Undergraduate Economic Review

Volume 11 | Issue 1 Article 3

2014

Corruption, Income Inequality, and Subsequent Economic Growth

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Abstract
This paper attempts to untangle the link between corruption and income inequality with subsequent economic growth. It uses standard OLS multiple regression analysis and data from 134 countries over a ten year time frame to test the hypothesis that after controlling for corruption, income inequality will be less significant in explaining subsequent growth rates. Perhaps it is not income equality that fosters economic growth, but rather a decrease in corruption that causes both economic growth and greater equality. This study yields some expected findings in support of well-established variables and concludes that inequality harms growth even after controlling for corruption.

Keywords
corruption, growth, income inequality

Cover Page Footnote
The author would like to thank Dr. Tom Lehman for supervising this project and providing helpful suggestions throughout the process.

I. Introduction

What makes some countries rich but others poor? This is a question as old as economics itself, dating back to Adam Smith's 1776 magnum opus, *An Inquiry into the Nature and Causes of the Wealth of Nations*. However, despite the question's age and importance, it is still relatively open. Prior research has established causal relationships in a large number of different variables; Durlauf et al. (2005) identify 145 different variables found to be statistically significant for impacting growth in at least one study. Among the most consistent factors positively impacting growth are level of investment, sound money, and openness to trade (Levine and Renelt 1992). Yet, with many African and Latin American countries still lagging behind, more recent research has focused on the effect of social cohesion on economic growth. This strand of research examines the effects of ethnic diversity, sharing a common language, and especially income inequality[1] on economic growth. Greater income inequality was first thought to positively influence economic growth. Arthur Okun argued in his influential 1975 book, *Equality and Efficiency: The Big Tradeoff*, that income equality is fostered by redistributive policies that harm growth[2] ("leaky bucket" analogy). This conventional textbook approach posits that income inequality is the result of healthy incentives, and thus, inequality is good for growth. However, the majority of subsequent research finds a negative relationship between income inequality and subsequent economic growth (Alesina and Rodrik 1994; Persson and Tabellini 1994; Perotti 1996; Rodrik 1999; Easterly et al. 2006; Berg et al. 2012).

Corruption is another variable consistently found to negatively impact growth (Mauro 1995; Mauro 1997; Tanzi 1998; Wei 2000). The literature on how corruption impacts growth and how inequality impacts growth has developed largely independently. However, since corruption is positively correlated with inequality (Gupta et al. 2002; Brempong 2002; Brempong and Camacho 2006) and negatively correlated with growth (Mauro 1995; Mauro 1997; Tanzi 1998; Wei 2000), the effects of income inequality and corruption on subsequent growth may not be fully understood independent of one another. Studies that examine the effects of income inequality on subsequent growth but fail to account for corruption may suffer from omitted variable bias. After controlling for corruption, income inequality may not influence economic growth as much as previous studies have found.

[1] Kuznets (1955) was the first to examine the relationship between economic growth and income inequality. However, Kuznets (1955) focuses on how economic growth impacts income inequality while this paper examines how income inequality impacts subsequent economic growth.

[2] Despite the trade-off that Okun identified, he nonetheless supported redistributive policies.

The purpose of this research is to bridge the gap between income inequality and corruption studies by analyzing both variables within the same model. My hypothesis is that after controlling for corruption, income inequality will be less significant in explaining subsequent growth rates across countries[3]. Perhaps it is not income equality that brings about economic growth but rather a decrease in corruption that causes both economic growth and greater income equality.

This study is organized as follows. Section II provides a summary of the literature on inequality and economic growth as well as corruption and economic growth. Section III details the data used and statistical techniques performed. Section IV discloses the findings of this study followed by key observations. Section V concludes with an interpretation of the findings, policy implications, and recommendations for future work.

II. Literature Review

Although one of the oldest areas in economic research, development economics still has many questions left unanswered or only partially answered. There have been a wide range of studies examining the determinants of economic growth using a variety of explanatory variables, control variables, and statistical techniques. A common problem throughout this broad body of literature is the difficulty in performing empirical analysis. The difficulty is brought about by poor data, small sample sizes, omitted variable bias, and endogeneity. Poor countries, especially those with corrupt governments, often do not have reliable data. Additionally, surveys attempting to measure the same variable may vary greatly across different countries (Deininger and Squire 1996). With small sample sizes and 145 variables found statistically significant for impacting growth (Durlauf et al. 2005), there is bound to be omitted variable bias. With the number of explanatory variables approaching the total number of countries in the world, no model could include anywhere close to all of the important variables. Even in models that account for several important variables, there is still the problem of endogeneity. Many variables in the development literature both influence economic growth and are influenced by it[4]. Despite the difficulties with empirical work, some variables, such as income inequality and corruption, have been consistent across a wide variety of studies.

[3] In statistical terms, if corruption is omitted from the growth model, this may generate a negative bias on the estimated income inequality coefficient. The coefficient on income inequality may appear more negative when corruption is excluded from the model.

[4] For example, lower levels of corruption may foster growth, but growth may also cause corruption to decrease. Additionally, the level of income inequality may impact growth, but growth may also impact income inequality (Kuznets 1955). These problems will be addressed more thoroughly in the methodology section.

Studies examining how initial inequality[5] impacts economic growth differ in both their methodology and their conclusions. Inequality is theorized to impact growth through three main channels: redistribution, weaker institutions handling external shocks[6] poorly, and credit market imperfections. Sachs (1989) theorizes that high income inequality in Latin American countries led to political pressure for redistributive policies to raise the incomes of lower income groups. These attempts at redistribution contribute to poor policy and thus weaker economic performance. Unlike Sachs (1989), Alesina and Rodrik (1994) and Persson and Tabellini (1994) develop formal models based on the median voter theory, and then test their models empirically. Both models start with the assumption that people with more capital prefer lower tax rates since those with capital own the means of production and benefit from economic growth that is fostered from low tax rates. However, those with labor income prefer higher taxes as some of the tax revenue is redistributed from capital owners to those with labor income. A pure capitalist prefers a tax rate that maximizes growth while those with labor income prefer a tax rate that exceeds the ideal tax rate for growth. Inequality is defined by how poor the median voter is compared to the average voter. Thus, a more equitable distribution means more capital for the median voter. With more capital, the median voter selects a lower tax rate that in turn promotes more growth. Both Alesina and Rodrik (1994) and Persson and Tabellini (1994) substantiate their theories by showing that initial inequality is negatively and significantly correlated with growth in a subsequent period. However, neither performs a statistical test to determine whether the specific channel of redistribution is how inequality impacts growth.

Weak institutions functioning poorly after an external shock is another channel through which income inequality is theorized to negatively impact subsequent economic growth. Rodrik (1999) builds a model where two groups battle for resources after an external shock. The two groups are less likely to cooperate when they cannot agree on what a "fair" distribution is and also when they have more to gain from excluding the other group. Determining a "fair" distribution is more difficult when latent social conflict, of which income inequality is a factor, is high. Excluding the other group is more profitable if the society's institutions are weak (De Soto 2003). Thus, Rodrik (1999) concludes that inequality harms growth by weakening political institutions. Using three-stage least squares Easterly et al. (2006) find that all their measures for institutional quality are positively correlated to growth and related to both of their

[5] In order to avoid reverse-causation (growth impacting inequality) researchers have used inequality at the start of a period to see how it influences subsequent growth in the next 5 or even up to 50 years.
[6] External shocks include a wide variety of factors such as natural disasters and changes in a country's terms of trade.

measures for social cohesion[7]. They conclude that societies with lower initial income inequality have more social cohesion and thus better institutions. According to Easterly et al. (2006), countries with solid institutions have longer growth spurts due to better handling of external shocks. The conclusions of Rodrik (1999) and Easterly et al. (2006) are supported by Berg et al. (2012) who find that external shocks are associated with a higher risk of a growth spell ending.

Credit-market imperfections are another avenue through which inequality is theorized to retard growth. Benabou (1996) contends that credit constraints prevent the poor from investing the optimal amount. Since there are decreasing returns to capital investments, redistributing from the rich (whose marginal productivity from investment is relatively low) to the poor (whose marginal productivity from investment is relatively high) may enhance productivity and economic growth (Benabou 1996). Aghion et al. (1999) examine more closely the incentives of poor borrowers and conclude that inequality also decreases borrowers' incentives. With limited liability, a poor borrower may suffer from a moral hazard problem. Since the borrower is poor, there is little for them to lose if the loan cannot be repaid. A borrower with a lower level of initial wealth will be less motivated to ensure the success of the project compared to a borrower with a higher level of initial wealth (Aghion et al. 1999). Barro (2000) supports the credit-market imperfections theory by finding that the effects of inequality on growth are negative for poor countries (GDP per capita below $2070) but positive for wealthier countries (GDP per capita above $2070). Since credit-market imperfections are more serious in developing countries, greater inequality harms growth more in poor countries (Barro 2000; Keefer and Knack 2002).

Although the majority of research has found a negative relationship between initial income inequality and subsequent economic growth, Banerjee and Duflo (2003) find that any change in inequality is associated with a decrease in subsequent growth. They contend that their findings are consistent with the theory that redistribution in either direction is costly due to social upheaval. However, this theory is given as an explanation to their empirical findings and is never tested empirically. Additionally, Banerjee and Duflo (2003) look at 5 and 10 year time intervals, while most other research uses longer time intervals of 15 to 50 years. Forbes (2000), in contrast to most other studies, finds a positive relationship between income inequality and subsequent growth. A 10-point increase in a country's Gini coefficient is correlated with a 1.3% increase in average annual growth over the subsequent 5 year period. However, Forbes

[7] Easterly et al. (2006) use both the Gini coefficient as well as the share of income going to the middle 60% as proxies for income distribution. Another measure for social cohesion they use is ethnolinguistic fractionalization, or the probability that two randomly selected people will not belong to the same ethnolinguistic group.

(2000) uses a sample with half OECD countries and no countries are from sub-Saharan Africa. She acknowledges that her sample is disproportionally wealthy, but contrary to Barro (2000), she finds no difference after separating rich and poor countries. Forbes (2000) tentatively supports the theory that there is a trade-off between reducing inequality and promoting growth.

Corruption awareness is growing and along with it there has been an increased interest in the causes and consequences of corruption (Tanzi 1998). However, corruption[8] by its very nature is not an easy subject to study. Corruption can be difficult to quantify because corrupt acts are almost always done secretly. Thus, the most common type of proxies used for corruption are subjective indices of how corrupt people think their government is. Despite the challenges, there is a growing body of literature examining the effects of corruption on subsequent growth. Although the studies have unanimously found that corruption harms growth, they differ in how corruption harms growth. Four main channels have been proposed for how corruption harms growth: it alters how government spends money, harms investments, distorts incentives, and increases political instability.

Corruption affects the composition of government expenditure because corrupt government officials may prefer expenditure that makes it easier to collect bribes (Mauro 1997). Expenditures on grand projects, such as large-scale infrastructure, with market values that are difficult to determine, may attract corruption. In health spending, there may be more opportunities for corruption in the procurement of hospital buildings and state-of-the-art medical equipment, but less opportunity in salaries of doctors and nurses (Mauro 1997). Using standard OLS multiple regression as well as two-stage least squares, Mauro (1997) finds that corruption does not impact the overall level of government spending; however, it does reduce the amount of spending on education[9]. In altering the composition of government expenditures, corruption negatively impacts bureaucratic efficiency; a corrupt bureaucracy may award service contracts to less efficient firms (Jain 2001).

Corruption harms investments both internally and externally. Using both OLS and two-stage least squares, Mauro (1995) finds that a one standard deviation improvement in corruption increases the investment rate by 4.75% of GDP. This in turn contributes to increasing the annual growth rate by .8 percentage points. Besides discouraging investment from internal sources,

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[8] Corruption has been defined in several ways. However, the most widely used and simplest definition is the abuse of public power for private benefit (Jain 2001). Although the corruption literature and rent-seeking literature have developed independently, corruption is a form of rent-seeking.

[9] This in turn may reduce growth because educational attainment has been shown to be positively correlated with growth (Levine and Renelt 1992; Benabou 1996; Barro 2000).

corruption also reduces investment from foreigners. Wei (2000) finds that a one-grade increase in corruption reduces foreign direct investment by 16%. With a large deviation in the level of corruption among countries, there can be a large difference in foreign direct investment due to corruption level. Wei (2000) demonstrates that an increase in the corruption level from that of Singapore (which is one of the least corrupt countries) to that of Mexico (which is a highly corrupt country) has an equivalent effect on reducing investment as increasing the tax rate by 24 percentage points. Investment is one of the traditional factors within the development literature shown to positively impact growth, but corruption harms investments.

Corruption also harms growth by distorting incentives. Murphy et al. (1993) theorizes that corruption, or more broadly rent-seeking, harms innovators because new businesses usually require more import quotas, permits, licenses, and other government-supplied "goods". Established firms require fewer government goods, are likely to be better connected with government officials, and also have fewer credit-constraints (Murphy et al. 1993). Thus, established firms are less likely to need to bribe public officials and can do so more easily when needed. The negative impact of corruption on new businesses can undermine the incentives for entrepreneurs in the long-run. Corruption over time can lead to entrepreneurial talent leaving the productive sector and entering the rent-seeking sector (Jain 2001).

Another vein through which corruption is thought to negatively impact growth is political instability. Mo (2001) finds that a 1% increase in the corruption level reduces the growth rate by .72% with the most important channel being political instability. In his statistical analysis, political instability accounts for 53% of the total effect. Mo (2001) reasons that corruption brings about political instability that in turn creates uncertainty over the protection of property rights. Uncertainty concerning property rights then reduces investment and economic growth. However, Wei (2000) points out that corruption and political instability causation could run both ways. Corruption may lead to public discontent that eventually topples a government; however, unstable political environments may cause officials to have short-term thinking and grab whatever rents while they still can (Wei 2000).

Corruption and income inequality are both thought to influence growth. Most of the literature has developed separately. However, a few studies do mention both income inequality and corruption (Li et al. 2000, Gupta et al. 2002, Brempong 2002, Brempong and Camacho 2006). These studies all find that corruption increases income inequality and conclude that income inequality is another channel through which corruption harms growth. These studies all assume that income inequality harms growth. Only Forbes (2000) mentions that controlling for corruption may alter the results of studies examining whether income inequality harms growth. However, Forbes (2000) performs no such statistical test.

This paper contributes to the literature by bridging the gap between the separate corruption and income inequality studies. To the best of my knowledge, this is the first study to include corruption and income inequality within the same model. Thus, I am able to determine whether income inequality on its own influences subsequent economic growth, or if income inequality only appears to influence subsequent economic growth because corruption impacts both income inequality and economic growth.

III. Methodology

The country is my unit of analysis as I examine between 55 and 126 countries depending on the model. The World Bank (http://data.worldbank.org/) is the primary data source since it is the data source for all variables except corruption. Data for corruption come from Transparency International's Corruption Perception Index (CPI) (http://www.transparency.org/research/cpi/). Table 1 displays bivariate correlations as well as means and standard deviations for the sample of 55 countries.

Table 1: Correlation Coefficients and Descriptive Statistics[10]

	GR	COR	GINI	y02	INV	OPEN	POPG	GOV	INF	HUMAN
GR	1.00									
COR	.386	1.00								
GINI	-.10	.41	1.00							
y02	-.46	-.84	-.29	1.00						
INV	.52	.13	-.28	-.12	1.00					
OPEN	.33	-.01	-.31	.05	.49	1.00				
POPG	-.28	.25	.53	-.34	-.31	-.46	1.00			
GOV	-.15	-.58	-.38	.47	-.17	.17	-.32	1.00		
INF	.19	.24	.02	-.21	-.05	.04	-.10	-.05	1.00	
HUMAN	.21	-.36	-.16	.52	.13	.27	-.59	.33	.24	1.00
Mean	3.19	5.82	45.7	3.42	21.4	39.48	.98	15.3	6.91	91.42
SD	2.27	2.13	8.48	.64	4.33	16.29	1.17	5.18	9.62	18.51

n=55

The bivariate correlations reveal some expected findings as well as potential problems. As expected, there is a relatively strong bivariate correlation of .408 between corruption and income inequality. There is also a positive bivariate correlation between corruption and growth. One explanation for this surprising finding is that corruption has a bivariate correlation of -.841 with initial level of income[11] which has a bivariate correlation with growth of -.463. These

[10] GR, average GDP per capita growth from 2002-2012; COR, the Corruption Perception Index; GINI, the level of income inequality; y02, logged GDP per capita; INV, gross capital formation as percentage of GDP; OPEN, imports of goods and services as percentage of GDP; POPG, population growth as an annual percent; GOV, government spending as percentage of GDP; INF, inflation rate; HUMAN, primary education completion rate.

[11] The strong bivariate correlation between corruption and initial level of income introduces multicollinearity into the model. This can make it difficult to distinguish the independent effect of

findings suggest that corrupt countries tend to be poor and poor countries grew faster over the time period. Thus, the negative effect of corruption on growth can only be understood by controlling for independent effects through multiple regression analysis.

The dependent variable is the average growth of real GDP per Capita[12] from 2002-2012. This variable is not normally distributed since it has a skewness of 3.615, which is well above the cut-off of 3. Having normally distributed variables, especially the dependent variable, is one of the assumptions of standard OLS multiple regression analysis. In order to normalize the dependent variable, I take the logarithm[13] of it. Thus, I display the results with both GDP per Capita growth as well as the logged GDP per Capita growth.

Data limitations are another challenge of this study. In the full model, I include a total of 10 variables while only having 55 observations. This is a violation of a rule of thumb that suggests a minimum number of cases equal to 50 plus 8 times the number of variables used (Tabachnick and Fidell 2001). This rule of thumb suggests that I should have at least 130 observations for my full model. Although I violate this rule of thumb, it is the norm[14] within the development literature. In an attempt to yield more observations, I created a dataset to analyze the 2007-2012 time period. However, I do not perform statistical tests with this dataset since it only contains a few more observations, has greater skewness, and constitutes a relatively short time period.

In order to avoid the problem of endogneity, all of the independent variables are taken as close to 2002 as possible. Since many of the explanatory variables both influence growth and are influenced by growth, reverse causation may plague the results if independent variables are taken after the initial period. For example, corruption may decrease growth, but a growing economy may decrease corruption by increasing the returns to the productive sector. Taking observations of independent variables from 2002 and using mean GDP per Capita growth from 2002-2012 as the dependent variable avoids the problem of reverse

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each variable on the dependent variable. However, since Mo (2001) has a similar bivariate correlation and keeps both variables in the model, I do as well.

[12] The majority of the literature employs GDP per Capita growth; however, since Mo (2001) and Brempong (2002) use GDP growth as a dependent variable, I also compiled a dataset with GDP growth. However, since skewness for GDP growth is 3.885 while skewness for GDP per Capita growth is 3.615, I only use GDP per Capita growth when performing the statistical tests.

[13] Since some of the growth rates are negative and logging a negative number is a mathematical impossibility, I follow the same procedure as Brempong and Camacho (2006) and add 6 before logging. 6 is used since the United Arab Emirates had a negative average growth rate of 5.6%, the most negative growth rate of all countries.

[14] For example, Mo (2001) has a model with 9 variables and 45 observations and Gupta et al. (2002) have a model with 11 variables and only 37 observations.

causation. It reveals the impact that initial levels of the independent variables have on subsequent economic growth.

The two key independent variables under consideration are corruption and income inequality. Both variables, however, have data limitations. Corruption is inherently difficult to measure since most corrupt acts are illegal (Jain 2001). Thus, I rely on perception of corruption rather than an objective measure. Using the perception of corruption could pose a validity problem if perceptions differ from reality. However, due to the difficulty in objectively measuring corruption, using perceptions is the norm within the corruption literature. Transparency International combines the results of numerous surveys to build an index for how corrupt people perceive their government to be. A score of 10 indicates no corruption while a score of 0 indicates complete corruption. In order to make interpretation more natural, I follow the same procedure as Wei (2000) and Li et al. (2000) by taking 10 minus the Corruption Perception Index. Thus, a higher score now represents a higher level of corruption.

For income inequality, I use the Gini coefficient taken from the World Bank. The Gini index ranges from 0 to 100 with a score of 0 representing perfect equality and 100 representing perfect inequality. Since there is a high cost of administering enough surveys to compile the Gini coefficient, data are not available each year for every country in the sample. Only 49 countries have a Gini index for 2002, but I am able to expand to 88 cases by including Gini data from 2000 and 2001. Besides the quantity of Gini coefficients available, another concern is quality. It is important for the data to be representative of the country as a whole. Therefore, I drop all cases where the index is compiled from urban or rural residents only[15]. Additionally, surveys in some countries are expenditure-based while others are income-based. Due to consumption smoothing, a person's expenditure varies less over their lifetime than their income (Deininger and Squire 1996). Thus, using expenditure-based data would understate inequality. Deininger and Squire (1996) find that, on average, expenditure-based coefficients are 6.6 points less than income-based coefficients. I follow the procedure developed by Deininger and Squire (1996) and used in Li and Zou (1998), Forbes (2000), Keefer and Knack (2002), and Banerjee and Duflo (2003) and add 6.6 to all expenditure-based coefficients.

Initial level of GDP per Capita is a critical control variable used throughout the literature. Initial level of GDP per Capita is theorized to be negatively correlated with subsequent economic growth. In the neoclassical growth model, since capital deepening faces diminishing returns, convergence occurs (all else equal) as poor countries "catch up" to rich countries over time (Solow 1956). In the literature surveyed, the initial level of GDP per Capita is

[15] For example, Argentina is dropped from the sample because the index is compiled only from surveys given to urban residents.

consistently negatively correlated with subsequent economic growth. However, with the exception of Alesina and Rodrik (1994), the variable is always logged. Since the skewness for initial GDP per Capita in my sample is 5.9, I also logged it.

Investment is theorized to increase economic growth because investment increases capital accumulation and thus productivity. Levine and Renelt (1992) perform sensitivity analysis to show that investment is one of the few variables in the development literature that remains statistically significant across different time periods, specifications, and models. Although a variety of variables have been used to proxy investment, I use gross domestic investment as a percentage of GDP.

Trade is one of the oldest variables theorized to promote growth. Adam Smith argued that trade with other nations allows for greater specialization as the market expands. This greater specialization fosters economies of scale and higher productivity. David Ricardo established a theory of trade based on comparative advantage where trade allows countries to consume more than they could under a condition of autarky. Trade is especially important to the literature linking income inequality with subsequent economic growth because trade is theorized[16] to decrease inequality in poor countries but increase inequality in rich countries (Barro 2000). Although different studies have used either exports, imports, or exports plus imports as proxies for openness to trade, Levine and Renelt (1992) find no difference between the three proxies[17]. Thus, I use the World Bank data for imports as a percentage of GDP.

Although economists have identified the effects of population growth to be ambiguous with respect to economic growth, it is still a widely used control variable (Levine and Renelt 1992). On the one hand, a growing population can make it more difficult to increase GDP per Capita since population growth increases the denominator in the GDP per Capita equation. However, population growth can serve as a proxy for growth in the labor force, and a growing labor force may be more productive by taking advantage of economies of scale (Mo 2001). Despite its ambiguous effects on growth, population growth can still alter the results of statistical tests relating inequality and growth. For example, using fertility as a similar variable to population growth, Barro (2000) finds that income inequality has no significant effect on subsequent economic growth, but omitting

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[16] This is a restatement of the Stolper-Samuelson Theorem (Stolper and Samuelson 1941). However, this theorem has not been borne out by subsequent empirical tests.

[17] This finding is expected since exports are simply the payments for imports (Lerner 1936). According to the Lerner Symmetry Theorem, the value of imported goods equals the value of exported goods.

fertility yields a statistically significant negative relationship. Thus, I include population growth[18] as a control variable.

Size of government is theorized to negatively impact growth because a larger government may crowd-out some of the growth-promoting effects of the market. Even if the government spends efficiently, there is still the risk that government growth-promoting policies may ultimately harm growth because of distortionary taxes (Levine and Renelt 1992). Thus, I use general government final consumption expenditure (percent of GDP) as a measure of the size of government. This includes all government expenditures for goods and services.

Inflation is another classic variable in the development literature theorized to harm growth. Inflation, regardless of how it is measured, has consistently been shown to harm growth (Levine and Renelt 1992). Inflation may be especially important in the literature examining the effects of inequality on subsequent growth because inflation increases inequality (Li and Zou 2002). Thus, I use inflation as measured by the annual growth rate of the GDP deflator. This measure shows the rate of price change in the economy as a whole.

Just as greater human capital makes an individual worker more productive, higher levels of human capital in a country as a whole, make the country more productive (Mincer 1984). Human capital as the source of new knowledge and technology can help shift the production function upward and break through the steady state implied by the neoclassical growth model. Although human capital development can occur outside of formal education (Mincer 1984), different measures for a country's level of education are common proxies for human capital. Thus, I include primary school completion rate as a proxy for human capital. Although this variable accounts for the quantity of formal education, it cannot control for the quality of education. However, in the regressions performed by Levine and Renelt (1992), variables for the quality of education, such as literacy rates, yield similar results.

This study employs standard OLS multiple regression analysis expressed in the following reduced-form theoretical model:

(1) $$Y_i = b_0 + b_1\alpha_i + b_2\delta_i + b_3\mu_i + b_4\omega_i + b_5\pi_i + b_6\rho_i + \varepsilon_i$$

where Y_i is the predicted average real GDP per Capita growth rate in country i , b is a partial slope measuring the impact that each term has on Y_i , α_i is a measure of corruption in country i, δ_i is an income inequality measure, μ_i represents current levels of economic well-being, ω_i is a set of indicators for the openness of an

[18] Population growth is defined by the World Bank as the exponential rate of growth of midyear population between two years.

economy, π_i contains demographic control variables, ρ_i reflects government-related variables, and ε_i is an error term accounting for omitted variable bias.

The hypothesis that the relationship between initial income inequality and subsequent economic growth is overstated because corruption decreases subsequent economic growth and increases income inequality is difficult to test. It requires careful selection and interpretation of different models. I start with a model where there is a statistically significant negative relationship between income inequality and subsequent growth. If inequality is no longer statistically significant or its coefficient is greatly reduced after adding corruption to the model, then I would tentatively support the hypothesis. If corruption is added and inequality maintains its statistical significance and magnitude on its coefficient, then the hypothesis would be rejected[19].

In order to make comparisons with the existing literature, it is important to make as few changes to previous regressions as possible. Ideally, this would mean replicating the results of a previous income inequality study and then simply adding corruption. Unfortunately, due to data limitations, I am unable to use the same time period as previous studies. However, I am able to closely match the variables used in both Alesina and Rodrik (1994) and Persson and Tabellini (1994). My Model 7 matches Models 1, 9, and 10 for Alesina and Rodrik (1994) except they do not log initial GDP per Capita, and they use primary school attendance rates rather than completion rates. My Model 7 also matches Model (i) for Persson and Tabellini (1994) except they use primary school attendance rates rather than completion rates and the size of the middle quintile for inequality instead of the Gini coefficient. Although these models constitute a different time period than my Model 7, the signs on the coefficients are consistent.

The reduced-form theoretical model can be expanded into a fully developed empirical model. Taking each of the variables described above and inserting them in as separate terms yields the following equation for average GDP per capita growth from 2002-2012 for country *i*:

$$(2) \qquad GR_i = \beta_0 + \beta_1 COR + \beta_2 GINI + \beta_3 Y02 + \beta_4 INV + \beta_5 OPEN + \beta_6 POPG + \beta_7 HUMAN + \beta_8 GOV + \beta_9 INF + e$$

[19] This statistical procedure and interpretation is similar to that used in Perotti (1996). After finding inequality to be statistically significant and negatively impacting growth, Perotti (1996) analyzes urbanization as a possible omitted variable. Urbanization may increase both economic growth and inequality. However, after adding in urbanization it is statistically insignificant and the coefficient for inequality is unchanged. Thus, Perotti (1996) concludes that urbanization is not an omitted variable.

Where GR_i is the mean GDP per capita growth for country i from 2002-2012, COR is the modified Corruption Perception Index for 2002, $GINI$ is the Gini coefficient for years 2000, 2001, and 2002, $Y02$ is the logged GDP per capita for 2002, INV is gross domestic investment as a percentage of GDP in 2002, $OPEN$ is imports as a percentage of GDP for 2002, $POPG$ is the rate of growth of midyear population between the years 2001 and 2002, $HUMAN$ is the primary school completion rate for 2002, GOV is the general government final consumption expenditure as a percentage of GDP for 2002, INF is the annual growth rate of the GDP deflator for 2002, and e is an error term.

IV. Findings / Observations

Tables 2 and 3, listed below, detail the results of the different regression models[20]. Ten separate models are included with the first model containing all the variables, Model 7 matching the models in Alesina and Rodrik (1994) and Persson and Tabellini (1994), and Model 8 adding corruption. I report unstandardized and standardized coefficients (in parenthesis), significance levels, r^2 values, and, in the bottom row, the number of observations. The unstandardized coefficient[21] is the partial slope of the regression plane. It gives the amount of change in the dependent variable from a one-unit change in the independent variable[22], all else constant. The standardized coefficients make use of a conversion to standard units, z-scores, and thus reflect the number of standard deviations the dependent variable will change from a standard deviation change in the independent variable. The r^2 value in each model is the percentage of variation in the dependent variable that can be explained by the variance in all the independent variables found in each model.

[20] Models 11-20 are in Appendix A and display the results with logged average GDP per Capita growth 2002-2012 as the dependent variable. Despite the problem of skewness, the results are similar to those in Models 1-10.

[21] For example, in Model 1 an increase in the corruption index by a unit of 1 decreases the average annual GDP per Capita growth rate by .167 percentage points, all else equal.

[22] However, since initial GDP per Capita is logged, the simple conversion does not work for this independent variable.

Table 2: Models 1-5. Dependent Variable: Average GDP per Capita Growth 2002-2012

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Corruption	-.167 (-.156)	-.163 (-.173)		-.193 (-.199)	
Inequality	-.017 (-.063)		-.025 (-.091)		
Logged Initial GDP per Capita	-3.272*** (-.915)	-3.193*** (-.976)	-2.857*** (-.798)	-3.245*** (-.967)	-2.629*** (-.750)
Investment	.164*** (.312)	.148*** (.317)	.125*** (.251)	.138*** (.290)	.042 (.102)
Openness to Trade	.002 (.012)				
Population Growth	-.214 (-.110)	-.339* (-.179)	-.330 (-.168)	-.313 (-.162)	-.623*** (-.300)
Government Spending	.000 (.001)				
Inflation Rate	-.022 (-.092)	-.011 (-.051)	-.026 (-.103)		
Primary Completion Rate	.066*** (.535)	.060*** (.492)	.050*** (.458)	.061 (.486)	.044*** (.404)
R Square	**.663**	**.635**	**.594**	**.591**	**.441**
Observations	55	71	65	72	126

Significance Measures:

- *p < .10 (90% confidence level)
- **p < .05 (95% confidence level)
- ***p < .01 (99% confidence level)

Standardized partial coefficients are in parentheses

Table 3: Models 6-10. Dependent Variable: Average GDP per Capita Growth 2002-2012

Variable	Model 6	Model 7	Model 8	Model 9	Model 10
Corruption			-.056 (-.051)	-.078 (-.081)	
Inequality		-.064** (-.229)	-.070** (-.258)		-.052** (-.185)
Logged Initial GDP per Capita	-2.398*** (-.694)	-3.045*** (-.837)	-3.277*** (-.892)	-2.908*** (-.884)	-2.828*** (-.772)
Investment					.117** (.234)
Openness to Trade					
Population Growth	-.643*** (-.312)				
Government Spending					
Inflation Rate					
Primary Completion Rate	.037*** (.345)	.067*** (.614)	.078*** (.616)	.077*** (.623)	.057*** (.511)
R Square	**.385**	**.507**	**.552**	**.458**	**.552**
Observations	134	68	56	73	66

Significance Measures:

- *p < .10 (90% confidence level)
- **p < .05 (95% confidence level)
- ***p < .01 (99% confidence level)

Standardized partial coefficients are in parentheses

The results of this study contain some expected findings, some unexpected findings, and a lack of support to confirm the hypothesis. As expected, level of investment and primary completion rate are both positively and significantly correlated with subsequent economic growth. Additionally, initial level of GDP per Capita has a large negative correlation with subsequent growth and is statistically significant at the 99% confidence level in every model. Population growth consistently has a negative coefficient; however, it is only statistically significant in roughly half the models.

Surprisingly, openness to trade, inflation rate, and government spending are never close to being statistically significant and have almost no effect on subsequent growth. Perhaps openness to trade is influenced by the Great Recession. Countries that are less interconnected may not have been influenced as much by contractions in other countries. However, the empirical link between openness to trade and susceptibility to external shocks is unclear. Easterly et al. (2001) find that openness to trade is associated with increased volatility in per capita growth rates while Cavallo and Frankel (2008) find that openness to trade decreases a country's chances of experiencing a recession due to external shocks.

Inflation may be a weak variable in my models because of the relatively short time period of 10 years under consideration. In the short-run, inflation may lower nominal interest rates. These lower interest rates may encourage investments into asset bubbles such as real-estate and the stock market. The economy appears to be growing in the short-run, and the negative effects of inflation may occur outside of a 10-year time frame.

Level of government spending may be showing a neutral effect on subsequent economic growth because the composition of government spending may matter more than the magnitude. Governments may provide growth-promoting public goods, or they might spend money on redistribution programs that harm growth (Levine and Renelt 1992). In some cases, government spending and market activities may be complements. For example, government financed infrastructure may promote growth by widening the extent of the market. Additionally, the negative effects of a high level of government spending may take longer than 10 years to develop. In the short-run, a government may be able to avoid growth-retarding tax increases by financing part of its spending through borrowing. The negative side-effects of borrowing may occur outside of a 10-year time horizon.

Corruption enters in with the expected sign in every model, but it is never statistically significant. However, its magnitude is fairly large in some models. For example, in Model 4, a 1 unit change in the corruption index is associated with a .193 percentage point decrease in annual GDP per Capita growth. To put this into perspective, if Bangladesh (the most corrupt country in the sample) were to reduce its corruption to the level in Finland (the least corrupt country), the model indicates that Bangladesh would increase its growth rate by 1.64 percentage points[23] (all else equal). Corruption also appears to have a nontrivial impact on the explanatory power of the models; removing corruption between Models 4 and 5 reduces the R Square from .591 to .441. Therefore, the findings

[23] The increase in the growth rate by 1.64 percentage points may appear small, but small differences in growth rates have a large impact in the long-run. For example, a country growing at 1% per year doubles every 70 years, but a country growing at 2.64% each year doubles every 43 years.

suggest that corruption has a sizable negative impact on growth, but this effect is not statistically significant.

There are a few possible reasons for this finding that relate to the quality of the corruption data. There is the possibility of a validity problem as the perception of corruption and the actual level of corruption may differ in some important way. For example, cultural norms in Africa may make the perception of corruption different than in other regions (Brempong 2002). Additionally, different types of corruption are not revealed by people's perception of corruption. Decentralized forms of corruption may be more harmful than centralized forms (Brempong and Camacho 2006). If there is no coordination between different public officials demanding bribes throughout a lengthy process such as securing a deed to property, then no individual public official can be held accountable for the success or failure of securing the deed. However, in a centralized system, public officials accepting a bribe can be held accountable. Thus, they will be more likely to ensure that the service is provided quickly (Brempong and Camacho 2006).

Income inequality has a negative coefficient across all models, but this effect is only statistically significant in the simplified models. The impact of inequality on subsequent growth is fairly large in the models where it is statistically significant. For example, in Model 7, increasing a country's Gini coefficient by a unit of 1, decreases subsequent growth by .064 percentage points each year. To put this into perspective, if Angola (the least equal country) reduced its inequality to the level of Sweden (the most equal country), the model indicates that Angola would increase its growth rate by 2.35 percentage points (all else equal).

The theory under consideration is that the negative relationship between initial levels of income inequality and subsequent growth is partly spurious because corruption decreases growth and increases inequality. However, there is no evidence from the statistical tests that this theory is valid. In Model 7, inequality has an unstandardized coefficient of -.064, standardized coefficient of -.229, and is statistically significant at the 95% confidence level. After adding corruption in with Model 8, the confidence level for inequality remains the same and the magnitude of the relationship actually increases slightly with an unstandardized coefficient of -.070 and standardized coefficient of -.258 for inequality. This is the exact opposite effect than what the theory would suggest[24]. Additionally, corruption is not statistically significant. These models suggest that inequality negatively impacts growth even after controlling for corruption.

[24] The same result can be observed in Appendix A with Models 17 and 18.

V. Conclusions

Using standard OLS multiple regression analysis, this study confirms the relationship between several factors and subsequent growth. However, this study does not find support for the theory that the relationship between inequality and subsequent growth is partly spurious due to corruption as an intervening variable. In fact, the observed effect of corruption on inequality is opposite of what the theory would suggest. Even though the hypothesis is rejected, this study still adds to the literature by eliminating a possible intervening variable in the relationship between inequality and growth. Additionally, it confirms the relationship between initial levels of GDP per Capita, investment, and level of human capital in a shorter and more recent time period than most studies.

This study, however, suffers from numerous weaknesses. Given the number of observations available, most models include more variables than are appropriate in multiple regression analysis. Additionally, the variables included do not fully match the variables included in the previous studies that I try to replicate. This study also differs from these prior studies because it uses a shorter and more recent time period. With a longer time period, the effect of inequality on growth may be different (Banerjee and Duflo 2003). Additionally, the key explanatory variable in my theory, corruption, is based on perceptions and is never statistically significant.

Due to the limitations of this study and the difficulties of empirical work in development economics as a whole, policy recommendations must be made cautiously. Just because a variable is shown to impact growth in a model does not mean that increasing or decreasing the variable makes for good public policy. For example, the initial level of GDP per Capita has a highly statistically significant negative relationship with subsequent economic growth. However, a growth policy advocating for an initial reduction in GDP in order to increase subsequent growth would be an absurd and self-defeating policy.

Even though this study finds a negative relationship between inequality and growth, the best policy for growth may not be redistribution. In the literature, some studies recommend redistribution on efficiency grounds (Aghion et al. 1999; Keefer and Knack 2002), but the majority of researchers recognize the adverse effects that redistribution can have on incentives. Although the results of the statistical tests suggest that there is no trade-off between equity and efficiency, the costs of redistribution may still exceed the benefits of a more equal society.

Although corruption is never statistically significant in any model, the size of its negative effects is substantial. Thus, policies that reduce corruption may encourage growth. However, the optimum level of corruption is not zero since there are costs associated with reducing corruption. The optimal level of corruption occurs where the marginal social costs of reducing corruption further equal the marginal social benefits of that reduction (Tanzi 1998). Since reductions in corruption are subject to diminishing returns (Brempong and Camacho 2006), countries that are highly corrupt may benefit from a development strategy focused on reducing corruption while countries that have little corruption would likely not benefit as much from a similar strategy.

The relationship between primary completion rate and subsequent economic growth is positive and highly statistically significant in almost every model. However, this does not mean that a simple public policy such as increasing government spending on primary education would automatically foster growth. For example, Levine and Renelt (1992) find that enrollment rates are positively and significantly correlated with subsequent growth, but government education expenditures are not. This finding suggests that the quality and quantity of education are not wholly dependent on the level of education spending. Additionally, since there are decreasing returns to education (Aghion et al. 1999), countries with different initial levels of education may yield different results from a policy encouraging more education. It is also important to keep in mind that primary completion rates are serving as a proxy for human capital, and there are avenues to increase human capital outside of education.

Even though my models show little relationship between openness to trade, the inflation rate, and subsequent growth, it does not necessarily mean these factors are unimportant. Due to the challenges of empirical analysis in development economics, the significance of variables can be sensitive to different control variables, specification, statistical technique, and time period. It is not possible to perfectly determine what causes growth. Therefore, it is especially important from a public policy perspective to ascertain what variables have an important role (significant across many studies) and what variables have little role (rarely significant) (Durlauf et al. 2005). Since economic growth is brought about by a complicated interaction of numerous variables, there is no single correct solution for achieving faster growth.

Given the complexity of the factors influencing economic growth, there are several avenues for subsequent research. Data limitations have been a major concern in prior studies as well as in this one. Subsequent research would be aided by larger data sets that are already standardized. This would also better allow researchers to replicate findings before testing a new theory since results can vary if models differ in time period and specification of variables (Levine and Renelt 1992). In the inequality literature, there is consistently a negative relationship between inequality and subsequent growth. However, the avenues through which inequality harms growth have been largely untested. Additionally, when some of the avenues, such as the demand for more redistribution, have been empirically tested, they are not borne out by the data (Perotti 1996). Future research should go beyond establishing a negative relationship between inequality and subsequent growth and test the channels through which inequality may harm growth.

Given that few of the channels have been tested empirically, it is also important for future work to continue to test the validity of the relationship between inequality and growth. It is especially important to test for omitted variables that may reveal the relationship to be spurious. For example, lack of property rights and a stable rule of law decrease economic growth by making capital dead and increase inequality by restricting the poor's access to legal institutions (De Soto 2003). Thus, it may not really be income inequality that harms growth, but lack of property rights and a stable rule of law that decrease growth and increase inequality[25]. However, there could be other variables that may strengthen the negative effect of inequality on growth. For example, if labor market flexibility is positively correlated with growth and positively correlated with inequality, then controlling for labor market flexibility may increase the coefficient for inequality.

This study does not find support for the hypothesis that the relationship between inequality and subsequent growth is partly spurious due to corruption as an intervening variable. The observed effect of corruption on inequality is opposite of what the hypothesis would suggest. Additionally, some factors theorized to influence growth such as inflation, openness to trade, and size of government have little impact. However, this study does confirm several factors such as initial level of GDP per Capita, investment level, and primary completion rates as being important for growth. The results of this study suggest that, although one of the oldest questions in economics, what causes growth is still partly unknown and likely will not ever be fully understood.

[25] Evidence for this effect may already exist. After adding a property rights index, Keefer and Knack (2002) find that the coefficient for income inequality is halved and no longer statistically significant. Additionally, the property rights index is statistically significant at the 95% confidence level and the R Square almost doubles. Keefer and Knack (2002) see this finding as a confirmation of their theory that inequality reduces growth mainly by harming property rights. However, they never test the direction of the relationship. I attempted to replicate the results of this study testing first with the overall score for the Economic Freedom Index in 2002 and then with the subcomponent for property rights. However, both variables behave like the corruption variable as they are statistically insignificant and have no discernable effect on the income inequality variable.

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Appendix A: Models with the Alternative Dependent Variable

Table 4: Models 11-15. Dependent Variable: Logged Average GDP per Capita Growth 2002-2012

Variable	Model 11	Model 12	Model 13	Model 14	Model 15
Corruption	-.004 (-.168)	-.004 (-.175)		-.004 (-.204)	
Inequality	.000 (-.053)		-.001 (-.088)		
Logged Initial GDP per Capita	-.074*** (-.961)	-.072*** (-1.006)	-.064*** (-.827)	-.073*** (-.989)	-.059*** (-.735)
Investment	.003** (.286)	.003*** (.297)	.002** (.230)	.003*** (.267)	.001* (.115)
Openness to Trade	.000 (.019)				
Population Growth	-.005 (-.126)	-.008* (-.187)	-.007 (-.173)	-.007 (-.166)	-.015*** (-.320)
Government Spending	.000 (.012)				
Inflation Rate	-.001 (-.103)	.000 (-.060)	-.001 (-.114)		
Primary Completion Rate	.001*** (.553)	.001*** (.507)	.001*** (.483)	.001*** (.496)	.001*** (.381)
R Square	**.682**	**.648**	**.610**	**.595**	**.437**
Observations	55	71	65	72	126

Significance Measures:

- *p < .10 (90% confidence level)
- **p < .05 (95% confidence level)
- ***p < .01 (99% confidence level)

Standardized partial coefficients are in parentheses

Table 5: Models 16-18. Dependent Variable: Logged Average GDP per Capita Growth 2002-2012

Variable	Model 16	Model 17	Model 18	Model 19	Model 20
Corruption			-.002 (-.073)	-.002 (-.090)	
Inequality		-.001** (-.226)	-.001** (-.252)		-.001** (-.187)
Logged Initial GDP per Capita	-.054*** (-.679)	-.068*** (-.854)	-.074*** (-.927)	-.066*** (-.907)	-.064*** (-.794)
Investment					.002** (.208)
Openness to Trade					
Population Growth	-.016*** (-.330)				
Government Consumption (percentage of GDP)					
Inflation Rate					
Primary Completion Rate	.001*** (.324)	.001*** (.626)	.002*** (.631)	.002*** (.633)	.001*** (.532)
R Square	**.381**	**.525**	**.574**	**.475**	**.560**
Observations	134	68	56	73	66

Significance Measures:

- *p < .10 (90% confidence level)
- **p < .05 (95% confidence level)
- ***p < .01 (99% confidence level)

Standardized partial coefficients are in parentheses