Income Inequality and Economic Growth: A Cross-Country Analysis

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Abstract

This study seeks to find a relationship between economic growth and income inequality. Past studies remain divided about this subject, where some find there to be a positive relationship and others support a negative relationship. Single and multiple linear regression models were formed using data from 2010. This study found a positive relationship between economic growth and income inequality. Statistical inference tests supported the significance of all but one variable, unemployment. A robustness test concluded that this variable was jointly significant. Further studies should include increasing sample size, splitting up countries based on level of development, and implementing new explanatory variables.

1. Introduction

On September 25-27 the 193 member states of the United Nations congregated to draft the Sustainable Development Goals (SDGs), with economic growth as one of the bedrock goals of this global initiative (UN, 2015). Reducing inequalities was also a major focus of the SDGs and thus the link between economic growth and inequality is an essential phenomenon to analyze.

Income inequality is a hot button topic in the political arena for a multitude of reasons. The social costs of inequality and its effects on the poor are highly important to consider because the quality of life for so many people is contingent on the level of income that they earn. There are several adverse impacts that income inequality has. Firstly, income inequality is shown to keep the poor from staying healthy and accumulating human and physical capital (Galor and Moav, 2004; Aghion, Caroli and Garcia-Penalosa, 1999). Secondly, social mobility is impaired by inequality, as Corak (2013) found that in countries with higher amounts of inequality a child's earning capacity is contingent on a greater level of the earning capacity of their parents. Finally, there is an increasing amount of evidence that shows that rising inequality has decreased the level of equal representation within government and has caused the rich to have a stronger voice, swaying policy in the direction that favors them. Increasingly, evidence is mounting that suggests that extended periods of high inequality within advanced economies is correlated with the financial crisis of 2008 (Rajan, 2010; Acemoglu, 2011).

While economic growth is undeniably a powerful mechanism for poverty reduction, it does not necessarily have to include a reduction of inequality. Theoretically a nation could experience economic growth without incurring any benefit on the poor - the rich get richer and the poor remain unaffected. Income inequality is an essential topic to fully understand as it is one of the hot-button topics in political debate and there is much misinformation guiding political decision making.

Ultimately, why is income inequality an incredibly important phenomenon to study? Because the essence of life (health, education, social mobility, representation in government etc.) can all be negatively impacted with high levels of income inequality.

We believe that there is a positive relationship between income inequality and economic growth, and will test that empirically using regression analysis. The model that this paper develops will seek to find a correlation between income inequality and economic growth using cross-country data obtained from 2010. This data, which is more recent than those from previous studies, will be more representative of the relationship between inequality and growth. Based on prior literature, the expected result is a positive correlation between income inequality and economic growth. We propose that with higher inequality there may be a greater amount of wealth within the top percent driving economic growth.

2. Literature Review

There is a divide in the literature as to whether income inequality and economic growth are negatively or positively related, with the reasons stemming from differing empirical approaches, different datasets ranging different years, and the use of different explanatory variables.

A number of the literature indicate a negative relationship between economic growth and income inequality (Chambers and Dhongde, 2011; Alesina and Rodrik, 1994 et. al.) with studies that include up to 96 percent of the developing world's population and 116 countries (Chambers and Dhongde, 2011). Chambers and Dhongde (2011) measured the growth elasticity of poverty (GEP) and found that in countries with higher amounts of inequality the GEP was low and those with lower inequality had much larger GEP values. They also utilized a non-parametric approach - with the majority of the coinciding literature using a parametric approach - and an extensive and updated dataset from the World Bank inclusive of 1977 through 2007 to derive their results. Their findings coincided with other literature which found a negative relationship between economic growth and inequality while utilizing more robust methods and more comprehensive data.

But the case for a negative relationship between income inequality and economic growth of a country is not all inclusive, as Forbes (2000) argued that many of those studies, showing a negative relationship between economic growth and income inequality, were not robust as they did not account for omitted variable bias. By using panel estimation to control for time-invariant country-specific effects, she showed a positive relationship between income inequality and economic growth of a country. Specifically, she directly estimated the correlation between changes in inequality and changes in economic growth in a given country. The results showed that in both short and medium-term there was a positive relationship between income inequality and economic growth. The implications of this study point to identifying and controlling for the omitted variables, such as corruption, government spending on education, and healthcare, as the next step in the continued research of this topic.

Clarke (1995) showed a negative correlation between income inequality and GDP for a country and also proposed that inequality is not a precondition for growth. The data used by this paper to conduct the research consisted of the Gini coefficient, coefficient of variance of income and the Theil index. They noted that there were quality issues with the data due to the fact that all income was not from the same year and in the case of some countries, he was unsure whether pre or post tax income was being used. After running the appropriate regression tests, a number of conclusions were made. Firstly, he stated that his results showed that inequality is negatively correlated with growth. Secondly, decreasing the inequality by one standard deviation caused the growth to increase by approximately 1.3% per annum. He also mentioned that the type of government structure (democracy

or non-democracy) did not affect the result. In his conclusion, he infers to treat the results with a degree of care as early theoretical work suggests that government economic intervention caused this negative correlation to take place, direction of causality has not been determined, and the impact of 'soak the rich' policies had not been tested. Overall he concluded that income inequality is not a precursor for economic growth. It was argued that as per trickle-down economics, higher inequalities lead to faster wealth accumulation, more savings, and as a result, better redistribution of income, and as a result more growth. It was also inferred that greater inequality caused more issues with regards to redistribution of income, which causes government to levy higher taxes that reduce capital accumulation and thus slow growth.

Fawaz, Rahnama, and Valcarcel (2014) addressed the correlation between economic growth and income inequality. Many studies had been conducted prior, even as early as the beginning of the nineteenth century searching for a solution to this problem. Some previous analyses found an indirect relationship between economic growth and income inequality, whereas others produced the opposite result. These contrasting conclusions were the result of the analysis of different confounding factors, such as the relative importance of sociopolitical factors, collateral, and credit market asymmetries. In order to avoid these issues, Fawaz focused on analyzing developing countries. A model was created using data from the World Bank for the year 2012, where developing countries decided from a new threshold were chosen. A total of 111 countries were sampled, with roughly even amounts classified as high and low income developing countries (HIDC and LIDC). A multiple regression analysis was conducted using these samples, with the dependent variable being per capita GNP growth for a country, and income inequality an independent variable, represented by the Gini coefficient. The multiple linear regression model also included explanatory variables such as female and male school years. The results of the analysis failed to find a decisive result. A positive relationship was found between income inequality and economic growth in HIDC countries whereas a negative relationship was found between the variables in LIDC countries. It was suggested that the relationship between the variables may be nonlinear. This supported earlier findings that the variables are sensitive to the regressors chosen, resulting in contrasting outcomes, as shown in prior literature. This paper is more recent than the prior two chosen for this study. Education does seem viable for further study, but the few number of variables chosen may be the cause of conflicting results. The division into HIDC and LIDC did not find a linear relationship, which was taken into account for our study.

The literature is divided by whether income inequality has a negative or positive relationship with economic growth. This paper seeks to add value to the literature with updated data from 2010 from the World Bank. While there are many plausible reasons as to the polar findings, it is essential to update old findings with recent data. The world is at the cusp of the fourth industrial revolution where

the way people consume, produce and interact with each other is starkly different than in decades past. The underlying economic environment is changing vastly and an analysis of the evolving global economy will provide clear results for the world in which we live in and where policy makers must make momentous decisions.

Additionally, we use different variables than some of the literature as we attempt to improve on past models and include important variables that have an impact on economic growth and inequality.

3. Data

For our simple linear regression model, the independent variable chosen was the Gini coefficient, a measure of income inequality. This Gini coefficient was a pre-tax coefficient. The dependent variable was annual growth percentage of gross domestic product (GDP). Thus, GDP growth was regressed on the Gini coefficient, where both data sets were gathered from the year 2010 (World Bank, 2010). This was decided because income inequality was believed to have more of a discernible impact on GDP growth than GDP growth on income inequality. The Gini coefficient was chosen for this model because it is a common measure of income inequality in countries, where 0 represents perfect equality and 100 represents max inequality, and is commonly used among the literature. Since the main goal of our project is to study the effect of income inequality on GDP growth, we wanted to control for other factors in an economy which would impact economic growth. As a result, the other independent variables chosen are natural resources, mean school years, unemployment rate and gross savings in an economy. Natural resources (World Bank, 2010) was calculated as a percentage of GDP, which was a sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. The natural resources, such as the availability of fertile soil, can significantly impact the GDP of a country and thus it was important to control for this. Secondly, mean school years (United Nations, 2010) was used to control for the differing levels of education accessibility and quality availability in each country. Mean school years was calculated using average number of years of education received by people ages 25 and older. The unemployment rate (World Bank, 2010) refers to the long term unemployment rate prevailing in a country's economy. The unemployment rate was taken into consideration as we wanted to control for the number of jobs available in an economy. Lastly, gross savings (World Bank, 2010), was calculated as percentage of GDP. The reason gross savings was used to control for the level of inflation in an economy is because the higher the inflation rate, on average, there will be a lower level of savings available in the economy. A summary of the variables is provided in Table 1 below.

Table 1: Variable Descriptions

gdpg	Growth of Gross Domestic Product
gini	Gini Coefficient (measure of inequality)
nat	Natural Resources
meansc	Mean School Years
une	Unemployment Rate
gross	Gross Savings

3.1 Summary Statistics

A table of the summary statistics for the data is shown in Table 2. 57 countries were used in this study. The minimum of gdpg is negative because a country's economy can regress. It is also noticeable that the standard deviation on natural resources is large, relative to its mean.

Table 2: Summary Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
gdpg	57	3.52	3.65	-5.45	13.09
gini	57	35.68	7.89	24.82	55.50
nat	57	4.63	7.39	0	37.84
meansc	57	9.82	2.35	2.20	12.90
une	57	8.91	4.81	0.40	19.90
gross	57	21.55	8.08	6.33	50.60

3.2 Gauss Markov Assumptions

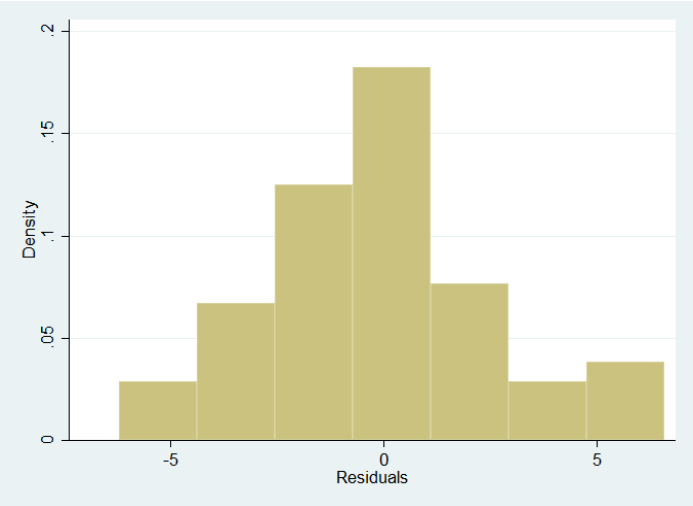
This section tests whether the data meets the Gauss Markov Assumptions, and as a result, whether or not we are justified in building a multiple linear regression model. For the first assumption, the model should be linear in parameters. The model is written is the form $Y = \beta 0 + \beta 1X1 + \ldots + \beta kXk + u$, thus it meets assumption one. For the second assumption, there should be a random sampling of regressors. We selected 57 countries at random without any particular reason for selecting any of them, thus there was a random sampling. The third assumption states that there should be no perfect collinearity between the regressors. As illustrated in Table 3, there is no perfect collinearity between any of the regressors and as a result our model meets assumption three.

Table 3: Correlation Among Variables

	gdpg	*gini*	*meansc*	*nat*	*une*	*gross*
gdpg	1					
gini	0.44	1				
meansc	-0.49	-0.46	1			
nat	0.37	0.07	-0.29	1		
une	-0.29	-0.13	0.08	0.16	1	
gross	0.32	-0.08	-0.06	0.26	-0.32	1

The fourth assumption requires that the expected value of the error given all explanatory variables equals zero. This was tested and proven by calculation of the residuals. As shown in Figure 1, the mean of the residuals for the multiple linear regression model tested was about 0 (2.88×10^{-9}). The fifth assumption is that the error u has the same variance given any value of the explanatory variables. The residual distribution in Figure 1 approximates a normal curve, so the fifth assumption is satisfied.

Figure 1: Residuals PDF



Note: This is a pdf of the residuals from regressing *gdpg* on *gini*, *nat*, *meansch*, *gross*, and *unem*.

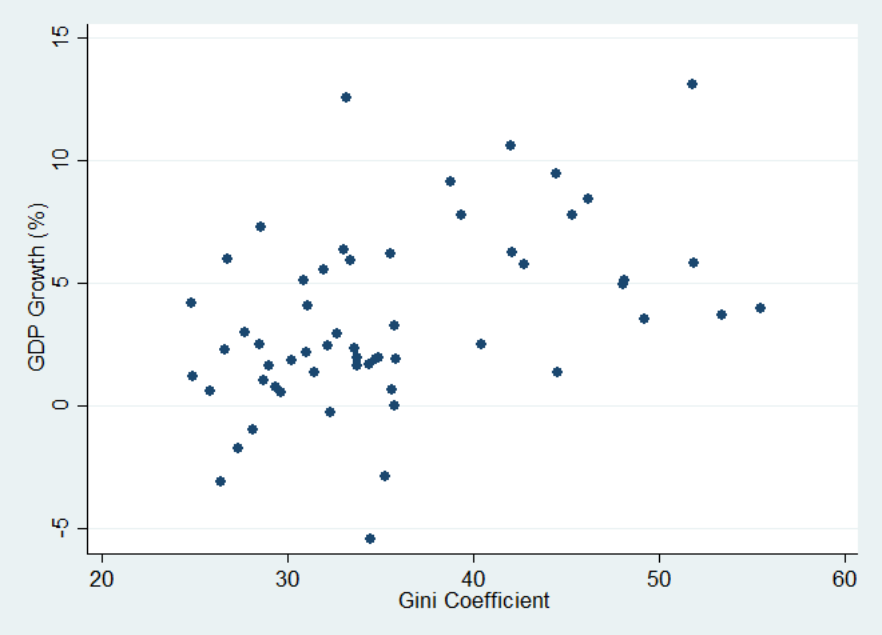
4. Results

4.1 Simple Linear Regression Model:

To test the relationship between GDP growth and the Gini coefficient, GDP growth was regressed only on the Gini coefficient. This is the simple linear regression model created, as shown in Equation 1. The estimates showed a positive relationship between the Gini coefficient and GDP growth, as shown by Figure 2 with the scatterplot of GDP growth (%) vs Gini Coefficient. For a one point increase in the Gini coefficient, we could expect GDP growth to increase 20.5%. The intercept found was negative, meaning for zero inequality, there would be negative growth. This is reasonable because assuming no inequality, which is perfect equality, one could assume there would be negative growth. The R^2 value found was 0.195. This is a low value, as only 19.5% of the variation in GDP growth was explained by this model. This could indicate a non-linear relationship.

Equation 1: $$gdpg = \beta_0 + \beta_1 gini + u$$

Figure 2: Scatterplot of GDP Growth (%) vs Gini Coefficient



4.2 Multiple Linear Regression

To remove any omitted variable bias, more variables with economic significance on GDP growth were added. The new variables were chosen to control for the Gini coefficient. GDP growth was regressed on the Gini coefficient and four new explanatory variables, creating the multiple linear

regression model seen in Equation 2. The Gini coefficient was consistent, maintaining a positive relationship with GDP growth, as shown in Figure 2. Natural resources and gross savings both had a positive relationship with GDP growth whereas mean school years and unemployment had negative relationships. It is noticeable that the intercept changed signs, but due to the high standard error relative to the small positive coefficient, this does not seem to be a significant change. The R^2 value found for this regression was 0.454, so 45.4% of the variance in GDP growth was explained by the multiple regression model. This is much larger than the previous value, but expected, as increasing the number of variables always increases the R^2 value.

Equation 2: $$gdpg = \beta_0 + \beta_1 gini + \beta_2 nat + \beta_3 meansch + \beta_4 gross + \beta_5 unem + u$$

The results obtained from the regressions support our hypothesis that GDP growth is positively related to the Gini coefficient. A one point increase in the Gini coefficient leads to an increase in GDP growth by 14.4%. A possible cause for this could be that as inequality increases, the wealth of the economy is concentrated in the hands of a few people, which in turn increases GDP growth through various factors such as increased level of investment in the economy. As the total natural resource rents of a country increases by 1%, GDP growth increases by 9.51%. Natural resources play a crucial role in economic growth of a country. For example, the OPEC countries have large oil reserves; as a result they are able to export it all over the world, increasing their exports and foreign income, thus increasing their level of economic growth. Counter intuitively, mean school years and GDP growth are negatively correlated. As mean years of schooling for adults decreases by 1 year, GDP growth increases by 41.47%. This is a very interesting result and further research needs to be conducted on this particular result as currently there is not much literature that supports this. More intuitively, gross savings and GDP growth in an economy are positively correlated. A 1% increase in gross savings, increases GDP growth by 11.11%. An increased level of saving in the economy, especially developing economies, leads to an increased level of innovation as this saving attracts foreign investment in technology in the economy (Aghion, Comin, Howitt and Tecu, 2009). The positive coefficient on gross savings is also consistent with the Clarke's (1995) findings. Lastly, unemployment rate and GDP growth are negatively correlated. A 1% decrease in long term unemployment rate in the economy, results in 8.62% increase in GDP growth. As unemployment rate increases in an economy, it has both social and economic implications. Broadly, increased unemployment is associated with a decrease in disposable income, and as a result reduced consumption, which in turn leads to reduced economic growth.

Table 4: OLS Regression Estimates

Dependent Variable *gdpg*		
Independent Variables	**SLR Model**	**MLR Model**
gini	0.205*** (0.056)	0.144** (0.055)
nat		0.095* (0.055)
meansch		-0.415** (0.189)
gross		0.111** (0.051)
unem		-0.086 (0.084)
Intercept	-3.78* (2.045)	0.373 (3.872)
No. of obs.	57	57
R-square	0.195	0.454

Note: The quantities in parentheses are the standard errors. *, **, *** means the variable is significant at the 10%, 5%, and 1% level, respectively.

4.3 Statistical Inferences

Two-tailed t-tests were performed on each variable in both regressions. The null hypothesis was that the coefficient of the variable equaled zero, while the alternative was that it did not equal zero. Each test was performed at the 1%, 5%, and 10% significance level. The t-values and p-values calculated are shown in the appendix.

For the simple linear regression model, the Gini coefficient was found to be statistically significant at all three levels. The intercept was found to be statistically significant at only the 10% level.

For the multiple linear regression model, the Gini coefficient was found to be statistically significant at the 10% and 5% level, thus decreasing in significance. Mean school years and gross savings were also found to be significant at the 5% and 10% levels. The natural resources variable was found to be significant at only the 10% level. Unemployment was found to be not statistically significant. The intercept was not statistically significant at any level in this model, unlike in the single linear regression model. Therefore, we can conclude from this model that the Gini coefficient,

mean school years, natural resources, and gross savings have an impact on GDP growth, while no conclusions can be made about unemployment.

4.4 Robustness

Although when using the t-test we failed to reject the null hypothesis with unemployment, we felt that unemployment still had an economic significance when it came to GDP growth, and as a result economic growth. Thus, we conducted the f-test in order to check whether unemployment collectively with the other control variables (natural resources, mean years of schooling and gross savings) had an impact on GDP growth. The null hypothesis for the f-test was the coefficients on all our control variables was equal to zero and our alternative hypothesis was that at least one of the variables had an intercept that was not equal to zero. For our f-test, the restricted model was the simple regression model which yielded a sum of squared residuals of 601.29 (SSR_R). Our unrestricted model was the multiple regression which yielded a sum of squared residuals of 408.11 (SSR_{UR}). We then calculated the f-statistic for our restricted and unrestricted models using the following equation: $F = [(SSR_R - SSR_{UR})/q]/[SSR_{UR}/(n-k-1)]$ where q is the number of restrictions imposed on the restricted model, 4 for our model and (n-k-1) corresponds to the degrees of freedom for the unrestricted model, which is 52 for this model. The equation leads to an f-statistic of 6.15. Looking at the f-distribution table for the degrees of freedom in our model [(4,51)], results in a critical value of 3.7 at 1% level of significance. Thus, although unemployment is not individually significant, it has a joint effect on GDP growth along with all the other control variables.

5. Conclusion

In summary, in our multiple linear regression model we found that a one point increase in the Gini coefficient leads to an increase in GDP growth by 14.4%. Additionally, the Gini coefficient, mean years of schooling, and natural resources were significant at least at the 10% level of significance. Unemployment, on the other hand, was insignificant even at ten percent, thus an f-test was conducted in order to determine whether unemployment had a joint impact on GDP growth along with other control variables. The result of the f-test was that although unemployment was individually insignificant, it had an impact on economic growth with the rest of the control variables. Our findings are in accordance with some of the literature that also finds a positive relationship between income inequality and economic growth.

Further research needs to be conducted, taking more variables into account, in order to dig deeper and determine if there can be an increase in economic growth and a simultaneous decrease in at least some levels of income inequality. Future studies should continue seeking to use more recent

data to continue to uncover the direction of the relationship between economic growth and income inequality. Additionally, it would be beneficial to separate countries based on level of development, assuming a large enough sample size for all variables as that was a difficulty we faced.

To conclude, we recognize that income inequality is a hot button topic for debate right now. For example, in the current Presidential debates, the idea of increasing the minimum wage in order to bridge the gap between the rich and the poor is brought up quite often. On one hand, income inequality is linked with some economic and social issues in a country. On the other hand, sustained economic growth is what tends to improve the overall conditions of the people in an economy. Thus, some amounts of income inequality may be a necessary evil for economic growth and this should be taken into consideration. Policies should look to find a balance between decreasing income inequality, reducing social ills, and preserving the increased economic growth that is a result of the presence of income inequality.

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United Nations, 2010. *Mean years of schooling (of adults) (years)*. (United Nations Development Programme).

World Bank, 2010. *GDP growth (annual %)* (The World Bank).

World Bank, 2010. *GINI index (World Bank estimate)* (The World Bank).

World Bank, 2010. *Gross Savings (% of GDP)* (The World Bank).

World Bank, 2010. *Long-term unemployment (% of total unemployment)* (The World Bank).

World Bank, 2010. *Total natural resources rents (% of GDP)* (The World Bank).

Appendix

A1: List of Countries

Argentina	Armenia	Australia	Austria	Bangladesh	Belgium
Bulgaria	Cambodia	China	Colombia	Costa Rica	Croatia
Cyprus	Czech Republic	Denmark	Ecuador	El Salvador	Estonia
Ethiopia	Finland	France	Georgia	Germany	Greece
Honduras	Hungary	Iceland	Indonesia	Ireland	Israel
Italy	Jordan	Kazakhstan	Latvia	Lithuania	Luxembourg
Mexico	Mongolia	Netherlands	Norway	Panama	Paraguay
Peru	Portugal	Romania	Serbia	Slovenia	Spain
Sweden	Switzerland	Thailand	Tunisia	Turkey	Ukraine
United Kingdom	United States	Uruguay			

A2: Correlation Stata Output

```
. corr gdpg gini meansch nat unem gross
(obs=57)
```

	gdpgro~h	gini	meansc~s	natura~s	unempl~e	grosss~s
gdpgrowth	1.0000					
gini	0.4421	1.0000				
meanschool~s	-0.4930	-0.4618	1.0000			
naturalres~s	0.3737	0.0681	-0.2877	1.0000		
unemployme~e	-0.2855	-0.1283	0.0812	-0.1630	1.0000	
grosssavings	0.3249	-0.0849	-0.0693	0.2623	-0.3203	1.0000

A3: Residuals MLR Stata Output

```
. summ residuals
```

Variable	Obs	Mean	Std. Dev.	Min	Max
residualsMLR	57	2.88e-09	2.699558	-6.210616	6.584359

A4: SLR STATA Output

```
. regress gdpg gini
```

Source	SS	df	MS	Number of obs	=	57
				F(1, 55)	=	13.36
Model	146.070182	1	146.070182	Prob > F	=	0.0006
Residual	601.297114	55	10.9326753	R-squared	=	0.1954
				Adj R-squared	=	0.1808
Total	747.367322	56	13.345845	Root MSE	=	3.3065

gdpgrowth	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gini	.204557	.0559624	3.66	0.001	.0924057	.3167082
_cons	-3.784096	2.044742	-1.85	0.070	-7.88185	.313658

A5: MLR STATA Output

```
. regress gdpg gini nat meansch gross unem
```

Source	SS	df	MS	Number of obs	=	57
				F(5, 51)	=	8.48
Model	339.260942	5	67.8521883	Prob > F	=	0.0000
Residual	408.106381	51	8.0020859	R-squared	=	0.4539
				Adj R-squared	=	0.4004
Total	747.367322	56	13.345845	Root MSE	=	2.8288

gdpgrowth	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gini	.1442906	.0551986	2.61	0.012	.0334748	.2551064
naturalresources	.0951506	.055442	1.72	0.092	-.0161539	.206455
meanschoolyears	-.4146949	.1894337	-2.19	0.033	-.7949989	-.0343908
grosssavings	.1111815	.0513262	2.17	0.035	.0081399	.2142231
unemploymentrate	-.0862519	.0843488	-1.02	0.311	-.2555892	.0830855
_cons	.3730819	3.872449	0.10	0.924	-7.401184	8.147348