The Park Place Economist

Volume 11 | Issue 1 Article 16

4-2003

Growth and Image Inequality: Global Evidence

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Abstract

This study will use Kuznets' inverted U hypothesis and the two-sector labor surplus model to try and find the true relationship between growth and income inequality around the globe.

Growth and Income Inequality: Global Evidence

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I. Introduction

Economic growth can be defined as growth in the value of all goods and services produced in a given country in the current year. This concept is more commonly known as growth in gross domestic product per capita. However, economic growth does not necessarily imply an improvement in the standards of living of all the individuals of the determined country. Income inequality may be one of the factors responsible for this phenomenon. Income inequality exists when the share of income going to the rich is higher than the share going to the poor. When income inequality worsens, the rich get richer and the poor, poorer. This disproportionate distribution of income is "largely due to differences in the amount of income derived from ownership of property and to a lesser extent, to the result of differences in earned income" (Todaro 2003). Income inequality is not only a problem in individual countries themselves, but it is a global problem as well. It is reported that the top 1% of income recipients receive 15% of worldwide income, and the top 5% receive 40% of all income (Braun 1990).

> ***"Economic growth does not necessarily imply an improvement in the standards of living of all the individuals of the determined country."***

Both developing and developed nations have battled with income inequality for many years. In Brazil, for example, the income share of the richest twenty percent of the population is thirty-two times that of the poorest twenty percent. This figure has hardly changed since 1960. Thus, for every dollar of income gained by the poor, the rich have gotten $32. This exact same ratio is found on Manhattan Island in New York City (Fields 2001). These facts are very disturbing if we consider that the world has 1.3 billion poor people who subsist on less than one dollar per person a day, and another 1.7 billion who live on between one and two U.S dollars per person per day (World Bank 1999). The problem of income inequality has become so pronounced that in September 1994, the Program of Action at the Cairo International Conference on Population and Development asserted that "despite decades of development efforts, both the gap between rich and poor nations and inequalities within nations have widened... Widespread poverty remains the major challenge to development effort" (Todaro 2003).

It has always been an important research problem whether or not economic growth helps improve the problem of income inequality. Numerous economists have incessantly tried to determine this relationship but unfortunately, they have failed to come to a consensus. This study will use Kuznets' inverted U hypothesis and the two-sector labor surplus model to try and find the true relationship between growth and income inequality around the globe. Theory states that income inequality increases for low levels of growth (GDP) and then, decreases for high levels of growth. In this research, I will test to see if data collected from various countries across time behave in a similar manner. In addition, other variables that are suspected to affect both inequality and growth are included in the model in order to better explain their relationship.

This paper is divided into seven different sections. The current first section introduces the problem of income inequality and emphasizes its importance. The second section states the theory from which this

research is based on and reviews the most important literature on the issue of income inequality. The third section presents the empirical research and explains the different variables that will be used to measure income inequality. The fourth section describes the data source for this research. Modifications to the original model due to data limitations are explained in the fifth section. The sixth section describes the results for the different regressions that were run in order to state the relationship between economic growth and income inequality. Finally, the last section describes the conclusions for this research and presents avenues for future research.

II. Theory and Review of Literature

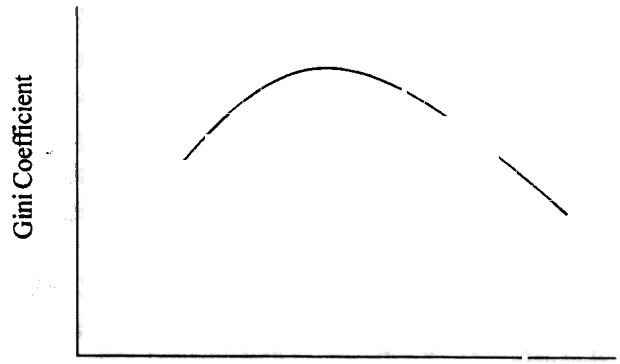
Much of the work done on income inequality is provided by Simon Kuznets. In 1963, a cross-section study of 18 countries led Kuznets to believe that there was a relationship between income inequality and growth. The formulation of his results state that

> *"it seems plausible to assume that in the process of growth, the earlier periods are characterized by a balance of counteracting forces that may have widened the inequality in the size distribution of total income for a while... It is even more plausible to argue that [there was a] recent narrowing in income inequality observed in the developed countries"* (Fields 2001).

In other words, Kuznets believed that the distribution of income would tend to worsen at early stages of economic growth and then improve at later ones. This idea eventually came to be known as "the Kuznets' curve" or "the inverted-U hypothesis." Figure 1 shows the relationship between the Gini coefficient, which is an aggregate numerical measure of income inequality ranging from 0 (perfect equality) to 1 (perfect inequality) and gross national product per capita. Kuznets' hypothesis became very famous because he was the first person to talk about what he thought was the primary mechanism by which growth affects income inequality.

Kuznets' inverted-U is a development pattern, not a theory. The difference between a pattern and a theory is that a pattern shows a relationship between two variables while a theory asserts that changes in one variable is the cause of a change in another variable (Banya 1995). According to Hollis Chenery (1975), patterns are often used in development economics because they provide a basis for comparative analysis in order to make generalizations about the development process of an individual country.

Figure 1: The "Inverted U" Kuznets' Curve



The two-sector labor surplus model supports the inverted U hypothesis. Assume that before a country starts to develop, its economy is basically agrarian and that there exists a surplus of labor in this sector. Since land is fixed and the supply of agricultural products varies, as labor increases, initially output will increase until diminishing marginal returns to labor set in. At this point, any additional worker will not increase output and thus, there will be an excess supply of labor.

As a country starts to industrialize, workers are going to be demanded in factories and since there is an excess supply of labor in the agricultural sector, the manufacturing sector has to offer a wage higher than subsistence wages in order to attract workers from the agricultural sector into the manufacturing sector. As long as the surplus of labor exists in the agricultural sector, income inequality will increase as workers move to the manufacturing sector. This is due to the fact that the increasing amount and low cost of labor in the industrial sector raises output in this sector, causing the owners of the industries to realize huge profits thus, increasing their incomes, while wages remain constant (Gillis 1992). This will continue to be the case until labor becomes a scarce factor.

As demand for labor by industries increases further, wages will have to rise and at the same time, workers in the agricultural sector become better off because the supply of agricultural labor is decreasing (Banya 1995). As the available land per worker and the marginal productivity of labor start to increase,

wages in the agricultural sector should also increase. This way, in order to attract more workers from the agricultural sector, the industry sector has to increase its wages higher than those in agriculture. We assume that as wages rise, income inequality falls because as workers earn higher wages, they are taking more money away from the wealthy and thus, wage differentials are reduced. In this manner, as wages rise on both the agricultural and manufacturing sectors, income inequality decreases.

According to Fields (2001) and Chenery's (1975) empirical studies, there are additional factors that affect the distribution of income other than growth such as the economic system, level of human capital, and population growth of a country. First of all, the nature of the economic system itself is very important. Empirical research has found that income inequality in socialist economies, ceteris parabus, is lower than that of non-socialist economies due to their patterns of asset ownership and government spending. The fact that many sectors of the economy are regulated by the government facilitates the equal distribution of resources amongst the population and thus, income inequality is low.

Second, the level and inequality of human capital, otherwise known as education, is a very important determinant of income distribution. According to human capital theory, education augments cognitive and individual skills, which increase a worker's productivity and thus, leads to higher labor income (Seligson 1998). Through the acquisition of education workers are able to eliminate skill differentials, which in turn reduce wage differentials. In the early stages of development, due to the scarcity of skilled workers, as education increases, wage differentials between skilled and unskilled workers widen. Afterwards, as the economy starts to develop and educational facilities are more available to the population, the number of skilled workers will increase causing their wages to fall. This way, wage differentials will be reduced, improving inequality. George Psacharpoulos (1991) considers that education contributes significantly to growth because it reduces both poverty and income inequality.

The third determinant of income distribution is population size. According to Banya (1995), high population growth rates are a determinant of the level of income inequality in a country. Following from the two-sector labor surplus model, the higher the population growth of a country, the longer labor costs will remain low as workers move from the agricultural sector to the manufacturing sector, enabling industry owners to make greater profits and worsening inequality. High population growth rates will then shift the country's inverted U curves upwards, increasing inequality at any given level of per capita income.

III. Empirical Research

Based on the preceding theory, this study will research the following hypotheses:

1. As rate of growth of per capita income increases, income inequality first increases and then decreases.
2. As government intervention in a country's economy increases, income inequality decreases.
3. As the availability of education increases, income inequality first increases and then decreases.
4. As the rate of population growth increases, income inequality increases.

In order to test the different hypotheses outlined above, this paper will use an ordinary-least squares model, which will have the following formulation:

$$\mathbf{Gini} = \alpha + \beta_1\mathbf{YPC} + \beta_2\mathbf{YPC}^2 + \beta_3\mathbf{Primary} + \beta_4\mathbf{Secondary} + \beta_5\mathbf{Primary}^2 + \beta_6\mathbf{Secondary}^2 + \beta_7\mathbf{Socialist} + \beta_8\mathbf{PopGrowth}$$

From all the measures of income inequality, I have decided to use the Gini coefficient. This index measures the extent to which the distribution of income amongst individuals or households within an economy deviate from a perfect equal distribution. Gini coefficients have a value between 0 and 1, where 0 implies perfect equality and 1 implies perfect inequality.

In the above model, YPC stands for real gross domestic product per capita. The Primary and Secondary variables refer to different levels of education. The Socialist variable is a dummy variable that represents whether the respective country has a declared socialist government or not. The Popgrowth variable refers to the rate of population growth. I have included the squared term for real gross domestic product and for both measures of education because according to theory and to the nature of the Kuznets' curve we expect a nonlinear relationship between these variables and the Gini coefficient.

Following from the review of the literature we would expect the coefficient for YPC to be positive

for low levels of income per capita and negative for higher levels of income per capita. Thus, since we are using both YPC and YPC^2 we would expect the coefficient for YPC to be positive and the coefficient for YPC2 to be negative. For low levels of GDP per capita, on the increasing side of the Kuznets' curve, the coefficient for YPC would dominate increasing income inequality. For higher levels of GDP per capita, though, on the decreasing side of the Kuznets' curve, the coefficient for YPC^2 would dominate decreasing income inequality. This is the same for both measures of education. Primary and Secondary are expected to have a positive relationship with income inequality for low levels of development. On the other hand, their squared terms, $Primary^2$ and $Secondary^2$, are expected to have a negative relationship with income inequality for higher levels of development or GDP per capita. The coefficient for Socialist is expected to be negatively correlated to the Gini coefficient. Finally, Popgrowth is expected to be positive at all times. Table 1 presents the definitions and expected signs of each of the variables used.

IV. Data

The data for this empirical study will be collected from the World Bank Development Indicators 2002. This data source contains the most detailed data on human welfare in order to provide a picture of the social effects of economic development on different countries. Data for over 550 development indicators and time series data from 1960-2001 for over 200 countries and 18 country groups are compiled into this single source. Data includes social, economic, financial, natural resources, and environmental indicators. The primary sources of social indicators data are the data files and publications of specialized international agencies such as the Food and Agriculture Organization, the International Labour Organization, the United Nations Educational, Scientific, and Cultural Organization, the UN Statistical Office, and the World Health Organization. Supplementary sources include the Population Council, the UN Research Institute for Social Development, and World Bank data files. Some demographic and labor force indicators are estimated by interpolating census

Table 1: Dependent and Independent Variables

Variable	Definition	Expected Sign
Dependent		
Gini	Measures the extent to which the distribution of income among individuals or households within an economy deviate from a perfectly equal distribution	
Independent		
	Refers to gross national income, converted to U.S. dollars using the World Bank Atlas method, divided by the midyear population. Estimates are in constant 1995 US dollars.	+
YPC^2		
Primary	Ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the primary level of education measured as a gross percentage. Estimates are based on UNESCO's classification of education levels.	+
$Primary^2$		
Secondary	Ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the secondary level of education measured as a gross percentage. Estimates are based on UNESCO's classification of education levels.	
$Secondary^2$		
Socialist	Dummy variable that takes the value of 1 for socialist governments and 0 for non-socialist government.	
Popgrowth	Annual population growth rate.	+

observations.

Due to limitations on the availability of dependable Gini coefficients across time, this research will only use cross-country data on 110 different countries from 1985 to 2001. The 110 different countries include all those countries that have a valid Gini coefficient, as published by the World Bank. A list of all 110 countries can be found in Appendix I.

V. Model Modifications

As a result of the existence of limitations on the availability of data across time and countries, my original regression model has become obsolete and thus, has to be modified. First of all, the variables Primary and Secondary as a proxy of education are no longer a good measure of the level of education in a country at a specific point in time because Gini coefficients are only available for a single year. Since the Gini index measures the income inequality of adults and the Primary and Secondary variables measure the education levels of the younger portion of the population I have decided to use illiteracy rates as the new proxy for education. Illiteracy rates are a better measure of the educational level of those individuals whose income was taken into account when calculating the Gini coefficient. In addition, population growth also becomes useless under these new constraints because the population growth during one specific year will not affect the Gini coefficient for that same year. Even if population grows at a high rate, this increase will not affect the income distribution of the adults in the workforce at that point in time. Thus, this variable will be omitted in the new model. Moreover, the Socialist variable will also be dropped. Although whether a government is socialist or not is very important, as explained in the theory section, this measure can create various problems and may cause distortions in the regression results. This is due to the fact that there are many countries in the sample size, such as the Scandinavian countries, which are not set up as socialist governments but have adopted some of their policies. Thus, by omitting this variable such problems will be avoided.

The new model will then have the following form:

$$\mathbf{Gini} = \alpha + \beta_1 \mathbf{YPC} + \beta_2 \mathbf{YPC}^2 + \beta_3 \mathbf{Illiteracy}$$

The new Illiteracy variable is defined by the World Bank (2002) as the percentage of people ages 15 and above who cannot, with understanding, read and write a short, simple statement on their everyday life. This variable is expected to be positively related to the Gini index. Thus, as illiteracy rates increase, income inequality will also increase.

VI. Results

Table 2 shows the results for the above regression.

Table 2: Gini Regression

Variables	Model 1
Constant	39.119**
	(14.410)
YPC	0.00158
	(1.125)
YPC^2	-1.038E-07*
	(-1.684)
Illiteracy	0.0872
	(1.539)
R^2	0.089
Adjusted R^2	0.055
Sample Size	110

Note: ** Significant at the 0.01 level. *Significant at the 0.10 level.

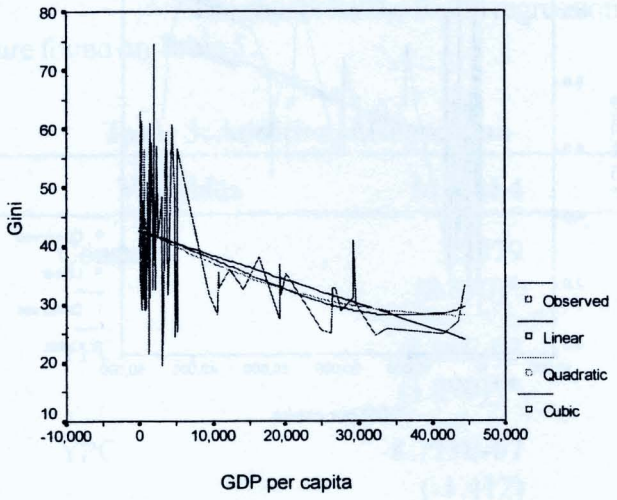
The results for the regression do not appear to be very robust for it only explains 5.5% of the total variation in the Gini coefficients. Although the coefficients for the variables appear to have the expected signs, these were not significant. The only significant variable at the 0.01 level was the constant, which had a coefficient of 39.119. This tells us that we did not account for much of the variation of the Gini coefficients through the variables we used. According to this model, as GDP per capita increases by one dollar, the Gini index increases by 0.00158. However, it is very surprising that this coefficient was not significant at all. On the other hand, the coefficient of -1.038E-07 for the GDP per capita squared variable was significant at the 0.10 level. This shows that the effect of GDP per capita squared on income inequality is greater than the positive effect exerted by the

coefficient of the GDP per capita. Even though neither of the GDP per capita variables had significant coefficients, the stated equation still generates an inverted U. The Illiteracy variable also turned out to be insignificant with a coefficient of 0.0872. In order to attempt to explain the low significance of this coefficient and of the model as a whole, I decided to run a correlation test between the GDP per capita and Illiteracy variables. The Pearson Correlation had a value of -0.418, which was significant at the 0.01 level. Although this correlation was determined as significant, the coefficient is so low that it should not matter.

After attempting to do a curve fit on the scatter plot of the Gini coefficients of the different countries against their GDP per capita, the negative relationship was once again confirmed. Figure 2 presents these results.

As identified above, the observed relationship varies significantly from the theoretical inverted-U curve that provided the basis for this model. More than a negative relationship, as the linear, quadratic and cubic curves show, it seems as if the relationship between GDP per capita and the Gini index is L-shaped. The plot shows no real relationship for low-income countries, whose Gini coefficients are wildly varied. At the same time, as GDP per capita increases, there seems to be a more defined negative relationship.

Figure 2: Model 1 Curve Fit



In order to confirm the validity of the results for Model 1, I decided to run two more regressions but with different dependent variables which also serve as a proxy for measuring income inequality. The two other dependent variables used in Models 2 and 3 were the percentage of income going to the poorest 10% of the population (Ypoor10) and the percentage of income going to the poorest 20% of the population (Ypoor20), respectively. The data for these two new dependent variables come from The World Development Indicators Online Database 2002. For these two models, we expect the coefficients to be the opposite from the previous model. Accordingly, YPC should be negative and YPC2 should be positive. GDP per capita is expected to be negatively related to the percentage of income going to the poorest 10% (20%) of the population because as income increases on the upward segment of the Kuznets' curve, inequality should rise and thus, the income going to the poorest 10% (20%) of the population should fall. At the same time, GDP per capita squared should have a positive relationship to the percentage of income going to the poorest 10%(20%) of the population because as income increases over the downward sloping segment of the Kuznets' curve, inequality should decrease and thus, the percentage of income going to the poorest 10% (20%) of the population should increase. In comparison to the original model, we expect illiteracy rates to be negatively correlated to the percentage of income going to the poorest 10% (20%) of the population. This is due to the fact that as the availability of education increases and illiteracy rates fall, wage differentials and income inequality should also fall and thus, the percentage of income going to the poorest 10% (20%) of the population should increase. Table 3 summarizes the expected results for the second and third models.

Table 3: Expected Signs for Models 2 & 3

Variable	Model 2	Model 3
Dependent		
	YPoor10	Ypoor20
Independent		
YPC	-	-
YPC^2	+	+
Illiteracy	-	-

The results for both models are found on Table 4.

Table 4: Supplementary Regressions

Variables	Model 2	Model 3
Constant	2.659 (9.233)**	6.531 (10.672)**
YPC	-1.174E-04 (-1.075)	-2.569E-04 (-1.107)
YPC^2	9.197E-09 (1.406)	2.115E-08 (1.522)
Illiteracy	-0.0053 (-0.884)	-0.01376 (-1.077)
R^2	0.038	0.052
Adjusted R^2	0.002	0.017
Sample Size	110	110

Note: **Significant at the 0.01 level.

The results for the regressions of both models were very similar. Once again, just like the results for original model, the coefficients of the variables had the expected signs, but they were not statistically significant. The only significant variable at the 0.01 level was the constant, which implies that we are not accounting for much of the variability in the income going to the poorest ten or twenty percent of the population through the independent variables used. The patterns of greater significance between the three independent variables are constant with the results for the original model too. In all three models the most significant independent variable is always YPC2. Once again, this advocates for a negative relationship between income inequality and GDP per capita. Regardless, both Models 2 and 3 lack robustness with adjusted R2 of 0.002 and 0.017, respectively. Thus, there is no crucial correlation between the percentage of income going to the poorest ten or twenty percent of the population and GDP per capita.

In order to complement the results for the second and third models, I ran a curve fit on GDP per capita and the dependent variables for each model, YPoor10 and YPoor20. Figures 3 and 4 show the results for the curve fit for both models 2 and 3.

Although both figures show relatively the same positive relationship between the percentage of income going to the poorest 10% (20%) of the population and GDP per capita, these curve estimations are not very reliable. The fact that there is still great variation on the percentage of income going to the poorest 10 and 20 percentage of the population of low GDP per capita countries makes the relationship between these two variables rather weak. Thus, there is no concise correlation between the two.

At the same time, though, the curve estimations for both dependent variables somewhat show the same L-shaped relationship as the original model with the difference that this one is upside down. The fact that both relationships are flips of each other is not surprising at all since real GDP per capita affects the Gini Coefficient and the percentage of income going

Figure 3: Model 2 Curve Fit (Poorest 10% of Population)

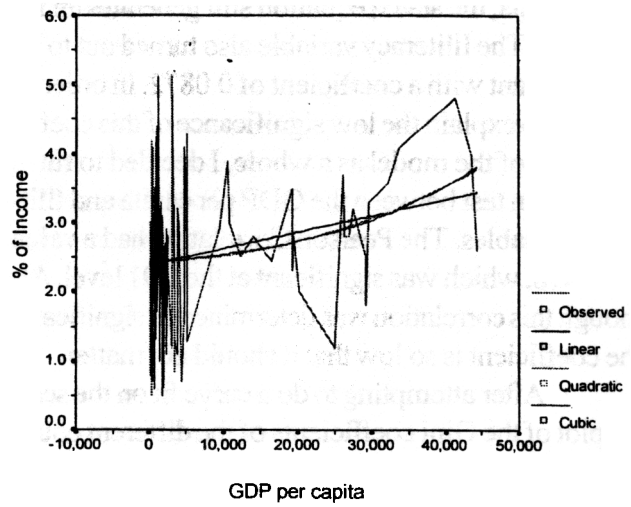
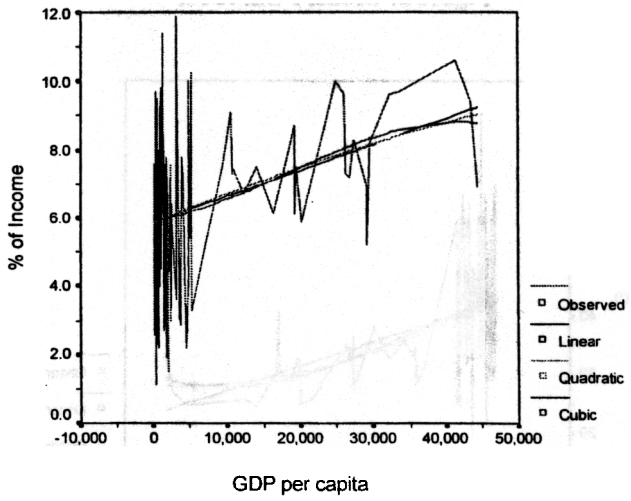


Figure 4: Model 3 Curve Fit (Poorest 20% of Population



to the poorest 10 or 20% of the population in opposite ways.

In addition to the above two regressions, I decided to include yet another regression which focuses solely on those countries whose real GDP per capita is less than or equal to $6,000. Since the countries with lower real GDP per capita seemed to show more variability in the proxies for income inequality, I decided to run this additional regression in order to see if there is any significant relationship between real GDP per capita and the Gini coefficient for these poorer countries. The formulation for this regression is the same as the modified formula that was presented earlier:

$$\text{Gini} = \alpha + \beta_1 \text{YPC} + \beta_2 \text{YPC}^2 + \beta_3 \text{Illiteracy}$$

The expectations for each variable are the same too with YPC being positively related, YPC2 being negatively related and Illiteracy being positively related to the Gini coefficient.

The results for the fourth regression are found on Table 5.

Table 5: Additional Regression

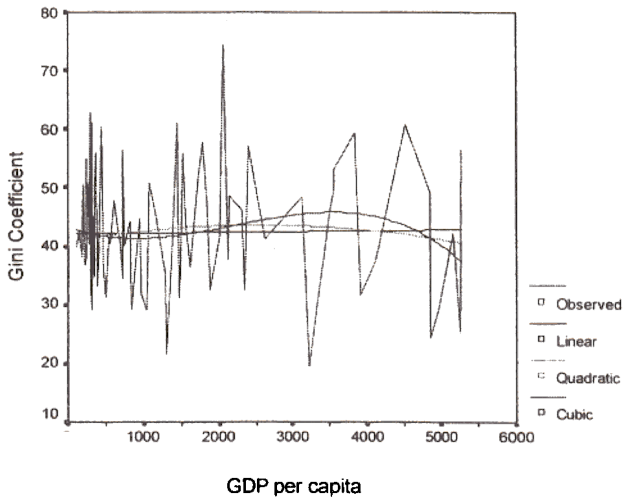
Variables	Model 4
Constant	33.879
	(8.870)*
	6.16E-03
	(1.890)**
	-8.723E-07
	(-1.412)
Illiteracy	0.138
	(2.238)**
R^2	0.082
Adjusted R^2	0.044

Note: *Significant at the 0.01 level. **Significant at the 0.10 level.

The results for this regression are a lot better than previous ones. All variables have the correct expected coefficient and the constant is once again very significant. What is surprising, though, is the fact that compared to the previous regressions the coefficient for YPC2 is not significant anymore. On the other hand, both YPC and Illiteracy turn out as significant variables. The coefficient for the YPC variable has a value of 6.16E-03 and it is significant at the 0.10 level. At the same time, the coefficient for the Illiteracy variable is 0.138 and this is significant at the 0.10 level. Even though more variables appear to be significant in this regression, its adjusted R square states that we only accounted for 4.4% of the variability in the Gini index for the poor countries and thus, the regression as a whole does not seem too robust. The signs of the coefficients, however, suggest that the equation still generates an inverted U.

After attempting to estimate a curve through the observed variability of the Gini coefficients for the selected countries I encountered a rather interesting result, which is illustrated on Figure 5.

Figure 5: Model 4 Curve Fit



According to Figure 4, we find that since neither the linear, quadratic or cubic curves fully capture the shape of the observed trend, we cannot make a solid conclusion about what the true relationship between real GDP per capita and income inequality is for these poorer countries. Nevertheless, it is clear that the inverted-U is not visible.

VII.Conclusions

The results for all of the four different models lead to the conclusion that the inverted U-hypothesis does not hold. What seems to be even more surprising is the faint appeal that there is somewhat of an L-shaped relationship between GDP per capita and income inequality. Although all the three different proxies for income inequality in the three first models seem to point in this general direction, the regression statis-

tics clearly affirm that these correlations are not statistically significant and thus, no definite conclusion can be made.

My results corresponded with the findings of many other economists who have attempted to recreate Simon Kuznets' experiment with cross-section data. According to Gary S. Fields (1989), "No relation is found between the change in inequality and the rate of economic growth or between the change in inequality and the level of national income. This suggests that the decisive factor in determining whether inequality increases or decreases is not the rate of economic growth but rather the kind of growth." Martin Ravallion (1995) also found that the Gini coefficient and mean per capita consumption are not significantly correlated with each other, and no inverted-U appears either. Fields (2001) also states that sometimes the shape of the Kuznets curve flips and the curve goes from a statistically significant inverted-U estimated by OLS to a statistically significant U with fixed effects estimation. In addition, he states that under other specifications, we can even obtain a monotonically declining pattern between GDP and income inequality. Consequently, there seems to be no distinct pattern between the level of development and the level of income inequality.

It must be recognized that this study is based on less than ideal data. Recall that on average there was only one reported and dependable value of a Gini coefficient for 110 different countries over a time span of over 15 years. The lack of available and dependable data might, along with plausible measurement errors when calculating the different Gini coefficients, have distorted the relationship between growth and income inequality.

Regardless that there was no significant correlation found between growth and income inequality, the inefficient distribution of income both within and amongst countries is a situation that should be alleviated. My recommendation for future research is that data-gathering methods should be more standardized and customary. It would be very helpful for future research to have a dependable and complete time series and cross-country database from which to base studies on. In addition, more research should be done through different databases in order to conclude if these results are constant across diverse sets of data. Moreover, including more variables that might affect the distribution of income should also be considered. This way, we might be able to explain a higher percentage of the variance in Gini coefficients amongst countries with similar levels of development. It is only through these means that we will someday come up with the answer to what really influences income inequality and then, both individual countries and the world as a whole will benefit from this newfound knowledge.

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