NEW EVIDENCE ON PENNSYLVANIA COUNTY INCOME CONVERGENCE

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ABSTRACT

I analyze convergence of per capita personal income across the Pennsylvania counties for the period 1969 to 2017. I find no evidence that county income has converged over that period. I use two standard metrics to evaluate convergence: (1) σ-convergence, a reduction over time in the variance of county per capita income and (2) β-convergence, the idea that poor counties grow faster than rich counties. Pennsylvania has seen σ-divergence as the variance of county per capita income is greater in 2017 than in 1969. β-convergence appears in the data beginning in 2004, but disappears several years later. This possible convergence may be due to natural gas fracking as several of the fastest growing counties since 2004 are major sites of Marcellus Shale drilling.

INTRODUCTION

The consensus at the turn of the century was that regional incomes were converging, with poor areas experiencing faster rates of economic growth than wealthier areas. The growth literature found consistent evidence of income convergence among economies that had similar human capital, savings, and governance characteristics. Both Dowrick and Nguyen (1989) and Mankiw, Romer, and Weil (1992) found that there was a significant tendency towards convergence of per capita income among a cross-section of OECD countries and Michelis and Neaime (2004) uncovered weak evidence of the same for East Asia. Latin American economies also exhibited income convergence (Galvao and Gomes 2007). Barro and Sala-i-Martin (1991) presented evidence of convergence across U.S. states. Austin and Schmidt (1998) demonstrated that per capita income growth of the counties of the Great Plains states was negatively related to initial year income, while Latzko (2002) showed, controlling for county demographic and economic characteristics, that low-income Pennsylvania counties had grown faster than high-income counties.

Interest in regional income convergence has reemerged in recent years as the narrative that poor regions were rapidly catching up has been confronted by evidence that regional income convergence has slowed or even reversed in the United States across cities (Berry and Glaeser 2005), counties (Higgins, Levy, and Young 2006), and states and
regions (Breuer, Hauk and McDermott 2014, Ganong and Shoag 2017; Austin, Glaeser, and Summers 2018; Patel, Sandefur, and Subramian 2018). Similar findings of a slowdown in regional income convergence have been found for Africa (Ben Hammouda, Karingi, Njuguna, and Sadni Jallab 2009), Asia (Haider, Hameed, and Wajid 2010), Europe (Ezcurra 2019; Iammarino, Rodriguez-Pose, and Storper 2019), and Latin America (Martin and Vasquez 2015).

The purpose of this paper is to investigate the pattern of income convergence or divergence among Pennsylvania counties over the last almost fifty years in order to determine whether Pennsylvania has experienced a similar change in the geographic distribution of its economic growth.

There are two kinds of convergence implied by the Solow growth model. The first is $\sigma$-convergence: the variance or any measure of dispersion of income per capita across a group of economies falls. $\sigma$-convergence means that the income gap between rich and poor entities gets smaller over time so that the distribution of income across economies becomes more equitable. The second type of convergence is $\beta$-convergence, which occurs if the growth rate of income per capita is negatively related to the initial level of per capita income. $\beta$-convergence implies that poor economies grow faster than rich economies. $\beta$-convergence is necessary but not sufficient for $\sigma$-convergence to occur so $\sigma$-convergence need not accompany $\beta$-convergence (Young, Higgins, and Levy 2008; Vollrath 2018).

I use county level data from the U. S. Bureau of Economic Analysis (BEA) to study income growth in Pennsylvania from 1969 to 2017 (U.S. Bureau of Economic Analysis 2003 and 2018). The data set includes 48 observations of personal income per capita for each of the 67 counties in Pennsylvania. The BEA definition of “personal income” is the income that people get from wages, proprietors’ income (with inventory valuation and capital consumption adjustments), dividends, interest, rental income (with capital consumption adjustments), and government benefits including social security. Per capita personal income is total personal income divided by total midyear population using population estimates from the U.S. Census Bureau. I express personal income per capita in 2017 dollars using the CPI-U. I then evaluate real per capita income levels as natural logs.

SIGMA CONVERGENCE

Table 1 reports the cross-sectional variances of the natural log of personal income per capita across Pennsylvania counties for 1969 and 2017. The 2017 variance (0.0337) is 56 percent greater than that of 1969 (0.0216). For Pennsylvania, $\sigma$-divergence has occurred since 1969. If the income distributions are not unimodal, then the variance is not a useful measure of dispersion. However, as Figure 1 demonstrates, for Pennsylvania county-level data the distribution of income is unimodal for both 1969 and 2017. Figure 1 also allows one to visually confirm that $\sigma$-convergence is not present.

I also report in Table 1 the Gini coefficient associated with Pennsylvania counties’ 1969 and 2017 log per capita incomes: 0.0080 and 0.0085, respectively, an increase of almost 6 percent. Recall that the Gini coefficient takes a value between 0 (perfect equality) and 1 (perfect inequality). The changes in the variance and the Gini coefficient are large enough to suggest that both the dispersion and inequality of county income in Pennsylvania have increased over the last five decades.

To try to understand further the evolution of the Pennsylvania county-level income distribution, Table 1 summarizes two additional statistics computed from the 1969 and 2017 income distributions: skewness and kurtosis. From 1969 to 2017, the skewness of the distribution decreased from 0.8301 to 0.3417. At the same time, kurtosis increased.
from 4.1750 to 7.0750, implying that the distribution became more tail heavy with a higher frequency of values at the extreme ends of the distribution curve. This combination of a more symmetric distribution with heavier tails can account for the observed increase in the variance and inequality in the distribution of county incomes.

Figure 2 plots the annual cross-sectional variances of the natural log of personal income per capita of Pennsylvania counties for each year between 1969 and 2017. The variance fell over the 1970’s before nearly doubling during the 1980’s. The variance then fell during the early 1990’s and rose again from the mid-1990’s until the turn of the century. Since then, the variance of per capita income has been very volatile, but generally increasing, from year to year. The variance in 2017 was the fourth highest in the sample and the seven largest variances in county income in the last 48 years have all occurred since 2004.

**BETA CONVERGENCE**

The unconditional $\beta$-convergence relationship estimate I estimate looks like

$$(\ln y_t - \ln y_0)/t = \alpha + \beta \ln y_0.$$  

The left-hand side is the growth rate of personal income per capita, $y$, from some initial year 0 to year t. On the right, $\alpha$ is some baseline growth rate common to all counties. The independent variable is the initial level of county personal income per capita, $y_0$. $\beta$ measures the strength of the relationship between the growth rate and the initial level of income. A $\beta$ less than zero means that rate of growth of income becomes smaller as the initial level of income is higher.

Figure 3 is a scatterplot of the rate of per capita income growth and the initial level of income per capita for each Pennsylvania county for the entire period for which data is available, 1969 to 2017. The plot also includes a regression line. The regression line is downward sloping, implying a negative relationship between county income growth and initial income. Table 2 reports the results of an estimation of equation (1) to gauge the strength of that relationship. The coefficient on initial income is not statistically significant, indicating that low income counties have not grown faster on average than high income counties since 1969.

Figure 4 investigates whether there has been any change during the last 48 years in the relationship between county income growth and initial income. Each point represents the coefficient for the log of initial county income per capita from a separate regression of equation (1) along with its 95 percent confidence interval. The dependent variable is the average annual growth rate of county personal income per capita from the year listed to 2017. The independent variable is the log of per capita income in the base year. In samples up to the 2000’s $\beta$ is essentially zero, which means no income convergence. Only in the mid-2000’s do any of the coefficients become significantly negative and in recent years several of the coefficients are significantly positive.

A hint of a possible explanation for this sudden change in the relationship between income growth and initial income can be seen in Figure 5. Figure 5 plots the average annual rate of per capita income growth between 2004 and 2017 against county income per capita in 2004. Aside from, most obviously, Philadelphia, which has seen the fastest income growth since 2004, several of the counties that had high per capita income growth rates, Greene, Sullivan, Butler, Washington, and Tioga Counties, are among the leading Marcellus Shale natural gas producers in the state. In fact, of the six counties with the highest number of Marcellus Shale gas wells (Washington, Bradford, Susquehanna, Tioga,
Greene, and Lycoming), all but Lycoming County experienced above-average per capita income growth rates between 2004 and 2017.\textsuperscript{3}

The first unconventional well was drilled in 2003 by Range Resources-Appalachia in Mount Pleasant Township, Washington County (Harper 2008). Use of hydraulic fracking led to the well producing gas in 2005. Three other unconventional wells were drilled in 2003. Figure 6 shows the number of unconventional wells drilled in Pennsylvania between 2003 and 2017. Until 2011, unconventional wells were only drilled into the Marcellus Shale. Starting in 2012, some wells began targeting the Utica Shale in western Pennsylvania. Drilling activity rose rapidly and peaked in 2011 when the price of natural gas fell rapidly, which was also when high-income counties began to grow faster on average than low-income counties across the state.

The second column of Table 2 reports the results of a regression of the rate of per capita income growth between 2004 and 2017 on the income per capita in 2004 for each Pennsylvania county. The coefficient on initial income, $\beta = -0.0116$, is significantly less than zero at the 0.05 level. The estimated $\beta$ can be used to estimate how long it will take a poor county to close the gap with a rich county. In 2017, personal income per capita in Tioga County, $39,202$, was about 51 percent of that of Chester County, which had the highest per capita income of all Pennsylvania counties, $77,465$. If the trend for 2004 to 2017 continues, it will take about 73 years for personal income per capita in Tioga County to go from about half that of Chester County to 90 percent of per capita income in Chester County.

CONCLUSION

There is no evidence that personal income per capita has converged across Pennsylvania counties since 1969. The variance in county income has risen ($\sigma$-divergence) and low-income counties have not grown significantly faster on average than high-income counties. For the period since 2004 when drilling for natural gas had just begun into the Marcellus Shale, low-income counties have experienced faster rates of income growth ($\beta$-convergence) but income variance still increased from 0.0334 in 2004 to 0.0337 in 2017. A plausible explanation for this recent combination of $\beta$-convergence and $\sigma$-divergence is that Marcellus Shale fracking impacted a small number of counties in a very large way.

ENDNOTES

1 The big time income divergence among dissimilar rich and poor countries (Pritchett 1997) still remains intact when looking at data over the past 50 years (Johnson and Papageorgiou forthcoming).
2 The figures in the paper were prepared using Wickham (2016).
3 See the Office of the State Fire Commissioner for a map of Marcellus Shale gas wells in Pennsylvania by county: https://www.osfc.pa.gov/SiteCollectionDocuments/Marcellus%20Shale%20Gas%20Well%20Activity%20by%20County.pdf
REFERENCES


https://www.cgdev.org/blog/everything-you-know-about-cross-country-convergence-now-wrong.


Figure 1. Distribution of Pennsylvania County Log Per Capita Incomes, 1969 versus 2017
Figure 2. Annual Cross-Sectional Variances of Log Income Per Capita for Pennsylvania Counties, 1969-2017
Figure 3. Average Annual Per Capita Income Growth and Initial Income for Pennsylvania Counties, 1969-2017
Figure 4. β-Coefficients of Unconditional Convergence
Figure 5. Average Annual Per Capita Income Growth and Initial Income for Pennsylvania Counties, 2004-2017
Figure 6. Number of Unconventional Wells Drilled in Pennsylvania by Calendar Year, 2003-2017

Table 1. Summary Statistics for Distribution of County Log Per Capita Incomes, 1969 and 2017

<table>
<thead>
<tr>
<th></th>
<th>1969 Per Capita Income</th>
<th>2017 Per Capita Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variance</td>
<td>0.0216</td>
<td>0.0337</td>
</tr>
<tr>
<td>Gini Coefficient</td>
<td>0.0080</td>
<td>0.0085</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.8301</td>
<td>0.3417</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>4.1750</td>
<td>7.0750</td>
</tr>
</tbody>
</table>

Table 2. Estimates of β-Convergence

<table>
<thead>
<tr>
<th></th>
<th>1969 to 2017</th>
<th>2004 to 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Income (β)</td>
<td>-0.0017</td>
<td>-0.0116</td>
</tr>
<tr>
<td></td>
<td>(0.0022)</td>
<td>(0.0051)</td>
</tr>
<tr>
<td>Constant (α)</td>
<td>0.0312</td>
<td>0.1333</td>
</tr>
<tr>
<td></td>
<td>(0.0221)</td>
<td>(0.0506)</td>
</tr>
<tr>
<td>Observations</td>
<td>67</td>
<td>67</td>
</tr>
<tr>
<td>Adjusted R-Squared</td>
<td>-0.0059</td>
<td>0.0591</td>
</tr>
</tbody>
</table>

Notes: Standard errors in parentheses.