

Impact of Economic Inequality on GDP Growth

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Abstract:

The relationship between inequality and growth is an important and controversial relationship in economic theory. Drawing from previous literature, this study seeks to test the commonly held theory that inequality and growth are negatively related. The study was undertaken using panel data taken from 62 countries from around the world, adjusting for factors such as standard growth models, development indexes, education, and income per capita. Our findings appear contrary to our expectations and literature, showing a significant positive relation between growth and inequality. Our findings suggest the need for further investigation into this relationship, before policy decisions can be made.

1. Introduction

Income inequality and economic growth are perhaps two of the most discussed facets of economies discussed by common people. The implications of both are simple enough to understand and draw meaning from. From this understanding stems controversy, and to a great extent what was once a economic question becomes a political one. Growth is necessary. It allows for people to have more of the things they want, and for more people to exist comfortably; new jobs, homes, and things which people desire. Without growth, life would never truly be able to improve, anything you had extra would have necessarily come from someone else. If considering the notion of population growth, the concept of economic growth not only becomes good, but necessary. If there was only so much in the world, and yet more people existed every day, there would naturally be less for everyone. Growth allows for the prospects of life to tend to be good, and as such it's something people, governments, and economies all seek to strive for.

On the other hand, inequality is very depressing, or at the very least an upsetting notion. The benefits one receives from the work they do, it becomes less enjoyable when one is aware that someone else would have less than them, or more. The notion is contentious, some might speak that the concept of being able to make more motivates them, while others speak of systemic inability to better one's situation as a result of where they stand now. Anger stems from apparent unfairnesses in the system, and the notion that in sufficiently unequal societies some might find it difficult to even survive. It's a discussion which cuts to the very core of the economic philosophies which have motivated conflict

throughout history. The controversy itself suggests the question, “How much inequality is too much? And if it exceeds such an amount, what is to be done about it?” Even before the issue becomes more complex, notions of redistribution and intervention become discussed, but the discussion becomes much more complicated when relationships between other ideas and inequality are investigated.

If growth and inequality are related, determining the exact nature of that relationship would be of paramount importance. If they trend in contrast, the obvious solution would be to increase growth and decrease inequality, but if they trend together controversy is born. How much inequality would be acceptable if it could mean having much more growth? How much growth could one willingly sacrifice to become more equal? If such a relationship were to exist, there would exist a fragile balancing act that all participants would stake in.

Drawing from previous literature and some degree of optimism, we hypothesize that the relationship between inequality and growth will be negative across countries.

2. Literature Review

The study of the relationship between economic growth and the inequality in the distribution of income was first considered in the later half of the twentieth century (Kuznets, 1955.) Kuznets sought to not only look at the relation between inequality and growth, but also to define ways to measure inequality when there existed none before. Kuznets discussed nuances of the question with regards to concepts such as aging, familial grouping, immigration, changes of industry, and urbanization; all of which he posited would complicate and define the notion of how an economy could be unequal in a time when data was more scarce and unrefined. The relationship Kuznets focused on was the ways in which growth affected inequality, and from his findings concluded that as economies begin to grow, there develops within them inequality, but as time progresses the inequality decreases; the overall trend following some inverted U-shape. This work would later motivate other studies looking at the reverse of the proposed relationship, how inequality might affect growth.

One such further study (Barro, 2000) investigated more comprehensive data in a panel format. Observing countries in this particular scale found little significance for a trend between inequality and growth overall, but upon categorizing countries as either high-income or low-income showed that the

trend initially starts as being negative for developing countries, but reverses to a positive relation for developed countries. This notion that the relationship might be modified by other factors opened up new territory with regards to the body of knowledge.

Amongst the literature of this topic there exists some degree of controversy as to whether there is a degree of certainty that the relationship between growth and inequality is negative. In one such study (Forbes, 2000,) utilizing more recent, more refined data a study approach the topic using panel estimation was conducted which aimed to contest the certainty with which the field viewed the relationship's direction. Citing omitted variable bias; such as corruption, public expenditures on health and education, or the quality of education systems as sources for systemic errors in determining coefficients, Forbes argued that country specific circumstances that were potentially too subtle to measure could be a source for the alleged incorrect conclusions of prior studies. In considering country-specific, constant factors standard growth/inequality models were augmented with country-specific dummy variables. In order to account for economic shocks, time-specific dummy variables were also included into the model. Contrary to the previously existing literature, Forbes found that coefficients predicting the effect of inequality on growth were positive and significant. Discussion was made as to how much of this drastic change in results could be attributed to using better datasets, but further discussion was made with regards to what other factors could have been responsible. Forbes commented on how the data used in the study existed within a panel covering five year increments, and how in comparison most other literature treated the subject with an orientation more targeted at the long run effects of initial inequality, and how with the future prospect of more comprehensive data which more completely spans longer periods of time the exact of changing the scope of time might have on the results of such studies. The conclusions of this study stood firm against scrutiny, and reopened the debate as to whether or not inequality is good or bad with respect to associated growth.

In another study (Cingano, 2014,) a panel data series comprising 34 OECD countries was conducted to further investigate the relationship between growth and inequality, and to determine which factors contributed to the ambiguous results between prior studies. Cingano tested the panel against the theoretical influence of five mechanisms through which growth and inequality would theoretically influence each other. These mechanisms included the principal of "Endogenous Fiscal Policy" which described how rising inequality could lead to citizens petition their governments for policy harmful to businesses and thus having a negative impact on growth. Another mechanism was the "Human Capital Accumulation Theory" which described how inequality could lead to lack of access to

investment resources; this lack of access could lead to investments in human capital which would otherwise have high returns going unfunded, the returns lost to inefficiency. Another theory looked at how technological advancements might only be undertaken if sufficient demand for the derivatives of such advancements was sufficient, with sufficiently inequality, the demand for such advancements might not exist. In contrast, the paper also considered theoretical factors by which inequality increased growth; among these included an incentive based theory where individuals could become motivated by the massive increases in income allowed by high degrees of inequality, and that such incentives led to risk-taking, work, and investments to achieve social mobility and growth. The final theoretical mechanism considered how richer individuals have higher propensity to save as compared to poorer individuals, and through having higher inequality more resources would be saved by rich individuals and through an increased savings rate a higher growth rate is derived. The results found that inequality was associated with a statistically significant decrease in growth. Further investigation found these results to be consistent when accounting for the effects of human and capital accumulation, and that the inclusion of a non-linear relationship with inequality made no significant effect on the model. Further results were motivated by the notion that redistribution policy might negatively contribute to growth by inefficiently transferring tax money to poor individuals, but there was found to be no significant evidence to suggest the existence of such inefficiencies. More results were drawn by using different metrics of inequality; the results of which indicated that the most impactful form of inequality was measures of how much poor and lower-middle class individuals had less than the mean income. From the results, Cingano concluded that the most influential mechanism in the relationship between growth and inequality for the OECD countries was the lack of access to human capital accumulation for poor individuals, and that it was less important that the rich were considered to have too much as it was that the poor had too little.

As the field has advanced with respect to knowledge about this topic, the data required to most comprehensively understand and observe the theoretical and empirical relationships amongst these variables has continued to increase in scope and accuracy. Even amongst the most advanced models there still exists some degree of controversy and uncertainty with regards to the exact nature of the relationship. As such, nearly all progress to be made in this topic is beyond the scope of this paper; the methods and data therein, but even if true progress is beyond the reach of these tools, taking a moment to review what has been gained and applying it to more simple settings might serve to demonstrate the success this field has made since its inception. By applying new theoretical frameworks to simple

panel data, the effectiveness of new frameworks can be compared to the unsophisticated frameworks used when panel data was the only available.

3. Data

For the simple regression, the dependent variable was the GDP growth rate in terms of U.S. 2005 dollars. The dependent variable was the GINI coefficient, which is a measure of income inequality within a nation. The GINI coefficient ranges from 0 (perfect equality) to 100 (maximal inequality).

This data covers 62 countries and is obtained from the World Bank. The year 2010 is chosen as the year of observation due to it having the greatest amount of observed GINI coefficients for the past 10 years. These values are found in **Table 1** and a simple trend is show in **Graph 1**.

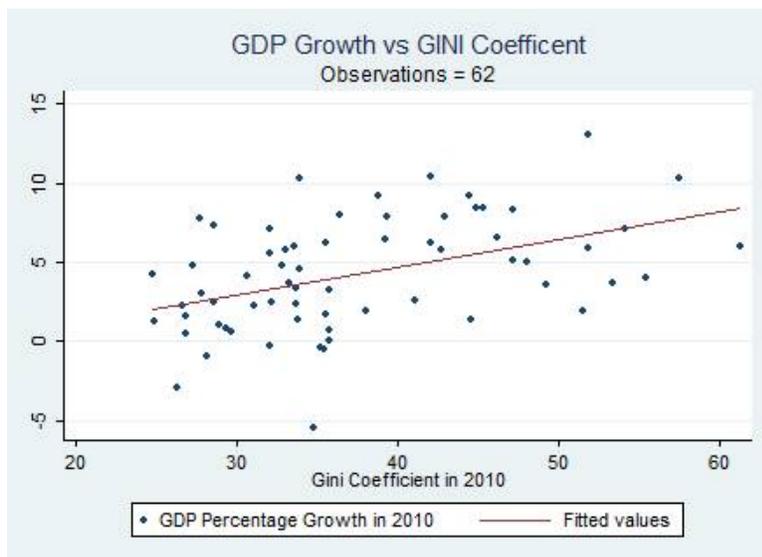


Table 1: List of Simple Regression Data and Countries

Country Name	Gini Coefficient	GDP Growth (In 2005 dollars)	Country Name	Gini Coefficient	GDP Growth (In 2005 dollars)
Argentina	44.50	9.14	Lesotho	54.17	7.09
Armenia	31.07	2.20	Lithuania	33.76	1.33
Bangladesh	32.12	5.57	Malawi	46.18	6.53
Belarus	27.72	7.74	Mali	33.02	5.82
Bulgaria	35.78	0.66	Moldova	32.05	7.10
Cambodia	33.55	5.96	Montenegro	28.60	2.46
China	42.06	10.45	Namibia	61.32	6.04
Colombia	55.51	3.97	Nepal	32.82	4.82
Costa Rica	48.10	4.95	Netherlands	28.87	1.07
Czech Republic	26.63	2.30	Nigeria	42.95	7.84
Denmark	26.88	1.63	Norway	26.83	0.48
Dominican Republic	47.20	8.30	Panama	51.91	5.85
Ecuador	49.26	3.53	Paraguay	51.83	13.09
El Salvador	44.53	1.36	Peru	44.92	8.45
Estonia	32.16	2.48	Poland	33.22	3.70
Finland	27.79	2.99	Romania	28.16	-0.94
Georgia	42.13	6.25	Sao Tome and Principe	33.87	4.51
Germany	30.63	4.09	Serbia	29.65	0.58
Greece	34.74	-5.45	Slovak Republic	27.31	4.83
Honduras	53.39	3.73	Slovenia	24.94	1.22
Hungary	29.37	0.79	Spain	35.75	0.01
Iceland	26.30	-2.93	Sri Lanka	36.40	8.02
India	33.90	10.26	Swaziland	51.49	1.87
Indonesia	35.57	6.22	Thailand	39.37	7.81
Ireland	32.06	-0.28	Tunisia	35.79	3.25
Israel	42.78	5.75	Turkey	38.79	9.16
Italy	35.52	1.71	Ukraine	24.82	4.20
Jordan	33.69	2.34	United Kingdom	38.04	1.91
Kazakhstan	28.56	7.30	Uruguay	45.32	8.40
Kyrgyz Republic	35.41	-0.47	Vietnam	39.25	6.42
Latvia	35.27	-0.34	Zambia	57.49	10.30

For the multiple regression the following variables were selected: savings rate, labor force, GDP per capita, gross capital accumulation, human development index, mean years of education, and the amount of scientific articles written in 2010.

The savings rate as a percentage of GDP was acquired from the World Bank for the year 2010. The total size of the labor force, GDP per capita (chained in 2005 dollars), gross capital accumulation (% GDP), and the amount of scientific journals and articles were also obtained from the World Bank. The Human Development Index value for each country and their mean years of education were obtained from the 2010 United Nation's Human Development report. These descriptive statistics can be found in **Table 2**. The reasoning behind the inclusion of the savings rate, labor force, gross capital accumulation rate, and technology level stems from Solow's model of economic growth. According to this model, these variables attempt to explain long-run economic growth and should be controlled for

when acquiring the relationship between inequality and economic growth. The inclusion of mean years of education is to accommodate The Human Capital Accumulation theory which describes the theoretical mechanism through which unequal societies, certain individuals are unable to undertake investments in their education (human capital). As such, the growth benefits of said capital are lost. HDI is included due to the Kuznet's theory that inequality would decrease as countries become more developed. Income has been included in prior literature to investigate the relationship between growth and inequality. This collinearity is mostly likely the result of diminishing returns of GDP per Capita on GDP growth and Kuznet's theorized relationship between inequality and income.

Table 2: Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
GDPGrow2010	62	4.28	3.60	-5.45	13.09
Gini2010	62	37.47	9.12	24.82	61.32
PerSave2010	62	20.67	9.09	-2.62	52.23
LabForce2010	62	3.29e+07	1.14e+08	62368	7.74e+08
GDPperCap2010	62	13420.22	17412.38	359.58	86096.13
GrossCapPerc	62	24	7.37	12.80	48.44
HDI	62	.69	.15	.31	.94
MeanEducation	62	8.64	2.56	1.40	12.60
TechLevel	62	5259.49	13440.93	1	79991.30

For a simple regression and multiple regression to be useful, it must satisfy all 5 of the Gauss Markov assumptions. Since the model is written in a linear parameter, the first assumption is satisfied. The assumption of random sampling isn't satisfied due to the data only being collected on countries that allowed the World Bank researchers to visit. The strictness of this assumption can be neglected in this case. The third assumption of no perfect collinearity is satisfied with **Figure 1**, which shows that no independent variables have a perfect linear relationship. The fourth assumption of zero conditional mean cannot be proven, while it will be assumed in order to perform these regression, the current datasets are still lacking to some degree in completeness and rigorous definition; as such we can not certainly say that this paper meets assumption 4. Finally, the assumption of homoskedasticity is satisfied because the error term is assumed to have the same variance given any values of the explanatory variables.

Figure 1: Collinearity Test

	GDPGrow2010	Gini2010	PerSave2010	LabForce2010	GDPperCap2010	GrossCapPerc	HDI	MeanEducation	TechLevel
GDPGrow2010	1.00								
Gini2010	0.45	1.00							
PerSave2010	0.31	-0.03	1.00						
LabForce2010	0.33	0.02	0.54	1.00					
GDPperCap2010	-0.46	-0.40	0.06	-0.12	1.00				
GrossCapPerc	0.35	-0.02	0.49	0.49	-0.34	1.00			
HDI	-0.50	-0.42	-0.05	-0.13	0.72	-0.36	1.00		
MeanEducation	-0.47	-0.39	-0.10	-0.21	0.56	-0.37	0.87	1.00	
TechLevel	0.08	-0.06	0.36	0.72	0.27	0.21	0.23	0.11	1.00

4. Results

4.1 Simple regression

To find the relationship between income inequality and GDP growth, first we did a simple regression, setting 2010 GDP growth as a dependant variable and 2010 GINI as an independent variable. Equation is :

$$GDPGrow2010 = \beta_0 + \beta_1(Gini2010) + u$$

To test the significance and effect of GINI on growth, the t-value, p-value and R² value was also calculated and shown in table 3 below.

Table 3: OLS Simple Regression

Dependent Variable: GDPGrow2010				
Independent Variable	Coefficient	t-value	p-value	R ²
Gini2010	.1771***	3.89	0.00	.2017
Constant	-2.36	-1.34	.184	

N =62. *Significant at 10%, **5%, ***1%

Having t value of 3.89 or p value of 0.00, our result is statistically significant. If we plug our findings into our equation, result would look like:

$$GDPGrow2010 = -2.36 + .1771 (Gini2010)$$

From here, we can see that in contrary to our initial hypothesis, we got positive relation between GINI and GDP growth. Regression coefficient of GINI was 0.1771, which means as GINI increase by 1 point, GDP growth rate also increases by 0.1771%. Our findings suggests that if we have ultimate equality, GDP growth would be -2.36% which results decrease in GDP. Based on our results, we can also interpret that in order to have growth of GDP, GINI should be more than 13.33.

4.2 Multiple regression.

To make our finding more accurate by avoiding omitted biases, we did a multiple regression test with more independent variables that are mentioned above in data section of this paper. Our multiple regression equation is:

$$GDPGrow2010 = \beta_0 + \beta_1(Gini2010) + \beta_2(PerSave2010) + \beta_3(LabForce2010) + \beta_4(GDPperCap2010) + \beta_5(GrossCapPerc) + \beta_6(HDI) + \beta_7(MeanEducation) + \beta_8(TechLevel) + u$$

Like we did in single regression calculation, the t-values, p-values and R² value was also calculated and shown in table 4 below.

Table 4: OLS Multiple Regression

Dependent Variable: GDPGrow2010				
Independent Variable	Coefficient	t-value	p-value	R ²
Gini2010	0.12**	2.45	0.02	0.4527
PerSave2010	0.09*	1.77	0.08	
LabForce2010	3.26e-09	0.53	0.60	
GDPperCap2010	-4.24e-05	-1.22	0.23	
<u>GrossCapPerc</u>	0.02	0.31	0.76	
HDI	-3.90	-0.63	0.53	
<u>MeanEducation</u>	-0.06	-0.18	0.86	
<u>TechLevel</u>	6.81e-06	0.14	0.89	
Constant	1.12	0.27	0.79	

Our main independent variable Gini2010 is statistically significant at 5% and PerSave2010 is statistically significant at 10%, whereas other independent variables are statistically insignificant. our equation would look like below, after plugging results.

$$\begin{aligned}
 GDP_{Grow2010} = & 1.12 + .12(Gini2010) + .09(PerSave2010) + 3.26e-09(LabForce2010) \\
 & + -4.24e-05(GDPperCap2010) + .02(GrossCapPerc) + -3.90(HDI) + -.06(MeanEducation) + \\
 & 6.81e-06(TechLevel)
 \end{aligned}$$

Again, oppose to our hypothesis, multiple regression model suggests positive relation between GDP growth and GINI. If country has ultimate income equality, GDP growth would be 1.12% and country sees 0.12 percentage point increase in GDP growth as a consequence of 1 point increase in GINI. GDP would increase by 0.09% when savings rate increases by 1%. Another interesting finding is mean years of education and human development index have negative relation with GDP growth. 0.01 point increase in HDI and 1 years of more education causes 0.039% and 0.06% decrease in GDP growth respectively, but these variables are statistically insignificant.

Since the independent variables beside Gini2010 are not quite significant, we did the F test hypothesizing all those 7 variables are equal to 0. Because this hypothesis leaves us with only one independent variable, our single regression model become our restricted model. If we calculate F value by using R² values from both model and restricting those 7 variables, F value equals to 3.47 which is statistically significant. Therefore we can't accept the robustness test's null hypothesis. In other word those 7 variables have joint effect on our dependent variable GDP growth and it also means our multiple regression model is better than our single regression model in terms of accuracy.

After determining better model, we tested our initial hypothesis as a one-sided t-test. For all significance levels, since our observed coefficients were positive they failed to surpass the critical values for our hypothesis, as such we failed to reject the null hypothesis that the coefficients are not negative.

5. Conclusion

Our hypothesis of a negative relationship between economic growth and inequality was not corroborated by the simple and multiple model regression that were run. Both models showed a positive relationship to economic growth with a 1 point increase in GINI causing growth rate to increase by .12%. Counter intuitively, an increase of 1 year of mean education decreases growth rate by .06%; while this result is found to be insignificant, it still is of interest to note the counterintuitive

nature of this result. This result not only challenges our hypothesis and the literature supporting it, but it also implies troubling policy implications if our results are true.

The notion that something like growth, which is considered universally useful and beneficial to society would potentially have a positive relationship with something as troubling as inequality leads to a natural conundrum. If we want to increase growth, are results indicate that there could be an associated increase in inequality as a direct result of that increase in growth. If we wish to decrease inequality, our results indicate that there could be an associated loss of growth that results from this decrease in inequality. The implications of these findings suggest that there exists some trade-off between growth and inequality which must be made whenever one wishes to alter one or the other. If this is a case, the question of determining what the acceptable level of inequality is, and how much growth we need, and attempt to consolidate those two requirements. The policy implications of such findings would further complicate and already contentious issue.

While the results of this paper seem grim, perhaps it is premature to speak with definitiveness. Data regarding inequality is often underreported, and the question of which forms of inequality are most influential on the relationship is a question rarely addressed even now. Further questions are posed by how our findings clearly represent short-term relationships, while more comprehensive series investigate long and medium-run relationships between past inequality and current growth. Further questions are posed by the issues of collinearity in the multiple regression model, and our own uncertainty of whether omitted variable bias could yet be involved. With these aspects of uncertainty, it seems that further investigation into this relationship is required, more comprehensive and longer term data will continue to become available, and with it a more thorough understanding of the relationship will be possible.

References

- Kuznets, Simon. "Economic Growth and Income Inequality." *The American Economic Review* 45, no. 1 (1955): 1-28. Accessed April 16, 2015. http://www.jstor.org/stable/1811581?seq=1#page_scan_tab_contents.
- Barro, Robert J. "Inequality and Growth in a Panel of Countries." *Journal of Economic Growth* 5, no. 1 (2000): 5-32. Accessed April 16, 2015. <http://link.springer.com/article/10.1023/A:1009850119329#>.

Forbes, Kristin J. "A Reassessment of the Relationship between Inequality and Growth." *American economic review* (2000): 869-887

Cingano, F. (2014), "Trends in Income Inequality and its Impact on Economic Growth", OECD Social, Employment and Migration Working Papers, No. 163, OECD Publishing.
<http://dx.doi.org/10.1787/5jxrjncwxv6j-en>

"GINI Index (World Bank Estimate)." GINI Index (World Bank Estimate). Accessed April 17, 2015. <http://data.worldbank.org/indicator/SI.POV.GINI/countries/1W?display=default>.

"GDP Growth (annual %)." GDP Growth (annual %). Accessed April 17, 2015.
<http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>.

"Human Development Report." Human Development Report. Accessed April 17, 2015.
http://hdr.undp.org/sites/default/files/reports/270/hdr_2010_en_complete_reprint.pdf.

"Gross Savings (% of GDP)." Gross Savings (% of GDP). Accessed April 17, 2015.
<http://data.worldbank.org/indicator/NY.GNS.ICTR.ZS>.

"Labor Force, Total." Labor Force, Total. Accessed April 17, 2015.
<http://data.worldbank.org/indicator/SL.TLF.TOTL.IN>.

"Indicators." Indicators. Accessed April 17, 2015.
<http://data.worldbank.org/indicator/NE.GDI.TOTL.ZS>

"Scientific and Technical Journal Articles." Scientific and Technical Journal Articles. Accessed April 17, 2015. <http://data.worldbank.org/indicator/IP.JRN.ARTC.SC/countries>.

"GDP per Capita (current US\$)." GDP per Capita (current US\$). Accessed April 17, 2015.
<http://data.worldbank.org/indicator/NY.GDP.PCAP.CD>.