Institutional Quality and the Income Inequality Paradox: Exploring the Inequality Dynamics in Latin America

Kurumsal Kalite ve Gelir Eşitsizliği Paradoksu: Latin Amerika'daki Eşitsizlik Dinamiklerinin Analizi

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Abstract

As countries incorporate technological advancements into their production processes, they achieve higher GDP levels, driving economic prosperity. However, the unequal distribution of income has raised concerns about income inequality. While many studies have focused on income as a determinant of inequality based on Kuznets' hypothesis, recent research has begun exploring the impact of institutional quality (IQ) on income distribution. Within this framework, this study examines the effects of IQ improvements on income distribution across three specific income groups using the Common Correlated Effects Mean Group (CCEMG) technique for 17 Latin American countries from 1996 to 2023. The findings indicate that improvements in IQ have worsened income distribution in favor of the P90 group (top 10% income share). When assessing the effects of individual IQ components, corruption, government effectiveness, rule of law, and voice & accountability were found to have significantly negative effects on income distribution. Additionally, this study reveals that the relationship between IQ and income inequality is inverse U-shaped: while IQ improvements initially exacerbate income inequality, once a certain threshold is exceeded, they contribute to a more equitable distribution of income. However, IQ improvements did not have a significant impact on the P99 group (top 1% income share) or the B50 group (bottom 50% income share).

Öz

Ülkeler teknolojik gelişmeleri üretim süreçlerine entegre ettikçe, daha yüksek GSYİH seviyelerine ulaşarak ekonomik refahı artırmaktadır. Ancak, gelir dağılımındaki eşitsizlik, gelir adaletsizliği konusunda endişeleri gündeme getirmiştir. Kuznets hipotezine dayanarak birçok çalışma gelir eşitsizliğinin belirleyicisi olarak gelire odaklanırken, son yıllarda kurumsal kalitenin (IQ) gelir dağılımı üzerindeki etkisi araştırılmaya başlanmıştır. Bu bağlamda, mevcut çalışma 1996-2023 yılları arasında 17 Latin Amerika ülkesi için Common Correlated Effects Mean Group (CCEMG) tekniğini kullanarak IQ gelişmelerinin üç spesifik gelir grubu üzerindeki etkilerini incelemektedir. Bulgular, IQ'daki iyileşmelerin P90 grubu (en üst %10'luk gelir dilimi) lehine olacak şekilde gelir dağılımını bozduğunu göstermektedir. IQ'nun bireysel bileşenlerinin etkileri değerlendirildiğinde, yolsuzluk, hükümet etkinliği, hukukun üstünlüğü ve katılım & hesap verebilirlik değişkenlerinin gelir dağılımı üzerinde anlamlı ve olumsuz etkileri olduğu bulunmuştur. Ayrıca, bu çalışma IQ ile gelir eşitsizliği arasındaki ilişkinin ters U şeklinde olduğunu ortaya koymaktadır: IQ'daki iyileşmeler başlangıçta gelir eşitsizliğini artırırken, belirli bir eşik değeri aşıldığında gelir dağılımında daha adil bir yapıya katkıda bulunmaktadır. Bununla birlikte, IQ'daki iyileşmelerin P99 grubu (en üst %1'lik gelir dilimi) veya B50 grubu (en alt %50'lik gelir dilimi) üzerinde anlamlı bir etkisi bulunmamıştır.

1. INTRODUCTION

In today's world, rapid technological advancements and their integration into the economic production process have led to an unprecedented increase in output, boosting countries' GDP (Kılıç and Gökçeli, 2024:2016). While overall living standards have improved, some groups have benefited more than others, leading to the emergence of income inequality as a new economic issue (Nielsen, 1994:654). This problem has seen a dramatic rise since the 1980s (Rowlingson, 2011:1) and continues to affect both developed and developing countries (Mdingi and Ho, 2021:2).

In economies with high-income inequality, lower-income groups earn less money, which reduces their ability to buy goods and services. As a result, overall demand in the economy decreases. This, in turn, negatively impacts production and slows down economic growth (Partridge, 1997:1019). Furthermore, lower-income groups may struggle to invest in education, resulting in a workforce with fewer skills. As a consequence, they are likely to remain in low-paying jobs, reducing their chances of improving their economic status. Moreover, as the gap between the rich and the poor widens, investment rates may decline due to public dissatisfaction, leading to political instability and discouraging investments in these countries (Alesina and Perotti, 1996:1024). The negative effects of income inequality extend beyond the economy, leading to serious social consequences. Rising inequality deepens divisions between lower- and higher-income groups, fostering social fragmentation and increasing the likelihood of political and social unrest (Barro, 2000:7). Barro (2000) also argues that higher income inequality is more likely to lead to increased crime rates, particularly among lower-income groups. Given the critical importance of income inequality, it has been recognized as one of the Sustainable Development Goals (SDGs) set by the United Nations in 2015, specifically SDG 10: Reduced Inequalities.

The groundbreaking study on income inequality entered the literature through Kuznets' theory, which linked income inequality to economic growth. The theory suggested that as income increases, inequality initially worsens but eventually improves after reaching a certain income level, leading to a fairer distribution of wealth. However, Kuznets' approach has been criticized in later studies and it has been claimed that inequality is not determined by only income but also many determinants and institutional quality (IQ) is one of the important ones (Zehra, Majeed and Ali, 2021: 166).

North (1990:41) defines institutions as both formal (rule of law, regulations) and informal (traditions, norms) rules that guide people's activities, impose constraints, and maintain order in society. He emphasizes the critical role of institutions in the economy by reducing uncertainty, which helps lower transaction and production costs.

It has been established by many studies in the literature that good governance is an integral part of economic development (Kaufmann, 2007:2). The idea of linking income inequality to institutional quality was first introduced by Engerman and Sokoloff (1994). However, this perspective gained wider recognition and inspired many further studies, particularly through the work of Acemoglu and Robinson (2012). In their study, they analyzed income inequality within the framework of colonial institutions, distinguishing between extractive institutions and inclusive institutions. In colonies where extractive institutions dominated, elites used their political and administrative power to serve their own interests, which led to the persistence of income inequality over time by keeping power and wealth concentrated. In contrast, under inclusive institutions, elite control was limited, and a more democratic environment allowed broader participation in the economy. This created conditions for a more equitable income distribution.

The contribution of this study can be listed as follows: (i) Most studies in the literature examining the impact of IQ on income distribution have used the Gini coefficient as a proxy for inequality (see Amendola, Easaw and Savoia, 2013; Lee and Lee, 2018). However, the Gini index represents overall inequality but does not provide information on income distribution among specific groups. Therefore, countries with the same Gini index may exhibit different levels of income inequality at specific percentiles, such as P50, P90, and P99. To address this limitation, this study

investigates the effect of IQ on income distribution across three specific income groups: P50, P90, and P99. (ii) Existing studies typically represent IQ using either the overall index or its individual components (e.g., Kemp-Benedict, 2011; Adams and Klobodu, 2019). In contrast, this study employs the overall index to represent IQ and then analyzes its components to determine how each one impacts income inequality. (iii) Some previous studies that use panel data employ methods that do not account for cross-sectional dependence (CSD) among countries (e.g., Naplava 2020; Nam, Frijns and Ryu, 2024), which can compromise the reliability of their findings. To overcome this issue, this study employs one of the second-generation techniques, CCEMG, which accounts for CSD, to obtain reliable and consistent long-term analysis results. (iv) Last but not least, most studies in the literature either conduct time series analysis for a single country, classify countries into broad groups such as 'developing' and 'developed,' or analyze country groups without considering development levels. However, this study is the first and only one in the literature that specifically focuses on Latin American countries. Considering these contributions, this study is expected to make a significant addition to the literature.

The main reason for choosing Latin American countries as a sample group is that no similar study has been conducted specifically for this region before. In addition, the common characteristics of these countries further justify their selection. First, Latin America is one of the regions with the highest income inequality in the world. More detailed data on income inequality are presented in Figure 1. As shown, the top 10% of earners received approximately 55% of the total income between 1996 and 2023, with no significant improvement over the years. Similarly, other income groups, namely B50 and P99, showed no notable progress in reducing inequality during the same period

Figure 1: Changes in Income Inequality Among Three Income Groups
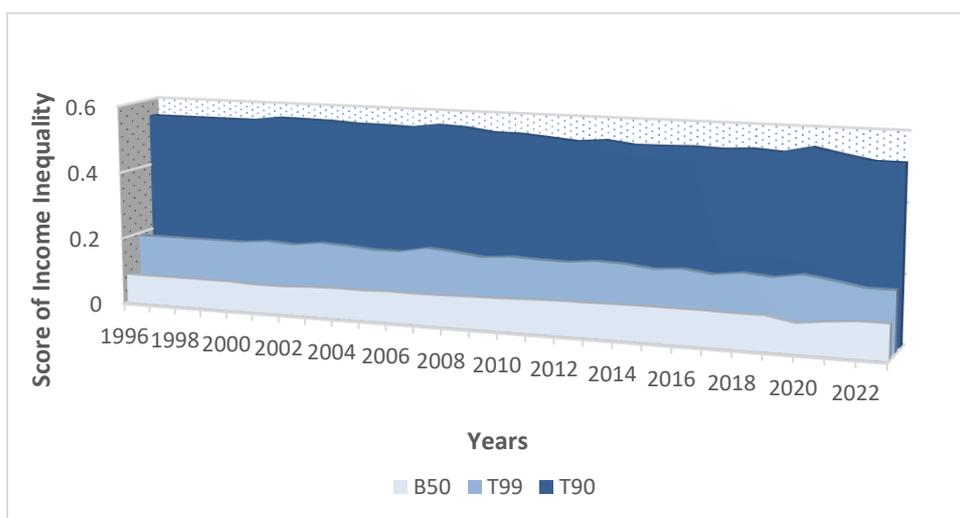
Another common feature of this region is the lack of significant improvement in IQ between 1996 and 2023. As seen in Figure 2, the overall IQ score started at 50 (out of 100) and declined to 47 by 2023. Among the sub-indicators of IQ, which will be explained in detail in the next section, the strongest performance has been observed in Voice and Accountability, which represents democratic participation. In contrast, the weakest aspects have been Corruption, Political Stability, and Rule of Law.

Figure 2: Institutional Quality Changes: Overall And By Component
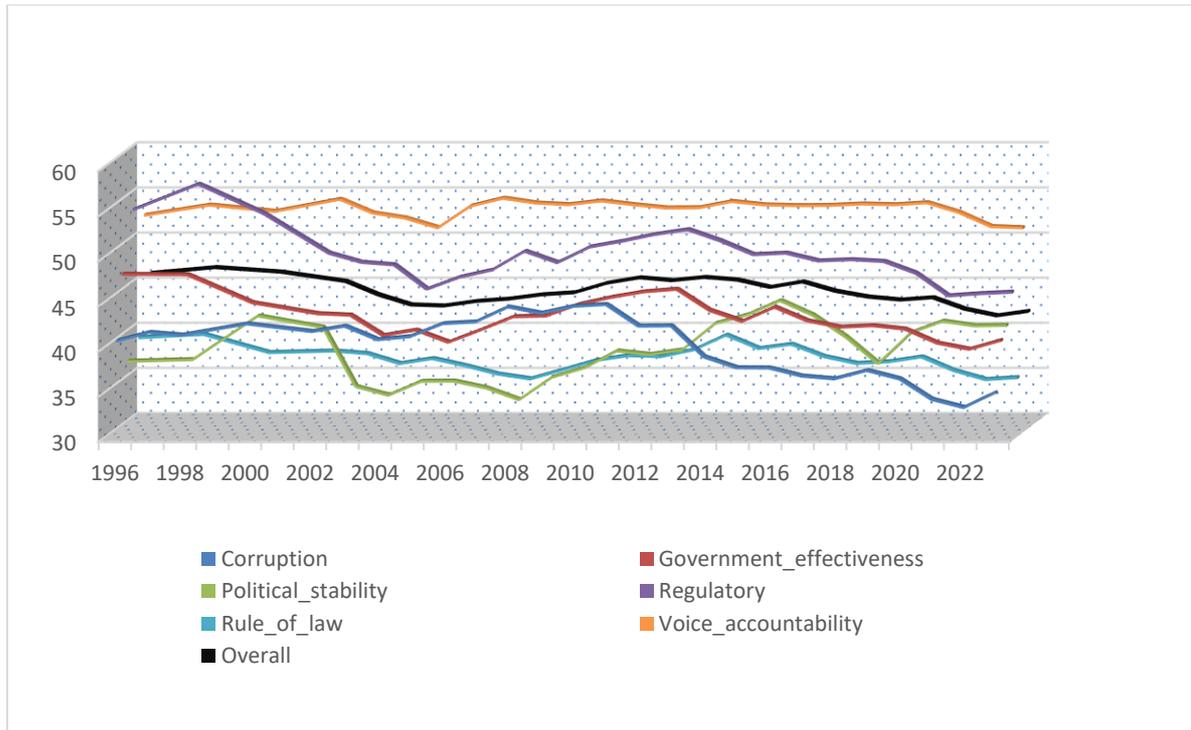
Other important common characteristics of these countries include the formation of economic blocs such as the Pacific Alliance and CAFTA-DR, the significant role of the tourism sector in their GDP, their abundance of natural resources, and the high prevalence of informal (underground) economic activity. These factors make the countries in this region highly similar to one another and provide strong motivation for focusing on this region in our study.

The remainder of this study is organized as follows: In the Literature Review section, previous studies on this topic are summarized, highlighting how this study differs from existing research and emphasizing its contribution to the literature. The next section, data and methodology, explains the advantages of the empirical analysis technique used, describes the data included in the model, and provides some key statistical information. In the empirical results section, the findings are presented, analyzed, and discussed in detail. Finally, the conclusion section summarizes the key findings, outlines important policy implications based on the results, discusses the study's limitations, and offers recommendations for future research.

2. THEORITICAL FRAMEWORK

As previously noted, income distribution is a key macroeconomic indicator and has been widely examined in the literature. Most studies rely on the Gini index, which reflects how evenly total income is distributed among individuals in a country. However, the measure has some limitations. Since it reduces inequality to a single figure, it does not reveal which parts of the distribution are most affected. In addition, it is particularly sensitive to changes in the middle-income groups while being less responsive to shifts at the lower and upper ends of the distribution.

To better capture the impact of institutional quality on income distribution, this study employs alternative indicators that provide more specific insights, namely B50, P90, and P99. The B50 index shows the share of national income received by the bottom half of the population, highlighting the position of low- and middle-income households. P90 indicates the portion of income accruing to the wealthiest 10%, thereby reflecting inequality at the upper end. Finally, P99 measures the share held by the richest 1%, capturing the extreme concentration of income among the very top earners.

As noted in the previous section, North (1990) provided a comprehensive definition of IQ. Based on the definition, various organizations have developed indices to capture IQ. Although the

different components are included to produce the IQ index, they often emphasize similar aspects. The most widely used measure is the World Bank's Worldwide Governance Indicators (WGI), which include six dimensions: corruption control, reflecting the misuse of public power for private benefit; rule of law, capturing confidence in legal systems and protection of rights; regulatory quality, assessing the state's ability to design policies that foster private sector activity; political stability, indicating the risk of unrest or violence; government effectiveness, linked to the competence and credibility of public administration; and voice and accountability, which measures citizens' participation in governance along with freedoms of expression, association, and media.

The relationship between institutional quality and income inequality was first examined empirically by Chong and Calderon (2000). They found that institutional quality affects income inequality differently depending on a country's level of development. In developing countries, improvements in institutional quality may initially worsen inequality, while in developed countries, such improvements tend to promote a more equal income distribution. This difference is largely explained by the widespread presence of the shadow economy in developing countries. When institutional reforms begin, the costs are often borne by lower-income groups, which increases inequality in the short run. However, as institutions strengthen and become more effective, lower-income groups gradually integrate into the formal economy and start to benefit, ultimately leading to a fairer distribution of income.

The link between institutions and income inequality has been explained through various channels in different empirical studies. For instance, Acemoglu and Robinson highlight the role of political dynamics and corruption, arguing that in weak institutional environments, a small elite is able to control key resources and extract disproportionate benefits. These privileged groups also gain greater access to financial assets, enabling them to accumulate more wealth compared to others, thereby increasing inequality. Similarly, Baligh and Piraee (2013) emphasize the financial system as a channel through which institutions affect inequality. In countries with poor institutional quality, lower-income groups face barriers in accessing credit, while elites can obtain loans more easily and expand their investments. As a result, the wealthy group earns higher returns, widening the income gap between the rich and the poor.

Glaeser, Scheinkman and Shleifer (2003) explain the link through the corruption channel, arguing that wealthy groups have more opportunities to maximize their interests by offering bribes and bypassing bureaucratic procedures. This enables them to increase their benefits and become even richer. Similarly, Murphy, Shleifer and Vishny (1993) support the view that corruption promotes income inequality.

IQ can also influence inequality through the channel of property rights. When the property rights of higher-income groups are better protected, they feel more secure in their assets and are encouraged to expand their investments within the country. As a result, their share of total income rises, which in turn intensifies income inequality. Bourguignon and Verdier (2000) highlight another mechanism related to political participation, suggesting that as societies democratize, wealthier and more educated individuals become increasingly engaged in politics. With access to voting and political influence, they are able to shape policies in ways that favor their own interests, thereby raising their incomes and widening the gap between rich and poor.

3. LITERATURE REVIEW

Institutional improvement has mostly been associated with macroeconomic topics such as FDI, growth rates, and socioeconomic indicators like health and environment. It has been the subject of numerous studies over the past two decades (e.g., Ahmed, Kousar, Pervaiz and Shabbir, 2022; Jahanger, Usman and Ahmad, 2023; Gökçeli, 2023; Nica et al., 2023). Although less frequent compared to other topics, there are also studies on the impact of IQ on income distribution. Table 1 summarizes most of the recent research conducted on this topic. As seen in the table, there is no consensus in the literature regarding the role of IQ in income distribution. While some studies

suggest that an increase in IQ leads to a more equitable income distribution (Nadia and Teheni, 2014; Babar and Quddus, 2020), others have found that it results in greater inequality (Adams and Klobodu, 2019; Naplava, 2020). Additionally, some studies have found no significant relationship between the two variables (Policardo and Carrera, 2018; Durgun, 2025).

One reason for the lack of consensus in the literature on this topic could be the selection of sample countries. Some studies analyze a single country using time series analysis (Szczepaniak, Geise and Bariyah, 2022), while most use panel data to study groups of countries (Amendola, Easaw and Savoia, 2013). Moreover, differences in results may even arise in panel studies because they often do not classify countries by level of development (Hartmann, Guevara, Jara-Figueroa, Aristarán and Hidalgo, 2017; Coccia, 2021). Even when they do, they may overlook geographical distance (Babar and Quddus, 2020), which can lead to varying responses to improvements in IQ due to differences in economic structures or cultural traditions. Another reason could be differences in the variables used to represent IQ across different studies. Some research incorporates broad indicators composed of multiple components (Carmignani, 2009), such as Economic Freedom or Governance Indicators (overall index), while others use more specific indicators like corruption or rule of law (Policardo and Carrera, 2018; Sulemana and Kpienbaareh, 2018). As a result, the findings vary depending on the choice of variables.

To the best of our knowledge, no studies in the literature have focused on Latin American countries to examine the relationship between IQ and income distribution, except for the study by Pedauga, Pedauga and Delgado-Márquez (2017). However, their study considered only corruption as a proxy for IQ and used the Gini index to measure income inequality. One of the key differences between this study and both Pedauga, Pedauga and Delgado-Márquez (2017) and other existing studies lies in its perspective on income inequality. As shown in Table 1, all previous studies have used the Gini index to represent income distribution. However, this index provides a holistic measure of income inequality but offers no specific insights into different income groups. The core objective of this study is to examine whether improvements in IQ affect income distribution differently across various income levels. Another distinction from previous studies is whether the impact of IQ on income distribution is monotonic in Latin American countries. To address this, the squared term of IQ has been included in the model. Finally, to represent IQ specifically within Latin American country groups, governance indicators have been used, both in the form of an overall index representing IQ and through its individual components, which have been tested separately in different models. With these distinguishing aspects, this study aims to fill a gap in the literature and contribute to the field.

Table 1: Overview of Studies on IQ And Income Distribution

Author(s)	Country(ies)/ Period	Variables		Effect of IQ	
		As a proxy for IQ	As a proxy for Income inequality	Worsening of income distribution	Improvement of income distribution
Durgun (2025)	Türkiye, 1988-2023	Overall Index	Gini Index	Not Supported	Not Supported
Kouadio and Gakpa (2022)	12 African Countries, 1984-2015	Bureaucracy, Stability, Democracy, Corruption, Law, Overall	Gini Index		Supported
Szczepaniak, Geise and Bariyah (2022)	Indonesia, 1999-2019	Economic Freedom, Corruption, Regulation, Government effectiveness, voice and accountability	Gini Index		Supported
Coccia (2021)	191 Countries,	Governance Indicators	Gini Index		Supported
Huynh (2021)	36 Asian Countries	Quality of Governance Index	Gini Index		Supported
Babar and Quddus (2020)	68 Developing Countries, 1990-2018	Legal, Politic, and Economic institutions	Gini Index		Supported

Naplava (2020)	Post-Soviet countries, 2002-2017	Worldwide Governance Indicator and Its components	Gini Index	Supported	Supported
Adams and Klobodu (2019)	21 African Countries, 1984-2014	Democratic Reforms	Gini Index	Supported	
Güray and Uzgören (2019)	29 developed and 24 developing countries, 1988-2014	International Country Risk Guide	Gini Index	Supported	Supported
Lee and Lee (2018)	110 Countries,	International Country Risk Guide	Gini Index		Supported
Policardo and Carrera (2018)	50 Countries, 1995-2015	Corruption	Gini Index	Not Supported	Not Supported
Sulemana and Kpienbaareh (2018)	48 Developing Countries, 1996-016	Corruption, Rule of Law	Gini Index		Supported
Apergis and Cooray (2017)	138 Countries, 1970-2010	Economic Freedom	Gini Index	Supported	Supported
Avci and Avci (2017)	23 OECD Countries	International Country Risk Guide	Gini Index		Supported
Hartmann, Guevara, Jara-Figueroa, Aristarán and Hidalgo (2017)	Around 150 countries, 1963-2008	Government Effectiveness, Regulatory, Corruption, Voice and Accountability, Rule of Law, Political Stability	Gini Index		Supported
Konu (2017)	OECD Countries, 2015	Economic Freedom	Gini Index	Supported	
Pedauga, Pedauga and Delgado-Márquez. (2017)	18 Latin American Countries, 1996-2012	Corruption	Gini Index		Supported
Adams and Klobodu (2016)	21 African Countries, 1985-2011	Corruption, Transparency Index	Gini Index		Supported
Ahmad (2016)	117 Countries, 1970-2014	Economic Freedom's components	Gini Index	Supported	Supported
Bennett and Nikolaev (2016)	98 Countries, 1990-2010	Rule of Law	Gini Index	Supported	
Batuo and Asongu (2015)	150 Countries, 1996-2010	Overall Index	Gini Index	Supported	
Nadia and Teheni (2014)	39 Developing and Developed Countries, 1996-2009	Political Stability, Regulatory, Corruption, Voice and Accountability, Rule of Law, Government Effectiveness	Gini Index		Supported
Amendola, Easaw and Savoia (2013)	63 Developing Countries, 1970-2004	Property rights, Democratization	Gini Index		Supported
Perera and Lee (2013)	9 Developing Asian Countries, 1985-2009	Democratic accountability, Corruption, Bureaucratic quality	Gini Index	Supported	
Kemp-Benedict (2011)	LAC, ME, EE, AFR, SA, EA, and OECD, 1970-1990	Political Regime	Gini Index		Supported

Carmignani (2009)	120 Countries, 1970-2000	Economic Freedom	Gini Index		Supported
Wagle (2009)	South Asian Countries, 1980-2003	Democracy	Gini Index		Supported
Scully (2002)	26 Developed Countries, 1975-1990	Economic Freedom	Gini Index	Supported	

4. DATA AND EMPIRICAL STRATEGY

This study aims to analyze the relationship between IQ and income inequality across specific groups, considering the possibility that IQ may have varying degrees of impact on income inequality for different groups. Therefore, B50, P90, and P99 are used as the dependent variables in three separate models, each focusing on a specific group as mentioned in detail in the previous section. The reason for focusing on these groups is the fact that IQ will be most closely related to these three specific income groups. To investigate whether the relationship between IQ and income inequality is monotonic within the income group where IQ is found to be significant, the variable IQSQ, which represents the square of IQ, is included in the model. Additionally, for the income group in which IQ has a significant effect, the six components of IQ are analyzed separately through individual regressions. Further details on the definitions, units, and sources of the data are provided in Table 2. It is also important to note that there is no gap in the data, so a balanced sample is used in this analysis.

Table 2: Overview of Variables

Symbol	Definition	Metric	Data Source
B50	Bottom 50% Share	Unit (Range: 0 to 1)	World Inequality
P90	Top 10% Share	Unit (Range: 0 to 1)	World Inequality
P99	Top 1% Share	Unit (Range: 0 to 1)	World Inequality
IQ	Institutional Quality	Unit (Range: 100 to 0)	World Bank (2024)
IQSQ	square of institutional quality	Unit	World Bank (2024)
GDP	Gross Domestic Product	Constant 2015 USD	World Bank (2024)
COR	Corruption	Unit (Range: 0 to 100)	World Bank (2024)
GOV	Government Effectiveness	Unit (Range: 0 to 100)	World Bank (2024)
POL	Political Stability	Unit (Range: 0 to 100)	World Bank (2024)
REG	Regulatory	Unit (Range: 0 to 100)	World Bank (2024)
RULE	Rule of Law	Unit (Range: 0 to 100)	World Bank (2024)
VOI	Voice and Accountability	Unit (Range: 0 to 100)	World Bank (2024)

The data description is reported in Table 3. The interpretations regarding income inequality can be conducted as follows: B50 indicates a relatively equal income distribution within the bottom 50% of the population. However, this pattern is similar in many other developing countries. Looking at P90, it is evident that income inequality is extremely high. On average, the top 10% of earners holds 54.4% of the total income in their respective countries. Similarly, P99 further highlights severe income disparity. The average value of 0.19 indicates that the top 1% of earners receive approximately 20% of total income. Regarding IQ, the average score for 17 Latin American countries is 44 out of 100, indicating that IQ levels in these countries are significantly lower than the average IQ in developed countries[1]. Within this framework, there is a strong need for increased support to improve IQ levels. The assessments of the other variables can be conducted using the same methodology.

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[1] The list of 17 Latin American countries is as follows: Dominican Republic, Nicaragua, Guatemala, Haiti, Panama, Ecuador, Colombia, Brazil, Uruguay, Paraguay, Chile, El Salvador, Costa Rica, Peru, Bolivia, Argentina, and Mexico.

Table 3: Descriptive Statistics Overview

Variable	Obser.	Mean v.	Stand. Dev.	Min.	Max.
B50	476	0.0927	0.0217	0.0479	0.168
P90	476	0.5444	0.0541	0.3944	0.6695
P99	476	0.1953	0.0380	0.0855	0.3415
IQ	476	44.0064	18.2181	4.1444	85.8392
IQSQ	476	2267.774	1809.262	17.1767	7368.362
GDP	476	2.44e+11	4.27e+11	6.10e+09	1.95e+12
COR	476	40.6791	23.0788	0	92.4528
GOV	476	43.6119	19.7959	0.9434	86.8852
POL	476	39.2061	19.3237	1.0050	88.5714
REG	476	49.7107	20.5067	6.4676	94.0217
RULE	476	37.4407	20.5481	0.9950	88.0383
VOI	476	53.3901	17.0195	9.6154	93.7198

The analysis in this study is based on three models, whose equations can be written as follows:

Model 1 $\longrightarrow$ $\ln B50_{i,t} = \alpha_0 + \beta_1 \ln IQ_{i,t} + \beta_2 \ln GDP_{i,t} + u_{i,t}$ (1)

Model 2 $\longrightarrow$ $\ln P90_{i,t} = \alpha_0 + \beta_1 \ln IQ_{i,t} + \beta_2 \ln GDP_{i,t} + u_{i,t}$ (2)

Model 3 $\longrightarrow$ $\ln P99_{i,t} = \alpha_0 + \beta_1 \ln IQ_{i,t} + \beta_2 \ln GDP_{i,t} + u_{i,t}$ (3)

In all the models, α represents the constant term, β refers to the coefficients of the independent variable, and u represents the error terms. i and t denote country and year, respectively. The only difference among the three models lies in the dependent variables. In the first model, the dependent variable is B50, in the second model, it is P90, and in the third model, it is P99. The final analysis in this study focuses on conducting a more in-depth investigation in cases where the IQ variable is found to be significant in the models above. Specifically, this involves analyzing the six components that constitute IQ individually to determine whether any component has a positive, negative, or insignificant impact on the dependent variable.

Before conducting the main method, CCEMG, certain preliminary tests must be performed, as summarized in Figure 3. First, the presence of cross-sectional dependence is checked, as it plays a crucial role in determining the appropriate method for the subsequent analyses. Second, a slope homogeneity test is conducted, which is also essential for assessing the suitability of the next tests. The next critical test is the unit root test, which serves as the fundamental analysis to determine whether cointegration tests can be applied. Finally, before implementing CCEMG, the cointegration test is the most fundamental step. This is because if there is no long-term relationship between the variables, performing the CCEMG test, which provides long-term results, would not be meaningful. All these steps are reported in Figure 1 below.

After conducting preliminary tests to ensure the selection of an appropriate method that yields reliable and accurate results, this study prefers the Common Correlated Effects Mean Group (CCEMG) technique developed by Pesaran (2006). The reasons for employing this method are as follows: First, this technique provides reliable findings in cases where cross-sectional dependence (CSD) exists in panel data (Adedoyin, Alola and Bekun, 2021:2; Addae, Sun and Abban, 2023:5873). CSD occurs when an economic shock in one country affects other units. Furthermore, this technique also addresses heterogeneity, which arises when units behave differently due to their unique characteristics. It is also effective when unobserved common effects are present (Pesaran, 2006: 269). Additionally, this technique can be applied when panel variables are either stationary at level or at their first differences (Küçükaksoy and Akalın, 2017:29). Moreover, this method allows for the estimation of the long-run coefficient, which cannot be obtained using other cointegration tests (Mano, 2024:61). The equation for the CCEMG estimators, following the study of Sarfraz, Ivascu and Cioca (2021:7), is presented below:

$\ln Y_{i,t} = \alpha + \beta_i X_{i,t} + \lambda_i \bar{X}_t + \delta_i \bar{Y}_t + \mu_{i,t}$ (4)

where Y and X represent the dependent and independent variables, respectively. $\bar{X}$ and $\bar{Y}$ refer to cross-sectional averages of explanatory and dependent variables. μ denotes the error terms.

The mean group estimator is also calculated by averaging the individual countries' coefficients as indicated below:

$$\beta_{CCEMG} = \frac{1}{N}\sum_{i-1}^{N}\beta_i \qquad\qquad (5)$$

Figure 3: Schema for Preliminary Tests
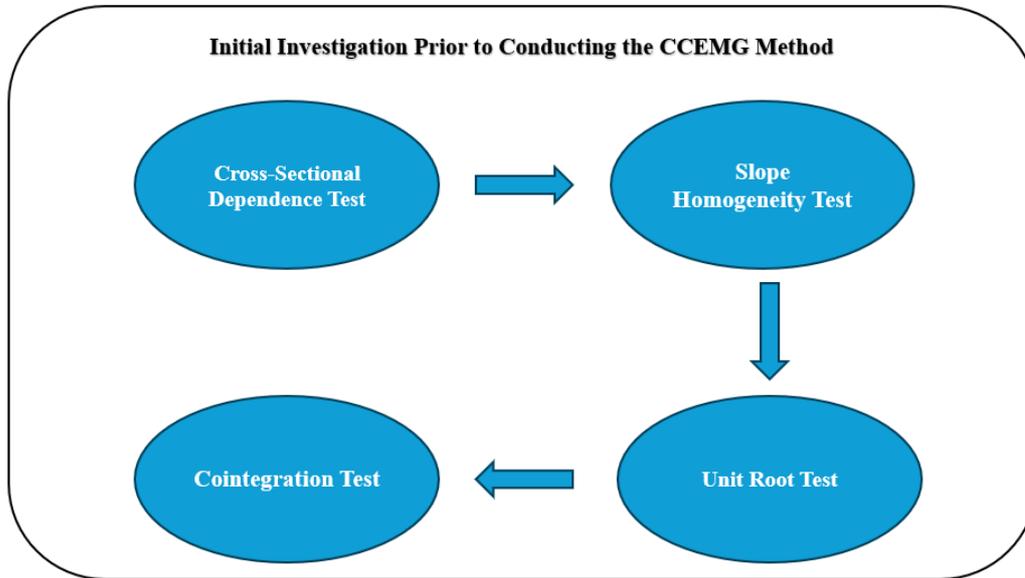
5. EMPIRICAL RESULTS

5.1. Results of Preliminary Test

The first step of the analysis is to check for the presence of cross-dependence (CD) in the variables used in the models. To do this, the Breusch-Pagan Likelihood test (1980) is applied first, and the results are presented in Table 4. The table indicates that the null hypothesis (Ho), which assumes the absence of CD, is rejected for all variables, confirming the presence of CD in the incorporated series. To ensure the robustness of these findings, two additional tests, Baltagi, Feng and Kao's (2012) bias-corrected scaled LM and Pesaran (2004) scaled LM unit root test, are also conducted. Both tests support the presence of CD in all variables.

Table 4: Results of the CD Tests for Variables

Variables	BP LM	P.Scaled Lm	B.Corrected LM
B50	1848.25***	96.91***	96.58***
	(0.000)	(0.000)	(0.000)
P90	1551.51***	79.95***	79.61***
	(0.000)	(0.000)	(0.000)
P99	1022.58***	49.71***	49.38***
	(0.000)	(0.000)	(0.000)
lnIQ	1162.97***	57.74***	57.40***
	(0.000)	(0.000)	(0.000)
lnCOR	950.95***	45.62***	45.28***
	(0.000)	(0.000)	(0.000)
lnGOV	1038.01***	50.59***	50.26***
	(0.000)	(0.000)	(0.000)
lnPOL	773.96***	35.50***	35.16***
	(0.000)	(0.000)	(0.000)
lnREG	825.88***	38.47***	38.13***
	(0.000)	(0.000)	(0.000)
lnRUL	795.07***	36.70***	36.37***
	(0.000)	(0.000)	(0.000)
lnVOI	931.62***	44.51***	44.18***
	(0.000)	(0.000)	(0.000)
lnGDP	3563.27***	207.81***	207.49***
	(0.000)	(0.000)	(0.000)

Note: P-values are reported in parentheses. (*), (**), and (***) denotes the significant level of 10%, 5%, and 1%, respectively[2].

Another essential pretest is to check the stationarity of the variables incorporated in all models. Due to the presence of CD in all variables, a second-generation test that accounts for CD should be selected to ensure accurate results. Therefore, the Cross-Section Dependence Augmented Dickey-Fuller (CDAF) test, developed by Pesaran (2007), was used, and its results are presented in Table 5. The test results indicate that the Ho of unit root is not rejected for all variables at the level, while it is rejected at their first difference, confirming that the variables are stationary.

Table 5: Findings of the CADF Unit Root Test

Variables	Level [I(0)]		First Difference [I(1)]	
	CADF Statistics	Critical Value (%5)	CADF Statistics	Critical Value (%5)
lnB50	-1.502	-2.2	-2.306**	-2.2
lnP90	-1.354	-2.2	-2.616***	-2.2
lnP99	-1.580	-2.2	-2.201**	-2.2
lnIQ	-1.378	-2.2	-2.702***	-2.2
lnCOR	-1.519	-2.2	-3.080***	-2.2
lnGOV	-2.001	-2.2	-2.937***	-2.2
lnPOL	-1.500	-2.2	-2.582***	-2.2
lnREG	-1.714	-2.2	-3.008***	-2.2
lnRUL	-1.804	-2.2	-2.780***	-2.2
lnVOI	-1.433	-2.2	-2.272**	-2.2
lnGDP	-1.919	-2.2	-2.474***	-2.2

In addition to the CADF test, another second-generation test, the Cross-Sectionally Augmented Im-Pesaran-Shin (CIPS) test, which is an extended version of the CADF test and was developed by Pesaran (2007), is applied to evaluate the presence of a unit root. The lag length was selected based on the Akaike Information Criterion, and the specification included both a constant and a trend. The findings are presented in Table 6. The results indicate that the findings obtained

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[2] In the following tables, the significance levels of 10%, 5%, and 1% are specified by *, **, and ***, respectively. In addition, if applicable, p-values will be shown in parentheses.

using the CIPS test support the previous results. Specifically, all variables are non-stationary at the level but become stationary after taking their first differences. However, unlike the other variables, lnP99 and lnGOV are stationary at the level, though the Ho is rejected at the 10% significance level, which is not considered robust. However, after taking their first differences, Ho is strongly rejected at the I(1) level, confirming their stationarity.

Table 6: Findings of the CIPS Unit Root Test

	Level [I(0)]		First Difference [I(1)]	
Variables	**CIPS Statistics**	**Critical Value (%5)**	**CIPS Statistics**	**Critical Value (%5)**
lnB50	-2.056	-2.2	-4.279***	-2.2
lnP90	-1.802	-2.2	-4.860***	-2.2
lnP99	-2.128*	-2.2	-5.671***	-2.2
lnIQ	-1.765	-2.2	-4.364***	-2.2
lnCOR	-1.779	-2.2	-4.776***	-2.2
lnGOV	-2.147*	-2.2	-4.544***	-2.2
lnPOL	-2.051	-2.2	-5.118***	-2.2
lnREG	-1.829	-2.2	-4.520***	-2.2
lnRUL	-1.868	-2.2	-4.472***	-2.2
lnVOI	-1.531	-2.2	-4.679***	-2.2
lnGDP	-2.012	-2.33	-3.794***	-2.33

As stated earlier, mainly three methods are used to investigate the impact of IQ on the three specific groups. To analyze the presence of slope heterogeneity in these models, the Pesaran and Yamagata (2008) test is employed and the findings are reported in Table 7. This test is chosen due to the presence of CD in the models. The results show that the Ho, which assumes slope homogeneity, is rejected, indicating variations in the slope coefficients. Therefore, the analysis method applied should account for slope heterogeneity.

Table 7: Results of the Heterogeneity Test for the Models

Models	**Statistic value of $\tilde{\Delta}$**	**Statistic value of $\tilde{\Delta}_{adj}$**
Model 1	16.70***	18.04***
lnB50$_{it}$ = f (lnIQ$_{it}$, lnGDP$_{it}$)	(0.000)	(0.000)
Model 2	18.20***	19.66***
lnP90$_{it}$ = f (lnIQ$_{it}$, lnGDP$_{it}$)	(0.000)	(0.000)
Model 3	12.17***	13.15***
lnP99$_{it}$ = f (lnIQ$_{it}$, lnGDP$_{it}$)	(0.000)	(0.000)

The final preliminary test before applying the CCEMG method is to check for the presence of cointegration. For the three main models, the cointegration test developed by Westerlund (2008) is chosen because it provides accurate and reliable results, especially in the presence of slope heterogeneity and cross-dependence (CD). As shown in Table 8, this test includes four statistics: two of them (Gt and Ga) focus on individual units, while the other two (Pt and Pa) assess the entire panel. Among these, three test statistics (Gt, Pt, and Pa) for the first two models indicate the presence of a long-run relationship among the variables, as they reject the Ho of no cointegration. The Ga statistic is the only one that fails to reject the Ho, suggesting no cointegration. Since the panel statistics (Pt and Pa) consider the entire panel and are generally more powerful in detecting cointegration across multiple units, their results provide stronger evidence. Therefore, based on the overall findings, the presence of cointegration is confirmed in the three models. Regarding the third model, all the tests suggest rejecting the Ho, indicating the presence of a long-run relationship.

Table 8: Findings of the Cointegration Test

Statistics	Value	Z-Value	P-Value	H$_0$: No Cointegration
Model 1: lnB50$_{it}$ = α + $\beta_1$lnIQ$_{it}$ + $\beta_2$lnGDP$_{it}$ + μ_{it}				
Gt	-2.113***	-2.960	0.002	Rejected
Ga	-6.917	0.848	0.198	Not Rejected
Pt	-8.043***	-3.061	0.001	Rejected
Pa	-6.339**	-3.324	0.000	Rejected
Model 2: lnP90$_{it}$ = α + $\beta_1$lnIQ$_{it}$ + $\beta_2$lnGDP$_{it}$ + μ_{it}				
Gt	-2.016***	-2.569	0.005	Rejected
Ga	-7.173	-1.047	0.148	Not Rejected
Pt	-7.929***	-2.975	0.002	Rejected
Pa	-6.542***	-3.500	0.000	Rejected
Model 3: lnP99$_{it}$ = α + $\beta_1$lnIQ$_{it}$ + $\beta_2$lnGDP$_{it}$ + μ_{it}				
Gt	-2.299***	-3.716	0.000	Rejected
Ga	-8.384**	-1.986	0.024	Rejected
Pt	-10.194***	-4.680	0.000	Rejected
Pa	-7.603***	-4.418	0.000	Rejected

5.2. Results of CCEMG Test

This study examines the impact of IQ on income inequality based on three specific groups, namely: the bottom 50% share of income, the top 10% share of income, and the top 1% share of income, during the period 1996–2023, for 17 Latin American countries, using the CCEMG techniques. Table 9 reveals the impact of IQ on different income inequality groups. In the first column, IQ does not show a significant effect on the distribution of unequal income, indicating that an improvement in institutions has no significant impact on the uneven distribution of median income groups (the poorer half of society). In column 2, the top 10% income share is used as the dependent variable in analyzing income inequality. The analysis results show that a better institutional environment is associated with a more uneven distribution of income. Specifically, an increase in IQ leads to a greater increase in the income of the top 10% compared to the rest of society. However, considering the possibility that the effect of IQ on income distribution may not be monotonic, column 3 includes both IQ and its square in the regression. According to the results, while IQ continues to worsen income distribution, its square has a negative and significant coefficient. This suggests that although IQ increases income inequality up to a certain level, beyond that point, further improvements in IQ have a reducing effect on income inequality. This finding of this research aligns with the studies of Chong and Calderon (2000); Naplava (2020). Finally, in column 4, the analysis focuses on the top 1% income share as a representation of income inequality. The results indicate that an increase in IQ is associated with a more uneven income distribution for the top 1%. However, since the significance level is above the 5% threshold, the result is not highly reliable.

According to the findings, IQ affects income distribution by primarily benefiting the top 10% (P90 Share), while having no significant effect on either the wealthiest 1% (P99 Share) or the bottom 50% (B50 Group) at %5 level. This can be attributed to the fact that the top 1% already have substantial wealth and privileged access to key institutional components such as property rights, the rule of law, democracy, and government effectiveness. Their established financial and political influence allows them to maximize these benefits, meaning that further improvements in institutional quality do not significantly alter their economic standing. However, the same is not true for the top 10% group. Although they are also affluent, they lack the same level of political and institutional influence as the top 1%. As a result, when institutional quality improves, particularly in areas like property rights and government effectiveness, this group benefits the most, as these changes enhance their economic opportunities and overall financial standing. This argument aligns with the findings of Babar and Quddus (2020:19). Moreover, Chong and Calderon (2000:762) argue that improvements in IQ are followed by a more uneven distribution of income because institutional reforms lead to significant transaction costs for low-income people working in the underground economy. The burden of these reform costs puts them in a poorer economic condition, thereby

widening the gap between poor and rich groups. The worsening effect of initial improvement in IQ on income inequality is explained by Bourguignon and Verdier (2000:305) through voting power. They argue that with the transition to democracy, educated and wealthy individuals become more interested in politics and are allowed to vote, giving them political power. They use this power to serve their own interests, increasing their incomes and further widening income inequality.

Meanwhile, institutional quality does not significantly impact the bottom 50% because they generally lack the financial resources necessary to take advantage of such improvements. Since institutional reforms primarily favor those who are already in a position to leverage them, the B50 group remains largely unaffected. However, in the future, continued improvements in institutional quality may eventually contribute to greater income equality, as suggested by the negative effect of IQSQ, which indicates that beyond a certain threshold, institutional enhancements may promote a more equitable income distribution.

Table 9: Long-run Results for Overall Index

Variables	Column 1 (B50)	Column 2 (P90)	Column 3 (P90)	Column 4 (P99)
lnIQ	-0.0449	0.0973**	0.9352**	0.2354*
	(0.672)	(0.046)	(0.018)	(0.71)
lnGDP	-3.3676*	-0.1653**	-0.1169**	-0.3126*
	(0.079)	(0.046)	(0.044)	(0.080)
lnIQSQ			-0.1121**	
			(0.017)	
Cons.	0.2654	0.03858	-1.9024**	1.0177
	(0.934)	(0.970)	(0.026)	(0.612)

Looking at GDP, which is used as a control variable, it is negative and significant in all columns, indicating that an increase in GDP enhances income equality, and this finding remains robust through all columns. The reduction effect of GDP on income inequality is actually consistent with Kuznets' hypothesis. As discussed by Kılıç and Gökçeli (2024), the Kuznets Curve, proposed in the 1950s, suggests a threshold level of GDP, beyond which further growth leads to a reduction in income inequality. With the integration of technological advancements into production, even developing countries (including Latin American countries) have experienced rapid GDP growth. Therefore, considering that GDP has exceeded the threshold in the Kuznets hypothesis, further increases in GDP lead to a fairer income distribution, as GDP corresponds to the downward-sloping section of the inverted U-shaped graph.

This study also attempts to determine whether each component of overall IQ has the same or different effects on income inequality for the top 10% group. To achieve this, six individual components are included in the model separately, and the results are reported in Table 10. As revealed, lnCOR, lnGOV, lnRUL, and lnVOI have positive and significant coefficients in columns 1, 2, 5, and 6, respectively. This implies that an improvement in the quality of these individual components, namely corruption level, government effectiveness, rule of law, and voice and accountability, benefits the income of the top 10% group, thus exacerbating the issue of income inequality.

As previously explained, changes in these four components significantly impact the wealthiest segment (top 10% share). Due to deficiencies in the rule of law, corruption levels, government effectiveness, and voice and accountability, this group is unable to fully capitalize on the income they could otherwise gain. Therefore, improvements in these four factors disproportionately increase the income of this specific group, further worsening income inequality. This result is consistent with the study of Perera and Lee (2013). Similar findings are also obtained by the study of Acemoglu, Naidu, Restrepo and Robinson (2015:1885) claiming that inequality increases with an improvement in democratization.

Regarding GDP, it again has a negative effect on the unfair distribution of income, confirming the previous finding that a higher GDP is associated with a fairer income distribution in Latin American countries.

Table 10: Long-run Results for Individual Components

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Dependent Variable: P90						
lnGDP	-0.1383*	-0.1512*	-0.2072**	-0.2038***	-0.1724**	-0.2080***
	(0.10)	(0.070)	(0.047)	(0.005)	(0.017)	(0.007)
lnCOR	0.0527*					
	(0.97)					
lnGOV		0.0623*				
		(0.062)				
lnPOL			0.0199			
			(0.370)			
lnREG				0.0528		
				(0.247)		
lnRUL					0.0965**	
					(0.045)	
lnVOI						0.1318**
						(0.013)
Cons.	0.1319	-0.0343	0.1402	-0.0222	-0.1142	0.5590
	(0.923)	(0.974)	(0.914)	(0.983)	(0.910)	(0.656)

6. CONCLUSION

With industrialization, the use of machines in production has significantly increased output. At the same time, technological advancements have steadily improved production efficiency. As a result, countries have been able to boost their economic growth. While the increase in production has raised the overall welfare level, the unequal distribution of income among individuals in society has led to the issue of income inequality.

In the past few decades, Kuznets' theory, which explains income inequality based on income, has been criticized, and the idea that IQ could influence income distribution has gained acceptance. This has led to studies exploring the relationship between IQ and income distribution.

Unlike previous studies in the literature, this research employs governance indicators as a proxy for IQ, analyzing both the overall index and its six components across three different income groups. The findings suggest that improvements in IQ disproportionately benefit the top 10% of the population, increasing their share of total income and thereby exacerbating income inequality. However, as IQ continues to develop, this negative effect reverses at a certain threshold, ultimately improving income equality. The study also found no significant impact on the P99 (top 1%) and B50 (bottom 50%) income groups.

Based on these findings, several key policy recommendations are proposed: Although IQ development initially worsens income inequality, it eventually reverses this effect and contributes to a fairer distribution of income. Therefore, it is crucial to reach the IQ threshold as quickly as possible so that IQ improvements not only enhance quality of life in these countries but also promote a more equitable income distribution. The P99 group, which holds the largest share of income, should not receive preferential treatment because of its economic power. They should have access to the same public services as other groups without favoritism. Individuals in the B50 group are in such poor financial conditions that they do not benefit from IQ-driven improvements. Therefore, relying solely on IQ improvements to address income inequality is insufficient. Policies such as redistribution should be implemented to quickly improve the economic power of lower-income groups.

This study is limited to three income groups associated with IQ. Future research could expand to include other income segments. Additionally, this study focuses only on Latin American countries. Further analyses could compare different regions to determine whether IQ affects income inequality differently across country groups. Finally, this study uses governance indicators as a proxy for IQ. Future research could explore alternative indices, such as Economic Freedom or the International Country Risk Guide, to examine whether they yield different effects on income inequality.

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