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Abstract

Frank (2009) constructed a comprehensive panel of state-level income inequality measures using individual tax filing data from the Internal Revenue Service. Employing an array of cointegration exercises for the data, he reported a positive long-run relationship between income inequality and the real income per capita in the US. This paper questions the validity of his findings. First, we suggest a misspecification problem in his approach regarding the order of integration in the inequality index, which shows evidence of nonstationarity only for the post-1980 data. Second, we demonstrate that his findings are not reliable because his panel cointegration tests require cross-section independence, which is inappropriate for the US state-level data. Employing panel tests that allow cross-section dependence, we find no evidence of cointegration between inequality and the real income.

JEL Classification: D31; O40

Keywords: Inequality; Economic Growth; Cointegration; Cross-Section Dependence; Nonstationarity

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1 Introduction

The unprecedented rise in US income inequality since the early 1980's has been attracting the attention of researchers and policy makers over the last decades. The key question in the academic and public debate surrounding inequality is its relation to growth. The current empirical literature provides quite mixed evidence, finding the correlation to be either negative or positive, or insignificant.[1]

Early researches on this topic predominantly found a negative correlation. Many of them used modified versions of the cross-country economic growth model proposed by Barro (1991) augmented with an inequality variable. See, among others, Alesina and Perotti (1994), Alesina and Rodrik (1994), Persson and Tabellini (1994), Birdsall, Ross, and Sabot (1995), and Deininger and Squire (1998). However, Forbes (2000), later on, questioned the validity of these findings, pointing at omitted variable and measurement error biases in the earlier works due to the fact that inequality was measured differently in the countries studied in these cross-country analyses.

More recent studies point towards a positive relationship between income inequality and economic growth, following the significant work of Deininger and Squire (1996) who constructed an improved database of cross-country inequality measures. Using these data, Forbes (2000) reports that income inequality and growth are positively correlated. This improved database served as a significant basis for much of the subsequent empirical papers on the relationship between inequality and economic growth. See, among others, Aghion, Caroli, and Garcia-Penalosa (1999) and Deaton (2003).

Other researches find little or no evidence for a relationship (e.g., Quah (2001) and Panizza (2002)), and Barro (2000) reports a positive correlation in wealthier countries and a negative one in low-income countries. In summary, the profession has failed to reach consensus.

More recently, Frank (2009) constructed a valuable dataset for state-level income inequality measures, i.e., top percentile shares of income, using highly confidential data from the Internal Revenue Service (IRS). Employing this dataset for panel co-integration tests, he reported strong evidence of a positive correlation between income inequality and economic growth.

In this work we question the validity of Frank (2009)'s findings, using more rigorous econometric procedures for the same dataset. First, we note that income inequality and economic growth are assumed to be nonstationary in his work, which is necessary for co-

[1] For a compact review on the theoretical literature see Aghion et al (1999), and for a more recent and comprehensive one see Quadrini and Rios-Rull (2015). The empirical literature is reviewed below.

integration analyses. We demonstrate that the income inequality measures in most 49 US states tend to follow a nonstationary stochastic process since the 1980's, while it is better approximated by a stationary process prior to 1980. This implies that Frank (2009)'s (2009) conclusion might not be valid because he uses co-integration tests for the entire sample period. Second, his panel co-integration tests require cross-section independence, which we show is an inappropriate assumption for US state-level data in what follows. When this assumption fails to hold, statistical inferences may suffer from severe size distortion. Applying panel co-integration tests that allow cross-section dependence, we obtain virtually no evidence of a positive correlation between inequality and economic growth.

The remainder of this paper is organized as follows. Section II describes the data and provides preliminary analyses. In Section III, we first describe our econometric procedures. Then, we report and discuss our empirical results. Section IV concludes.

2 Data Descriptions and Pre-test Analyses

We employ annual observations of the state-level inequality data for 49 US states, which was compiled by Frank (2009). Using highly confidential IRS data, he constructed the top decile share of income data, that is, the percentage of total *income* held by the top 10% income earners in each state. Observations range from 1945 to 2011. We obtained the data from his website.[2] Also, we obtained the state-level real income per capita data from the Federal Reserve Economic Data (FRED) for the same sample period to measure economic growth in the US. The real income per capita is log-transformed.

We noticed a substantial degree of common tendency from each of the 49 state-level inequality measures. Similar co-movements were observed from the real income variables. This observation has an important implication on our econometric test procedures, because panel cointegration tests that require cross-section independence perform poorly when the true (panel) data-generating process is given a common factor structure. One may estimate a vector of common factors via the method of the principal components to study the patterns of the cross-section dependence. It turns out that the cross-section average of the data resembles the first common factor (see Pesaran (2007)). In order to see these common dynamics of these variables over time, we report the cross-section averages of the inequality and income variables in Figure 1.

Note that the cross-section mean of the real GDP per capita is continuously trending upward since the beginning of the data in 1945, while the top decile share of income exhibits a positive trend only after 1980. It should be noted that the inequality variable exhibits

[2] http://www.shsu.edu/eco_mwf/inequality.html

ups and downs around 32% until around 1980. Put it differently, the real GDP per capita seems to follow a non-stationary stochastic process for the entire sample period, whereas the stochastic nature of the inequality measure might have changed from a stationary process to a nonstationary process around 1980. This observation casts a doubt on the cointegration tests by Frank (2009) for the entire sample period, since a cointegration relationship requires a set of nonstationary variables. We implement an array of econometric tests in the next section to investigate these issues.

Figure 1 around here

3 Empirical Findings

3.1 Unit Root Tests

This section implements formal econometric tests for the stochastic properties of our key variables, inequality and real income data in 49 US states. For this purpose, we report an array of univariate and panel unit root tests for the two sub-sample periods, the pre-1980 and post-1980 samples, which are crucially important for the validity of the panel cointegration tests we implement afterward.

3.1.1 Univariate Unit Root Tests

We employ the conventional augmented Dickey-Fuller (ADF) test on two sub-samples: the pre-1980 (1945-1979) and the post-1980 (1980-2011) periods. We use 1980 as an *ad hoc* break point based on our eye-ball inspection of the inequality graph shown in Figure 1. We do not attempt to estimate the structural break date, because, to the best of our knowledge, no econometric procedures are available when the data generating process (DGP) changes from a stationary process to a nonstationary one in the middle of the data. However, many researchers acknowledge that the late 1970's or early 1980's as the time when income inequality in the US started to grow rapidly. See, for example, e.g. Frank (2009) and Saez and Zucman (2014).

The ADF test is based on the following regression model for each US state.

$$\Delta y_t = \alpha + \rho y_{t-1} + \sum_{j=1}^{p} \beta_j \Delta y_{t-j} + \varepsilon_t \tag{1}$$

The ADF test statistic is defined as,

$$ADF = \frac{\hat{\rho}}{s.e.(\hat{\rho})}, \tag{2}$$

where $\hat{\rho}$ is the ordinary least squares (OLS) estimate of ρ and $s.e.(\hat{\rho})$ is the OLS standard error. We chose 2 lags ($p = 1$) via the Bayesian Information Criteria. We report the test results in Tables 1 through 4.

In the pre-1980's sample period, the ADF test rejects the null of nonstationarity in the inequality series for 32 out of 49 states, which is slightly over 65% of the total samples. Since the ADF test lacks the power in small samples, we interpret such results as strong evidence of stationarity for the pre-1980's inequality series. On the other hand, we find no evidence in favor of stationarity for the post 1980's inequality series as the test fails to reject the null for all 49 states even at the 10% significance level. Therefore, it seems that the inequality series exhibit nonstationarity only for the post-1980's data.

As to the real income series, we observe very weak evidence of stationary in both sub-samples. The ADF test fails to reject the null for all states in the pre-1980's, whereas it rejects the null for 6 out of 49 states (about 13%) for the post-1980's data. We also note that the evidence of stationarity for 6 states lacks robustness to the number of lags. Overall, the test implies that the real income series obey a nonstationary process, which is consistent with the upward trend as seen in Figure 1.

In a nutshell, our univariate ADF test supports the nonstationarity of the inequality variable only for the post-1980's samples, while the real income data seems to obey a nonstationary process for the entire sample period. Therefore, cointegration tests for the full sample period (Frank (2009)) seem to have a misspecification problem.

Tables 1, 2, 3, and 4 around here

3.1.2 Panel Unit Root Test

We note that the pre-1980 and the post-1980 sub-samples include 35 and 32 annual observations, respectively. Since the univariate ADF test has low power in small samples, we investigate the possibility that weak evidence of stationarity is due to lack of power. For this purpose, we implement a panel unit root test proposed by Pesaran (2007). By adding more observations in a panel framework, we may expect greater power from using panel test (Taylor and Sarno (1998)). However, it is crucially important to do a pre-test about the cross-section structure of the panel data, because panel tests that require cross-section independence suffer from severe size distortion in the presence of the cross-section dependence.

Via the formal test proposed by Pesaran (2004), we establish the existence of cross-section dependence in our data by using the following test statistic.

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{i,j} \right) \xrightarrow{d} N(0,1) \tag{3}$$

where $\hat{\rho}_{i,j}$ is the pair-wise correlation coefficients from the residuals of the ADF regressions in (1) for each state. The test results in Table 5 imply a strong presence of cross-section dependence in the panels for inequality and real income per capita. The test statistics rejects the null of the cross-section dependence with a 0% p-value for both series. Total average $\hat{\rho}$ is 0.473 and 0.524 for inequality and the real income, respectively. We also report average correlations of each state in Figures 2 and 3, which show high degree cross-section dependence in both variables.

Table 5, Figures 2 and 3 around here

Since both the inequality and the real income series are characterized by cross-section dependence, we need to use the so-called second generation panel unit root tests.[3] In this paper, we implement a revised version panel unit root test proposed by Pesaran (2007)) with the following least squares regression model.

$$\Delta y_{i,t} = \alpha_i + \beta_i y_{i,t-1} + \gamma_i \bar{y}_{t-1} + \sum_{j=0}^{p} \theta_{ij} \Delta \bar{y}_{t-j} + \sum_{j=1}^{p} \delta_{ij} \Delta y_{i,t-j} + \varepsilon_{i,t} \tag{4}$$

where $y_{i,t}$ is a variable in state $i \in \{1, 2, ..., N\}$ at time t and $\bar{y}_t$ denotes the common factor at time t, which is proxied by the cross-section mean, $N^{-1} \sum_{i=1}^{N} y_{i,t}$. Note that this is a version of the ADF regression model extended by the cross-section mean in order to control for the effect of the common factor on the panel unit root test. The panel test statistic is then computed as follows.

$$t(N,T) = N^{-1} \sum_{i=1}^{N} t_i(N,T) \tag{5}$$

where $t_i(N,T)$ is the t-statistic for β_i from the regression equation (4) for state $i \in \{1, 2, ..., N\}$.

[3]First generation panel unit root tests such as the ones by Im, Pesaran, and Shin (2003), Levin, Lin, and James Chu (2002), and Maddala and Wu (1999) require the cross-section independence. Since the US state-level data exhibit high degree cross-section dependence, we cannot use those tests.

It should be noted that the panel unit root test using this procedure requires an assumption that the common factor is *stationary.* When this assumption holds, the panel unit root test based on (5) provides meaningful inferences on the stationarity of the panel $\{y_{i,t}\}_{i=1,..,N,t=1,..,T}$. If this assumption fails, however, stationarity evidence from idiosyncratic components does not necessarily provide evidence in favor of stationarity.

Therefore, we first report the ADF test results for the common factors of the inequality and the real income data in Table 6. Table 7 provides Pesaran's (2007) panel unit root test results based on (5). Note that the ADF test rejects the null of nonstationarity only for the inequality common factor during the pre-1980 period. Given this, strong evidence of panel stationarity for the idiosyncratic components implies that only the inequality for the pre-1980 period obeys a stationary stochastic process.

In a nutshell, we conclude that there is a possible misspecification problem in Frank (2009)'s approach, who uses panel cointegration tests for the state-level data for the inequality and the real income. Cointegration tests require nonstationarity in all variables in the cointegrating relationship. Our unit root tests imply that one may employ a panel cointegration framework only for the post-1980 sample periods, because the inequality series show clear evidence of stationarity for the pre-1980 samples.

Tables 6 and 7 around here

3.2 Cointegration Test

In addition to the nonstationarity issue, Frank (2009)'s findings may not be valid because he employed cointegration tests that require cross-section *independence*. In this section, we implement robust cointegration tests that incorporate cross-section dependence in the data. We demonstrate that Frank's finding of a positive relationship between inequality and the real income is not supported by data when correct econometric procedures are used.

Even though it is appropriate to test for cointegration only for the post-1980 sample period because both inequality and the real income obey a nonstationary process, here we implement the test using the full sample to emulate the work of Frank (2009) with cross-section independence and compare the results with ours with cross-section dependence.

For this purpose, we employ the error correction-based panel cointegration tests proposed by Persyn and Westerlund (2008). The tests allow for a large degree of heterogeneity between the cross-sectional units and can account for cross section dependence via bootstraps. The tests assume the following data-generating process.

$$\Delta y_{it} = \delta_i'\mathbf{d}_t + \alpha_i(y_{i,t-1} - \beta_i'\mathbf{x}_{i,t-1}) + \sum_{j=1}^{p_i} \alpha_{ij}\Delta y_{i,t-j} + \sum_{j=-q_i}^{p_i} \gamma_{ij}\Delta\mathbf{x}_{i,t-j} + e_{it}, \tag{6}$$

where $\mathbf{d}_t$ is a vector (or scalar) of deterministic components. α_i denotes the error correction parameter with the cointegrating vector $[1 \quad -\beta_i']'$. p_i and q_i are the numbers of lags and leads, respectively. (6) can be rewritten as follows.

$$\Delta y_{it} = \delta_i'\mathbf{d}_t + \alpha_i y_{i,t-1} - \lambda_i' x_{i,t-1} + \sum_{j=1}^{p_i} \alpha_{ij}\Delta y_{i,t-j} + \sum_{j=-q_i}^{p_i} \gamma_{ij}\Delta x_{i,t-j} + e_{it}, \tag{7}$$

where $\lambda_i' = -\alpha_i\beta_i'$. Note that $\alpha_i < 0$ implies that there is an error correction when deviations from the long-run equilibrium occur. If $\alpha_i = 0$, there is no cointegration because there is no adjustment toward the long-run equilibrium when shocks occur.

Persyn and Westerlund (2008) propose two types of the cointegration test with the null hypothesis $H_0 : \alpha_i = 0, \forall i$, that is, there is no cointegration for all i. Note that the test can be implemented without paying much attention on the cointegration vector itself. He proposes two alternative cointegration tests: the group mean tests and the panel tests. The *group mean test* does not require homogeneity in α_i estimates. That is, the alternative hypothesis is, $H_A : \alpha_i < 0$, for at least one i. On the other hand, his *panel test* requires homogeneity with $H_A : \alpha_i = \alpha < 0, \forall i$.

Our test results in Table 8 clearly reveal our point. When we impose a cross-section independence assumption, both the group mean test and the panel test strongly reject the null of no cointegration. However, the test that incorporates cross-section dependence via bootstrap fails to reject the null of no cointegration whichever specifications are employed.[4] Put it differently, Frank's empirical results seem to be caused by size distortion due to the cross-section independence assumption in addition to the misspecification problem which was explained in the previous section. Accounting for cross-section dependence in our cointegration tests, we find no statistically meaningful evidence for cointegration between inequality and the real income.

Table 8 around here

[4]We implemented the same tests with different combinations of leads and lags and different types of kernels and bandwidths. Results are very similar each other. All results are available upon request.

4 Conclusion

This paper revisits the cointegrating relationship between income inequality and economic growth using Frank (2009)'s state-level inequality measures data constructed from confidential individual tax filing data from the IRS.

We questioned the validity of Frank (2009)'s finding that implies a positive long-run relationship between inequality and economic growth based on the following two issues. First, his cointegration analyses may have a misspecification problem as to the order of integration of the data. As is well documented, cointegrating tests can be implemented among the integrated non-stationary variables. Via an array of univariate and panel unit root tests, we demonstrate that the nature of the stochastic process in the income inequality series has changed around 1980. More specifically, the inequality index seems to obey a stationary process during the pre-1980 sample period, while the real income data follows a non-stationary process for the entire sample period. That is, the econometric model in Frank (2009) may be misspecified for the pre-1980 data.

Second, we note that Frank's panel cointegration tests require cross-section independence, which is strongly rejected by our test for the US state-level data. Employing rigorous panel cointegration tests that allow cross-section dependence via bootstrap, we find no such evidence of a stable long-run relationship using the same data. When we employ the test imposing cross-section independence as in Frank (2008), we obtain the same positive cointegration results. Put it differently, the strong cointegration found in Frank (2009) is likely to be caused by size distortion.

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Table 1. Unit Root Test for the Inequality Index: 1945 to 1979

State	ADF	State	ADF
Alabama	-2.700 *	Nebraska	-3.927 ***
Arizona	-3.321 **	Nevada	-3.983 ***
Arkansas	-3.846 ***	New Hampshire	-2.987 **
California	-2.086	New Jersey	-1.669
Colorado	-2.845 *	New Mexico	-2.497
Connecticut	-2.796 *	New York	-2.765 *
Delaware	-0.957	North Carolina	-2.948 **
District of Columbia	-1.121	North Dakota	-2.415
Florida	-3.530 ***	Ohio	-2.470
Georgia	-3.574 ***	Oklahoma	-2.985 **
Idaho	-3.582 ***	Oregon	-1.865
Illinois	-2.948 **	Pennsylvania	-2.805 *
Indiana	-2.280	Rhode Island	-4.349 ***
Iowa	-2.383	South Carolina	-2.490
Kansas	-2.352	South Dakota	-3.134 **
Kentucky	-3.423 **	Tennessee	-2.734 *
Louisiana	-3.202 **	Texas	-2.811 *
Maine	-4.534 ***	Utah	-1.407
Maryland	-2.220	Vermont	-2.578 *
Massachusetts	-2.372	Virginia	-3.206 **
Michigan	-4.563 ***	Washington	-1.257
Minnesota	-2.250	West Virginia	-3.237 **
Mississipi	-3.142 **	Wisconsin	-3.122 **
Missouri	-3.073 **	Wyoming	-3.112 **
Montana	-2.584 *		

Note: We report the ADF test results with an intercept. *, **, and *** denote rejections of the null hypothesis of nonstationarity in the 10%, 5%, and 1% significance level, respectively.

Table 2. Unit Root Test for the Income per capita: 1945 to 1979

State	ADF	State	ADF
Alabama	0.391	Nebraska	-0.193
Arizona	-0.444	Nevada	-0.842
Arkansas	0.237	New Hampshire	-0.982
California	-0.795	New Jersey	-1.359
Colorado	0.031	New Mexico	-0.955
Connecticut	-1.085	New York	-1.620
Delaware	-0.516	North Carolina	0.291
District of Columbia	-0.384	North Dakota	-0.528
Florida	-1.064	Ohio	0.064
Georgia	-1.326	Oklahoma	0.185
Idaho	0.208	Oregon	1.623
Illinois	-0.356	Pennsylvania	-0.857
Indiana	-0.075	Rhode Island	-0.946
Iowa	-0.007	South Carolina	0.245
Kansas	0.201	South Dakota	0.606
Kentucky	-0.357	Tennessee	-0.917
Louisiana	-0.172	Texas	0.704
Maine	0.375	Utah	0.257
Maryland	-1.194	Vermont	-0.640
Massachusetts	-1.417	Virginia	-0.754
Michigan	-0.202	Washington	-0.676
Minnesota	0.285	West Virginia	0.627
Mississipi	0.468	Wisconsin	-0.322
Missouri	-0.960	Wyoming	1.650
Montana	0.486		

Note: We report the ADF test results with an intercept. *, **, and *** denote rejections of the null hypothesis of nonstationarity in the 10%, 5%, and 1% significance level, respectively.

Table 3. Unit Root Test for the Inequality Index: 1980 to 2011

State	ADF	State	ADF
Alabama	-1.682	Nebraska	-1.559
Arizona	-1.583	Nevada	-1.741
Arkansas	-0.895	New Hampshire	-1.656
California	-1.772	New Jersey	-2.208
Colorado	-1.614	New Mexico	-1.384
Connecticut	-1.429	New York	-1.769
Delaware	-1.959	North Carolina	-1.773
District of Columbia	-2.135	North Dakota	0.332
Florida	-1.989	Ohio	-1.428
Georgia	-1.799	Oklahoma	-1.414
Idaho	-1.551	Oregon	-1.882
Illinois	-2.500	Pennsylvania	-2.550
Indiana	-2.473	Rhode Island	-1.867
Iowa	-1.155	South Carolina	-1.665
Kansas	-1.919	South Dakota	-0.997
Kentucky	-1.828	Tennessee	-1.863
Louisiana	-2.498	Texas	-1.902
Maine	-1.651	Utah	-2.150
Maryland	-2.082	Vermont	-1.392
Massachusetts	-1.418	Virginia	-1.850
Michigan	-2.256	Washington	-1.690
Minnesota	-1.670	West Virginia	-1.346
Mississipi	-1.166	Wisconsin	-2.227
Missouri	-2.194	Wyoming	-1.779
Montana	-1.752		

Note: We report the ADF test results with an intercept. *, **, and *** denote rejections of the null hypothesis of nonstationarity in the 10%, 5%, and 1% significance level, respectively.

Table 4. Unit Root Test for the Income per capita: 1980 to 2011

State	ADF	State	ADF
Alabama	-2.972 **	Nebraska	-1.400
Arizona	-1.562	Nevada	-1.537
Arkansas	-1.772	New Hampshire	-2.616 *
California	-1.409	New Jersey	-2.412
Colorado	-1.525	New Mexico	-1.054
Connecticut	-2.189	New York	-2.099
Delaware	-2.512	North Carolina	-3.355 **
District of Columbia	-0.535	North Dakota	0.968
Florida	-2.148	Ohio	-1.975
Georgia	-3.534 ***	Oklahoma	0.058
Idaho	-1.320	Oregon	-1.265
Illinois	-1.860	Pennsylvania	-1.807
Indiana	-1.931	Rhode Island	-2.086
Iowa	-0.321	South Carolina	-2.890 **
Kansas	-1.251	South Dakota	-0.439
Kentucky	-2.272	Tennessee	-2.808 *
Louisiana	-0.116	Texas	-0.885
Maine	-2.311	Utah	-1.217
Maryland	-2.174	Vermont	-1.824
Massachusetts	-2.485	Virginia	-2.181
Michigan	-1.977	Washington	-1.147
Minnesota	-1.679	West Virginia	-0.673
Mississipi	-1.383	Wisconsin	-1.273
Missouri	-2.225	Wyoming	0.086
Montana	0.058		

Note: We report the ADF test results with an intercept. *, **, and *** denote rejections of the null hypothesis of nonstationarity in the 10%, 5%, and 1% significance level, respectively.

Table 5. Cross-Section Dependence Test Results

	Inequality	Real Income
CD	129.68 ***	143.86 ***
Average $\hat{\rho}$	0.473	0.524

Note: CD is Pesaran's (2004) cross-section dependence statistic. *** denotes a rejection of the cross-section independence at the 1% significance level.

Table 6. Unit Root Test Results: Common Components

	Inequality	Real Income
$1945 - 1979$	-2.541 *	0.488
$1980 - 2011$	-2.072	-1.638

Note: The common components are identified by taking the cross-section means of the series. The first common factors estimated via the method of the principal components are qualitatively similar to the cross-section means. * denotes a rejection of the nonstationarity null hypothesis at the 10% significance level.

Table 7. Panel Unit Root Test Results: Idiosyncratic Components

	Inequality	Real Income
1945 – 1979	-3.310 ***	-2.694 ***
1980 – 2011	-2.473 ***	-2.075 *

Note: Test statistics are from Pesaran (2008) that controls the cross-section dependence. * and *** denote rejections of the nonstationarity null hypothesis at the 10% and 1% significance level, respectively.

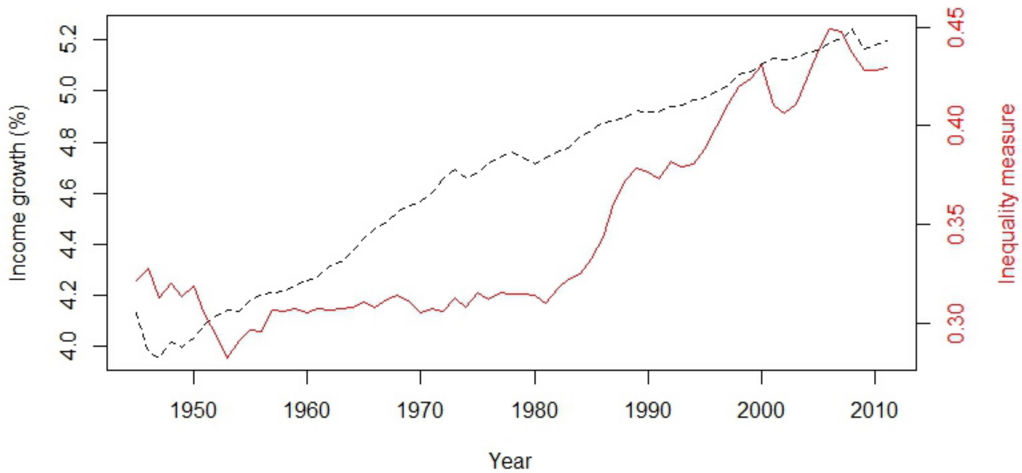
Table 8. Panel Cointegration Test Results

	Tests with an intercept		
	Statistics	p-value	p-value with CSD
Group Mean Test	-2.025	0.034	0.550
Panel Test	-13.969	0.000	0.312

	Tests with an intercept and time trend		
	Statistics	p-value	p-value with CSD
Group Mean Test	-3.065	0.000	0.186
Panel Test	-17.311	0.002	0.702

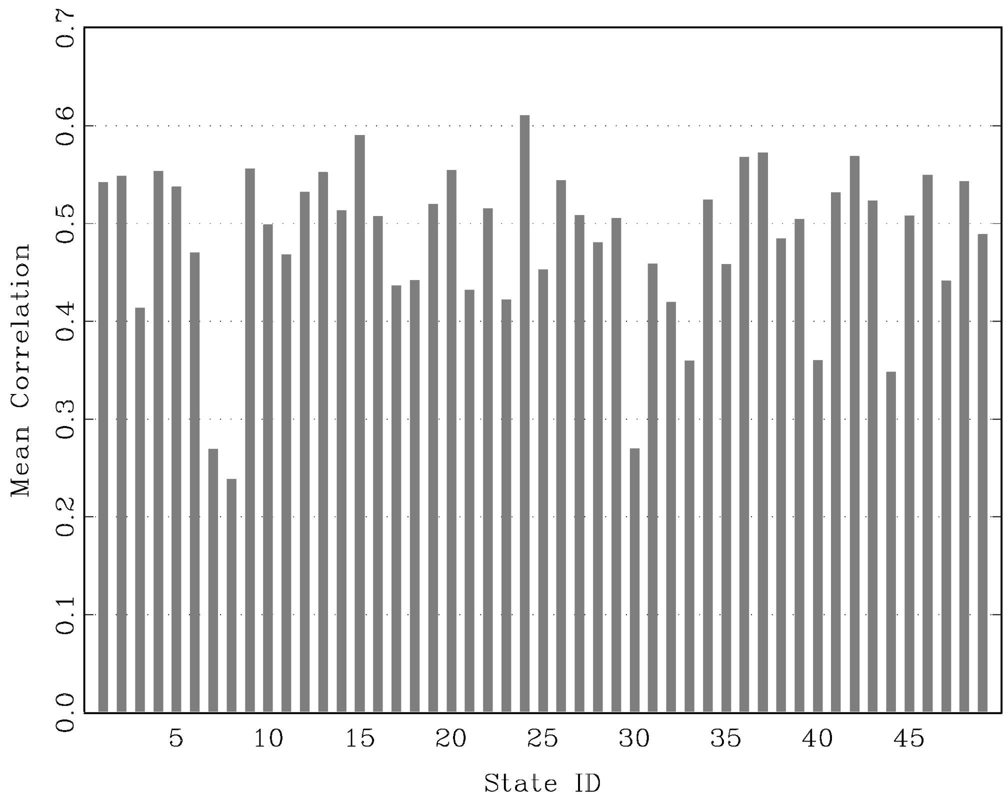
Note: We implement Westerlund's (2007) t-test type panel cointegration test statistics. Number of leads and lags are determined by the AIC. p-value is not sized correctly when cross-section independence fails to hold. p-value with CSD denotes p-values with cross-section dependence via 500 bootstraps. The null hypothesis is no cointegration for both tests. The group mean test does not require homogeneity and the alternative hypothesis is there is at least one cointegration. The panel test does require homogeneity and the alternative hypothesis is the common cointegration exists for all panel seris.

Figure 1. Inequality and Real Income per capita



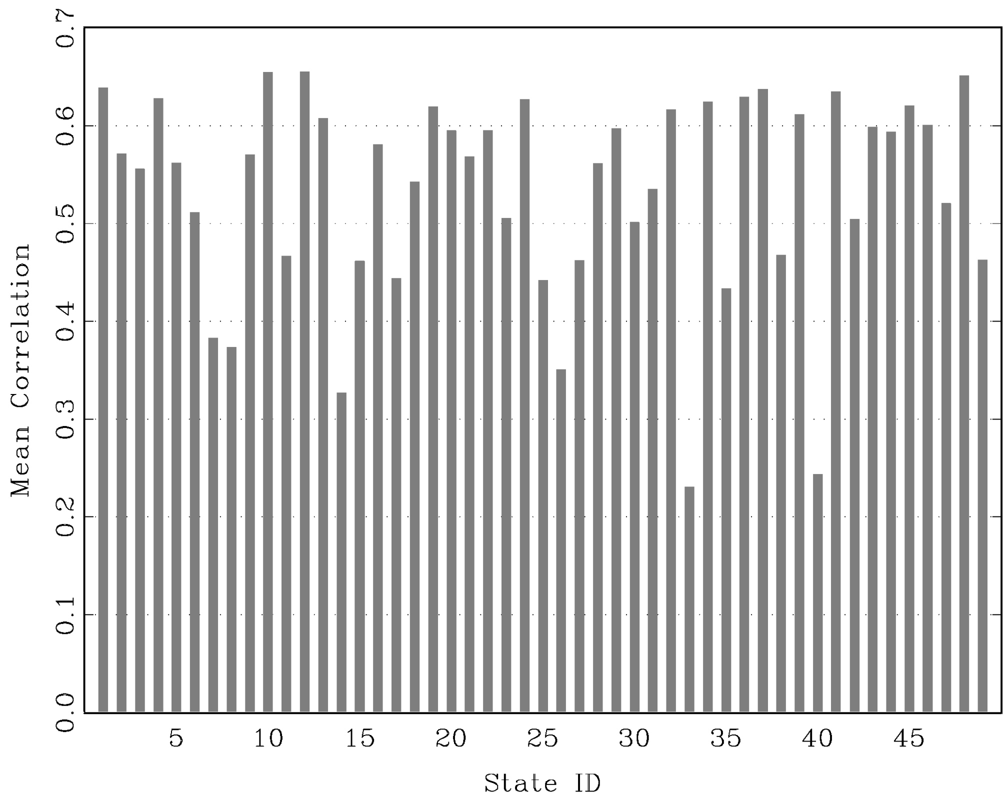
Note: Cross-section averages of the 49 state-level data are presented.

Figure 2. Mean Correlation Coefficients: Inequalty Series



Note: We report the mean correlation coefficient of each state with respect to other 48 states.

Figure 3. Mean Correlation Coefficients: Real Income Series



Note: We report the mean correlation coefficient of each state with respect to other 48 states.