Relationship between Income Inequality and Economic Productivity: A Cross-Country Analysis

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Abstract

This analysis attempts to find the relationship between economic productivity and income inequality. Previous literature has produced mixed results, with some analyses finding a positive correlation and some finding a negative explanation, as to how income inequality affects economic performance. This study uses single and multiple linear regression analysis to uncover the relationship between the two variables. Mixed results were produced in accordance with previous studies, with models 1 through 3 finding that income inequality does not reduce economic growth. Models 4 through 6 find the opposite to be true, and that there is a negative relationship between income inequality and economic growth. Specific attention was given to a country's stage of development as outlined by the dummy variable used in the study.

I. Introduction

Country development has been of increasing concern in the international community since the aftermath of World War II. The inequality of a country is a useful indicator to assess the standards of living and the economic productivity a region employs, as well as indicating the areas that require improvement in order to promote growth and prosperity. As the world becomes more globalized and interconnected, more research into how a country's income inequality affects its current level of economic output will be needed. Globalization has connected economies from all over the world to each other and will only become more connected in the future. Typically, a country exposed to conflict has greater income inequality and will incur lower levels of economic growth as a result. Countries wrought with conflict that negatively impact income distribution not only have an impact on their own economic productivity, but could extend potential impacts to economies throughout the world. As we saw from the financial crisis of 2008, understanding the threats posed to individual economies is crucial to prevent further domino effects and increase income equality globally.

To analyze the effects, gross domestic product has long been evaluated as the measure of productivity of a nation and has proved influential in determining the technological and societal advancement of a population. Countries that produce above average levels of gross domestic product tend to be correlated with higher levels of technological progress and decreased level of conflict. The dissolving of the Soviet Union led to increased unequal distribution of wealth amongst nations that negatively affected the income equality and economic productivity of developing countries and prohibited growth.

This paper will draw connections between a country's level of development and their economic growth by analyzing the effects that income inequality has on progress by using cross-sectional data to create simple and multiple regression models. It is hypothesized that countries with greater income inequality will see decreased levels of economic performance. It is further hypothesized that conflict will increase the negative impact of income inequality and further decrease the respective economic output. The economic rationale here is that as a country experiences greater unequal income distribution, its ability to utilize human and physical capital to technologically advance and produce higher levels of GDP will decrease.

II. Literature Review:

Previous works have analyzed the effects of income inequality on economic growth and have produced mixed results. Some conclude that the greater the income inequality, the lower the respective economic growth while others argue the opposite. The differences between these results can be partially explained by the data collected across different explanatory variables and the methods used for the analysis.

Several approaches to the relationship between income inequality and economic growth have highlighted the negative relationship between the two variables. A systematic approach to this topic conducted a cross-country analysis looking at four factors that are used in determining growth performance (Mo 2003). The variables included the share of investment in GDP, the rate of population growth, the initial level of real GDP per capita, and the GINI coefficient. It was expected that the coefficients on the variables for the GINI coefficient would have a negative impact on total factor productivity in response to higher levels of inequality, and thus lead to a decrease in economic growth. The study found that a one percent increase in the GINI coefficient negatively impacts the growth rate of GDP by 2.16 percent (Mo 2003). A decline in economic growth is also likely to have adverse effects on investment and subsequently a negative effect on human capital stock, which relies on it. The study showed that approximately 55 percent of the impact on GDP growth rate can be explained by income inequality (Mo 2003). The author also concludes that the impact of income inequality will differ depending on development, which this paper will analyze further later on.

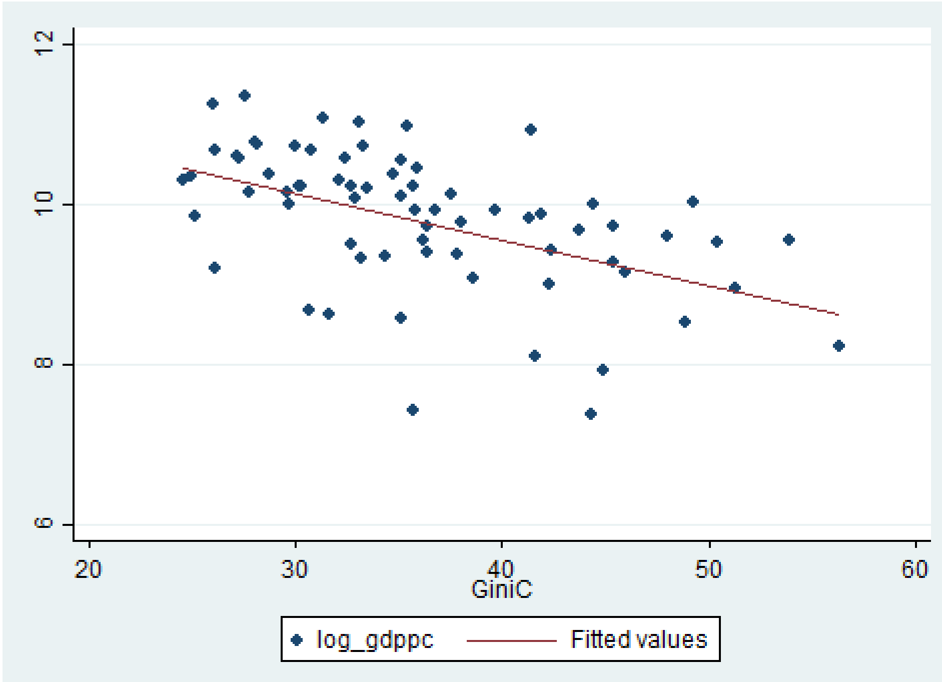
Other studies focused closer attention to income inequality perpetuated by violence and civil conflict. Humphrey's (2003) analyzed the role of conflict on economic growth and productivity, highlighting inequality as a factor of GDP growth, along with government policy, wealth, poverty, economic structure and trade. He found that economic policy leaves room for policy makers to promote conflict as a form of personal economic gain and that these policies often lead to economic, political, and financial inequality. The analysis looked at inequality as a measurement for economic productivity measured as overall inequality, defined as "inequality between individuals regardless of group membership," and horizontal inequality which is inequality among groups or regions (Humphrey 2003). The differences in inequality and wealth are more aggravated in poorer countries and more likely to lead to decreased levels of economic performance as a result (Cramer 2003). Humphrey (2003) finds that a country with a GDP per person of 250 U.S. Dollars is likely to experience war with a probability of 15 percent compared to a 4 percent probability of nations with a GDP per person of $1250. Since extreme income inequality often leads to civil conflict, then it follows that increases in wealth disparities will decrease GDP per capita. The unequal allocation of resources and wealth has contributed to the lack of development of some countries and further exacerbated income disparities as a deterrent of economic growth and productivity (Cramer 2003).

Further literature that shows the mixed relationship between income inequality and economic growth took urban and rural differences within states into consideration. Odedokun and Round (2001) looked at the direct effect of inequality on growth by regressing growth on income distribution variables including initial level of per capita GDP, 5-year population average annual growth rate and, the share of consumption expenditure bared by the government. The explanatory power of these variables proved low so further research into urban and rural areas was conducted across a few countries. They found that the sign of the coefficient attached to income share of the middle class was positive and statistically significant in rural areas, while it was negative and insignificant elsewhere (Odedokun and Round 2001). The analysis in this study was limited to fewer countries than previous studies which could potentially explain the conflicting results of income inequality on growth.

While there is a lot of research concerning the effects of income inequality on economic growth and productivity, this research will be slightly altered. In this paper, I will analyze how increases in income inequality lead to decreases in gdp. The dependent variable of this cross country analysis will be the natural logarithm of gross domestic product per capita (log gddpc). The primary independent variable will be the GINI coefficient to measure the overall inequality experienced in the country. To further explain the data in terms of conflict or peace, military expenditure, foreign direct investment as a percentage of gdp, research and development, battle-related deaths (to reflect decline in human capital), expected years of schooling, and the status of the country as a developing or developed nation will be taken into consideration. A simple regression analysis will be performed followed by several multiple regressions to further extrapolate the data.

III. Data

To identify the relationship between income inequality of countries exposed to conflict and economic growth, cross-sectional data was gathered from the World Bank and United Nations. The main dependent variable is the natural log of gross domestic product (GDP) per capita to show the economic growth of a country for a controlled year. The primary independent variable used in this study is the GINI coefficient which is a measure of the overall income inequality in a country. The independent variable was used to determine whether a country with greater income inequality could improve their standards of living through a redistribution of wealth resources. Data concerning economic growth and the GINI index (GiCo) was collected from the World Bank. The countries used are listed in this study are listed in the appendix below. A scatterplot of the natural logarithm of GDP and the GINI is shown below. It is worth noting that GINI values closer to zero tend toward perfect equality whereas values closer to one hundred tend towards perfect inequality. The results show a general correlation between the two variables. As the GINI coefficient tends towards 100, the natural logarithm of GDP per capita declines, indicating the income inequality has a negative effect on economic growth.



There were several other explanatory variables used to support and strengthen the multiple regression model in addition to the main variable. This was done to uncover the true ceteris paribus effect of development of a nation's income inequality on GDP per Capita. Among these other independent variables were battle-related deaths, to reveal the impacts of conflict on income equality, foreign direct investment as a percentage of GDP, and research and development (RD). Military expenditure (MilExp) as a percentage of GDP was also recorded along with life expectancy (life), expected years of schooling (SchYrs), and a dummy variable for status labeled dev, to analyze statistical differences between developed and developing countries. It is expected that these additional variables will have an additional positive or negative impact on income inequality. The variables battle-related deaths and military expenditure are likely to have a negative impact on the GINI coefficient and lead to further declines in economic productivity, while foreign direct investment, life expectancy, and research and development will likely have a positive impact. The status of a country was taken into consideration to uncover the relationship between the effects of income inequality in developing countries versus those recorded in developed countries. Battle-related deaths were recorded to determine if countries exposed to conflict experience greater income inequality compared to those at peace. The data availability for this variable was extremely limited and was recorded as the natural logarithm of battle deaths (log_Bdeaths) to more accurately show its impact. MilExp, fdigdp, and RD were measured as a percentage of GDP in order to account for the economic size differences of individual nations. This is done because more developed nations would be capable of allotting greater financial sums to the aforementioned sectors creating a potential skew and bias in the data against developing nations. Military expenditure is analyzed to show the relationship between spending on military activities, as defense or offense, and a subsequent misallocation of resources resulting in inequality which may potentially decrease GDP per capita. A description and summary of the variables used in this study can be found below.

Table 1: Variable Description

Variable Name	Description	Year	Units	Source
log_gdppc	Natural logarithm of gross domestic product (GDP) per capita	2018	Constant 2010 USD	World Bank
Dev (dummy variable)	Development Status of Countries.	2018	Dummy: 0 = developing 1 = developed	United Nations
MilExp	Military expenditure as a percentage of GDP per Capita.	2018	Percentage	World Bank
RD	Research and development as a percentage of GDP per Capita	2018	Percentage	World Bank
LifeExp	Life Expectancy	2018	Years	World Bank
fdigdp	Foreign Direct Investment	2018	US Dollars	World Bank
log_Bdeaths	Natural Logarithm Battle Related Deaths	2013- 2018	No. of deaths	World Bank

GiCo	Gini Coefficient	2017-2018	0-100	World Bank

Note: The closer the Gini coefficient is to 0, the closer to perfect equality the country is. Gini coefficient values closer to 100 tend towards perfect inequality.

Table 2: Descriptive statistics for each variable can be found below.

Variable	Observations	Mean	Standard Deviation	Min	Max
log_gdppc	179	9.234	1.181	6.435	11.943
GiCo	89	36.028	7.204	24.6	56.3
dev	461	0.078	0.269	0	1
life	254	72.157	7.481	52.805	84.934
fdigdp	246	-2.519	81.314	-1268.174	31.921
RD	96	1.290	1.066	0.014	4.953
MilExp	202	1.845	1.340	0	9.518
log_Bdeaths	58	6.131	2.571	0	10.823

Outliers: The minimum values and standard deviation attached to the fdigdp variable indicate that a different measurement of foreign direct investment may be better to more accurately portray its relationship to the dependent variable.

Before performing regression analyses for the aforementioned variables, the Classical Linear Model (CLM) assumptions were checked for bias, variance, and a normal distribution. These assumptions are as follows:

1. Assumption 1: The model must be linear in parameters

   The model in this study passes the assumption linear in parameter on the equation:

$$y = B_0 + B_1X_1 + B_2X_2 + ...B_kX_k + u$$

2. Assumption 2: Random Sampling

   All data pulled from the World Bank, and the United Nations, is drawn from random populations and samples around the globe and therefore the model satisfies this assumption.

3. Assumption 3: No perfect collinearity

   To test for perfect collinearity the model was placed in STATA software for the data collected for the variable in table 1. I initially performed regressions including a variable for ‘intensity level’ of conflict. However, this variable proved to have a perfect collinear relationship with the ‘status’ variable. For this reason, the variable, ‘intensity’ was removed to preserve the integrity of the model. Intensity level was not included in any of the following regressions and therefore, the model satisfies the assumption of no perfect collinearity. Correlation statistics performed in vy the STATA output can be found in the Appendix.

4. Assumption 4: Expected value of error term, u, is zero.

   The simple regression model for economic productivity and the Gini coefficient cannot fully explain the independent model since there are many factors that influence economic productivity. Multiple regression analyses are run in order to satisfy this requirement, but we cannot definitively say the assumption is satisfied. For this reason, the results of the model will be spelled out carefully.

5. Assumption 5: Homoscedasticity

   This assumption requires the expected variance of the error term, u, to be constant given any dependent variable. Given that there are variables within the error term not included in this analysis, this assumption also cannot be met with certainty. Due to these uncertainties, the model below will be interpreted accordingly and with caution.

6. Assumption 6: Standard Normal Distribution

   The standard normal distribution is also assumed for this model in order to compute simple and multiple regression analysis.

IV. Results

The simple regression model is tested to identify the relationship between GDP per capita and income inequality without any additional explanatory variables. This is done to uncover the direct impact that an increase or decrease in the GINI coefficient will have on GDP.

Simple Regression Model 1: log_gdppc = $B_0 + B_1$(GiCo) + u

Regressing log_gdppc on status gives the equation:

Equation 1: log_gdppc = 11.865 - 0.058(GiCo)

(0.440) (0.012)

n = 75 R^2 = 0.244

Note: The numbers represented in parentheses are the standard errors associated with the coefficients. The sample size is denoted by 'n', and the sum of squared residuals is 'R^2'. This format will be followed through the rest of the multiple regression and the adjusted R^2 values (adj. R^2) can be found in the summary regression table below. All regressions were performed using STATA.

This equation reflects an analysis of 75 observations across 264 countries. It shows us that as the GINI coefficient increases by 1 unit, log_gdppc decreases by .058. This reflects the notion that as the income inequality of a country increases, their economic productivity and output declines. This aligns with the predictions assumed above. The relatively small coefficient in front of the GINI variable is worth noting in that it may suggest using a different measure of GDP per capita in future research analyses. While this presents the model with a beneficial baseline for econometric analysis, by adding more variables through multiple regressions, the data on GDP can be more accurately reported.

Multiple Regression 1: Model 2: log_gdppc = $B_0 + B_1$(GiCo) + B_2(fdigdp) +B_3(RD)

Regressing produces the equation:

Equation 2: log_gdppc = 10.142 - 0.013(GiCO) - 0.001(fdigdp) + 0.386(RD)

(0.416) (0.011) (0.005) (0.071)

n = 44 R^2 = 0.533

This model collects data from 44 observations across 264 countries. Results from this regression produce an R^2 value of 0.533 indicating that these variables represented in this regression explain 53.3 percent of the variation in GDP per capita. The coefficient attached to the Gini remains negative similar to the simple regression above but it has significantly declined. The positive coefficient 0.386 on RD indicates that a percent increase in research and development increases log_gdppc by 0.386 percent. A negative coefficient on foreign direct investment was slightly surprising, indicating that a percent increase in fdigdp will decrease log_gdppc by 0.001 percent. The initial predictions outlined above anticipated a positive impact of foreign direct investment. The negative effects of fdigdp could indicate the investment resources are not always allocated where they are supposed to be..

Multiple Regression 2: Incorporates military expenditure

Model 3: log_gdppc = B_0 + B_1(GiCo) + B_2(MilExp) +B_3(fdigdp) + B_4(RD)

Regressing produces the equation:

Equation3 : log_gdppc = 9.935 - 0.002(GiCo) - 0.107(MilExp) - 0.002(fdigdp) + 0.393(RD)

(0.383) (0.011) (0.056) (0.005) (0.064)

n = 43 R^2 = .609

This regression produces a R^2 value of 0.609 indicating that 60.9 percent of the dependent variable can be explained by the variables in this regression. The only change made to the previous regression was the addition of the military expenditure variable to show that statistically, and similar to the aforementioned prediction, it will have a negative effect of economic growth. The coefficient 0.107 in front of MilExp indicates that a percent increase in MilExp results in a .107 percent decrease in log_gdppc. Because of the small coefficient attached to the variable fdigdp in models 2 and 3, it was removed. For future research a better measure of foreign direct invest may be necessary to uncover its relationship to GDP per capita.

Multiple Regression 3:

Model 4: log_gdppc = B_0 + B_1(GiCo) + B_2(MilExp) +B_3(life) + B_4(log_Bdeaths)

Regressing produces the equation:

Equation: log_gdppc = 7.453 + 0.004(GiCo) - 0.047 (MilExp) + 0.039(life) - 0.193 (log_Bdeaths)

(1.498) (0.018) (0.072) (0.02) (0.092)

n = 16 R^2 = .826

This model records 16 observations which is significantly smaller than the previous regressions. This micronumerosity was dependent on lack of available information. The result of this regression produced suggests that in order to account for conflict, additional factors must be taken into consideration. After the logarithm of battle deaths was recorded the sample size of our regression decreased to 16 which cannot accurately represent the relationship between the dependent and independent variables. The coefficient attached to log_Bdeaths is worth noting given that a percent increase in battle deaths results in a 0.193 percent decrease in GDP per capita. Though our sample size is small, it suggests that battle-related deaths and by extension conflict, have a negative impact on the dependent variable, leaving room for future research opportunities.

Multiple Regression 4:

Model 5: log_gdppc = $B_0 + B_1(GiCo) + B_2(MilExp) + B_3(life) + B_4(RD) + B_5(SchYrs)$

Regressing produces the equation:

log_gdppc = 3.684 + 0.001(GiCo) - 0.054 (MilExp) + 0.061(life) + 0.206(RD) +0.119(SchYrs)

(1.665) (0.009) (0.048) (0.016) (0.068) (0.092)

n = 43 R^2 = .738

By adding expected years of schooling to our regression, we can see that the number of observations increases again. The coefficient 0.119 attached to the SchYrs variable means that a per unit increase in years of schooling increases log_gdppc by 0.119 percent. The R^2 value of 0.738 indicates that the independent variables in the model explain the dependent variable by 73.8 percent.

Multiple Regression 5:

Model 6: log_gdppc = $B_0 + B_1(GiCo) + B_2(MilExp) + B_3(life) + B_4(RD) + B_5(SchYrs) + B_6(dev)$

Regressing produces the equation:

log_gdppc = 4.983 + 0.003(GiCo) - 0.056(MilExp) + 0.039(life) + 0.175(RD) + 0.126(SchYrs) +

(1.729) (0.009) (0.046) (0.018) (0.068) (0.088)

0.294(dev)

(0.148)

n = 43 R^2 = .764

The final regression recorded in this data reflects the dummy variable status. Developing countries received a value of 0 in the sample, while developed countries were represented by a 1. This was done in order to uncover the effects that income inequality has on developing countries versus developed countries and how this affects a country's economic productivity and output. By analyzing the coefficients on the independent variables above it is interesting to see that almost all of them have a positive effect on log_gdppc. The only variable still sporting a negative coefficient is military expenditure. This can be explained by the economic rationale that more developed countries will tend to spend more on military resources which may negatively impact economic growth.

Table 3 below portrays a summary regression statistics for the simple and multiple regressions outlined above. It shows the coefficients, standard errors, significance levels, R^2, and adjusted R^2, values for each variable.

Dependent Variable: log_gdppc						
Independent Variables:	**SLR**	**MLR1**	**MLR2**	**MLR3**	**MLR4**	**MLR5**
GiCo	-0.058*** (0.012)	-0.013 (0.011)	-0.002 (0.11)	0.004 (0.018)	0.001 (0.009)	0.003* (0.009)
fdigdp		-0.001 (0.005)	-0.002 (0.005)			
RD		0.386*** (0.071)	0.393*** (0.064)		0.206*** (0.068)	0.175** (0.068)
MilExp			-0.107* (0.056)	-0.047 (0.072)	0.054 (0.048)	-0.056 (0.046)
log_Bdeaths				-0.193* (0.092)		
life				0.039* (0.02)	0.061*** (0.016)	0.039** (0.018)
SchYrs					0.119 (0.092)	0.126 (0.088)
dev						0.294* (0.148)
Intercept	11.865 (0.440)	10.142 (0.416)	9.935 (0.383)	7.453 (1.498)	3.684 (1.665)	4.983 (1.729
No. of obs.	75	44	43	16	43	43
R^2	0.244	0.533	0.609	0.826	0.738	0.764
Adj. R^2	0.234	0.4982	0.567	0.757	0.703	0.725

Significance levels: 10%*, 5%**, 1%***

V. Statistical Inference

The statistical significance of these variables can be proven using t-test, p-values, and confidence intervals. For this section, the results of the t-values, p-values, and 95% confidence intervals are recorded for model 6, MLR5, in table 4 below.

Table 4: MLR5

Variable	Coefficient	t-value	p-value	95% Confidence Intervals
GiCo	0.003	0.37	0.710	(-0.015 , 0.022)
MilExp	-0.056	-1.22	0.230	(-0.149 , 0.037)
life	0.039	2.15**	0.038	(0.002 , 0.077)
RD	0.175	2.59**	0.014	(0.038 , 0.313)
SchYrs	0.126	1.42	0.164	(-0.054 , 0.305)
dev	0.293	1.99*	0.054	(-0.005 , 0.593)

The hypothesis below is used for this study to test each variable in MLR5.

$$H_0 : B_k = 0$$

$$H_1 : B_k \neq 0$$

Note: B_k represents any of the independent variables B_1 - B_6

H_0 represents the null hypothesis, and H_1 represents the alternate hypothesis.

To determine whether the above variables are statistically significant or different from zero, a two-tailed t-test can be performed. A two-tailed test compares the critical value to the t-value in the t-distribution. The number of observations in MLR5 is 43. The formula, n-k+1, can be used to determine the degrees of freedom in the model which turns out to be 38. Therefore, the model possesses 38 degrees of freedom for all t-tests performed. The critical value for 38 degrees of freedom at the 1% significance level is 2.72. For two tailed tests, the absolute value of the t-value is used. If the absolute value of the t-value is greater than the critical value at the specified significance level then the null hypothesis can be rejected. If the null is rejected it can be said that the variable is statistically significant and different from 0. None of the above t-values are greater than 2.72, so the model cannot reject the null at the 1% level. The critical value for the 5% level is 2.03. The variables life and RD both possess t-values greater than 2.03 so these variables are statistically significant and different from 0 and the null hypothesis can be rejected at the 5% significance level. For the 10% level significance, the critical value 1.69 is used for 38 degrees of freedom. The variable for development, dev, has a t-value of 1.99 which is greater than the critical value, so the null can be rejected at the 10% significance level for this variable. The variables for the GINI coefficient, military expenditure, and expected years of schooling are not found to be statistically significant.

These results can be confirmed by looking at the p-values for the variables above. The p-value is the smallest probability where the null hypothesis can be accepted. The p-value for life is 0.038 which corresponds to 3.8 percent which falls between the 1% and 5% significance levels. This means that the coefficient on life is statistically significant at the 5% level but not the 1% level, which confirms the results obtained from the t-test. The same applies to RD. The p-value for RD is 0.014, meaning that the minimum value the null can be accepted is 1.4 percent. 1.4 percent falls between the 1% and 5% significance levels so again the coefficient is significant at the 5% level but not at the 1% level. The p-value for development is 0.054, 5.4 percent, so the coefficient on dev is significant at the 10% level but not at the 1% or 5% levels. The p-values for military expenditure, the GINI coefficient, and expected years of schooling fall outside that 10% significance level, and so the null cannot be rejected and is statistically insignificant for these variables, as previously illuminated by the t-tests.

The final test that can be performed to determine the significance of the coefficients attached to the independent variables is to analyze the confidence intervals. By looking at the confidence intervals in Table 4, if 0 falls within the confidence interval, it can be said with 95% confidence that the null hypothesis cannot be rejected and the coefficient on the variable not statistically different from 0. The variables for military expenditure, the GINI coefficient, and expected years of schooling all have 95% confidence intervals that contain 0, and so the null cannot be rejected. This supports the conclusions from both the t-test and p-values sections. It is worth noting that the coefficient on development possesses an interval which contains 0, but this can be explained by the fact that this variable falls within the 10% level significance and not the 5% level.

VI. Robustness

To more accurately explain the natural logarithm of GDP per capita in terms of the primary independent variable, the GINI coefficient, an F-test was performed. This was done to determine if the GINI coefficient was jointly significant when combined with another dependent variable and to uncover the effects of income inequality on economic performance. The F-test was computed using the dummy variable for development to show the relationship that the development status of a country and its income inequality have on GDP per capita. The F-test for joint significance between the variables was performed using the unrestricted model MLR5, which contained all the variables in this study, and the restricted model which removed the GINI coefficient. By removing the GiCo variable, the coefficient for development became statistically insignificant at the 1%, 5%, and 10% significance levels (this regression can be found in the appendix). This suggests that the two variables may be jointly significant. The F-test was performed using the formula: $F = [(SSR_r - SSR_{ur})/q] / [SSR_{ur}/(n-k-1)]$, where SSR_{ur} is the sum of squared residuals from the unrestricted model, SSR_r is the sum of squared residuals from the restricted model, q is the number of restrictions in the restricted model, and n-k-1 is the degrees of freedom in the unrestricted model. The null hypothesis for this test is $H_0 : B_1 = B_6$ and the alternate hypothesis is that H_0 is not true.

$$F = [(8.56450541 - 2.65984835)/1] / (2.65984835/36)$$

$$F = 79.917$$

Since this F-statistic is larger than the F-stat given for the unrestricted model $F [6, 36] = 19.45$, then it can be concluded that the null hypothesis can be rejected at the 10% level. While the coefficient on GiCo is not individually significant from 0, it is jointly significant when combined with the development variable.

VII. Conclusion

In summary, the regression finds that a decrease in the Gini coefficient will lead to an increase in the natural logarithm of GDP per capita. The multiple regressions, MLR1 and MLR2, produced similar results finding the initial hypothesis that increases in income inequality reduces economic growth to be false. Initially, the GINI coefficient was found to be statistically insignificant, but after completing a joint significance f-test with the dummy variable for the development of a nation, it was found to be statistically significant at the 10% level. The regressions MLR3 through MLR5 support the hypothesis that income inequality reduces economic performance. Research and development (RD) and life proved to be statistically significant across all models they were included. This implies that the stage of development of a country will impact whether or not income inequality has a positive or negative effect on economic performance as a measure of gross domestic product per capita. The mixed results from this analysis regarding the primary dependent variable highlight the problems associated with cross-country data availability and also indicate that further research into this topic is needed.

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Appendix:

A1:

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. regress log_gdppc GiCo

      Source |       SS           df       MS      Number of obs   =        75
-------------+----------------------------------   F(1, 73)        =     23.60
       Model |  13.5751045         1  13.5751045   Prob > F        =    0.0000
    Residual |   41.983791        73  .575120425   R-squared       =    0.2443
-------------+----------------------------------   Adj R-squared   =    0.2340
       Total |  55.5588955        74  .750795885   Root MSE        =    .75837

------------------------------------------------------------------------------
   log_gdppc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        GiCo |  -.0577219   .0118809    -4.86   0.000    -.0814005   -.0340434
       _cons |    11.8653   .4403093    26.95   0.000     10.98777    12.74284
------------------------------------------------------------------------------
```

A2:

```
. regress log_gdppc GiCo fdigdp RD

      Source |       SS           df       MS      Number of obs   =        44
-------------+----------------------------------   F(3, 40)        =     15.23
       Model |  6.57794005         3  2.19264668   Prob > F        =    0.0000
    Residual |  5.75925937        40  .143981484   R-squared       =    0.5332
-------------+----------------------------------   Adj R-squared   =    0.4982
       Total |  12.3371994        43  .286911615   Root MSE        =    .37945

------------------------------------------------------------------------------
   log_gdppc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        GiCo |  -.0124915   .0111776    -1.12   0.270    -.0350823    .0100992
      fdigdp |  -.0008649   .0049796    -0.17   0.863    -.0109291    .0091993
          RD |   .3856231   .0711557     5.42   0.000      .241812    .5294342
       _cons |   10.14202   .4160671    24.38   0.000      9.30112    10.98293
------------------------------------------------------------------------------
```

A3:

```
. regress log_gdppc GiCo fdigdp RD
```

Source	SS	df	MS			
Model	6.57794005	3	2.19264668	Number of obs	=	44
Residual	5.75925937	40	.143981484	F(3, 40)	=	15.23
				Prob > F	=	0.0000
				R-squared	=	0.5332
				Adj R-squared	=	0.4982
Total	12.3371994	43	.286911615	Root MSE	=	.37945

log_gdppc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
GiCo	-.0124915	.0111776	-1.12	0.270	-.0350823	.0100992
fdigdp	-.0008649	.0049796	-0.17	0.863	-.0109291	.0091993
RD	.3856231	.0711557	5.42	0.000	.241812	.5294342
_cons	10.14202	.4160671	24.38	0.000	9.30112	10.98293

A4:

```
. regress log_gdppc GiCo MilExp life log_Bdeaths
```

Source	SS	df	MS			
Model	5.5489074	4	1.38722685	Number of obs	=	15
Residual	1.16730962	10	.116730962	F(4, 10)	=	11.88
				Prob > F	=	0.0008
				R-squared	=	0.8262
				Adj R-squared	=	0.7567
Total	6.71621703	14	.479729788	Root MSE	=	.34166

log_gdppc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
GiCo	.0039654	.0181035	0.22	0.831	-.0363716	.0443024
MilExp	-.0469996	.0721902	-0.65	0.530	-.2078494	.1138502
life	.0390073	.0201308	1.94	0.081	-.005847	.0838616
log_Bdeaths	-.1935689	.0919546	-2.11	0.062	-.3984564	.0113186
_cons	7.453469	1.498119	4.98	0.001	4.115452	10.79149

A5:

```
. regress log_gdppc GiCo MilExp life RD SchYrs
```

Source	SS	df	MS
Model	8.32879671	5	1.66575934
Residual	2.9524961	37	.079797192
Total	11.2812928	42	.26860221

Number of obs	=	43
F(5, 37)	=	20.87
Prob > F	=	0.0000
R-squared	=	0.7383
Adj R-squared	=	0.7029
Root MSE	=	.28248

log_gdppc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
GiCo	.0004993	.0092981	0.05	0.957	-.0183404	.0193389
MilExp	-.0539694	.0477571	-1.13	0.266	-.1507345	.0427956
life	.0606139	.0156126	3.88	0.000	.0289797	.0922481
RD	.2055236	.0684972	3.00	0.005	.0667351	.344312
SchYrs	.1185938	.0918506	1.29	0.205	-.0675133	.3047009
_cons	3.684067	1.664733	2.21	0.033	.3109977	7.057136

A6: Model with Dummy Variable

```
. regress log_gdppc GiCo MilExp life RD SchYrs dev
```

Source	SS	df	MS
Model	8.62144447	6	1.43690741
Residual	2.65984835	36	.073884676
Total	11.2812928	42	.26860221

Number of obs	=	43
F(6, 36)	=	19.45
Prob > F	=	0.0000
R-squared	=	0.7642
Adj R-squared	=	0.7249
Root MSE	=	.27182

log_gdppc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
GiCo	.0033977	.0090647	0.37	0.710	-.0149864	.0217819
MilExp	-.0560729	.0459659	-1.22	0.230	-.1492961	.0371503
life	.039554	.0183758	2.15	0.038	.0022862	.0768217
RD	.1753347	.0676337	2.59	0.014	.0381672	.3125022
SchYrs	.1256422	.0884533	1.42	0.164	-.0537494	.3050338
dev	.2935942	.1475204	1.99	0.054	-.005591	.5927795
_cons	4.982569	1.729649	2.88	0.007	1.474678	8.490461

A7: Correlation Graph

```
. corr log_gdppc GiCo MilExp life RD SchYrs
(obs=43)
```

	log_gd~c	GiCo	MilExp	life	RD	SchYrs
log_gdppc	1.0000					
GiCo	-0.3750	1.0000				
MilExp	-0.3097	0.2600	1.0000			
life	0.7889	-0.2909	-0.2608	1.0000		
RD	0.7519	-0.4186	-0.1434	0.6757	1.0000	
SchYrs	0.5172	-0.4924	-0.2713	0.4144	0.4543	1.0000

Country used in research:

Jordan, Mali, Afghanistan, Albania, Algeria, American Samoa, Andorra, Angola, Antigua and Barbuda, Arab World, Argentina, Armenia, Aruba, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bermuda, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Canada, Caribbean small states, Cayman Islands, Central African Republic, Central Europe and the Baltics, Chad, Chile, China, Colombia, Comoros, Congo, Costa Rica, Cote d I'voire, Croatia, Cuba, Curacao, Cyprus, Czech Republic, Czechoslovakia, D.P.R. of Korea, Denmark, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Estonia, Eswatini, Ethiopia, Faroe Islands, Fiji, Finland, Former Yugoslavia, France, French Polynesia, Gabon, Gambia, Georgia, Germany, Ghana, Gibraltar, Greece, Greenland, Grenada, Guam, Guatemala, Guinea, Guyana, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iran, Israel, Iraq, Ireland, Isle of Man, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kiribati, Korea, Kosovo, Kuwait, Kyrgyz Republic, Kyrgyzstan, Lao, Latvia, Lebanon, Lesotho, Liberia, Libya, Liechtenstein, Lithuania, Luxembourg, Macao SAR, China, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Marshall Islands, Mauritania, Mauritius, Mexico, Moldova, Monaco, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Netherlands, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Puerto Rico, Qatar, Republic of Korea, Republic of Moldova, Romania, Russia (Soviet Union), Russian Federation, Rwanda, Saint Lucia, Samoa, San Marino, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, Slovak Republic, Slovakia, Slovenia, Solomon Islands, Somalia, South Africa, South Asia, South Asia (IDA & IBRD), South Sudan, Spain, Sri Lanka, St. Kitts and Nevis, St. Lucia, State of Palestine, Sudan, Sudan (Former), Suriname, Swaziland, Sweden, Switzerland, Syria, Syrian Arab Republic, TFYR of Macedonia, Taiwan, Taiwan, Province of China, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Turks and Caicos Islands, Tuvalu, Tanzania, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, Virgin Islands (U.S.), Yemen, Yemen (North Yemen), Yemen, Rep., Zambia, Zimbabwe.