Applied Time Series and Panel Data

The Economic Appropriateness of Political Orientations

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I. Abstract

This paper conducts two types of panel data regressions – Fixed Effects and Random Effects, with a total of 18 regressions, on a data set comprising of the 50 States of the Unites States of America over a 15-year time frame (from 2006-2021). It uses a combination of 3 economic variables (GDP Growth Rate, Unemployment Growth Rate and Inequality Growth Rate [measured by the percentage change in income inequality]) to understand if certain political orientations are better equipped than others when dealing with economic downturns or improving macroeconomic conditions. It analyses the data set using the hypothesis that right-wing governments, proxied by the Republican Governor, are better suited to efficiency, while the left-wing Democrat leader is designed to create equality.

II. Introduction

Most governments in the world today are democratically lead. There are free and competitive elections, checks on political power, economic activities that boost citizen welfare and the continuous expansion of civil rights. However, democracy has evolved over time, to root itself into the orientation of the government that leads it, which, by definition, takes the side of either the left wing, the right wing, or a weighted amalgamation of the two, that they use to define their position on the political, social, ideological and economic spectrums.

Traditionally, the right wing has always been labelled as the 'conservative' orientation or wing, in many democracies, the key right-wing party also shares the moniker of the 'conservative party'. This is partially because of the right wing's ideas to 'keep the nation first' which implied, closed economic policy, with little dependence on external outcomes, policies that favour current and most importantly free-market orientation without interference from government, with the notion that the 'the market can correct for inefficiencies by itself'. This type of government tends to focus on efficiency, and prioritizes this efficiency over equality, therefore, right-wing leaders endeavour to improve growth, reduce unemployment, and attempt to improve productivity.

On the other hand, the left-wing has almost always been considered the liberal-side of government, that focuses on reducing barriers to trade, international participation, equality in policy, in citizenship and even in economic livelihoods of the public. The left-wing, is also usually labelled as the progressive side, denoted as the 'progressive-left', their chief objective being, the reduction of disparity and inequality through government-augment redistribution efforts. The progressive-left also champions the cause of social equality, in terms of the advocation of women's empowerment, LGBTQ rights, and so on. Economically, this paper hypothesizes that the left-wing government will reduce income inequality, as is explained by Kohli (1989)[1].

This paper aims to understand if certain political orientations are especially suited to certain forms of economic development and growth.

[1] https://www.princeton.edu/~kohli/docs/Liberalization03_1989.pdf

It will focus on shedding light on the hypothesis that right wing governments are more suited towards focusing on efficiency (measured by real GDP growth, and unemployment reductions) whereas left-wing governments are more suited towards reducing inequality (measured by changes in the personal incomes).

This study will utilise a panel data set comprising a statewise distribution of the 50 American States over a 15-year time-frame. Here, the Entity will be the State, and the Time will be the Year.

III. Literature Review

Understanding the impact of democracy on growth, has been an area of study that has warranted much attention, especially over the course of the last decade, with drastic changes in the way institutions function, and countries witnessing numerous changes in political institutions, within short spans of time. Acemoglu et al.'s (2018), seminal work on Democracy causing growth, conclusively established the long run impacts of Democracy being a 20-25% increase in real gdp per capita[2]. Various other authors also work in similar areas as they uncover links between inequality, growth and unemployment from a democratization context. However, a magnified look within a Democratic nation, to understand the links between political orientations and economic growth, has not seen as much comprehensive work.

Most of the economic and econometric literature in this area is region specific. For instance, Ahrend (2007)'s research[3] on the impact of political institutions on growth, is focused on 77 Russian from 1990 -1998. Another paper by Cheliotis and Xenakis (2020)[4], focuses on political orientations, economic conditions and incarceration in Greece. This paper explains how certain political orientations are more likely to increase forms of punishment in society, increasing fear and thus efficiency and public dissatisfaction. It attempts to provide a generally applicable juxtaposition between fear and efficiency using the political orientations of the Syrian-led government in Greece. In a series of essays edited by Kohli and Basu (1998)[5], the authors look at regions within India that share similar cultures, and attempt to understand the links between democratic institutions, violence, and economic growth. While their main focus was to understand the impact of levels of democratic institutionalization on growth, they also found that, depending on culture and authority, nationalistic parties carry the ability to exercise power to limit violence and improve growth.

One reason for such geo-centric work, is perhaps because of the existence of region-specific effects such as culture, that affect how citizens elect leaders, and spending behaviour as well. This may lead to endogeneity, when we look at geographically-diverse data sets and perhaps even lead to

[2] Acemoglu, Naidu, Restrepo, Robinson (2019). 'Democracy Does Cause Growth', Journal of Political Economy, 2019, 127:1, 47-100. https://doi.org/10.1086/700936
[3] https://doi.org/10.1080/14631370500204198
[4] Cheliotis LK, Xenakis S. What's Left? Political orientation, economic conditions and incarceration in Greece under Syriza-led government. European Journal of Criminology. 2021;18(1):74-100. doi:10.1177/1477370820966568
[5] Community Conflicts and the State in India. Edited by AMRITA BASU and ATUL KOHLI. Delhi: Oxford University Press, 1998. xi, 287 pp..

misleading interpretations. Even when controlling for such individual or time-specific effects, by using perhaps a 'within' panel estimation, there could be factors such as the growth rate of population, that change over time and our specific to the country, that lead to endogeneity. The series of essays (Kohli and Basu, 1998), lends support to this claim. Alternatively, one may also prefer region-specific regressions due to the availability of data, and the orientation of the research idea. This paper utilizes a region-specific approach, precisely because the orientation of the research topic is specifically suited to the United States of America.

The expanse of literature centered around political orientations in the US States is surprisingly minimal. Given the diversity in social groups, economic policy preferences, ideologies, and even cultures, one would generally expect a myriad of resources as reference when working on such similar research. However, in actuality, this is far from the case. This paper aims to introduce work in this academic spectrum and allow for significant dialogue and economic analysis to take place accounting for Diversity. Eventually, this work can and should be extended to various other nations, as we account for individual cultures and connotations in the same manner as authors have done.

IV. Data and Descriptive Statistics

We are using a multitude of resources to gather our data points, and as we use them to understand our values, it becomes imperative to understand how these are defined to understand the impact of each variable.

1. **Real GDP Growth (*GDP_Growth*)**:- One of our primary areas of study, we look at the effect of a governor on that state's real Gross Domestic Product (GDP) growth. Our hypothesis suggests that a right-wing government would result in increases in GDP Growth. This variable has been procured by data from the *Bureau of Economic Analysis* (BEA)[6]. Since this data was gathered in quarterly intervals, the *GDP_Growth* has been calculated using the first quarter findings. GDP Growth is measured by:

$$GDP\_Growth_{i,t+1} = \frac{GDP_{i,t+1} - GDP_{i,t}}{GDP_{i,t}} * 100$$

   Where *i* is the respective US State, and *t* is year value that varies from 2006 to 2020.

2. **Income Inequality (perchg_inc_ineq)**:- To understand the hypothesis of the different political orientations improving different economic variables, we are also considering the impact of the left wing (Democrats) on income inequality. To calculate income inequality, we are using the Interquartile range of the income distribution, and then normalizing this by the median. This data has been gathered by using the Monthly Household Income Data

[6] Bureau of Economic Analysis, Real GDP Data, Organised by State - https://www.bea.gov/data/gdp/gdp-state

from US Census archives, presented by *IPUMS USA* [7]. The formula utilized to estimate the income inequality is given below:

$$Ineq_{i,t} = \frac{Income\ at\ 75th\ percentile_{i,t} - Income\ at\ 25th\ percentile_{i,t}}{Median\ Income_{i,t}}$$

We then take the percentage change in our measure of income inequality, and use it in our analysis. This is a standard percentage change formula that is given by:

$$perchg\_inc\_ineq_{i,t+1} = \frac{Ineq_{i,t+1} - Ineq_{i,t}}{Ineq_{i,t}} * 100$$

Where *i* is the respective US State, and *t* is year value that varies from 2006 to 2020.

3. **Unemployment Growth (Ugrowth)**:- A metric for the growth rate of unemployment has also been captured. The main idea behind utilizing this particular variable is that, it is related to both income inequality (*positively* - as with an increase in the unemployment rate, it is more likely that economically poorer sections of society face the most impact, and therefore see drops in their income), and real GDP Growth(*negatively* – there is no dearth of economic literature that informs us of the inverse relationship between GDP growth and unemployment growth – for instance, Okun's Law[8]). This data has been gathered from the *Bureau of Labour Statistics* (BLS)[9]. We estimate unemployment growth with the following formula:

$$Ugrowth_{i,t+1} = \frac{Unem\ Rate_{i,t+1} - Unem\ Rate_{i,t}}{Unem\ Rate_{i,t}} * 100$$

Where *i* is the respective US State, and *t* is year value that varies from 2006 to 2020.

4. **Governor of State (GOS)**:- Perhaps the most important data variable that is required for the purpose of this paper is the governor of each state at every year in our sample. This has been encoded as a dichotomous(dummy) variable which denotes if the governor of the state was a Republican by the value 0, or a Democrat by the value 1, in each state at every year. In other words Republican = 0, and Democrat = 1 per this index[10]. We consider, for all intents and purposes of this paper, that Democrats represent the left-wing, while Republicans represent the right-wing.

[7] US Census Data for Social, Economic and Health Research - https://usa.ipums.org/
[8] Klenton and Scott, 2020, Investopedia. 'Okun's Law' https://www.investopedia.com/terms/o/okunslaw.asp
[9] Bureau of Labour Statistics, Seasonally Adjusted Unemployment Rate, Organised by State- https://www.bls.gov/
[10] This data has been gathered manually by Noor Puliani who has visited various webpages and understood the orientation of the governor. It has not yet been uploaded to her website for public use.

In our time frame, two governors, identified as members of independent parties (neither Democrat nor Republican) and a secondary analysis has been conducted to assign these candidates to one side of the spectrum (please see footnote[11] for explanation). These governors are:-

a. Alaska (2014-2017) – Gov. Bill Walker identified as an independent candidate, and for this paper has been 'converted' to a 'Democrat' representative, and shows the value '1' for his tenure as governor. This is because his policies were relatively left-wing, and he had also formed a coalition with a Democrat member to contest elections. It is assumed that one would not work with a candidate who does not share similarities in policy or ideology or both.
b. Rhode Island (2011-2012) – Gov. Lincoln Chaffee identified as an independent candidate, and for this paper has been 'converted' to a 'Democrat' representative, and shows the value '1' for his tenure as governor. This is because his tax-policy was to increase taxes, which identifies as a traditional left-wing policy.

In summary, our data set is therefore a strongly balanced, wide panel that uses data from all the 50 states, from the years 2006-2020.

V. Model and Methodology

a. Fixed Effects Model

We will consider a fixed effects model first. We will be using a within estimation as we conduct the analysis. This is because, the within estimator allows us to demean the values with entity specific averages over time, reducing the chances of Omitted Variable Bias in these regressions. It is important to note, as the within-estimator works on demeaning, it also removes the constant, and hence regressions below do not show 'constant' or 'Intercept' terms in the output

i. GDP Growth

We can begin my understanding the impact of the governor of a state on the GDP Growth rate.

1. Regression: GDP 1 – FE

$$GDPGrowth_{i,t} = \alpha_0 + \boldsymbol{\beta} GOS_{i,t} + \gamma_i + \varepsilon_{i,t}$$

[11] While it is commonly understood that the political spectrum, like most spectrums, is not clearly bifurcated into two parts, for the purpose of analysing and presenting the results of this paper, representing these governors as part of a dichotomous index seemed to be a relatively risk-less undertaking that allows us to make important inferences as we proceed.

```
Oneway (individual) effect Within Model

Call:
plm(formula = GDP_Growth ~ GOS, data = pdf, model = "within")

Balanced Panel: n = 50, T = 15, N = 750

Residuals:
     Min.   1st Qu.    Median   3rd Qu.      Max.
-13.22519  -1.17783   0.12507   1.46120  18.26552

Coefficients:
    Estimate Std. Error t-value Pr(>|t|)
GOS -0.39174    0.27429 -1.4282   0.1537

Total Sum of Squares:    5661.1
Residual Sum of Squares: 5644.6
R-Squared:      0.0029096
Adj. R-Squared: -0.068413
F-statistic: 2.03973 on 1 and 699 DF, p-value: 0.15368
```

In this regression, we can see that the governor of a state, has no significant impact on the GDP growth rate of that state. If we were to extend the significance to greater than 16%, then we find that the governor of the state reduces the GDP Growth rate by .39 %

2. Regression: GDP 2 – FE

$$GDPGrowth_{i,t} = \alpha_0 + \boldsymbol{\beta} GOS_{i,t} + \delta UGrowth_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Within Model

Call:
plm(formula = GDP_Growth ~ GOS + Ugrowth, data = pdf, model = "within")

Balanced Panel: n = 50, T = 15, N = 750

Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-13.462672  -1.229186   0.059724   1.353154  17.885999

Coefficients:
          Estimate Std. Error t-value  Pr(>|t|)
GOS     -0.1969053  0.2648326 -0.7435    0.4574
Ugrowth -0.0206842  0.0026977 -7.6673 5.907e-14 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    5661.1
Residual Sum of Squares: 5206.1
R-Squared:      0.080363
Adj. R-Squared: 0.013169
F-statistic: 30.4977 on 2 and 698 DF, p-value: 2.0049e-13
```

In this model, we notice that the governor of the state has no significant impact on the GDP growth rate, while the unemployment growth is strongly significant and negatively related to the GDP growth rate. However, these results may be biased if the unemployment growth rate impacts the governor's chair in this model. A correlation test (pearson) suggests that there is no correlation between the governor and unemployment growth rate, however, political theory suggests otherwise, and therefore, this regression can be improved upon.

3. Regression: GDP 3 – FE

$$GDPGrowth_{i,t} = \alpha_0 + \boldsymbol{\beta} GOS_{i,t} + \delta UGrowth_{i,t} + \varphi perchginc_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Within Model

Call:
plm(formula = GDP_Growth ~ GOS + Ugrowth + perchg_inc_ineq, data = pdf,
    model = "within")

Balanced Panel: n = 50, T = 15, N = 750

Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-13.155061  -1.218587   0.087494   1.355702  17.961148

Coefficients:
                  Estimate Std. Error t-value  Pr(>|t|)
GOS             -0.1398498  0.2645153 -0.5287  0.597180
Ugrowth         -0.0201483  0.0026932 -7.4812 2.224e-13 ***
perchg_inc_ineq -0.0591793  0.0220305 -2.6862  0.007398 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    5661.1
Residual Sum of Squares: 5152.8
R-Squared:      0.089787
Adj. R-Squared: 0.02188
F-statistic: 22.9182 on 3 and 697 DF, p-value: 3.7001e-14
```

In this model, we consider a macro view of all the parameters in the model, which include GOS, Unemployment growth and percentage change in income inequality. We notice that the p-value for our GOS estimate actually increases, which implies that we cannot reject the null hypothesis that ß(hat) is significantly different from 0. Which implies that neither a Republican nor a Democrat governor make any difference to the GDP Growth rate. In contrast we find that unemployment and percentage changes in income inequality significantly impact GDP growth rate.

It is also imperative to note that the viability of this model hinges on the exogeneity assumption, because if any of the variables are correlated, it may lead to biasedness and inconsistency.

ii. Unemployment Growth

1. Regression: Unemployment 1 – FE

$$UGrowth_{i,t} = \alpha_0 + \boldsymbol{\beta} GOS_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Within Model

Call:
plm(formula = Ugrowth ~ GOS, data = pdf, model = "within")

Balanced Panel: n = 50, T = 15, N = 750

Residuals:
     Min.   1st Qu.    Median   3rd Qu.      Max.
-48.22925 -18.84881 -11.59158  -0.76722 335.77075

Coefficients:
    Estimate Std. Error t-value Pr(>|t|)
GOS   9.4195     3.6959  2.5486  0.01103 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    1034400
Residual Sum of Squares: 1024900
R-Squared:      0.0092068
Adj. R-Squared: -0.061665
F-statistic: 6.49535 on 1 and 699 DF, p-value: 0.011028
```

Here, we regress the governor of the state on the unemployment growth rate, and find that the results are statistically significant at the 5% level. Our results allow us to infer that a Democrat governor increases the unemployment growth rate by ~9.42 percentage points on average.

2. Regression: Unemployment 2 – FE

$$UGrowth_{i,t} = \alpha_0 + \beta GOS_{i,t} + \delta GDPgrowth + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Within Model

Call:
plm(formula = Ugrowth ~ GOS + perchg_inc_ineq, data = pdf, model = "within")

Balanced Panel: n = 50, T = 15, N = 750

Residuals:
     Min.   1st Qu.    Median   3rd Qu.      Max.
-49.75960 -18.51702 -11.97660  -0.19887 332.77241

Coefficients:
                Estimate Std. Error t-value Pr(>|t|)
GOS              8.78356    3.70263  2.3722  0.01795 *
perchg_inc_ineq  0.60597    0.30877  1.9625  0.05010 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    1034400
Residual Sum of Squares: 1019200
R-Squared:      0.014644
Adj. R-Squared: -0.057352
F-statistic: 5.18669 on 2 and 698 DF, p-value: 0.005808
```

In this model, we are now including the impact of percentage change in income inequality on Unemployment Growth. We notice that both parameters are significant at the 10% level and that the Democrat governor increases the unemployment growth rate by 8.78 percentage points and that increases in percentage change of income inequality, lead to an increase in the unemployment growth rate by 0.60 percentage points. These estimates can only be considered accurate if both independent parameters are uncorrelated with each other.

3. Regression: Unemployment 3 – FE

$$UGrowth_{i,t} = \alpha_0 + \beta GOS_{i,t} + \delta GDPgrowth_{i,t} + \varphi perchginc_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Within Model

Call:
plm(formula = Ugrowth ~ GOS + perchg_inc_ineq + GDP_Growth, data = pdf,
    model = "within")

Balanced Panel: n = 50, T = 15, N = 750

Residuals:
    Min.  1st Qu.   Median  3rd Qu.     Max.
-62.0160 -17.9713 -10.1519   2.6139 324.5453

Coefficients:
                Estimate Std. Error t-value  Pr(>|t|)
GOS              7.61475    3.56835  2.1340   0.03319 *
perchg_inc_ineq  0.34261    0.29936  1.1445   0.25283
GDP_Growth      -3.68914    0.49312 -7.4812 2.224e-13 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    1034400
Residual Sum of Squares: 943470
R-Squared:      0.087885
Adj. R-Squared: 0.019837
F-statistic: 22.3861 on 3 and 697 DF, p-value: 7.5773e-14
```

This final regression considers a macro view of all the parameters that we assume affect unemployment growth rate. We find that the governor significantly impacts unemployment growth rate at the 5% level (even though the standard error is quite high). We can observe that a Democrat governor increases the unemployment growth rate by 7.61 percentage points. We also find that GDP Growth is significantly and negatively related to unemployment growth rate.

Once again, if these values are correlated, it may lead to significant endogeneity, and therefore inconsistent results.

iii. Percentage Changes in Income Inequality

This part of the paper explores the relationship of the governor with Income Inequality under the Fixed Effects model.

1. Regression: Inequality 1 - FE:

$$perchginc_{i,t} = \alpha_0 + \beta GOS_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Within Model

Call:
plm(formula = perchg_inc_ineq ~ GOS, data = pdf, model = "within")

Balanced Panel: n = 50, T = 15, N = 750

Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-47.491012  -2.283691  -0.025445   2.384277  29.051352

Coefficients:
    Estimate Std. Error t-value Pr(>|t|)
GOS  1.04941    0.45182  2.3226  0.02049 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    15434
Residual Sum of Squares: 15316
R-Squared:      0.0076584
Adj. R-Squared: -0.063324
F-statistic: 5.39457 on 1 and 699 DF, p-value: 0.020486
```

This is perhaps one of the most important and controversial findings of our entire paper. This fixed effects regression, suggests that that a left-wing governor actually has a positive effect of increasing the percentage change in Income Inequality at a 5% significance level. If we consider this to be the true effect of a left-wing governor, then it tells us that a Democrat governor changes income inequality by 1.05 units, essentially implying that Democrats exacerbate income inequality.

2. Regression: Inequality 2 - FE:

$$perchginc_{i,t} = \alpha_0 + \beta GOS_{i,t} + \delta GDPGrowth_{i,t} + \gamma_i + \varepsilon_{i,t}$$

One may consider that the Regression: Inequality 1- FE may be subject to considerable Omitted Variable Bias, as there are various factors that may impact both the appointment of the governor and the percentage changes in income inequality, such as the governor's monthly income or their tax bracket, or perhaps even the ideological orientation of the electoral populous. One such factor may even be the GDP growth rate.

It would perhaps be logical to note that an increase in the GDP growth rate implies an increase in productivity as GDP is a metric for aggregate production(Callen, 2020)[12]. Therefore, an increase

[12] https://www.imf.org/external/pubs/ft/fandd/basics/gdp.htm

in the GDP, may also reduce unemployment growth because, to increase production, employers need to hire more workers. For now, to remove biasedness as a constraint, we are assuming that there is no correlation between the governor and unemployment growth. One theory to justify this assumption would be the realization of the maxim "An economist's lag is a politician's nightmare". Here, if the governor, Republican or Democrat implements a policy, then the impact of that policy will not be witnessed immediately, these effects take time and therefore carry a 'lag', which impacts the personal incomes, (therefore inequality and percent changes in income inequality) in a delayed fashion.

```
Oneway (individual) effect Within Model

Call:
plm(formula = perchg_inc_ineq ~ GOS + GDP_Growth, data = pdf,
    model = "within")

Balanced Panel: n = 50, T = 15, N = 750

Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-46.814315  -2.224340   0.068715   2.363270  28.740329

Coefficients:
            Estimate Std. Error t-value Pr(>|t|)
GOS         0.973532   0.449665  2.1650  0.03072 *
GDP_Growth -0.193707   0.061916 -3.1285  0.00183 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    15434
Residual Sum of Squares: 15104
R-Squared:      0.021381
Adj. R-Squared: -0.050123
F-statistic: 7.62499 on 2 and 698 DF, p-value: 0.00052986
```

Here we discuss the impact of GDP growth on percentage changes in income inequality in juxtaposition with the GOS variable, and find both of these parameters to be statistically significant at the 10% level. We observe that a Democrat governor increases the percentage change in income inequality by 0.97 percentage points. These results would only be consistent if the GDP Growth and GOS factors are uncorrelated.

3. Regression: Inequality 3 - FE:

$$perchginc_{i,t} = \alpha_0 + \beta GOS_{i,t} + \delta GDPGrowth_{i,t} + \varphi Ugrowth_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Within Model

Call:
plm(formula = perchg_inc_ineq ~ GOS + GDP_Growth + Ugrowth, data = pdf,
    model = "within")

Balanced Panel: n = 50, T = 15, N = 750

Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-46.867691  -2.244741   0.053373   2.353478  28.870441

Coefficients:
             Estimate Std. Error t-value Pr(>|t|)
GOS         0.9300185  0.4511699  2.0613 0.039640 *
GDP_Growth -0.1731467  0.0644569 -2.6862 0.007398 **
Ugrowth     0.0054746  0.0047836  1.1445 0.252828
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    15434
Residual Sum of Squares: 15076
R-Squared:      0.023217
Adj. R-Squared: -0.049657
F-statistic: 5.52218 on 3 and 697 DF, p-value: 0.00094567
```

In this model, we are combining the effects of Unemployment growth, GDP Growth and the governor on the changes in income inequality. Here we find that the impact of a Democrat governor is significantly impacting the percentage changes in income inequality at the 10% level, additionally, the GDP growth is significantly impacting the inequality change at 1% significance.

This model is only consistent if Ugrowth, GDP Growth and GOS are uncorrelated with each other.

Now we look at the Random Effects model.

b. Random Effects Model

One problem with the fixed effects model, is that it is less efficient than most other regression analyses and shows a high standard error in many cases. Therefore, we can also consider using the Random Effects Model. The one area of concern however is that the unobserved changes in the dependent variable, must not be causing changes in the independent variable. In case that it is correlated, our estimator will lose it’s property of unbiasedness and asymptotic consistency.

i. GDP Growth

1. Regression: GDP 1 – RE

$$GDPGrowth_{i,t} = \alpha_0 + \boldsymbol{\beta} GOS_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Random Effect Model
   (Swamy-Arora's transformation)

Call:
plm(formula = GDP_Growth ~ GOS, data = pdf, model = "random")

Balanced Panel: n = 50, T = 15, N = 750

Effects:
                 var std.dev share
idiosyncratic 8.0753  2.8417 0.966
individual    0.2863  0.5351 0.034
theta: 0.192

Residuals:
    Min.  1st Qu.   Median  3rd Qu.     Max.
-13.5012  -1.3260   0.2229   1.4687  20.8247

Coefficients:
            Estimate Std. Error z-value Pr(>|z|)
(Intercept)  1.57627    0.16304  9.6682  < 2e-16 ***
GOS         -0.40809    0.22578 -1.8075  0.07069 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    6058.7
Residual Sum of Squares: 6032.3
R-Squared:      0.0043486
Adj. R-Squared: 0.0030175
Chisq: 3.26692 on 1 DF, p-value: 0.07069
```

In our first Random Effects model, we look at the direct impact of Governor on the GDP of the state. Since the GOS factor is a dichotomous variable (takes the value of 1 when Democrat and 0 when Republican), we can understand the above regression as the impact of the each group GDP.

The ‘GOS’ estimate ß(hat) explains the impact of the Democrat governor on GDP growth rate, which here is 1.16(Statistically significant at 10%). While the impact of the Republican governor [measured in the intercept, α_0(hat)] GDP is positive at 1.58 percentage points (Statistically significant at 1%).

2. Regression: GDP 2 – RE

$$GDPGrowth_{i,t} = \alpha_0 + \boldsymbol{\beta} GOS_{i,t} + \delta UGrowth_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Random Effect Model
   (Swamy-Arora's transformation)

Call:
plm(formula = GDP_Growth ~ GOS + Ugrowth, data = pdf, model = "random")

Balanced Panel: n = 50, T = 15, N = 750

Effects:
                 var std.dev share
idiosyncratic 7.4587  2.7311 0.956
individual    0.3447  0.5871 0.044
theta: 0.2315

Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-13.685559  -1.321219   0.095936   1.385328  20.375786

Coefficients:
              Estimate Std. Error z-value  Pr(>|z|)
(Intercept)  1.6502641  0.1628898 10.1312 < 2.2e-16 ***
GOS         -0.2544142  0.2212461 -1.1499    0.2502
Ugrowth     -0.0204923  0.0026851 -7.6319 2.313e-14 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    6020.8
Residual Sum of Squares: 5561.7
R-Squared:      0.076247
Adj. R-Squared: 0.073774
Chisq: 61.6579 on 2 DF, p-value: 4.0848e-14
```

In this model, the impact of the unemployment growth is also considered and controlled for as we measure the impact of governor on GDP Growth rate. We find that the Republican governor's effect is very significant and positive, while the Democrat governor's effect is insignificant. Unemployment Growth also significantly affects GDP Growth. These values will be considered to be biased if the Unemployment Growth rate is correlated with the governor's political orientation.

3. Regression: GDP 3 – RE

$$GDPGrowth_{i,t} = \alpha_0 + \boldsymbol{\beta} GOS_{i,t} + \delta UGrowth_{i,t} + \varphi perchginc_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Random Effect Model
   (Swamy-Arora's transformation)

Call:
plm(formula = GDP_Growth ~ GOS + Ugrowth + perchg_inc_ineq, data = pdf,
    model = "random")

Balanced Panel: n = 50, T = 15, N = 750

Effects:
                 var std.dev share
idiosyncratic 7.3928  2.7190 0.954
individual    0.3535  0.5946 0.046
theta: 0.2369

Residuals:
     Min.   1st Qu.    Median   3rd Qu.      Max.
-13.36291  -1.33714   0.10767   1.35999  20.51602

Coefficients:
                  Estimate Std. Error z-value  Pr(>|z|)
(Intercept)      1.6012374  0.1641851  9.7526 < 2.2e-16 ***
GOS             -0.2170075  0.2212712 -0.9807   0.32673
Ugrowth         -0.0199904  0.0026814 -7.4551  8.98e-14 ***
perchg_inc_ineq -0.0557047  0.0218181 -2.5531   0.01068 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    6015.7
Residual Sum of Squares: 5508.6
R-Squared:      0.084302
Adj. R-Squared: 0.080619
Chisq: 68.679 on 3 DF, p-value: 8.1863e-15
```

In this final RE GDP model, we conduct a complete GDP analysis with all out variables of interest, and add to our previous model by also accounting for percentage changes in income inequality. We notice that in this case, the Democrat governor's impact is even more insignificant than the last case, while the Republican governor's impact, while still significant, is reduced by .05 percentage points. Unemployment growth and inequality growth are still statistically significant, but negatively related to GDP growth.

These values will only be considered consistent if the GOS, Unemployment Growth and percentage change in income inequality are not correlated with each other.

ii. Unemployment Growth

1. Regression: Unemployment 1 – RE

$$UGrowth_{i,t} = \alpha_0 + \beta GOS_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Random Effect Model
   (Swamy-Arora's transformation)

Call:
plm(formula = Ugrowth ~ GOS, data = pdf, model = "random")

Balanced Panel: n = 50, T = 15, N = 750

Effects:
                  var std.dev share
idiosyncratic 1466.17   38.29     1
individual       0.00    0.00     0
theta: 0

Residuals:
    Min.  1st Qu.   Median  3rd Qu.     Max.
-48.1406 -18.6875 -12.5128  -1.4713 353.3594

Coefficients:
            Estimate Std. Error z-value Pr(>|z|)
(Intercept)   3.9876     1.8262  2.1836  0.02899 *
GOS           6.6530     2.7365  2.4312  0.01505 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    1045900
Residual Sum of Squares: 1037700
R-Squared:      0.00784
Adj. R-Squared: 0.0065136
Chisq: 5.91068 on 1 DF, p-value: 0.015049
```

At the 5% significance level, the impact of both Democrat and Republican governments, are significant, (here the Republican governor's value is measured by the intercept value). The Democrat governor increases unemployment by 10.63 percentage points, which is larger than the increase by the Republican governor given by 3.98 percentage points.

2. Regression: Unemployment 2 – RE

$$UGrowth_{i,t} = \alpha_0 + \beta GOS_{i,t} + \delta GDPgrowth_{i,t} + + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Random Effect Model
   (Swamy-Arora's transformation)

Call:
plm(formula = Ugrowth ~ GOS + perchg_inc_ineq, data = pdf, model = "random")

Balanced Panel: n = 50, T = 15, N = 750

Effects:
                  var std.dev share
idiosyncratic 1460.22   38.21     1
individual       0.00    0.00     0
theta: 0

Residuals:
     Min.   1st Qu.    Median   3rd Qu.      Max.
-42.99454 -18.62910 -12.50650  -0.88046 350.63563

Coefficients:
                Estimate Std. Error z-value Pr(>|z|)
(Intercept)      4.45082    1.83722  2.4226  0.01541 *
GOS              6.30088    2.73675  2.3023  0.02132 *
perchg_inc_ineq  0.59106    0.29585  1.9978  0.04574 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    1045900
Residual Sum of Squares: 1032200
R-Squared:      0.013113
Adj. R-Squared: 0.010471
Chisq: 9.92557 on 2 DF, p-value: 0.0069934
```

In the second case, we have added another variable to help understand the impact of the governor, and we notice that all variables are statistically significant at the 5% level. Once again, we see the Democrat governor increases unemployment growth by more than what the Republican governor(intercept) increases it by.

Here controlling for percentage changes in income inequality lead to increases in the estimate of the impact of the Republican governor to 4.45, while there is a slight increase in the impact of the Democrat governor to 10.75. These results are only consistent if the percentage change in income inequality does not impact the governor of the state. To put it in simply, if a Texan's tax bracket were to change, they would not change the party they vote for.

3. Regression: Unemployment 3 – RE

$$UGrowth_{i,t} = \alpha_0 + \beta GOS_{i,t} + \delta GDPgrowth_{i,t} + \varphi perchginc_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Random Effect Model
   (Swamy-Arora's transformation)

Call:
plm(formula = Ugrowth ~ GOS + perchg_inc_ineq + GDP_Growth, data = pdf,
    model = "random")

Balanced Panel: n = 50, T = 15, N = 750

Effects:
                  var std.dev share
idiosyncratic 1353.62   36.79     1
individual       0.00    0.00     0
theta: 0

Residuals:
    Min.  1st Qu.   Median  3rd Qu.     Max.
-56.3839 -18.2150 -11.1019   1.1121 342.3941

Coefficients:
                Estimate Std. Error z-value  Pr(>|z|)
(Intercept)      9.53248    1.90911  4.9932 5.940e-07 ***
GOS              5.05565    2.65195  1.9064    0.0566 .
perchg_inc_ineq  0.37416    0.28764  1.3008    0.1933
GDP_Growth      -3.32696    0.45757 -7.2710 3.568e-13 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    1045900
Residual Sum of Squares: 963890
R-Squared:      0.078423
Adj. R-Squared: 0.074717
Chisq: 63.4824 on 3 DF, p-value: 1.0591e-13
```

This model accounts for GDP growth rate, and finds that when we do so, the Republican governor's impact increases the unemployment growth rate by 9.53 % points (even at a 1% significance level), while this time the Democratic governor's increase in the unemployment rate is 14.58 percentage points (10% significance level).

To reiterate, it is imperative that the assumption for exogeneity hold and that the percentage change in income inequality is not correlated with the GDP Growth Rate. This may imply that changes in growth rates of income will be entirely comprised of factors that are not related to GDP, such as transfer payments to senior citizens, or shifts in income distribution. Additionally, GDP Growth and Income Inequality Growth are not to be correlated with the governor.

iii. Percentage Changes in Income Inequality

1. Regression: Inequality 1 – RE

$$perchginc_{i,t} = \alpha_0 + \beta GOS_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Random Effect Model
   (Swamy-Arora's transformation)

Call:
plm(formula = perchg_inc_ineq ~ GOS, data = pdf, model = "random")

Balanced Panel: n = 50, T = 15, N = 750

Effects:
                 var std.dev share
idiosyncratic 21.912   4.681     1
individual     0.000   0.000     0
theta: 0

Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-50.155825  -2.399279   0.048291   2.550145  29.800878

Coefficients:
            Estimate Std. Error z-value  Pr(>|z|)
(Intercept) -0.78375    0.22524 -3.4796 0.0005021 ***
GOS          0.59575    0.33752  1.7651 0.0775543 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    15852
Residual Sum of Squares: 15787
R-Squared:      0.0041477
Adj. R-Squared: 0.0028164
Chisq: 3.11542 on 1 DF, p-value: 0.077554
```

When we run this regression with a random effects model, we observe that in this case, a left-wing (Democrat) governor now only decreases the income inequality at a lower rate of .19 points, this is much lower than what the fixed effects model predicted. It is also important to note that while the fixed effects model estimated the governor's impact to be statistically significant at a 5% rate, the Random Effects model estimates the governor's impact to be significant only at the 10% rate and the standard errors are lower in the Random Effects case, as expected. Additionally, we notice that intercept is highly significant at 1%; if we consider the case of a Republican governor (where GOS = 0), then the intercept tells us the impact of the Republican governor. This would tell us that the right-wing governor reduces income inequality by .78.

2. Regression: Inequality 2 – RE

$$perchginc_{i,t} = \alpha_0 + \beta GOS_{i,t} + \delta GDPGrowth_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Random Effect Model
   (Swamy-Arora's transformation)

Call:
plm(formula = perchg_inc_ineq ~ GOS + GDP_Growth, data = pdf,
    model = "random")

Balanced Panel: n = 50, T = 15, N = 750

Effects:
                  var std.dev share
idiosyncratic 21.639   4.652     1
individual     0.000   0.000     0
theta: 0

Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-49.623602  -2.262945  -0.070757   2.367267  29.619892

Coefficients:
             Estimate Std. Error z-value Pr(>|z|)
(Intercept) -0.523334   0.242085 -2.1618 0.030636 *
GOS          0.527594   0.336780  1.5666 0.117211
GDP_Growth  -0.164978   0.057889 -2.8499 0.004373 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    15852
Residual Sum of Squares: 15617
R-Squared:      0.014859
Adj. R-Squared: 0.012221
Chisq: 11.267 on 2 DF, p-value: 0.0035761
```

Interestingly, when we include GDP Growth in this equation, the impact of our Democrat governor on percentage changes in income inequality, becomes insignificant, while Republican impact remains significant at the 5% level but reduces (in absolute terms) slightly to -0.52. Essentially, when accounting for GDP Growth rates, the impact of the governor on GDP reduces slightly. GDP Growth is significantly and negatively related to Inequality Growth.

Ofcourse, this analysis can only be considered unbiased and asymptotically consistent when the GDP Growth is considered to be independent of the governor's status.

3. Regression: Inequality 3 – RE

$$perchginc_{i,t} = \alpha_0 + \beta GOS_{i,t} + \delta GDPGrowth_{i,t} + \varphi Ugrowth_{i,t} + \gamma_i + \varepsilon_{i,t}$$

```
Oneway (individual) effect Random Effect Model
   (Swamy-Arora's transformation)

Call:
plm(formula = perchg_inc_ineq ~ GOS + GDP_Growth + Ugrowth, data = pdf,
    model = "random")

Balanced Panel: n = 50, T = 15, N = 750

Effects:
                  var std.dev share
idiosyncratic 21.630   4.651     1
individual     0.000   0.000     0
theta: 0

Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-49.639307  -2.277948  -0.070935   2.343854  29.735620

Coefficients:
              Estimate Std. Error z-value Pr(>|z|)
(Intercept) -0.5798056  0.2458370 -2.3585  0.01835 *
GOS          0.4958220  0.3375088  1.4691  0.14182
GDP_Growth  -0.1444822  0.0599695 -2.4093  0.01598 *
Ugrowth      0.0060484  0.0046498  1.3008  0.19333
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    15852
Residual Sum of Squares: 15582
R-Squared:      0.017088
Adj. R-Squared: 0.013136
Chisq: 12.9695 on 3 DF, p-value: 0.0047031
```

In this model, we are controlling for both GDP Growth and Unemployment Growth. However, we notice that even at the 10% level, Ugrowth and Democrat governor have insignificant impacts on changes in income inequality. The Republican governor still has a significant impact in reducing rate of growth of income inequality.

However, this analysis is susceptible to endogeneity, as it economic theory dictates the existence of a (negative) correlation between GDP Growth and Unemployment Growth.

c. ***Hausman Test***

The Hausman Test, between Fixed and Random Effects, allow us to compare which model is better to be utilized in testing. The null hypothesis (H0) of the Hausman Test states that both Fixed and Random Effect models are consistent, in which case, we prefer to use the Random Effects model as it is more efficient. The alternate hypothesis (H1 / Ha) however, states that one model is inconsistent (which is the Random Effects model), in which case, we adopt the Fixed Effects model.

In the following cases, we have taken one of the models from each prior estimation (GDP Growth, Unemployment Growth, Percent Change in Inequality), prioritizing first, the statistical significance of the GOS estimate and second, the size of the estimate. Then, a Hausman Test is conducted to understand which effects allows us to understand the model better. The results of the Hausman Test are shown below:

It is perhaps important to note, that these are not the 'correct' models, they are instead, the models which suggest that the governor has been most impactful (if at all).

i. For GDP – Choosing Regression 1

```
        Hausman Test

data:  GDP_Growth ~ GOS
chisq = 0.011014, df = 1, p-value = 0.9164
alternative hypothesis: one model is inconsistent
```

For the GDP growth case, we find that the p-value is very high, suggesting that we fail to reject the null hypothesis that both models are consistent, and therefore implying that we ought to consider the Random Effects model. Here ß(hat) = -0.40809

Under the Random Effects model, the values are more efficient, and as long as we fail to reject the null hypothesis that both models are consistent, Random Effects gives us a more efficient idea of the model.

ii. For Unemployment

```
        Hausman Test

data:  Ugrowth ~ GOS + perchg_inc_ineq
chisq = 1.1467, df = 2, p-value = 0.5636
alternative hypothesis: one model is inconsistent
```

For the Unemployment growth case, we find that the p-value is once again very high, and therefore we follow the same case as earlier, and adopt the Random Effects model. This is true for all values of significance greater than 57%. Here ß(hat) = 6.60088

iii. For Percentage Change in Income Inequality

```
        Hausman Test

data:  perchg_inc_ineq ~ GOS
chisq = 2.2812, df = 1, p-value = 0.131
alternative hypothesis: one model is inconsistent
```

For the Income Inequality metric we notice that while the p-value is as high as the earlier two cases, it is still higher than the 10% significance level, implying that we do not reject the null hypothesis and adopt the Random Effects model. In case we are willing to adopt a 15% significance level, one must then consider the Fixed Effects model, as the Random Effects model would be inconsistent.

Under the Fixed Effects model, the values are less efficient (higher standard errors, and therefore higher variance) but more likely to be consistent.

VI. Conclusion

The conclusions in this paper are both remarkable and surprising, challenging and improving sections of our hypothesis and yet presenting findings that usher in new avenues of both political and economic academia.

As we measure the impact of the political orientation of the governor of the state on different economic variables (Real GDP Growth, Unemployment Growth, and Percentage Change in Income Inequality), we see that our two models (Fixed and Random Effects), in certain cases present similar results, just with the Random Effects model giving us lower standard errors.

In our 3 case approach, the first case is simply 1 dependent variable regressed on the GOS, our second case adds another independent variable, and our third case adds another one completing the model. The results from this paper are summarized in the table in the appendix (See appendix c).

A Hausman test was conducted for all 9 pairs of regressions (9 Fixed and 9 Random), and it was found all 9 preferred the Random Effects method (we have shown only 3 here for the sake of

comprehension and conciseness). Therefore, our results will in general refer to the results from the Random Effects model.

The average Republican governor is expected to increase the GDP Growth rate more than the average Democrat governor. Here only the Republican results are significant under the Random Effects model. Estimates from Case 2 (which controls for unemployment growth) inform us that the Republican governor can increase GDP Growth Rate by 1.65 percentage points (this case shows the largest expected increase in GDP Growth rate). This aligns with our hypothesis that the right-wing governors (and therefore governments) priorities efficiency over equality and therefore increase GDP Growth rate.

In our second scenario we look at unemployment growth rate, and we find that both Democrats and Republicans increase the unemployment growth rate, however, increases by Republican led governments are smaller than increases by Democrat led governments. This increase is magnified as we add variables to our model. It is somewhat consistent with our hypothesis that Republican governments, priortise efficiency, augment productivity and therefore decrease unemployment. Only difference in this case is that both increase unemployment growth rate, but the magnitude across the parties differ.

Finally, we look at percentage changes in income inequality (referred to as inequality growth) and find that, in these results that, depending on the scenario, both left-wing and right-wing governors can reduce inequality growth, and in agreement with our hypothesis, there is a case (Case 3 – Full Model) where Democrat governors can reduce inequality growth more than Republican governors, however, the more likely case (Case 1 – as it is more significant) is that Republican Governments reduce inequality growth more than Democrat governments. This could perhaps be because democratic influences aimed at development by redistributing incomes is not likely to be very successful, especially when demands for lower classes and poorer sections of society are not likely to be compromised (Basu, 1980)[13].

It is also important to note that in almost all these models, the Adjusted-R^2 is quite low. As the Adjusted-R^2 is a measure of fit that allows us to understand how much of the variation in the 'y-variable' is explained by the 'x – variables', it is safe to assume that these models are not all-encompassing, and the inclusion of further factors would allow us to understand the impact of the governor on growth and inequality better.

Therefore, it would be fair to say that our hypothesis has been tested using the variables in this model extensively, and found that, in many cases the Republican governments are more efficient and perhaps economically better suited to leadership and policy roles that their Democratic counterparts. However, much more analysis using more sophisticated techniques such as the Dynamic Linear Panel Model, would be required to impart conclusive judgments.

[13]Kohli, Atul. Review of Democracy, Economic Growth, and Inequality in India's Development, by Francine Frankel. World Politics 32, no. 4 (1980): 623–36. https://doi.org/10.2307/2010060.

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VIII. Appendix

a. *Unemployment Growth and Stationarity*

i. Non – Demeaning

```
. xtunitroot ips ugrowth

Im-Pesaran-Shin unit-root test for ugrowth
------------------------------------------

H0: All panels contain unit roots           Number of panels  =     50
Ha: Some panels are stationary              Number of periods =     15

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                   sequentially
Time trend:   Not included

ADF regressions: No lags included
```

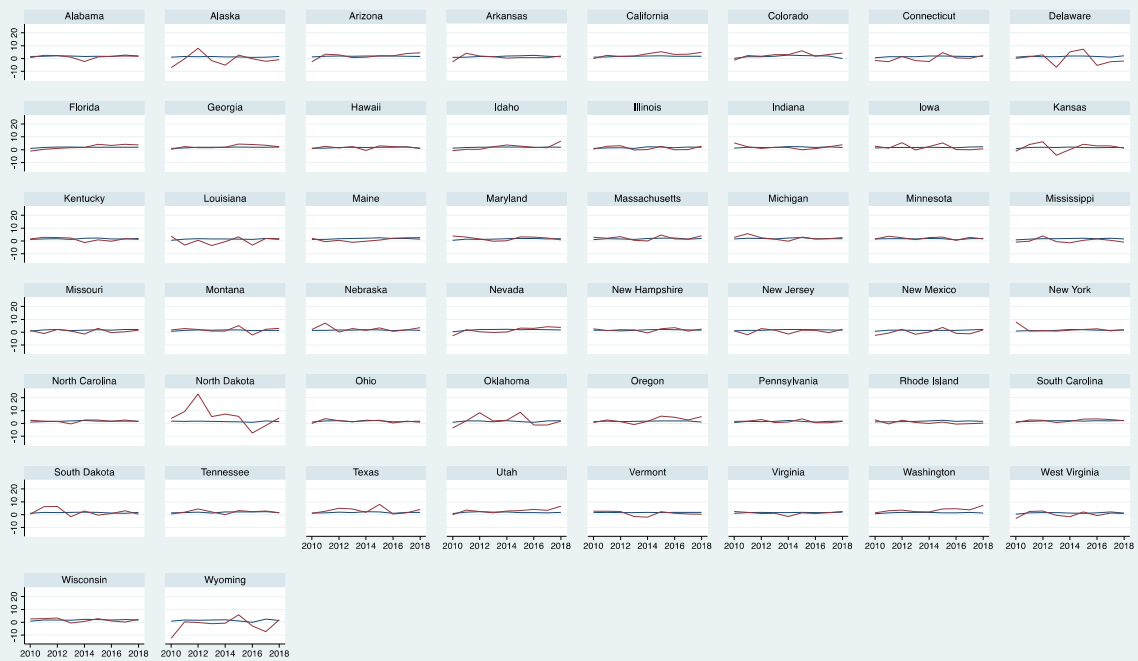
	Statistic	p-value	Fixed-N exact critical values 1%	5%	10%
t-bar	-1.5686		-1.830	-1.740	-1.690
t-tilde-bar	-1.4468				
Z-t-tilde-bar	-0.9199	0.1788			

ii. After removing points 2008, and 2020

```
. xtunitroot ips ugrowth if year!=(2008) & year!=(2020)

Im-Pesaran-Shin unit-root test for ugrowth
------------------------------------------

H0: All panels contain unit roots           Number of panels  =     50
Ha: Some panels are stationary              Number of periods =     13

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                   sequentially
Time trend:   Not included

ADF regressions: No lags included
```

	Statistic	p-value	Fixed-N exact critical values 1%	5%	10%
t-bar	-2.3143		-1.830	-1.740	-1.690
t-tilde-bar	-1.9399				
Z-t-tilde-bar	-5.9338	0.0000			

b. ***Forecast Analysis using Stata and xtgls***



c. ***Summary of Estimates***

No. of independent variables	Dependent Variable - Governor Of State								
	GDP Growth Rate			Unemployment Growth Rate			Percentage Change in Income Inequality		
	FE	RE (Democrat)	RE(Republican)	FE	RE (Democrat)	RE(Republican)	FE	RE (Democrat)	RE(Republican)
1	-0.39174 ()	1.16818 (.)	1.57627 (***)	9.4195 (*)	10.6406 (*)	3.9876 (*)	1.04941 (*)	-0.188(.)	-0.78375(***)
2	-0.1969053 ()	1.3958499()	1.6502641(***)	8.78356 (*)	10.7517(*)	4.45082(*)	0.973532 (*)	0.0042 ()	0.523334 (*)
	UGrowth			Income Change			GDP_Growth		
3	-0.1398498 ()	1.3842299 ()	1.6012374 (***)	7.61475 (*)	14.58813 (.)	9.53248 (***)	0.9300185 (*)	-0.0839836 ()	0.4958220 ()
	UGrowth and Income Change			Income Change and GDP Growth			GDP_Growth and UGrowth		

*Note – FE for Republicans = 0 as it has been accounted for and normalized.

d. Stationarity Test: Im - Pesaran – Shin (IPS) Unit Root Test

To understand if our utilized data points are stationary, we will need to understand if the data has a unit root. In the case of existence of a unit root, this data will be considered non-stationary. Data that is stationary will display statistical properties that do not change over time, such as autocovariance (Weak Stationarity), mean, and autovariance (Strong Stationarity). When we test for stationarity in a panel data setting, our null hypothesis (H0) suggests that a unit root exists, and our alternate hypothesis (H1) suggests that there are panels that are stationary.

i. GDP Growth

```
. xtunitroot ips gdp_growth, demean

Im-Pesaran-Shin unit-root test for gdp_growth
------------------------------------------------

H0: All panels contain unit roots           Number of panels  =     50
Ha: Some panels are stationary              Number of periods =     15

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                   sequentially
Time trend:   Not included                  Cross-sectional means removed

ADF regressions: No lags included
------------------------------------------------------------------------------
                                                Fixed-N exact critical values
                     Statistic      p-value         1%       5%       10%
------------------------------------------------------------------------------
 t-bar                -3.7229                     -1.830   -1.740   -1.690
 t-tilde-bar          -2.5464
 Z-t-tilde-bar       -11.2638        0.0000
------------------------------------------------------------------------------
```

As we can see from the table above, GDP Growth is stationary, as the p-value is low enough for us to reject the null hypothesis at almost every level of statistical significance.

ii. Unemployment Growth

```
. xtunitroot ips ugrowth, demean

Im-Pesaran-Shin unit-root test for ugrowth
-----------------------------------------

H0: All panels contain unit roots           Number of panels  =     50
Ha: Some panels are stationary              Number of periods =     15

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                   sequentially
Time trend:   Not included                  Cross-sectional means removed

ADF regressions: No lags included
```

			Fixed-N exact critical values		
	Statistic	p-value	1%	5%	10%
t-bar	-2.5643		-1.830	-1.740	-1.690
t-tilde-bar	-1.9997				
Z-t-tilde-bar	-6.1210	0.0000			

As we can see from the table above, Unemployment Growth is stationary, as the p-value is low enough for us to reject the null hypothesis at almost every level of statistical significance.

Unemployment Growth is a special case, as this value is not stationary when it is not demeaned. Demeaned values take the mean of the cross section of values and remove that each individual data point. If not demeaned, unemployment growth shows that a unit root exits. This unit root is most likely because of the unemployment growth rates in 2008 (Financial Crisis), and 2020 (COVID-19 Crisis), as when these years are removed, we once again observe stationarity. However, we continue to demean as we do not intend to lose values that are part of the data set. (See Appendix IX a. for tables)

iii. Change in Income Inequality

```
. xtunitroot ips perchg_inc_ineq, demean

Im-Pesaran-Shin unit-root test for perchg_inc_ineq
------------------------------------------------------------------------------
H0: All panels contain unit roots           Number of panels  =     50
Ha: Some panels are stationary              Number of periods =     15

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                   sequentially
Time trend:   Not included                  Cross-sectional means removed

ADF regressions: No lags included
------------------------------------------------------------------------------
                                                Fixed-N exact critical values
                     Statistic      p-value        1%       5%       10%
------------------------------------------------------------------------------
 t-bar                -5.4206                    -1.830   -1.740   -1.690
 t-tilde-bar          -2.9694
 Z-t-tilde-bar       -15.2431       0.0000
------------------------------------------------------------------------------
```

As we can see from the table above, Changes in Income Inequality is stationary, as the p-value is low enough for us to reject the null hypothesis at almost every level of statistical significance.