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ECONOMIC CONVERGENCE: EVIDENCE FROM COUNTIES IN THE CAROLINAS

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Abstract

This paper applies a common empirical methodology in testing for convergence of per capita incomes across the counties in North and South Carolina. Decennial census data on per capita income for the 46 counties of South Carolina and the 100 counties of North Carolina are used to test for two types of income convergence over the 1959-2010 time span. The results indicate that both beta and sigma convergence occurred across the counties for the full period, but there were sub-periods (the 1980s, and the 2000s) over which neither measure of convergence was evident. In fact, measured by the beta method, there was statistically significant divergence of per capita incomes across both North and South Carolina counties in the decade of the 1980s. In general, there was great similarity in convergence measured by either method across the counties in these two states.

Introduction

Modern growth theory, based on neoclassical models introduced by Ramsey (1928), Solow (1956), and Swan (1956), has lent itself in recent years to wide application in empirical estimations that often confirm the convergence in per capita incomes across regions or nations predicted by the models. Put simply, the neoclassical models predict that poorer regions would grow more rapidly than richer ones—thus closing the income gaps between the rich and poor. This sort of convergence is known as beta (β) convergence.

A second measure of convergence, known as sigma (σ) simply looks at the dispersion of per capita income over time by economic unit—here by county.

This paper presents evidence for absolute β-convergence and σ-convergence of incomes across counties in North and South Carolina. The remainder of the paper is organized as follows: the literature on convergence is reviewed in the immediately following section; that section is followed by a description of the methodology for such tests; the data set employed is described next; the results of the convergence tests follow; and our conclusions comprise the final section.

Literature review

As stated in the introduction, the neoclassical models introduced by Ramsey (1926), and refined by Solow (1956), and Swan (1956) provide the basis for empirical estimations that frequently confirm the convergence in per capita incomes predicted by the models. The type of convergence that the Solow-Swan neoclassical models suggest is *conditional* beta (β) convergence. The convergence is conditional because the models assume the same technology, the same population growth rate, and the same savings rate for all of the economies in the sample. Convergence is *absolute* if poorer regions grow more rapidly than richer ones regardless of their initial conditions (other than lower incomes). The model implies that per capita income will have a tendency to converge across nations and regions within nations. The lower the initial level of real per capita income relative to the long run or steady-state level, the faster will be the growth rate. That result suggests that regions with lower initial income per capita will eventually close the gap between themselves and those regions with greater initial income per capita. The convergence is ultimately a product of diminishing returns to capital, as economies with less initial capital per worker relative to their steady state equilibrium will have greater returns and higher growth rates.

In original formulations these growth models assume that the level of capital (and labor) productivity are constant over time and that economies would reach a steady-state in which per capita income would remain constant. However modifications by Hicks, Harrod, and Solow allow for technology to improve over time, so that diminishing returns do not result in constant per capita incomes in the steady-state. Hicks defined technological innovation as neutral if the ratio of marginal products remained unchanged for a given capital/output ratio. Harrod and Solow define technological innovation as neutral if the relative input shares of capital and labor remain constant for a given labor/output ratio. As long as the technological innovation is neutral, the assumptions of the Solow-Swan neoclassical models are not violated.

Early research on absolute convergence by Baumol (1986) found evidence of *absolute β*-convergence across a sample of 16 OECD countries. When the sample was extended to 72 countries, absolute convergence did not exist for this larger sample. Generally, research has suggested that similar economies show evidence of convergence, but larger samples of more diverse economies do not. The absence of absolute convergence among large samples of nations is possibly because dissimilar nations were converging on different steady-states. The convergence among similar economies became known as "convergence clubs." These results led researchers in two directions. In one research path researchers attempted to control for difference in basic characteristics such as human capital, health, government types, and fertility. This is *conditional β*-convergence. Another path led researchers to consider regional economies within larger economies. Examples included states within the United States, prefectures in Japan, and regions within Europe. Generally, these results confirmed absolute β-convergence. Further when the regional data sets were augmented with control variables, the estimates of β did not change substantially (Sala-i-Martin (1996b), p. 1330).

Research by Dan Ben-Davi (1996) suggests that groups of economies that engage in substantial intra-regional trade will experience greater convergence than groups of economies that do not trade substantially. Counties and independent cities in the same state are likely to be substantial trading partners. As a result, greater convergence might be anticipated among counties in the same states than between different states or countries.

Barro and Sala-i-Martin (1991) apply β and σ convergence methods to study the rate of convergence and the reduction of dispersion in per capita incomes across states and regions in the U.S. Their research applies conditional convergence to control for migration and government investment. Again, the control factors seem to have little effect because the states are deemed to have similar characteristics.

In his research, Sala-i-Martin (1996b, p. 1326) concludes that "Economies converge at a speed of about two percent per year." This conclusion was offered as the "mnemonic rule" of economic growth empirics. Results in line with this rule were first reported by Barro and Sala-i-Martin (1991) and by Mankiw, Romer, and Weil (1992).

Previous research by Pfitzner and Lang (2006) confirmed the Solow-Swan neoclassical model's predictions for regions in Virginia. They found that per capita incomes converged over time across counties in Virginia for the 1959-1999 period. The initially poorer counties grew faster (β-convergence) than the initial richer counties in their research. The dispersion of per capita income between counties and cities in Virginia also decreased over time (σ convergence.)

Higgins, Levy, and Young (2006, 2008) have studied convergence for all counties in the US for the period 1970-1999. Their data are annual from the Bureau of Economic Analysis Regional Economic Information System (BEA-REIS). The data employed in this research differ—the time frame covers a period that is twice that length (though with fewer data points) and is collected from the Census Bureau. Interestingly, Higgins, Levy, and Young find evidence of conditional β-convergence alongside evidence of sigma *divergence*. These authors (and others—see Sala-i-Martin, [1996b], pp. 1329-1330) show that *absolute* β-convergence is a necessary, but not sufficient, condition for σ-convergence. Thus, though the concepts are related, it is entirely possible to find beta convergence and fail to find convergence based on the sigma version of dispersion.

The methods pioneered by Baumol, Barro and Sala-i-Martin have been subject to some lively debate in the literature on growth. Criticism of the method of β-convergence described above has proceeded along several lines. Friedman (1992) and Quah (1993) argue that the method is plagued by Galton's fallacy. Friedman's critique is generally interpreted as arguing that a negative relationship between growth and initial income is plagued by a Galton fallacy effect. That is, economies that experience faster than average growth in some periods can be expected to regress to the mean. Galton found that taller than average fathers had taller than average sons but the sons were not as tall, on average, as the fathers. That is, the sons regressed to the mean.

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Galton's fallacy[1] was to conclude that the regression to the mean would result in a fall in dispersion (σ) as heights would eventually regress to some level of mediocrity. Of course the dispersion in heights does not decrease over time. As Bliss (1999) has pointed out, however, Barro and others who test for beta convergence did not purposely choose some subset of rapidly growing countries and find their growth rates subsequently to be lower. Quah (1997) has also suggested that the values of β in these tests of convergence *could* be consistent with unit roots in the time series. Quah and Friedman, in their separate works, further suggest that the problems with beta convergence are such that research should focus on the sigma (σ) aspect of convergence.

Sala-i-Martin (1996a, 1996b, and 2002) has provided a formidable defense of the methods Barro and he pioneered. He argues that since beta convergence is a necessary but not sufficient condition for sigma convergence, beta methods provide information about sigma as would any necessary condition. β-convergence also provides information about the *mobility* of individual economies within some larger distribution of incomes, whereas sigma provides information as to whether or not the dispersion of income across economies is shrinking or not. Beta measures are useful as well in determining the length of time it takes poorer economies to close some portion of the gap between themselves and their richer counterparts. Finally, β analysis is also informative as a test of the neoclassical growth theory.

Methodology

The literature on convergence has generated two primary tests of convergence that produce implications for convergence in per capita incomes across nations or regions.

Beta Convergence

Empirical testing for what is known as β-convergence in per capita income across nations or regions often utilizes a form of a solution to the neoclassical growth model, popularized by Barro and Sala-i-Martin (1991, 1992), that allows the growth rate of per capita income between two points in time to be related to some initial level of income. That form may be represented as:

$$\log(y_{it} / y_{i,t-1}) = a - (1 - e^{-\beta}) \cdot \log(y_{i,t-1}) + \mu_{i,t}, \qquad (1)$$

where y represents per capita real GDP, t represents the time (year), i represents the nation or region and μ is the stochastic error term. The symbol log refers to natural logarithms and *e* is the base of the natural logs. The left-hand side of (1) is the growth in per capita income and the explanatory variable on the right-hand side is initial period per capita income. The coefficients *a*

[1] See Barro (1996, p. 11) for a clear statement of Galton's fallacy.

and β are estimated by non-linear least squares techniques. If β (the speed of convergence) is estimated to be positive (note the negative sign attached to β in the formula), convergence is implied—lower per capita income regions (here counties) grow faster than those regions with higher initial per capita incomes. A larger estimate of β represents faster convergence.

For time separated by years, equation (1) is modified as

$$(1/T)\cdot\log(y_{it}/y_{i,t-T}) = a - [(1-e^{-\beta T})/T]\cdot\log(y_{i,t-T}) + \mu_{i0,T}, \qquad (2)$$

where T = the length of the interval in years between initial income and its level at the end of the period, so that the left-hand side of (2) becomes an annualized growth rate. The estimate of β in this form is independent of the interval T.

Finally, for β-convergence, the estimate of β will be biased if there are shocks that affect certain subgroups within the regions in asymmetric ways. For example, an energy price shock could affect the coal mining regions in a different way than regions in which economic activity is oriented more toward service or manufacturing. If such influences are to be accounted for in the regressions, equation 2 is simply expanded to include other variables as follows:

$$(1/T)\cdot\log(y_{it}/y_{i,t-T}) = a - [(1-e^{-\beta T})/T]\cdot\log(y_{i,t-T}) + \theta_i OV_i + \mu_{i0,T}, \qquad (3)$$

where OV represents other variables. Such variables may include educational attainment levels, measures of asymmetric shocks, and other relevant variables.

Sigma Convergence

Sigma (σ) convergence is a simpler concept. Data on per capita income are collected as a time series for each of the nations or regions under analysis. Then the standard deviation of the log of per capita income is computed for each year across the regions. If this standard deviation declines over time, per capita incomes are less dispersed and σ convergence is implied.

Generally β-convergence implies σ-convergence, but the process may be offset by shocks that increase income dispersion. As emphasized above, β-convergence is a necessary, but not sufficient, condition for σ-convergence. It follows that the reverse does not hold; that is, it is possible to have sigma divergence accompanied by beta convergence (again, see Sala-i-Martin, 1996b).

Application to Counties IN THE Carolinas

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The data for this project were drawn from the U.S. census and consist of the per capita income by county from 1959 to 2010 at the census for 10 year intervals. For 1959 to 1989 the data were extracted from a single table (Census Table C3) from the U.S. Census (http://www.census.gov/hhes/www/income/data/historical/county/county3.html). That table presents data in 1989 (real) dollars. However, the data for 1999 and 2010 were acquired separately, but also from the Census Bureau, and were converted into 1989 dollars using the CPI-U version of the consumer price index. The data for 2010 are from the American Community Survey (ACS) for the 5-year period 2008-2012. The authors of these reports warn that these data reference that 5-year interval and do not represent a particular year, though the mid-point is 2010. These latter data are treated in this research as 2010 data. There exist data for the year 2009, which would preserve the 10-year interval precisely, but those data cover fewer than the full set of counties. The estimation formulae are modified easily to account for an 11 year interval.

The data were tested for evidence of sigma convergence over the 1959-2010 period. In addition, β-convergence was tested via regressions of the type described above and implemented as equation (2). Again, the technique for estimation of these regressions is non-linear least squares.

Results

In the following two subsections we present the results of the analysis of sigma convergence for this data set, followed by our findings for beta convergence.

Sigma Convergence for Counties in the Carolinas

Table I presents the results of the sigma computations for the 100 counties of North Carolina and the 46 counties of South Carolina. Generally, over the sample period, the data reflect some degree of sigma convergence, with most of the convergence taking place in the 1960s and 1970s. The reader may be struck (as we were) with the similarity of the measures of sigma, and the respective time paths, for these two states. In fact, the simple correlation for the measures across these two states is very strong (r = .977). For North Carolina sigma is estimated at 0.28 in 1959 and declined to 0.17 by 2010. The data also suggest that the dispersion in real per capita incomes increased in the 1980s and then fell slightly again in the 1990s only to increase again in the 2000s. The results for South Carolina follow, as suggested, a remarkably similar pattern. The measured *levels* of per capita incomes are similar as well.

Table I: Sigma Measures for North and South Carolina 1959 – 2010

State	# Counties	Sigma59	Sigma69	Sigma79	Sigma89	Sigma99	Sigma10
North	100	0.27700	0.19101	0.14723	0.17122	0.16059	0.16929

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Carolina							
South Carolina	46	0.26093	0.19267	0.15488	0.18820	0.17043	0.19296

Figure 1 contains the graphical representations of the sigma measures from Table I. The very close relationship between sigma measures for these two states is evident. It is also interesting to note that the pattern in Figure 1 for North and South Carolina counties is very similar to the pattern of income dispersion across states in the U.S. as computed by Sala-i-Martin (1996b). Further, Sala-i-Martin notes that sigma convergence within nations (for other nations as well as states within the US) stopped for about a decade approximating the 1980s. The same phenomenon appears to be present in the data for Carolina counties.

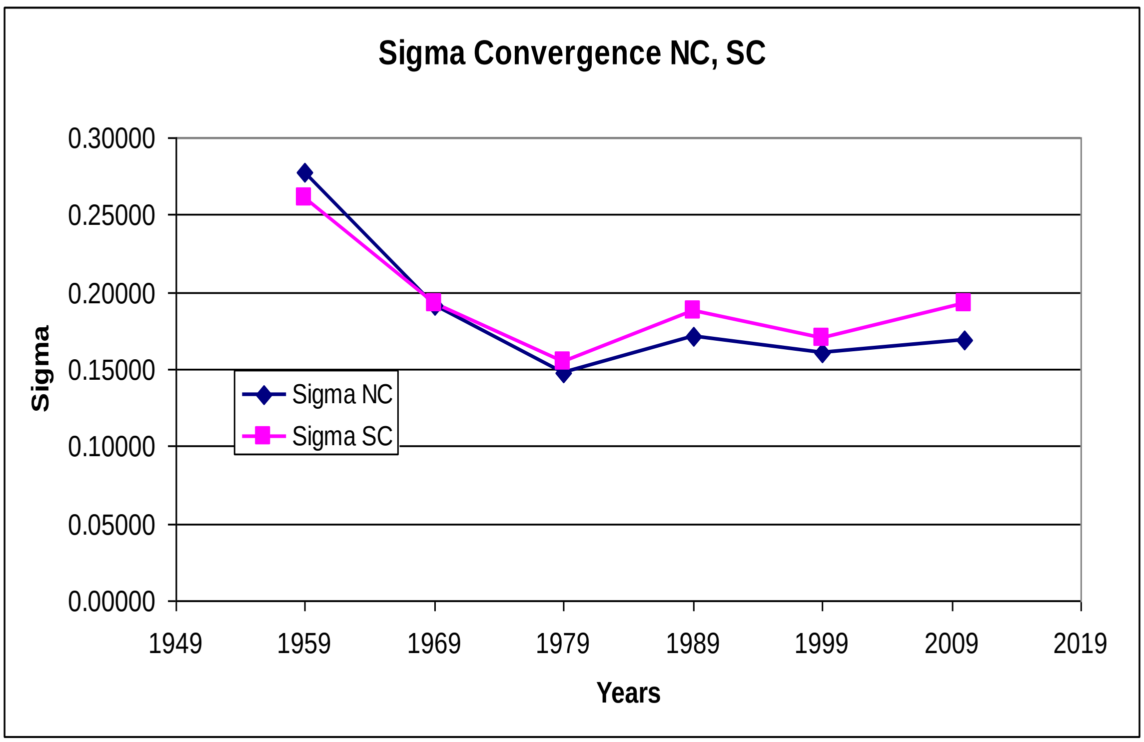

Figure 1: Dispersion of per capita income across North and South Carolina counties

Beta Convergence for North and South Carolina Counties

Table II contains the estimates of the regressions for North Carolina based on equation (2). Of crucial importance are the estimates of β, which represents the speed of convergence. The first row of results in the table shows the estimates for the full sample, 1959-2010. The estimate of β is correctly signed (consistent with convergence) and statistically significant, indicating beta convergence for the full sample period of about 2% per year. The overall explanatory power of the regression is reasonably impressive ($\bar{R}^2$ = 0.622). The second row of estimates covers the 1959-99 period, which shows convergence at a slightly faster rate. The 1959-99 evidence is presented because many economists would argue that the US, and therefore the counties of the Carolinas were not on the equilibrium growth path in the aftermath of the Great Recession.

We also present evidence for five 10-year sub-periods (the last is actually 11 years in length) in the last five rows of the table. The results for the sub-periods from 1959 to 1969 and 1969 to 1979 give the strongest evidence in favor of convergence and those results seem to dominate the other sub-periods for the full time frame. For North Carolina over the decade from 1979 to 1989, the sign of the β is negative, and also significantly different from zero. In other words, there was in the 1980s statistically significant *divergence* in per capita incomes across North Carolina counties (richer counties grew faster than poorer ones). For the 1990s, the estimate of β once more has the correct sign (for beta convergence) and is statistically significant. Finally, for the 1999-2010 period the estimated beta convergence is essentially zero. All of these results are consistent with the earlier evidence on sigma convergence.

Table II: Regression results, per capita income across NC Counties

Period	$\hat{\beta}$	$\bar{R}^2$	see
Full period 1959 – 2010	0.01929* (0.00256)	0.622	0.0026
Sub-period 1959 – 1999	0.02177* (0.00242)	0.674	0.0028
Sub-period 1959 – 1969	0.04210* (0.00325)	0.723	0.0059
Sub-period 1969 – 1979	0.03374* (0.00413)	0.486	0.0056
Sub-period 1979 – 1989	-0.00941* (0.00351)	0.053	0.0056
Sub-period 1989 – 1999	0.01405* (0.00410)	0.112	0.0061
Sub-period 1999 – 2010	0.00330 (0.00412)	0.000	0.0067

(Standard errors are in parentheses. * indicates statistically significant at $\alpha < .01$. All regressions include an unreported constant term. Note: see = standard error of the estimate, n = 46.)

Table III: Regression results, per capita income across SC Counties

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Period	$\hat{\beta}$	$\bar{R}^2$	see
Full period 1959 – 2010	0.01417* (0.00340)	0.447	0.0029
Sub-period 1959 – 1999	0.01972* (0.00389)	0.565	0.0031
Sub-period 1959 – 1969	0.033711* (0.00398)	0.690	0.0050
Sub-period 1969 – 1979	0.02959* (0.00617)	0.401	0.0059
Sub-period 1979 – 1989	-0.01493* (0.00466)	0.149	0.0056
Sub-period 1989 – 1999	0.01583* (0.00534)	0.171	0.0058
Sub-period 1999 – 2010	-0.00547 (0.00507)	0.002	0.0068

(Standard errors are in parentheses. * indicates statistical significance at $\alpha < .01$. All regressions include an unreported constant term. Note: see = standard error of the estimate, n = 46.)

Table III contains the corresponding estimates for South Carolina. Again, as was the case for the evidence on σ convergence, the estimates are very similar to those for North Carolina. For the 1959-2010 period and the 1959-1999 periods, the estimated rate of convergence is statistically significant and slightly slower than that for North Carolina counties. The first two decade long sub-periods, 1959-69 and 1969-79, saw relatively rapid convergence. Once again, significant divergence was evident for the 1990s, convergence reappeared in the 1990s, and convergence was absent from the most recent decade.

Considering the results for the full sample (or the 1959-99 period), the degree of convergence suggested is similar to that found in other studies. Sala-i-Martin (1996a) finds convergence for US states (from 1880 to 1990) to be on the order of 2% per year; these results suggest convergence of near 2.0% per year for counties in South and North Carolina over the period 1959 to 2010.

Figures 3 and 4 depict the visual evidence on the convergence suggested by the regressions for the full sample period.

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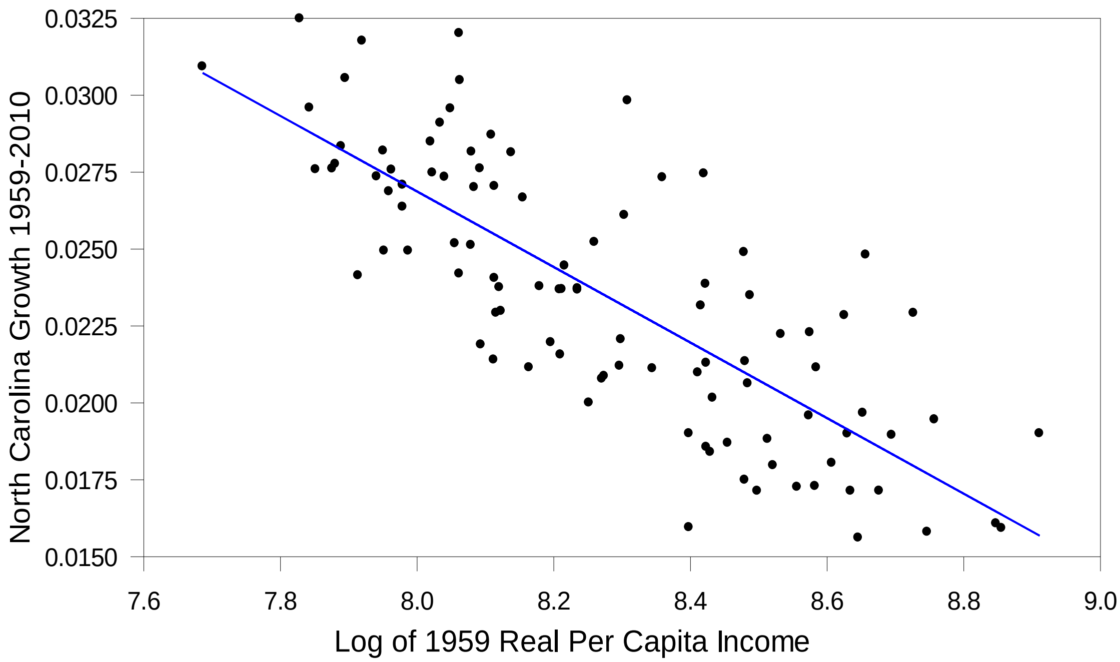

Figure 3: Beta convergence for North Carolina, full sample period

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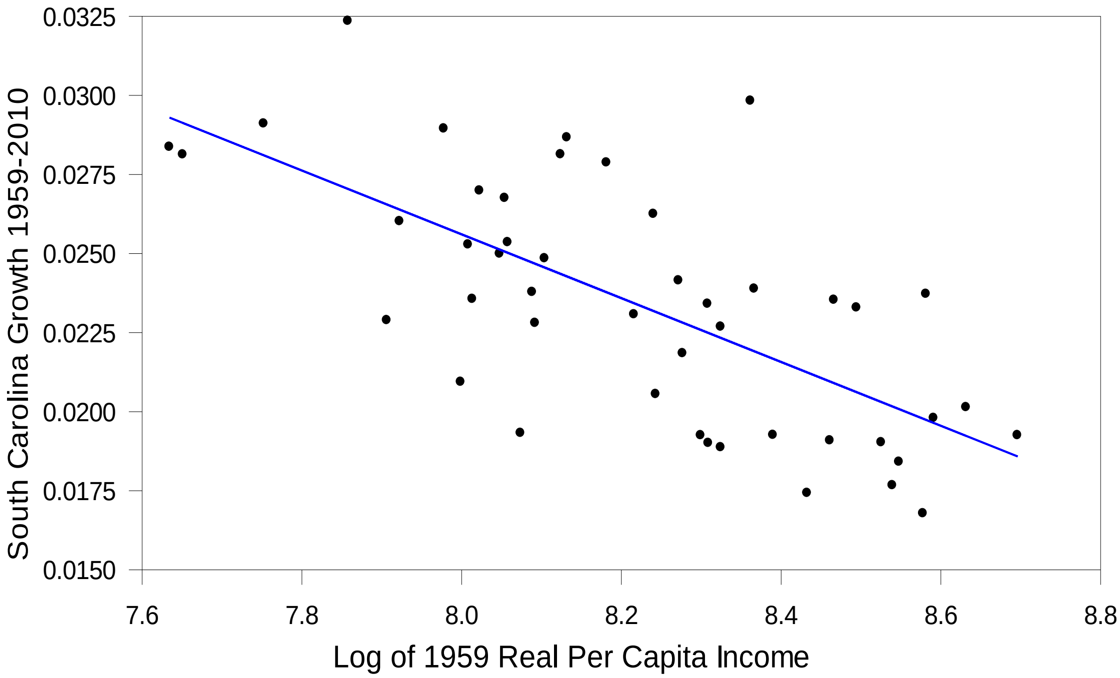

Figure 4: Beta convergence for South Carolina, full sample period

Half-lives

To give a practical interpretation rate of convergence, the half-life (the time it takes for one-half of the gap between incomes to be closed) is often presented. The rate of convergence is governed by the equation:

$$e^{-\beta T} = p\,, \tag{3}$$

where e, β, and T, are as defined above and p is the proportion of the gap between incomes to be eliminated. Setting p = ½ and solving for T (log is again the natural log), the half-life can be computed as:

$$T = \frac{\log(2)}{\beta} \tag{4}$$

The implied half-life based on the estimate of β for the full period is approximately 36 years for North Carolina. That is, it would take 36 years for one-half of the gap in incomes across counties to be eliminated if per capita incomes were to converge at 1.929% per year. If the 1959-99 period is more indicative of convergence (as we believe), the half-lives are approximately 32-35 years for counties in either of these two states.

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Some Additional Characteristics of the Carolinas

Given the similarities of the σ and β-convergence results from above for these states, we decided to investigate a few general characteristics of these two states that may help to explain why the measures of convergence evince such secular congruence. Some obvious common characteristics include the form of government, a shared border and ocean, similar climate, levels of technology, and significant tourism industries. The reader is cautioned that these data primarily reference state level data, not county level.

A common conditioning variable in β-convergence is human capital, with educational attainment serving as the usual proxy. Levels of educational attainment in North and South Carolina, which are displayed in Table IV, have been remarkably similar over time. In 1960, only 32.3% of North Carolina residents (age 25 and over) and 30.4% of South Carolinians held high school diplomas, compared to 41.1% for the U.S. overall. By 2010, those figures had grown to over 84% in both states and 85.7% nationally. The growth in the percentage of residents in both states who had earned bachelor's degrees was similar to the increase in the national rate from 7.7% in 1960 to 28.0% in 2010. In addition to the state level data in the table, using the "American FactFinder" tool from the Census Bureau we found measures of educational attainment at the county level. Importantly, the means and variances across counties in North and South Carolina were similar.

Table IV: Educational Attainment for North and South Carolina 1960-2010

	Percent of Total Population 25 Years and Over with a H.S. Diploma					
State	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**
North Carolina	32.3	38.5	54.8	70.0	78.1	84.5
South Carolina	30.4	37.8	53.7	68.3	76.3	84.0
	Percent of Total Population 25 Years and Over with a Bachelor's Degree					
State	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**
North Carolina	6.3	8.5	13.2	17.4	22.5	26.8
South Carolina	6.9	9.0	13.4	16.6	20.4	24.6

Source: United States Census Bureau

We also found broad similarities in the industry mix across the Carolinas. The industry compositions were very similar at the start of the period and they experienced similar changes

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over time. Manufacturing accounted for 38.8% of output in North Carolina and 33.1% of output in South Carolina in 1963. By 2010, the manufacturing shares of output had declined by roughly half to 19.2% and 16.3%, respectively. The agricultural share of output fell from 5.6% to 1.1% in North Carolina and from 4.8% to 0.6% in South Carolina during that same period. The service sector grew considerably in both states. Using the SIC (Standard Industrial Classification) system, output in the service sector doubled from roughly 8% of output in both states in 1963 to 16% by 1997. That pattern continued through 2010 as output in service-producing industries, using NAICS (North American Industrial Classification System) categories, rose from 54.1% to 61.6% of output in North Carolina and from 56.3% to 61.9% in South Carolina.[2]

Finally, we wondered whether the economic units (here considered to be counties) were of similar size. According to the 2010 Census, the mean population by county in North Carolina was approximately 95,000 versus 103,000 in South Carolina. The standard deviations were 142,000 for North Carolina and 112,000 for South Carolina (an F-test for equal variances could not be rejected at the 0.05 level of significance). Based on the 2010 data, the counties were of roughly equal size in terms of population and the dispersion by county did not differ greatly for the Carolinas, at least at the end of the period of analysis.

These cursory comparisons are not offered as proximate causes for the results of the σ and β similarities obtained above. However, these structural measures *may* have some relevance with respect to those statistical results.

Conclusions

Several conclusions based on the estimations in this project are warranted. First, for the full period, per-capita incomes converged across counties for both North and South Carolina. The convergence was evident irrespective of the measure of convergence (beta or sigma). Second, the measures of income inequality across counties as measured by sigma are remarkably similar for these two states, as are the time paths for 1959 – 2010 (such is not the case for other individual states in the US). Third, based on the sub-period analysis, incomes *diverged* during the 1979 – 1989 decade by either measure. Put in simple terms, income inequality increased across counties and richer counties grew significantly faster than poorer ones in North and South Carolina in the 1980s. Fourth, for the most recent reported sub-period, 1999 – 2010, income inequality as measured by sigma increased slightly across counties in both states and there was no evidence of beta convergence. Finally, the two measures of convergence are very consistent with one another for the sub-periods as well as the full period.

[2] Data from the Bureau of Economic Analysis.

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References

Ben-Davi, D. (1996). "Trade and convergence among countries," *Journal of International Economics*. < http://www.tau.ac.il/~danib/trade-growth/tradconv.pdf>

Barro, Robert. (1991). “Economic growth in a cross section of countries.” *The Quarterly Journal of Economics.* 106 (May). 407-443.

Barro, Robert. (1996). “Determinants of economic growth: a cross-country empirical study NBER *Working Paper 5698, National Bureau of Economic Research,* Cambridge, MA.

Barro, Robert and X. Sala-i-Martin. (1991). “Convergence across states and regions.” *Brooking Papers on Economic Activity*. 1. 107-182(a).

Barro, Robert and X. Sala-i-Martin. (1992). “Convergence.” *Journal of Political Economy*, 100(2). 223-251, April.

Baumol, William J. (1986) “Productivity growth, convergence, and welfare," *American Economic Review* 76(5), 1072{85}, December.

Bliss, C., (1999). Galton’s fallacy and economic convergence. *Oxford Economic Papers* 51, 4–14.

Friedman, Milton (1992). “Do old fallacies ever die?”, Journal of Economic Literature, 30(4), 2129-2132, December.

Higgins, Matthew J., Daniel Levy, and Andrew T. Young. (2006) “Growth and convergence across the U.S.: evidence from county-level data.” *Review of Economics and Statistics,* 88, 671–81.

Higgins, Matthew J., Daniel Levy, and Andrew T. Young. (2008) “Sigma convergence versus beta convergence: evidence from U.S. county-level data,” *Journal of Money, Credit and Banking,* Volume 40, Issue 5, August, pages 1083–1093.

Jones, Charles, (1997). “On the evolution of the world income distribution,” *Journal of Economic Perspectives,* XI, 19–36.

Mankiw, N. Gregory, Romer, David, and David Weil (1992), “A contribution to the empirics of economic growth,” *Quarterly Journal of Economics,* CVII: 407-37.

Pfitzner, C. Barry and Steven D. Lang. "Economic convergence: evidence from counties in Virginia." *Virginia Social Sciences Journal*, Volume 41, 2006, pp. 44-56.

Quah, D.T. (1993). "Galton's fallacy and tests of the convergence hypothesis," The *Scandinavian Journal of Economics* 95(4), 427, December

Quah, D.T., (1996). Twin peaks: growth and convergence in models of distributional dynamics. *Economic Journal* 106, 1045–1055.

Quah, D.T., (1997). Empirics for growth and distribution: stratification, polarization, and convergence clubs. *Journal of Economic* Growth 2, 27–59.

Ramsey, F.P. (1928). "A mathematical theory of saving." *Economic Journal*. 38 (December). 543-59.

Sala-i-Martin, X. (1996a). "The classical approach to convergence." *The Economic Journal*. 106(July). 1019-1036.

Sala-i-Martin, X. (1996b). "Regional cohesion: evidence and theories of regional growth and convergence." *European Economic Review*, 40, (July). 1325-1352.

Sala-i-Martin, X. (2002). "Fifteen years of new growth economics: what have we learned?". *Economic Growth: Sources, Trends, and Cycles*, edited by Norman Loayza and Raimundo Soto, Santiago, Chile, Central bank of Chile.

Solow, R.M. (1956). "A contribution to the theory of economic growth." *Quarterly Journal of Economics*. LXX. 65-94.

Swan, T.W. (1956). "Economic growth and capital accumulation," *Economic Record*. 32(2). 334-61.

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