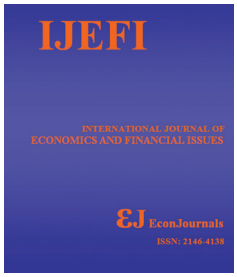

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The Relationship between Informal Economy and Income Inequality: An Econometric Analysis for BRICS Countries

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ABSTRACT

This research investigates the intricate relationship between the informal economy and income inequality in BRICS nations from 2000 to 2018. Defining the informal economy as economic activities outside the formal sector contributing to GDP, the study addresses a gap in existing literature that tends to overlook this sector's impact on income distribution. Utilizing panel unit root and panel cointegration tests, the findings reveal a significant and direct correlation between income inequality, the informal economy, and GDP in BRICS countries. The study uncovers a noteworthy revelation: A 1% increase in the informal economy leads to a substantial 3.24% rise in the GINI coefficient, showcasing the informal sector's profound influence on income inequality. Country-specific analyses identify India and Russia as frontrunners in this correlation, with China, Brazil, and South Africa following suit. Intriguingly, the analysis indicates that while a 1% rise in official GDP slightly worsens income distribution, the informal economy exerts a disproportionately negative impact on income inequality. This research provides valuable insights for policymakers, emphasizing the need to consider the informal economy's role in crafting effective strategies for mitigating income inequality within the BRICS context.

Keywords: Income Inequality, Informal Economy, Poverty Measurement, BRICS Economies
JEL Classifications: E26, J46, O17, O53

1. INTRODUCTION

Within the ever-changing realm of global economics, the informal economy exists as a mysterious and elusive entity, functioning outside the boundaries of conventional economic frameworks. The BRICS countries, including Brazil, Russia, India, China, and South Africa, are a group of developing economies, each characterized by its own distinct socio-economic fabric. Although previous studies have explored various aspects of the informal sector and income inequality, there is a noticeable lack of a thorough examination of how these two factors are related, specifically within the BRICS countries.

This study will try to investigate the complex connection between the informal sector and income inequality in the BRICS countries. Through this groundbreaking endeavor, our objective is to close existing gaps in knowledge, offering vital perspectives that go beyond national borders and contribute to a more sophisticated comprehension of global economic processes.

The informal sector, known for its elusive nature and exclusion from official data, plays a crucial part in the socio-economic structure of the BRICS countries. The effect of the informal economy extends across several sectors, ranging from street sellers and unregistered firms to informal labor markets. This influence not only affects economic indicators but also plays a role in defining income distribution patterns. The growing importance of the informal sector in shaping income disparity becomes more evident as these economies progress.

Through the use of a econometric method, our aim is to identify and analyze the patterns, differences, and distinct dynamics that

constitute the basis of the connection between the informal sector and income disparity in each of the BRICS countries.

As we embark on this groundbreaking endeavor, we anticipate that our findings will not only enhance academic discourse but also inform governmental initiatives aimed at fostering holistic economic growth. One of the primary objectives of this study is to comprehensively analyze the relationship between the informal sector and income inequality in BRICS countries using econometric methods. We anticipate that our discoveries will facilitate the formulation of evidence-based solutions to address the challenges and capitalize on the opportunities presented by the evolving economic environments of the BRICS countries.

Recent academic contributions have provided useful insights into several aspects of the informal sector, including its conceptual structure and transformational impacts.

Hassan and Schneider (2016), Schneider (2012), and Alm and Embaye (2013) have together shown that the informal sector constitutes around 30% of the global economy. Considering the unavoidable existence of economic disparities, it is crucial to examine the correlation between the informal sector and income inequality in both developed and developing nations.

The objective of this study is to address a gap in the existing literature by investigating the relationship between the informal sector in BRICS nations and income inequality. The investigation will mostly focus on the period from 2000 to 2018. The assessment of the relationship will be carried out using panel unit root and panel cointegration tests.

The paper will be organized as follows: Section 2 will provide a comprehensive review of the existing literature. Section 3 will provide a presentation of the data and methodology used in the study. Additionally, the outcomes and discoveries of the panel data analysis will be shown in Section 3, while conclusion and policy implications will be examined in Section 4.

2. LITERATURE REVIEW

The intricate correlation between the informal sector and income inequality has always captivated the interest of scholars and policymakers. With the shifting global economic environment, it is crucial to comprehend the intricate intricacies of this interaction. This literature review aims to present a comprehensive analysis of the current body of research on the influence of the informal sector on the distribution of wealth.

Adriana et al. (2022) present empirical evidence that highlights the one-sided viewpoint, focusing on categories such as informality, urban informality, and sustainable development. In addition, the multilateral approach examines important factors such the informal economy, entrepreneurship, tax evasion, tax morale, tax compliance, the shadow economy, the informal sector, and corruption.

Breman (2023) examines the influence of capital and capitalism on the process of informalization, spanning a period of six decades. The study presents a historical narrative of the changing nature of informality. The author's work demonstrates a consistent improvement of arguments, with a specific focus on the impact of capital on the process of informalization.

Simba and Tajeddin's (2023) study question the prevailing notion that the informal sector is diminishing, particularly in emerging areas. Utilizing comprehensive datasets, their research emphasizes the profound influence of the informal sector on both social and economic aspects, particularly in sub-Saharan Africa. This research stimulates a reassessment of the significance of maintaining an equilibrium between economic and social transformation through policy measures.

Bergstrom's (2022) study enhances comprehension of the complex correlation among income disparity, economic growth, and poverty alleviation. The study demonstrates that income disparity has a substantial impact on reducing poverty, surpassing the influence of economic development. This conclusion is based on the use of log-normal distribution assumptions. The findings emphasize the subtle influence of income disparity on poverty, even though economic expansion has traditionally played a major part in reducing poverty.

The study conducted by Xiao et al. (2023) specifically examines the dynamics of social assistance (SA) in China's informal employment sector. Their study examines the patterns of receiving social assistance and investigates the factors that influence the termination of participation in these programs. The research emphasizes the specific difficulties presented by the informal work system, which affects the efficiency of employment services and influences the specific patterns of social assistance receipt in China.

Collectively, these publications provide a thorough examination of the informal sector, covering conceptual frameworks, historical developments, transformational effects, and policy ramifications. The many viewpoints add to a deeper comprehension of this intricate and ever-changing economic issue.

Ulyssea (2020) critically examines the economic literature pertaining to informality, exploring its underlying factors and the subsequent impact it has on growth. The research included in this body of work encompasses a wide range of investigations, including well-established experiments, macro models that focus on equilibrium, and more recently, structural models that combine both micro and macro influences. The existing data suggests that reducing the expenses associated with formality is not an effective strategy for decreasing informality. However, it may have beneficial overall consequences, such as increasing production and total factor productivity (TFP).

Informality, driven by people seeking to maximize their own gains, is a micro-level occurrence. However, the extensive measures implemented to tackle this issue might give the impression of it being a macro-level event, with substantial ramifications for the overall economy (Ulyssea, 2020).

According to Medina and Schneider (2021), informality is influenced by various factors including tax and social security burdens, institutional quality or corruption, regulations, public

sector services, tax morale, deterrence, official economy development, self-employment, agricultural sector size, cash usage, labor force share, and economic growth.

It is important to acknowledge that the informal economy lacks a universally acknowledged definition or quantification method. Feld and Schneider (2010) define the term "informal economy" as including any economic activities that are not part of the formal sector but yet contribute to the officially estimated GDP. The informal sector encompasses commodities and services that are not accounted for in official GDP measurements, as stated by Smith (1994). These unreported economic activities, regardless of their legality, may be concealed rather readily. According to Schneider et al. (2010), it refers to the intentional evasion of certain administrative procedures, such as labor market restrictions, by non-payment of taxes or social security contributions, or by hiding legally established goods and services from government officials. The informal economy encompasses any profitable activity that lacks official registration, according to the existing literature.

There has been a surge in public interest about the issue of income inequality in recent times. The focus of global economic forums is on the extent to which this is connected to development plans, including the eradication of extreme poverty, ensuring access to quality primary education, and promoting gender equality. However, the majority of research examining income inequality tend to overlook its connection to the informal sector, instead focusing on its correlation with more formal economic factors like as growth and trade openness (Kuznets, 1955; Bahmani-Oskooee et al., 2008).

The correlation between income inequality and the informal economy is increasingly being subjected to scrutiny. Gutierrez-Romero (2007) discovered that locations with higher levels of wealth disparity are associated with larger informal economies. In their study, Mishra and Ray (2010) discovered a positive correlation between the prevalence of poverty and the size of the informal sector. The informal sector is preferred by individuals and businesses with limited access to official finance due to its much cheaper costs, resulting in their reluctance to participate in the formal sector. As a result, enterprises with innovative concepts but little financial resources are excluded from the formal economy. Both inequality and informality are intensified due to this phenomenon, since it results in increased profits for the preexisting firms in the sector (Mishra and Ray, 2010).

Rosser et al. (2000) identified a positive association between income inequality and the informal sector in developing countries. As to Schneider and Enste (2000), when developing economies implement high taxes and stringent regulations, it leads to the expansion of a larger informal sector. The growth of the informal sector intensifies income inequality.

Pashardes and Polycarpou (2008) establish a clear correlation between the informal sector and income inequalities in Cyprus. Individuals with higher incomes were more likely to downplay their earnings in comparison to those with lower pay. In a similar vein, Chong and Grandstein (2007) discovered a positive association between the informal sector and the exacerbation of income inequality, as well as a decline in overall wealth. In his study, Straub (2005) analyzed the link between the two variables from the perspective of the loan market. According to him, companies have difficulties in obtaining formal financing, which explains the strong association between the elements.

Mishra and Ray conducted a study in 2010, analyzing data from 27,086 organizations across 63 nations to establish the correlation between these two factors. It was shown that an increase in the informal sector is correlated with elevated levels of inequality. Winkelried (2005) provided more evidence to support this conclusion by using data obtained from Mexican companies. Income inequality affects both aggregate demand and a company's inclination to participate in informal economic activity. The reaction of the informal sector to fiscal policies designed to meet specific demand or supply requirements is significantly impacted by income distribution characteristics.

Most research indicates that there is a positive correlation between income disparities and the informal sector. Okumu (2014) discovered a negative correlation between these two variables using the dynamic stochastic general equilibrium model. Bhattacharya (2011) also obtained the same result. Bhattacharya argues that the urban informal economy provides higher earnings to those residing in rural areas, hence incentivizing them to engage in informal sector employment and contributing to the reduction of income inequality. Furthermore, these workers often have greater job stability, hence reducing the likelihood of unemployment and income reduction.

Although there is insufficient evidence directly connecting economic growth to income inequality, numerous governments have taken action to address this issue by implementing redistributive programs funded by progressive taxation. The aim is to decrease economic disparity and mitigate its negative consequences.

The informal sector, which serves as an alternative means of production and employment outside the formal economy, exists in all nations, but with variable levels of prevalence. According to Schneider et al. (2010), about one-third of the global gross domestic product is produced by the informal sector. The informal sector accounts for 40% of the Gross Domestic Product (GDP) in Latin America and Sub-Saharan Africa, whereas it only makes up 17% of the GDP in high-income OECD nations. According to scholarly research, the informal sector has a detrimental impact on political institutions, such as the government's capacity to collect taxes required to provide public services to all individuals (Schneider and Enste, 2000; Gërxhani, 2004). The presence of the informal sector also distorts the government statistics that officials rely on for their job (Feige, 1989; Schneider and Enste, 2000). Asea (1996), Schneider and Enste (2000), and Dell'Anno and Solomon (2008) emphasize the potential of the informal sector to stimulate economic development by fostering entrepreneurial endeavors. Individuals who are unable to get employment inside the formal economy may seek employment within the informal

market, as shown by Dell'Anno and Solomon (2008). Hence, the regulated sector might use the money from the unregulated sector, hence increasing the total demand (Schneider and Enste, 2000; Gërxhani, 2004).

Gutierrez-Romero's (2007) research on Latin America and Sub-Saharan Africa demonstrates that in wealthy countries, there exists a direct relationship between the magnitude of the informal sector and the level of inequality. However, in developing countries, the reverse relationship holds true.

Dabla-Norris et al. (2015) state that wealth inequality has attracted attention from the general public, policymakers, and academics. Although a certain level of income inequality may be beneficial for the economy by encouraging more savings and investment in capital and technology, excessive inequality can hinder individuals' access to necessary healthcare and education. Severe instances might result in governmental instability and civil discontent, both of which would diminish the motivation to amass money.

Prior to making a decision to participate in either the formal or informal sectors, economic agents carefully consider the advantages and disadvantages associated with each kind of production (Loayza, 1996; Kaufmann, 1997). Individuals with lower financial means may choose to work in the informal sector as a means to avoid official sector costs such as taxes and regulations (Johnson et al., 1997; Loayza, 1996; Schneider and Enste, 2000; Gërxhani, 2004). Recent research has shown that income inequality has various effects on the informal sector.

Chong and Gradstein (2007) developed a model that categorizes individuals based on their economic status. There is a competition for advanced innovation, but it is limited by regulations that prohibit involvement in the formal sector. According to their concept, economic players are incentivized to participate in "rent-seeking" behaviors. Consequently, people may choose to sacrifice a portion of their income in order to acquire high-quality technology in the formal sector. Alternatively, individuals can choose to engage in the informal sector, where they would have the opportunity to use more affordable but less dependable equipment. Chong and Gradstein (2007, p. 165) argue that when the wealth gap widens, wealthy individuals invest more money in activities aimed at obtaining economic benefits without creating any real value, such as rent-seeking businesses. Conversely, the less affluent individuals contribute less money to such projects. Stated differently, individuals with lesser earnings are less inclined to engage in rent-seeking activities to acquire contemporary technology inside the formal sector. This is due to the fact that they have challenges in obtaining capital as a result of increasing economic inequality. This reduces the likelihood of their transitioning to the informal sector.

According to Mishra and Ray (2010), individuals with lower incomes are less inclined to have the financial means to cover the expenses related to entering and staying in the formal sector. As a result of the rising wealth inequality, individuals may resort to the informal sector due to insufficient resources. Mishra and Ray (2010) enumerate two more methods via which income inequality advantages the informal sector. Income inequality hinders resource-limited innovative entrepreneurs from entering the formal sector, hence increasing the profitability of enterprises in the informal sector. Consequently, these individuals are compelled to use their entrepreneurial abilities in less formal undertakings. The increasing demand for goods from the informal sector is driven by the growing inequality in income between the affluent and the rest of the population. The informal sector offers these products at much cheaper costs. Consequently, this facilitates the expansion of informal economic activity.

Winkelried (2005) and Foellmi and Zweimüller (2011) have put up a similar argument. Foellmi and Zweimüller's 2011 research investigates the impact of income inequality on both formal and informal economies, specifically focusing on its effects on aggregate demand and employment. The authors hypothesize that when income inequality increases, "elite producers" will have the ability to set high prices in order to appeal to affluent clientele, while "mass producers" would be obliged to maintain cheap costs in order to serve low-income households. Foellmi and Zweimüller (2011, p. 242) argue that when there is a substantial level of inequality, a large number of individuals are compelled to engage in informal economic activities. Advocates argue that by enhancing subsistence production, low-income households would have more disposable cash, resulting in a subsequent rise in employment opportunities and higher wages for those without specialized skills.

The researchers emphasize that elevated economic inequality erodes the trust of lower-income people in their government, hence posing a danger to democratic institutions. Their decision to participate in informal economic activities is a direct result of this. According to Rosser et al. (2000, p. 158), economic inequality leads to a loss of trust among individuals and society as a whole, resulting in feelings of animosity, distrust, and a motivation to exploit the system. Businesses are therefore motivated to engage in the informal sector as a means to avoid government supervision and high taxation. Due to the perceived ease of evading tax obligations, economic actors opt for the informal sector instead of the official sector when they have little trust in governmental institutions (Wintrobe, 2001). Moreover, a decline in public trust in the government diminishes individuals' inclination to fulfill their tax obligations, thereby prompting businesses to transition into the informal sector (Torgler and Schneider, 2007).

The emergence of the informal sector may contribute to income inequality by diminishing the government's capacity to generate tax revenue and provide efficient public goods and services. Consequently, the government's capacity to enact measures that redistribute resources is hindered, ultimately worsening the problem of economic inequality. Some researchers have suggested that there exists a negative correlation between the informal sector and income inequality. The rise of the informal sector results in increased income inequality, since it reduces competition and shifts economic surplus from consumers to capital owners.

Nevertheless, research provides data indicating that the informal sector might contribute to a decrease in income inequality. Eilat and

Zinnes (2002) contend that when individuals with low incomes exit the official job market, they may seek other means of employment and income generation inside the informal sector, so potentially mitigating income inequality. This is also discussed within the context of the informal labor force. The results of Dell'Anno and Solomon were published in 2008. As to Bajada and Schneider (2009), individuals who are unemployed in the formal sector may seek financial assistance in the informal sector. As stated by Hatipoğlu and Özbek (2011, p. 84), those who have poor productivity or are destitute and would often rely only on state subsidies have more employment options in the informal sector. This, in turn, decreases the need for government redistribution. In addition, the informal sector offers an environment where aspiring entrepreneurs may experiment with lower financial risk and less supervision. Williams (2006) shown that those with lower incomes and limited access to financial resources have a greater advantage from this phenomenon.

Binelli (2016) and Binelli and Attanasio (2010) suggest that an expansion of the informal sector might lead to a widespread rise in pay inequality. The reason for this is that pay structures in the informal sector exhibit more flexibility compared to those in the formal economy. Consequently, an excess of workers in the informal sector may lead to the worsening of income disparities (Binelli and Attanasio 2010; Binelli, 2016). Moreover, if there is already a discrepancy in income within the informal economy, as evidenced by research conducted by Krstic and Sanfey (2007, 2011), Lukiyanova (2015), and Xue et al. (2014), the expansion of the informal sector, particularly if its workers persistently earn meager wages, has the potential to exacerbate inequality. According to the studies undertaken by Krstic and Sanfey (2007), Xue et al. (2014), Dell'Anno and Solomon (2014), and other researchers, there is a suggestion that an expansion of informal sector employment might potentially exacerbate inequality. The degree to which the informal sector contributes to income inequality remains uncertain.

The aforementioned debate suggests a potential mutually beneficial connection between economic disparity and the clandestine economy. The existence of the informal sector has the capacity to either exacerbate or alleviate economic disparity, but it is more likely that greater income inequality fosters its expansion. However, it is plausible that there is no correlation between income inequality and the informal sector. This section will analyze the arguments of the BRICS countries on the matter by using panel unit root and panel cointegration tests, after providing an introduction to the approach and data sets.

3. METHODOLOGY AND FINDINGS

For our informal economy data, we will use the research conducted by Mai and Schneider (2016). Additionally, we will rely on the World Bank Informal Economy Database. We will get our income inequality (GINI) and GDP statistics from The World Bank database.

This section of the study aims to analyze the correlation between the informal economy and income inequality in BRICS member nations. To do this, panel unit root and panel cointegration tests will be employed over the time frame of 2000-2018. The study includes each variable in the model to assess the comparative influence of the informal economy and GDP on income inequality. This is accomplished by computing the logarithm of each individual value.

The majority of studies examining the correlation between income inequality and the informal economy indicates a favorable association between the two. The literature section highlighted the most significant of these investigations. The data utilized in economic analysis exhibit a diverse range owing to the swift and occasionally volatile fluctuations in market conditions. Panel data analysis is a prevalent and contemporary approach in econometrics, which involves estimating economic correlations using cross-sectional data that also includes a temporal dimension. Panel data analysis offers several advantages. Firstly, it allows for the control of individual heterogeneity, ensuring more accurate results. Additionally, it provides more informative insights and offers greater degrees of freedom and efficiency. Moreover, panel data analysis reduces the occurrence of multicollinearity between variables, enhancing the reliability of the findings. Furthermore, it enables better dynamic adjustment and allows for the identification and measurement of cross-section and time series effects simultaneously. Lastly, panel data analysis is capable of analyzing more complex models compared to the cross-section or time series method.

For the current investigation, we initially employ panel unit root testing. The primary concern in panel unit root testing is the independence of the horizontal cross-sections that make up the panel. The analysis utilized the unit root tests of Levin et al. (2002) and Im et al. (2003). Table 1 displays the outcomes of the unit root test for fixed capital, GDP, and the human capital index.

The values in brackets in Table 1 represent the series' statistical values and probabilities (P-values).

Table 1: Unit root test results

Variables	LLC (level)			IPS (level)		
	NC-without trend	C-with trend	C-without trend	NC-without trend	C-with trend	C-without trend
IE	10.80	3.782	−1.78**	–	1.829	0.543
GINI	11.428	−1.045	0.864	–	−1.354*	4.455
GDP	3.435	−1.423	1.843	0.176	3.411	−0.464
Variables	**LLC (first difference)**			**IPS (first difference)**		
IE	−3.647***	−4.211***	−1.201**	–	−5.677***	−3.669***
GINI	−1.441**	−5.406***	−3.860***	–	−4.846***	−4.435***
GDP	−1.907**	−0.41	−1.532***	–	1.754**	–

Significance levels at the 1%, 5%, and 10% levels are denoted by ***, **, and *, respectively. The terms C and NC respectively denote constant and nonconstant. Source: Author's Calculation Based on results generated by STATA 17.0. GDP: Gross domestic product, IE: Informal economy

The Schwarz Information Criterion designates the optimal lag duration as 1. The primary hypothesis of the LLC Unit Root Test posits that "there exists at least one unit root." In IPS, the primary hypothesis posits that no unit exhibits stationarity, whereas the alternative hypothesis suggests that at least one unit does exhibit stationarity.

$$Yi,t = a\ i + S\ it + ß1\ iX\ 1\ i,t + ß\ 2iX2i,t + ... + ßmiXmi,t + ei,t$$
$$t = 1...\ ,T\ m = 1...\ ,M\ i = 1..., N \quad (1)$$

The LLC and IPS unit root tests indicate that the variables do not exhibit stationarity at their levels. Cointegration may be conducted on non-stationary series by employing the Schwarz Information Criterion (SIC) and ensuring that the series becomes stationary by the use of first-order differences, denoted as I(1). To determine the existence of a long-term link between the series, it is necessary to conduct a unit root test.

We will employ the panel cointegration test devised by Pedroni and Kao. The Pedroni cointegration test requires the use of residuals, as indicated by equation (1). The symbols ßn, ßa, and ßmi represent the quantities T, M, and N, respectively, where T is the number of observations, M is the number of regression variables, and N is the total number of horizontal sections in the panel (Pedroni, 1999).

Pedroni's cointegration test considers the differences in the cointegration vector's heterogeneity, guaranteeing that the fixed and dynamic effects vary throughout the panel's cross-sections and the cointegrated vector's cross-sections (Pedroni, 1999). The Pedroni test is conducted to evaluate the null hypothesis (H_0) that there is no cointegration, against the alternative hypothesis (H_1) that there is cointegration. Table 2 displays the outcomes of the Pedroni panel cointegration test, indicating the presence of a persistent connection between income inequality (GINI), informal economy (IE) and official gross domestic product growth rate (GDP).

$$LnGINI = ß_0 + ß_A\ IE + ß_2 GDP + ut \quad (2)$$

The Pedroni panel cointegration test consists of seven distinct techniques, which may be categorized into four within-group approaches and three between-group ones. Table 2 displays the enduring correlation between income inequality, informal economy, and GDP. Both the within-group and between-group techniques demonstrate statistical significance at the 5% significance level. To clarify, four out of the seven distinct Pedroni procedures have been verified.

Nevertheless, Pedroni's study indicates that group ADF and panel ADF statistics yield superior outcomes when the time dimension of the panel is limited. Given the limited duration of the panel data, it would be more precise to base a conclusion on an analysis of these test statistics. Thus, the null hypothesis "H_0: There is no cointegration" may be definitively rejected as the test statistics provide strong evidence of a cointegration connection between variables and yield significant findings.

The findings of the Pedroni panel cointegration test are corroborated by the Kao test, which is based on the Engle-Granger method. The Kao panel cointegration test is conducted using the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests. Newey-West estimators are employed to calculate the long-term variance when an individual constant is present. Table 3 displays the outcomes of the Kao panel cointegration test.

The results of the Kao test are displayed in Table 3. Thus, the null hypothesis "H_0: There is no cointegration" is disproven, whereas the alternative hypothesis "H_1: There is cointegration" is supported. Furthermore, it was shown that there exists an enduring correlation between the factors.

Once the Pedroni and Kao's cointegration tests have established a connection between income inequality, informal economy, and official GDP over a long period, it becomes imperative to ascertain the coefficients of the independent variables, namely the informal economy and GDP, in the cointegration relationship. In this context, FMOLS (Fully Modified Ordinary Least Squares) as proposed by Pedroni (2000) was also employed. FMOLS estimates for each horizontal component of the model. The subsequent procedure involves calculating the average cointegration coefficients for each horizontal segment based on the FMOLS estimations. The FMOLS coefficients determined individually for each nation are aggregated to derive the average panel FMOLS coefficient for the group. The findings of the panel utilizing the FMOLS approach are displayed in Table 4.

Table 2: Pedroni panel cointegration test results

Tests	t-stat	Prob
Panel v statistics	0.243	0.413
Panel rho- statistics	−1.258	0.143
Panel PP- statistics	−1.783	0.021
Panel ADF statistics	−1.832	0.031
Group P- statistics (nonparametric) Phillips-Perron R- statistics	−0.314	0.453
Group T- statistics (nonparametric) Phillips-Perron T- statistics	−1.578	0.040
Group T- statistics (parametric) DF T statistics	−1.689	0.042

Source: Author's calculation based on results generated by STATA 17.0. ADF: Augmented Dickey-Fuller

Table 3: Kao panel cointegration test results

t-stat	Prob
T-statistics	−4.3421
P	0.0000

Source: Author's estimation based on results generated by STATA 17.0

Table 4: Panel fully modified ordinary least squares results

Countries	IE	T-statistics	GDP	T-statistics
Brasil	3.4823	8.358***	1.780	4.224***
Russia	4.9832	4.691***	1.944	5.671***
India	5.4022	3.229***	1.769	4.322***
China	3.8744	6.238***	1.954	7.464***
South Africa	1.3641	1.671**	0.952	8.578***
Panel	3.2450	9.429***	1.131	12.11***

Significance levels at the 1%, 5%, and 10% levels are denoted by ***, **, and *, respectively. Source: Author's estimation based on results generated by STATA 17.0. GDP: Gross domestic product, IE: Informal economy

The findings from Table 4 indicate a direct correlation between income inequality, informal economy, and GDP in BRICS countries, aligning with the anticipated outcomes. An increase of 1% in the informal economy among BRICS nations resulted in a corresponding rise of 3.24% in income inequality, as measured by the GINI coefficient. All results are statistically significant with a minimum level of significance of 5%. When considering individual countries, India and Russia have the highest percentage correlation between the informal economy and income inequality. China, Brazil, and South Africa followed, ranking third, fourth and fifth, respectively. Based on the panel average, the correlation between the informal economy and income inequality is below average in South Africa. A rise of 1% in official GDP resulted in a corresponding increase of 1.13% in income inequality. This ratio is below the level of inequality created by the informal economy. In other words, a slight deterioration in income distribution in developing countries with economic growth is a situation that does not contradict economic development theories. What is negative here is that the informal economy has a very negative impact on income inequality with an excessive effect. However, the results of our analysis show that the relationship between informal economy, GDP and income inequality is in the same direction as expected.

4. DISCUSSION AND CONCLUSION

Our study has unveiled a significant and direct correlation between income inequality, the informal economy, and GDP in the BRICS nations. The anticipated outcomes align with the empirical evidence presented in Table 4, showcasing a robust statistical significance across the board. Notably, a noteworthy revelation is the substantial impact of the informal economy on income inequality, with a 1% increase leading to a substantial 3.24% rise in the GINI coefficient. Delving into country-specific analyses, India and Russia emerge as the frontrunners, exhibiting the highest percentage correlation between the informal economy and income inequality. China, Brazil, and South Africa follow suit, each contributing to the overarching understanding of this intricate relationship. South Africa, however, demonstrates a below-average correlation between the informal economy and income inequality, providing a nuanced perspective within the BRICS context. On another note, the analysis underscores that a 1% rise in official GDP leads to a 1.13% increase in income inequality. Yet, intriguingly, this ratio falls below the level of inequality induced by the informal economy. This implies that while economic growth may slightly worsen income distribution in developing countries, the informal economy exerts a disproportionately negative impact on income inequality.

These findings hold crucial implications for policymakers seeking to address income inequality within the BRICS nations. Recognizing the pronounced impact of the informal economy on income inequality, targeted policy interventions are imperative. Implementing measures to formalize and regulate informal economic activities, thereby integrating them into the formal economy, could serve as a viable strategy. Moreover, understanding the nuanced variations across BRICS countries is paramount. Tailored policies should be devised for nations such as India and Russia, where the informal economy exerts a significant influence on income inequality. Conversely, South Africa, with a below-average correlation, may benefit from policies focusing on enhancing formal economic sectors rather than solely curbing informal activities.

Additionally, policymakers should be cognizant of the delicate balance between economic growth and income distribution. While fostering economic growth is essential for development, strategies should be in place to mitigate the exacerbating effects of the informal economy on inequality. This involves creating an environment that encourages formal employment, provides social safety nets, and addresses disparities in wealth distribution. In conclusion, addressing the complex interplay between income inequality, the informal economy, and GDP requires a multifaceted and tailored approach. The insights provided by this study pave the way for informed policy decisions aimed at fostering more inclusive and equitable economic development within the BRICS nations.

Here are some potential avenues for new academic research based on the subject and results you've presented:

Causal mechanisms: Investigate the causal mechanisms behind the observed correlation between the informal economy, income inequality, and GDP in BRICS countries. Explore factors such as labor market dynamics, institutional frameworks, and policy interventions that may contribute to or mitigate these relationships.

Informal economy dynamics: Conduct a comprehensive study on the dynamics of the informal economy in each BRICS country. Explore variations in informal sector size, composition, and characteristics, and how these factors influence income inequality patterns. This could involve qualitative research methods, such as interviews and case studies.

Policy effectiveness: Assess the effectiveness of existing and proposed policies aimed at formalizing the informal economy. Analyze the impact of regulatory measures, incentives for formalization, and social protection programs on reducing income inequality within the context of each BRICS nation.

Social inclusion policies: Evaluate the impact of social inclusion policies on mitigating the negative effects of the informal economy on income inequality. Explore initiatives that aim to provide education, healthcare, and social protection to informal workers and their families, and assess their effectiveness in promoting more equitable outcomes.

Globalization influence: Investigate how globalization influences the informal economy, income inequality, and GDP within the BRICS nations. Analyze the role of international trade, foreign direct investment, and global economic trends in shaping the dynamics observed in the study.

Technological innovation: Explore the role of technological innovation in influencing the relationship between the informal economy and income inequality. Investigate how advancements in digital technologies and online platforms impact informal sector

activities and whether they contribute to more inclusive economic development.

These research points can provide valuable insights into the complex dynamics of the informal economy, income inequality, and GDP in BRICS countries, contributing to a deeper understanding of the challenges and opportunities for sustainable and equitable economic development.

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