0.17%
Mercer	-0.17%
Wayne	-0.21%
Beaver	-0.69%
Northampton	-0.82%
Monroe	-1.08%
Pike	-1.23%

Table 2 – Main Results from Regressions

variable	fraction significant	coefficient	standard deviation	CDF normal	CDF non-normal (weighted)	CDF non-normal (not weighted)
fraction of adults with college degree	100.00%	3.2442	0.6911	0.9999	0.9999	0.9970
population growth rate	22.93%	-7.5749	2.2884	0.9984	0.9966	0.8163
fraction of total earnings in agriculture	28.80%	912.78	277.73	0.9983	0.9964	0.8500
fraction of voters registered Democratic	31.28%	-0.0579	0.0307	0.9360	0.9302	0.9264
percent urban population	33.38%	0.2646	0.1190	0.9702	0.9224	0.7876
distance from Philadelphia	17.67%	-0.0003	0.0002	0.8309	0.8122	0.7269
share of income in manufacturing exports	0.00%	-0.3220	0.2572	0.7847	0.7819	0.6071
log 1970 total earnings per capita	4.96%	-0.1706	0.1079	0.8811	0.7676	0.5385
manufacturing employment share	6.84%	-0.2429	0.2256	0.7142	0.6742	0.6898
deposits as a percentage of personal income	13.68%	-0.2017	0.1906	0.7059	0.6357	0.7623
municipality density	31.65%	0.5798	0.6391	0.6322	0.5973	0.8555
new capital investment rate	0.00%	-0.4324	0.5374	0.5759	0.5712	0.4389
public assistance as a fraction of earnings	0.00%	570585	677044	0.5974	0.5486	0.4179
distance from Pittsburgh	6.09%	-0.0002	0.0003	0.5623	0.4980	0.3821
liquor sales per capita	1.35%	-0.0019	0.0024	0.5684	0.4711	0.4638
total employment in 1970	9.47%	0.0000	0.0000	0.3747	0.3558	0.6317
population density	2.48%	-0.0000	0.0000	0.2340	0.2828	0.4883
percent of housing renter occupied	7.67%	0.1096	0.5183	0.1668	0.2776	0.6987
highway density	7.22%	0.0029	0.0103	0.2208	0.2641	0.5448
local government tax revenue	0.00%	1.1754	9.2056	0.1012	0.1190	0.3280
public school expenditures per pupil	9.85%	0.0000	0.0003	0.0266	0.1773	0.7545
land area	0.00%	0.0000	0.0000	0.0809	0.1550	0.4803

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