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Occupy This: The Effect of Income Inequality on GDP Per Capita Growth Using Panel Data in the United States from 1963 to 2009

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Abstract

Income inequality and its relationship to long-term GDP per capita growth has been researched for decades since the development of the Kuznet's Curve. Theoretical and empirical research has shown mixed results including positive, negative, non-existent, or statistically insignificant relationships. Empirical research on income inequality and economic growth in the United States has also shown mixed results. In addition to using existing data, this paper uses originally-constructed Gini Coefficients from 2005 to 2009. A statistically significant negative correlation between income inequality, and both short-term growth and long-term growth is found in the analysis of this data. Finally, this paper attempts to justify a causal relationship between income inequality and long-term growth.

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1. Introduction

Lord Macaulay, an early Victorian historian, poet, and critic, once wrote:

> The day will come when in the State of New York, a multitude of people, none of whom has had more than half a breakfast, or expects to have more than half a dinner, will choose a Legislature. On one side is a statesman preaching patience, respect for vested rights, strict observance of public faith. One the other is a demagogue ranting about the tyranny of capitalists and usurers, and asking why anybody should be permitted to drink champagne and ride in a carriage when thousands of honest folk are in want of necessaries. Which of the two candidates is likely to be preferred by a working-man who hears his children cry for more bread? There will be, I fear, spoliation. The spoliation will increase the distress. The distress will produce fresh spoliation. There is nothing to stop you.[1]

Lord Macaulay's premonitions about the United States have not entirely materialized and might never in their entirety, but income inequality and wealth distribution have become a topic of national and even international debate.

Income inequality in the United States might be the most contentious and biggest topic for generation Y. It is the subject of political debate between and within the two main political parties. President Barack Obama addressed the issue in his state-of-the-union message as "'the defining issue of our time." Rick Santorum, a Republican presidential hopeful, proclaimed, "'There is income inequality in America. There always has been and, hopefully, and I do say that, there always will be.'" While he is correct in that income inequality exists and will exist until a utopian or dystopian state (depending on one's political leanings) is achieved, the rate of change in income inequality in the United States has fluctuated since economists have been able to (retroactively) record it.[2] Income inequality spiked just prior to the Great Depression, then, income inequality

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[1]Martin Bronfenbrenner, *Income Distribution Theory* (Chicago: Aldine Publishing Company, 1971), 14.
[2] "Inequality: The Gap Widens, Again," *The Economist,* March 10, 2012, http://www.economist.com/node/21549944 (accessed April 20, 2012).

seemed to level off between the late 1920s and the 1980s. Since the 1980s, income inequality has been increasing (see Figure 1).[3] In 2007, the top 10% earned 46% of the nation's income, while the top 0.1% earned just over 12%. From 2007 to 2009, income declined 11.6% (adjusted for inflation) for the bottom 99% of income earners while the top 1% suffered a 36.3% decline – the largest decline for both groups since the Great Depression.[4] Yet in 2010, after the decline, the top 1% earned an additional 11.6% in income while the rest of income-earners saw their wages rise by 0.2%.[5]

The statistics cited above, along with unemployment, rising healthcare premiums, student loans, and a "sense of despair," have fueled the Occupy Movement.[6] By shifting the debate to the aforementioned issues, the Occupy Movement has gained momentum, influenced policy-makers, and had an impact on the general public. In fact, anywhere from 37% to 59% of Americans support the Movement.[7][8][9] According to the Movement's website, the message has spread to over 100 cities in the United States and 1,500 cities internationally.[10] To people who want to understand the debate on a more quantitative level (moral arguments aside), it is not so much the content of their message that matters, but the effect it has on society and the economy. An estimate by the Associated Press

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[3] Ibid.
[4] Ibid.
[5] Ibid.
[6] Shaila Dewan, "The 99 Percenters 53 Percenters Face Off," *New York Times Economix Blog*, October 11, 2011, http://economix.blogs.nytimes.com/2011/10/11/99-percenters-and-53-percenters-face-off/ (accessed April 20, 2012).
[7] Laurie Kellman, "Over A Third Americans Support Occupy Wall Street Protests: Poll," *Huffington Post*, November 23, 2011, Business Section, http://www.huffingtonpost.com/2011/10/23/occupy-wall-street-poll_n_1027109.html (accessed April 20, 2012).
[8] Todd Wallack, "Occupy's Support Divided, Poll Says," *The Boston Globe*, December 5, 2011, http://www.bostonglobe.com/business/2011/12/05/occupy-support-divided-poll-says/q2YU9cJprKbRyx3dW7WTOL/story.html (accessed April 20, 2012).
[9] Mathew Cooper, "Poll: Most Americans Support Occupy Wall Street," *The Atlantic,* October 19, 2011, http://www.theatlantic.com/politics/archive/2011/10/poll-most-americans-support-occupy-wall-street/246963/ (accessed April 20, 2012).
[10] Occupy Wall Street, "About," http://occupywallst.org/about/ (accessed April 20, 2012).

declares taxpayers have paid around $13 million in police overtime and other municipal services in response to Occupy.[11] Whether or not one believes in more or less income inequality, the fact of the matter is there are economic consequences to varying levels of inequality.

Political debate aside, why is income inequality important? Similar to the political arena, income inequality and its relation to economic growth has been a contentious topic. Research and theory on distribution of income and economic growth will be discussed in the literature review section. This paper hopes to address the relationship between economic growth and income inequality in the United States using existing data from 1963 to 2004, and originally-constructed data from the IRS from 2005 to 2009.

[11] David Francis, "The Politics and Economics of Occupy Wall Street," *U.S. News World and Report*, December 12, 2011, Business and Economy section, http://money.usnews.com/money/business-economy/articles/2011/12/12/the-economics-of-occupy-wall-street?page=2 (accessed April 20, 2012).

2. Literature Review

One of the first economists to research the relationship between income inequality and long-term economic growth was Simon Kuznets. Similar to most research conducted on the topic, Kuznets collected cross-country data. However, he admits, "The paper is perhaps 5 per cent empirical information and 95 per cent speculation, some of it possibly tainted by wishful thinking."[12] Nonetheless, grounded on his limited data, Kuznets theorized the Kuznets Curve – an inverted U-shaped curve plotting income inequality on the y-axis and GDP per capita on the x-axis. He theorized that "underdeveloped" countries in the early phases of industrialization would grow in both inequality and GDP per capita, until the maximum point on his curve where "leveling forces become strong enough" to reduce income inequality.[13] He speculated that might occur because industrial profits will be assumed by the top 5%, but, eventually, the profits will be distributed more evenly. He has little explanation as to why the profits might be more equally distributed, and only points to the "scanty empirical evidence" – "[T]he narrowing of income inequality in the developed countries is relatively recent and probably did not characterize the earlier stages of their growth."[14] Nevertheless, Kuznets stated that industrializing countries might not follow this curve if political and social institutions are "long-established," and if a decline in both birth rates and death rates (seen in many developed countries) decreasing the "relative economic position of lower-

[12] Simon Kuznets, "Economic Growth and Income Inequality," *The American Economic Review* 45, no. 1 (1955), 23.
[13] Ibid., 24.
[14] Ibid., 18.

income groups" occurs.[15] While lacking empirical evidence, Kuznets' research hoped to spark interest in the topic. His hopes have come to fruition.

Fast-forwarding to the relatively recent, there are four main theoretical approaches to the relationship between economic growth and income inequality: credit-market imperfections, political economy, social unrest, and savings rate.[16] Credit-market imperfections entail imperfect credit markets acting in favor of the rich because of asymmetric information or limitations in legal institutions. Therefore, there is little access to credit – people do not trust the credit market as it is too risky – and most people rely on wages and assets for income opportunities.[17] Low income households will forego human capital investments which have high rates of return because they do not trust the credit markets to finance their investment. Foregoing any high rate of return implies lower economic growth, and therefore more unequal income distribution means lower economic growth.

Conversely, in countries where financial institutions are more developed, Galor & Zeira postulate there will tend to be higher economic growth as human capital investments can be financed by readily available credit.[18] Therefore, richer countries (typically having developed financial institutions) will benefit from income inequality because everyone can access human capital investments financed by safer credit institutions. If everyone invests in human capital, higher levels of income inequality would have a beneficial effect on economic growth.

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[15] Ibid., 18.
[16] Robert Barro, "Inequality and Growth in a Panel of Countries," *Journal of Economic Growth* 5 (2000): 5.
[17] Oded Galor & Joseph Zeira, "Income Distributions and Macroeconomics," *Review of Economic Studies* 60 (1993): 35-36.
[18] Ibid.

Theory involving political economy entails income or wealth redistribution through taxes or government spending (typically social welfare). This happens, "[i]f the mean income in an economy exceeds the median income, then a system of majority voting tends to favor redistribution of resources from rich to poor."[19] It is argued that greater redistribution reduces investment and therefore growth. However, there might be a positive relationship between growth and inequality. There is a difference between ex-ante and ex-post inequality meaning income inequality before taxes and after taxes, respectively. Those with less ex-post inequality tend to redistribute the income the most and cause most distortions of economic decisions.[20] In this scenario, inequality is positively correlated with economic growth and investment. Another factor to consider, in the political economy framework, is that countries with higher inequality tend to have the top income-earners in positions of power. Following a neo-classical economic model, these high income-earners will spend money (in the form of lobbying) to prevent redistribution. These activities (especially lobbying) consume resources and could lead to higher corruption.[21] In this respect, higher income inequality will negatively affect growth.

A third factor in the relationship between growth and inequality is sociopolitical unrest. In neo-classical economics, because of the law of diminishing returns, poorer countries are predicted to grow faster than richer countries. Benhabib and Rustichini use game theoretical models to show why theory and empirical evidence diverge – many

[19] Barro, "Inequality and Growth in a Panel of Countries," 6.
[20] Ibid.
[21] Ibid.

poorer countries are not growing faster than richer countries.[22] Conversely, high income groups attempt to hold power (as mentioned above in the political economy theory), while social groups, with lower incomes, will organize themselves to manipulate political systems for more favorable redistribution. Instead of allocating this capital into investments, the capital is spent lobbying the government. Therefore, what the low income-earners deem "unfair" tends to stymie economic growth as they want a fair share of the income earned through growth.[23] In an empirical study of income inequality, investment, political instability, and growth, Alesina and Perotti, find that income inequality increases political stability, and political stability reduces investment. Therefore, income inequality reduces growth through this channel. Their findings were statistically significant in a sample of 75 countries from 1960 to 1985.[24] However, there are two implications to their results: 1) Fiscal redistribution increases the tax burden on the "capitalists and investors," thus decreasing investment, but, 2) these same policies might reduce political and social unrest and foster investment. They speculate there must be an optimum point where the benefits of redistribution equal the costs.[25]

Most likely influenced by Keynes's *General Theory*, some economists believe individual savings rates rise with higher income. Therefore, redistributing income from high earners to low earners reduces the aggregate savings rate. Through this channel,

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[22] Jess Benhabib and Aldo Rustichini "Social Conflict and Growth," *Journal of Economic Growth* 1, no. 125, (1996): 125.
[23] Ibid., 125.
[24] Alberto Alesina & Roberto Perotti, "Income Distribution, Political Instability, and Investment," *European Economic Review,* Vol. 40, 6 (1996): 1203-1205.
[25] Ibid., 1227.

investment is raised causing an increase in economic growth. Income inequality increases economic growth in a "transitional sense."[26]

Similar to the theoretical research on the relationship between income inequality and economic growth, empirical research has shown positive, negative and inconclusive relationships. While the focus of this paper is on U.S. income inequality and GDP growth, a look into cross-country studies is helpful. Perrson and Tabellini look into the percentage income share of top 20% income earners in the long-run (20 year periods). They controlled for education, using a schooling index, and political participation. In almost all their models, they found the relationship between average 20 year GDP growth and the income share of the top 20% of income-earners was statistically significant and negatively correlated.[27] They also found, "economical significance," in that an increase of one standard deviation (from the sample of the inequality measure) of 0.07 would decrease growth by half a percentage point.[28] However, there are few problems with their analysis, including an absent control for population growth, incomplete data (their data is spotty and dates back to 1830), varied and unreliable sources, and a limited number of sample countries.[29]

Deininger and Squire compiled a fairly comprehensive dataset of Gini Coefficients (a measurement of income inequality that will be discussed in further detail in the methodology section) of 108 countries, dating back to the 1960s.[30] In order to

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[26] Barro, "Inequality and Growth in a Panel of Countries," 9.
[27] Torsten Persson & Guido Tabellini, "Is Inequality Harmful for Growth? Theory and Evidence," *NBER Working Paper Series*, Working Paper no. 3599 (1991): 21.
[28] Ibid., 21.
[29] Ibid., 17, 42.
[30] Klaus Deininger & Lyn Squire, "A New Data Set Measuring Income Inequality," *The World Bank Economic Review,* 10, no. 3 (1996): 578.

address data reliability issues they required the data be based on household surveys, be representative of the given population, and be comprehensive, or including nonwage earnings, self-employment, and nonmonetary income.[31] They omitted any data that did not adhere to these standards or that might contain biases or errors, whittling a dataset from 2,600 observations to 682. They admit that, "Decisions concerning the inclusion or exclusion of certain observations are always based on some judgment and arbitrariness."[32] Their high quality dataset opened the door to further empirical research on income inequality and growth.

Barro used this dataset in conjunction with GDP and investment measurements from the World Bank and the National Bureau of Economic Research to research the relationship between the Gini index and GDP growth.[33] Barro found the estimated Gini Coefficient's effect on GDP per capita growth was "essentially zero."[34] However, omitting other explanatory variables such as fertility rate shows a negative relationship similar to other studies. Also, regressing the Gini Coefficient on GDP per capita, or "economic development" showed a negative relationship that was statistically significant at the p=0.059 level. Barro's analysis also showed the Gini "lacked explanatory power for the investment ratio" and secondary and higher level education is a "critical factor." The theory that income inequality hinders investment was not found to be empirically verified, but human capital accumulation was.[35] Barro also found that the Kuznets Curve was empirically verified – income inequality increases and then decreases as a country

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[31] Ibid., 567-571.
[32] Ibid., 572.
[33] Barro, "Inequality and Growth in a Panel of Countries," 8, 10.
[34] Ibid., 13.
[35] Ibid.

becomes more economically developed; however, the relationship does not explain the "bulk of variations in inequality across countries or over time."[36]

Forbes found a positive relationship using the same dataset and applying Perotti's economic analysis, but adding dummy variables to control for global shocks of a certain period and country dummy variables to control for omitted country-specific, and time-invariant biases.[37] This positive relationship was both statistically significant in the short and medium-term, but Forbes found that the model did not explain poor countries. However, because there is little data on long-term effects of income inequality on growth, her paper suggests it is not the definitive paper on income inequality and growth.[38]

More recently, the IMF in *Finance and Development* found a negative relationship between income inequality and economic growth. However, instead of regressing income inequality on GDP growth, they used the Gini Coefficient and regressed it on "growth spells," or "a period of at least five years that begins with an unusual increase in the growth rate and ends with an unusual drop in growth"[39] The study controlled for other determinants of growth spells such as political institutions, trade openness, exchange rate competitiveness, external debt, and foreign direct investment. They found income inequality to have a negative effect on the duration of growth spells, but argued "poorly designed efforts to reduce inequality might be counterproductive."[40] They give the example of China reforming its agricultural policies.

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[36] Ibid., 25.
[37] Kristin Forbes, "A Reassessment of the Relationship Between Inequality and Growth," *The American Economic Review* 90, no. 4 (2000): 872.
[38] Ibid., 885.
[39] Andrew Berg & Jonathan Ostry, "Equality and Efficiency," The IMF's *Finance & Development* 48, no. 3 (2011): 14.
[40] Ibid., 15.

China gave stronger incentives to farmers to produce more agricultural products which decreased overall income inequality, but raised income inequality among farmers causing resistance efforts by the very farmers the policy was aimed at.[41] The IMF argues sustainable growth is only sustainable when it is shared, and efforts to combat income inequality must be efficient and appropriate.[42]

When analyzing the effect on income inequality and GDP growth it is hard to generalize for all countries, as one can see from the discussion provided above. The relationship largely depends on the economic development of a country, political institutions, and other (usually omitted) variables. Also, data collected for these studies have sometimes been unreliable and inconsistent, or compiled from different various sources.[43] Focusing on a certain country alleviates this problem in that it is country specific and, additionally, something such as policy recommendations can be tailored to the given country. This paper discusses the effect of income inequality and GDP growth in the United States.

The United States has experienced an increase in income inequality since the 1980s.[44] Dadkhan uses time-series data from 1947 to 2001 to find a negative relationship between income inequality and growth in the United States. He argued there was a virtuous cycle of the United States promoting economic equality which encourages

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[41] Ibid.
[42] Ibid.
[43] Kamran Dadkhah, "Income Distribution and Economic Growth in the United States: 1947 – 2001," http://www.economics.neu.edu/papers/documents/03-006.pdf
[44] "Inequality: The Gap Widens, Again," *The Economist*.

growth. Cutting taxes to the low and medium income earners would encourage this cycle.[45]

Frank collected a sample of the 50 states and the District of Columbia from 1945 to 2004 measuring the Gini Index, Top 10% share of income, and Top 1% share of income compiled using data from the IRS. He notes his statistics were consistent with trends in U.S. income inequality in the United States from Piketty and Saez.[46] Because the states are more structurally similar to each other than most countries are to one another, the analysis suffers from less omitted variable bias and less explanatory variables are needed. However, similar to other panel data analysis, other regressions were employed such as the fixed effects estimator, the mean group estimator, and pooled mean group estimator.[47] He found the relationship between income inequality and GDP per capita growth in the United States to also be negative. His results also showed the relationship was driven by the upper end of the income distribution (or top income earners).[48] His study lacks in the "impact of structural breaks in state-level time series," and the relationship potentially being nonlinear.[49] Frank's dataset is used in this paper, and will be discussed next in the methodology and data section.

[45] Dadkhah, "Income Distribution and Economic Growth in the United States: 1947 – 2001."
[46] Mark Frank, "Inequality and Growth in the United States: Evidence from a New State-Level Panel of Income Inequality Measures," *Economic Inquiry* 47, no. 1 (2008): 58.
[47] Ibid., 65.
[48] Ibid.
[49] Ibid.

3. Data and Methodology

3.1 Estimating the Gini Index

Income inequality will be measured by the Gini Coefficient. The Gini coefficient is calculated as "twice the area between the 45° line and the Lorenz curve or as 2 cov (Y,F(Y))/μ where Y is the income, F(Y) the cumulative distribution and μ the expected income."[50] The Lorenz curve "plots the percentage of total income earned by various portions of the population when the population is ordered by size of their incomes."[51] The 45° line is the line of equality where everyone ordered by size of their incomes would have equal income. Simply put, the Gini Index of Concentration is the difference between the line of equality and the Lorenz curve which can be expressed as:

(1) $G = \frac{A}{A+B}$

Where G is the Gini Index, A is the area between the curve and diagonal 45° line, and B is the area under the diagonal (see Figure 1).[52] Because one is dealing with areas, it easily computed with integrals. A more technical definition using integrals can be found in Gastwirth's "A General Definition of the Lorenz."[53]

The Gini does not perfectly reflect changes in the index and underlying income distribution. For example, the same change in the Gini could be caused by a higher percentage of income made from top earners and less from middle earners, or a higher percentage of income made from low earners and less from top earners. This implies

[50] Joseph Silver, ed., *Income Inequality Handbook* (Norwell: Kluwer Academic Publishers, 1999), 225.
[51] Joseph Gastwirth, "A General Discussion of the Lorenz Curve," *Econometrica* 39, no. 6 (1971): 1037.
[52] Mary Henson, "Trends in the Income of Families and Persons in the United States, 1947 – 1964," *U.S. Department of Commerce, Bureau of the Census*, (1967): 34.
[53] Gastwirth "A General Discussion of the Lorenzs Curve," 1037.

countries can have the same Gini, but different income distributions.[54] Some scholars use quintile percentages, or what percentage of income is earned by the top 10% of income earners, the next 10% of income earners, etc.[55] The aforementioned issue aside, "[i]t has been generally agreed, after much discussion, that the *best* single measure of inequality is… the Gini Index."[56] [57]

Data for this paper is gathered from Frank's working paper on inequality measures in the United States.[58] Frank collected data from the IRS and constructed Gini Indexes for the 50 states and the District of Columbia from 1916 to 2005. However, he did not include Alaska from 1916 to 1958 as Alaska did not gain statehood until 1959. Yet, for some reason, Hawaii's Gini Coefficients were included even though Hawaii did not gain statehood until 1959. The use of data from Hawaii, Alaska, and the District of Columbia will be excluded because either they are not included in the continental U.S., or for lack of complete data in the time period from 1963 to 2009. Because the IRS releases its data using income brackets (i.e. number of returns, and average income earned by those earnings $5,000-$10,000), constructing a Gini Index had to be estimated using Cowell's method. The Gini Coefficient was constructed using:

(2) $G_L = \frac{1}{2}\sum_{i=1}^{k}\sum_{j=1}^{k}\frac{n_i * n_j}{n^2 * u}\left|u_i - u_j\right|$

[54] Alicja Krol & Judy Miedema, "Measuring Income Inequality: An Exploratory Review," Region of Waterloo Parks, (2009) 7.
[55] Deininger et al., "A New Data Set Measuring Income Inequality," 567.
[56] James Morgan, "The Anatomy of Income Distribution," *The Review of Economics and Statistics* 44, no. 3 (1962): 270.
[57] Emphasis Added
[58] Mark Frank, "U.S. State-Level Income Inequality Data," Sam Houston State University: Department of Economics, http://www.shsu.edu/~eco_mwf/inequality.html (accessed April 20, 2012).

Where the *i* and *j* subscripts denote within-group (an income earning bracket) values, and u denotes the average income within a group. The "n" denotes the numbers of tax returns. This equation assumes everyone in group earns the average income.[59]

(3) $G_U = G_L + \sum_{i=1}^{k} \frac{n_i^2(a_{i+1}-u_i)(u_i-a_i)}{n^2 * u(a_{i+1}-a_i)}$

The a_{i+1} denotes the highest possible income for the *i*th group, while a_i denotes the lowest possible income for the *i*th group. This equation assumes maximum inequality, or everyone in a group receives either the highest or lowest income in a given group.[60]

(4) $G = \frac{2}{3}G_U + \frac{1}{3}G_L$

This is the "compromise" in estimating the Gini Index given grouped data such as the IRS data. Cowell notes this approximation, "works remarkably well for most distributions."[61]

Because Frank does not provide data after 2005, I constructed the Gini Index from 2005 to 2009 using the Cowell approximation of the Gini. Personal income bracket data is provided by the IRS from 1996 to 2009 on their website.[62] In order to construct the Gini Indices for each state from 2005 to 2009, I assumed Cowell's approximations (3), (4), and (5). a_{i+1} was assumed to be \$10 million for highest tax bracket, or those who make more than \$200 thousand. Changing the income assumption of the highest tax bracket a_{i+1} from \$10 million to \$1 million and from \$100 million to \$10 million changed the Gini indices of the 48 states an average of 0.0004 with the maximum change being 0.0046. It would be safe to assume $a_{i+1}$to be \$10 million because of this minimal

[59] Frank Cowell, *Measuring Inequality* (Cambridge: Prentice Hall/Harvester Wheatsheaf, 1977), 121.
[60] Ibid.
[61] Ibid., 129.
[62] "SOI Tax Stats," *Internal Revenue Service,* February 13, 2012, http://www.irs.gov/taxstats/article/0,,id=171535,00.html (accessed: April 20, 2012).

change to the Gini. a_i, the lowest possible income for the group, was assumed to be $0 as earning a negative personal income in a year is very infrequent. See Table 1 for summary statistics on the Gini Coefficient, and Table 5 for Gini averages for the individual 48 states being analyzed.

It should also be noted this study relies on income inequality data constructed from the IRS which might not accurately reflect income distribution within the United States. Relying on IRS data has at least three implications. Firstly, the obvious implication is that some U.S. citizens might not pay taxes. This might cause bias in both directions. Secondly, the IRS's definition of income is defined by tax code, and not by income inequality theory. Thirdly, the implication that U.S. citizens might underestimate their income on their tax returns exists. This would probably cause a downward bias of the Gini, as tax payers are incentivized to pay at or under a certain tax bracket to avoid higher tax rates. These implications aside, IRS tax data should be relatively accurate when it comes to income inequality when compared to other sources such as surveys. Surveys might not include capital gains and other incomes defined as personal income.

3.2 Economic Growth Measurements

Economic growth is defined by real GDP per capita growth. Real GDP statistics and population statistics were taken from the BEA.[63] The GDP deflator to calculate real GDP is indexed to 2005 U.S. dollars. The GDP divided by the population gives the GDP per capita in a given year and state. Annual growth was calculated using:

[63] "Regional Data," *U.S. Department of Commerce, U.S. Bureau of Economic Analysis,* http://www.bea.gov/iTable/iTable.cfm?ReqID=70&step=1 (accessed: April 20, 2012).

(5) $Growth_t = \frac{GDP\ per\ Capita_t - GDP\ per\ Capita_{t-1}}{GDP\ per\ Capita_{t-1}}$

Since the dataset ranges from 1963 to 2009, there are 46 growth rate points for each of the 48 states. Summary statistics for GDP per capita growth are provided in Table 1.

In order to measure long term growth similar to Barro's study an average growth rate is taken over both a 10 year period and a 5 year period. But because there are 46 growth rates for each state, there are 5, and 9 constructed points, respectively, where 1963-1969 constitute one data point for each of these long term growth measurements. These points were included because they include all the data from 1963 to 2009. The next point in each of these measurements of ten year average growth and five year average growth, is 1970-1979, and 1970-1974, respectively. The ten and five year averages of economic growth continue until the final data point ending on 2009. Summary statistics for both the ten year and five year averages are provided in Table 1. Additionally, economic growth averages for the individual 48 states are provided in Table 5 from the 1963 to 2009 period.

3.3 Human capital Measurement

Human capital attainment will be another important explanatory variable for GDP per capita growth. This is typically found in educational attainment statistics. Using the data from Frank's working paper, college degree indices will be controlled for in the analysis. The college degree index is calculated as the percentage of people who have obtained a college degree, or higher degree. This variable is defined as:

(6) $college = \frac{c}{n}$

This index is calculated as a percentage of the total number of citizens, n, within the state.[64] The variable c is defined as the number of college degrees and postgraduate degrees earned by the population. Summary statistics for college attainment are in Table 1.

3.4 Methodology

Because the data is both cross-sectional and time-series, the data is best analyzed through a panel analysis framework. The fixed effects model for panel analysis will be used in this study. The fixed effects model will use the GDP per capita growth as defined above as the dependent variable while the Gini Coefficients will be the independent variable and education (college degree attainment) will be controlled for. This is shown in:

(7) $gdppcgrowth = \beta_1 Gini_{it} + \beta_2 College_{it} + a_i + u_{it}$

The following models will use average growth rates from either five or ten years as the dependent variable. The Gini Coefficient's initial value at $t = 1$ will be regressed on five year averages or ten year averages depending on the model. Equation (7) will reflect model (4) in Table 2. Model (3) is the same, but without the college independent variable.

(8) $averagegrowth = \beta_1 Gini_{it} + \beta_2 College_{it} + a_i + u_{it}$

The fixed effects models (7), (8) on Table 3, and models (11), (12) on Table 4, will use equation (8) as the model (with models (7) and (8) excluding the college variable).

[64] Frank, "Inequality and Growth in the United States: Evidence from a New State-Level Panel of Income Inequality Measures," 66.

The pooled OLS does not take control for fixed effect, a_i. The pooled regressions will follow:

(9) $gdppcgrowth = \beta_1 Gini_{it} + \beta_2 College_{it} + u_{it}$

(10) $averagegrowth = \beta_1 Gini_{it} + \beta_2 College_{it} + u_{it}$

Again, for equation (10), average growth rate in a period of five or ten years will also be used reflected in model (5), (6), (9), and (10). Equation (9) reflects the models used in Table 2, model (1) and (2).

4. Results

All models show that as the Gini Coefficient increases, GDP per capita growth will fall. When the GDP per capita growth is regressed on the Gini Coefficient (see model 3 in Table 2) in the same period in time using the fixed effects methods, a negative correlation exists. Additionally, when controlling for education the negative correlation (see model 4 in Table 2) still exists and is statistically significant at the 1% level. Human capital attainment, or education, represented by the number of college degrees attained over the population is positively correlated with GDP per capita growth. The "within R^2 values" are displayed on Table 7 for the (3) and (4) models. 12.3 percent and 14.4 percent of the variation in the GDP per capita growth are explained by the Gini Coefficient, and the Gini Coefficient and college degree attainment, respectively. This shows relatively small, but significant power in explanation of variation. The rho value was 0.032 and 0.057 for models (3) and (4), respectively. This means 3.2% and 5.7% of the variation is due to the differences across panels.

The models using the pooled OLS with GDP per capita growth each year as the dependent variable show the Gini Coefficient statistically significant at the 1% level, model (1), and, also, statistically significant at the 1% level when controlled for education, model (2). Both models showed a negative correlation in respect to the Gini Coefficient and economic growth. Education was positively correlated with economic growth, but was statistically insignificant. The R^2 values were 10.4% and11.6% for the models (1), and (2), respectively.

Models (7) and (8) on Table 3, show there is a negative relationship between initial levels of the Gini Coefficient and five year average GDP per capita growth rate

which is statistically significant at the 1% level. These models measure whether the initial income inequality will affect economic growth over a five year period. When education was controlled for, the Gini Coefficient remained statistically significant and further negatively affected average GDP growth over a five year period. 39.9% and 40.0% the variation in the average 5 year GDP per capita growth was explained by the Gini Coefficient, and the Gini Coefficient and educational attainment, respectively. 13.2% and 15.8%, the rho values for (7) and (8), respectively, of the variance in the models is explained by the difference in the cross-sections, or states.

The pooled OLS model using five year average growth rates and initial Gini Coefficients had a negative correlation at the 1% level. Education was not controlled for in model (5), but was controlled for in model (6). This control variable was statistically insignificant and positively correlated with the dependent variable. 32.4% and 33.0% of the variation in five year average growth was explained by the models (5), and (6), respectively.

Changing the dependent variable to a ten year average of GDP per capita growth in models (11) and (12), still showed a statistically significant Gini Coefficient at the 1% level. Like the 5 year average growth rate, the ten year average was regressed on initial Gini Coefficient. This gives an indication of whether income inequality has an effect on long-run growth. 5.3% and 11.1% of the variation in the (11) and (12) models were explained by the differences in the states. 14.8% and 17.3% of the variation in 10 year GDP per capita growth was explained by the variation in Gini Coefficients for the models (11) and (12), respectively. Also, the human capital control was statistically significant and positively correlated for the (12) model at the 1% level.

The change in 10 year average growth rates for the pooled OLS regressions resulted in statistically significant, negatively correlated, Gini Coefficients at the 1% level in models (9) and (10). Education was also statistically significant at the 5% level in model (10) and was positively correlated with economic growth. The R^2 values were 12.1% and 12.0% for models (9) and (10), respectively.

5. Discussion

In all of the models the Gini Index for each state is statistically significant at the 1% level. This suggests there is a correlation between economic growth and income inequality that is non-zero, and, in fact, negative. The models in Tables 2,3, & 4 show this relationship. While the pooled OLS models might seem unreasonable to use, they are included to show that even without controlling for fixed effects, income inequality is statistically significant in relationship to growth. This paper confirms Frank's results in his working paper using additional data constructed from 2005 to 2009 that income inequality is negatively correlated in respect to GDP per capita growth. In addition to determining the relationship between the Gini Coefficient and its effect on economic growth in that period in time, an average was taken over a five or ten year period in each state to determine the effect of initial income inequality on economic growth. These models also showed statistically significant negative correlations at the 1% level. It is remarkable that even the pooled OLS regressions (which do not take into account time and cross-section effects) managed to confirm the Gini Coefficient was negatively correlated with economic growth.

Most theoretical research of income inequality and economic growth points to a negative correlation as seen in this empirical study. These studies attempt to justify why there might be a casual relationship. The most reasonable in this case might be the human capital investment theory, which states higher income inequality will mean the lower classes cannot afford human capital investments. Poorer classes foregoing high-

return human capital investments will negatively affect GDP per capita growth.[65] Additionally, the theory that sociopolitical unrest, especially in at the present time, is caused by income inequality which negatively affects economic growth, could be employed.

However, other studies have argued that income inequality might simply be a symptom of economic growth, or that a spurious relationship exists. Theoretical arguments, such as those argued in the literature review section, suggest otherwise. However, it is still within the realm of possibility that a spurious relationship exists. It might be that Gini Coefficients are highly correlated with another explanatory variable that causes GDP per capita growth to retard.

The cross-sections, or states, had a maximum rho of 15.7%, meaning variance due to the cross-sections was relatively low. These relatively smaller rho values are theoretically sensible seeing as states within the United States have similar economies.

Human capital attainment, the control variable in half the models, is positively correlated to GDP per capita growth in models (2), (4), (8), (10), and (12). However, it is negatively correlated in the (6) model which is not reasonable. Historically and empirically speaking, education tends to cause positive economic growth.[66] Model (6) is a pooled regression and the negative correlation with human capital attainment is statistically insignificant. Therefore model (6) is probably not reliable. Again, however, the pooled regressions are less meaningful as these models do not taken into account cross-sections and time effects. Model (10) which averages 10 year growth periods, has a positive, statistically significant at the 1% level, college attainment control variable. This

[65] Galor et al., "Income Distributions and Macroeconomics," 35-36.
[66] Persson et al., "Is Inequality Harmful for Growth? Theory and Evidence," 21.

positive correlation between education and long term growth is quite reasonable. It also makes the Gini Coefficient more negatively correlated with long-term average growth.

It is interesting to note, however, when changing the dependent variable from a five year average growth rate to a ten year average growth rate variability in long term average growth is explained less by income inequality and educational attainment as reflected in the smaller R^2 values – Models (7) and (8) using five year average growth with 39.9% and 40.4%, to 14.8% and 17.3% in the models (11) and (12) using ten year average growth rates. Additionally, the pooled OLS reflect the same trend – smaller R^2 values when the dependent variable changes from a five year average growth rate to a ten year average growth rate. If one were to assume the primary relationship attempting to be explained in this paper is correct, one would expect a higher R^2 value for the 10 year average economic growth rate – that is, more of the variation in the 10 year average is explained by the model than a five year average.

As discussed above, it is difficult to interpret the income inequality measurement, the Gini Coefficient, because a change in the Gini might represent either an up-down, or down-up transfer of income. In other words, a change in the Gini might be represented by less income gained by the top income-earners and more by the middle income-earners, or less income gained by the middle income-earners and more by the top earners – both, if the change were the same, would reflect the same change in Gini. Thankfully, measurements of income inequality come in other forms such as what the top 0.1%, 1%, 5%, etc. earn as a percentage of total income. Using Alvaredo, Atkinson, Piketty, and Saez's database available online, one can see the trend of top income earners from 1963-

2009 – this paper's period of focus.[67] The percentage of total income earned by the top 1%, 5%, and 10% from 1963 to 2009 are shown in Figure 2. From 1984 (with some exceptions) the top 1%, 5%, and 10% of top income earners have steadily increased their share of total income. This indicates, for the period of 1984 to 2009, the Gini Coefficient's increase has been at least, in part, due to the top income-earners increase in share of total income. However, this does not account for the period of 1963 to 1983. Nonetheless, whether or not the Gini changed due to down-up, or up-down effects, income inequality is shown to have a negative effect on economic growth.

[67] Facundo Alvaredo, Tony Atkinson, Thomas Piketty, & Emmanuel Saez, "The World Top Incomes Database" http://g-mond.parisschoolofeconomics.eu/topincomes/ (accessed: April 20, 2012).

6. Conclusion

This paper concludes that a statistically significant negative correlation between income inequality and economic growth exists in the United States when using panel data from 1963 to 2009. Constructing new data, Gini Coefficients from 2005 to 2009 in 48 states, does not change the negative relationship found by Frank (2008). However, unlike Frank's working paper, the educational attainment variable was not always positive in regard to economic growth.[68] Also, this paper found that in all models, income inequality was unequivocally negatively related to economic growth. While this paper points to a rather robust negative relationship between income inequality and economic growth, there are a few other things to consider. As the Kuznet's Curve suggests, there might be a non-linear relationship between income inequality and economic growth – income inequality will rise as economic growth rises until a point where economic growth continues to rise, but income inequality falls.[69] This might be caused by a transition from a basic economy (pre-industrial) to an advanced economy (either industrial or postindustrial).[70] However, since this paper only looked into this relationship in the United States, it would be expected that there would be strictly either a positive or negative relationship. Seeing how the United States is a fairly developed country (within an economic framework), a negative relationship would be expected.

Again, as mentioned in the discussion section, a spurious relationship might exist. This would mean research on economic growth and income inequality is futile. Yet because of the theoretical backing as seen in the Kuznet's Curve, income inequality's

[68] Frank, "Inequality and Growth in the United States: Evidence from a New State-Level Panel of Income Inequality Measures," 62.
[69] Kuznets, "Economic Growth and Income Inequality," 23.
[70] Ibid.

relationship to investment and human capital investment, and other theoretical research on the subject, a causal relationship is more likely. If there were a way to test for a spurious relationship there would be a number of U.S. policy implications. Further research into such an argument would be important.

Data for this paper was collected using IRS data. It might be interesting to compare the constructed Gini Coefficients from the IRS data and other survey data. Gini Coefficients are difficult to measure accurately without raw data that can provide both cumulative population and the reflected cumulative income statistics for an entire population. Because survey data might be less reliable, it might be in the IRS's best interest to use their data to construct their own Gini Coefficients.

7. Appendix

Figure 1: The Lorenz Curve and Gini Coefficient

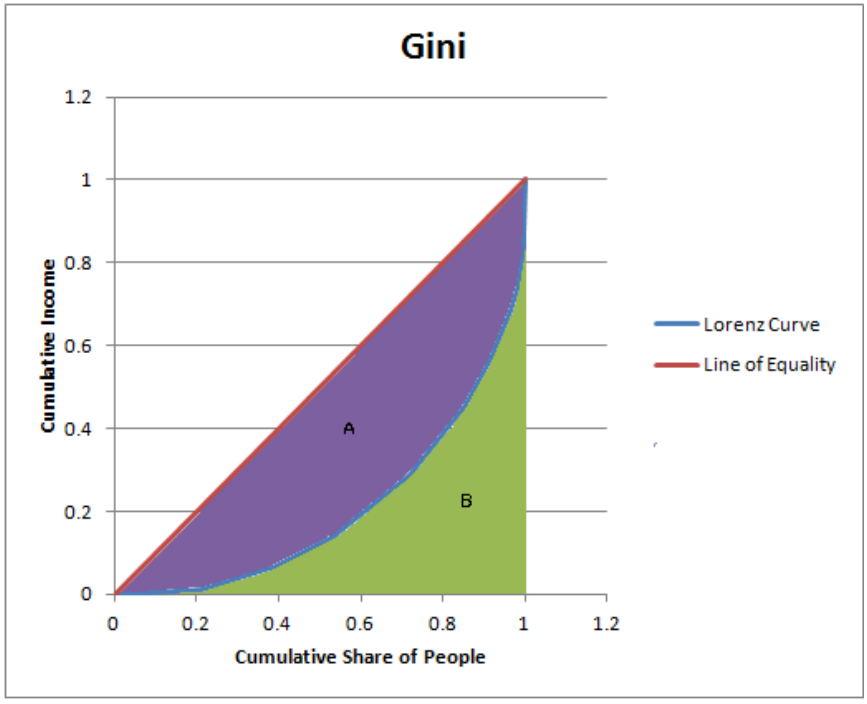

Figure 2: Top Income Earners Share of Total Income from 1963 to 2009

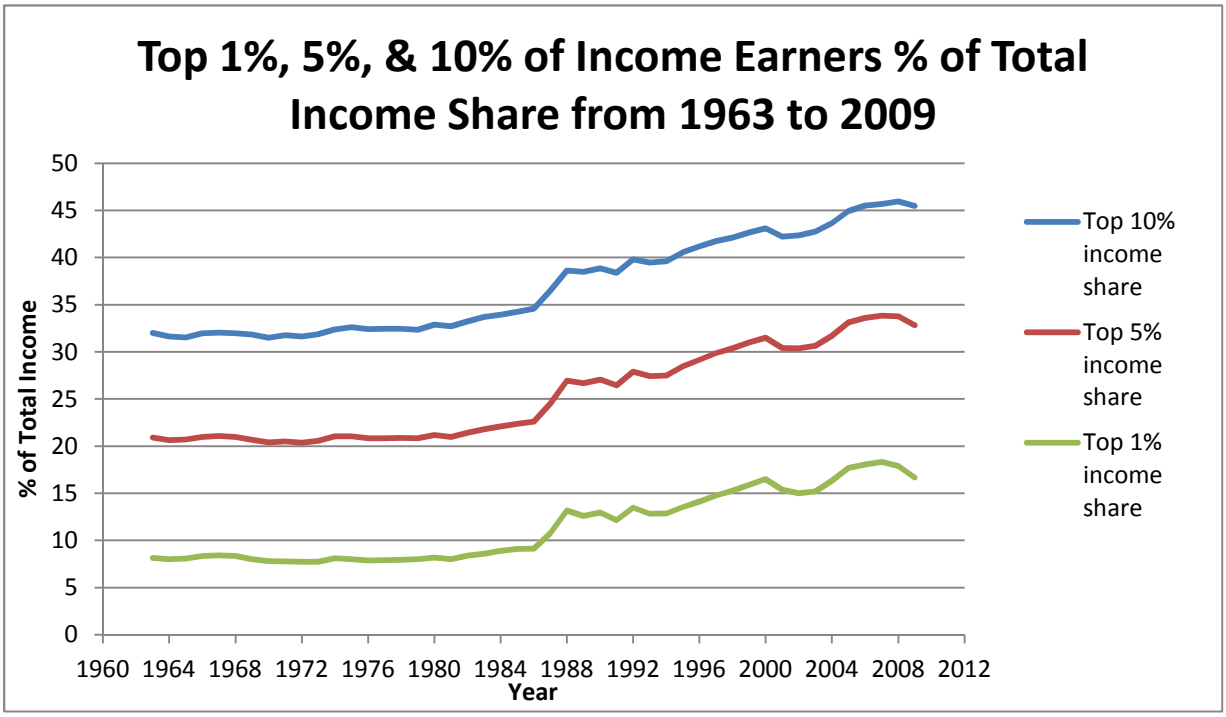

Table 1: Descriptive Statistics of Variables

Variable	Obs.	Mean	Stan. Dev.	Min	State (Year)	Max	State (Year)
growth	2208	0.0298	0.0357	(0.1599)	Wyoming (1986)	0.3493	North Dakota (1973)
gini	2256	0.5244	0.0556	0.4097	West Virginia (1971)	0.6951	New York (2007)
college	2016	0.1050	0.0470	0.0235	North Dakota (1966)	0.2548	Massachusetts (2004)
tengrow	240	0.0289	0.0198	(0.0096)	Utah (1965-1969)	0.0911	Wyoming (1980-1989)
fifthgrow	432	0.0306	0.0234	(0.0259)	Wyoming (1984-1989)	0.1259	North Dakota (1974-1979)

Table 2: Models with Growth as the Dependent Variable

	1	2	3	4
Explanatory Variable	Pooled OLS	Pooled OLS	FE	FE
Gini	-0.2090***	-0.2594***	-0.2379***	-0.3977***
	[0.0130]	[0.0231]	[0.0128]	[0.0330]
College		0.0259		0.16034***
		[0.0257]		[0.0382]
Observations	2208	1968	2208	1968

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Models with 5 Year Average Growth as Dependent Variable

	5 Pooled OLS	6 Pooled OLS	7 FE	8 FE
Gini	-0.2594*** [0.0189]	-0.2499*** [0.0267]	-0.3040*** [0.0132]	-0.3712*** [0.0275]
College		-0.0206 [0.0284]		0.0905** [0.0341]
Observations	432	384	432	384

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Models with 10 Year Average Growth as Dependent Variable

	9	10	11	12
	Pooled OLS	Pooled OLS	FE	FE
Gini	-0.1333***	-0.1928***	-0.1530***	-0.3134***
	[0.0222]	[0.0341]	[0.0266]	[0.03320]
College		0.1124**		0.2599***
		[0.0455]		[0.0502]
Observations	240	192	240	192

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Averages in Gini Coefficients, Average Growth in Gini, and Average Economic Growth for Individual States

State	Average Gini	Average Growth in Gini	Average Economic Growth	State	Average Gini	Average Growth in Gini	Average Economic Growth
Alabama	0.5183	0.00502	0.03123	Nebraska	0.5354	0.00355	0.03208
Arizona	0.5269	0.00428	0.02722	Nevada	0.5435	0.00557	0.02125
Arkansas	0.5294	0.00437	0.03236	New Hampshire	0.5058	0.00620	0.03346
California	0.5469	0.00651	0.02659	New Jersey	0.5252	0.00732	0.02979
Colorado	0.5319	0.00476	0.03198	New Mexico	0.5411	0.00460	0.02617
Connecticut	0.5454	0.00876	0.03347	New York	0.5509	0.00733	0.02817
Delaware	0.5178	0.00139	0.03322	North Carolina	0.5112	0.00455	0.03130
Florida	0.5590	0.00556	0.02980	North Dakota	0.5326	0.00406	0.03735
Georgia	0.5293	0.00578	0.03189	Ohio	0.4926	0.00563	0.02464
Idaho	0.5331	0.00388	0.02652	Oklahoma	0.5380	0.00394	0.03092
Illinois	0.5258	0.00616	0.02637	Oregon	0.5155	0.00552	0.02864
Indiana	0.5002	0.00546	0.02527	Pennsylvania	0.5086	0.00660	0.02844
Iowa	0.5111	0.00358	0.03075	Rhode Island	0.5083	0.00626	0.02922
Kansas	0.5231	0.00522	0.03076	South Carolina	0.5092	0.00541	0.03224
Kentucky	0.5165	0.00334	0.02715	South Dakota	0.5592	0.00427	0.03767
Louisiana	0.5388	0.00509	0.03264	Tennessee	0.5256	0.00418	0.03093
Maine	0.5006	0.00466	0.03035	Texas	0.5591	0.00469	0.03188
Maryland	0.5100	0.00506	0.03168	Utah	0.5157	0.00542	0.02714
Massachusetts	0.5258	0.00685	0.03250	Vermont	0.5112	0.00531	0.03092
Michigan	0.5060	0.00600	0.02058	Virginia	0.5114	0.00438	0.03485
Minnesota	0.5178	0.00402	0.03123	Washington	0.5096	0.00634	0.02690
Mississippi	0.5336	0.00469	0.03154	West Virginia	0.4919	0.00512	0.02652
Missouri	0.5202	0.00464	0.02623	Wisconsin	0.5025	0.00513	0.02750
Montana	0.5494	0.00597	0.02636	Wyoming	0.5493	0.00503	0.03397

Table 6: Fixed Effects Models with Rho and Within R-Squared Values

	3 FE	4 FE	7 FE	8 FE	11 FE	12 FE
Rho Values	0.032	0.057	0.132	0.158	0.053	0.111
Within R-Sq	0.123	0.144	0.399	0.404	0.148	0.173
Observations	2208	1968	432	384	240	192

Table 7: Pooled OLS Models with R-Squared Values

	1 Pooled OLS	2 Pooled OLS	5 Pooled OLS	6 Pooled OLS	9 Pooled OLS	10 Pooled OLS
R Squared	0.104	0.116	0.324	0.330	0.121	0.120
Observations	2208	1968	432	384	240	192

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