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INCOME INEQUALITY AFFECTING ECONOMIC GROWTH – PANEL DATA ANALYSIS

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Abstract
The subject paper aims to empirically assess the effect of income inequality on a country's economic growth. GINI coefficient Index is considered as proxy for income inequality and macroeconomic variables for 32 countries, for both developed and developing, from 2010-2014, are used to examine the effect. Other macroeconomic variables used as control variables are inflation rate, unemployment rate, investment as percentage of Gross Domestic Product (GDP), gross savings as percentage of GDP whereas level of economic development is taken as dummy variable. Empirical analysis reveals that both income inequality as well as economic growth has a negative relationship but income inequality is not significant. In addition to the Gini coefficient, analysis shows that unemployment rate and gross saving to GDP are statistically significant and has a negative and positive impact on economic growth, respectively. Macroeconomic variable, inflation carries a predicted negative sign, though it is statistically not significant. Functional form of GINI coefficient, GINI squared has a small magnitude but is statistically significant affecting GDP growth rate. A contradictory relationship between investment to GDP ratio and economic growth is observed which warrants further research.

Keywords: *income inequality, economic growth, Gini coefficient (GINI), Gross Domestic Product(GDP)*
JEL Classification: O4, E24

Introduction

Income inequality has been an impeding issue against economic growth for several countries globally. Large divides in income between poor, middle and upper class in a society results in a decrease in citizen welfare and many governments struggle in closing this income inequality gap. Income equality not only ensures that citizens across the country have a balance quality of life, but it also impacts the Gross domestic product (GDP) and growth of an economy. Equal distribution of wealth has been known to impact a country's output. In 1912, Corrado Gini, an Italian Statistician developed a tool to measure economic inequality taking into account income or wealth distribution within population. Gini index works as a tool to gauge inequality in income distribution within households. GINI Index is lower if a country has equal income distribution and higher, in case the country has an unequal income distribution. As per World Bank definition, index value will be zero if there is complete income equality while it is reported as 100 in case of absolute inequality. Several explanatory variables have been known to affect GDP of a country and the subject research incorporates some of these other than GINI index to study their effect on a country's GDP.

Association between income inequality and economic growth was first established by Kuznets (1955) by using data from developed countries, USA, Britain and Germany. Several researches since then provide conflicting findings – some claim that income inequality has a positive while others say it has negative relationship with economic growth. Developing countries generally exhibit greater level of economic growth compared to developed countries. An important aspect here is also to consider data quality – because developing economies have larger number of informal employment sectors, this tends to create differences in data collection in reality and on paper which might create biases in results. Data across regions further adds to the argument for instance, East Asian countries like Thailand, Japan, Singapore do not conform to Kuznets (1955) inverted U-hypothesis. Their economies reveal low income inequalities along with swift economic development after the World War II era. Increase in national income in Asian countries was shared amongst its populations and millions of people were lifted out of poverty. Government interventions such as land re-distribution have also been witnessed to play major role in enhancing growth process by lowering inequality in income distribution.

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This paper aims to assess the impact of income inequality (measured through GINI Index) on economic growth (measured through GDP growth rate) of a country. Impact of various explanatory variables like inflation, unemployment rates, income inequality, savings and investment ratios and development dummy on a country's growth has also been assessed in this study.

Literature Review

Kuznet (1955) inverted U- hypothesis theory suggested that during earlier stages of a country's development the inequality of income will be greater which will later start to decrease as the country achieves more growth and development. However, review of empirical literature reveals conflicting result in terms of income inequality's relationship with economic growth. One such study assessing the relationship was conducted by Barro (2000) using school attainment, inflation, birth rate, investment, democracy index and GINI coefficient as the main explanatory variables. Findings indicate that for low GDP countries, there exists a negative relationship whereas high GDP countries report a positive relationship between income inequality and economic growth. Overall economic growth is improved through wealth redistribution and income equality (Barro, 2000). In contrast, Malinen (2013) reports negative relationship which can be attributed to bias originating from social and political unrest and credit market imperfections. Bank loans, savings rate and firm leverage are the main indicators used in the study. Forbes (2000) considers social factors like corruption level, government expenditure on education and health and economic diversity as factors which significantly impact cross sectional country data. Results show that income inequality has a positive, direct relation with growth, specifically for short and medium run.

Study conducted by Persson and Tabellini (1994) employed income, consumption, aggregate individual investment and political preferences as main variables to examine the relationship. Findings indicate that growth is negatively affected by inequality as it leads to infringement of property rights and disallow full appropriation of returns on investment. Specifically, in the US market, inequality of income was observed to influence growth during post-war period that is from 1953 to year 2008 by using inflation, unemployment rate, income distribution and stock market data. When compared to low income households, high income households report greater income which is more sensitive to growth which is inclusive of current and future expected growth. Increased sensitivity is because a greater proportion of income for high income household comes from their wealth which is more sensitive as compared to labour income (Rubin & Segal, 2015).

Yet another research on the topic was conducted by Fawaz, Rahnama and Valcarcel (2014) wherein annual percentage change in per capita Gross National Product (GNP) is the dependent variable to proxy for economic development and net male and net female enrolment ratios, purchasing power parity ratio of investment to exchange rate as key explanatory variables. For countries falling under low income bracket, researchers observed negative whereas for high income, a positive association. Data from developing countries is employed to conclude that in the presence of income inequality, economic growth of a country is incapable of reducing poverty (Tabassum & Majeed, 2008). Both equitable distribution of income and economic growth are deemed as significant in order to reduce levels of poverty in the long run. The study also indicates that imperfections in the credit market create a negative influence on human capital investment, thereby hampering the growth rates.

Wahiba and El Weriemmi (2014) conducted an empirical investigation specifically in the context of an emerging country, Tunisia. GINI Index was main explanatory variables and amongst others were exports as a percent of GDP, fertility rates, monetary aggregate M2 for money supply, and enrollment rates at secondary level. Economic growth was proxied through GDP growth rate. Results indicate that income inequality and economic growth are negatively associated and attributes failure of redistribution rules and trade openness as main reasons behind this inverse relationship. In contrast, another study for more developed markets focused on only three countries – China, Japan and US. Yang & Greaney (2017) observe a positive and causal relationship between variables stating that increased income inequality in these countries actually spur economic growth. Data on labour force, exports and investment was used in their study.

Determinants of Economic Growth

Economic relationship of variables under theoretical considerations is explained as below in Table 1

Table 1. *Economic Determinants of Growth*

Variables	Predicted Sign	Economic Justification
Income Inequality	Positive (+) /Negative (-)	***POSITIVE*** When income inequality increases, economic growth also increases, albeit in the short run. It is because few income groups either do not change or change over longer time periods. Hence, a category of social class will take all benefits of economic development through accumulation of capital and others remain unaffected (Galor and Moav, 1999). ***NEGATIVE*** When distribution of income and wealth is equitable, individuals will be saving and consuming more, which will require more products and services to be produced in an economy, hence boosting the per capita GDP. Wealth concentrated within a small group of individuals in an economy would not produce a multiplier effect since there consumption pattern is not comparable with rate of consumption of the rest of the population.
Inflation Rate	Negative (-)	An increase in the rate of price level within a country will decrease economic growth rate. Increase in prices means demand for higher salaries by workers which translate to companies increase in prices of goods and services. When prices increases, consumers will cut their consumption patterns, thereby producing negative impact on GDP.
Unemployment Rate	Negative (-)	An increase in employment means work force is attached with better jobs which lead to an increase in their income, consumption and economic growth.
Net Investment as a % of GDP	Positive (+)	In case of higher economic growth, more resources are employed and tied up for investments. When investments increase, aggregate demand increases leading to higher productive capacity within country.
Gross savings as % of GDP	Positive (+)	Causal relationship whereby increased savings stimulate economic growth through increased investment
Development dummy	Negative (-)	Developing and emerging economies exhibit higher and faster GDP growth whereas developed countries are considered to have a lower GDP growth rate. It can though, appear as a statistical bias.

Data & Methodology

Table 2. indicates the list of countries chosen for the study under two main categories classified as developed and developing, as apportioned by World Bank classification report. High income countries were considered as developed, whereas upper middle income, lower middle income and low income economies were considered as developing. Total of 32 countries are part of analysis, equally divided into 2 groups.

Table 2. *Country listing*

Developed	Developing
Australia	Argentina
Austria	Armenia
Canada	Brazil
Finland	Bangladesh
France	Belarus
Germany	Cambodia
Iceland	China
Japan	India

Netherlands	Indonesia
New Zealand	Malaysia
Norway	Singapore
Portugal	South Africa
Spain	Pakistan
Sweden	Srilanka
United Kingdom	Uganda
United States	Thailand

Macroeconomic data for selected variables of 32 countries presented for a sample period of 15 years starting from 2000 to 2014 has been collected from World Bank collection of development indicators (World Development Indicators) and International Monetary Fund financial indicators. Panel data has been used as it accounts for individual heterogeneity by including variables at distinct level of analysis (countries), appropriate for multilayered or hierarchical modeling (Torres-Reyna, 2007). In case the variables are time variant, problems of omitted variable bias can also be resolved by using panel data (Sheytanova, 2014).

Variables defined

Variables selected for study are defined in Table 3. Model includes both focus and control variables. Control variables impact dependent variable and are added to avoid model misspecification and omitted variable bias.

Table 3. *Variable Description/Formulas as per World Bank and IMF*

GDP per capita growth (annual %) **(Dependent Variable)**	Calculated as change in the ratio of GDP to population (midyear level)
GINI Index **(Independent variable)**	Used as proxy for inequality in income. The Gini index measures degree by which an economy demonstrates inequitable distribution of wealth and income, amongst households. If Index value = 0 (absolute equality), while an index value = 100 (absolute inequality). The lower the value, the more equitable distribution of income.
Inflation, consumer prices (annual %) **(Independent variable)**	Used as proxy for price level and measured through CPI - Consumer Price Index.
Unemployment Rate **(Independent variable)**	Calculated as: Total percentage of labor unemployed/ labor force
Investments as a % of GDP **[Control variables]**	Calculated as: LCY investments/ LCY GDP
Gross Savings as a % of GDP **[Control variables]**	Calculated as : (GNI – total consumption + net transfers)/GDP
Level of Economic Development **(Independent variable)**	Taken as dummy/binary variable. Value of 1 indicates country is developed and 0 indicates it's developing.

Empirical Analysis & Findings

In the first step, it is important to ensure that data meets all of the requirements of the Gauss Markov assumptions so that estimators are unbiased and BLUE - best linear unbiased estimates. Secondary data has been obtained from World Bank and IMF databases through random sample. Normality of the data has been check through descriptive statistics whereas constant variance is tested through Breusch Pagan tests, explained below.

Data Normality / Histogram of residuals

The kernel density plot in graph 1 shows that the data is platykurtic that is it has thinner tails than a normal distribution.

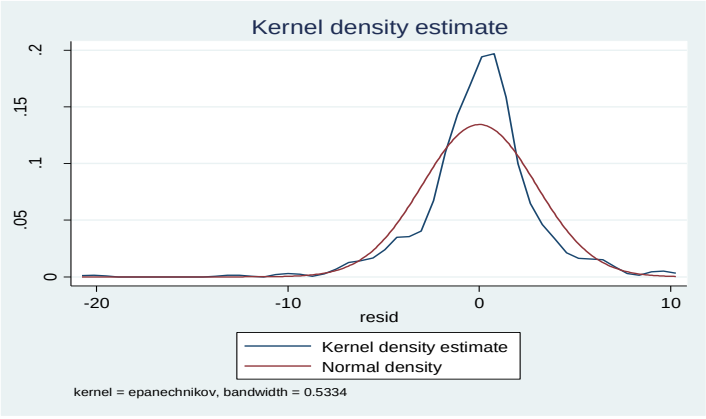

Figure 1. Data Distribution

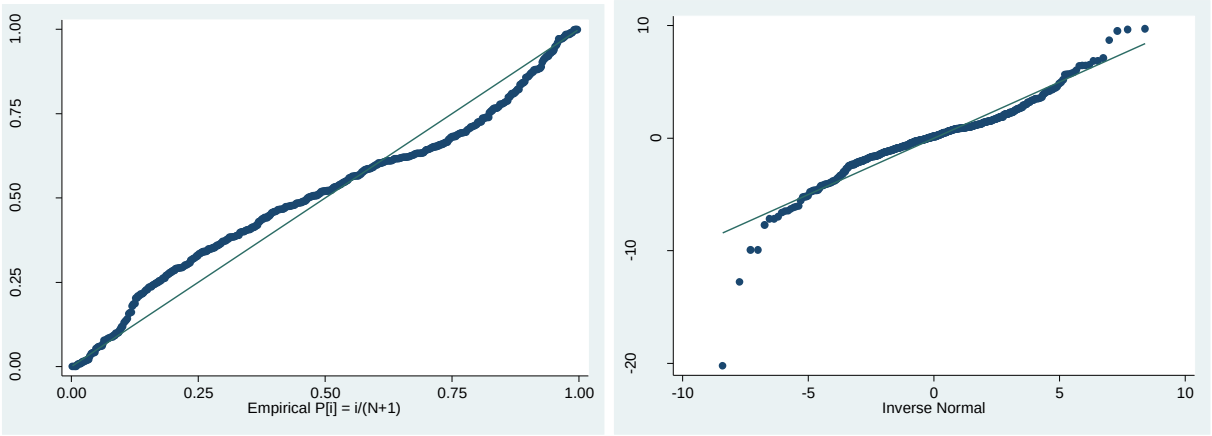

Figure 2. Data Distribution (pp/qq plots)

The standardized normal probability plot (p-p plot) and normal q-q plot which provides quantiles of variable also proves that data is platykurtic in nature. The q-norm indicates deviation from normal from the upper and lower tails.

Descriptive Statistics

Descriptive statistics for variables are discussed as below in Table 4

Table 4. *Descriptive Statistics*

Variable	GDP grw %	GINI Coef	Unemp rate	Infl	Inv%GDP	Sav%GDP
Mean	3.212	35.44	6.59	4.84	24.31	24.77
Maximum	15.24	69.4	27.18	168.62	48.01	52.27
Minimum	-14.15	22.7	0.16	-1.35	10.31	2.78
Standard Deviation	3.65	8.67	5.05	9.67	6.1	8.96

Source: Author calculation

GINI coefficient highest (69.4) was reported for South Africa in year 2011 representing higher income inequality whereas lowest (22.7) was reported for Iceland in year 2013, which represents equal income distribution. Maximum inflation rate of 168.62% is recorded for Belarus in 2000 and lowest (-1.35) for Japan in year 2009. Values of standard deviation, minimum and maximum show the dispersion of values from its mean. Minimum and maximum values in the table provide the range. The value of standard deviation tells the spread or variation in data. The standard deviation for inflation is greatest amongst the explanatory variables, followed by gross savings to GDP ratio. Lowest standard deviation is for GDP growth rate which means its more closer to the mean.

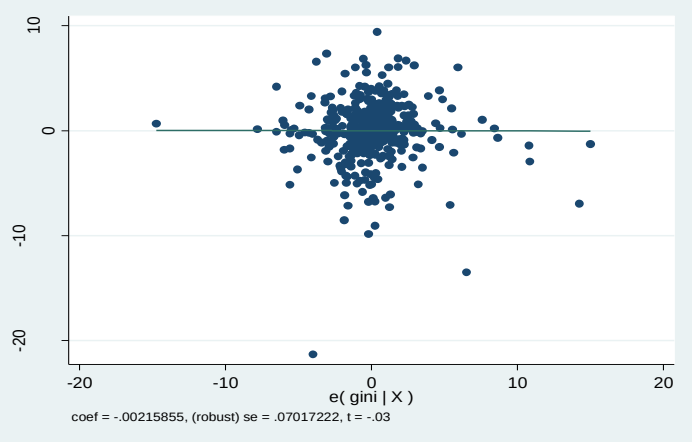

Figure 3. Outlier graph for GINI coefficient

Correlation Matrix

To detect multicollinearity, correlation matrix was created as per Table 5. Correlations of variables were generally on lower side, except for 58.97% positive correlation between investment and savings. Correlation sign of GINI Index (positive) and inflation (positive) with GDP growth rate is unexpected.

Table 5. *Correlation Matrix*

	GDP grw%	GINI	Unemp	Inf	Devdummy	Inv%GDP
GDP grw%						
GINI	0.1425					
Unemp	-0.1822	0.3284				
Inf	0.1035	0.0160	-0.1162			
Devdummy	-0.4916	-0.5469	0.0534	-0.2700		
Inv%GDP	0.4528	-0.0775	-0.2744	0.1068	-0.3046	
Savings%GDP	0.3096	-0.1390	-0.3344	-0.0409	-0.2247	0.5897

Source: Author calculation

Diagnostic Tests

The assumption of constant variance is tested through Breusch Pagan test for heteroscedasticity.

Null Hypothesis H_o: $E(u^2|x_1, x_2, \ldots, x_k) = \alpha_0$ [σ^2 - constant variance]
Alternate Hypothesis: H_a: $E(u^2|x_1, x_2, \ldots, x_k) \neq \sigma^2$ [heteroscedasticity]

As per results, chi square statistic is 18.74 (with p value = 0.000 i.e. statistically significant) hence null hypothesis is rejected which confirms on the presence of heteroscedasticity. To cater to heteroscedasticity, variance–covariance matrix of the estimators (vce) robust standard errors is used for regression.

Hausman Specification Test

Hausman test is conducted to determine existence of fixed or random effects in the model. Hypothesis for Hausman Specification Test is as follows:

Null Hypothesis H_o: Preferred model is random effect and error term (u_i) is not correlated with the regressors ($C, \boldsymbol{x_{it}} = 0$)
Alternate Hypothesis: H_a: Preferred model is fixed effect and errors are correlated with regressors ($C, \boldsymbol{x_{it}} \neq 0$)

As per results, chi square statistic is 60.11 (with p value = 0.000 i.e. statistically significant) hence null hypothesis is rejected and fixed effect OLS model is the appropriate model for the panel regression for the available data set. Using fixed effects model within panel data helps to deal with the unobserved heterogeneity. As seen from the results, there

is no constant term in the fixed effects model. Also, the development dummy variable has been dropped due to multicollinearity. Results are discussed in Table 4.3.

Ordinary Least Squares (OLS) regression

In the next step, OLS regression is run on variables. OLS is estimated through the following equation.

$$Y_{it} = \beta_0 + \sum_{k=1}^{k} \beta_k * \left(X_{kit-1} \right) + \varepsilon_{it}$$

Where, Y_{it} represents GDP per capita growth rate as the dependent variable and X_{kit-1} represents

Group of independent variables (focused and control) including GINI Index, inflation rate, unemployment rate, investment and savings ratio as percentage of GDP and level of economic development. Table 6. compares the results from different model estimators.

Table 6. *Results from Four Different Estimators*

Dependent Variable: GDP growth Rate				
Independent Variables	Pooled OLS (normal)	Pooled OLS (Robust)	Random Effects	Fixed Effects
GINI Coefficient	-0.022	-0.022	0.0000	-0.0008
	(0.023)	(0.032)	(0.029)	(0.052)
Unemployment rate	-0.048	-0.049	-0.0852	- 0.3603***
	(0.033)	(0.054)	(0.042)	(0.074)
Inflation	-0.019	-0.020	-0.015	-0.0186
	(0.015)	(0.019)	(0.016)	(0.017)
Development Dummy	-3.228***	-3.228***	- 2.962***	omitted
	(0.409)	(0.543)	(0.526)	
Investment%GDP	0.178***	0.178***	0.145***	-0.0572
	(0.029)	(0.040)	(0.035)	(0.051)
Savings%GDP	0.001	0.001	0.0352	0.2915***
	(0.021)	(0.028)	(0.026)	(0.048)
R-Square			0.345	0.0770
rho			0.07	0.62
# of Observations			432	432

Standard errors are given in parenthesis. (***) indicates significance at 1%.

Source: Author calculation

OLS (robust estimates) and Fixed Effects provide contrasting results. The GINI coefficient under both the models has a negative sign and the impact is much smaller in FE model. GINI coefficient is statistically insignificant under both the models, but it can be said that negative sign indicates if GINI coefficient increases by one percent, GDP growth rate will decrease by about 0.02% under OLS. Unemployment rate has the expected sign and is significant at 99% confidence interval, with a coefficient value of 0.36 under model 4. This means that if unemployment increases by 1 percent, GDP growth rate will fall by 0.36%. Explanatory variable, inflation is again not significant under model 2 and 4 but it has the expected sign. The impact is almost the same under OLS and FE. Development level as dummy under FE is omitted but it is statistically significant under OLS at 99% confidence level. If a country is developed, the GDP growth rate will decrease by 3.2 percent. Investment to GDP ratio is statistically significant, at 1 percent under OLS whereas gross Savings to GDP is statistically significant at 1percent under FE. This means that if savings to GDP ratio in any country increases by 1 percent, the GDP growth ratio will increase by 0.29%.

Model with Functional Form Variable

GINI coefficient in quadratic form was also introduced in model since the main objective is to investigate impact of income inequality on GDP growth rate. This helps in identifying effect of the change in inequality on growth. Although small in magnitude, a significant (at 5%) negative beta coefficient value of gini squared from Table 7. indicates that GDP growth rate decreases as inequality increases and it falls more sharply with increased inequality. As per earlier

results, both GINI and GINI squared have the expected negative sign and appear as statistically significant. Moreover, it can be said that if GINI Index is zero percent, then the growth rate will be 4.72%.

Table 7. *Effect of Income Inequality on GDP Growth Rate*

Dependent Variable: GDP growth Rate	
Independent Variables	
Constant	4.725*
	(2.875)
GINI Coefficient	-0.726**
	(0.291)
GINI Coefficient Squared	- 0.009**
	(0.003)

Source: Author calculation

Table 8. provides comparison on the effect of GINI coefficient under three different models. Results under all three confirm on the negative relationship of GINI coefficient with GDP growth rate, however the impact is very minimal and statistically insignificant under the full set model (3). It is only statistically significant at 1 percent level of significance under model (1) with no other control variables. If GINI index increases by one percent, the GDP growth rate is expected to fall by 0.061 percent. Interesting to note here is that under model (2), GINI coefficient comes as statistically insignificant, whereas GINI squared term was statistically significant at 5 percent level of significance, with coefficient value of negative 0.003.

Table 8. *Effect of Income Inequality on GDP Growth Rate*

Independent Variables	(1)	(2)	(3)
Constant	0.965	3.617	-0.146
	(0.670)	(2.353)	(2.357)
GINI Coefficient	-0.061***	-0.147	-0.0008
	(0.019)	(0.108)	(0.052)
Other controls	No	$GINI^2$, Dev Dummy	Full Set
Observations	437	437	432
R-Squared	0.021	0.265	0.077

Source: Author calculation

Model with Interaction Variables

Interaction variables were generated in Stata to observe their effects on GDP growth rate. They were unemployment and inflation and GINI and unemployment. Results are presented in Table 9. below. Both the interaction variables are seen to be statistically significant at 1 percent level of significance. The signs are expected however the impact of gini*unempl on GDP growth rate is very minimal.

Table 9. *Effect of Income Inequality on GDP Growth Rate*

Independent Variables	
GINI	0.079
	(0.056)
Gini*unemp	-0.008***
	(0.002)
Unemp*inf	-0.012***
	(0.005)

Source: Author calculation

Dummy Variable Estimation / Entity and time fixed effects

Since three categorical variables for level of development, country (ID) and period (time period) has been included, it is easy to run the fixed effects. The dependent variable GDP growth rate is regressed on main explanatory variable of interest that is GINI coefficient and on categorical variables. Stata creates temporary dummy variables for use in regression. Blocks of dummy variables for each country and each period are created such that first country and time period are taken as base years and excluded from results, due to perfect multicollinearity. For level of development dummy, the factor is statistically significant at 2 percent level of significant with a coefficient value of negative 3.588 (t value= -12.38) which means that if country is developed, the GDP growth rate is expected to be 3.58 percent lower.

Model with Time Trend

The possibility of time trend being linear is there and if time trend is linear, we can condense the individual period dummies into a period dummy in its original state. While regressing GDP growth rate on GINI coefficient using period dummy, coefficient of period is negative 0.14 which tells the average change by one period.

Conclusion

Relationship of income inequality with economic growth of a country is considered an argument in several studies. Economic growth rate measured through GDP is influenced by various other factors; 6 considered in the research are income inequality (measured through GINI Index) unemployment rate, inflation, level of development of a country, investment to GDP ratio and gross savings as percentage of GDP. For the research, data of 32 countries was used and these countries were divided as per their level of economic development into two categories – developed and developing.

Overall, the Fixed effect model shows that inequality and economic growth share a negative relationship. In addition to the Gini coefficient, analysis indicates that unemployment rate and gross savings to GDP are statistically significant and have negative and positive impact on economic growth, respectively. The functional form of GINI coefficient, GINI squared has a small magnitude but is statistically significant affecting GDP growth rate. Macroeconomic indicator of inflation carries a predicted negative sign, though it is statistically not significant. A contradictory relationship between investment to GDP ratio and economic growth is observed which warrants further research. Better and recent data, especially in regards to the Gini coefficient, would help for further research and analysis.

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