State and Regional Convergence in Economic Freedom of North America

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Abstract

This research determines the equality of the means and convergence of economic freedom of North America for U.S. states and regions between 1981 and 2014 as classified by BEA. The source of data is *Economic Freedom of North America 2016*, published by the Fraser Institute. The response variable is the Economic Freedom Index. The equality of the means is assessed both on the basis of time and region using a two-way analysis of variance for both among the states and among the BEA regions. The evidence suggests the means of the economic freedom index differs by states and over time, as well as the regions and over time. The convergence is determined using the absolute β-convergence. There is evidence of an overall convergence, as well as decennial convergences among states, although the rates are different for different periods. The results for the regions are mixed, and there is some evidence of convergence for some periods, but for most periods there is no evidence of convergence or divergence.

1 Introduction

The Economic Freedom of the World (EFW) (Gwartney et al., 2017) provides an index to measure "the consistency of a nation's policies and institutions with economic freedom" (Hall and Lawson, 2014). While classical economists were aware of the contributions of education, stable government, property rights, etc. to economic growth, they were unable to measure them, so treated them as constants under *ceteris paribus*. When "other things" do not remain constant, the analyses suffer from the bias of exclusion. A notable example is the exclusion of the technology variable in early economic growth models which resulted in fairly sizable "Solow's residual." EFW provides a measure to account for changes in some of those control variables.

Hall and Lawson (2014) report EFW is used in hundreds of academic articles. They excluded studies with minor use of EFW (174 out of 392). The majority of the remaining 134 articles (67%) "found that EFW independent variable(s) to be correlated in a good way with the dependent variable" where variables such as "growth, investment, peace, human rights, and the like" are defined as "good." Taking the outcomes of those studies at their face values indicates that EFW and by extension, economic freedom, human rights, property rights, and similar control variables affect economic outcomes. Therefore, it would be of interest to determine whether EFW values are converging or diverging because if EFW is converging, and it improves the "good" economic outcomes, it would add credibility to the neoclassical growth model's assertion that economies converge as they grow. This perspective ignores the possibility that economic freedom and liberalizations in general could have an adverse effect on income inequality as set forth by Carter (2007); Bergh and Nilsson (2010); Apergis and Cooray (2017).

The same argument can be made for investigating economic freedom at the state or regional levels. Bueno et al. (2011) construct an index similar to EFW for the U.S. This Economic Freedom of North America

(EFNA), based at the state and province levels, includes three major areas of the size of government, taking and discriminatory taxation, and regulation. A scale from zero to ten is given to rate each component of the three areas; the higher is the score the higher is the level of economic freedom. The three areas are given equal weights in the construction of the overall index. The present study uses the updated version for data (Stansel et al., 2016).

Garrett and Rhine (2011) employ the economic freedom index to estimate state employment growth for three separate periods: 1980-1990, 1990-2000, and 2000-2005. They find a direct relationship between economic freedom and growth Thus, further justifying a study of convergence of EFNA over states and/or regions of the United States. Kallioras et al. (2017) find similar results The period of this study spans 1981-2014, which makes it one of the longest periods studied to determine convergence, especially for EFNA data. More detail about the methodology and data is provided in the Data and Methodology section.

2 Data and Methodology

The EFNA data consists of the all-government and subnational index. The former includes federal, state, and local governments and "...helps isolate the impact of different levels of government on economic freedom..." while the latter "...provides a comparison of how individual jurisdictions within a country measure up against other jurisdictions in that country." (Stansel et al. (2016), 2). Since the purpose of this study is to determine the convergence of EFNA among state and regions in the United States the subnational index is the appropriate data set. Stansel et al. (2016) use equal weight for "each component within each area." Therefore, states within each region can be averaged to obtain regional values without affecting the original methodology.

Two statistical techniques are employed for analysis. The first, a two-way analysis of variance, is for testing for equality of means among the 50 states as well as among the eight regions. The entire data set is used for this methodology. There are 50 states over 34 years resulting in 1,700 observations for the states comparisons and 272 observations for the regions. Table 1 shows EFNA by state for select years. Two-Way ANOVA, which is also known as Two-Factor ANOVA can be used to test the differences of the means of the response variable (EFNA) with respect to each factor (states and years for the state data and regions and year for regions data). For the sake of space only the results for the entire period for each case are discussed.

The second technique is a linear regression, that provides the coefficients for determining β-convergences (Baumol, 1986) for the entire period (1981-2014) as well as the periods 1981 to 1991, 1991 to 2000, 2001 to 2010, and 2008 to 2014. The first four sub-periods are decennials beginning with the first year of available data for ENOVA. The last period serves two purposes. First, it covers the period since the Great Recession of 2007. Convergence over this period would imply that the Great Recession has not had an adverse effect on the economic freedoms of the state and region or that the effect(s) have been similar without causing divergence in economic freedom. While divergence could hint the existence of structural differences and that the units of study have been affected differently by the Great Recession. Second, it allows to have a reasonably long period, almost comparable to the decennial periods. There is evidence that convergence in sub-periods of data change (Barro and Sala-i Martin, 1991). Naghshpour (2009) demonstrates the influence of temporal choices. Hall (2016) uses β-convergence to determine the convergence of economic freedom among countries from 1980-2010.

To determine whether the economic freedom among the states and/or regions is converging or diverging a regression models is utilized. The concept of convergence stems from the neoclassical growth theory, which predicts incomes of countries will converge due to slower growth rates at later stages of development. This notion has been challenged by the endogenous growth model and New Growth Theory (Romer, 1986). According to Romer (1994), who is credited with the idea, there is nothing new about the theory. Both concepts raise the possibility of sustained as well as accelerated economic growth rates.

Table 1: EFNA by State within Region for Years used for β-convergence

Region	State	1981	1990	1991	2000	2001	2008	2010	2014
1	Connecticut	7.0	7.3	7.0	7.2	7.2	7.2	6.9	7.1
1	Maine	5.5	6.1	5.7	6.3	6.4	6.3	6.4	6.5
1	Massachusetts	5.8	6.8	6.5	7.5	7.4	7.2	6.9	7.3
1	New Hampshire	7.5	8.2	7.9	8.5	8.4	8.1	7.8	8.3
1	Rhode Island	5.2	6.5	5.8	6.3	6.2	6.3	6.2	6.8
1	Vermont	5.3	6.5	6.0	6.7	6.7	6.4	6.1	6.3
2	Delaware	5.7	7.2	7.0	7.3	7.3	7.0	6.8	6.7
2	Maryland	6.4	7.3	7.1	7.6	7.5	7.4	7.2	7.2
2	New Jersey	6.1	7.0	6.5	7.3	7.2	6.6	6.3	6.7
2	New York	4.1	5.3	4.9	5.9	5.8	5.6	5.4	5.7
2	Pennsylvania	5.7	7.0	6.8	7.4	7.3	7.0	6.7	7.2
3	Illinois	6.0	7.0	6.7	7.3	7.2	7.0	6.6	6.7
3	Indiana	6.6	7.2	7.0	7.5	7.5	7.1	6.7	7.2
3	Michigan	4.5	5.7	5.7	6.9	6.8	6.5	6.1	6.9
3	Ohio	5.7	6.1	5.9	6.5	6.3	6.2	5.9	6.5
3	Wisconsin	5.7	6.2	6.0	6.6	6.6	6.6	6.2	6.7
4	Iowa	6.3	6.5	6.4	7.0	6.9	6.9	6.5	6.9
4	Kansas	6.3	6.9	6.8	7.2	7.1	7.2	6.8	7.3
4	Minnesota	5.2	6.0	5.8	6.5	6.5	6.7	6.2	6.3
4	Missouri	6.9	7.5	7.4	7.4	7.3	7.3	7.1	7.4
4	Nebraska	6.5	7.2	7.0	7.4	7.4	7.3	7.0	7.4
4	North Dakota	6.7	6.2	6.1	7.0	7.0	7.2	7.1	7.4
4	South Dakota	6.5	7.6	7.5	8.0	7.9	8.1	7.8	8.0
5	Alabama	6.2	7.0	6.9	6.9	6.7	7.1	6.8	7.0
5	Arkansas	6.4	7.0	6.8	7.1	6.9	6.8	6.4	6.7
5	Florida	7.6	7.8	7.5	8.1	8.1	7.7	7.6	8.1
5	Georgia	6.4	7.1	6.9	7.5	7.4	7.3	6.9	7.4
5	Kentucky	5.8	6.8	6.4	6.9	6.8	6.6	6.1	6.4
5	Louisiana	6.3	6.3	6.2	6.6	6.5	6.7	6.5	7.0
5	Mississippi	5.8	6.5	6.4	6.5	6.5	6.5	6.2	6.4
5	North Carolina	6.4	7.1	6.9	7.2	7.1	7.1	6.6	7.3
5	South Carolina	6.3	6.9	6.7	7.0	6.8	6.6	6.2	6.7
5	Tennessee	6.8	7.6	7.5	8.0	7.9	7.6	7.5	7.9
5	Virginia	7.0	7.7	7.4	7.7	7.8	7.8	7.6	7.8
5	West Virginia	4.6	5.6	5.3	5.9	5.7	6.4	6.0	6.3
6	Arizona	6.8	6.8	6.6	7.4	7.4	7.2	7.0	7.4
6	New Mexico	5.7	6.1	5.9	5.9	6.0	6.1	5.9	6.2
6	Oklahoma	6.7	6.6	6.5	7.2	7.1	7.4	7.0	7.4
6	Texas	7.7	7.6	7.4	7.9	7.8	8.1	7.6	8.0
7	Colorado	7.1	7.1	7.0	7.9	7.8	7.5	7.0	7.3
7	Idaho	6.2	6.7	6.6	6.9	6.8	6.9	6.5	7.2
7	Montana	6.1	5.7	5.9	6.7	6.7	7.0	6.6	6.9
7	Utah	6.1	6.6	6.5	6.9	7.0	7.1	6.6	7.0
7	Wyoming	6.8	6.2	6.1	7.1	7.0	6.9	6.2	7.0
8	Alaska	4.6	5.3	5.0	5.4	5.5	5.9	5.8	6.2
8	California	5.5	5.9	5.6	6.4	6.2	5.9	5.7	5.9
8	Hawaii	5.4	6.3	6.2	6.1	6.1	6.2	6.1	6.2
8	Nevada	6.8	7.3	6.9	7.9	7.8	7.6	7.0	7.3
8	Oregon	5.3	6.1	5.9	6.4	6.3	6.5	5.8	6.3
8	Washington	6.1	6.3	6.2	6.7	6.5	6.8	6.3	6.9

3 Data Analysis

It is expected and hoped that the economic freedom of the states and, hence, the BEA regions improve over time, which would mean that the means of EFNA do not remain constant over time and the units of study (states or regions). Since the numbers of states in each region are different, instead of using the actual economic freedom data for each year their averages are used. There are 1,700 observations (50 states by 34 years). Averaging data for each year for each of the 8 regions results in 272 (8 regions by years). Table 2 provides the results for the two-way analysis of variance comparing the means of EFNA for regions over the 34 years (Year) as well as the mean of each year over the 8 regions (Region).

Table 2: Two-Way Test of Equality of Means by Regions and Over Time

Source	Partial SS	df	MS	F	Significance
Model	35.82	40	0.896	47.69	0.0000
Regions	16.36	7	2.337	124.46	0.0000
Year	19.46	33	0.59	31.41	0.0000
Residual	4.34	231	0.188		
Total	40.16	271	0.148		
N	272				
Root MSE	0.137				

The model and both regions and years factors are all statistically significant. As expected the average EFNA has changed over the years 1981-2014. The average for the regions for each year are also different from each other. The fact that the means of regions are different on the average does not mean that the means for the regions are not getting closer over time, which is the subject of the convergence analysis. But first, let's examine the equality of EFNA means for the eight regions for the latest year (2014). A one-way analysis of variance suffices to test the equality of the means for one year and the results are depicted in Table 3.

Table 3: Two-Way Test of Equality of Means of States in 2014

Source	Partial SS	df	MS	F	Significance
Model	3.12	7	0.445	1.40	0.2328
Residual	13.40	42	0.319		
Total	16.52	49	0.337		
N	50				
Root MSE	0.565				

As can be seen, there is insufficient evidence to reject the null hypothesis of the equality of the means of the eight EBA regions. This might be taken as a hint of the possibility of convergence over time, indicating that by 2014 the averages of EFNA for regions in the United States are practically the same. To obtain the full picture, it is necessary to conduct 33 similar analyses for the remaining years, which is, not only tedious but misleading (Bonferroni, 1935; Perneger, 1998). Instead, the more customary approach of the absolute β-convergence, is pursued. But first the equality of the means among the states are tested to make sure there is nothing peculiar about the grouping of the regions and the differences stem from the state and not how they are grouped.

The results of testing the equality of the means among the state are depicted in Table 4. Here too, the model and both factors of state and year are statistically significant; therefore, refute the null hypothesis of equality of the means among the states and over time.

3.1 Absolute β-convergence

To obtain the absolute β-convergence the natural logarithm of the ratio of the EFNA for the last period to the first period is regressed on the EFNA of the first period. The overall period is 1981-2014 and the

Table 4: Two-Way Test of Equality of Means of States 1981 to 2014

Source	Partial SS	df	MS	F	Significance
Model	774.380	82	9.444	178.31	0.0000
State	661.267	49	13.495	254.81	0.0000
Year	113.114	33	3.428	64.72	0.0000
Residual	85.639	1617	0.053		
Total	860.019	1699	0.506		
N	1700				
Root MSE	0.230				

sub-periods are 1981-1990, 1991-2000, 2001-2010, and 2008-2014. The first run covers the entire period, while the rest of the runs provide detail for the sub-periods. The last period begins at the Great Recession year. Naghshpour (2009) demonstrates that the choice of beginning and ending periods can and do affect the inference regarding convergence. The above periods are crucial in providing the results addressed in this paper, which is the reason they were chosen on precedence of previous studies and before selecting the data. The choices here are based on the first available year of data (1981) and decennial periods are chosen for their simplicity; with the exception of the last period that starts in 2008, as explained earlier.

Table 5 depicts the results of regressions of the natural logarithm of the ratio of the last year's EFNA to the first year's EFNA on the natural logarithm of the first year's EFNA. A negative and statistically significant coefficient indicates convergence. When the entire period from 1981 to 2014 is considered the results are inconclusive because the slope is not statistically significant. In addition, the slope is positive. However, all of the decennial sub-periods have a negative slope and the first two periods are statistically significant. The slope for the period after the Great Recession is also positive and statistically not significant. This means that if one chooses either the period 1981 to 1990 or 1991-2000 the conclusion would be that the EFNA for the regions are converging. On the other hand, if one chooses the periods 2001 to 2010, 2008 to 2014, or 1981 to 2014 there would be no evidence of convergence or divergence of EFNA among the regions.

Table 5: Regions Regressions of $Ln(Y_T/Y_0)$ on $Ln(Y_0)$

	1981-2014	1981-1990	1991-2000	2001-2010	2008-2014
Coefficient	0.002	-0.487	-0.734	-0.264	0.114
P-value	0.982	0.003	0.010	0.139	0.655
R^2	0.000	0.790	0.694	0.327	0.036
N	8	8	8	8	8

The ANOVA and the absolute β-convergence cast doubt on the equality of the means of the EBA regions. Furthermore, the inference based on the absolute β-convergence would depend on the choice of the period. One can argue that the BEA regions are not uniform and have been chosen on geographical proximity rather than economic similarity. Although one might expect that the within variation in a geographical region would be less than between region variations. Next, the absolute convergence of the 50 states are examined for the same periods as the above periods.

Table 6 depicts the results of regressions of the natural logarithm of the ratio of the last year's EFNA to the first year's EFNA on the natural logarithm of the first year's EFNA. All slopes are negative and statistically significant except for the period 2008-2014. EFNA for the entire period from 1981 to 2004 has converged indicating that over the 34 years the economic freedom among the states has become closer. When the range is broken down to decennial periods the same conclusion could be inferred for all periods. However, the same is not true for the period after the Great Recession (2008-2014). For the period since the Great Recession there is no evidence of convergence or divergence for EFNA among the States.

Table 6: State Regression of $Ln(Y_T/Y_0)$ on $Ln(Y_0)$

	1981-2014	1981-1990	1991-2000	2001-2010	2008-2014
Coefficient	-0.495	-0.394	-0.185	-0.172	-0.066
P-value	0	0	0.001	0.004	0.172
R^2	0.651	0.452	0.196	0.159	0.039
N	50	50	50	50	50

4 Conclusion

The present study examines the equality of the means of EFNA for EBA regions as well as the states in the United States. There is some evidence of equality of the means for some periods, but not all periods or classifications. The strongest evidence of convergence of EFNA is among the states when the absolute β-convergence is used, but even among the states the means of EFNA are far from being equal as is evidenced by the Two-Way ANOVA of the states. Furthermore, it is demonstrated that the choice of the period of study affects the conclusion of convergence or divergence although care was taken not to examine multitude of starting and ending periods to conduct the research.

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