Divided: The Two Americas-Examining Club Convergence in the U.S.

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Abstract

This paper finds club convergence within the 50 U.S. states using Phillips and Sul's (2007, 2009) regression-based convergence test using per capita real state domestic product from 1997 to 2017. Two clubs with diverging transition paths are found. Clubs 1 and 2 mimics the divide that is seen in the flow of funds from the federal government to the states (DiNapoli 2017, 2018). Hence, the log *t* test of Phillips and Sul (2007) is telling the tale of there being two Americas if all factors remain the same, but this need not be the case with the proper policy prescription.

Keywords: Convergence Clubs; Economic Convergence; Log *t*-Test; Growth and Development; U.S.

***JEL* Classifications**: C33; O11; O33; O47

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1. Introduction

The neoclassical growth model predicts that relatively poorer economies will grow faster than relatively richer ones has been applied to countries, but now, modern growth theories have also been focusing on the growth of regions, which extends Solow's (1956) ground-breaking work. Romer (1986) and Lucas (1988) have suggested that the distribution of per capita income in regions may point towards a tendency to cluster around a small number of poles of attraction, instead of "overall convergence." In addition, modifications to the original neoclassical model have been proposed by replacing homogeneous technological progress across countries in the neoclassical production function with the assumption of country-specific, technological growth rates (Barro and Sala-i-Martin 1997, Howitt and Mayer-Foulkes 2005). In a similar manner, Galor (1996) shows that the neoclassical growth model can actually generate multiple equilibria. So, countries with identical economic structures need not converge to the same equilibrium growth path, but instead may converge to a high steady-state income level while others may face a poverty trap, giving rise to the "club convergence" hypothesis. Hence, the club convergence hypothesis permits the possibility of multiple locally, stable steady-states (Durlauf and Johnson 1995).

The notion of regional convergence that allows for multiple stable equilibria is applied to the fifty states of the U.S. in this paper. In particular, this work seeks to investigate the evolution of convergence between states in the U.S. from 1997 to 2017.

The 50 states are diverse in terms of geography, size, population, and economy. The U.S. has a tradition of state's rights, meaning that rights not mandated to the federal government are given to the states, which gives states a degree of autonomy. This paper seeks to determine the level convergence within the 50 U.S. states using a regression based convergence test that has been developed by Phillips and Sul (2007, 2009), which is referred to as the log *t* test. The Phillips and Sul regression based convergence test (2007, 2009), *i.e.* the log *t* test is to be referred to as PS henceforth.

The log *t* test is based on the cross-sectional variance ratio of per capita income over time. Durlauf and Johnson (2006) notes the utility of the econometric tools developed by Phillips and Sul (2007, 2009) in capturing the transitional dynamics of output that processes towards steady states.

Regarding the application of the PS (2007, 2009) log *t* test to U.S. data, there has not been a great deal of research. Apergis and Payne (2012) and Kim and Rous (2012) examine convergence in U.S. house prices using the housing price index. More recently, Choi and Wang (2015) applying the PS method to real output per worker for the 48 continental states of the U.S. and they find that states have not fully converged over the last five decades (1963-2011). Their clustering algorithm reveals the convergence of four distinct subgroups of states with respect to productivity.

Furthermore, Apergis, Christou, Gupta, and Miller (2018) have used the PS model to test for the convergence of different inequality measures (the share of total income held by the top 10% of the income distribution and the Gini coefficient) across states in the U.S. from 1916 to 2012, which includes a series of different periods such as the Great Depression (1929–1944), the Great Compression (1945–1979), the Great Divergence (1980-present), the Great Moderation (1982–2007), and the Great Recession (2007–2009).

In their seminal paper, Phillips and Sul (2007) use their methodology to examine the cost of living for 19 metropolitan areas in the U.S. In their follow-up paper, Phillips and Sul (2009) examine 8 Western OECD countries from 1500 to 2001, 152 countries from 1970 to 2003, and 98 countries from 1960 to 2003. Phillips and Sul (2009) further breaks down relative convergence into club convergence for the countries but not for the U.S.

As it pertains to the U.S., Phillips and Sul (2009) examine log per capita real income for all 48 contiguous states from 1929 to 1998. Phillips and Sul (2009) find there to be a common transition behavior for all 48 contiguous states, which indicates growth convergence and there being heterogeneity across states. For all 48 contiguous states, PS (2009) find there to be relative convergence.

This paper extends the work of Phillips and Sul (2009) with respect to per capita real state domestic product (SDP) for club convergence for all 50 states of the U.S. using panel data from 1997 to 2017 by finding two diverging transition paths.

The type of convergence a country or region experiences has important policy implications. Using the definitions of convergence by Galor (1996), the Absolute Convergence Hypothesis, which is also known as σ-convergence, refers to the countries/states converging to the same steady-state level of output per capita since they have the same characteristics such as preference, technology and market structure, but the initial conditions could be different (Barro and Sala-i-Martin 1992). The Conditional Convergence Hypothesis, which is also known as β-convergence, refers to countries/sates having the possibility of different initial conditions with respect to physical and human capital, so they converge to their own steady state even though they have similar structural characteristics (Mankiw, Romer, and Weil 1992). Club Convergence can be seen as a subset of Conditional Convergence. The Club Convergence Hypothesis refers to countries/state having identical structural characteristics but with different initial levels of human and physical capital clustering around different steady-state equilibria (Galor 1996). Hence, this could create multiple equilibria.

According to Galor (1996), if there is conditional convergence, the policy remedy is to provide aid that focuses on improving the structure of the economy such as infrastructure, technological preferences, population growth, education, financial systems, government policy, factor market structure, etc.

Regarding Club Convergence, low SDP per capita could also have low economic growth rates. So, the policy implications are to include income transfers from the richer clubs to the poorer clubs because income does indeed matter for economic growth. The income transfers to the poorer clubs are done with the intent of changing the structural characteristics and initial conditions.

Some works, where the result of the number of clubs has been four or more, have empirically demonstrated that both the initial conditions and the structural characteristics, have been predominantly driven by technology and human capital (Bartkowska and Riedl 2012, Choi and Wang 2015, Von Lyncker and Thoennessen 2017). This is consistent with the prevailing view in the theoretical economic growth literature.

The PS test (2007) rejects absolute convergence in the U.S. at the 95% significance level but it does find club convergence. Specifically, according to the PS log *t* test (2007), the U.S. is divided into two growth clubs. Club 1 is the higher growth club that contains 28 states, which is diverging from Club 2, the lower growth club. Club 2 contain 22 states.

Clubs 1 and 2 mimics the divide that is seen in the flow of funds from the federal government to the states (DiNapoli 2017, 2018). The vast majority of the states that run a deficit, meaning they receive less from the federal government than they give, are in Club 1, which the club with the higher steady state. There are states that have a surplus meaning they get back more from the federal government than they give are in Club 1. It should be noted that a surplus amounts to an income transfer. It seems that the spending done by these states are ensuring long rung growth.

The PS log *t* test developed by is also able to identify clubs that are on the verge of switching clubs, which has important policy implications. So, the nine at-risk states in Club 1 have the potential of losing their high growth and becoming part of Club 2. Alternately, there are 10 states in Club 2 that have the potential of switching to the high growth club. Hence, the findings of the PS test (2007) can be used to identify states that are in need of improving the structure of the economy in order to promote long term growth (Galor 1996).

Furthermore, in order to further test membership in each club, the differences in means between clubs is analysed using the balance of payments in per capita terms, the growth rate of research and development (R&D) as a percentage of SDP, growth in the number of patents, population growth, and the percentage of people with bachelor's degrees in Science or Engineering. Using the afore-mentioned technological and human capital variables, a logit regression is used to show the probability of belonging to Club 1.

The structure of this paper is organized as follows: Section 2 describes the methodology; Section 3 presents the data and the empirical results; and Section 4 concludes.

2. Methodology

The PS convergence test (2007, 2009) is a non-linear factor model that is able to use stationary or non-stationary data while being able to capture absolute, conditional, or club convergence as well as transitional heterogeneity. It is also able to overcome the omitted variable bias.

In addition, it endogenously identifies regions/states with similar structural characteristics but with different initial conditions, which helps to identify convergence clusters, and this is useful in examining transitional behaviour (Aksoy, Taştan, and Kama 2019). The test is a regression that can also provide a grouping, which does not depend on eventual assumptions about the stationary trend of the examined variables (Monfort, Cuestas, and Ordóñez, 2013).

PS (2007) propose using a nonlinear, time-varying, factor model for testing the convergence hypothesis and the identification of convergence clubs. The variable of interest is per capita real SDP for all 50 states of the U.S., which is denoted as X_{it} where $i = \{1, \ldots, N\}$ and $t = \{1, \ldots, T\}$ with N refers to the total number of states, which is 50 and t ranging from 1997 to 2017. Hence, the PS model (2007, 2009) introduces a cross-sectional analysis as well as a heterogeneous time series analysis in the parameters of a neoclassical growth model in order to form the data panel $\{X_{it}\}$.

In practice, the natural log of X_{it}, which is $Ln(X_{it})$ is used and is decomposed into two components:

$$Ln(X_{it}) \approx \varphi_i \mu_t, \tag{1}$$

where φ_i is the component containing the idiosyncratic factors of each state while μ_t represents the common stochastic trends.

To take into account the heterogeneity of a temporary transition variable, h_{it}, is analyzed. In this formulation, the factor loading portion, φ_i measures the distance between X_{it} and common factor μ_t.

Given the data panel $\{X_{it}\}$, the following steps are performed. First, for each time t, the mean value is calculated, and each individual value, X_{it}, is compared against the obtained average value of:

$$h_{it} = \frac{X_{it}}{\frac{\sum_{i=1}^{N} X_{it}}{N}} \tag{2}$$

A panel of $\{h_{it}\}$ is formed from h_{it} for all 50 states and years from 1997 to 2017 from Equation (2) with the elimination of the initial X_{it}.

The second step involves the variance of the h_{it} values for each time t with the variance being calculated from the following formula:

$$H_t = \frac{\sum_{i=1}^{N} (h_{it} - 1)^2}{N} \tag{3}$$

The reason for comparing each h_{it} value to 1 is that if there is convergence, all these values should converge to 1, which are the transition curves.

In order to specify the null hypothesis of convergence, PS (2007) formulate the idiosyncratic element φ_{it} as:

$$\varphi_{it} = \varphi_i + \frac{\sigma_i \varepsilon_{it}}{L(t)t^{\alpha}} \tag{4}$$

where φ_i is fixed, σ_i is an idiosyncratic scale parameter, ε_{it} is *iid*(0.1) across *i*, *L(t)* is a slowly varying function such as *Ln(t)* (*L(t)*→ ∞ as *t*→ ∞) and α denotes the speed of convergence. The null hypothesis of convergence is formulated as:

H_0: $\varphi_i = \varphi$ and $\alpha \geq 0$

against the alternative of no convergence, which is

H_A: $\varphi_i \neq \varphi$ for all *i* or $\alpha < 0$.

The absolute convergence hypothesis is based on the fact that H_t tends to zero. To test for absolute convergence, the following model is used:

$$Ln\left(\frac{H_1}{H_t}\right) - 2Ln(Ln(t)) = a + \beta Ln(t) + u_t, \text{ where } t=[rT], [rT]+1,\ldots,T. \tag{5}$$

Based on Monte Carlo simulations provided by PS (2007), it is suggested that $r = 0.30$ for sample sizes below $T = 50$. If $\beta<0$, then the absolute convergence hypothesis, *i.e.* σ-convergence is rejected and the next step is to proceed to testing for conditional convergence, specifically club convergence using the value obtained for β.

To test for club convergence, *i.e.* β-convergence, an iterative algorithm developed by PS (2007) is applied and tested at the 95% significance level, which they refer to as the log *t* test. The iterative procedure to identify convergence clubs is summarized in four steps:

(i.) The panel data is ordered from the highest to lowest based on the observations of the last period.

(ii.) The next step is to select k in the panel states to form each club, where k is the number of members of each club. This begins to form groups of states. *i.e.* clubs from the highest value of each variable in the last period, so that the clubs could contain anywhere from $2 \leq k < N$ members, where the size of the club is determined based on the estimated *t*-statistic of the estimated coefficient of *Ln(t)*, which is β from Equation (5). As long as the estimated *t*-statistic is > -1.65, the state is counted in the club.

(iii.) If, in the previous step, two states meet the established criterion, the process will continue to add states in the order as they appear in the data panel, which is already sorted. As long as the data continues to meet the criterion, the state is added to the club. When the data no longer meets the criterion, the first club is formed and completed.

(iv.) The fourth and last step for the remaining states is to iteratively apply Steps (i.) to (iii.) in order to find successive clubs. The states show divergent behavior if no core group can be found.

Phillips and Sul (2007) also propose modeling the transitional elements φ_{it} by building a relative measure based on the average value provided in Equation (2):

$$h_{it} = \frac{X_{it}}{\frac{\sum_{i=1}^{N} X_{it}}{N}} = \frac{\varphi_{it}}{\frac{\sum_{i=1}^{N} \varphi_{it}}{N}}. \qquad (6)$$

This measures the weighted coefficients, φ_{it} in relation to the panel data so that the variable h_{it} is called the relative transition path. It traces an individual path for each state i relative to the average of the panel data. Thus, h_{it} measures the trajectory of each state i from the starting position relative to the path of common growth. When there is common behavior in the path of growth between regions, $h_{it} = h_t$, a convergence club between that group is formed and, in the same way, a path of common growth for the club in the panel data can be traced.

Studying convergence in a panel data set has several appealing features. Since the model traces an individual path for each region i relative to the average panel of data, we can distinguish, empirically, different degrees of convergence. The regression coefficient, β provides a scaled estimator of the speed of convergence, parameter α, specifically, $\beta = 2\alpha$.[1]

2. Data and Empirical Results

In this paper, by dividing real SDP by the population permits a comparison of real SDP across states without having the size of the population skew the findings. To test for club convergence in all 50 states of the U.S., real SDP per capita in chained 2009 dollars from the Bureau of Economic Analysis (BEA) is used from 1997 to 2017. A list of all 50 states is provided in Table 1 along with the real SDP per capita for 1997 and 2017.

FIGURE 1
Per Capita Real Income Growth between 1997 and 2017

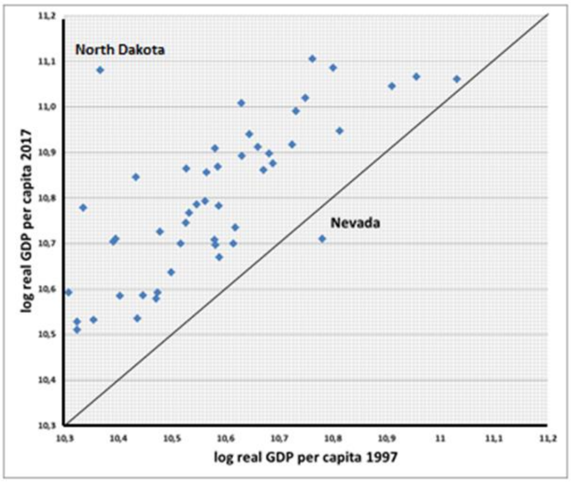


Figure 1 shows a dispersion diagram of the natural log of real SDP per capita in 1997 against log real SDP per capita in 2017 for the 50 states. The distance between the 45-degree line and each data point reflects the average growth rate for 20 years for each state. All the states, except for Nevada, are above the 45-degree line, which indicates that the states have been,

[1]Please see Appendix B in PS (2007).

overall, quite successful during the last two decades with 49 states having experienced an increase in real SDP per person on average.

Figure 2 shows the evolution of cross-sectional real income dispersion over time in what illustrates the notion of σ-convergence, which is the Pearson coefficient of variation. The Pearson coefficient of variation is used as a measure of convergence in the sense that it describes the overall movement of the data in the panel. If the Pearson coefficient of variation increases, this indicates that the dispersion in the data increases and the reverse also holds.

The graph of the Pearson coefficient of variation in Figure 2 shows that dispersion increases around the Dot.com recession of 2001 and The Great Financial Crisis of 2007 and decreases once these crises are overcome. The polynomial regression trend line smooths out the Pearson coefficient of variation in order to capture the overall trend.

When the iterative log t test is applied to per capita real SDP across all 50 states, the hypothesis of overall convergence is strongly rejected at the 5% significance level since the value of the estimated t-stat. is -10.3433, which is less than the critical value of -1.65. Therefore, absolute convergence is rejected at the 95% significance level for the U.S.

The next step is to proceed to check for the clustering using the PS (2007) Club Convergence Model. In the U.S., this paper has found there to be two clubs with no divergent states being identified.

The first convergence club contains twenty-eight states; they are the states with the highest per capita real SDP with an average of $55,399 in 2017 as is shown in Table 2. For the first club, the estimated β coefficient is -0.2226 and the estimated t-statistic is -1.3618. The estimated β coefficient provides the speed of convergence, which is not fast for Club 1 as indicated by the negative sign of the estimated β coefficient. Since the estimated β coefficient is statistically significant at the 95% significance level, it meets the club convergence criterion of PS (2007).

TABLE 1

Real SDP per Capita across U.S. States (in Chained 2009 Dollars) from the BEA

States	1997	2017
Alabama	31,398	37,508
Alaska	61,797	63,610
Arizona	34,434	39,583
Arkansas	30,435	36,714
California	41,345	60,359
Colorado	43,558	54,026
Connecticut	54,740	62,633
Delaware	57,306	63,955
Florida	35,372	39,842
Georgia	40,873	45,925
Hawaii	43,832	52,869
Idaho	28,780	36,441
Illinois	45,435	55,102
Indiana	37,285	46,427
Iowa	37,319	52,284
Kansas	37,497	47,435
Kentucky	35,264	39,277
Louisiana	40,733	44,372
Maine	32,967	39,521
Maryland	41,966	56,375
Massachusetts	47,182	66,500
Michigan	39,408	44,201
Minnesota	42,631	54,805
Mississippi	28,265	32,447
Missouri	39,677	43,036
Montana	29,984	39,833
Nebraska	39,369	54,654
Nevada	48,066	44,812
New Hampshire	39,557	52,509
New Jersey	49,643	56,776
New Mexico	36,297	41,619
New York	49,045	65,220
North Carolina	39,330	44,706
North Dakota	31,785	64,911
Ohio	39,635	48,188
Oklahoma	32,588	44,535
Oregon	33,967	51,312
Pennsylvania	38,759	51,841
Rhode Island	38,025	48,314
South Carolina	34,069	37,637
South Dakota	30,784	48,004
Tennessee	36,910	44,348
Texas	41,366	53,737
Utah	35,533	45,493
Vermont	32,725	44,831
Virginia	43,069	52,124
Washington	45,753	59,333
West Virginia	30,445	37,353
Wisconsin	38,663	48,666
Wyoming	46,585	61,091

FIGURE 2

Dispersion of Real SDP per Capita between 1997 and 2017

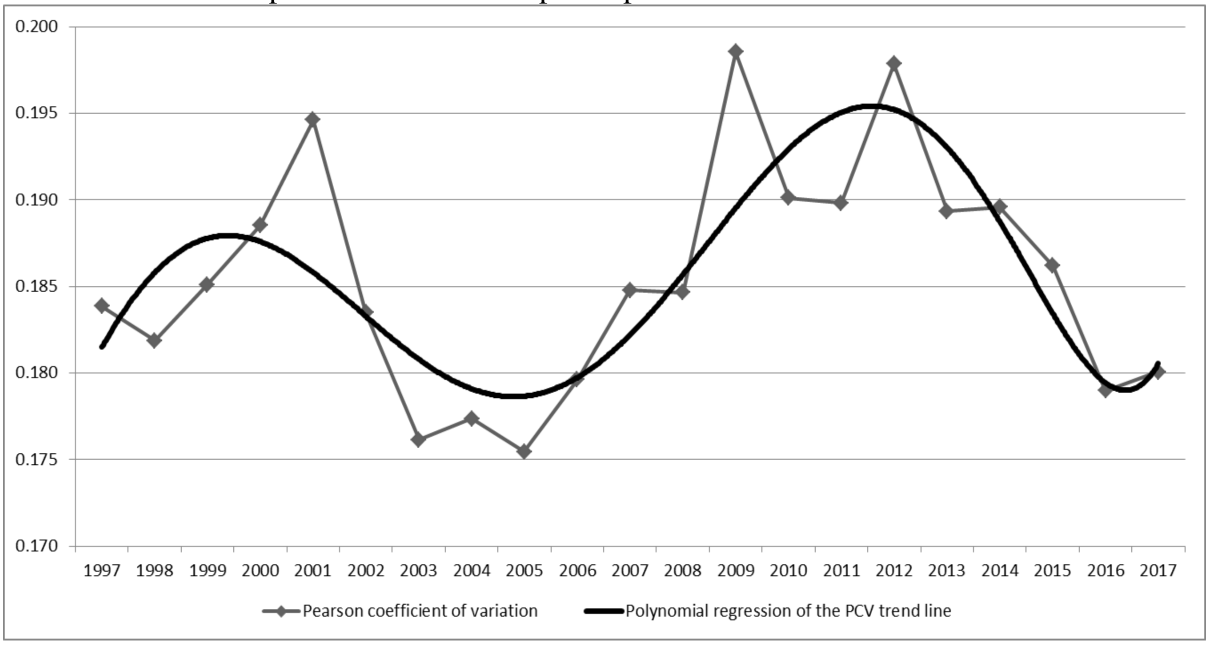


TABLE 2

Convergence Clubs Classification of U.S.

	States	"β" Coefficient	t Statistic	Per capita SDP (2017)
	All states in the sample	-0.8935	-10.3433	
Club 1	Massachusetts, New York, North Dakota, Delaware, Alaska, Connecticut, Wyoming, California, Washington, New Jersey, Maryland, Illinois, Minnesota, Nebraska, Colorado, Texas, Hawaii, New Hampshire, Iowa, Virginia, Pennsylvania, Oregon, Wisconsin, Rhode Island, Ohio, South Dakota, Kansas, Oklahoma	-0.2226	-1.3618	55,399
Club 2	Indiana, Georgia, Utah, Vermont, Nevada, North Carolina, Louisiana, Tennessee, Michigan, Missouri, New Mexico, Florida, Montana, Arizona, Maine, Kentucky, South Carolina, Alabama, West Virginia, Arkansas, Idaho, Mississippi	-0.0470	-0.4292	41,178

The second convergence club includes twenty-two states, which has an average of \$41,178 per capita real SDP in 2017 as is shown in Table 2. This is also a weakly cohesive club as indicated by the estimated β coefficient is -0.0470 and the estimated t-statistic is -0.4292. As it is with Club 1, the speed of convergence for Club 2 is slow as indicated by the negative sign of the estimated β coefficient, but it is statistically significant at the 95% significance level. Therefore, it meets the log t test convergence criterion. The convergence for Club 2 is seen as stronger than Club 1 since the results of the log t test are further away from the critical value of -1.65, when compared to the estimated t-statistic of Club 1.

Figure 3 is a map of the U.S., which shows the member states of Club 1 and Club 2. Figure 4 illustrates the relative transition paths of the two clubs, which are calculated as the cross-sectional mean of the members of each club using Equation (6). The transition paths show that Club 1 and Club 2 are diverging away from each other across the sample period of 1997 to 2017. The transition path for Club 1 is above one, which indicates that it is above average and Club 2 is below average since its transition path is less than unity.

FIGURE 3
Map of Convergence Clubs in the U.S.

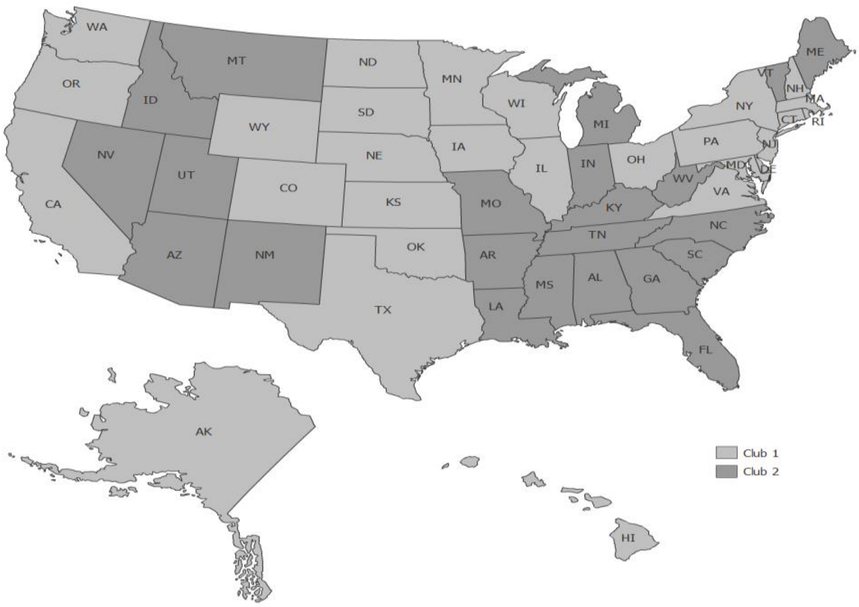
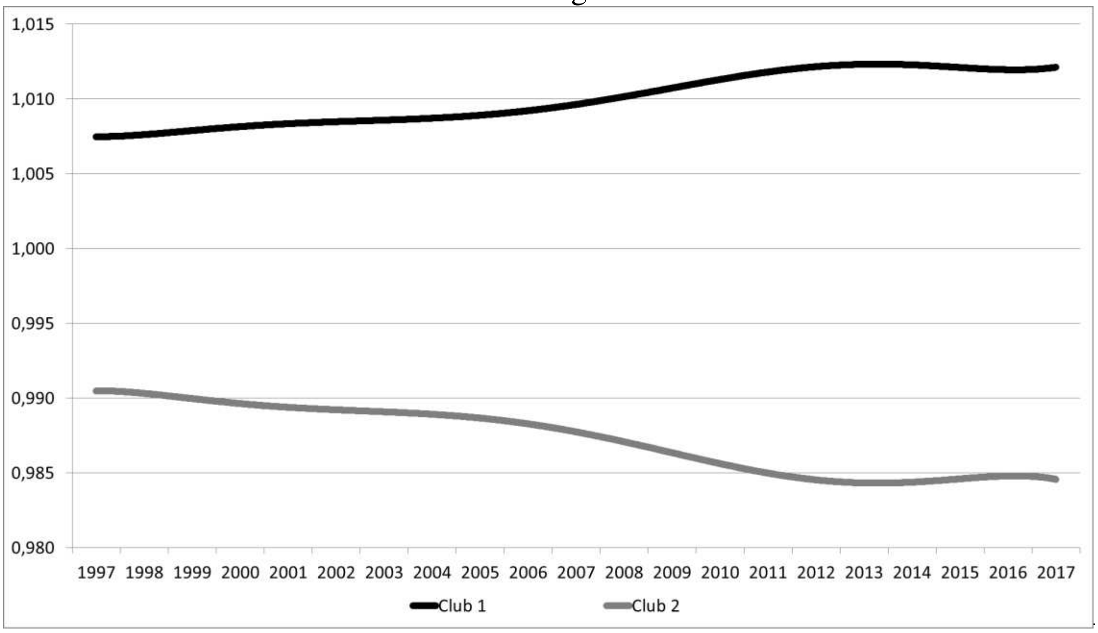


FIGURE 4
Transition Paths of Convergence Clubs in the U.S.



After having established the existence of 2 clubs in the U.S. from 1997 to 2017, the tendencies across clubs are explored. Following Bartkowska and Riedl (2012), the log *t* test for the lower-income members in Club 1 are tested against the higher-income members in Club 2 in order to see if these member states also meet the criterion of club convergence according to PS (2007).

It is possible for the members of each club to transition to the other club in the future with the boundary member states having the highest capability of switching clubs. There are important policy implications regarding the identification of member states that have the capability of switching clubs.

The log *t* test finds that 36% of the lower-income members in Club 1 and 40% of the higher-income members in Club 2 have the potential of switching clubs at a future time. This could indicate that some of the states that belong to different clubs could converge to each other over time, but also, that the borders between the clubs are somewhat diffuse. Therefore, some states could be in transition to a higher or lower club. Similar findings are found by Bartkowska and Riedl (2012) for 206 European regions between 1990 and 2002 and by PS (2009) for 152 countries between 1970 and 2003.

From Club 1, nine states have the potential of transitioning to Club 2, which are Virginia, Pennsylvania, Oregon, Wisconsin, Rhode Island, Ohio, South Dakota, Kansas, and Oklahoma. Ten states from Club 2 have the potential of switching to Club 1 and these states are Indiana, Georgia, Utah, Vermont, Nevada, North Carolina, Louisiana, Tennessee, Michigan and Missouri. The other states not mentioned definitely belong in their respective clubs and they do not appear to have the potential to switch clubs at the moment.

In terms of their growth paths, the two convergence clubs follow the pattern of the flow of funds from the federal government to the 50 states, which DiNapoli (2017, 2018) provides in nominal per capita SDP terms for 2016 and 2017. Table 3 provides a list of states by convergence clubs and it shows the ranking of states according to the surplus or deficit of each state in 2017 along with the amount of the surplus or deficit as provided by DiNapoli (2018). If a state runs a deficit, this means that for each $1 the state gives to the federal government, the state receives less than $1 back in funds from the federal government. The states, that get back more from the federal government than what they give to the federal government, are classified as a surplus.

Surpluses are classified into four categories as is shown in Table 4. Since the convergence clubs are classified as Club 1 and Club 2, each surplus/deficit designation is assigned a letter in order to help with the processing of the information. As is shown in Table 4, there are 17 states that have a per capita surplus of $4,001 or more is denoted as “A”. 10 states have a per capita surplus from $2,001 to $4,000 and is denoted as “B”, 12 states have a per capita surplus from $0 to $2,100 and 11 states have deficits and are donor states, which are denoted as “C” and “D,” respectively.

TABLE 3

List of States by Convergence Clubs and by Surpluses or Deficits

State	Abb.	Club Conv	Rank of Surplus/Deficit State	Surplus or Deficit	Surplus or Deficit Amount
Virginia	VA	1	4	A	Per Capita Surplus of $4,001 or more
Maryland	MD	1	6	A	Per Capita Surplus of $4,001 or more
Alaska	AK	1	8	A	Per Capita Surplus of $4,001 or more
Hawaii	HI	1	9	A	Per Capita Surplus of $4,001 or more
Oklahoma	OK	1	14	A	Per Capita Surplus of $4,001 or more
Rhode Island	RI	1	23	B	Per Capita Surplus $2,001 to $4,000
Pennsylvania	PA	1	24	B	Per Capita Surplus $2,001 to $4,000
Ohio	OH	1	25	B	Per Capita Surplus $2,001 to $4,000
Oregon	OR	1	28	C	Per Capita Surplus $0 to $2,000
Texas	TX	1	30	C	Per Capita Surplus $0 to $2,000
Kansas	KS	1	31	C	Per Capita Surplus $0 to $2,000
Delaware	DE	1	33	C	Per Capita Surplus $0 to $2,000
Iowa	IA	1	34	C	Per Capita Surplus $0 to $2,000
Colorado	CO	1	35	C	Per Capita Surplus $0 to $2,000
North Dakota	ND	1	36	C	Per Capita Surplus $0 to $2,000
South Dakota	SD	1	37	C	Per Capita Surplus $0 to $2,000
Wisconsin	WI	1	38	C	Per Capita Surplus $0 to $2,000
Washington	WA	1	39	C	Per Capita Surplus $0 to $2,000
Nebraska	NE	1	41	D	Per Capita Deficit-Subsidizes Other States
Wyoming	WY	1	42	D	Per Capita Deficit-Subsidizes Other States
California	CA	1	43	D	Per Capita Deficit-Subsidizes Other States
New Hampshire	NH	1	44	D	Per Capita Deficit-Subsidizes Other States
Minnesota	MN	1	45	D	Per Capita Deficit-Subsidizes Other States
Illinois	IL	1	46	D	Per Capita Deficit-Subsidizes Other States
New York	NY	1	47	D	Per Capita Deficit-Subsidizes Other States
Connecticut	CT	1	48	D	Per Capita Deficit-Subsidizes Other States
Massachusetts	MA	1	49	D	Per Capita Deficit-Subsidizes Other States
New Jersey	NJ	1	50	D	Per Capita Deficit-Subsidizes Other States
New Mexico	NM	2	1	A	Per Capita Surplus of $4,001 or more
West Virginia	WV	2	2	A	Per Capita Surplus of $4,001 or more
Mississippi	MS	2	3	A	Per Capita Surplus of $4,001 or more
Alabama	AL	2	5	A	Per Capita Surplus of $4,001 or more
Maine	ME	2	7	A	Per Capita Surplus of $4,001 or more
Kentucky	KY	2	10	A	Per Capita Surplus of $4,001 or more
South Carolina	SC	2	11	A	Per Capita Surplus of $4,001 or more
Louisiana	LA	2	12	A	Per Capita Surplus of $4,001 or more
Arizona	AZ	2	13	A	Per Capita Surplus of $4,001 or more
Arkansas	AR	2	15	A	Per Capita Surplus of $4,001 or more
Montana	MT	2	16	A	Per Capita Surplus of $4,001 or more
Vermont	VT	2	17	A	Per Capita Surplus of $4,001 or more
Idaho	ID	2	18	B	Per Capita Surplus $2,001 to $4,000
Missouri	MO	2	19	B	Per Capita Surplus $2,001 to $4,000
Tennessee	TN	2	20	B	Per Capita Surplus $2,001 to $4,000
North Carolina	NC	2	21	B	Per Capita Surplus $2,001 to $4,000
Florida	FL	2	22	B	Per Capita Surplus $2,001 to $4,000
Georgia	GA	2	26	B	Per Capita Surplus $2,001 to $4,000
Michigan	MI	2	27	B	Per Capita Surplus $2,001 to $4,000
Indiana	IN	2	29	C	Per Capita Surplus $0 to $2,000
Nevada	NV	2	32	C	Per Capita Surplus $0 to $2,000
Utah	UT	2	40	D	Per Capita Deficit--Subsidizes Other States

TABLE 4

List of Surplus or Deficit Received by States

Surplus/Deficit Code	Surplus/Deficit Amount	Number of States
A	Per Capita Surplus of $4,001 or more	17
B	Per Capita Surplus $2,001 to $4,000	10
C	Per Capita Surplus $0 to $2,000	12
D	Per Capita Deficit-Subsidizes Other States	11

The ranking of donor states, as provided by DiNapoli (2018) is from 1 to 50 with the first state having the highest surplus, which is New Mexico, and the state with the largest deficit is the fiftieth state, which is New Jersey. Hence, New Mexico receives the most money back from the federal government and therefore has the largest surplus. Alternatively, New Jersey is the state that receives the least back from the federal government and thus, has the largest deficit.

Club 1 contains all 10 out of 11 states that have per capita deficits, which are Nebraska, Wyoming, California, New Hampshire, Minnesota, Illinois, New York, Connecticut, Massachusetts, and New Jersey, which are ranked as the 41st to the 50th donor states.

Utah is the only state that is a deficit state, which is in Club 2, but the deficit is close to \$0. It is ranked as the 40th donor state in 2017. In 2016, Utah has a rank of 37 and it has received a surplus that ranges from \$0 to \$2,000 (DiNapoli 2017, 2018). Utah is also one of the higher income states in Club 2 that has a chance of transitioning to Club 1.

In Club 1, there are 18 states that have per capita surpluses. Nine of these states, which are Virginia, Pennsylvania, Oregon, Wisconsin, Rhode Island, Ohio, South Dakota, Kansas, and Oklahoma, are at the lower end of Club 1, but they are at risk of slipping into the lower club, *i.e.* Club 2 if their growth does not continue as projected.

Maryland, Alaska, and Hawaii are in Club 1 and they have received per capita surpluses of more than \$4,001 but they also have relatively high real SDP per capita in 2017. Maryland, Alaska, and Hawaii are in the top 20 when ranking the real SDP per capita from the highest to the lowest in 2017 with Alaska being fifth, Maryland being twelfth, and Hawaii being seventeenth. This indicates, that based on club convergence and real SDP per capita in 2017, Maryland, Alaska, and Hawaii are firmly ensconced in Club 1. Texas, Delaware, Iowa, Colorado, North Dakota, and Washington also receive per capita surpluses that ranges from \$0 to $2,000 but their real SDP per capita are also in the 20 highest of all 50 states, which firmly puts them in Club 1.

In Club 2, there are 12 states that have per capita surpluses of more than $4,001, 7 states with per capital surpluses of $2,001 to $4,000, 2 states with per capital surpluses of $0 to $2,000 and 1 state with a per capita deficit, which is Utah as previously has been stated.

Indiana, Georgia, Utah, Vermont, Nevada, North Carolina, Louisiana, Tennessee, Michigan and Missouri have the potential of switching from Club 2 to Club 1, which is not surprising given that their real SDP per capita are ranked in the top thirtieth in 2017. Hence, with the proper aid that focuses on improving the structure of their respective economies such as infrastructure, technological preferences, population growth, education, financial systems, government policy, factor market structure, etc., they have the ability to move to Club 1 (Galor 1996).

New Mexico, Florida, Montana, Arizona, Maine, Kentucky, South Carolina, Alabama, West Virginia, Arkansas, Idaho, and Mississippi are the remaining member states of Club 2 and they are firmly entrenched in Club 2. This is understandable especially since their real SDP per capita in 2017 ranked at or below the fortieth level with Mississippi having the lowest real SDP per capita for all 50 states.

The policy implications of the club convergence for each of states varies. The member states that are firmly entrenched in Club 1, which are Nebraska, Wyoming, California, New Hampshire, Minnesota, Illinois, New York, Connecticut, Massachusetts, New Jersey, Maryland, Alaska, Hawaii, Texas, Delaware, Iowa, Colorado, North Dakota, and Washington, are doing well by being above the average since their transition paths are greater than unity. The states, that are running a deficit, meaning they get back less from the federal government than they give, indicate that their economies have a tendency of being self-sufficient barring some sort of large calamity.

In Club 1, the states that are receiving back more from the federal government than what they give are being spent in a manner that improves their overall infrastructure, which is helping these states to grow. It is important to note that there are states at risk of slipping from Club 1 to Club 2, which are Virginia, Pennsylvania, Oregon, Wisconsin, Rhode Island, Ohio, South Dakota, Kansas, and Oklahoma. These states need to examine their infrastructure for weaknesses or they might need more aid to shore-up these weaknesses from becoming major problems down the line.

Regarding Club 2, the member states who have the potential from moving from Club 2 to the higher club of Club 1, which are Indiana, Georgia, Utah, Vermont, Nevada, North Carolina, Louisiana, Tennessee, Michigan and Missouri, might need more help with their infrastructure. It seems as if they are making strides but they are not strong enough to break into Club 1 on their own.

The remaining states are firmly entrenched in Club 2, which are New Mexico, Florida, Montana, Arizona, Maine, Kentucky, South Carolina, Alabama, West Virginia, Arkansas, Idaho, and Mississippi. They are at risk of decline, which means that the gap between the firmly entrenched states in Club 2 will grow farther away from the firmly entrenched states in Club 1 thereby creating a socio-economic divide within the U.S., which will lead to a divided U.S. So, the policy remedy according to Galor (1996) is to have an income transfers to the states that are firmly entrenched in Club 2 by developing their infrastructure such as education, technological preferences, etc. It is necessary to introduce state-level policies that focus on technology, innovation, and human capital improvements with the aim of knowledge accumulation since these are essential to economic growth by increasing productivity (Bartkowska and Riedl 2012, Choi and Wang 2015, Von Lyncker and Thoennessen 2017).

Table 5 shows differences between Club 1 and Club 2 using the balance of payments in per capita terms, the growth rate of R&D as a percentage of SDP, growth in the number of patents, population growth, and the percentage of people with bachelor's degrees in Science or Engineering.[2] The surplus in the balance of payments per capita is higher in Club 2. So, the Club 1 members, in many instances, act as donors for the Club 2 members. The descriptive analysis confirms this. The members in Club 1 have on average $3,019 less in per capita terms, when compared to the members in Club 2 in reference to the balance of payments in per capita terms. Another significant difference is the gap between the percentage of the population with a bachelor's degree in in Science or Engineering in terms of education. The members in Club 1 have more people with college degrees than Club 2. Club 1 is 4.19% higher on average when compared to Club 2.

TABLE 5
Differences between Club Members by Observed Characteristics

	Club 1		Club2		Diff.
Variable	Mean	St.Er.	Mean	St.Er.	Mean
Balance of Payments per Capita, 2017	1244.8	507.7	4264.2	509.9	-3019.4***
Growth of R&D Spending as % of SDP, 1996-2016	18.60%	7.1	7.13%	7.2	11.40%
Growth in Number of Patents per Capita, 1995-2015	79.40%	14.2	52.10%	6.7	27.30%
Population Growth, 1996-2017	19.30%	2.1	26.60%	4.7	-7.30%
% of Bachelor Degree and +, 1996	21.60%	0.6	17.40%	0.6	4.19%***

*** significant at the 1% level, **-significant at the 5% level, *-significant at the 1% level

Although the estimates are not statistically significant, Table 5 identifies the other important differences across the members of the two clubs. On average, the states of Club 1 experience a 7.3 percent lower population growth in the period between 1996 and 2017. The growth in spending on R&D and the number of patents per capita are also lower in the

[2] The number of U.S. patents is obtained from the U.S. Patent and Trademark Office. The next technological variable is R&D as a percentage of SDP with the data being acquired from the National Science Foundation and the human capital variable is the number of Bachelor's Degrees in Science or Engineering conferred per 1,000 individuals with the data being acquired from the National Science Board.

club with the lower SDP per capita, which is Club 2. For example, the number of patents per capita in Club 1 grows by 14.2% in the period between 1995 and 2015 while the growth in the counterpart club is more than twofold less. R&D spending has grown by 18.6% in the richer club, which is 11.4% higher than the poorer club.

TABLE 6

Factors Explaining the Membership in Club 1 (Logit Regression)

Variable	Coef.	*Z*-stat	*p*-value
Balance of Payments per Capita, 2017*1000	-0.0582	-3.71	0.000
Growth of R&D Spending as % of SDP, 1996-2016*10	-0.0031	-0.48	0.634
Growth in Number of Patents per Capita, 1995-2015*10	0.0160	0.9	0.366
Population Growth, 1996-2017	-0.0076	-2.12	0.034
% of Bachelor Degree, 1996	0.0616	5.25	0.000

Reported coefficients are the marginal effects computed for the average values of the controlled factors. Standard errors are computed using the delta-method.

The earlier analysis demonstrates that certain states are in the borderline between the rich and poor club. Table 6 reports the average marginal effects from the logit regression with Club 1 membership as the dependent variable, which is regressed on the set of controls from Table 6. The three most important factors that could set the transition paths for the clubs are the balance of payments per capita, population growth, and education.

Specifically, the propensity of being in Club 1 is negatively affected by the surplus in the balance of payments. A $1,000 decrease in the balance of payments increases the state's chance of become a member of Club 1 by 6% at the 95% significance level. Regarding the effect of the population with a bachelor's degree in Science or Engineering, a 1 % increase in these degree holders increases membership in Club 1 by 6% at the 95% significance level. Lastly, the population growth has a relatively smaller implication on Club 1 membership. At the 95% significance level, a 1% increase in the population growth decreases the probability of being in Club 1 by 0.7%.

The results from the logit regression shows that technological development has a lesser implication on the propensity of Club 1 membership with the growth in the number of patents per capita being used as a proxy of technological innovation. New products or technologies can easily cross the state borders and positive benefits of new technologies are shared between the states of both clubs. The effects of the growth in R&D spending as a percentage of SDP and the growth in the number of patents per capita are found to be statistically insignificant with respect to membership in Club 1.

4. Conclusion

The PS econometric tools (2007) are able to capture both absolute and conditional convergence. When there is conditional convergence, the PS econometric tools (2007) are also able to specify club convergence while being able to use either stationary or non-stationary data and by also being able to overcome the omitted variable bias.

With respect to the per capita real SDP for all 50 states of the U.S., the log *t* test of PS model (2007) rejects absolute convergence at the 95% significance level and it finds two diverging clubs. Club 1, the high growth club contains 28 states with 9 having the ability to slip into the lower growth club, Club 2. Club 2 has 22 states and 10 of the states have the ability to becoming part of the higher growth club, Club 1.

It is understandable that absolute convergence is rejected for the U.S. since the composition of each state is different in terms of population, infrastructure, resources, etc. There are states in Club 1, which receive funds from the federal government and are high growth. Alternatively, there are low growth states that receive funds from the federal government and are in Club 2.

It seems that the states with a surplus in Club 1 are using the income transfers from the federal government in a manner that ensures above average growth in the long-run. Twelve out of seventeen states that have surpluses of more than $4,001 are in Club 2 yet five out of seventeen have surpluses of more than $4,001 are in Club 1, the high growth club.

For the aforementioned states in Club 2, there are three possible scenarios or possible mix of scenarios with respect to their surplus, which are: (i.) the federal funds are being used to shore up the bottom, meaning the funds are more about the present day survival of the state; (ii.) the federal funds might not be enough to focus on long-term growth; or (iii.) are being used inefficiently. The states with surpluses of more than $4,001 in Club 1 seem to be using the federal funds on infrastructure that promotes long-term economic growth.

The factors that affect membership in Club 1 are tested using the logit regression. The balance of payments per capita has an inverse relationship with the probability of belonging to Club 1 as does population growth. The percentage of the population with a bachelor's degree in Science or Engineering has a positive relationship with respect to the probability of being in Club 1. The growth of R&D spending as a percentage of SDP and the growth in the number of patents per capita are found to be statistically insignificant at the 95% significance level regarding the probability of Club 1 membership.

Hence, the PS log *t* test (2007) is telling the tale of there being two Americas if all factors remain the same, but this need not be the case. A state need not necessarily be entrenched in any given club. With the proper aid to improve the structure of a state's economy, a low growth state can become a high growth state that has a deficit instead of a surplus.

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