Senior Project
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"General Versus Specific Income Inequality in the United States: How do Their Effects on Growth Compare?"

Kyle Whittaker
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Advisors: *Francesco Renna*
Elizabeth Erickson

Abstract

Previous studies address either effects of overall inequality or effects which specific groups such as the rich or middle class have on growth. Theory conflicts as to whether positive or negative effects prevail, and empirical results are mixed. This study uses a ratio of income levels for the 90^{th} percentile over 50^{th} percentile of the income distribution alongside the Gini coefficient for overall inequality to test theories which predict that both greater inequality and increased income for those higher in the income spectrum have growth-enhancing effects. Fixed Effects estimations conducted in this study suggest that the income distribution has multiple avenues through which inequality can act on growth. This study finds a negative linkage between overall inequality and growth, while demonstrating that increasing incomes for the top ten percent of income earners relative to the middle class may be beneficial.

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I - Introduction

Traditionally, gains in productivity have been expected to rise in tandem with real wages. However, from 1966 to 2001 only the top 10% of income earners in the United States have experienced an increase in real wages exceeding the average growth in productivity for the larger economy. The top 10% has seen 58% gains in real income during this period, while the top 1% received gains of 121%. Astoundingly, the top .01% has gained by 617%. (Irvin 2011) As of 2000, the top 10% in the United States enjoyed 43% of total income, which represents a high degree of income inequality relative to historical levels. (Frank 2009). This can be demonstrated by looking at the Gini coefficient, a statistic frequently used to measure the overall degree of income inequality in an economy. The Gini is measured from zero to one, with one being the highest level of inequality. The figure for the year 2000 was 0.433. To demonstrate the importance of this, the United States had its lowest Gini of 0.348 in 1968, while the highest recorded Gini was measured was 0.444 in 2006[1]. This clearly shows how inequality has trended upwards in recent years.

The Gini coefficient measures *overall* inequality in an economy, but literature is inconclusive as to what effect this type of inequality has on economic growth. Some authors assert positive effects and others negative ones. Furthermore, opposing studies contend that *specific* brackets of different income earners such as the middle class or the top ten percent are the most important to strengthen in order to promote economic growth. Since studies assert that both overall inequality and inequality between specific groups can affect growth, it is not clear how the general measures of inequality used by some can affect growth when compared to the specific measures of inequality used by others.

[1] Source for Gini's is US Census Bureau, *Historical Income Tables*

This paper attempts to resolve this issue by testing two inequality measures alongside one another. One is an overall measure, the Gini coefficient, and the other is a specific inequality measure, which is used to test two opposing beliefs about which income earners are most important for growth. This inequality measure is a ratio of the top income earners' real wage over the median income earners' real wage. If this ratio has a positive relationship with growth, it will indicate that increasing levels of income in the upper end of the distribution is more effective for economic growth. If the relationship is negative, it will suggest that concentration of income is bad for economic growth, and that increasing the wages of the middle class is more important.

For reasons I discuss later, I hypothesize that both overall income inequality and the ratio of the top ten percent relative to the median will have a positive effect on growth. The theoretical model I use is based on an endogenous growth model in which accumulation of physical and human capital contributes to economic growth (measured by per capita Gross Domestic Product). I use the aforementioned ratio as an independent variable in both Ordinary Least Squares (OLS) and Fixed Effects (FE) models, alongside the Gini coefficient for overall inequality to test the hypothesis. The literature review makes clear the conflicting ideas which necessitate this study. As a result, this paper contributes to the body of work which focuses on specific brackets of income earners, and represents the first known use of a ratio comparing these different groups as an inequality measure on a study of the United States.

The outline of the paper is as follows: First, the literature review. The main goal of this section is to discuss opposing theories about income inequality and its effect on growth, and to make clear the arguments in favor of the middle class or top income earners to promote growth. Second, I develop the theoretical model and provide justification for the inequality measures used. Third, I explain the econometric procedure I use, along with specification of the variables included and their expected signs. In the fourth section I include the results of the procedures and interpret the results, while the fifth and final section elaborates on the main conclusions from the study and discusses the major limitations of this paper.

II - Literature Review

A – Positive and Negative Effects of Income Inequality

Studies contend that high levels of overall inequality in an economy can affect growth in both positive and negative ways. It is possible that higher wages earned by the rich can act as an incentive for those in lower brackets of the income scale to attempt to increase their economic status. For example, increased income inequality may have played a role in the increased level of college degrees obtained during the 1980's and 90's. Finis Welch believes this to be due to the possibility of a wage premium to be gained from well-paying professions such as physicians or scientists which require high levels of education (Welch 1999). This suggests that maintaining a degree of inequality could be beneficial to overall growth, especially as measured by per capita income.

Another way in which inequality may promote growth is through potential differences in savings behavior. Nicholas Kaldor hypothesized that the "capitalist class" has a higher marginal propensity to save than working class individuals (Kaldor, Nicholas. 1957). The possibility of more income allotted to the capitalist class having a positive effect on growth is shown in the Solow growth model, where the amount of income saved is directly related to GDP growth. As a result, it may be the case that a higher degree of inequality in an economy will result in greater GDP growth due to the productivity of investments made by the rich (Stiglitz, Joseph E. 1969).

Perhaps because of such a disparity among income earners, voters often attempt to enact redistributive policies via political means, such as raising income taxes on the rich (Persson, Torsten. 1994). In addressing the possibility of taxation, Philippe Aghion argues that excessive taxation on an economy which has a high level of inequality may hurt incentives to invest. This is because the application of taxes reduces returns on investment, which may subsequently reduce the number of investors or the magnitude of their investments, acting as a drag on economic growth (Aghion, Philippe. 1999, pg.1620).

Arguments for negative effects of inequality are just as prevalent as those in favor of a positive relationship. Inequality may actually be the *cause* of low levels of human capital in the poor or middle classes. Although some authors suggest that inequality may provide a motivation for lower income earners to invest in human capital attainment, Aghion suggests that it may also act as a hindrance to the ease with which such capital is obtained (Aghion 1999). Sarah Voitchovsky presents a similar argument, stating that a lack of funds may result in a lack of unexploited talent by workers or entrepreneurs who otherwise would be more productive in their investments (Voitchovsky, Sarah 2005). Diminishing returns on capital may magnify the effect that disproportionate levels of income could bring. This is because the marginal benefit of an increase in income to someone with fewer resources will be greater than a similar increase to someone with greater resources. As a result, groups that would benefit by having more to invest in physical and/or human capital are forced to go without, potentially reducing aggregate output (Aghion 1999).

In cases of extreme inequality, moving up the income distribution may appear so difficult that the cost of attempting to gain higher levels of capital appears to outweigh the benefits (Welch, Finis. 1999). George Akerlof's "fair wage-effort hypothesis" suggests that workers decrease their productivity when they feel their actual wage has fallen below what they consider a "fair" wage (Akerlof, George. 1990). If income inequality drives this resentment, economy wide productivity will be negatively affected, resulting in a growth rate short of the optimal level.

Additionally, inequality may have adverse effects via the political system. William Easterly states that the rich may be reluctant to support broad measures to raise aggregate human capital, such as public education reform, preferring investment in their own enterprises. If some of this investment would be more efficiently directed to public goods such as infrastructure rather than the private sector, this may represent a form of allocative inefficiency. Easterly also believes that inequality may contribute to overall political instability due to rent-seeking or corruption by the rich, which could negatively affect growth (Easterly, William. 2001).

The empirical evidence is also split on how inequality affects growth. Studies done across both US states and with cross-country data have produced mixed results. Some contend that inequality has a positive effect (Partidge 1997, Forbes 2000, Partridge 2005, Frank 2009,), while others find that inequality has negative effects (Persson 1994, Panizza 2002). Mark Partridge suggests that estimation technique plays a large role in the observed outcomes of both state and country studies. In particular, earlier cross-sectional studies often reported negative relationships between inequality and growth, while those studies employing panel data techniques have tended towards positive results. OLS results typically exhibit sign reversals after switching to Fixed Effects (FE) models, a problem which is found in both country and state studies (Partridge 2005). Kristin Forbes suggests that this may be because the inequality/growth relationship differs between the short run and long run. As such, FE models may be most accurate when they are used to capture short run changes in growth, whereas OLS models tend to reflect cross-sectional differences that persist in the long run (Forbes 2000). More specifically, the time series variation found in panel data may reflect how changes in an economy's levels of inequality affect changes in its growth rate, while cross-sectional data might more adequately capture how the initial level of inequality in an economy relates to its long run levels of growth (Partridge 2005).

Further complicating the issue, Voitchovsky suggests that inequality among individuals in the top end of a country's income distribution has positive effects, but that inequality within the bottom of the distribution has negative ones (Voitchovsky 2005). She attributes this finding to the fact that the positive and negative effects of inequality can act simultaneously on different segments of income earners, and that some effects may prevail over others depending on which segment is studied. Arguments centered on savings and investment may be more relevant when studying individuals with higher incomes, due to their larger available investment capital. In contrast, arguments which focus on level of human capital may be more relevant to areas of the income distribution at which lack of income may significantly reduce the levels of capital available. Robert Barro found in a cross-country study that inequality may have a positive growth relationship among rich nations but a negative one in poor or developing nations (Barro, Robert J. 2000). If distribution of wealth between countries is analogous to distribution of wealth *within* a country, Barro's findings may support those of Voitchovsky.

B – Importance of Different Income Earners

An area of dispute in the literature is which percentiles of the income distribution are more important for analyzing the relationship between inequality and growth. Some of the literature focuses on the middle class, claiming that the well-being of the middle class (a strong middle class represents low inequality) is responsible for economic growth (Easterly 2001). This may be especially true in the long run, as a strong middle class tends to be found alongside quality education systems and high levels of worker productivity (Partridge 2005). Two-stage least-squares (2SLS) and FE estimations by Partridge (1997, 2005) find a positive relationship between share of income held by the middle class and economic growth as measured by per-capita GDP. The use of 2SLS helps to address a problem inherent in inequality studies, which is endogeneity. Inequality may have an effect on growth, while growth may in turn have an effect on the level of equality. The results Partridge finds may demonstrate how the middle class can use their vote to enact legislation which aims to improve education and/or availability of public goods such as health or transportation, all of which are conducive to growth (Easterly 2001). The middle class has a large degree of *de facto* political power, leading it to be referred to as the "median voter" in some models.

Other studies suggest that the top end of the income distribution is more important for encouraging economic growth than the middle class. A dynamic-panel study of countries by Voitchovsky uses the Gini coefficient as well as variables representing top and bottom end inequality, in order to capture possible separate effects of inequality acting on growth. In doing this, she finds a positive relationship between strength of the upper class and economic growth (Voitchovsky 2005). The dynamic panel is important because estimation techniques using it address both reverse causality and country/state-specific time-invariant effects. This is accomplished by the use of instrumental variables similar to those of a 2SLS estimation. By doing a dynamic panel study of the United States, Mark Frank finds that increasing the share of income earned by the top 10% or 1% can bring about increases in real per capita income. He suggests that the positive relationship between inequality and growth shown through the Gini may be capturing the effect caused by the top decile, meaning that only the top income earners have a significant effect on growth. (Frank 2009.)

III - Theoretical Model

The recent literature implies that both the well-being of the middle class *and* the rich are positively related to growth, as well as overall inequality. However, these are forces which are at odds with one another, given that any increase in middle class income must mean decreasing that of other income brackets, and vice versa. As I set out in the literature review, redistribution of income to the middle class may have a positive effect on growth due to two factors: First, the possibility that diminishing returns to capital exist could limit the benefit of additional top decile growth, and secondly, the fact that median income earners have greater marginal benefit from increased income due to their inability to sufficiently invest in human capital. However, these effects contrast with the argument that aggregate savings and investment by the rich may also contribute to growth in a positive manner. Any potential redistribution of income might hinder this effect.

This paper attempts to reconcile these two opposing views in the literature by taking a ratio of top earners real income levels to the median income earners level, and placing it alongside an overall inequality measure. This will indicate how inequality between two groups may affect real per capita income growth, and provide some further insight into the role that distribution of wealth plays in growth. Ratios have been used before by Voitchovsky, who tested the hypothesis that inequality may have different effects depending on which part of the distribution is studied (Voitchovsky 2005) Her study considers ratios such as 90^{th} percentile of income earners over the 75^{th} as a way of determining how top-end inequality affects economic growth. This was done to compare specific segments of income earners to see how changes in their relative income levels affected growth. This study is similar, but focuses on inequality between the top earners compared to the median rather than comparing inequality *within* the top-end of the distribution. Furthermore, this study is a within-country estimation instead of the cross-country study done by Voitchovsky.

A different measure was used by Partridge, who tests for the strength of the middle class by using the share of income held by the middle quintile. This compares the middle class to the top end of the distribution at the same time as the bottom end (Partridge 1997, 2005). A ratio of the 90^{th} percentile of income earners' real wages to the 50^{th} percentile's will directly compare both groups with no interference from other areas of the income distribution. (Henceforth referred to as the 90/50 ratio) Additional ratios will consider the 95^{th} percentile and 99^{th} percentile relative to the median to investigate levels of income disparity between progressively richer individuals and the middle class.

The usage of these ratios is important because an inequality measure such as the Gini coefficient gives information about inequality in a society as a whole, acting as a summary statistic. It cannot show the shape of the income distribution in the same way that a ratio comparing specific percentiles of the distribution can. Although the complete data used for calculating the Gini coefficient would show the shape of income distribution via the Lorenz curve, the Lorenz curve itself cannot be included in a regression. As a result, the Gini cannot be used to reveal what the effect of inequality between two specific groups will be. For example, the disparity between any two given percentiles of the income distribution would be captured with the Gini coefficient, but it would be impossible to tell from a change in the Gini if it was the two percentiles of interest which had changed, or if it was other groups that had. For this reason it cannot show inequality between specific groups but *can* be used to show what effect inequality has overall. For this reason, the Gini will be included alongside the ratio variable, to allow for the possibility of inequality acting in specific or general means.

The economic model employed in this paper is an endogenous growth model following the work of Partridge (1997), in which real per capita income growth is a function of initial income (representing physical capital), human capital attainment, and an inequality measure. The model Partridge employed follows the assumptions of the Solow growth model, where it is assumed that states are converging to a steady-state level of income. The dependent variable of real per capita income growth is measured over decades, while all the independent variables are measured at the beginning of each decade so that the effect which their initial level has over the remainder of the period is observable. Measuring the independent variables in this manner creates a causal relationship which Partridge claims will help to reduce endogeneity concerns.

I choose to use state data to test my hypothesis for several reasons. The first reason is that there are many similarities among states in a single country, both culturally and politically, which should mitigate unobserved heterogeneity which may be present in studies focusing on cross-country panels. States exhibit comparable levels of corruption and have similar labor markets, which can help to reduce omitted variable bias (Frank 2009). A second reason is that the open nature of states and large degree of freedom related to capital and labor flows should allow for any differences in the initial endowments of a state to show clearly in following growth period. An example of this would be the tendency of skilled workers to move to states where their profession is better compensated (Partridge 2005). This is often not the case in the international economy, in which tariffs and other trade barriers may limit the flow of resources. As a result, inequality's effect on growth could be obscured by the growth-reducing potential of the aforementioned trade barriers. For this reason only the continental states will be used, as it is likely that trade and growth will be affected by higher transaction costs due to their distance from the mainland.

Even given these factors, it is still not the case that all states are identical. Although the inherent similarities between states should allow for a sufficient level of comparability (Partridge 1997), it is unlikely that each state is so similar as to allow an OLS regression coefficient to be perfectly accurate for all states and time periods. Although states are similar, the possibility of time-invariant state specific effects still exists. For example, the political systems of each state are highly similar in function, but the actual political beliefs that prevail in each state differ to a large degree. In addition, factors such as climate or geographic location differ vastly across the United States. To account for the possibility that these differences affect growth, I use FE estimations alongside OLS ones, as this issue may bias any results obtained from the OLS estimations.

Arguments for the effects of inequality revolve around savings, incentives, and human capital, often suggesting that they have simultaneous and opposing effects which act through different groups of income earners. Two of these groups are the middle class, and the top ten percent. As this study is based on the methods of Partridge, who uses FE models and finds a positive result for his Gini measures, it is expected that this study will see similar findings. However, later studies using more advanced econometric techniques provide evidence that strength of the top ten percent is correlated with growth, in contrast to what Partridge found for the middle class. For this reason it is expected that the ratio inequality measure will be positively related to growth. Furthermore, Forbes indicates that the choice of regression technique has an impact on observed results, and states that FE models tend to find positive results.

The results of this study have implications for potential benefit of redistributive policies in the political arena, such as tax or welfare policies, since allocation of funds across the income distribution will affect the ability of both the middle class and individuals higher up the income distribution to invest or acquire human capital. While other papers consider the inequality/growth relationship for middle and upper classes separately, and some use ratios to study income inequality effects among countries, this paper represents the first use of an inequality ratio to directly compare both groups in a study on the United States.

IV - Model Specification and Data

A - Model Specification

The empirical model I use is as follows,

$$Y_{i,t} = \alpha_i + \beta_1 Gini_{i,t} + \beta_2 Ratio_{i,t} - \beta_3\, InitPCPI_{i,t} + \beta_4 \boldsymbol{X}_{i,t} + \beta_5 \boldsymbol{V}_{i,t} + \varepsilon_{i,t}$$

Where $Y_{i,t}$ is real per-capita income growth, ***X*** is a vector for the human capital measures, and ***V*** is a vector for the employment variables. The Gini coefficient and income ratio are included The estimation uses a panel of the 48 continental US states, from 1970 to 2010, resulting in 192 observations.

B - Data Sources and Expected Signs

The first inequality measure I include is the Gini coefficient, which is used to control for the effects of overall inequality. Data on the Gini coefficients for US states is measured on a family basis from the US Census Bureau's *1970, 1980, 1990, and 2000 Censuses of Population*. The expectations for the Gini coefficient's sign are somewhat ambiguous, given the variety of contradictory findings in the literature, but it is expected that the effect of overall inequality will be positive, given findings by Partridge with the same model and data for the Gini coefficients (Partridge 1997).

The ratios of top income levels to the median are constructed from data obtained from the Integrated Public Use Microdata Series, (IPUMS). The data set has a vast array of possible information available for use, drawn from fifteen federal censuses, as well as the American Community Surveys taken from 2000-2010. To begin creating the ratios of income, I collected a 1% sample of population in each state (Random 1-in-100, from the US Census Bureau) at the beginning of each decade. Each observation drawn specified a unique household in the US, their state location, and their pre-tax income for that year. [2] Using statistical analysis software, I determined the average real level of income for the median, as well as the 90th, 95th, and 99th percentiles. From this the ratios are easily calculated by dividing the upper income levels by the median, for each state by decade.

A one unit increase in the ratio variables represents a one unit increase in how many times the upper income level is a multiple of the median. For example, if the value of the 90/50 ratio was two, it means that the level of income for the 90th percentile is twice that of the median, while a one unit *increase* of this ratio to a value of three means that the 90th percentile has an income level that is now three times as much as the median. The expected sign on this coefficient is positive, as the endogenous growth model predicts that higher levels of savings and investment in an economy are directly related to economic growth. If the rich tend to save and invest more, due to having more income, then this variable will also positively correlate to economic growth, as a higher ratio would reflect a greater level of income for the rich relative to the middle class.

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[2] Use of larger 5% samples resulted in approximately 40 million observations. Attempts to sort the data resulted in computer crashes due to insufficient memory. The refined 1% samples had a total of approximately 9 million observations.

The next variables I include are the human capital measures. The level of human capital is represented by the percent of the population 25 years or older that has a high school diploma or higher, and similarly, the percent of the population over 25 years of age that has obtained a bachelor's degree or higher. Data for both these variables is found in the US Census Bureau's *Decennial Census of Population*. Although these two measures are highly correlated with one another (See Table 4), they are nevertheless both included to more accurately replicate Partridge's model. It is expected that increased human capital will bring more economic growth, so the expected sign is positive for the human capital measures.

The final variables are industry employment shares, to account for the fact that different industries experience different levels of economic growth over time. Including these variables in the empirical analysis will help to account for the fact that different states have different mixes of industry. If some industries grew faster than others, this would show in the growth rates of a state with a large employment share in those sectors. For this reason, the industry employment shares are included as controls. The shares are calculated for specific industries such as finance or construction as a percent of non-farm employment, and for farm employment as a percent of total employment overall. The source for all industry variables is the Bureau of Economic Analysis.

A table of summary statistics is found in Appendix A, Table 1. A look at this table reveals no oddities in either minimum or maximum values of the data, indicating a low possibility of outliers. Additionally, the correlations shown in Table 4 indicate that the Gini and ratio variables have low correlations with one another, perhaps indicating that they capture separate effects. The highest correlation is .308, between the Gini and the 90/50 ratio, with the lowest being .057 between the Gini and the 95/50 ratio. This provides further support for the simultaneous inclusion of the Gini and one ratio variable per model estimated.

V - Results

A – OLS Results

To begin with, I estimate a variety of OLS regressions, the results of which are presented in Table 2. Equations (1) – (3) present separate models estimating each ratio variable alongside the Gini coefficient. Appendix B contains the relevant output for each of these models.

The relationship between the income ratios and per capita growth seems to be inconclusive based on the OLS results. Not only are the t-values so low as to make the estimates statistically insignificant, the coefficients on each specific inequality measure are small magnitude and have a negative sign which is the opposite of the expected finding. Had the results been significant, the observed coefficients would indicate that increasing inequality by raising income levels of the 90^{th}, 95^{th}, and 99^{th} percentile relative to the median has negative effects. These contrasting OLS results do not allow for conclusive evaluation of the hypothesis. The observed signs may be a reflection of the hypothesis that workers with middle incomes would benefit from having more income to invest in capital measures, whereas marginal benefit for the richer income earners may be much lower.

Taking the 90/50 ratio in equation (1) as an example to show how the results are interpreted, the coefficient suggests that on average across the states, increasing the income received by the top one percent by one more multiple of median income will bring about a .35 percent decrease in growth. This implies that the estimate is low in statistical significance *and* economic significance, due to the small magnitude of the coefficients, so the OLS results have very little explanatory power about the effects of specific income inequality.

In regards to the Gini coefficient as a measure of overall inequality, the results are the first to be significant. In all models estimated, the Gini coefficient has a negative parameter estimate, indicating that increasing levels of overall inequality in the US may bring about negative impacts on subsequent growth. Since the Gini coefficient was scaled on a 0-100 point range, this parameter estimate implies that increasing the Gini coefficient by one tenth would decrease growth by about 5 percent over a decade[3]. These results are in direct contrast to what was expected based on the findings of Partridge, who finds a positive result for the Gini using a very similar model.

The sign on the initial income variable however, does match Partridge's finding of a negative coefficient. Partridge states that convergence towards a steady-state growth path may play a role in the finding of this negative estimate. In analyzing his results, he speculates that the gap between richer and poorer states may be closing, hence states with larger initial levels of per capita income experiencing subsequently less growth, and states with lower per capita perhaps having greater relative gains.

The coefficients for the education measures are somewhat striking, in that while obtaining a college degree plays a positive role on growth (a one percent increase in percent of population with a bachelor's or higher brings nearly a one percent increase in growth), obtaining a high school diploma but not a bachelor's displays a negative effect. This may be due to

[3] As the Gini is defined on a 0-1 scale, a one unit increase as measured by a regression's parameter estimate would be meaningless, as it is a mathematical impossibility, hence the transformation to a 0-100 point scale.

increased presence of technology in the labor force, requiring more advanced job skills and education, or some other shift in markets increasing the demand for more skilled labor.

A tentative conclusion can be drawn from the OLS results that inequality is bad for per capita income growth in two ways. First, that overall inequality acts as a drag on growth, and secondly, that concentration of wealth on the upper end of the income distribution may have a negligible effect based on the insignificance of findings.

B – Fixed Effects Results

After the OLS estimates, regressions analogous to those done with OLS were estimated using two-way FE models. Although states are more similar in nature than countries would be to one another, it is still the case that inherent state-specific effects will be present, hence necessitating the usages of FE models to account for them. The results are presented in Table 3, with models (4)-(6).

Moving to the FE estimations from OLS has some readily apparent consequences. The most important of these is that the variables for the income ratios become highly significant, where they were once inconsequential, and change signs from negative to positive. This is likely a sign that state-specific effects were masking the true nature of the specific inequality measures' growth enhancing effects. The magnitude of their parameter estimates increases greatly as well. From equation (4), for example, we see that increasing earnings at the beginning of the decade for the top 10 percent by an additional multiple of the median income brings an approximately 10 percent increase in per capita income growth over the following ten years. The standard deviation in per-capita income growth for the data in this study is 9.79, indicating the large economic significance of this result. Estimates for the other ratios have progressively smaller coefficients, suggesting that model (4) may be the one most relevant for study.

The second most notable difference of the FE results compared to the OLS results is the increase in magnitude of the parameter estimate for the college degree variable. This may be due to the FE model controlling for state-specific business practices which would reward those with a degree more highly than high school graduates. Another possibility for this result could be shown through the estimates on employment variables, which shows positive effects for industries such as finance and government, which largely require degrees, but negative effects for less skilled labor such as construction or mining. The variables for degrees and diplomas have a high level of correlation, however (Table 4), and the high school diploma measure is insignificant in every case, suggesting that perhaps obtaining only a diploma is not a motivating factor for growth compared to a college degree.

It is also clear that the Gini measure of overall inequality has a different effect from that of the upper income ratios. As in the OLS results the sign of the estimated coefficients is still negative in the FE estimations, which is opposition to the hypothesis. In these results, increasing the Gini coefficient by 1 point on the 1-100 scale it was transformed to would bring a negative impact of 1.5 percent (Average of coefficient for all 3 FE models) on the total economic growth over the decade. The standard deviation of the Gini in this dataset is 3.28, so it could be reasonably expected that states' respective differences in overall inequality play a role in the fact that some states have faster growth than others. Correlations between the Gini inequality measure and the income ratios are low (Table 4), so an implication of these results is that general and specific measures of income inequality have different impacts on economic growth.

VI - Conclusions, Limitations, and Future Direction

An interesting result of this study is that the general inequality measure and specific inequality measures exhibit opposing effects on economic growth. If inequality in a state is high *overall*, the results seem to suggest that growth will suffer over the following years. However, if the shape of the income distribution is such that the incomes earned by the top of the income distribution are increasing, growth may also see a net positive impact. The literature suggests that inequality has multiple paths through which it can effect growth, such as human capital attainment, or investment and savings. As some authors contend that certain effects predominate in different income groups, it may be the case that for overall inequality, human capital is the most important channel of growth. In this case, the negative results for overall inequality may represent the loss of possible human capital for a large group of income earners, especially the middle class. In explaining the positive specific inequality results, it may be the case that the savings and investments made possible by increased income for the top ten percent of income earners has a positive effect on growth. The suggestion that top income earners may exhibit positive effects while negative ones are found elsewhere in the income distributions is supported by other studies as well (Voitchovsky 2005).

The true degree of causality between income inequality and growth is difficult to determine, but this study adds to the body of literature supporting at least a positive connection between specific inequality measures on growth, as well as those studies which support a negative connection between overall inequality and economic growth. It also contributes the use of the specific income ratios as new inequality measures in the United States. Using a similar data set, the results found for the ratio variables contradict the findings of Partridge, who suggested that the middle class was the most important for growth. Also, Partridge found that overall inequality as measured by the Gini coefficient had a positive effect on growth, while this study implies the opposite. This may be due to the inclusion of the income ratio variables. If the Gini coefficient measures overall inequality, then failing to include the specific measure will result in omitted variable bias, and will pick up the positive effects found by the specific measure of inequality included in this study. As a result, studies which use only one measure of inequality may have misleading findings.

A key limitation of this study is the endogeneity issue that is present when studying inequality and growth. Partridge considered this to be an issue somewhat resolved by having growth over one period as a function of initial endowments, but endogeneity is still a concern due to the fact that any results for growth over one decade will become the initial endowments of the next period. Other studies address this issue using two-stage least squares estimations on cross-sectional data, or dynamic panel data studies such as those used by Frank and Voitchovsky. Their studies do not investigate the relationship specifically between the median and upper end of the income distribution however, so possible future extension of this study would be an application of these econometric techniques to the research already done.

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Appendix A: Tables

Table 1					
Summary Statistics and Variable Definitions (N=192, PCPIGrowth is dependent variable)					
Variable	**Definition**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Degree	% Population > 25 years old with Bachelor's.	17.41	5.94	6.70	33.19
Diploma	% Population > 25 years old with HS Diploma.	69.36	12.73	37.80	87.95
InitPCPI	Initial per-capita personal income (1999 dollars, in 1000's)	21.69	5.45	11.28	40.56
PCPIGrowth	Real per-capita income growth over each decade.	16.29	9.79	-8.50	43.72
Gini	Gini inequality measure. 100 = perfect inequality	38.21	3.28	31.70	47.20
ConstEmp	Share of construction employment.	5.63	0.98	3.16	9.70
FarmEmp	Share of farm employment.	4.15	3.57	0.22	20.48
FinanceEmp	Share of finance, real estate, and insurance employment.	7.26	1.49	3.93	14.11
GovtEmp	Share of government employment.	17.28	3.83	10.48	29.85
ManuEmp	Share of manufacturing employment.	16.05	6.96	3.53	33.04
MineEmp	Share of mining employment.	1.24	1.98	0.04	14.63
TranspEmp	Share of transporation and public utilities employment.	5.15	0.88	3.08	7.92
Ratio3 (90/50)	90th percentile of income level divided by median level.	3.69	0.79	2.64	6.76
Ratio2 (95/50)	95th percentile of income level divided by median level.	4.86	0.99	3.45	8.85
Ratio1 (99/50)	99th percentile of income level divided by median level.	9.73	2.06	6.00	16.57

Table 2			
OLS Regression Results - Dependent variable is per capita income growth. (Absolute value of t-values in parentheses)			
Variable	**(1)**	**(2)**	**(3)**
Constant	69.63 (4.56)	69.99 (4.66)	71.53 (5.00)
Degree	0.91 (3.36)	0.92 (3.35)	0.92 (3.39)
Diploma	-0.35 (2.81)	-0.36 (2.73)	-0.37 (3.06)
InitPCPI	-1.33 (5.06)	-1.34 (5.07)	-1.30 (4.84)
Gini	-0.51 (2.52)	-0.50 (2.43)	-0.47 (2.16)
Ratio3 (90/50)	-0.35 (0.26)	- -	- -
Ratio2 (95/50)	- -	-0.23 (0.22)	- -
Ratio1 (99/50)	- -	- -	-0.19 (0.52)
R^2	**0.5461**	**0.5460**	**0.4681**

Table 3						
Fixed Effects Results - Dependent variable is per capita income growth.						
Model	**(4)**		**(5)**		**(6)**	
Variable	**Estimate**	**t -Value**	**Estimate**	**t-Value**	**Estimate**	**t-Value**
Intercept	79.78	1.53	71.27	1.35	94.01	1.76
Degree	2.36	4.03	2.58	4.41	2.63	4.45
Diploma	0.09	0.33	0.18	0.66	0.20	0.71
RealInitPCPI	-3.85	-6.42	-4.02	-6.66	-4.22	-6.89
Gini	-1.36	-2.04	-1.46	-2.13	-1.67	-2.31
ConstEmp	-2.39	-2.53	-2.54	-2.67	-3.26	-3.43
FarmEmp	0.53	0.83	0.55	0.85	1.02	1.57
FinanceEmp	1.39	1.71	1.57	1.90	1.53	1.82
GovtEmp	1.12	2.19	1.19	2.28	0.90	1.72
ManuEmp	0.66	1.44	0.80	1.72	0.81	1.70
MineEmp	-2.13	-2.75	-1.90	-2.45	-1.27	-1.62
TranspEmp	-0.11	-0.07	0.37	0.26	0.02	0.02
Ratio3	10.92	5.47				
Ratio2			7.77	5.11		
Ratio1					2.72	4.67
R^2	**0.8232**		**0.8191**		**0.8137**	

Table 4

Pearson Correlation Coefficients, N = 192

Prob > |r| under H0: Rho=0

	Ratio1	Ratio2	Ratio3	Gini	Degree	Diploma
Ratio1 99/50	1	0.79696 <.0001	0.71621 <.0001	0.30887 <.0001	-0.2421 0.0007	-0.44248 <.0001
Ratio2 95/50	0.79696 <.0001	1	0.98284 <.0001	-0.05652 0.4361	-0.64316 <.0001	-0.76543 <.0001
Ratio3 90/50	0.71621 <.0001	0.98284 <.0001	1	-0.18905 0.0086	-0.71762 <.0001	-0.79756 <.0001
Gini	0.30887 <.0001	-0.05652 0.4361	-0.18905 0.0086	1	0.47286 <.0001	0.33958 <.0001
Degree	-0.2421 0.0007	-0.64316 <.0001	-0.71762 <.0001	0.47286 <.0001	1	0.87048 <.0001
Diploma	-0.44248 <.0001	-0.76543 <.0001	-0.79756 <.0001	0.33958 <.0001	0.87048 <.0001	1

Appendix B: Selected SAS Code

```
CODE FOR PUMS MICRODATA VARIABLE CREATION

libname IPUMS "C:\Users\krw26";
filename ASCIIDAT "usa_00004.dat";

proc format cntlout = IPUMS.usa_00004_f;

/*Omitted statements for labeling input based on state and year */
data IPUMS.usa_00004;
infile ASCIIDAT pad missover lrecl=21;

input
  YEAR       1-4
  SERIAL     5-12
  STATEFIP   13-14
  INCTOT     15-21
;

label
  YEAR     = "Census Year"
  SERIAL   = "Household Serial Number"
  STATEFIP = "State"
  INCTOT   = "Total Personal Income"
;

format
  YEAR      YEAR_f.
  STATEFIP  STATEFIP_f.
  INCTOT    INCTOT_f.
;
run;

/* remove all unneeded observations from data set, and create a new data set
from the remaining observervations */

DATA new;
    SET IPUMS.usa_00004;
      IF    INCTOT = 9999999 THEN DELETE;
      IF STATEFIP = 99 THEN DELETE;
      IF STATEFIP = 15 THEN DELETE;
      IF STATEFIP = 02 THEN DELETE;
      IF STATEFIP = 11 THEN DELETE;
RUN;

/* manual sort was performed, new sorted set saved in Work library, named
"Sorted" */

/* Use the PROC MEANS statement to calculate the different percentiles from
the data, first by state, then by year.
      This will allow for creation of the primary interest variable, P90/P50,
P95/P50, P99/P50 */

proc means data = work.new
                        mean median p90 p95 p99;
```

```
      class statefip year;
      var inctot;
      run;
```

CODE FOR CREATING DATA SET

```
/* imported data sets for each year */
/* created new data set that is a compilation of the separate years with PROC
APPEND */

data two;
      set work.year1970;

proc append
      base=two data=year1980;
run;

proc append
      base=two data=year1990;
run;

proc append
      base=two data=year2000;
run;

/*sort newly created data set by state and then by year */

proc sort data=two;
      by state;
run;


data three;
      set work.two;

      RealInitPCPI = InitPCPI / (CPI/166.6);
      RealEndDecadePCPI = EndDecadePCPI / (ECPI/166.6);
      PCPIGrowth = (RealEndDecadePCPI - RealInitPCPI)/ RealInitPCPI;
      PCIgrowth = (Log(RealEndDecadePCPI) - Log(RealInitPCPI))*100;
      Gini = Gini * 100;
      Degree = Degree * 100;
      Diploma = Diploma * 100;
      ConstEmp = ConstEmp * 100;
      FarmEmp = FarmEmp  * 100;
      FinanceEmp = FinanceEmp  * 100;
      GovtEmp = GovtEmp  * 100;
      ManuEmp = ManuEmp  * 100;
      MineEmp = MineEmp  * 100;
      TranspEmp = TranspEmp  * 100;
      RealInitPCPI = RealInitPCPI /1000;
      label ratio3 = '90/50';
      label ratio2 = '95/50';
      label ratio1 = '99/50';
run;
```

CODE FOR FIXED EFFECTS AND OLS REGRESSIONS

```
proc means data = three;
      title 'Summary Statistics';
run;

proc corr;
      title 'Overall Correlations';
run;

proc corr;
      title 'Inequality and Education Correlations';
      var ratio1 ratio2 ratio3 gini degree diploma;
run;

/* Estimated a variety of OLS models */


proc reg data=three;
      model PCPIGrowth = degree diploma RealInitPCPI Gini ratio3 ConstEmp
      FarmEmp FinanceEmp GovtEmp ManuEmp MineEmp TranspEmp;
      title 'OLS - 90/50';
run;


proc reg data=three;
      model PCPIGrowth = degree diploma RealInitPCPI Gini ratio2 ConstEmp
      FarmEmp FinanceEmp GovtEmp ManuEmp MineEmp TranspEmp;
      title 'OLS - 95/50';
run;

proc reg data=three;
      model PCPIGrowth = degree diploma RealInitPCPI Gini ratio1 ConstEmp
      FarmEmp FinanceEmp GovtEmp ManuEmp MineEmp TranspEmp;
      title 'OLS - 99/50';
run;



/* Estimate a variety of two way Fixed Effects models to account for state
and time effects. */

proc panel data=three;
      title 'Fixed Effects - 90/50';
      id state year;
      model PCPIGrowth = degree diploma RealInitPCPI Gini ratio3 ConstEmp
      FarmEmp FinanceEmp GovtEmp ManuEmp MineEmp TranspEmp
            /FIXTWO;
run;

proc panel data=three;
      title 'Fixed Effects - 95/50';
      id state year;
      model PCPIGrowth = degree diploma RealInitPCPI Gini ratio2 ConstEmp
      FarmEmp FinanceEmp GovtEmp ManuEmp MineEmp TranspEmp
            /FIXTWO;
run;
```

```
proc panel data=three;
      title 'Fixed Effects - 99/50';
      id state year;
      model PCPIGrowth = degree diploma RealInitPCPI Gini ratio1 ConstEmp
      FarmEmp FinanceEmp GovtEmp ManuEmp MineEmp TranspEmp
            /FIXTWO;
run;
```