THESIS / THÈSE

SPECIALISED MASTER IN INTERNATIONAL AND DEVELOPMENT ECONOMICS

Economic Growth, Income Inequality, and Poverty Nexus in Peru

GELAW, Ashiber

Award date:
2023

Awarding institution:
University of Namur

Link to publication

Economic Growth, Income Inequality, and Poverty Nexus in Peru

_____

Thesis presented by
Ashiber Tsegaye Gelaw

Supervisor(s)
Mary van Overbeke

Tutor(s)
Stéphanie Weynants

Academic year 2022-23

**Project presented as part of the requirements for the award of the
Specialized Master in International and Development Economics
Jointly organized by the ESLN and the ESL**

Abstract

This study investigates the relationship between economic growth, income inequality, and poverty in Peru in the period 1997-2019 by using the Autoregressive Distributed Lag (ARDL) model. The study founds a negative and significant relationship between economic growth and poverty both in the short and long run. The result also shows a positive and significant relationship between income inequality and poverty both in the short and long run. Moreover, the result also reveals that by reducing the level of income inequality, economic growth indirectly reduces the poverty headcount ratio. Furthermore, the result also shows that by promoting economic growth, the reduction in income inequality indirectly reduces the poverty headcount ratio. This implies that growth is a necessary but not a sufficient condition for poverty reduction. Therefore, as the reduction in the level of income inequality increases the poverty reduction effect of economic growth, this study suggests that governments should strengthen policies that would aim at reducing the level of income inequality, such as progressive taxation, social safety nets, and investment in infrastructure, education, and healthcare; which can help to promote more equitable income distribution and poverty reduction.

Keywords: ARDL, Economic Growth, Inequality, Poverty, and Peru

Acknowledgment

I would like to express my deep gratitude to everyone who has contributed to the success of this personal project.

Firstly, I would like to thank my supervisor, **Mary van Overbeke**, for her thoughtful comments, constructive advice, and stimulating discussions, which have greatly enriched this personal project. I appreciate your time and expertise.

I would also like to thank my tutor, **Stéphanie Weynants,** for her guidance, support, and valuable feedback throughout the project.

Finally, I would like to acknowledge my **family and friends** for their unwavering support and encouragement throughout this project. Your love and support have kept me motivated and inspired.

Table of Contents

Lists of Tables

List of Figures

1. Introduction

Poverty reduction remains a key policy goal in development strategies throughout the history of economic thought (Akanbi, 2016). For most countries, the success of development policies is increasingly judged by how well it addresses poverty levels (Fosu, 2017). Explicitly speaking, while some countries simultaneously enjoy higher growth and lower poverty rate; some other countries still face high levels of poverty even if they have fast-growing economies. Hence, the extent to which the poor benefit from the growth is important and become a hotly contested topic in development literature (Nguyen et al, 2020).

The empirical literature on the relationship between growth, inequality, and poverty also suggestes inconclusive results. For instance, literature like Dollar and Kraay (2002) argues that economic growth benefits all income groups proportionally. At the macro level growth enhances the quantity and quality of public resource availabilities, and at the micro level growth reduces poverty through the labor market by creating job opportunities. Hence, for them, growth is both a necessary and sufficient condition for poverty reduction (Zaman and Khilji, 2013). Literature like Bourguignon (2004) and Ravallion (2005) on the other hand argues that not only growth but inequality also matter for poverty reduction. Inequality accelerates poverty both directly and indirectly through growth. Hence, for them, growth is a necessary but not a sufficient condition for poverty reduction strategies.

Understanding the link between economic growth, inequality, and poverty reduction is extremely important to design effective and appropriate social policies and programs. While redistribution policies are prioritized if it helps a nation to reduce poverty more quickly; growth policies are prioritized when growth alone trickles down to the poor (Mulok et al, 2012). Moreover, growth and redistribution policies could also be complementary in fighting against poverty (Bourguignon, 2004). Historically, targeting inequality has not always been a top priority for major donor organizations when they implement anti-poverty programs (Permadi, 2018). Hence, currently more than 698 million and by 2030 nearly 600 million people in the world will struggle in extreme poverty (World Bank, 2022).

In the last two decades, most developing nations grow at the fastest rate even at a higher growth rate than those of developed nations. Since the 1990s poverty rate has also been declining in most developing countries. However, on the one hand, the progress has not been uniform where most of the reduction comes from China and India. On the other hand, extreme poverty is still high in most developing countries. Globally, most of the population who are living in extreme

poverty are from these countries. Inequality also remains a key development challenge in most developing countries (i.e. China, India, Brazil, South Africa…), which would pose a warning for the achievement of Target 1 of the Sustainable Development Goals (Fosu, 2017).

Like some developing countries, Latin America and Caribbean countries experiences a positive and fast growth rate in the past couple of years. On average Latin America and Caribbean countries grow by an annual average of 2.5% over the past 2 decades (World Bank, 2022). Contrarily, 32.1% of the population in the region live below the poverty line; of them, 13.1% are living in extreme poverty. One potential explanation might be the inequality level that we have observes in the region. As inequality affects poverty directly and indirectly, high-income inequality is considered detrimental to human development in most Latin American and Caribbean countries. As a region, Latin America and the Caribbean region is the 3rd unequal region next to MENA and SSA countries; where the top 10% of the population earns 55% and 77% of the total income and wealth, respectively (Chancel et al., 2022).

As a part of Latin America and Caribbean countries, the Peruvian economy has made significant socioeconomic progresses since the 1990s. With a 5% average annual growth, over the last two decades Peruvian economy has been among the fastest growing in Latin America and Caribbean countries. Moreover with an 11.21% average headcount ratio; the poverty rate in Peru has been substantially declining since the 1990s. Furthermore, since the 1990s with 47.7% average Gini coefficient inequality in Peru has been declining. Despite its rapid economic development and effective anti-poverty programs; still nearly 7 million Peruvians are suffering material deprivation (i.e. one out of five) and about 37.6% of the total population cannot access quality public services (INEI, 2022). Hence understanding the relationship between growth, inequality, and poverty reduction in Peru is extremely important to design appropriate poverty reduction programs and policies.

Explicitly speaking, for several reasons Peru is an interesting case study. Firstly, the Peruvian economy made dynamic progress in poverty, growth, and inequality over the past couple of years. Secondly, in the existing literature, the relationship between inequality, growth, and poverty has produced conflicting results. Lastly, even if a lot of empirical studies have been documented on the nexus, there seems to exist a dearth of empirical studies in Peru. Hence, to zoom in on the resolution and understand better the nexus between inequality, growth, and poverty; further research is required. At large by filling the above gaps, this study tries to answer the following questions: Does economic growth affects poverty in Peru? Does income inequality affect poverty in Peru? Does income inequality affect economic growth?

The rest of the paper is organized as follows. Part 2 presents the theoretical and empirical literature reviews. Part 3 discusses the research methodology part of the study. Part 4 will present the result and discussion part of the study. Lastly, part 5 will present the conclusion and recommendation part.

2. Literature Review

2.1. Theoretical channels on how growth and inequality are related in fighting against poverty

In contemporary economic literature, several theories have been developed on the link between growth, inequality, and poverty reduction. One of the most prominent models is the Poverty-Growth-Inequality Triangle (GIP) model. The triangular relationship between growth, inequality, and poverty was popularized by a former World Bank chief economist, François Bourguignon in 2004. Accordingly to the model, a change in economic growth and income inequality fully explains changes in poverty in a given nation. Henceforth, the GIP triangle becomes the finest poverty framework to develop better poverty reduction strategies. The intricate relationship between growth, inequality, and poverty is graphically represented by a triangle with arrows emerging from each corner that signifies cause and effect (see Figure 1 below). As a representation, "Absolute poverty" which represents the proportion of people whose income is below the poverty line is located at the top of the triangle. "Income inequality" which measures the variation of income among the population is located at the bottom left corner of the triangle. Finally, "Growth" which measures the change in Gross Domestic Product (GDP) in a given nation is located at the bottom right corner of the triangle. Consequently, poverty in this model is expressed as a function of growth, inequality, and changes in inequality (Bourguignon, 2004).

In contrast to earlier models of poverty, this model scrutinizes the interaction of inequality and growth rather than treating them separately. According to the model, a combination of national policies that aim at both growth and inequality is indispensably important to reduce poverty. Hence, the opportunity to reduce poverty would miss if the development strategies of a country focus either on growth or inequality. In the GIP triangle, there are two ways that income inequality affects poverty. Firstly, income inequality affects absolute poverty by directly altering the numbers of the population who are living in poverty. Secondly, income inequality affects poverty indirectly by affecting economic growth (through the growth elasticity of poverty). Therefore, the country's ability to reduce poverty would be restricted in these two ways if policymakers simply focused on growth policies. Because of this, economists now a day predict

that Sub-Saharan Africa and other developing nations would not be able to meet Sustainable Development Goals through growth policies alone (Bourguignon, 2004).

Figure 1: Conceptual framework on the growth-inequality-poverty triangle
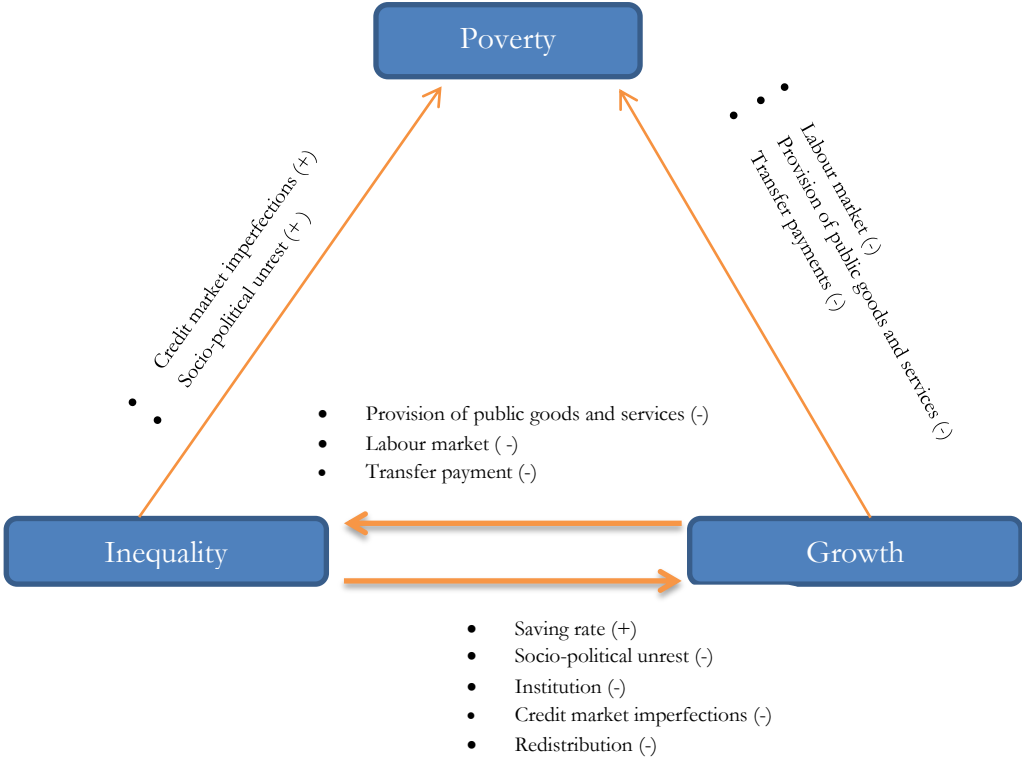
Source: Self-developed based on Bourguignon (2004)

Pronouncedly speaking, the relationship between growth, inequality, and poverty might be negative, positive, or inconclusive. Whether the link is positive, negative, or inconclusive; it depends on the channel that links inequality and growth. Hence, from the theoretical literature, we can identify the following transmission mechanisms: savings rate, socio-political unrest, institution, credit market imperfections, provision of public goods, and labor market. Let's look at each transmission mechanism one by one.

The channel that links growth and poverty

Through the public goods and services provision channel, the effect of growth on poverty is negative (Blau, 2018). This is because the expansion of growth raises the capacity of the public sector to collect taxes and the tax base. Explicitly speaking, a greater tax ratio makes it easier to provide public goods that may benefit the poor, such as health and education. These provisions in public goods and services increase the well-being of the poor which further able to decreases the poverty level.

Through the transfer channel, the effect of economic growth on poverty has also been negative. This is because, with increases in economic growth, the capacity of the public sector to collect taxes and the tax base has expanded and made it easier for the government to provide social programs i.e. cash transfers, school feeding, unemployment, and pension payments, which further able to reduces the poverty level (Breunig and Majeed, 2020).

Through the labour market channel, the effect of growth on poverty is negative. This is because as the economy grows, there is an increase in demand for goods and services; hence, firms need to hire more workers to meet the increased demand, leading to an increase in employment. Economic growth can also create new opportunities for businesses and industries to expand, which can lead to the creation of new jobs. This increases the labor income and hence reduces the poverty level (Akanbi, 2016).

The channel that links inequality and poverty

Through the imperfect capital market channel, the effect of income inequality on poverty is positive (Piketty, 1997). This is because, under an imperfect credit market, high levels of inequality can lead to limited access to credit for low-income households, which can make it difficult for them to invest in education, start businesses, or purchase assets that can help them escape poverty hence in turns intensify the poverty level.

Through socio-political unrest channels brought on by worsening income disparity, the effect of inequality on poverty is positive. This is because high levels of inequality can lead to discontent and unrest among the poor, who may feel that they are being left behind by the rest of society. This can lead to protests, strikes, or even violence, which result in the destruction of physical infrastructures, forced displacement, and diversion of resources from productive to unproductive… these make it difficult to pursue poverty reduction efforts (Lakner et al., 2020).

The channel that links inequality and growth

Through the saving channel, inequality has a favorable effect on economic growth (Aghion et al., 2019). This is under classical economists, who relate saving as a function of income. Accordingly, as the marginal propensity to save for rich people is higher than the poor, with high income inequality richer people can save more. Hence by raising the aggregate savings and capital accumulation, high-income disparities are favorable for economic growth.

Through the institution channel, high-income inequality has also an unfavorable effect on economic growth (Hoff and Stiglitz, 2004). This is because, in societies with high levels of

inequality, a small group of wealthy individuals or corporations may have a disproportionate amount of wealth and power. This concentration of wealth and power can make it easier for these individuals or corporations to use their resources to influence government officials, policymakers, and other decision-makers to advance their interests. This creates fertile ground for extractive institutions that exacerbates inefficiency which in turn limits the productive capacity of the economy.

Through the redistribution channel, income inequality has negatively affected economic growth. This is because with high inequality levels usually the government applies redistribution policies (i.e. regressive taxation) to control it and get a public vote, but these discourage investment and hence lower the productive capacity of the economy (Loayza and Raddatz, 2010).

Through socio-political unrest channel, the effect of inequality on economic growth is also negative. this is because high levels of social unrest resulting from worsening inequality, cause people to engage in unproductive activities (protests, strikes, violence, crime…), which leads to destruction, damage, and displacement which in turn reduce/discourage investments (Lakner et al., 2020). This reduction in investment limits the productive capacity of the economy.

Through the imperfect capital market channel, the effect of income inequality on growth is negative. This is because, under an imperfect credit market, high levels of inequality can lead to limited access to credit for low-income households, which can make it difficult for them to invest in education, start businesses, or purchase assets. This credit constraint reduces the investment level which in turn limits the productive capacity of the economy (Akanbi, 2016).

The channel that links growth and inequality

Through the public goods and services provision channel, the effect of growth on inequality is negative (Blau, 2018). This is because as the economy grows, governments may have more resources available to invest in public goods like education and healthcare that may benefit the poor. These provisions in public goods and services increase the well-being of the poor which further decreases the inequality level.

Through the transfer channel, the effect of economic growth on inequality is negative. This is because, as the economy grows, governments may have more resources available to invest in programs (cash transfers, school feeding, unemployment insurance, pensions, and healthcare coverage) that are designed to help those in need. This can help to address income inequality by

providing support to those who may not have had access to it before (Breunig and Majeed, 2020).

Through the labor market channel, the effect of economic growth on inequality is inconclusive. On one hand, if the technological change is skill-biased, economic growth increases the income of high-skilled workers relative to low-skill workers and hence increases income inequality and poverty (Krusell et al. 2000). On the other hand, growth induces more work effort by offering higher returns to labor hence people with higher incomes would increase their work less than persons with lower income if leisure is assumed to be a normal good (Bick et al, 2018). This reduces both inequality and poverty level. Moreover, if growth happens in the sector where the majority of the population has participated; growth reduces inequality and poverty as it creates more job opportunities for majorities (Loayza and Raddatz, 2010).

2.2. Empirical Literature Reviews

Growth, poverty, and inequality have been linked in a large body of theoretical and empirical research. These inquiries unsurprisingly have verified that there is a significant link between these variables. Yet, the relationships between inequality, growth, and poverty are extremely complicated.

Kolawole et al. (2014) examines the dynamics of economic growth, inequality, and poverty in Nigeria for the period 1980-2012 by using Ordinal Least Square (OLS) estimation techniques and found a positive relationship between economic growth and inequality but a negative relationship between growth and poverty. Katsushi et al. (2015) also examine the relationship between agricultural growth, inequality, and poverty in 46 developing countries for the period 1970-2008 by using a fixed and random effect method of estimation and found a negative relationship between agricultural growth and poverty. Similarly, Akanbi (2016) examines the relationship between growth, inequality, and poverty in South Africa for the period 1995-2012 by using the OLS estimation technique and found a negative relationship between growth and poverty. The result also shows a negative relationship between poverty and inequality.

Permadi (2018) also investigates the relationship between growth, inequality, and poverty in Indonesia for the period 2005-2013 by using Random Effect (RE) and Fixed Effect (FE) estimation techniques and found a negative relationship between economic growth and poverty. The result also shows that growth in the manufacturing sector has a significant impact on poverty reduction. Iniguez and Kurosak (2018) examine the dynamics of growth, inequality, and poverty in Mexico for the period 1992-2014 by using the Generalized Method of Moment (GMM)

estimation technique and found a negative relationship between economic growth and income inequality. Their result also shows a positive relationship between inequality and poverty. Zaman et al. (2019) analyzes the dynamics of growth, inequality, and poverty in 124 countries for the period 2010-2013 by using pooled mean group estimator and founds that the average income of households reduced poverty. The result also shows a positive relationship between inequality and poverty headcount.

Adeleye et al. (2020) conducts a comparative analysis of the dynamics of growth, inequality, and poverty between 58 Sub-Saharan and Latin American and Caribbean countries for the period 2000-2015 by using RE, FE, and GMM and found a negative relationship between economic growth and poverty in all sample but the magnitude differs across regions. Their result also shows a positive relationship between inequality and poverty. Bergstrom (2020) analyzes the role of inequality in poverty reduction in 135 countries for the period 1974-2018 by using the OLS estimation technique and found a negative relationship between growth and poverty and a positive relationship between inequality and poverty. Hence, growth is a necessary not a sufficient condition for poverty reduction. Lakner et al. (2020) simulate the effect of inequality on poverty reduction in 166 countries for the period 2029-2030 and found a poverty reduction effect of economic growth and a positive relationship between inequality and poverty headcount ratio.

Breunig and Majeed (2020) analyzes the relationship between economic growth, inequality, and poverty in 152 countries for the period 1956-2011 by using the GMM estimation technique and found that inequality negatively affects economic growth when they included poverty. Their result also indicates that growth also negatively affects poverty and policies that target poverty reduction promote economic growth. Zhu et al. (2022) assesses the relationship between growth and poverty in Vietnam for the period 1990-2016 by using various estimation techniques and found that economic growth is a matter for poverty reduction. Their result also indicates that inequality and poverty have negatively affected economic growth.

Loayza and Raddatz (2010) examine the effect of growth on poverty reduction in 55 developing countries by using the OLS estimation technique and found a negative relationship between economic growth and poverty. The result also reveals that not only growth but also its composition matters for poverty reduction as growth in labor-intensive sectors have more poverty reduction elasticity. Fosu (2017) examines the dynamics of growth, inequality, and poverty in 123 developing countries for the period 1977-2007 by using RF, FE, and GMM estimation techniques and found that the effect of growth on poverty is influenced by initial inequality. The result also reveals a positive relationship between inequality and poverty. Adams

(2014) estimates the growth elasticity of poverty in 60 developing countries for 126 new data set intervals by using the first difference estimation technique and found a negative relationship between growth and poverty when growth is measured as a change in consumption but the result turned to insignificant when growth is measured as change in GDP per capita. Zaman and Shamsuddin (2017) analyze the relationship between growth, inequality, and poverty in 18 Latin American and Caribbean countries for the period 1981-2013 by using OLS and GMM estimation techniques and found that growth has a poverty reduction effect but it is not a sufficient condition. This implies that the poverty reduction effect of economic growth is influenced by income distribution.

Mulok et al. (2012) also analyzes the effect of economic growth on poverty in Malaysia for the period 1970-2009 by using the Autoregressive Distributive Lag Model (ARDL) estimation technique and found an insignificant effect of growth on poverty. Stephen and Simeon (2013) examine the effect of economic growth on poverty reduction in Nigeria for the period 1981-2008 by using the OLS estimation technique and found that economic growth does not reduce poverty. Khemili and Belloumi (2018) analyzes the relationship between growth, inequality, and poverty in Tunisia for the period 1970-2013 by using the ARDL estimation technique and found a negative relationship between growth and poverty and inequality and poverty in the short run. Their result also shows a positive relationship between inequality and poverty in the long run while growth insignificantly affects poverty.

Bourguignon (2002) estimates the relationship between growth, inequality, and poverty in 50 countries by using the OLS estimation technique and found that the poverty reduction effect of growth is much more affected by inequality. Son (2007) examines the interrelationship between growth, inequality, and poverty in 7 Asian countries for the period 1981-2001 by using the OLS estimation technique and found a positive relationship between inequality and poverty. Cheema and Sial (2012) investigates the relationship between growth, inequality, and poverty in Pakistan for the period 1993-2008 by using FE and RF estimation techniques and found a positive relationship between inequality and poverty. The result also shows a positive effect of growth on inequality and the effect of growth on poverty is also offset by rising inequality.

Nguyen et al. (2020) investigates the relationship between growth, inequality, and poverty in Vietnam for the period 1996-2014 by using the OLS estimation technique and found a positive relationship between inequality and poverty. Wan et al. (2020) examines the relationship between growth, inequality, and poverty in 87 Asian countries for the period 1960-2017 by using the OLS estimation technique and found a positive relationship between inequality and poverty.

Contrarily, Ajibola et al. (2018) examine the implication of poverty and inequality for pro-poor growth in Nigeria for the period 1980-2013 by using the OLS estimation technique and found a negative effect of inequality on poverty.

By using fixed effect and pool regression models, Niyimbanira (2017) also investigates the effect of growth on poverty and inequality in South Africa for the period 1996-2014 and found a poverty reduction effect of growth but growth increases income inequality. Scholl and Klasen (2019) re-examines the relationship between economic growth and inequality in 122 countries for the period 1961-2012 by using Instrument Variable (IV) and GMM methods of estimation and found a positive relationship between growth and inequality in all sampled countries. Blau (2018) examines the relationship between inequality, poverty, and liquidity of the stock market in 91 countries for the period 1960-2014 by using the OLS estimation technique and found that stock market liquidity is negatively affecting income inequality and poverty. The result also indicates a negative relationship between liquidity-induced wage growth and inequality and poverty.

Brueckner and Lederman (2018) analyze the role of initial income on economic growth and income inequality in 144 countries for the period 1970-2010 by using Two-stage Least Square (2SLS) and GMM estimation techniques and found that higher income inequality positively affects low-income countries while such effect turned negative in high-income countries. Erman and Kaat (2019) examines the effect of inequality on growth (industry-level value-added growth) in 86 countries and 22 industries for the period 1980-2012 by using the OLS estimation technique and found that a positive relationship in capital-intensive industries, and a negative relationship in skilled labor-intensive industries.

Jaumotte et al. (2013) analyze the relationship between income inequality, trade, and financial globalization in 51 countries for the period 1981-2003 by using FE estimation techniques and found a negative relationship between trade integration and inequality and a positive relationship between financial globalization and inequality. Foster and Székely (2008) examine the effect of economic growth on poverty in 20 countries for the period 1976-1999 by using IV and GMM estimation techniques and found no statistically significant effect of growth on income distribution. Brueckner et al. (2014) analyzes national income and its distribution in 154 countries for the period 1960-2007 by using the 2SLS method and found a positive relationship between economic growth and income inequality.

3. Methodology of the Study

3.1. Description of the study area

This study is conducted in Peru. Peru is a country located in South America, bordered by Ecuador, Colombia, Brazil, Bolivia, Chile, and the Pacific Ocean. With a population of approximately 32 million people, Peru is the third most populous country in South America. The capital city of Peru is Lima, which is home to approximately 10 million people and is the country's largest city.

Figure 2: Map of Peru

Source: Bergmann (2021)

The Peruvian economy is driven by the services sector which accounts for approximately 62% of GDP, followed by manufacturing at 15%, the mining sector at 15%, and agriculture at 7%. As shown in Figure 3 below, the GDP growth rate of Peru fluctuated with a minimum of -0.39% and a maximum of 9.13% in 1998 and 2008, respectively. A negative growth rate in 1998 could be explained by the 1997/98 *El Niño* that has been happened in the northern part of Peru where its cost was estimated to be $32-96 billion. Moreover, from 2003-2008 the Peruvian GDP growth rate has increased rapidly from 4.17% to 9.13%. This was partly explained by the export boom that has been experienced from 2003 to 2010 with the rise of China. It has increased from USD 6.3 billion in 1998-2000 to USD 28.8 billion in 2007-2009 as around 33% of its export goes to China. Explicitly speaking, on average from 2003 to 2008 the prices and volume of commodity exports has been increased by 13.7% and 5.3%, respectively. Furthermore, from 2001 to 2008 exports made up 22.6% of the GDP. Hence the positive trended growth rate that has been observed in Peru from 2003-2008 could be partly explained by the boom in the export sector. Due to the

2008/9 global financial crisis, in 2009 growth rate of GDP has been declined and in the aftermath due to government stimulus measures GDP growth rate has been increased. However, after 2010 there was a downturn in trade with China, hence export value showed a slight reduction, and the GDP growth rate has been declined.

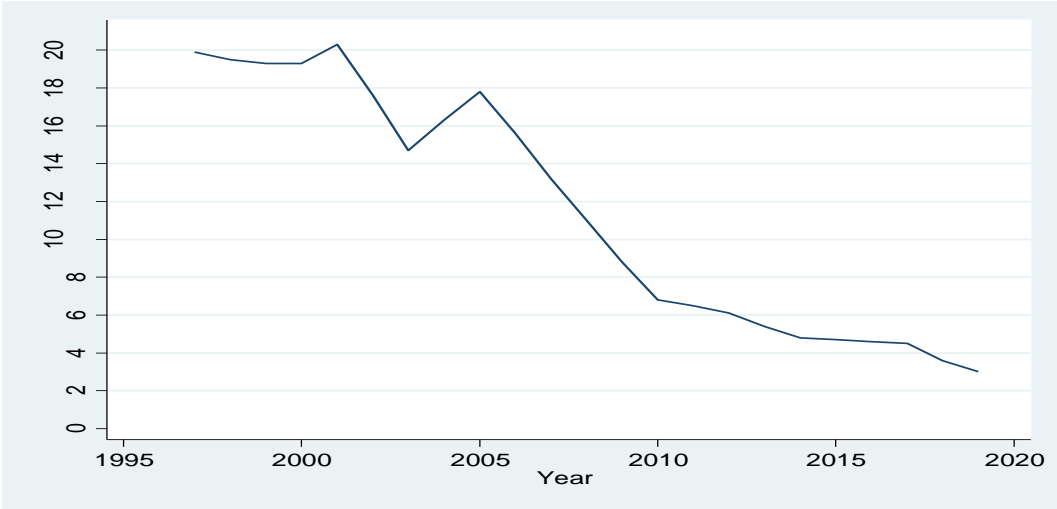**Figure** 3: GDP growth rate of Peru from 1997-2019
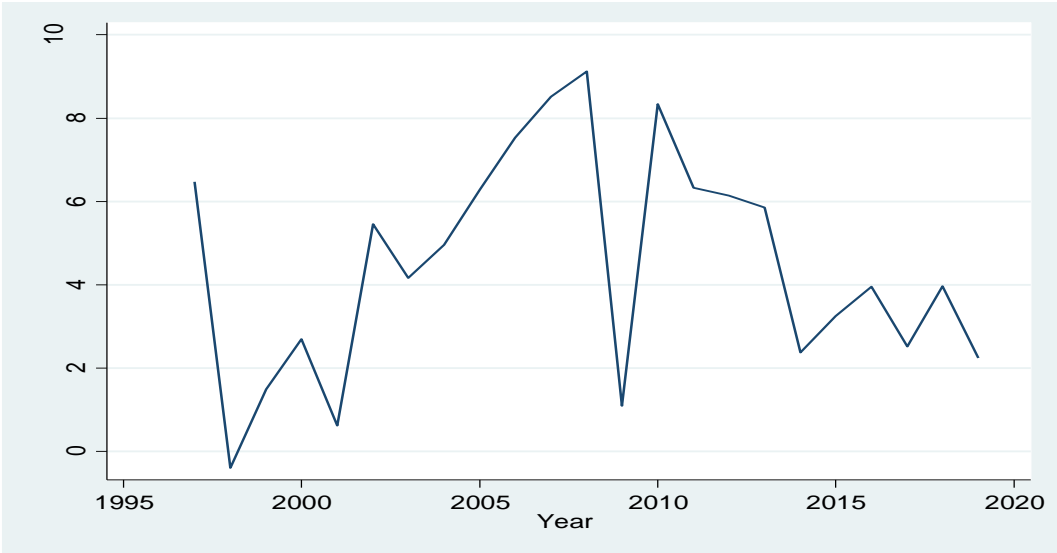
Source: World Bank, 2022

With an 11.45% average annual headcount ratio from 1997-2019 poverty rates in Peru has been substantially declining. As Figure 4 below shows, the minimum and maximum headcount ratio of Peru was 3% and 20.3% in 2019 and 2001, respectively.

**Figure 4**: Poverty headcount ratio of Peru from 1997-2019

Source: World Bank, 2022

From 2005-2010 poverty headcount ratio has been declined rapidly due to the increment in government expenditure from expansion in the export sector. In this memo, the government's general social spending has increased from 24,046 million sole in 2003 to 33,425 million sole in 2008. The government also implemented a conditional cash transfer program (i.e. Juntos) in the 2000s where each eligible individual receives a fixed 100 soles (approximately 30 USD) per month (World Bank, 2022). Despite this reduction in the poverty headcount ratio still, 12.1% and 2.1% of the poor live in extreme poverty in rural areas and urban areas, respectively.

Furthermore, with a 47.7% average annual Gini coefficient from 1997 to 2019 income inequality in Peru has been sharply declining. The Peruvian economy ranked 31st in the world Gini index ranking in 2020. The minimum and maximum Gini index was 41.6 (in 2019) and 55.1 (in 1998), respectively (see Figure 5 below). From 2004 to 2008 inequality has been declined rapidly because of an increase in government transfers to the most vulnerable people as a result of the boom in the export sector (World Bank, 2022). Despite this rapid socio-economic progress; still, nearly 7 million Peruvians are suffering material deprivation (i.e. one out of five) and about 37.6% of the total population cannot access quality public services (INEI, 2022). Hence understanding the relationship between growth, inequality, and poverty reduction in Peru is extremely important to design appropriate poverty reduction programs and policies.

Figure 5: Gini-coefficient in Peru from 1997-2019
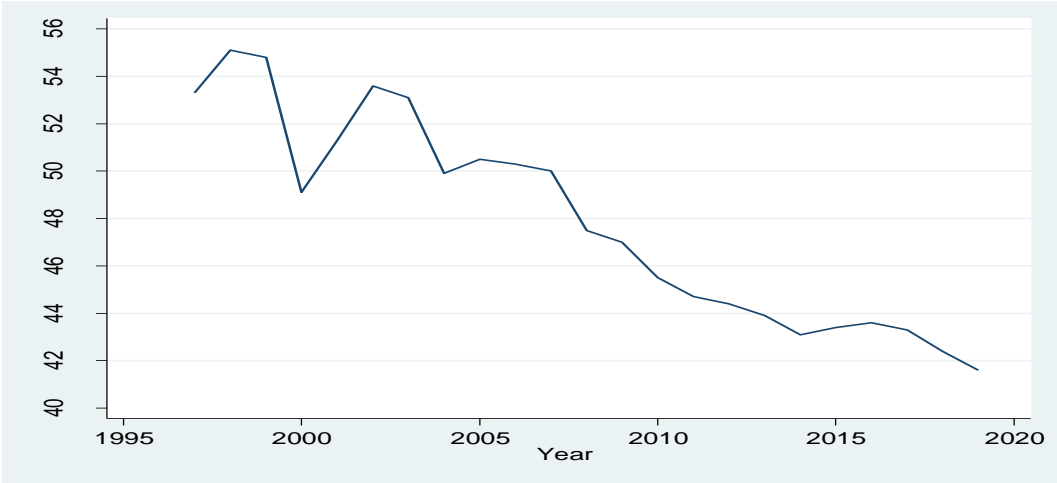
Source: World Bank, 2022

3.2. Source of data

This study will utilize annual time series data obtained from World Development Indicator Databases for the period 1997-2019.

3.3. Model specification

According to the Growth-Inequality-Poverty triangle model that we discussed earlier, a change in economic growth and income inequality fully explains the changes in poverty in a given nation (Bourguignon, 2004). Hence, poverty in this model is expressed as a function of growth and inequality.

$$P = F(G, I)$$

Where P is the poverty level, G is economic growth and I is income inequality.

Estimating the relationship between economic growth, income inequality, and poverty using econometric methods involves developing statistical models that capture the relationships among these variables, testing hypotheses about the direction and strength of these relationships, and evaluating the robustness of the results.

Hence, following Pesaran et al (2001), Hicham (2016), and Khemili and Belloumi (2018) this study employed Autoregressive Distributed Lag (ARDL) model to examine the relationship between growth, inequality, and poverty in Peru.

ARDL model is a multivariate regression model used to analyze the relationships among economic variables. ARDL model is a combination of autoregressive and distributive lagged models. The distributed lag element of the model arises as it relates the current value of the independent variables with its past values; whereas, the autoregressive part arises as it relates the current value of the dependent variable with its past value. The ARDL model also includes an error correction term, after confirming the existence of co-integration among variables. This term represents the extent to which the deviation from the long-run equilibrium value of the dependent variable is corrected in the next period (Pesaran and Shin, 1997). The ARDL model can be estimated using ordinary least squares (OLS) or Maximum Likelihood Estimation (MLE) methods.

The choice of ARDL model in this study is based on the following reasons: (1) the model is applicable regardless of whether variables are I (0), I (1) or mixed co-integrated unless it is not I(2); (2) the model leads to a more reliable and better result with small sample sizes than other co-integration techniques (3) the model simultaneously estimates both the long-run and short-run parameters regardless of the lag length of the variables; (4) the model corrects the omitted lagged variable bias; (5) the model also addresses endogeneity issues.

Poverty in this study is measured by the poverty headcount ratio, which is commonly used to measure the extent of poverty within a population. It quantifies the percentage of people living below a certain poverty line or threshold. However; poverty headcount ratios typically focus on income or consumption as the sole indicator of poverty. This narrow focus may overlook other important dimensions of poverty, such as education, health, housing conditions, or social exclusion, which are crucial in understanding and addressing poverty comprehensively. Moreover, poverty headcount ratios provide a snapshot of poverty at a particular point in time. They may not capture changes in poverty levels over time or fluctuations due to seasonal or cyclical factors.

Income inequality is measured by the Gini coefficient which measures how far the income distribution deviates from perfect equality. Its value ranges between 0 and 1, where 0 represents perfect equality (i.e., every individual or household has an equal share of income), and 1 represents perfect inequality (i.e., a single individual or household possesses all the income). However; the Gini coefficient primarily focuses on the distribution of income and does not capture other dimensions of inequality, such as disparities in education, healthcare, social mobility, or access to opportunities. Moreover; the Gini coefficient is relatively insensitive to the changes in the middle-income groups. It places more weight on extreme values and hence does not adequately capture changes in inequality within the middle class, where a significant portion of the population resides.

Economic growth in this study is proxy by the real GDP per capita, also known as per capita income, which measures a country's economic output per person. It represents the total value of goods and services produced in an economy adjusted for inflation and divided by the population. However; real GDP per capita primarily focuses on market-based economic activities excluding non-market or informal sector activities, such as subsistence farming or unpaid household work. This exclusion can underestimate the economic well-being of certain population segments where a large percentage of the population in developing countries like Peru is engaged in these activities. Moreover; real GDP per capita provides a measure of economic output but does not capture other dimensions of well-being, such as healthcare, education, environmental quality, or social factors.

Accordingly, this study specifies the following three ARDL models:

Model 1: To examine the effect of growth and inequality on poverty

$$\Delta Pov\,t = \beta 0 + \sum_{i=1}^{q} \beta 1 \Delta Pov\,t-1 + \sum_{i=1}^{p} \beta 2 \Delta Gini\,t-1 + \sum_{i=1}^{p} \beta 3 \Delta lnrgdp\,t-1 + \delta 1 Pov\,t-1 + \delta 2 Gini\,t-1 + \delta 3 lnrgdp\,t-1 + vt$$

Model 2: To examine the indirect effect of economic growth on the poverty

$$\Delta Pov\,t = \beta 0 + \sum_{i=1}^{q} \beta 1 \Delta Pov\,t-1 + \sum_{i=1}^{p} \beta 2 \Delta Gini\,t-1 + \sum_{i=1}^{p} \beta 3 \Delta gdpgini\,t-1 + \delta 1 Pov\,t-1 + \delta 2 Gini\,t-1 + \delta 3 gdpgini\,t-1 + vt$$

Model 3: To examine the indirect effect of income inequality on the poverty

$$\Delta Pov\,t = \beta 0 + \sum_{i=1}^{q} \beta 1 \Delta Pov\,t-1 + \sum_{i=1}^{p} \beta 2 \Delta lnrgdp\,t-1 + \sum_{i=1}^{p} \beta 3 \Delta gdpgini\,t-1 + \delta 1 Pov\,t-1 + \delta 2 lnrgdp\,t-1 + \delta 3 gdpgini\,t-1 + vt$$

If there is co-integration among variables, the study will employ the following ECM models

Model 1:

$$\Delta Povt = \beta 0 + \sum_{i=1}^{q} \beta 1 \Delta Pov\,t-1 + \sum_{i=1}^{p} \beta 2 \Delta Gini\,t-1 + \sum_{i=1}^{p} \beta 3 \Delta lnrgdp\,t-1 + \lambda ECT\,t-1 + \mu t$$

Model 2:

$$\Delta Povt = \beta 0 + \sum_{i=1}^{q} \beta 1 \Delta Pov\,t-1 + \sum_{i=1}^{p} \beta 2 \Delta Gini\,t-1 + \sum_{i=1}^{p} \beta 3 \Delta gdpgini\,t-1 + \lambda ECT\,t-1 + \mu t$$

Model 3:

$$\Delta Povt = \beta 0 + \sum_{i=1}^{q} \beta 1 \Delta Pov\,t-1 + \sum_{i=1}^{p} \beta 2 \Delta lnrgdp\,t-1 + \sum_{i=1}^{p} \beta 3 \Delta gdpginit-1 + \lambda ECT\,t-1 + \mu t$$

Where,

> **Pov**[1] is the poverty headcount ratio, **Gini**[2] is the Gini coefficient, **lnrgdp**[3] is a log of real GDP per capita, and **gdpgini** is the interaction term of the Gini coefficient and real GDP per capita. β's are short-run parameters, δ's are long-run parameters, v_t & μ_t are the error term of the ARDL and EC model respectively, Δ is the difference operator; **q** & **p** are the lag length of dependent and independent variables respectively, λ is the speed of adjustment parameter and **ECT** is error correction term which is residuals from the estimated ARDL model.

---

[1] *Poverty headcount ratio used as a proxy for poverty at international poverty line*

[2] *Gini coefficient used as a proxy for inequality*

[3] *GDP per capital used as a proxy for economic growth*

4. Result and Discussion

4.1. Unit root test

Since most macroeconomic variables are not stationary, the first step in time series analysis is to test for the stationarity of the variables. A variable is said to be stationary if its properties (mean, variance, covariance…) are independent of the observational time. Non-stationary time series regression; therefore, leads to a spurious result. Hence it is important to check whether the variables are unit root or not before conducting a regression. Dickey-Fuller and Philips Perron are the most commonly used methods to test unit root tests of a variable. Consequently, table 1 below presents the result of the Dickey-Fuller and Philips Perron tests.

Table 1: Result of Augmented Dickey-Fuller and Philips Perron

Variables	Dickey-Fuller (DF)			Philips Perron (PP)		
	Level	1st Difference	Decision	Level	1st difference	Decision
Pov	-0.464	-3.385**	I(1)	-0.480	-3.294**	I(1)
Gini	-0.766	-5.316***	I(1)	-0.418	-5.845***	I(1)
lnrgdp	0.133	-3.022**	I(1)	-0.051	-2.976*	I(1)
gdpgini	-1.180	-5.176***	I(1)	-0.805	-5.640***	I(1)

*Note: *, ** & *** represent stationarity at 10% , 5% & 1% respectively*

Source: authors' computation

As presented in the above table, the result of the DF test shows that poverty and growth are stationary at the first difference at a 5% level of significance. This result is also confirmed by the PP test where poverty and growth are stationary at I(1) at 5 % and 10% level of significance, respectively. Moreover, the result also shows that inequality and the interaction term are stationary at the first difference at a 1% level of significance in both tests (i.e. ADF and PP). Furthermore, none of the variables are integrated at the second difference i.e. I (2). Hence, based on the orders of integration this study employed the ARDL bounds test for the co-integration test.

4.2. ARDL Model

After checking the stationarity of the variables, the next step is to check whether the variables are co-integrated in the long run or not. Specifically, co-integration measures whether the mean difference of variables is constant or not. Johansen's, Philip-Ouliaris, Engle-Granger Two-Step, and ARDL bounds tests are the most common methods to test co-integration in time series analysis. Following the stationary order of the variables, the study employed ARDL bound tests to determine the co-integration relationship of the variables. The F statistics results of the ARDL

bound tests are 10.282, 11.070, and 8.699 in models 1, 2, and 3, respectively. As the F statistics in all models is higher than the 5% critical value of I(1), the results of Table 2 below imply that there is a co-integration relationship among variables in the long run.

Table 2: ARDL bound tests

Model	Hypothesis	Level of significance	Lower I(0)	Upper I(1)	Decision
Model 1	*H0: No co-integration*	1%	5.15	6.36	**Reject H0**
		2.5%	4.41	5.52	
		5%	3.79	4.85	
		10%	3.17	4.14	
Model 2	*H0: No co-integration*	1%	5.15	6.36	**Reject H0**
		2.5%	4.41	5.52	
		5%	3.79	4.85	
		10%	3.17	4.14	
Model 3	*H0: No co-integration*	1%	5.15	6.36	**Reject H0**
		2.5%	4.41	5.52	
		5%	3.79	4.85	
		10%	3.17	4.14	

Source: authors' computation

4.3. Long run and Short run analysis

After confirming the long-run relationship among variables in all models, the next step is to estimate the long and short-run parameters of the model. To do so, in the following section the study presents the effect of economic growth on poverty, the effect of inequality on poverty, and the indirect effect of growth and inequality on poverty by specifying the short and long-run Unrestricted Error Correction[4] for all models separately.

4.3.1. The effect of economic growth on poverty

$$SR: Pov_t = 53.8789 + 0.8859\, Pov_{t-1} + 0.5393\, Gini_{t-1} - 9.1754\, lnrgdp_{t-1}$$
$$(44.1357) \quad (0.1574) \quad\quad (0.1446) \quad\quad\quad (3.9667)$$

$$LR: Pov_t = 53.8789 + 0.7409\, Pov_{t-1} + 0.8086\, Gini_{t-1} - 10.7306\, lnrgdp_{t-1}$$
$$(44.1357) \quad (0.1583) \quad\quad (0.2972) \quad\quad\quad (4.4571)$$

---

[4] UECM is a model that does not impose any restrictions on the coefficients of the model, allowing the data to determine the parameters that best describe the relationships between the variables.

$$ECTt - 1 = -0.8550 \; (0.1553)$$

The short-run result of the above specification shows that growth has a negative and significant effect on poverty. Accordingly, a one percent increase in growth is associated with on average a 0.09 percentage point reduction in poverty headcount ratio, at ceteris paribus, and it is statistically significant at a 5% level of significance. Similarly, the long-run result of the model confirms the short-run relationship where a one percent increase in growth is associated with on average a 0.01 percentage point reduction in poverty headcount ratio, at ceteris paribus, and it is statistically significant at a 5% level of significance. This implies that growth in Peru has been translating to poverty reduction. This result is in line with the conclusion made by Kolawole et al. (2014), Katsushi et al. (2015), Akanbi (2016), Santos et al. (2016), Fosu (2017), Iniguez and Kurosak (2018), Zaman et al. (2019), Permadi (2019), Bergstrom (2020), Adeleye et al. (2020), Breunig and Majeed (2020), Lakner et al. (2020), and Zhu et al. (2022) who founds a negative relationship between growth and poverty but different in magnitude. Moreover, the coefficient of the speed of adjustment in the error correction model is negative and statistically significant at a 1% level of significance, which implies that within a year about 85.5% of the short-run distortion in poverty has been corrected and converges to the long-run equilibrium.

The result could be explained by the following three scenarios:

Firstly, by raising the capacity of the public sector to collect taxes, economic growth makes it easier for the government to provide public goods and services that benefit the poor (Blau, 2018). Explicitly speaking, when the economy is growing, individuals and businesses tend to earn more money, which increases the tax revenue of the government. In addition, economic growth also increases the sales tax revenue by increasing the consumption of goods and services. As more goods and services are purchased, the government collects more revenue in the form of taxes on those transactions (Zhu et al., 2022). Hence, as theoretically economic growth is supposed to increase the provisions of public goods and services, this increment in tax revenue makes it easier for the government to provide it and hence contribute to the reduction of poverty by improving their human capital. Furthermore, economic growth also creates new opportunities for innovation and technological advancement, which leads to improvement in the provision of public goods and services and hence contributes to the reduction of poverty (Adeleye et al., 2020). According to OECD (2020) reports on public governance reform in Peru the provision of

public goods and services (i.e. education, health, infrastructure, etc.) can play a crucial role in poverty reduction in Peru.

Specifically, to sustain its economic growth, Peru has undergone several macroeconomic reforms in the past two decades. Of these, according to INEI (2020), the following are the most effective and significant macroeconomic reforms that have been implemented in Peru:

- In 1999, Peru passed the Fiscal Responsibility Law, which mandated that the government maintain a balanced budget and limit its borrowing. This law was aimed at controlling inflation and reducing the country's debt burden.
- Since the late 1990s, Peru has implemented several trade liberalization policies, including the reduction of tariffs and the signing of free trade agreements with several countries. These policies aimed to increase competition, reduce the cost of imports, and promote exports.
- Since the late 1990s, Peru has privatized many state-owned enterprises, including utilities, telecommunications, and mining companies. This policy aimed to increase efficiency and reduce government spending.
- Since the early 2000s, Peru has reformed its financial sector by liberalizing interest rates, removing restrictions on foreign investment, and strengthening bank supervision. These reforms aimed to increase the availability of credit and promote investment.
- In the recent past, Peru has also implemented several tax incentives aimed at promoting investment and economic growth. For example, the government offers tax breaks for companies that invest in research and development, and it provides tax incentives for companies that operate in special economic zones.

Secondly, by raising the capacity of the public sector to collect taxes, economic growth also enhances the provisions of social security programs that benefit the poor and most vulnerable members of society (Breunig and Majeed, 2020). Specifically, by providing support to those who are most in need, and by promoting human capital development among the poorest segments of society; the provisions of social programs reduce the poverty rate. To do so, in the recent past, Peru has implemented several social programs that aimed at reducing poverty, improving health and education, and promoting social inclusion. Of these, according to INEI (2020), the following are the most effective social programs that have been implemented in Peru:

- Since 2002 Peru has implemented a health insurance program called Seguro Integral de Salud (SIS) that provides free healthcare to poor families who are not covered by other

insurance programs. Since its implementation, the program provides healthcare services to over 10 million beneficiaries.

- Since 2005 Peru has implemented a conditional cash transfer program called Juntos that provides cash transfers to poor families in exchange for their commitment to keep their children in school, get them vaccinated, and attend health check-ups. Since its implementation, the program has reached over 2 million households and provides a cash transfer to over 3.7 million children.

- Since 2008 Peru has also implemented a cash transfer program called Pensión 65 that provides a monthly cash transfer to elderly citizens who are living in poverty. Since its implementation, the program has reached over 540,000 elderly beneficiaries across the country.

- Since 2012 Peru has also implemented a scholarship program called Beca 18 that provides financial assistance to low-income students to attend university or technical school. Since its implementation, the program provides scholarships to over 29,000 students to pursue higher education at universities and technical institutes across Peru.

- Since 2013 Peru has implemented a school feeding program called Qali Warma that provides free meals to children in public schools in rural areas. Since its implementation, the program has provided meals to over 4 million children in more than 63,000 public schools.

Thirdly, by raising employment opportunities, economic growth has also contributed to the reduction in the poverty rate. This is because when the economy expands, the businesses see an increase in the demand for goods and services, hence to meet the demand they tend to employ more workers (Akanbi, 2016). In addition, as businesses expand, they also invest in new technologies or infrastructure, which creates additional labor demand (Kolawole et al., 2014). Sustained economic growth can also attract foreign investment, which further creates additional job opportunities (Zaman et al., 2019). These increments in demand for labor could also lead to higher wages as businesses compete for workers (Loayza and Raddatz, 2010). Overall, by increasing employment, economic growth reduces the poverty rate. According to World Bank (2022) report the unemployment rate in Peru has been declining from 4.64% in 1997 to 3.38% in 2019 at the same time the real GDP per capita has increased from USD 2292.4 to USD 6955.81 and poverty has also declined from 19.9% to 3%. This implies that an increase in employment has a poverty reduction effect in Peru.

4.3.2. The effect of inequality on poverty

$$SR: Pov\ t = 53.8789 + 0.8859\ Pov\ t - 1 + 0.5393\ Gini\ t - 1 - 9.1754\ lnrgdp\ t - 1$$
$$(44.1357) \quad (0.1574) \quad\quad (0.1446) \quad\quad\quad (3.9667)$$

$$LR: Pov\ t = 53.8789 + 0.7409\ Pov\ t - 1 + 0.8086\ Gini\ t - 1 - 10.7306\ lnrgdp\ t - 1$$
$$(44.1357) \quad (0.1583) \quad\quad (0.2972) \quad\quad\quad (4.4571)$$

$$ECTt - 1 = -0.8550\ (0.1553)$$

Note: figures in parenthesis are standard errors

Source: *STATA output*

The short-run result of the above specification shows a positive relationship between inequality and poverty. This implies that a one percentage point increase in inequality is associated with on average a 0.54 percentage point increase in poverty headcount ratio, at ceteris paribus, and it is statistically significant at a 1% level of significance. Similarly, the long-run result of the model confirms the short-run relationship where a one percentage point increase in inequality is associated with on average a 0.8 percentage point increase in poverty headcount ratio, at ceteris paribus, and it is statistically significant at a 5% level of significance. This result implies that income inequality in Peru has positively related to the poverty headcount ratio. The fall in inequality in Peru contributes to the reduction in the poverty headcount ratio. This finding is in line with the findings of Cheema and Sial (2012), Iniguez and Kurosak (2018), Khemili and Belloumi (2018), and Nguyen et al. (2020) who founds a poverty reduction effect of inequality but with different magnitude.

The result could be explained by the following two scenarios:

Firstly, by reducing the socio-political unrest brought on by worsening income disparity, the declining income inequality in Peru has theoretically a poverty reduction effect. As theoretically hypothesized, high levels of inequality create social tensions, exacerbate conflicts, and undermine trust in institutions. This uncertainty in socio-political stability could reduce investment; lead to destruction and damage, and increase displacement, which further accelerates the poverty rate (Lakner et al., 2020).

Secondly, by relaxing the credit availability to the poor[5], the decline in income inequality in Peru has contributed to the reduction in the poverty rate. As theoretically hypothesized, a high degree

---

[5] Peru has implemented several reforms aimed at improving credit availability and fostering a more inclusive financial system. These reforms have focused on increasing access to credit for individuals, small and medium-sized enterprises (SMEs), and underserved populations. Of these reforms financial inclusion, simplified the loan procedure, support agricultural credit, credit information system, credit guarantee program and collateral registry are the most significant ones

of inequality constrains the poor to access credit, since they may not have the assets or collateral required to obtain loans (Nguyen et al., 2020). Moreover, as they do not have access to formal financial institutions like banks and credit unions, poor people may find it challenging to get loans. This leaves them vulnerable to high-interest loans from predatory lenders (Iniguez and Kurosak, 2018). Furthermore, with high levels of inequality lenders may be less willing to extend credit to poor borrowers, or they may charge higher interest rates and fees to compensate for the perceived risk. This again makes it more difficult for the poor to obtain affordable credit which contributes to a situation where the poor are trapped in a cycle of debt and poverty (Cheema and Sial, 2012). Accordingly, by relaxing these constraints, the decline in the level of inequality in Peru has contributed to the reduction in the poverty rate.

To reduce inequality and promote social inclusion, in recent years Peru has implemented several policies. Of these, according to INEI (2020), the following are the most effective and significant policies that have been implemented in Peru:

- In the early 2000s, Peru implemented a series of minimum wage reforms aimed at improving the income of workers and reducing inequality. The first minimum wage reform was implemented in 2004, which increased the minimum wage by 40% and was followed by further increases in the minimum wage in 2005 and 2007.

- In 2004, Peru introduced a series of income tax reforms aimed at simplifying the tax system and reducing inequality. These reforms include a progressive income tax system, a value-added tax (VAT), and a tax on luxury goods.

- In the 2000s Peru implemented several social programs that aim to reduce poverty and promote social inclusion, such as the Juntos program.

- In the 2000s Peru has also implemented several education reforms aimed at increasing access to quality education and reducing inequality. These reforms include providing free school meals, expanding access to preschool education, and increasing the number of schools in rural areas.

- In recent years, Peru has also implemented policies aimed at redistributing land to poor farmers and indigenous communities. This policy aims to address historical inequalities in land ownership and promote economic development in rural areas.

4.3.3. The indirect effect of economic growth on poverty

$$SR: Pov\ t = -24.4594 + 0.8959\ Pov\ t-1 + 1.5719\ Gini\ t-1 - 0.1724\ gdpgini\ t-1$$

$$(12.3831) \quad (0.1497) \qquad\quad (0.5172) \qquad\qquad (0.0683)$$

$$LR: Pov\ t = 53.8789 + 0.7101\ Pov\ t-1 + 2.6408\ Gini\ t-1 - 0.2117\ gdpgini\ t-1$$

$$(44.1357) \quad (0.1564) \qquad\quad (0.4572) \qquad\qquad (0.0856)$$

$$ECTt-1 = -0.8142\ (0.1468)$$

Note: figures in parenthesis are standard errors

Source: *STATA output*

The short-run coefficient of the above specification shows a negative relationship between the interaction term and the poverty headcount ratio. The result of the model also reveals a positive relationship between inequality and poverty headcount ratio, just like the result in the above discussion. The coefficient implies that each additional percent of economic growth, increases the poverty reduction effect of inequality by 0.17 percentage points, at the ceteris paribus, and it is statistically significant at a 5% level of significance. Similarly, the long-run result of the model confirms the short-run relationship where each additional percent of economic growth increases the poverty reduction effect of inequality by 0.21 percentage points, at the ceteris paribus, and it is statistically significant at a 5% level of significance. This implies that the effect of inequality on poverty depends on economic growth. This implies that economic growth indirectly has also a poverty reduction effect. This result is in line with Table 5 in the appendix which depicts the negative relationship between growth and inequality both in the short and long run. Specifically, on average a one percentage point increase in growth reduce income inequality by 0.17 and 0.21 percentage point in the short and long run respectively, at ceteris paribus. This implies that by reducing inequality economic growth has indirectly affected the poverty headcount ratio in Peru. Moreover, the coefficient of the speed of adjustment in the error correction model is negative and statistically significant at a 1% level of significance, which implies that within a year about 81.4% of the short-run distortion in poverty has been corrected and converges to the long-run equilibrium.

The result could be explained by the following scenarios:

By reducing the level of income inequality, economic growth increases the poverty reduction effect of inequality. As discussed earlier, economic growth increases government revenue through direct and indirect taxes. This provides additional resources for the government to implement programs aimed at reducing inequality. Moreover, economic growth also increases the provisions of public goods and services like education and healthcare, which reduce inequality levels by

providing more opportunities for people to improve their human capital and productivity. Furthermore, economic growth also increases job opportunities, which increases the income of labor (i.e. most poor have) and hence reduces the inequality level. As discussed earlier, income inequality has also positively related to the poverty headcount ratio. This implies that by reducing the level of inequality, economic growth increases the poverty reduction effect of inequality. Since the Peruvian government has implemented several macroeconomic reforms to sustain the economy as we have discussed earlier, the poverty reduction effect of inequality via growth is not a surprising result.

4.3.4. The indirect effect of inequality on poverty

$$SR: Pov\ t = 76.4366 + 0.8961\ Pov\ t - 1 - 11.9326\ lnrgdp\ t - 1 + 0.0662\ gdpgini\ t - 1$$
$$(37.0362) \quad (0.1628) \quad\quad (3.3907) \quad\quad\quad (0.0185)$$

$$LR: Pov\ t = 76.4366 + 0.7042\ Pov\ t - 1 - 14.7661\ lnrgdp\ t - 1 + 0.1026\ gdpgini\ t - 1$$
$$(37.0362) \quad (0.1607) \quad\quad (3.2021) \quad\quad\quad (0.0402)$$

$$ECTt - 1 = -0.8081\ (0.1586)$$

Note: figures in parenthesis are standard errors

Source: *STATA output*

The short-run result of the above specification shows that the interaction term has a positive and significant effect on poverty. The result of the model also reveals a negative relationship between growth and poverty headcount ratio, just like the result in the above discussion. The coefficient implies that by promoting economic growth the reduction in income inequality in Peru indirectly reduces the poverty headcount ratio i.e. it increases the poverty reduction effect of economic growth by 0.07 percentage points, at the ceteris paribus, and it is statistically significant at a 1% level of significance. Similarly, the long-run result of the model confirms the short-run relationship where reduction in inequality increases the poverty reduction effect of growth by 0.1 percentage points, at ceteris paribus; and it is statistically significant at a 1% level of significance. Pronouncedly, these results are in line with Table 5 in the appendix which shows a negative relationship between inequality and growth both in the short and long run, which strengthens the poverty reduction effect of inequality. Specifically, a one percentage point reduction in inequality increases economic growth by 11.93 and 14.77 percentage points in the short and long run respectively, at ceteris paribus. This implies that measures that have been undergone to reduce inequality in Peru were successful to promote the inclusiveness of economic growth. The result also implies that economic growth is necessary but not enough to maximize poverty reduction in Peru hence a combination of policies that aim at both growth and inequality is indispensably

important to reduce poverty. This result is consistent with the findings of Bourguignon (2004), Ravallion (2005), Loayza and Raddatz (2010), and Zaman and Shamsuddin (2017) who conclude that not only growth but inequality also matter for poverty reduction. Moreover, the coefficient of the speed of adjustment in the error correction model is negative and statistically significant at a 1% level of significance, which implies that within a year about 80.8% of the short-run distortion in poverty has been corrected and converges to the long-run equilibrium.

The result could be explained by the following scenarios:

By expanding the productive capacity of the economy, the reduction in the inequality level increases the poverty reduction effect of economic growth. This is because, if there is a low level of inequality, individuals cannot influence or manipulate institutions in their favor. Hence, by increasing efficiency, a low level of inequality expands the productive capacity of the economy (Stephen and Simeon, 2013). Moreover, in societies with low inequality, individuals have better access to education, healthcare, and other essential services. This enables more people to acquire skills, knowledge, and good health, which, in turn, enhances human capital. A well-educated and healthy workforce contributes to higher productivity, innovation, and economic growth (Jaumotte et al., 2013). If there is a high level of inequality, small groups of individuals have a disproportionate amount of income and wealth, which can create resentment and unrest among the rest of the population. This can lead to socio-political instability, which in turn limits the productive capacity of the economy (Niyimbanira, 2017). Conversely, if there is a low level of inequality socio-political unrest would be reduced which in turn expand the productive capacity of the economy. Furthermore, if there is a high level of inequality, the government usually applies redistribution policies, which can discourage investment and hence limits the productive capacity of the economy (Son, 2007). Conversely, if the level of inequality is declining the government doesn't have pressures to apply more aggressive redistribution polices which in turn encourage investment and hence expand the productive capacity of the economy. As we discuss earlier growth has a negative relationship with poverty, hence the reduction in the level of inequality increases the poverty reduction effect of growth.

4.4. Diagnostic Tests

4.4.1. Normality test

Normality is one of the major assumptions in econometric regression analysis. According to this assumption, the sample is assumed to be taken from a normally distributed population. If this assumption is violated the result would be unreliable, the t-test would not be powerful, and

difficult to make generalizations. Hence it is extremely important to test whether the sample data is drawn from a normally distributed population. The Jarque-Bera test is the most commonly used method of normality tests (Greene, 2012). Accordingly, Table 3 below presents the result of the Jarque-Bera test of normality for the three models.

Table 3: the result of the Jarque-Bera test

Models	Test	Hypothesis	Result	Decision
Model 1	*Jarque-Bera*	*H0: Normality*	*Chi (2) =0 .7163*	*Accept H0: Normality*
Model 2	*Jarque-Bera*	*H0: Normality*	*Chi (2) =0 .8163*	*Accept H0: Normality*
Model 3	*Jarque-Bera*	*H0: Normality*	*Chi (2) =0 .4522*	*Accept H0: Normality*

Source: authors' computation

The result of Jarque-Bera tests in all models reveals that the sample data in the study are drawn from a normally distributed population as Chi (2) values in all models are greater than the 5% level of significance; hence, the study fails to reject the null hypothesis. Therefore results in the above table confirm the normal distribution of the error term.

4.4.2. Heteroscedasticity

Homoscedasticity is also another major assumption in econometric regression. According to this assumption, error terms are assumed to have constant variance or independent of the observational time. If it is violated it leads to a biased standard error, and a wrong confidence interval, and hence hypothesis testing would be wrong (Greene, 2012). Even if the estimators are still unbiased, it is not best (i.e. it doesn't satisfy the BLUE assumption). So it is important to test whether the variance of the error term is constant. The White test is the most commonly used method of heteroscedasticity tests. Accordingly, the result of White tests of the model is presented in Table 4 below.

Table 4: the result of White test

Models	Test	Hypothesis	Result	Decision
Model 1	*White*	*H0: Homoscedasticity*	*Prob>chi(2)=0.3971*	*Accept H0*
Model 2	*White*	*H0: Homoscedasticity*	*Prob>chi(2)=0.3971*	*Accept H0*
Model 3	*White*	*H0: Homoscedasticity*	*Prob>chi(2)=0.3971*	*Accept H0*

Source: authors' computation

The result of White tests in all models confirms that the variance of the error term is constant over time as the Chi (2) value for all models is greater than the 5% level of significance; hence,

the study fails to reject the null hypothesis. Therefore the result in the above table confirms that there is no evidence of a heteroscedasticity problem in the model.

4.4.3. Autocorrelation

Another assumption in econometrics regression is autocorrelation. It is a statistical measure that describes the correlation between a time series variable and its past values. Explicitly speaking, this assumption states that the error term in the current period does not depend on the past value. If it is violated it would lead to a biased standard error, and wrong confidence interval, and hence hypothesis testing would be wrong. Even if the estimators are still unbiased, it is not best (i.e. it doesn't satisfy the BLUE assumption). Hence it is important to check whether there is an autocorrelation problem in the model or not. The Durbin-Watson test is one of the most commonly used tests of autocorrelation in times series analysis (Greene, 2012). The result of the Durbin-Watson tests are 1.871898, 1.91796, and 1.857722 in models 1, 2, and 3, respectively; which is relatively normal as the rule of thumb for Durbin-Watson test is 1.5 - 2.5 to be considered as normal. The result is also confirmed by the Breusch–Godfrey test where the Prob>chi (2) are 0.5285, 0.4523, and 0.3809, respectively. Therefore the result of the Durbin-Watson and Breusch–Godfrey tests in all models shows no evidence for the autocorrelation problem.

4.4.4. Stability

The stability of the model is also another prerequisite to relying on the model result for prediction and inference. CUSUM and CUSUM square tests are the most commonly used methods of stability tests in econometrics analysis. Specifically, the CUSUM and CUSUM square test checks the structural stability of the model. Hence, the result of the CUSUM and CUSUM square test for all models reveals that the parameters are stable and the result can be used for policy analysis because the CUSUM and CUSUM square plots for all models lie within the 95% upper and lower boundaries.

Figure 6: CUSUM and CUSUM square plots

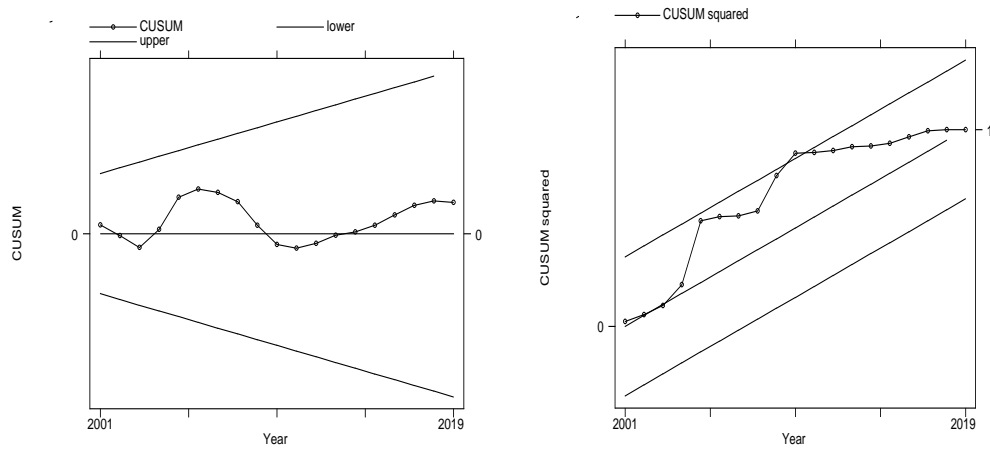Figure 6a: CUSUM and CUSUM square plots for model 1

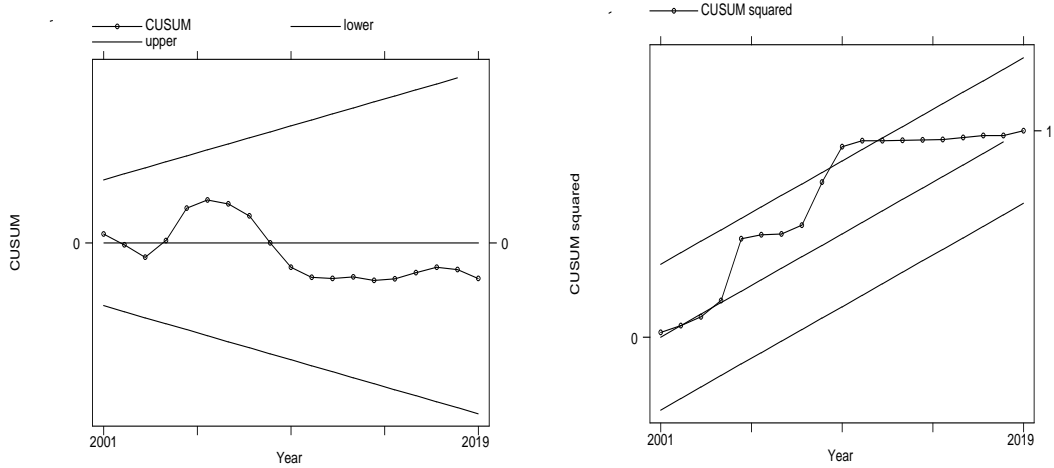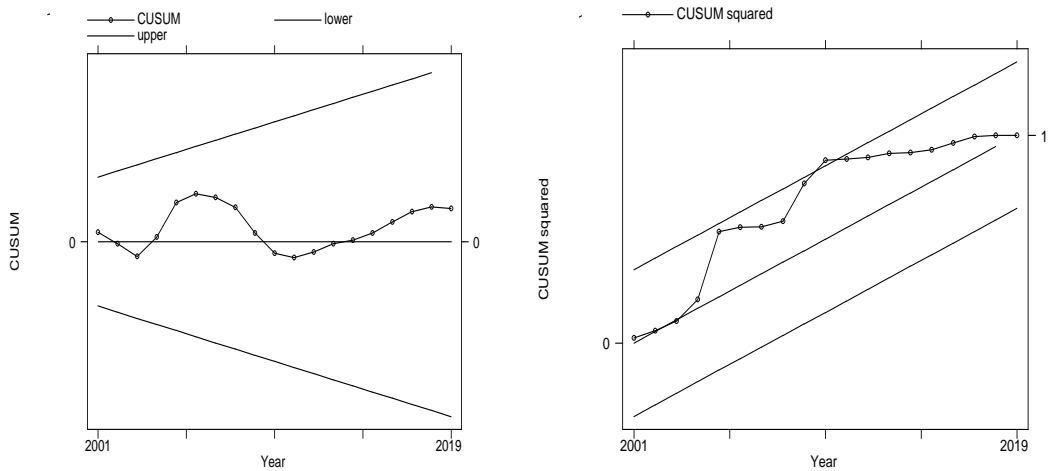Figure 6b: CUSUM and CUSUM square plots for model 2

Figure 6c: CUSUM and CUSUM square plots for model 3

Source: authors' computation

5. Conclusion and Recommendation

This study investigated the relationship between inequality, economic growth, and poverty in Peru in the period 1997-2019. To do so the study employed three autoregressive distributive lag models (ARDL). Accordingly, the result of the model shows a negative and significant relationship between growth and poverty both in the short and long run. Specifically, a one percent increase in growth is associated with on average a 0.09 percentage point reduction in poverty headcount ratio in the short run, at ceteris paribus. Similarly, the long-run result of the model shows that a one percent increase in growth is associated with on average a 0.01 percentage point reduction in poverty headcount ratio, at ceteris paribus. The result also shows a positive and significant relationship between inequality and poverty both in the short and long run. Specifically, a one percentage point increase in inequality is associated with on average a 0.54 percentage point increase in poverty headcount ratio in the short run, at ceteris paribus. Similarly, the long-run result of the model reveals that a one percentage point increase in inequality is associated with on average a 0.8 percentage point increase in poverty headcount ratio, at ceteris paribus.

The result of the model also shows that by reducing the level of income inequality economic growth indirectly reduces the poverty headcount ratio in Peru. Specifically, the coefficient implies that economic growth increases the poverty reduction effect of inequality by 0.17 and 0.21 percentage points in the short and long run, respectively. This implies that the effect of inequality on poverty depends on economic growth. Economic growth increases government revenue through direct and indirect taxes, this provides additional resources for the government to implement programs aimed at reducing inequality. This reduction in income inequality reduces the poverty head count ratio by reducing the socio-political unrest and relaxing credit availability. Therefore, by reducing the level of income inequality economic growth indirectly reduce the poverty headcount ratio.

The result of the model also shows that by promoting economic growth the reduction in income inequality indirectly reduces the poverty headcount ratio. Specifically, the coefficient implies that a reduction in inequality increases the poverty reduction effect of economic growth by 0.07 and 0.1 percentage points in the short and long run, respectively. This implies that the effect of growth on poverty depends on the level of income distribution. Pronouncedly, by expanding the productive capacity of the economy, the reduction in the inequality level increases the poverty reduction effect of economic growth. The reduction in inequality reduces socio-political instability and increases human capital development, this expands the productive capacity of the

economy. Besides, growth has also negatively related to poverty, hence by expanding the productive capacity of the economy the reduction in inequality increases the poverty reduction effect of growth.

Therefore, from the above finding the study suggests the following recommendations:

o   As economic growth has a poverty reduction effect in Peru, policies that promote economic growth are most relevant such as privatization, liberalization (trade and finance), tax incentives, and fiscal responsibility law. These policies help to reduce poverty by improving the provision of public goods and services such as infrastructure, education, and healthcare; and social safety net programs such as cash transfers, school feeding, pension payment, and healthcare support that provide a safety net for the poor and vulnerable populations. When economic growth is accompanied by policies and interventions that address inequality and promote inclusive development, it can have a more significant impact on poverty reduction.

o   Moreover, as declining in the level of inequality increases the poverty reduction effect of economic growth, governments should strengthen policies that would aim at reducing income inequality, such as progressive taxation, social safety nets, and investment in education and healthcare... These policies can help to ensure that everyone has access to the resources they need to improve their living standards and hence contribute to poverty reduction. These policies also make economic growth inclusive. Hence, when inequality is accompanied by policies and interventions that promote economic growth, it can have a more significant impact on poverty reduction.

o   Lastly, in terms of future research, this study only considered the effect of economic growth and inequality on the poverty headcount ratio, hence further research that considers the effect of economic growth and inequality on the poverty gap and square poverty gap ratio would be appreciated as poverty headcount ratio doesn't show the extent and severity of poverty. Moreover, future studies that incorporate other control variables like education, and inflation that alter the effect in the model would also have a positive contribution to the existing literature.

References

Adams, R. H. (2004). Economic growth, inequality and poverty: Estimating the growth elasticity of poverty. *World Development*, *32*(12), 1989–2014. https://doi.org/10.1016/j.worlddev.2004.08.006

Aghion, P., Akcigit, U., Bergeaud, A., Blundell, R., & Hemous, D. (2019). Innovation and top income inequality. *The Review of Economic Studies*, *86*(1), 1–45. https://doi.org/10.1093/restud/rdy027

Akanbi, O. A. (2016). The growth, poverty and Inequality Nexus in South Africa: Cointegration and causality analysis. *Development Southern Africa*, *33*(2), 166–185. https://doi.org/10.1080/0376835x.2015.1120654

Benhabib, J., & Rustichini, A. (1996). Social Conflict and Growth. *Journal of Economic Growth*, *1*(1), 125–142. https://doi.org/10.1007/bf00163345

Bergmann, J. (2021). Planned relocation in Peru: advancing from well-meant legislation to good practice. J Environ Stud Sci 11, 365–375. https://doi.org/10.1007/s13412-021-00699-w

Bergstrom, K. (2022). The role of income inequality for poverty reduction. *The World Bank Economic Review*, *36*(3), 583–604. https://doi.org/10.1093/wber/lhab026

Bick, A., Fuchs-Schündeln, N., & Lagakos, D. (2018). How do hours worked vary with income? cross-country evidence and implications. *American Economic Review*, *108*(1), 170–199. https://doi.org/10.1257/aer.20151720

Blau, B. M. (2018). Income inequality, poverty, and the liquidity of stock markets. *Journal of Development Economics*, *130*, 113–126. https://doi.org/10.1016/j.jdeveco.2017.10.006

Bourguignon, F. (2019). Afterword. growth, inequality, and poverty reduction. *Measuring Poverty around the World*, 218–231. https://doi.org/10.1515/9780691191898-015

Breunig, R., & Majeed, O. (2020). Inequality, poverty and economic growth. *International Economics*, *161*, 83–99. https://doi.org/10.1016/j.inteco.2019.11.005

Bruckner, M., Dabla-Norris, E., & Gradstein, M. (2014). National income and its distribution. *IMF Working Papers*, *14*(101), 1. https://doi.org/10.5089/9781498347815.001

Brueckner, M., & Lederman, D. (2018). Inequality and economic growth: The role of initial income. *Journal of Economic Growth*, *23*(3), 341–366. https://doi.org/10.1007/s10887-018-9156-4

Cheema, A., & Sial, M. (2012). Poverty, income inequality, and growth in Pakistan:A pooled regression analysis. *The Lahore Journal of Economics*, *17*(2), 137–157. https://doi.org/10.35536/lje.2012.v17.i2.a6

Chancel, L., Piketty, T., Saez, E., Zucman, G. et al. (2022). World inequality report 2022. *World Inequality Lab wir2022.Wid.world*. https://doi.org/10.4159/9780674276598

De la Croix, D., & Doepke, M. (2003). Inequality and growth: Why differential fertility matters. *American Economic Review*, *93*(4), 1091–1113. https://doi.org/10.1257/000282803769206214

Dollar, D., & Kraay, A. (2002). Growth Is Good for the Poor. *Journal of Economic Growth*, *7*(3), 195–225. https://doi.org/10.1023/a:1020139631000

Erman, L., & te Kaat, D. M. (2019). Inequality and growth: Industry-level evidence. *Journal of Economic Growth*, *24*(3), 283–308. https://doi.org/10.1007/s10887-019-09169-z

Foster, J. E., & Székely, M. (2008). Is economic growth good for the poor? tracking low incomes using general means. *International Economic Review*, *49*(4), 1143–1172. https://doi.org/10.1111/j.1468-2354.2008.00509.x

Fosu, A. K. (2017). Growth, inequality, and poverty reduction in developing countries: Recent global evidence. *Research in Economics*, *71*(2), 306–336. https://doi.org/10.1016/j.rie.2016.05.005

Galor, O., & Tsiddon, D. (1997). Technological Progress, Mobility, and Economic Growth. *Journal of Economic Growth*, *2*(1), 93–124. https://doi.org/10.1023/a:1009785714248

Greene, W. (2012). Econometric Analysis. 7th Edition, Prentice Hall, Upper Saddle River.

Hichem A, (2016). Poverty, Inequality And Economic Growth In Algeria: An Ardl Approach, Journal of Social and Economic Statistics, Bucharest University of Economic Studies, vol. 5(1), pages 1-20

Hoff, K., & Stiglitz, J. E. (2004). After the big bang? obstacles to the emergence of the rule of law in Post-Communist societies. *American Economic Review*, *94*(3), 753–763. https://doi.org/10.1257/0002828041464533

Imai, K. S., Cheng, W., & Gaiha, R. (2015). Agricultural growth, poverty and inequality in developing countries. *Development*, *58*(2-3), 230–236. https://doi.org/10.1057/s41301-016-0009-1

Iniguez-Montiel, A. J., & Kurosaki, T. (2018). Growth, inequality and Poverty Dynamics in Mexico. *Latin American Economic Review*, *27*(1). https://doi.org/10.1186/s40503-018-0058-9

INEI (National Institute of Statistics and Information of Peru) (2022). Evolution of Monetary Poverty 2010-2021. Retrieved from: https://www.inei.gob.pe/prensa/noticias/pobreza-afecto-al-259-de-la-poblacion-del-pais-en-el-ano-2021-13572/

Jaumotte, F., Lall, S., & Papageorgiou, C. (2013). Rising income inequality: Technology, or trade and financial globalisation? *IMF Economic Review*, *61*(2), 271–309. https://doi.org/10.1057/imfer.2013.7

Khemili, H., & Belloumi, M. (2018). Cointegration relationship between growth, inequality and poverty in Tunisia. *International Journal of Applied Economics, Finance and Accounting*, *2*(1), 8–18. https://doi.org/10.33094/8.2017.2018.21.8.18

Kolawole, B. O., Omobitan, O. A., & Yaqub, J. O. (2015). Poverty, inequality and rising growth in Nigeria: Further empirical evidence. *International Journal of Economics and Finance*, *7*(2). https://doi.org/10.5539/ijef.v7n2p51

Krusell, P., Ohanian, L. E., Rios-Rull, J.-V., & Violante, G. L. (2000). Capital-skill complementarity and inequality: A macroeconomic analysis. *Econometrica*, *68*(5), 1029–1053. https://doi.org/10.1111/1468-0262.00150

Kuznets, S. (1955). Economic Growth and Income Inequality. *The American Economic Review*, *45*(1), 1–28. http://www.jstor.org/stable/1811581

Lakner, C., Mahler, D. G., Negre, M., & Prydz, E. B. (2022). How much does reducing inequality matter for global poverty? *The Journal of Economic Inequality*, *20*(3), 559–585. https://doi.org/10.1007/s10888-021-09510-w

Loayza, N. V., & Raddatz, C. (2010). The composition of growth matters for poverty alleviation. *Journal of Development Economics*, *93*(1), 137–151. https://doi.org/10.1016/j.jdeveco.2009.03.008

Mulok, D., Kogid, M., Asid, R., & Lily, J. (2012). Is economic growth sufficient for poverty alleviation? empirical evidence from Malaysia. *Cuadernos De Economía*, *35*(97), 26–32. https://doi.org/10.1016/s0210-0266(12)70020-1

Nguyen, H. N., Le, Q. H., & Nguyen, T. T. (2020). The linkages between growth, poverty and inequality in Vietnam: An empirical analysis. *Accounting*, 177–184. https://doi.org/10.5267/j.ac.2019.10.005

OECD (2020). Multi-dimensional Review of Peru: Volume 1. Initial Assessment, OECD Publishing, Paris; OECD (forthcoming) OECD Public Governance Review: Peru, Chapter 1: Contextualising Public Governance Reform in Peru

Permadi, Y. A. (2018). Growth, inequality, and poverty: An analysis of pro-poor growth in Indonesia. *Jurnal Ekonomi Kuantitatif Terapan*. https://doi.org/10.24843/jekt.2018.v11.i02.p08

Pesaran, M. H., & Shin, Y. (1997). Long-run structural modeling. *Econometric Reviews*, *21*(1), 49–87. https://doi.org/10.1081/etc-120008724

Piketty, T. (1997). The dynamics of the wealth distribution and the interest rate with credit rationing. *The Review of Economic Studies*, *64*(2), 173. https://doi.org/10.2307/2971708

Piketty, T. (2015). About Capital in the Twenty-First Century. *American Economic Review*, *105*(5), 48–53. https://doi.org/10.1257/aer.p20151060

Ravallion, M. (2005). A poverty-inequality trade-off? *Policy Research Working Papers*. https://doi.org/10.1596/1813-9450-3579

Scholl, N., & Klasen, S. (2018). Re-estimating the relationship between inequality and growth. *Oxford Economic Papers*, *71*(4), 824–847. https://doi.org/10.1093/oep/gpy059

Son, H. H. (2010). Growth, inequality, and the Labor Market: The Philippines. *Poverty, Inequality, and Inclusive Growth in Asia*, 323–343. https://doi.org/10.7135/upo9780857288066.011

Stephen B., & Simeon I. (2001). Does economic growth reduce absolute poverty? *International Institute for Science, Technology and Education, 3(9),* 62-68. https://doi.org/10.7551/mitpress/2465.003.0006

Wan, G., Wang, C., & Zhang, X. (2020). The poverty-growth-inequality triangle: Asia 1960s to 2010s. *Social Indicators Research*, *153*(3), 795–822. https://doi.org/10.1007/s11205-020-02521-6

World Bank (2022). World Development Indicators (WDIs), World Bank, Washington DC. Retrieved from: https://databank.worldbank.org/source/world-development-indicators

Zaman, K. and Khilji, B.A. (2013) "Retracted: The relationship between growth–inequality–poverty triangle and pro-poor growth policies in Pakistan: The twin disappointments," *Economic Modelling*, 30, pp. 375–393. Available at: https://doi.org/10.1016/j.econmod.2012.09.023.

Zaman, K., & Shamsuddin, S. (2017). Linear and non-linear relationships between growth, inequality, and poverty in a panel of Latin America and the Caribbean countries: A new evidence of pro-poor growth. *Social Indicators Research*, *136*(2), 595–619. https://doi.org/10.1007/s11205-017-1581-9

Zaman, K., Al-Ghazali, B. M., Khan, A., Rosman, A. S., Sriyanto, S., Hishan, S. S., & Bakar, Z. A. (2019). Pooled mean group estimation for growth, inequality, and poverty triangle: Evidence from 124 countries. *Journal of Poverty*, *24*(3), 222–240. https://doi.org/10.1080/10875549.2019.1678553

Zhu, Y., Bashir, S., & Marie, M. (2022). Assessing the relationship between poverty and economic growth: Does sustainable development goal can be achieved? *Environmental Science and Pollution Research*, *29*(19), 27613–27623. https://doi.org/10.1007/s11356-021-18240-5

Appendix

Table 5: The relationship between Growth and Inequality

	Dependent Variable	Independent Variable	Coefficient
Short run	*Gini*	*Pov*	*1.571918**
		Lnrgdp	*-0.1723877***
Long run	*Gini*	*Pov*	*2.640827**
		Lnrgdp	*-0.2117312***
		ECT	*-0.8141819**
Short run	*Lnrgdp*	*Pov(-2)*	*0.0662016**
		Gini	*-11.93261**
Long run	*Lnrgdp*	*Pov*	*0.1026***
		Gini	*-14.7661**
		ECT	*-0.8081101**

Note: *** , &**** *represent significance at* **1%** *&* **5%** *level of significance, respectively*

Source: authors' computation