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Does Human Capital Play a Role in the Growing Income Inequality in the OECD Countries?

By

Jordan Cram

A Thesis Submitted to the Department of Economics
of Trinity College in Partial Fulfillment of the
Requirements for the Bachelor of Science Degree

Economics 498-99

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Abstract

Researchers have tried to determine reasons for the growing income inequality in the OECD countries, but human capital is not a reason typically addressed. This paper empirically seeks to determine a relationship between human capital and income inequality using multiple regression analysis. I hypothesize a negative relationship; meaning increases in the independent variable, average human capital in a country, will cause a decrease in the dependent variable, income inequality due to the idea that increases in education should increase the incomes of the poor more than those of the rich. Income inequality will be measured by the Gini coefficient and human capital by average educational attainment. I intend to control for additional independent variables that could affect income inequality such as GDP growth, government spending on education, economic freedom, corruption, and multifactor productivity. Through OLS and fixed effects estimation techniques, I find that a negative relationship between human capital and income inequality possibly exists. Thus, human capital can play a role in fighting against the growing income inequalities in the OECD countries.

Dedications

I would like to dedicate my senior thesis to my parents, Jacquelyn and John, and my little brother, Joshua. Mom and Dad, thank you for giving me the opportunity to receive an education at Trinity College. Without your unconditional love and support, this thesis would not have been possible. Joshua, thank you for being one of my biggest supporters and I hope to read your senior thesis one day.

Acknowledgements

I would like to thank my thesis advisor, Professor Mark Stater, for his continuous support and help along the way to the completion of this thesis. I would also like to thank Professor Nichole Szembrot for her guidance in the process of writing this thesis. To the economics department, thank you for your feedback along the way as well as all the lessons you have taught me over the past four years.

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Abbreviations

OECD - Organization of Economic Co-operation and Development

GDP - Gross Domestic Product

MFP - Multifactor Productivity

OLS - Ordinary Least Squares

FE - Fixed Effects

VAR - Vector Autoregression

GMM - Generalized Method of Moments

PMG - Pooled Mean Group

FDI - Foreign Direct Investment

GINI - Gini Coefficient

ENROLL - Gross Enrollment Ratio, Tertiary

ENROLL² or ENROLL2 - Squared Gross Enrollment Ratio, Tertiary

CORRUPT - Corruption Perceptions Index

FREEDOM - Economic Freedom

GDPGROWTH - GDP Growth Rate

GOVTEXP - Government Expenditure on Education

RESET - Regression Equation Specification Error Test

VIF - Variance Inflation Factor

GLS - Generalized Least Squares

Chapter 1: Introduction

One major ongoing economic situation hurting many countries around the world is growing income inequality. Income inequality is the unequal distribution of income in an economy. The distribution of household income widened due to different income brackets increasing more rapidly than others over time. Developed, developing, and underdeveloped countries have seen increased income inequality. One group of countries that have experienced this increase is the Organization of Economic Co-operation and Development (OECD). The OECD aims to advocate for policies that look for the economic and social improvement in each of the countries part of the organization.¹ The thirty-five countries that make up the OECD are highly developed or fairly developed nations ranging from the United States and the United Kingdom to Mexico and Chile.

Background

Since the creation of the OECD in September of 1961, the economies of many countries have progressed, like the United States whose wealth has tripled.² Though the economies appear to be progressing in terms of gross domestic product per capita growth, the income distribution continues to widen.

On average in the OECD countries, the richest 10% incomes are approximately nine times higher than those of the poorest 10%.³ However, this varies from country to country where

¹ "History." *OECD*. N.p., n.d. Web. 1 Mar. 2017.

² "History." *OECD*.

³ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings." *OECD Economics and Future Studies* 2011.14 (2011): 22. *Google Scholar*. Web. 18 Sept. 2016.

in some the difference is fourteen times more or even twenty-seven times more in countries like Mexico and Chile.⁴ This unequal distribution of income began increasing in the late 1970s in countries like the United States and Israel, but more countries followed suit in the 1980s. By the 2000s, countries that tended to have lower levels of inequality also started to see increases in the gap.⁵ Some of these countries included Germany and the Nordic nations. It should be noted that not all the countries in the OECD witnessed increased income inequality over this period. Figure 1.1, from “An Overview of the Growing Income Inequalities in OECD Countries: Main Findings,” shows that Turkey and Greece saw decreases in their income inequality. This is due to the high levels of inequality that were already present. Turkey, for example, was and still is one of the worst countries in Europe when it comes to inequality. It appears that over this period, top incomes decreased while the bottom incomes increased, which closed the gap slightly. Although the gap decreased, the gap was previously so large, that the income inequality is still an issue for Turkey. France, Hungary, and Belgium have seen little change in income inequality, which the OECD defines as being less than two percentage points.⁶ Figure 1.1 displays the change in the Gini coefficient for each country over the period of 1985 to 2008, where 1985 is represented by the gray bar and 2008 is the end of the blue arrow.⁷

OECD countries have witnessed a faster increase in the share of top incomes. Figure 1.2 demonstrates the changes in the share of top incomes from 1990 to 2007, except for Belgium, France, and Switzerland that date up to 2006; Japan, Netherlands, New Zealand, Portugal, Spain and the United Kingdom until 2005; 2004 for Finland; and 2000 for Germany and Ireland.⁸ This

⁴ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 22.

⁵ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 22.

⁶ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 24.

⁷ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 24.

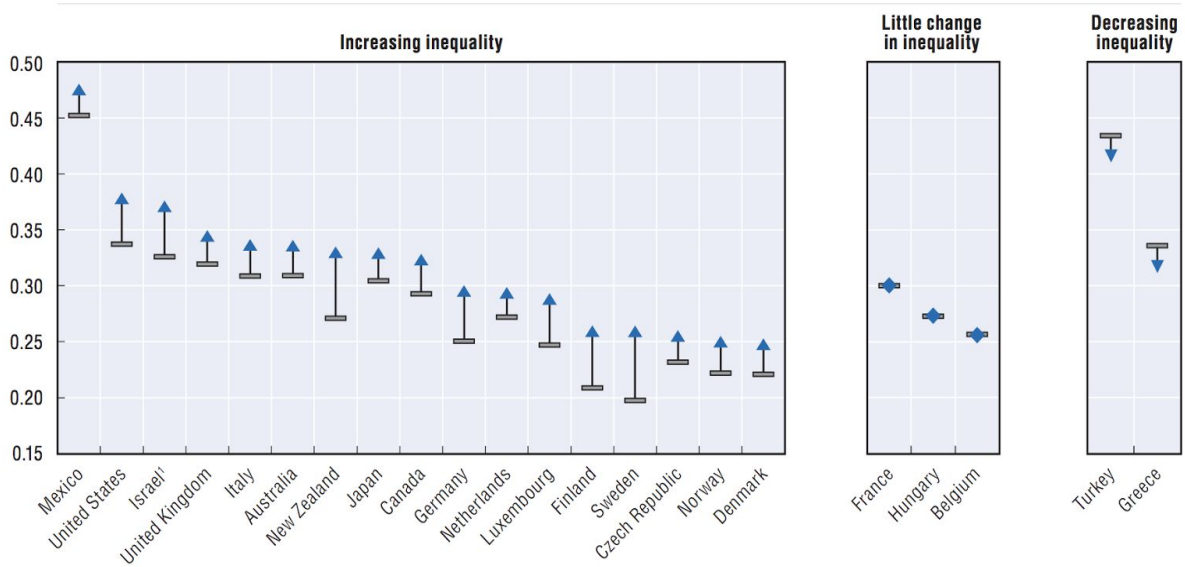
⁸ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 39.

figure also comes from an overview report on income inequality published by the OECD. The OECD defines top incomes as the countries' top 1% incomes. The y-axis is measured but the percent of total pre-tax income and the countries are ranked on the x-axis by "decreasing shares in the latest year."⁹ Not all the countries' top incomes have increased significantly, but it seems as though the English-speaking countries, United States, United Kingdom, and Canada, have seen the largest increases.¹⁰

⁹ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 39.

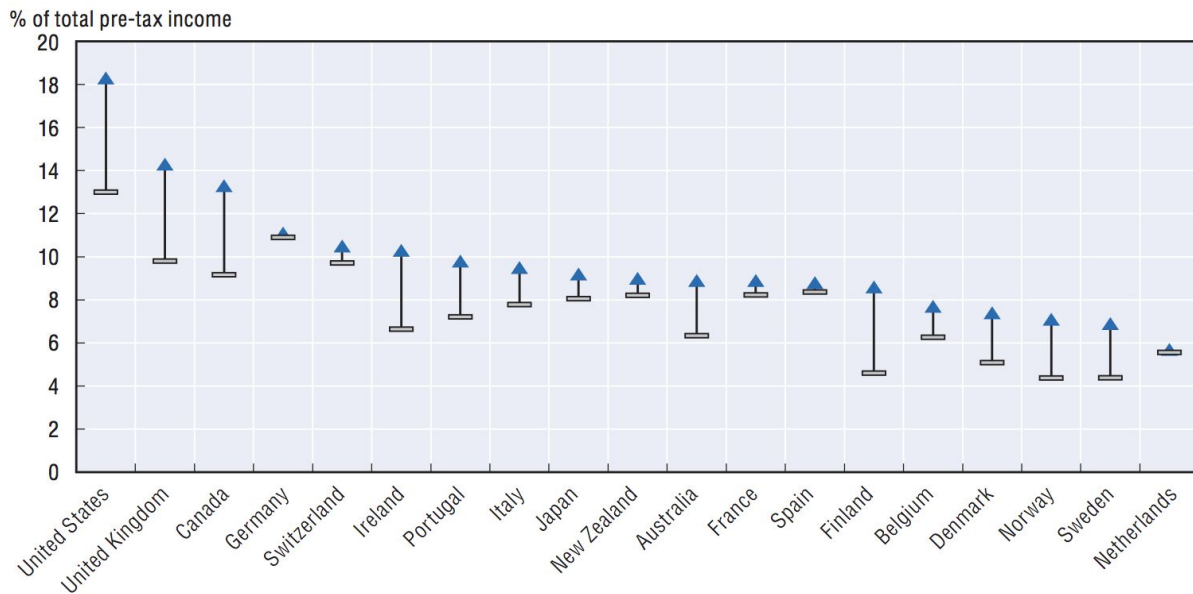
¹⁰ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 39.

Figure 1.1 Income Inequality in the OECD Countries, 1985-2008



Source: “An Overview of Growing Income Inequalities in OECD Countries: Main Findings” 22.

Figure 1.2 Top Incomes in the OECD Countries, 1990-2007



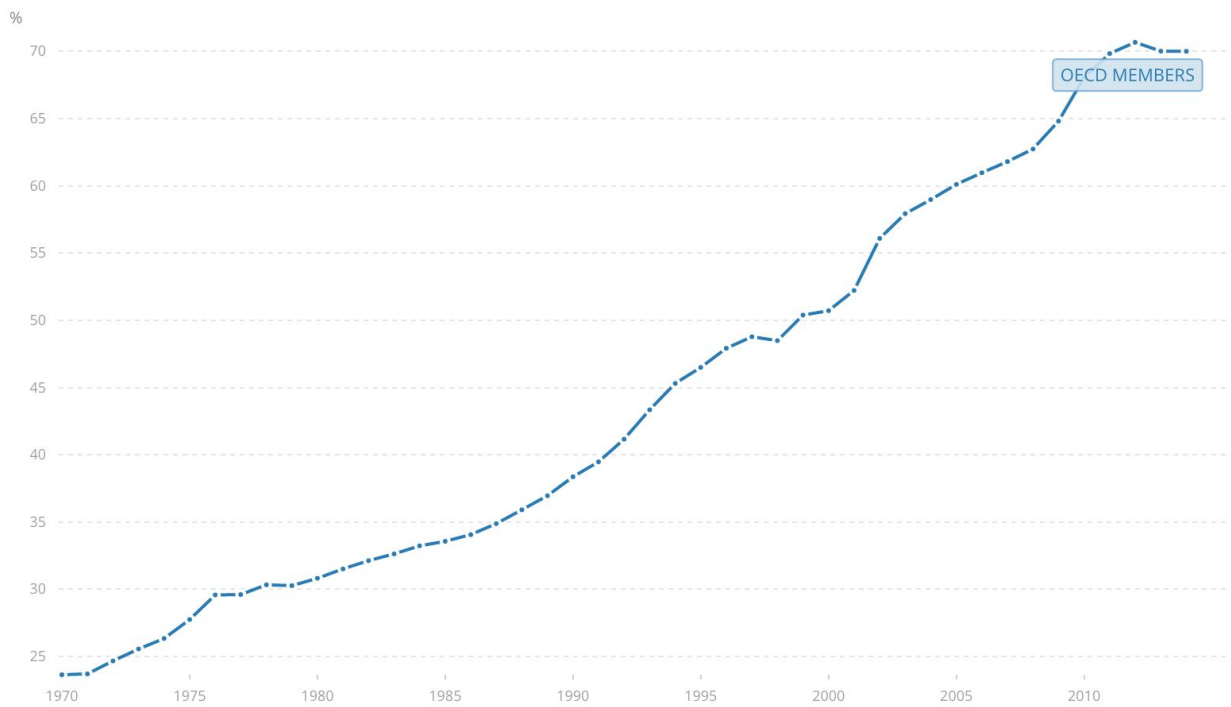
Source: “An Overview of Growing Income Inequalities in OECD Countries: Main Findings” 39.

Another economic factor that continues to increase around the world is human capital attainment. Human capital refers to the stock of knowledge one attains to increase productivity. An increase in human capital is accredited as an investment. An investment in human capital is usually in the form of education or training to contribute to the productivity of human labor. Investments made to an individual's human capital are important for earnings later in his or her career. Human capital investments lead to increases in economic growth and productivity. Though many different forms of human capital investments have increased in the past few decades, one form that continues to see increases is college level education. The OECD states that policies that include investments in human capital especially in the form of "higher educational attainment" will help in the fight against the growing earnings inequality in the long-run.¹¹ Higher educational attainment can be measured in a variety of ways. One example is by the gross enrollment ratio of tertiary schooling, which will be discussed more in chapter four. Figure 1.3 shows the increase in the gross enrollment ratio of tertiary schooling for the OECD countries from 1970 to 2014. The average enrollment ratio for OECD countries in 1970 is 24% and as of 2014 is approximately 70%.¹²

¹¹ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 41.

¹² World Bank. *World Bank*. N.p., n.d. Web. 5 Sept. 2016. Gross Enrollment Ratio, Tertiary (both sexes)

Figure 1.3: Increasing Gross Enrollment Ratio, Tertiary (both sexes), 1970-2014



Source: *World Bank DataBank*

Hypothesis

Economists and researchers have published articles giving potential reasons for the growing income inequalities. Some of these reasons include technological advancements, economic growth, and globalization. Though research discusses these possibilities, not all the research has found statistically significant effects. Lack of human capital is not a commonly addressed potential reason for the growing income inequalities, but some past research has been done and will be discussed in depth later. Although some research has been successful in determining reasons for the growing income inequalities, there is no one reason for the increase

in the dispersion within the income distribution. This study will look to determine if there is a relationship between human capital attainment and income inequality.

A negative relationship between human capital and income inequality is hypothesized, such that an increase in the average human capital in a country will lead to a decrease in income inequality. This is under the assumption that with overall increases in human capital attainment, those in the lower income bracket would both be investing in human capital and seeing an increase in income due to their investments. A potential reason for a larger increase in income for the lower income bracket would be a greater opportunity to invest in income-yielding assets that they previously could not make. Another reason is those in the lower income bracket are less skilled and an increase in human capital would affect their skills and productivity more than it would for those who are skilled workers. This increase in productivity leads to an increase in their incomes.

Purpose and Outline

The purpose of exploring this topic is that there is not much literature surrounding the possibility of human capital being a reason for the growing income inequalities. Also, the literature that does exist regarding potential factors to income inequality are often inconclusive. There is also more than one reason for the growing inequality. Therefore, the purpose is to possibly give another reason for the growing income inequalities, specifically in the OECD countries.

In the following chapter, I will discuss the human capital analysis of earnings and the theory of Kuznets curve and why I believe the curve relates to the continuing increase in income

inequality. I will then discuss literature surrounding the topic of the growing income inequalities and the potential reasons as to why the increase continues. Chapter four outlines the development of the empirical model as well as a description of the data and variables used. Chapter five examines the results and provides econometric analysis. The thesis concludes in chapter six with a discussion of the findings, limitations to the model, and potential policy changes.

Chapter 2: Conceptual Model

This chapter focuses on the human capital analysis of earnings to explain the continuing increase in human capital attainment and the theory behind Kuznets curve to explain the increasing income inequality. This chapter aims to address why the two, human capital attainment and income inequality, are connected and why increases in human capital could explain the growing income inequality.

Human Capital Analysis of Earnings

The human capital analysis of earnings demonstrates that investments made in human capital will in turn increase income and earnings in the long-run. Individuals tend to make investments in their human capital whether in the form of college education or through on-the-job training earlier in life. When an individual invests earlier in his or her career, the benefits of higher salaries are seen later in life.¹³ Due to the cost of investments, individuals receive smaller salaries at the beginning of their careers and as their skills develop, earnings increase over time. It is more valuable to invest early on and lose earnings at the start of one's

¹³ Freeman, Richard B. *Labor Economics*. Ed. Otto Eckstein. 2nd ed. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1979, pp. 96. Print.

career to eventually reap the benefits later than to not invest in capital. Those who do not invest have a “flat profile,”¹⁴ which means they will not have an upward sloping age to earnings curve. Typically, if investments are made in human capital, the age to earnings curve is upward sloping and begins to level off as age increases to a certain point.

Human capital attainment increased over the past few decades due to the knowledge of the benefits of higher earnings later. Since human capital attainment increased and continues to do so, then individuals should be witnessing an increase in income and earnings. As time goes on, those who made investments years or decades ago should be earning more than they would have without the human capital investments. Due to the human capital investment increases, incomes should also be increasing, but the gap between the rich and the poor continues to increase.

Kuznets Curve

One possibility to this increase in the gap of the income distribution is the theory behind Kuznets curve. The Kuznets curve shows that when an economy is improving, there is an increase in inequality prior to a decrease. This is due to the idea that after a point of development, the inequality will decrease naturally.¹⁵

The purpose of Kuznets’ research was to look at the causes for the changes in the personal income distribution as well as determine if increases in economic growth in a country produce increases or decreases in the income distribution.¹⁶ Kuznets (1955) argues two

¹⁴ Freeman 96.

¹⁵ Worstall, Tim. "The Kuznets Curve and Inequality." *Adam Smith Institute*. N.p., 27 Sept. 2009. Web. 1 Mar. 2017.

¹⁶ Kuznets, Simon. "Economic Growth and Income Inequality." *The American Economic Review* 45.1 (1955): 1. *Google Scholar*. Web. 1 Mar. 2017.

explanations for the possible increase in inequality when a country improves in terms of growth. One argument relates to the consumption and saving of income. Those in the upper income bracket are the ones who consume and save income, while those in the lower income bracket use all their income on consumption.¹⁷ With a high level of inequality of savings, there would also be an increase in proportion of income-yielding assets in the upper income bracket.¹⁸

Income-yielding assets, i.e. stocks and bonds, provide additional income to those in the upper income bracket.

A second argument of the causation deals with the structure of the income distribution. The question of structure arises because it is important to know what fields of work are yielding higher incomes. During the time that Kuznets study was conducted and published, developed countries were industrialized or urbanized. He explains that the incomes of those in rural areas are less than the incomes of those in urban areas and inequality within rural areas is narrower than in urban areas.¹⁹ He concludes that due to the higher population in urban areas, income inequality would be greater than in rural areas. The income differences between urban and rural areas does not necessarily evoke a decline from economic growth; the income distribution widens due to the productivity per capita in urban areas increasing at a faster rate.²⁰ Kuznets describes how increases in productivity due to urbanization will cause an increase in economic growth, but due to the lack of industrialization in rural areas, there is still inequality in the income distribution. Therefore, Kuznets (1955) suggests that inequality in the income distribution will increase even with an increase in economic growth.

¹⁷ Kuznets 7.

¹⁸ Kuznets 7.

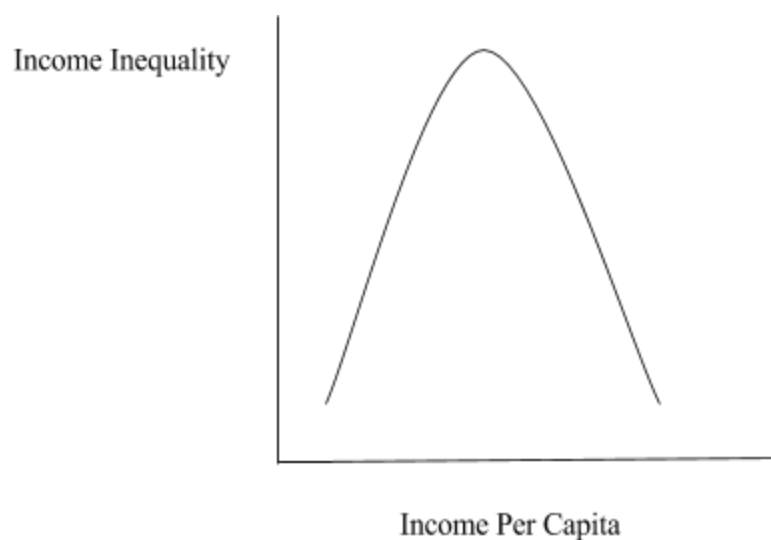
¹⁹ Kuznets 7-8.

²⁰ Kuznets 8.

To apply this to the human capital analysis of earnings, one can see that the investments made in human capital lead to an increase in income per capita over time. Income per capita increases promote economic growth, which connect to Kuznets' theory behind increases and decreases in income inequality. Kuznets (1955) found that when the economies in developed countries progressed and grew, income inequality still increased. He expressed that this inequality should decrease eventually over time possibly due to natural causes. At this point in time, income inequality continues to rise and it is unclear what the reasons are for this increase. It is also unclear if countries have yet to reach the peak of inequality prior to the decrease suggested by Kuznets.

Figure 2.1 is an example of Kuznets curve showing the potential relationship between income per capita and income inequality. Increases in income per capita, a sign of an improving economy, lead to an increase in the gap of the income distribution followed by a decrease in the gap of the income distribution. Perhaps the countries in the OECD are still moving along the upward sloping portion of the Kuznets curve and have yet to witness the decline.

Figure 2.1: Kuznets Curve



Chapter 3: Literature Review

This chapter highlights previous literature surrounding the topic of income inequality and human capital. The literature that examines the relationship between income inequality and human capital will be discussed first. Though there is not an ample amount of literature on the relationship I chose to focus on, there is literature on economic growth regarding its relationship with income inequality and human capital. This literature will be discussed followed by other potential reasons for the growing income inequality that was researched in the past.

Income Inequality and Human Capital

Jose De Gregorio and Jong-Wha Lee conducted an empirical study using panel data with a broad range of countries from 1960 to 1990.²¹ The purpose of their research is to determine the relationship between educational attainment and income inequality. In doing their research, they also consider the relationship between income level and income inequality following the theory behind Kuznets inverted curve.²²

De Gregorio and Lee discuss how other economists stated that the relationship between education inequality and income inequality is up for debate. The human capital model of income distribution finds a positive relationship between education inequality and income inequality,²³ such that a wider distribution of educational attainment in a country will cause a wider income distribution. This model argues that the relationship between income inequality and educational attainment could be positive or negative due to the rate of return on education.²⁴ Therefore, the

²¹ De Gregorio, Jose, and Jong-Wha Lee. "Education and Income Inequality: New Evidence From Cross-Country Data." *The Review of Income and Wealth* 48.3 (2002): 395. *Google Scholar*. Web. 5 Oct. 2016.

²² De Gregorio and Lee 395.

²³ De Gregorio and Lee 395-6.

²⁴ De Gregorio and Lee 396.

direction of the relationship is dependent on the rate at which individuals witness a change in income due to their human capital investment.

De Gregorio and Lee use the Gini coefficient to measure income inequality and a standard deviation of educational attainment by using categories, such as no formal education, primary education, etc., to measure education.²⁵ Their number of countries changes over the time period due to more data becoming available and they use data on a five-year interval. They break the countries up into categories of all countries, African countries, Asian countries, Latin American countries, and OECD countries. On average, all the categories saw an increase in educational attainment from 1960 to 1990 and the “all countries” category saw an increase in the Gini coefficient.²⁶

Figure 3.1 depicts a negative linear relationship between educational attainment and income inequality. The data used for the graph is from sixty-five countries in the year 1990. A trend line was added to show that countries with a higher average level of educational attainment had a smaller Gini coefficient and countries with a lower average level of educational attainment had a large Gini coefficient in 1990. This graph does not demonstrate a causal relationship between educational attainment and income inequality over time, but it does give insight to the potential relationship.

Figure 3.2 highlights the other relationship De Gregorio and Lee considered based on the human capital model of income distribution. It shows a positive relationship between education inequality and income inequality for sixty-five countries in 1990. Countries with higher levels of education inequality, meaning they have a greater dispersion of education levels across the

²⁵ De Gregorio and Lee 398.

²⁶ De Gregorio and Lee 399.

country, have a higher Gini coefficient, while countries with lower levels of education inequality have a lower Gini coefficient. This graph also does not demonstrate a relationship over time between the two variables, but provides an observation of the relationship.

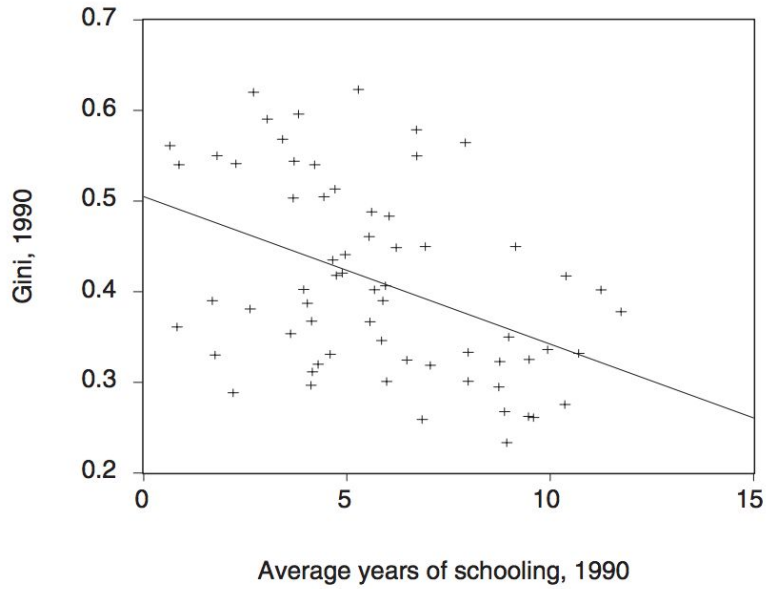
De Gregorio and Lee found a statistically significant relationship between educational attainment and income equality. Higher educational attainment and less education dispersion together cause less income inequality in a country.²⁷ They were unable to determine why there is variation in cross-country income inequality.²⁸

Like De Gregorio and Lee, my study looks to identify a negative relationship between human capital attainment and income inequality. One difference between the two studies is the time period. Their data begins in 1960 and ends in 1990, while my data starts in 1981 and ends in 2014. The way in which human capital is measured is also different as I used the gross enrollment ratio of tertiary schooling and they categorized education levels and used standard deviations. I solely looked at the OECD countries and they chose to look at various African, Asian, and Latin countries in addition to the OECD countries. I also include control variables that they did not use. Though the studies have their differences, their study helps confirm the negative relationship as well as gives insight to the idea that human capital helps in the fight against inequality.

²⁷ De Gregorio and Lee 395.

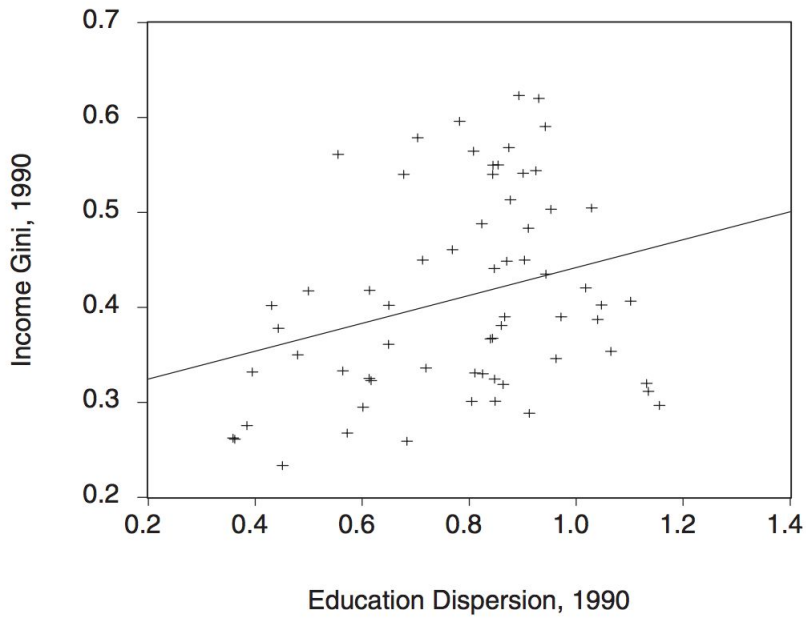
²⁸ De Gregorio and Lee 395.

Figure 3.1: De Gregorio and Lee - Educational Attainment and Income Distribution, 1990



Source: De Gregorio and Lee "Education and Income Inequality: New Evidence From Cross-Country Data" 401.

Figure 3.2: De Gregorio and Lee - Education Dispersion and Income Distribution, 1990

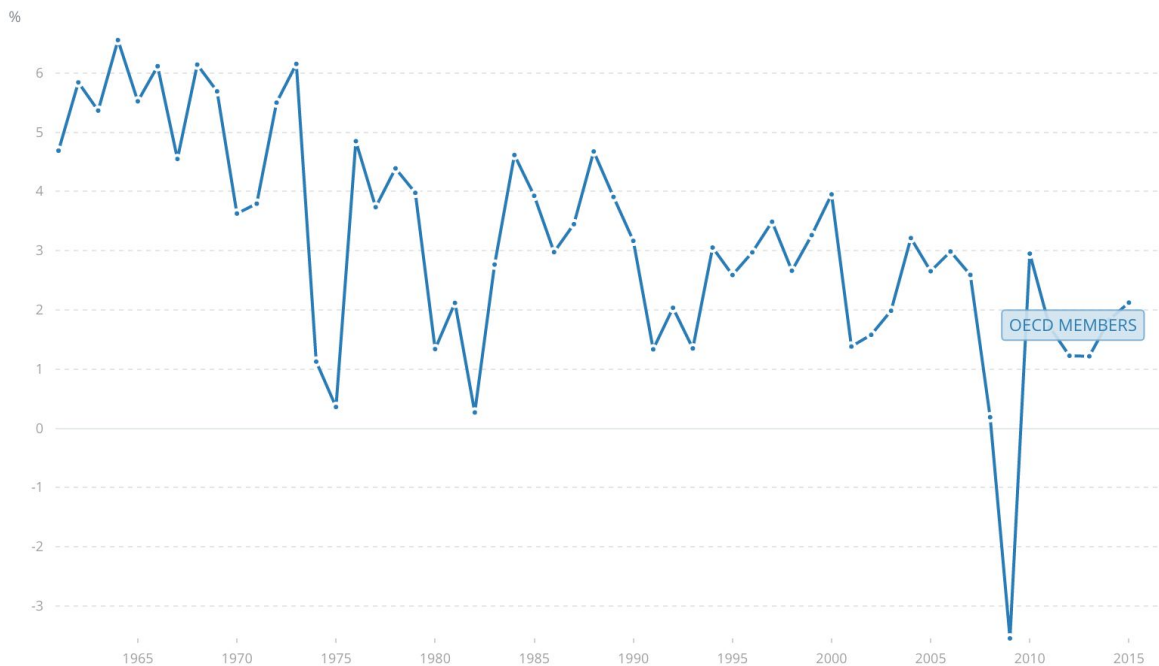


Source: De Gregorio and Lee "Education and Income Inequality: New Evidence From Cross-Country Data" 401.

Economic Growth

One of the most common factors for the growing income inequalities explored by economists is economic growth. Economic growth has fluctuated since the 1960s among OECD countries. During recessions, economic growth tends to decrease significantly. Figure 3.3 shows the fluctuation of GDP growth for the OECD countries from 1961 to 2015. In 1961, the average GDP growth rate for the OECD countries was 4.7% and in 2015, the average was only 2.1%.²⁹ Some of the OECD countries, like the United States and Turkey, have a higher percentage of GDP growth in 2015 than in 1961, but the majority have a lower percentage than in 1961. Though GDP growth varied over time, it overall decreased in the OECD countries. Economists look to make a connection between the decreasing growth and increasing income inequality.

Figure 3.3: Fluctuating OECD GDP Growth (annual %), 1961-2015



Source: *World Bank DataBank*

²⁹ World Bank. *World Bank*. N.p., n.d. Web. 5 Sept. 2016. GDP Growth (annual %)

Bahar Bayraktar-Saglam examines the relationship between human capital and economic growth. He explains that human capital is a driving force for economic growth due to the neoclassical growth model, which inputs human capital into the production model that produces economic growth.³⁰ However, Bayraktar-Saglam (2016) believed that past literature encountered problems with endogeneity due to reverse causality. Due to the production function, one can see an increase in economic growth due to human capital investments, but it is also possible that with increases in economic growth, there is an expansion of human capital opportunities. He explains that new resources come with growth, which allow education to expand. Increases in education lead to a rise in incomes, which increase the demand for more human capital.³¹ It is unclear as to if human capital causes economic growth or if economic growth causes increases in human capital. He addresses this problem in his paper as well as the problem of heterogeneity in past literature.

Bayraktar-Saglam states that past literature proved that there was a positive relationship between human capital and economic growth in low-income countries, but not in the OECD countries.³² He argues that OECD countries may not see an increase in economic growth due to diminishing marginal returns,³³ meaning that these countries have already hit the peak of returns from human capital investments and now the returns have leveled off. Bayraktar-Saglam (2016) looked to correct the problems of heterogeneity and endogeneity while finding a relationship between economic growth and human capital.

³⁰ Bayraktar-Saglam, Bahar. "The Stages of Economic Growth: Does the Direction of Causality Matter for the Rich and the Poor?" *Social Indicators Research* 127.1 (2016): 245. *Google Scholar*. Web. 2 Oct. 2016.

³¹ Bayraktar-Saglam 245.

³² Bayraktar-Saglam 245.

³³ Bayraktar-Saglam 245.

Bayraktar-Saglam collected data from 90 countries, including 25 high-income OECD countries, from 1970-2015. He used the percentage of the population to complete primary, secondary, and tertiary schooling and the average years of each schooling to measure human capital.³⁴ Economic growth was measured by GDP growth rate per capita and the share of investment as a percent of GDP.³⁵ He used a panel vector VAR framework under GMM estimates.³⁶

Bayraktar-Saglam found different relationships between human capital and economic growth depending on the income bracket of the country. High-income OECD countries had a positive significant relationship in all stages of human capital formation.³⁷ Tertiary education especially predicted economic growth in these countries. However, economic growth also predicted human capital accumulation.³⁸ The results for higher levels of education in the low income and even low middle income countries were insignificant due to the delayed development with technology.³⁹ These developing countries can still predict economic growth with increases in education, but economic growth cannot predict human capital accumulation.⁴⁰ He finds that skilled labor is integral for increases in productivity and development of growth in a country.⁴¹ He explains that high income and developed countries, like the countries in the OECD, should focus on policies that promote tertiary level of schooling, which will be discussed in the conclusion.

³⁴ Bayraktar-Saglam 247.

³⁵ Bayraktar-Saglam 247.

³⁶ Bayraktar-Saglam 246.

³⁷ Bayraktar-Saglam 275.

³⁸ Bayraktar-Saglam 243.

³⁹ Bayraktar-Saglam 275.

⁴⁰ Bayraktar-Saglam 243.

⁴¹ Bayraktar-Saglam 275.

Bassanini and Scarpetta (2002) looked to determine if human capital in the form of educational attainment affects economic growth in the OECD countries.⁴² Unlike Bayraktar-Saglam, they did not look to see if economic growth affected educational attainment. They argue that previously done studies that claimed human capital is not statistically related to output growth were incorrect due a bad quality of data and wrong econometric approach.⁴³ They measured human capital attainment by collecting data on the average years of schooling for the OECD countries over twenty-seven years. They used Pooled Mean Group (PMG) estimators to allow for variance across countries in short-term adjustments and convergence speeds, but for long-run coefficients imposed homogeneity restrictions.⁴⁴

Bassanini and Scarpetta (2002) found that the output per working-age population to average years of education in a country is significantly different from zero.⁴⁵ Therefore, they found a statistically significant positive relationship between human capital and economic growth. They also compared their estimated long-run elasticity of output to human capital with the microeconomic knowledge of returns to schooling and found that it is constant.⁴⁶

Bayraktar-Saglam (2016) and Bassanini and Scarpetta (2002) found positive relationship between human capital and economic growth.

⁴² Bassanini, Andrea, and Stefano Scarpetta. "Does Human Capital Matter for Growth in the OECD Countries? A Pooled Mean-Group Approach." *Economics Letters* 74.3 (2002): 399. *Google Scholar*. Web. 18 Sept. 2016.

⁴³ Bassanini and Scarpetta 399.

⁴⁴ Bassanini and Scarpetta 400.

⁴⁵ Bassanini and Scarpetta 403.

⁴⁶ Bassanini and Scarpetta 403.

Potential Factors

As mentioned, past literature addresses many factors and explanations for the growing income inequalities in the OECD countries. In this section, past researched potential factors, besides economic growth, will be addressed, including globalization and technological change. This section will also address the pattern of growing in income inequality through the research of A. B. Atkinson.

Atkinson (2003) researched the growing income inequalities over time to determine the shape of growth. He explains that past literature argues two different shapes of the growing inequalities. One potential shape is the “U-turn,” in which countries’ income inequalities started to rise after it fell post World War II.⁴⁷ The other potential shape is a glacial increase over time. He examines nine of the OECD countries from 1945 to 2001 to identify the shape of the growth in income inequality while also analyzing possible reasons for the increase.⁴⁸ Atkinson discusses that past literature focuses on the bottom of the income distribution and that it is the unskilled workers in this section that are causing greater levels of income inequality.⁴⁹ However, he believes that the problem of growing inequality is those within the top income section of the distribution becoming richer.⁵⁰

The nine countries examined were the United States, the United Kingdom, Canada, the Netherlands, West Germany, Finland, Sweden, Norway, and Italy. Atkinson looked to see the changes in income inequality and whether those changes followed a U-turn or glacial path. He found that the countries followed different pathways. For example, the United Kingdom, the

⁴⁷ Atkinson, A.B. “Income Inequality in OECD Countries: Data and Explanations.” *CESifo Economic Studies* 49.4 (2003): 479. *Google Scholar*. Web. 3 Oct. 2016.

⁴⁸ Atkinson 479.

⁴⁹ Atkinson 481.

⁵⁰ Atkinson 481.

Netherlands, and Finland exhibited a U-turn path, while Italy demonstrated a W shaped pathway.

⁵¹ Some countries he was unable to identify a shape, such as West Germany and Norway. The only country that possibly increased glacially was Canada.⁵²

Though Atkinson discovered different shapes of increasing income inequality in the nine OECD countries, he concluded that income inequality is indeed on the rise. He then began to explore potential reasons and highlighted the fact that the Gini coefficient is simply a summary of the income distribution in a country and it does not give insight to what is happening in the top income groups.⁵³ Atkinson looked at income tax data and capital income to explore the increase in top incomes. He looked at the share of income at the top 1 percent and top 10 percent due to the variation of incomes within the share of the top 10 percent.⁵⁴ Though it is commonly understood that there is great variation in the income distribution, there is also great variation within the share of the top 10 percent. When looking at the top income groups, there is a clearer U shape increase in inequality. After the decline in inequality post World War II, many of the countries in the study saw a rapid increase in inequality within the top income groups.⁵⁵ Countries, such as France and the Netherlands, did not see a sharp increase and countries like, the United Kingdom and Canada, witnessed the increase later than the rest of the countries.⁵⁶

Atkinson explored potential reasons to this decrease in inequality among the top income groups followed by a sharp increase. Globalization increased during this period and it was frequent for executives to travel between countries to develop business relations. He explained

⁵¹ Atkinson 493.

⁵² Atkinson 493.

⁵³ Atkinson 500.

⁵⁴ Atkinson 502.

⁵⁵ Atkinson 502.

⁵⁶ Atkinson 502.

that globalization possibly increased competition among firms.⁵⁷ The importance for executives to travel from country to country to negotiate and to develop relations increased and there was an increase in the need for executives. With more executives, the top income groups would see an increase in incomes. Atkinson also explained that with the combination of globalization and changes in technology, unskilled workers lost job opportunities due to their inability to perform.

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Atkinson concluded by looking to the future and stated that it was possible that income inequality would not continue to increase due to some countries not appearing to be continuous into the 1990s.⁵⁹ However, income inequality in the OECD countries continued to increase throughout the 1990s, into the 21st century, and continues to increase.

As previously discussed, the OECD released a report on the main findings of the growing income inequalities in the OECD countries. The report discusses that empirical evidence on the reasons for the growth in the inequality gap are often inconclusive because of differing definitions and concepts used. Chapter one demonstrated the OECD's findings on the growing income inequalities as well as the growing top incomes. This chapter will focus on the potential reasons the OECD believes could be driving the growing income inequalities.

The OECD states that globalization is a commonly addressed reason and gives a political view and a conceptual view as to why this is. Politically, it is believed that increased levels of productivity are due to the skilled and highly educated laborers, which causes a decrease in the demand for unskilled and uneducated laborers.⁶⁰ Conceptually, according to the international

⁵⁷ Atkinson 503.

⁵⁸ Atkinson 505.

⁵⁹ Atkinson 505.

⁶⁰ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 24.

trade theory, with increases in trade integration, richer countries tend to see increases in the wages of the skilled workers.⁶¹

Structural changes swept through the majority of the OECD countries⁶² due to the OECD's mission to integrate the world economies and promote trade and progress. These structural changes were due to technological progress and the integration of trade and financial markets.⁶³ The structural changes favored the skilled and educated workers, which resulted in a larger gap in the wages and incomes of the skilled and unskilled laborers. Figure 3.4 shows the increase in trade and financial market integration as well as technological progress. This increase began in 1980 and continues to increase. Two factors of globalization are trade integration and foreign direct investment (FDI). In the OECD countries, trade integration doubled while FDI increased, on average, from 5% of GDP to 50% of GDP.⁶⁴ Figure 3.4 shows the increase in trade integration and financial openness. The OECD defines trade integration as "the sum of imports and exports as a percentage of GDP" and financial openness as "the sum of cross-border liabilities and assets as a percentage of GDP."⁶⁵ The OECD's report did not find trade integration or financial openness to be significant in the changes in the income distribution, but an increase in financial flows through FDI and technology were significant to the growing income inequalities in the OECD countries.⁶⁶ FDI mostly affected the upper part of the income distribution, while technology affected the overall income distribution.⁶⁷

⁶¹ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 24.

⁶² "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 28.

⁶³ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 28.

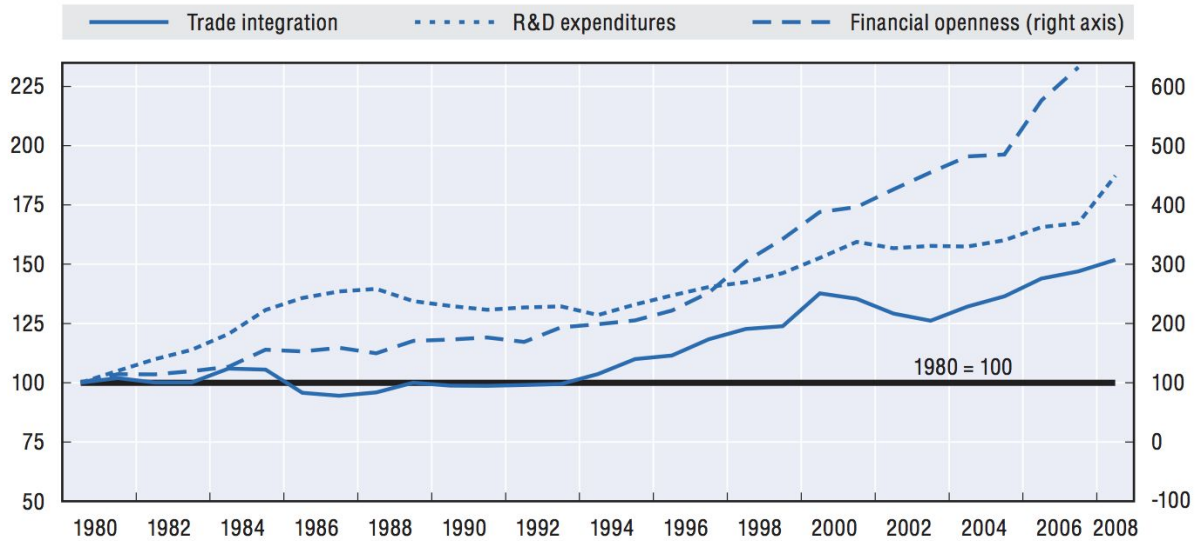
⁶⁴ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 28.

⁶⁵ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 29.

⁶⁶ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 29.

⁶⁷ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 29.

Figure 3.4: Integration of Trade and Financial Markets and Technological Progress, 1980-2008



Source: “An Overview of Growing Income Inequalities in OECD Countries” 29.

This chapter outlined the factors past literature researched to determine the causes for the growing income inequalities. Economic growth, globalization, and technology affect income inequality, but those are not the only driving forces behind this economic concern. In chapter four, I begin to outline the model to find a link between human capital and income inequality.

Chapter 4: Model Specification

This chapter gives a full description of the variables in my regressions and the sources and compilation procedures of my data. I also provide hypotheses of the expected signs of the coefficients. After the data and variable description, I outline the empirical model and discuss the estimation techniques. Chapter five will then discuss the results of the model.

Data and Variable Description

Since this research looked across countries and over time, a panel data set was used. All the data collected was for the thirty-five OECD countries. The period began for some countries in 1981 and went until 2014. The dependent variable was income inequality and the main independent variable was human capital attainment. Income inequality was measured by the Gini Coefficient. The Gini Coefficient measures the gap between the rich and the poor. It is calculated by taking the area between the perfect equality line and the Lorenz curve and dividing it by the total area under the perfect equality line for each country. A coefficient of zero means everyone in the country has the same income and a coefficient of 1 (or 100 if in percentage terms) means all the income in that country goes to one person.⁶⁸ The Gini Coefficient data was collected from the World Bank DataBank.

Human capital attainment can be measured in a variety of ways since an investment in human capital is through education and/or training. Since there is no one way to measure human capital attainment, the gross enrollment ratio for tertiary schooling was used. The gross enrollment ratio is a percentage of those enrolled in tertiary level schooling. This data was also taken from the World Bank DataBank. The selection of tertiary schooling is because more people are pursuing a college level education and college education seems to be a better indicator of an investment made to increase one's earnings than secondary or primary schooling. For some regressions, an enrollment squared variable was added into the estimation.

Five additional independent variables were added to act as control variables due to the likelihood they may play as factors to the growing income inequalities. One of the control

⁶⁸ "An Overview of Growing Income Inequalities in OECD Countries: Main Findings" 22.

variables is the growth rate of the gross domestic product (GDP) in a country. The growth rate is a percentage that measures how much GDP grows from year to year. It is expected that as GDP growth increases, income inequality would decrease. GDP growth rate was chosen due to it being a frequently mentioned factor of income inequality. The data used for the GDP growth rates is from the World Bank DataBank.

Corruption has the potential of being an indicator of income inequality meaning that increased levels of corruption would lead to increases in income inequality in the country. The measurement of corruption used in this study is known as the Corruption Perceptions Index and is a scale system originally on a scale of zero to ten and has become a scale of zero to one hundred. For the purpose of this study, data from the new scaling system was converted to the zero to ten scale. The variable represents corruption in the public sector and the data comes from Transparency International. A score of zero represents high levels of corruption while ten or one hundred represents levels of low corruption. Countries who score low have internal issues with the police and/or judiciary, while high score countries have independent judiciary systems and access to public expenditure.⁶⁹ It is predicted that when the corruption index increases, the Gini coefficient will decrease.

When considering the variable of corruption in the public sector, one may consider looking at a variable to measure economic freedom. The Fraser Institute developed a one to ten scale system to put a value on the level of economic freedom in a country. Economic freedom looks at “(1) personal choice, (2) voluntary exchange coordinated by markets, (3) freedom to enter and compete in markets, and (4) protection of persons and their property from aggression

⁶⁹ "Corruption Perceptions Index 2016." *Transparency International*. Transparency International, n.d. Web. 01 Mar. 2017.

by others”.⁷⁰ Countries with a higher ranking, like Finland and Sweden, work to protect their citizens and their citizens’ property while also providing a fair legal system.⁷¹ These countries also avoid trade barriers and allow for the markets to allocate goods as opposed to the government.⁷² The Fraser Institute has an overall value for each country as well as a breakdown of economic freedom in each sector of the economy. The data is released every five years and in recent years is released every year. For the purpose of this study, data values were interpolated to create a more complete dataset. It is expected that as the value of economic freedom increases, income inequality would decrease due to the availability of economic opportunities.

Government spending on education is another control variable used in this research. The government spending on education is a percentage of the gross domestic product (GDP). It is expected that as the government spending on education increases, income inequality would decrease due to the availability of human capital investments. The data comes from the World Bank DataBank.

To measure productivity, the variable multifactor productivity was added to the regression. Multifactor productivity (MFP) is an efficiency measurement of how labor and capital inputs work together in the production of goods and services in the economy.⁷³ Unfortunately, data was only available for about half of the countries in the sample. The data is over the period of 1985 to 2011. In the desire to see the effect of this variable, separate regressions were run with only the countries that had data available and all other countries were

⁷⁰ “Economic Freedom Basics.” *Fraser Institute*. N.p., 16 Jan. 2017. Web. 20 Nov. 2016.

⁷¹ “Economic Freedom Basics.”

⁷² “Economic Freedom Basics.”

⁷³ “Productivity - Multifactor Productivity.” *OECD*. OECD, 2016. Web. 01 Mar. 2017.

dropped from this regression. It is expected that as the multifactor productivity increases, the gap in the income distribution would decrease. The data is collected from the OECD Data site.

For fixed effects estimation, an additional variable was created to numerically denote the countries. The numbers were given in alphabetical order (Australia = 1, Austria = 2, etc.). This variable was called COUNTRYNO and was only used to set the fixed effects estimation.

It should be noted that data was interpolated for some variables, including the Gini coefficient, economic freedom, and GDP growth rates, to create a more balanced panel data set.

Empirical Model and Methodology

To test the relationship between human capital and income inequality, I used multiple regression analysis. Specifically, I used Ordinary Least Squares (OLS) and Fixed Effects (FE) regressions. OLS is an estimation technique used to find the regression line that best fits the data points. The line of best fit is found through the minimization of the sum of squared residuals. In multivariate regressions, the coefficients on the X's are chosen to minimize the sum of squared residuals. Fixed effects will be discussed later. To begin, I started with a simple multivariate linear regression model, where the GINI coefficient was the dependent variable, ENROLL was the independent variable, and the control variables were FREEDOM, CORRUPT, GDPGROWTH, and GOVTEXP. Equation 4.1 depicts the regression equation used to estimate the coefficients on the X's.

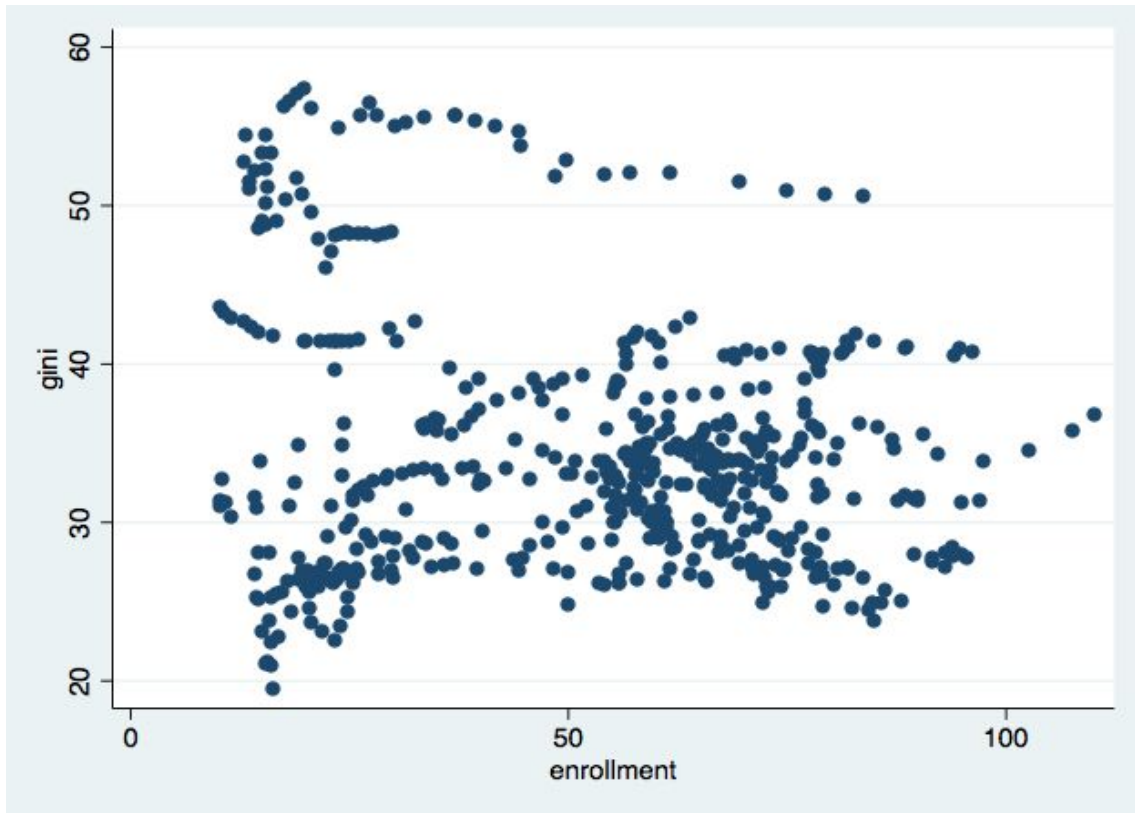
$$\text{GINI}_{it} = \beta_{0t} + \beta_{\text{ENROLL}} \text{ENROLL}_{it} + \beta_{\text{FREEDOM}} \text{FREEDOM}_{it} + \beta_{\text{CORRUPT}} \text{CORRUPT}_{it} + \beta_{\text{GDPGROWTH}} \text{GDPGROWTH}_{it} + \beta_{\text{GOVTEXP}} \text{GOVTEXP}_{it} + \epsilon_{it} \quad (4.1)$$

The results of the OLS regression using this equation will be discussed in chapter five. The results can be found in Table 5.1. After estimating this regression, other specifications were estimated, such as lin-log, log-lin, and double log. The results for these regressions were less significant or not too different from the linear model.

Due to the concept of Kuznets curve, a regression was setup to include a squared ENROLL variable, ENROLL². As discussed in chapter two, Kuznets curve suggests that when an economy is improving, inequality will increase prior to the decrease. Figure 2.1 showed income per capita on the x-axis and income inequality on the y-axis. With increases in the gross enrollment of tertiary schooling, it is predicted that income per capita will increase. Figure 4.1 is the scatterplot of the gross enrollment ratio and the Gini coefficient. It is hard to tell the exact shape of the scatterplot. Due to the theory of Kuznets curve, it appears a variable for enrollment squared should be included in the equation. Though the shape of the scatterplot is not necessarily an inverted U shape, enrollment squared was added to the regression. Equation 4.2 depicts a quadratic equation that was ran through OLS. The results to Equation 4.2 are shown in Table 5.2 in chapter five.

$$\text{GINI}_{it} = \beta_{0t} + \beta_{\text{ENROLL}} \text{ENROLL}_{it} + \beta_{\text{ENROLL}^2} \text{ENROLL}_{it}^2 + \beta_{\text{FREEDOM}} \text{FREEDOM}_{it} + \beta_{\text{CORRUPT}} \text{CORRUPT}_{it} + \beta_{\text{GDPGROWTH}} \text{GDPGROWTH}_{it} + \beta_{\text{GOVTEXP}} \text{GOVTEXP}_{it} + \epsilon_{it} \quad (4.2)$$

Figure 4.1: Enrollment and Gini



Note: Scatterplot created through Stata.

Since this study is dealing with panel data, across country and over time, it is possible that OLS regressions are not accounting for unobserved effects. To account for unobserved effects in the panel data model, fixed effects estimation was used. Any unobserved effects in this panel would be country specific and vary over time. The possible unobserved effects could relate to the political systems (i.e. a change in political parties or a change in the type of government) or cultural entities (i.e. a change in the racial or ethnic makeup of a country). Since this study looks at many countries over time, it is helpful to remove these effects to fix possible endogeneity. Another way to account for unobserved effects is first differencing, but under

certain assumptions fixed effect estimation works better.⁷⁴ Fixed effects estimation works to eliminate the unobserved effect, a_i , prior to estimation as well as any time constant explanatory variable.⁷⁵ Jeffrey Wooldridge (2012) outlines how the regression equation changes under fixed effects. He explains that the average of the regression equation over time for each cross-sectional unit is subtracted from the original regression equation to drop the unobserved effects, a_i . Equation 4.4 is the average of the original regression (Equation 4.3). Equation 4.5 depicts the time-demeaned data.⁷⁶ The variables in Equation 4.5 depicted with ^ denote that the variable is the difference of the original variable and the mean of that variable.

$$y_{it} = \beta_1 x_{it} + a_{it} + u_{it}, \quad t = 1, 2, \dots, T \quad (4.3)$$

$$\bar{y}_i = \beta_1 \bar{x}_i + a_i + u_i \quad (4.4)$$

$$\hat{y}_i = \beta_1 \hat{x}_{it} + \hat{u}_{it} \quad (4.5)$$

Two fixed effects regressions were estimated to account for possible unobserved effects. The first fixed effects regression (Equation 4.6) was estimated using the same X variables from Equation 4.1. The second fixed effects regression (Equation 4.7) was run using those same X variables, but also the ENROLLMENT² variable. The results to these regressions are highlighted in Tables 5.3 and 5.4.

$$\widehat{GINI}_i = \beta_1 \widehat{ENROLL}_{it} + \beta_2 \widehat{FREEDOM}_{it} + \beta_3 \widehat{CORRUPT}_{it} + \beta_4 \widehat{GDPGROWTH}_{it} + \beta_5 \widehat{GOVTEXP}_{it} + \hat{u}_{it} \quad (4.6)$$

⁷⁴ Wooldridge, Jeffrey M. *Introductory Econometrics A Modern Approach*. 5th ed. United States: South-Western Cengage Learning, 2012, pp.484. Print.

⁷⁵ Wooldridge 484.

⁷⁶ Wooldridge 485.

$$\widehat{GINI}_i = \beta_1 \widehat{ENROLL}_{it} + \beta_2 \widehat{ENROLL}_{it}^2 + \beta_3 \widehat{FREEDOM}_{it} + \beta_4 \widehat{CORRUPT}_{it} + \beta_5 \widehat{GDPGROWTH}_{it} + \beta_6 \widehat{GOVTEXP}_{it} + \widehat{u}_{it}$$

(4.7)

Another variable was later added into the study. The multifactor productivity variable was added to assess the productivity in the countries. As mentioned, MFP was unavailable for many of the OECD countries and the sample period was smaller as a result. However, regressions were run with MFP as a control variable due to the likelihood that increase productivity levels in a country could affect income inequality. MFP was added to the original linear OLS regression (Equation 4.8) and the results are presented in Table 5.5.

$$GINI_{it} = \beta_{0t} + \beta_{ENROLL} ENROLL_{it} + \beta_{FREEDOM} FREEDOM_{it} + \beta_{CORRUPT} CORRUPT_{it} + \beta_{GDPGROWTH} GDPGROWTH_{it} + \beta_{GOVTEXP} GOVTEXP_{it} + \beta_{MFP} MFP_{it} + \epsilon_{it}$$

(4.8)

Due to an increase in the fit, which will be discussed further later, an additional OLS regression was run without the MFP variable. Only the countries that had the MFP variable were included in this regression to determine if the fit increased due to the addition of the MFP variable or due to a smaller number of countries and smaller period. Those results are presented in Table 5.6. Lastly, Table 5.7 documents the results of a fixed effects estimation including MFP. Stata was used for all the estimations presented in this study.

Chapter 5: Econometric Analysis

Ordinary Least Squares

Equation 4.1 from the previous chapter depicts the first linear regression. The results obtained were used as preliminary results to gage the next steps of the multiple regression analysis. Table 5.1 shows the results including the coefficients on the independent variables,

standard errors, t-statistics, p-values, R-squared, and F-statistic. In this regression, the gross enrollment ratio of tertiary schooling, the human capital variable, was significant at the 1% level and the coefficient was negative. This means that when there are increases in the enrollment ratio, there is a decrease in the Gini coefficient. This falls in line with the original hypothesis that increases in the human capital attainment in a country should decrease the income inequality, meaning the income distribution becomes more equal. Economic freedom and government expenditure on education were also significant at the 1% level. The sign on government expenditure was negative as expected since increases in spending on education would cause a greater availability of schooling, therefore decreasing income inequality. The coefficient on economic freedom was positive, which was not the expected sign. It was expected that with more economic freedom, income inequality would decrease due to the lower income bracket having more economic opportunities, but with reconsideration an increase in income inequality seems plausible. Communist countries, which are not part of this data set, believe in the absence of class and want equality amongst the working population. Therefore, it is more likely for communist countries with less economic freedom to have a lower level of income inequality. Countries with high levels of economic freedom will have a wider income distribution due to the ability to enter markets and earn profit through private capital ownership, which contributes primarily to the top of the income distribution leading to an increase in inequality.

A linear relationship was not expected for the relationship between human capital and income inequality and past literature shows nonlinear relationships between the two variables. Though the relationship is nonlinear, tests were still conducted to test for misspecification, multicollinearity, and heteroskedasticity. Ramsey's Regression Equation Specification Error Test

(RESET) was used to test for misspecification. The results concluded that there was joint significance in the model. Therefore, there is evidence of misspecification in the model. The limitation of this test is it does not provide any indication of where the error is. But it does suggest the functional form is incorrect. Alternative models were tested, such as log-lin, lin-log, and double log, and similar results were produced. An additional variable was added later and will be discussed in the MFP section of this chapter.

When testing for multicollinearity, the variance inflation factor (VIF) was computed for each variable. It measures the amount by which the variance of the coefficient is inflated by the correlation between X_j and the other X 's. The VIFs ranged from 1.00 to 1.86, which are not large enough to indicate multicollinearity in the model. For heteroskedasticity, the residuals were predicted and plotted against enrollment. The graph suggested heteroskedasticity due to a wide dispersion of values across X_j . Both the Breusch-Pagan Test and the White Test concluded that there was indeed heteroskedasticity at the 1% level. Robust standard errors were estimated to make the standard errors valid in the presence of heteroskedasticity. Through the Lagrange Multiplier Test, serial correlation was also found in this estimation. To fix the serial correlation, the feasible generalized least squares (GLS) estimator was used.

Table 5.1: OLS Linear

Dependent Variable: GINI							
Variable	OLS Coefficient	OLS Std. Error	t-statistic	Robust Std. Error	Robust t-stat	GLS Coefficient	GLS Std. Error
Enrollment	-0.152***	0.027	-5.71***	0.030	-5.12***	-0.152***	0.026
Freedom	4.490***	0.854	5.26***	0.784	5.73***	4.490***	0.846
Corruption	-0.465	0.294	-1.58	0.294	-1.58	-0.465	0.292
Gdpgrowth	0.073	0.100	0.74	0.093	0.79	0.073	0.099
Govtexp	-1.447***	0.411	-3.52***	0.408	-3.54***	-1.447***	0.408
Constant	20.554***	5.345	3.85***	4.511	4.56***	20.554***	5.298
R-squared	0.2571						
Adjusted R-squared	0.2462						
F-statistic	23.67						
Prob(F-statistic)	0.0000						

Note: Estimate is significant at the 1% (***), 5% (**), and 10% (*) level. An increase in the corruption variable is actually a decrease in the level of corruption, as countries with more corruption have a ranking closer to zero.

Due to the misspecification in the model as well as knowledge regarding Kuznets' curve, an alternative approach was to add an enrollment squared variable to the equation. The results to the inclusion of an enrollment squared variable can be seen in Table 5.2. It should be noted that a GDP growth rate squared variable was also tried due to the use of a squared GDP growth term in regressions from past literature, but the results were not significant. The introduction of the enrollment squared variable caused an increase in the fit of the regression. The R-squared term increased from 0.2571 to 0.3059. In addition to the increase in fit, corruption became significant at the 5% level and the p-value on GDP growth decreased, but was still not significant at the 10% level. All other coefficients remained significant at the 1% level. The enrollment squared variable was also significant at the 1% level. The enrollment variable remained negative and the enrollment squared variable was positive.

Ramsey's RESET test once again found misspecification in the model. VIFs were computed to detect multicollinearity and the VIFs for the variables ENROLL and ENROLL² were 12.42 and 11.57, respectively. These VIF values are high enough to indicate a problem with multicollinearity, but the high correlation is probably due to ENROLL² being the squared term of ENROLL. A possible way to fix this problem would be to drop the ENROLL² variable from the regression. The Breusch-Pagan Test and the White Test found heteroskedasticity in the model and the robust standard errors were estimated to create valid standard errors. Serial correlation was also found and the feasible GLS estimator was used. Since the data set is an unbalanced panel and unobserved effects could be affecting the estimation, the next approach was to run fixed effects estimations to find a better regression to conclude a relationship between human capital and income inequality.

Table 5.2: OLS Enrollment²

Dependent Variable: GINI							
Variable	OLS Coefficient	OLS Std. Error	t-statistic	Robust Std. Error	Robust t-stat	GLS Coefficient	GLS Std. Error
Enrollment	-0.639***	0.103	-6.22***	0.101	-6.33***	-0.639***	0.102
Enrollment2	0.004***	0.001	4.90***	0.001	5.17***	0.004***	0.001
Freedom	5.811***	0.869	6.68***	0.825	7.04***	5.811***	0.861
Corruption	-0.627**	0.287	-2.19**	0.283	-2.21**	-0.627**	0.284
Gdpgrowth	0.089	0.097	0.92	0.085	1.04	0.089	0.096
Govtexp	-1.118***	0.404	-2.77***	0.397	-2.81***	-1.118***	0.400
Constant	22.806***	5.194	4.39***	4.76	4.79***	22.806***	5.142
R-squared	0.3059						
Adjusted R-squared	0.2937						
F-statistic	25.04						
Prob(F-statistic)	0.0000						

Note: Estimate is significant at the 1% (***), 5% (**), and 10% (*) level. An increase in the corruption variable is actually a decrease in the level of corruption, as countries with more corruption have a ranking closer to zero.

OLS Summary

To summarize the findings from the OLS estimations, an increase in enrollment led to a decrease in income inequality even though both increased over the past few decades. Decreases in corruption and increases government spending on education caused decreases in inequality, though corruption was only significant in the regression including enrollment squared. GDP growth was not significant in either model. Economic freedom increases would increase the income inequality. However, both models faced problems with misspecification, heteroskedasticity, and serial correlation. In the following section, the results for the fixed effects regressions will be discussed.

Fixed Effects

The dependent variable of the first fixed effect estimation is the Gini coefficient and the independent variables are enrollment, economic freedom, corruption, GDP growth, and government expenditure on education. The group variable was COUNTRYNO. With fixed effects, increases in enrollment caused a decrease in income inequality. Enrollment, corruption, and freedom were all significant at the 1% level. All the signs were expected, except the original expectation for economic freedom, but the new expected sign was in line with the fixed effects regression as well. GDP growth and government expenditure on education were highly insignificant. The expected sign on government expenditure was negative, but the results showed a positive sign, meaning increases in the government spending on education would cause an increase in the gap of the income distribution, but it was insignificant. The overall fit of the regression was 0.1395, which is considered low. All the results can be viewed in Table 5.3.

Table 5.3: Fixed Effects

Dependent Variable: GINI							
Method: Fixed Effects							
Group variable: countryno							
Variable	FE Coefficient	FE Std. Error	t-statistic	Robust Std. Error	Robust t-stat	FE AR(1) Coefficient	FE AR(1) Std. Error
Enrollment	-0.043***	0.009	-4.74***	0.024	-1.81*	-0.032**	0.016
Freedom	1.445***	0.290	4.98***	0.404	3.58***	0.968**	0.402
Corruption	-0.887***	0.172	-5.16***	0.348	-2.54**	-0.432**	0.192
Gdpgrowth	-0.00009	0.022	-0.00	0.027	-0.00	0.009	0.016
Govtexp	0.015	0.179	0.09	0.346	0.04	0.341*	0.178
Constant	31.951***	2.313	13.82***	3.735	8.56***	30.073***	0.945
sigma_u	5.666					6.088	
sigma_e	1.258					0.885	
rho	0.953					0.711	
R-squared within	0.1526					0.0594	
R-squared between	0.2095					0.1131	
R-squared overall	0.1395					0.1073	
F-statistic	11.20					3.54	
Prob(F-statistic)	0.0000					0.0041	
F test all u_i=0	276.51					50.87	
Prob(F test)	0.0000					0.0000	
corr(u_i, xb)	0.1526					0.2284	

Note: Estimate is significant at the 1% (***), 5% (**), and 10% (*) level. An increase in the corruption variable is actually a decrease in the level of corruption, as countries with more corruption have a ranking closer to zero.

Testing for misspecification, multicollinearity, and heteroskedasticity were performed for this estimation as well. Ramsey's RESET Test found misspecification at the 10% level, which is an improvement from the misspecification at the 1% level in the OLS estimation. The next fixed effects estimation looks to fix this error by trying a different functional form. VIFs ranged from 1.00 to 1.80, which are not high enough to indicate a multicollinearity problem in the model. The Breusch-Pagan Test and the White Test still found heteroskedasticity in the model and the robust standard errors were computed to create valid standard errors. The robust t-statistics for enrollment and corruption became less significant, but were still significant at the 10% and 5% levels, respectively. Serial correlation was also found through the Lagrange Multiplier Test and a GLS estimation was estimated that accounts for an AR(1) disturbance in a fixed effects model. With the GLS estimation, GOVTEXP became significant at the 10% level, while enrollment, corruption, and freedom dropped from being significant at the 1% level to the 5% level.

The following fixed effects regression also has the Gini coefficient as the dependent variable. The independent variables are the same as the ones from the prior regression, but the enrollment squared variable was added. The overall R-squared increased from 0.1395 from the last regression to 0.1694. The enrollment squared term is positive and significant at the 10% level. Enrollment, corruption, and freedom remained significant at the 1% level with the same signs. GDP growth and government expenditure on education are both still insignificant, but their p-values did decrease. The results are looked in Table 5.4.

Ramsey's RESET Test produced an F-statistic of 2.53 making the model misspecified at the 10% level. VIFs were computed to detect multicollinearity and the VIFs for the variables ENROLL and ENROLL² were 11.1 and 11.65, respectively. These VIF values are high enough

to indicate a problem with multicollinearity, but the high correlation is probably due to $ENROLL^2$ being the squared term of $ENROLL$. A possible way to fix this problem would be to drop the $ENROLL^2$ variable from the regression. According to the Breusch-Pagan and White tests, there is still heteroskedasticity in the model and the robust standard errors were computed to create valid standard errors. Serial correlation was also found through the Lagrange Multiplier Test and a GLS estimation was estimated that accounts for an AR(1) disturbance in a fixed effects model. With the robust standard errors and the GLS estimation with AR(1), enrollment and enrollment squared lost their significance, while $GOVTEXP$ became significant with GLS. Due to lack of significance in the main independent variable, this fixed effects regression is not the best indicator of the relationship between human capital and income inequality.

Table 5.4: Fixed Effects with Enrollment²

Dependent Variable: GINI							
Method: Fixed Effects							
Group variable: countryno							
Variable	FE Coefficient	Fe Std. Error	t-statistic	Robust Std. Error	Robust t-stat	FE AR(1) Coefficient	FE AR(1) Std. Error
Enrollment	-0.130***	0.046	-2.81***	0.096	-1.35	-0.105	0.079
Enrollment2	0.0007*	0.0004	1.91*	0.0008	0.88	0.0006	0.0006
Freedom	1.905***	0.376	5.06***	0.504	3.78***	1.102***	0.426
Corruption	-0.934***	0.173	-5.40***	0.314	-2.97***	-0.435**	0.192
Gdpgrowth	-0.002	0.022	-0.10	0.027	-0.08	0.009	0.016
Govtexp	0.140	0.190	0.74	0.297	0.47	0.365**	0.180
Constant	30.635***	2.404	12.75***	3.636	8.43***	31.154***	1.006
sigma_u	5.620					6.017	
sigma_e	1.252					0.885	
rho	0.953					0.709	
R-squared within	0.1625					0.0626	
R-squared between	0.2393					0.1659	
R-squared overall	0.1694					0.1568	
F-statistic	10.02					3.11	
Prob(F-statistic)	0.0000					0.0058	
F test all u_i=0	259.99					46.15	
Prob(F test)	0.0000					0.0000	
corr(u_i, xb)	0.1956					0.2887	

Note: Estimate is significant at the 1% (***), 5% (**), and 10% (*) level. An increase in the corruption variable is actually a decrease in the level of corruption, as countries with more corruption have a ranking closer to zero.

FE Summary

To summarize the results in the fixed effects estimations, there is a negative relationship between human capital attainment and income inequality. There were problems in these two fixed effects models in terms of serial correlation, heteroskedasticity and misspecification, though the misspecification was at a lower level than with the OLS estimations. The following section will consider the possibility of adding the multifactor productivity variable.

MFP OLS and Fixed Effects

The multifactor productivity (MFP) variable was added to the research later. The problem that arose was the variable was not available for all the countries in the study. When MFP was added to the regression, the fit increased greatly. Table 5.5 shows an OLS estimation with the Gini coefficient as the dependent variable and enrollment, freedom, corruption, GDP growth, government expenditure on education, and multifactor productivity as the independent variables. When MFP was added to the regression, all the independent variables became significant, but the number of observations decreased. MFP was significant at the 5% level, while all the other variables were significant at the 1% level. Though all the variables are significant, MFP has an unexpected sign. It was assumed that with higher levels of productivity, there would be a decrease in income inequality, but the sign is positive. A reason this may be the case is that the highly skilled and educated are the ones increasing productivity, which would cause their incomes to increase and the income distribution to grow wider. Lastly, the coefficient on enrollment is positive. This is the only estimation that produced a significant positive

relationship between enrollment and the Gini coefficient. Though the opposite was hypothesized, this trend is what is seen across the OECD countries.

Ramsey's RESET Test showed misspecification at exactly the 10% level. The VIFs ranged from 1.01 to 1.79, which are not large enough to indicate multicollinearity in the model. The White Test found heteroskedasticity at the 5% level and robust standard errors were estimated. Though the testings were problematic, the significance of the coefficients and the increase in fit were interesting. To test if the significance and fit were improved due to a small sample size, an OLS regression was run with only the countries that have the MFP variable available, but without including the MFP variable in the regression. Table 5.6 depicts the results of this estimation.

The results in Table 5.6 show that the coefficients were all significant and the fit is stronger when only the countries that have the MFP variable available were included in the data set. The sign on enrollment is positive as it was in the last regression. The countries that had data available for MFP are the richer countries within the OECD. There are two possibilities for those countries not witnessing a decrease in income inequality. One is that those countries have not reached the peak of the Kuznets curve yet. Therefore, the decline has yet to come. Another possibility is that since those countries are even more developed than the others in the OECD, they may have reached a point of diminishing returns on education. The Solow growth model shows that with increases in capital, eventually the economy will reach a steady state, where it remains. Perhaps, these OECD countries have reached their steady state in terms of returns from educational investments. The R-squared term did still increase when the MFP variable was added and GDP growth became more significant. However, it can be concluded that though the MFP

variable increases the fit of the regression, the large increase from the original regression to the regression including MFP was due to the small sample size, not the MFP variable itself.

Though this was determined, a fixed effects estimation was still conducted including the MFP variable. The results are shown in Table 5.7. Corruption was the only variable that was significant so no further testing was done on the model.

Table 5.5: OLS with Multifactor Productivity

Dependent Variable: GINI					
Method: Ordinary Least Squares					
Variable	OLS Coefficient	OLS Std. Error	t-statistic	Robust Std. Error	Robust t-stat
Enrollment***	0.048***	0.161	2.97***	0.020	2.44**
Freedom***	8.168***	0.583	14.00***	0.454	18.00***
Corruption***	-2.386***	0.210	-11.36***	0.230	-10.39***
Gdpgrowth***	-0.300***	0.104	-2.89***	0.095	-3.15***
Govtexp***	-0.836***	0.272	-3.08***	0.271	-3.08***
MFP**	0.312**	0.151	2.07**	0.146	2.14**
Constant**	-10.031**	4.213	-2.38**	3.913	0.011**
R-squared	0.7517				
Adjusted R-squared	0.7407				
F-statistic	68.12				
Prob(F-statistic)	0.0000				

Note: Estimate is significant at the 1% (***), 5% (**), and 10% (*) level. An increase in the corruption variable is actually a decrease in the level of corruption, as countries with more corruption have a ranking closer to zero.

Table 5.6: OLS Countries with MFP

Dependent Variable: GINI				
Method: Ordinary Least Squares				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Enrollment***	0.0484591	0.0156018	3.11	0.002
Freedom***	7.885103	0.5813549	13.56	0.000
Corruption***	-2.373603	0.208123	-11.40	0.000
Gdpgrowth*	-0.13608	0.0742087	-1.83	0.069
Govtexp***	-0.838977	0.2607096	-3.22	0.002
Constant*	-8.114567	4.210403	-1.93	0.056
R-squared	0.7247			
Adjusted R-squared	0.7155			
F-statistic	78.96			
Prob(F-statistic)	0.0000			

Note: Estimate is significant at the 1% (***), 5% (**), and 10% (*) level. An increase in the corruption variable is actually a decrease in the level of corruption, as countries with more corruption have a ranking closer to zero.

Table 5.7: Fixed Effects with MFP

Dependent Variable: GINI				
Method: Fixed Effects				
Group variable: countryno				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Enrollment	-0.0285011	0.0198037	-1.44	0.153
Freedom	0.2211652	0.8233805	0.27	0.789
Corruption***	-1.121835	0.3579545	-3.13	0.002
Gdpgrowth	-0.074012	0.0651598	-1.14	0.258
Govtexp	-0.5853543	0.4165347	-1.421	0.163
MFP	0.1127705	0.0806569	1.40	0.165
Constant***	45.17678	7.679403	5.88	0.000
sigma_u	2.8819482			
sigma_e	0.91047296			
rho	0.9092503			
R-squared within	0.1206			
R-squared between	0.3207			
R-squared overall	0.2648			
F-statistic	2.70			
Prob(F-statistic)	0.0172			
F test all u_i=0	34.72			
Prob(F test)	0.0000			
corr(u_i, xb)	0.0752			

Note: Estimate is significant at the 1% (***), 5% (**), and 10% (*) level. An increase in the corruption variable is actually a decrease in the level of corruption, as countries with more corruption have a ranking closer to zero.

Chapter 6: Conclusion

Through the ordinary least squares and fixed effects estimation techniques, the gross enrollment ratio of tertiary schooling had a negative effect on income inequality. Increases in the enrollment ratio of tertiary schooling led to a decrease in the income inequality in a country. However, when the multifactor productivity variable was added into the estimations, enrollment had a positive effect on income inequality. It is difficult to conclude the relationship between human capital and income inequality for two reasons. One reason is that there are problems with heteroskedasticity and serial correlation within the models. The other reason is that the results show a significant negative relationship, but both income inequality and human capital continue to increase. Though the relationship is difficult to determine, it is clear that human capital can play a role in the growing income inequalities in the OECD countries. As the OECD highlighted as well as De Gregorio and Lee (2002), educational attainment and less education inequality improves income inequality in a country.

In terms of the other variables, economic freedom was significant at the 1% level in the OLS estimations and the fixed effects estimations. Economic freedom was always positive, which came as a surprise. After reconsideration, it made more sense that the relationship between economic freedom and income inequality is positive because more economic opportunity will allow for more financial opportunities. GDP growth and government expenditure on education were not significant in every model. When government expenditure on education was significant, it showed a negative relationship with income inequality. Increases in government expenditure on education led to decreases in income inequality, which is relevant due to more opportunities to invest in education. Corruption was significant at the 1% level in all the models, except the

first OLS regression. Corruption depicted a negative relationship with income inequality, but an increase in the corruption variable is a decrease in the level of the corruption due to the ranking system. Therefore, increases in corruption in the public-sector lead to increases in income inequality.

Limitations

One limitation to this study was the fact that the panel data was unbalanced. A more balanced panel could have created better results. The issue was that some of the variables, like corruption and multifactor productivity, did not go as far back as the other variables. Also, some countries did not have data as far back as others. A balanced panel data set would give better insight to the relationship between human capital and income inequality.

Another limitation was the Gini coefficient. Though the Gini coefficient measures the income inequality in a country, which is what this study needed, it would have been good to also have another measure for inequality. One specifically that compared a low-income group to a high-income group. When data was collected, there was data for a 90-10 ratio, but the data for the Gini coefficient was more complete. Atkinson explains in his paper, previously discussed, that changes can occur within the income distribution, but the changes are not visible with the Gini coefficient because it is possible that the Gini will not change depending on the changes within the distribution.⁷⁷ Due to this knowledge and the OECD's proof of growing top incomes, a ratio comparing the incomes of two groups may give further understanding to the widening income distribution.

⁷⁷ Atkinson 481.

Policy Changes

To combat the growing income inequalities, the countries in the OECD and the organization itself must work to alter policies to benefit the low-income groups. The OECD discusses in their main findings overview that human capital is one of the most important ways to narrow the gap in the income distribution. The OECD states that job training for the low-skilled and formal education over working life are two policies initiatives that would help close the gap.⁷⁸ If companies would provide more on-the-job training for the lower-skilled, the workers productivity and long-run earnings would increase.⁷⁹ Since technology continues to progress every day, training involving learning about technology and learning new programs would be beneficial. Employers would have to establish quality training programs as well as incentives for the employees to invest in the training.⁸⁰ Employers would also need incentive to provide these investment in human capital. The OECD mentions the need for corporate tax policies, such as writing off training costs as business costs.⁸¹

Formal education in the form of tertiary schooling would create more skilled and educated laborers, who will have a higher earnings profile due to their investments. This aspect is part of the purpose of this study. The human capital analysis of earnings that was discussed in chapter three explains that with more investments made in human capital, the higher earnings one will make later in life. It is better for those to invest early in their career to reap the benefits in the future. The key to making formal education beneficial in terms of decreasing the gap in the income distribution is to target those in the low-income bracket. It is important to encourage and

⁷⁸ "An Overview of Income Inequalities in OECD Countries: Main Findings" 41.

⁷⁹ "An Overview of Income Inequalities in OECD Countries: Main Findings" 41.

⁸⁰ "An Overview of Income Inequalities in OECD Countries: Main Findings" 41.

⁸¹ "An Overview of Income Inequalities in OECD Countries: Main Findings" 41.

assist those in the low-income bracket in getting higher formal education. One of the ways to do this would be to lower in-state tuition at state colleges and universities. Another way is to specifically reach out to high school students in low-income families to ensure they can attend college, gain skills and knowledge, and then be able to enter the workforce as highly skilled and educated workers.

Another key way to close the gap in the income distribution is to increase the access to employment.⁸² There are inequalities within the labor market. Policy changes or reforms must target these inequalities.⁸³ Women, youths, and minorities, in terms of race, do not make as much as white males. These groups need better access to employment as well as human capital to increase their wages.

Redistribution reforms are another policy possibility. Income support policies, such as government transfers, can help those in the low-income groups.⁸⁴ Redistribution of taxes can also help with the income distribution. The OECD countries should consider the tax provisions currently in place considering the share of tax burdens from the high-income groups has decreased over the past few years, according to the OECD.⁸⁵

From these policy changes, one can see that the OECD countries should focus on helping those in the low-income groups to increase human capital to increase wages. If the OECD countries were to implement some of these policies or reform current policies, then possibly over time, the countries will begin to see a decrease in income inequality.

⁸² "An Overview of Income Inequalities in OECD Countries: Main Findings" 41.

⁸³ "An Overview of Income Inequalities in OECD Countries: Main Findings" 41.

⁸⁴ "An Overview of Income Inequalities in OECD Countries: Main Findings" 41.

⁸⁵ "An Overview of Income Inequalities in OECD Countries: Main Findings" 41.

Appendix A: Averages and Standard Deviations

		1981	1985	1990	1995	2000	2005	2010	2014
Gini	average	31.965	34.906	33.456	34.957	36.336	33.749	33.084	40.145
	std. dev	0.898	10.619	11.146	9.343	8.761	6.424	6.138	11.406
Enrollment	average	23.164	25.717	30.832	40.853	50.844	62.150	68.532	69.695
	std. dev	11.372	12.173	15.794	18.015	15.891	18.616	17.367	14.692
Freedom	average	6.236	6.305	6.869	7.070	7.472	7.626	7.404	7.520
	std. dev	1.199	1.260	1.184	1.003	0.747	0.474	0.419	0.367
Corruption	average				6.992	6.809	6.991	6.849	6.883
	std. dev				2.109	2.091	2.022	1.887	1.550
GDPGrowth	average	2.166	3.585	3.542	3.695	4.853	3.758	2.453	2.039
	std. dev	2.641	1.583	2.673	3.126	2.152	2.386	2.922	1.279
GovtExp	average	4.823	4.674	4.409	4.829	4.922	5.068	5.518	5.103
	std. dev	1.484	1.529	1.180	1.376	1.164	1.135	1.034	1.895

Note: Corruption data from the Corruption Perceptions Index did not begin until 1995.

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