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Dynamics of Social Inequalities in the Face of Macroeconomic Shocks in Morocco: An Econometric Analysis Using the Model Ardl

Sanaa DFOUF[1], Fekkak HAMDI[2], Tarik CHAROUK[3], Abdelhak FAIDI[4]

Abstract

This article evaluates the relationship between macroeconomic shocks and social inequalities in Morocco through the lens of the ARDL model. It uses annual information on GDP, unemployment, and inflation and social spending in order to analyzed social inequalities manifested by the Gini index.Empirical studies suggest that the economic growth has ambiguous consequences on inequality, as its resource mobilization tendency on one hand leads to a long term decrease in income disparity. Furthermore, unemployment and inflation are negative determinants of inequalities, specifically targeting the lower most household. On the other hand, social transfers do help mitigate inequality, even though their effect is virtually nonexistent in the absence of any form of redistribution.The econometric findings indicate a long run co-integration of the variables which in effect means that there are persistent inequalities over time which tend to be influenced by the macro shock incidence. This strengthens the urgency for comprehensive economic strategies that incorporate active labor market policies and social services to counter inequalities.In conclusion, this study appeals for increased attention towards redistributive policies alongside implementable economic strategies that can soften the impact of macroeconomic shocks on social inequalities in Morocco.

Keywords: *Social Inequality, Macroeconomic Shocks, Economic Growth, Social Transfers, ARDL Model.*

Introduction

Social inequalities are a real issue for equality and social justice in a modern economy, and they stand in the way of both social development and economic growth. Disparities are most often exacerbated by shocks to the macroeconomy, such as economic crises, changes in inflation, or unemployment levels. With this in mind, it is vital to examine the effects these shocks have on the distribution of wealth and to propose measures likely to reduce inequalities.

The essence of this research may lead to the following question: To what extent do macroeconomic shocks influence social inequalities, and what economic mechanisms underlie these dynamics? The answer lies in an econometric approach using the ARDL (Auto-Regressive Distributed Lag) model, which simultaneously examines the effect and counter-effect relationships of the Gini index (social synthesis of inequalities) at the expense of several important economic variables in the region: gross product, unemployment, inflation rate, and social benefit allocation.

The approach adopted in this article is based on several stages: first, after reviewing the literature on the effects of macroeconomic shocks on social inequalities, we provide the econometric methodology and data used. Next, we present the empirical results, which include stationarity, cointegration relationships, and ARDL model estimation. Finally, we highlight the main conclusions of the work and some suggestions on how to deal with inequalities in times of crisis.

[1] Doctorate in Economics and Management, Faculty of Legal, Economic and Social Sciences – Mohammedia, Hassan II University of Casablanca, Morocco, Email: Sanaadf.prof@gmail.com
[2] Professor / Researcher, Multidisciplinary Research Laboratory in Economics and Management (LARPEG)
Faculty of Economics and Management - Béni Mellal, Sultan Moulay Slimane University of Béni Mellal, Morocco, Email: hamdidff@gmail.com.
[3] Professor / Researcher Applied Research Laboratory on Literature, Language, Art and Cultural Representations (L.R.A.L.L.A.R.C) Faculty of Economics and Management - Béni Mellal Sultan Moulay Slimane University of Béni Mellal, Morocco, Email: charouktarik@hotmail.fr.
[4] PhD student Economic and Logistics Performance Laboratory Faculty of Legal, Economic and Social Sciences - Mohammedia Hassan II University of Casablanca, Morocco, Email: faidi.abdelhek@gmail.com.

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Literature Review

Kuznet's work on socio-economic analysis suggests that mid-20th century economists were interested in the evolution of social inequalities through macroeconomic shocks. In his book, Kuznet (1955) discussed how social inequalities seem to behave like an inverted U curve: they worsen in the early phases of economic growth. However, further theoretical investigations have shifted this paradigm to include the worsening of inequality due to economic crises (Atkinson & Piketty, 2010), which is now more commonly accepted.

For more recent economic crises, such as the COVID-19 pandemic, Blundell et al. (2020) explain that certain categories of socioeconomic status face greater risks than others. Undoubtedly, informal employment and unskilled workers have been hardest hit in this crisis, with large income losses and fewer job opportunities. Meanwhile, higher-skilled workers have been able to take advantage of the upheavals, benefiting from a wider range of better-paid, more secure jobs.

Various statistical tools are used to measure inequality, one of the most common being the Gini index. Deininger and Squire (1996) remind us that changes in this index directly reflect variations in the concentration of wealth and income. In other words, a failure to mitigate or a negative increase in the Gini index is generally accepted as a sign of declining economic equity.

Moreover, inflation plays a crucial role in deepening economic disparities. Romer and Romer (1998) have shown that inflation generally diminishes the purchasing power of the middle and lower classes, thus increasing economic divisions. In Morocco, studies by the HCP (2022) found that inflation affects rural households and the poorest classes the most, due to their heavy dependence on basic goods.

Ravallion's family of studies told us that structural adjustments and monetary policies, for example, work differentially across social groups, with some having much more support than others. As far as econometric methods are concerned, ARDL is one of the models versatile enough to provide answers on the short- and long-term effects of macroeconomic variables on social disparities.

In this sense, we have developed a hypothesis that social disparity in Morocco is an econometric measure sensitive to macroeconomic shocks, and we have tried to estimate it with an ARDL approach. This research aims to try to understand and suggest economic policies that would respond to the real social gaps presented in the data.

Methodology

To study inequality and economic growth in Morocco from 1990 to 2021, we will use the ARDL (AutoRegressive Distributed Lag) model. This model was previously developed by Pesaran Shin. 1999 Pesaran et al, 2001, Shin Byungchul and Greenwood, 2013, it is best known for its simplicity and ease of implementation. These advances in econometric analysis have been able to address the problems posed by traditional co-integration methods. This model is well suited to taking account of possible breaks in the trend of a statistical time series. In cases where exogenous variables have asymmetric effects on the endogenous variable, it is suggested (Shin et al, 2013) to use the non-linear ARDL approach. For this thesis, we decided to use the ARDL approach due to the sample size of only 32 observations. For small sample sizes, this approach helps to mitigate bias problems. In addition, when using the co-integration technique, the variables in question must have the same level of integration. Another advantage of ARDL models is that they can take into account both short-term and long-term effects caused by exogenous variables on the endogenous variable at the same time.

Econometric Model Specification

In capturing the impacts caused by macroeconomic shocks on social inequality, we employ ARDL (Auto-Regressive Distributed Lag) model, which permit us to examine both short and long term relations among the underlying factors. The model is formulated as follows:

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$$\text{Ln}Gini_t = \alpha + \sum_{i=1}^{p}\beta_i \text{ln}Gini_{t-i} + \sum_{j=0}^{q_1}\gamma_j GDP_{t-j} + \sum_{j=0}^{q_2}\delta_j \text{Unemployment}_{t-j} + \sum_{j=0}^{q_3}\theta_j Inflation_{t-j} + \sum_{j=0}^{q_4}\lambda_j Transfers_{t-j} + \varepsilon_t$$

Where:

- Ln is the neperian logarithm;
- $Gini_t$ is the Gini index at time t ;
- GDP, unemployment, inflation and social transfers are the macroeconomic explanatory variables;
- α, βi, γj, δj and θj Effects of past values of variables ;
- εt is the error term.

The Data

This study aims to examine the relationship between social inequalities and macroeconomic shocks. For this reason, we have defined the variables which make up the table below:

Table 1. Description of Variables

The variable	Measurement indicator	Unit	Source
GINI	GINI index	In percent	The World Institute for Development Economics Research (WIID)
GDP	Growth rates	In percent	World Bank data
Unemployment	Unemployment rate	In percent	World Bank data
Inflation	Inflation rate	In percent	World Bank data
Transfers	Social transfers in education and health	In percent	Ministry of Finance data (Manar stat)

Source : Adapted by us

This analysis is concerned with the data cover the period from 1990 to 2021, which was gathered from World Bank and World Institute for Development Economics Research (WIID) databases. To maintain uniformity for longitudinal analysis, the values for all variables are collected annually.

Results and Discussion

In this section, we present and analyze the empirical results obtained by estimating the ARDL model. The aim is to explore the effects of macroeconomic shocks on social inequality and to assess the growth dynamics of their relationship with economic productivity.

To begin with, we'll analyze descriptive statistics to capture patterns in the distribution and movements of the target variables. Next, we'll discuss the relationships between the correlations of the variables, allowing us to determine the preliminary relationships expected for model estimation. Subsequently, we will test the unit root through the appropriate tests, ensuring that the econometric analysis will be as rigorous as possible. Finally, we offer a discussion of the ARDL estimation results, firstly explaining the model's short- and long-term impacts and, secondly, comparing the results with existing literature.

This approach aims to contribute to understanding the impact of macroeconomic shocks on social inequalities and to provide a basis for formulating economic policy recommendations.

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Descriptive Analysis Of Variables

Prior to estimating the econometric model, it is crucial to analyze the main characteristics of the selected variables. The descriptive analysis enables the checking of dispersion of values, patterns and outliers, if any. This step offers obtaining the preliminary information on social inequalities and the selected macroeconomic variables, which can help to understand the results of the econometric analysis.

Table 2. Results of Descriptive Analysis of Variables

	LNGINI	GDP	UNEMPLOY	INFLATION	TRANSFERS
Mean	3.747476	3.515520	11.38065	2.440710	10.35823
Median	3.742515	3.499557	11.00000	1.635000	10.33200
Maximum	3.760688	12.37288	15.90000	7.986000	12.06400
Minimum	3.735095	-7.178207	8.900000	0.303000	7.283000
Std. Dev.	0.008761	4.068039	2.167090	2.079217	1.092423
Skewness	0.462539	-0.506370	0.339750	1.207531	-0.968640
Kurtosis	1.708457	3.932561	1.629456	3.355570	4.214844
Jarque-Bera	3.259978	2.448114	3.022644	7.696982	6.753992
Probability	0.195932	0.294035	0.220618	0.021312	0.034150
Sum	116.1717	108.9811	352.8000	75.66200	321.1050
Sum Sq. Dev.	0.002303	496.4683	140.8884	129.6942	35.80166
Observations	31	31	31	31	31

Source: Compiled by us on Eviews 12

Social inequalities, as analyzed by LOGINI, tend to be relatively stable. It should be noted that they have low variability and a quasi-normal distribution. The relative GDP component shows very high dispersion and negative asymmetry, meaning that very large savings tend to occur. Unemployment is relatively stable, but high. On the other hand, although inflation is the main factor, it too is marked by a significant lack of variance and non-normality, which means that there are episodes of strong, rapid winds of price rises for goods and services. According to this analysis, unemployment, gross domestic product, and inflation are elements that, at a given moment, are potential triggers of inequality. Social transfers, on the other hand, are a stabilizing factor, although their efficiency requires further study.

Correlation Between Model Variables

Understanding relationships before estimating an econometric model requires examining the nature and strength of linear associations using correlation analysis. This step is important to identify possible relationships between independent variables, to avoid problems of multicollinearity and to guide the interpretation of results. Several variables may be highly correlated, which may justify additional tests to check the robustness of the model.

Attempting to estimate an econometric model requires a prior understanding of relations which needs an examination of associations by the means of correlation analysis. This process is critical to detecting possible relationships among independent variables so as to avoid multicollinearity problems as well as to assist in result interpretation. Several variables may be highly correlated, which may justify additional tests to check the robustness of the model.

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Table 3. Correlation Matrix Between Variables

	LNGINI	GDP	UNEMPLOY	INFLATION	TRANSFERS
LNGINI	1.000000	0.246260	-0.419498	-0.388087	0.414659
GDP	0.246260	1.000000	-0.084981	0.021644	0.044006
UNEMP	-0.419498	-0.084981	1.000000	0.610567	-0.731040
INFLAT	-0.388087	0.021644	0.610567	1.000000	-0.676281
TRANS	0.414659	0.044006	-0.731040	-0.676281	1.000000

Source: Compiled by us on Eviews 12

These results show that macroeconomic shocks affect inequality in nuanced ways. The weak correlation between GDP and the Gini index indicates that growth alone does not reduce inequality. Both unemployment and inflation have a moderate and detrimental impact on inequality, while social transfers, which are fundamental, seem unable to effectively bridge social gaps. More work needs to be done, including causality tests and regression analysis, to better understand these dynamics.

Variable Stationarity

Analyzing the stationarity of variables is a fundamental step in econometrics to prevent spurious regressions and ensure the validity of estimates. A series is considered stationary if its statistical parameters (mean, variance, autocorrelation) remain constant over a given period. To verify this condition, the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test are commonly used to determine the required degree of differencing of a variable before incorporating it into an ARDL model.

Table 4. Variable Stationarity Results

	In level		In 1st differentiation		Order of integration
Variable	ADF	Results	ADF	Results	
LnGINI	0,181848 (0,7337)	NST	-2,96027 (0,0045)	ST	I(1)
GDP	-0 ,965708 (0,2902)	NST	-9,800859 (0,0000)	ST	I(1)
Unemployment	-1,668225 (0,0894)	NST	-7,84814 (0,0000)	ST	I(1)
Inflation	-2,654088 (0,0098)	ST	-	-	I(0)
Transfers	0,563170 (0,8322)	NST	-8,920200 (0,0000)	ST	I(1)

Source: Compiled by us on Eviews 12

The results indicate that most variables, such as macroeconomic time series, are non-stationary in level but stationary in first difference. Although most variables seem to belong to a different category, inflation is stationary in level and therefore behaves differently from the others.

In an econometric context, these findings imply that :

- Common regression models would require a first difference to avoid spurious regressions for I(1) variables.

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- A cointegration approach (such as the ARDL model or the Johansen approach) might be reasonable if there is a suspected long-term equilibrium relationship between the variables.

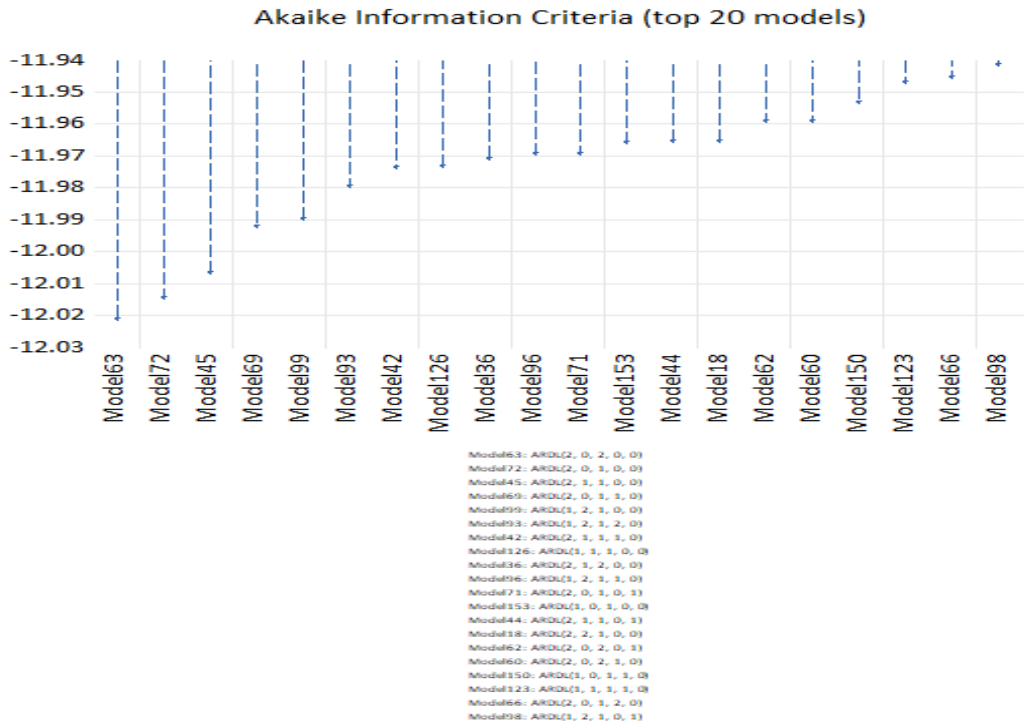
- A transformation is probably not necessary for inflation in models.

This illustrates the need for careful processing of time series data before econometric modeling.

Optimal Model

Following the examination of prerequisites for applying the ARDL model, my estimation results indicated that the optimal ARDL model is ARDL (1,2,1,0,1) illustrated in the graph below :

Figure 1. Optimal Model Selection



Source: Compiled by us on Eviews 12

The ARDL model (1,2,1,0,1) has the lowest criterion value, indicating that it provides the best compromise between fit and complexity among those tested.

Cointegration Test

To determine if there is a long-term relationship between the variables, we conducted a cointegration test with the bounds test approach. In this instance, the results of the test shown in the table demonstrate that the Fisher F-statistic (1.975579) is not within the critical bounds (1%, 5% and 10%), and this allows us to reject the null hypothesis of the absence of any long-term relationship.

Table 5: Boundary cointegration test results

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F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	1.975579	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
Actual Sample Size	29		Finite Sample: n=35	
		10%	2.46	3.46
		5%	2.947	4.088
		1%	4.093	5.532
			Finite Sample: n=30	
		10%	2.525	3.56
		5%	3.058	4.223
		1%	4.28	5.84

Source. : Compiled by us on Eviews 12

Short-Term Model

The ECM model derived from ARDL evaluates the effect of unemployment and lagged Gini index values on short-term social inequality. The results indicate that the lagged Gini index has a positive and significant effect (0.3438, p = 0.0463), suggesting that changes in social inequality in the past have an impact on the present. The direct effect of unemployment is negative: (-0.000386, p = 0.0482) suggesting that an increase in unemployment reduces inequality in the short term, while the lagged effect is positive (0.000266) but not significant (p = 0.0740). This may indicate a form of impact inversion in the longer term.

Significant and negative (-0.0514, p = 0.0010), the coefficient of the error correction term scatters the long-term convergence speed at 5.14% per period. Thanks to the optimal value of 50%, as well as negative AIC, BIC, and Durbin-Watson values of 1.77, this model adjusts errors without severe autocorrelation. From this integrator, we deduce a deadlock in the temporal relationship between yield and unemployment, with an adjustment mechanism towards equilibrium.

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Table 6. CT ARDL Model

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGINI(-1))	0.344028	0.161780	2.126517	0.0461
D(UNEMPLOYMENT)	-0.001913	0.000908	-2.106585	0.0480
D(UNEMPLOYMENT(-1))	0.001318	0.000700	1.882798	0.0744
CointEq(-1)*	-0.051564	0.013390	-3.851036	0.0010

R-squared	0.555043	Mean dependent var	0.000236
Adjusted R-squared	0.501648	S.D. dependent var	0.003288
S.E. of regression	0.002321	Akaike info criterion	-9.166159
Sum squared resid	0.000135	Schwarz criterion	-8.977567
Log likelihood	136.9093	Hannan-Quinn criter.	-9.107094
Durbin-Watson stat	1.780822		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Source: Compiled by us on Eviews 12

The Long-Term Model

The results of the long-term model show that most of the explanatory variables do not appear to have a statistically significant effect on changes in social inequality. The coefficient associated with the lagged Gini index is negative (-0.0514), indicating the existence of some inertia in inequality; however, this relationship is not significant either (p = 0.5380). The effect of GDP on inequality is also insignificant (-4.89E-05) and does not reduce the probability of the null hypothesis (p = 0.1772). This calls into question the hypothesis that economic growth will reduce inequality.

For lagged unemployment, there appears to be a positive effect (5.93E-05), which may indicate an increase in inequality during periods of high unemployment, but this is statistically insignificant (p = 0.4488). The effect of inflation on inequality appears to be negative (-0.000127), probably due to the inflationary erosion of purchasing power, but it remains almost statistically significant (p = 0.1052). In contrast, social benefit transfers have a rather negative effect (-0.000341) and are almost statistically significant (p = 0.0979), indicating that they appear to play some role in reducing inequality.

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Table 7. Long-Term Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.210177	0.305171	0.688719	0.4989
LNGINI(-1)*	-0.051564	0.082012	-0.628739	0.5366
GDP**	-0.000242	0.000173	-1.396503	0.1779
UNEMPLOYMENT(-1)	0.000295	0.000380	0.775986	0.4468
INFLATION**	-0.000631	0.000370	-1.704530	0.1038
TRANSFERS**	-0.001686	0.000972	-1.735274	0.0981
D(LNGINI(-1))	0.344028	0.190845	1.802659	0.0865
D(UNEMPLOYMENT)	-0.001913	0.001293	-1.479622	0.1546
D(UNEMPLOYMENT(-1))	0.001318	0.001051	1.253198	0.2246

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Source: Compiled by us on Eviews 12

Overall, these results suggest that the dynamics of inequality are not directly influenced by these long-term economic variables, which underlines the importance of analysis using robustness and validation tests.

At a broader level, these results indicate that the dynamics of inequality are not directly affected by these long-term economic variables, which reinforces the need for analysis based on robustness and validation tests.

Model Validation

To guarantee the accuracy and robustness of our model, we carried out several validation tests: error normality test, heteroscedasticity test, and error autocorrelation test. These tests verified its reliability. First, we performed normality tests to see whether the model's error terms are normally distributed. Next, we performed a heteroskedasticity test to check whether the variance of the error terms remains constant at different levels of the explanatory variables. In addition, we analyzed the autocorrelation of the errors to see if there is a correlation between the error terms at different times, which may influence the efficiency and reliability of the model. Finally, we analyzed model stability, to determine whether relationships between variables remain stable over time.

Normality Test

Based on the results of the Jarque-Bera test presented below (Figure 2), we draw our conclusion that the calculated probability (5.144981) exceeds the 5% significance level. This indicates that our model follows a normal distribution.

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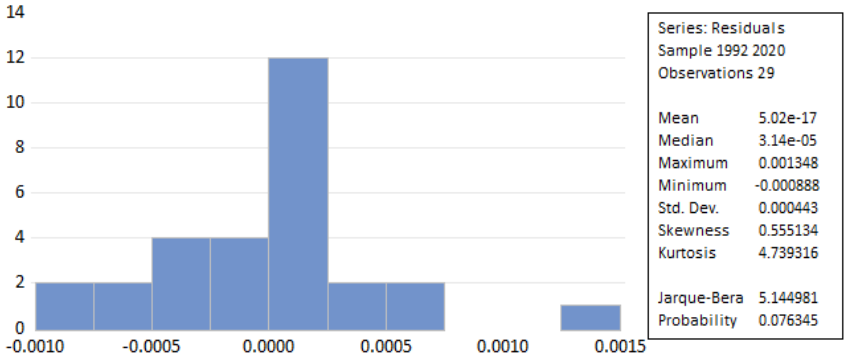
Figure 2. Normality Test



Source: Compiled by us on Eviews 12

Heteroscedacity Test

To verify the presence of heteroscedasticity in our model, we performed the Breusch-Pagan-Godfrey test, and the results indicate that the chi-square probability is greater than 5%, so we reject the null hypothesis that postulates the presence of heteroscedasticity and accept the alternative hypothesis, according to which our model is homoscedastic, meaning that the variance of the error term in the model is constant for all values of the independent variables.

Table 8. Breush-Pagan-Godfrey Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	2.405526	Prob. F(8,20)	0.0533
Obs*R-squared	14.22075	Prob. Chi-Square(8)	0.0762
Scaled explained SS	12.64587	Prob. Chi-Square(8)	0.1246

Source: Compiled by us on Eviews 12

Residual Autocorrelation Test

Based on the results of the Breusch-Godfrey test, the obtained p-value exceeds 5%, leading us to reject the null hypothesis and accept the alternative hypothesis that the residuals are not autocorrelated.

Table 9. Breush-Godfrey Test

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	2.047417	Prob. F(2,18)	0.1581
Obs*R-squared	5.374568	Prob. Chi-Square(2)	0.0681

Source: Compiled by us on Eviews 12

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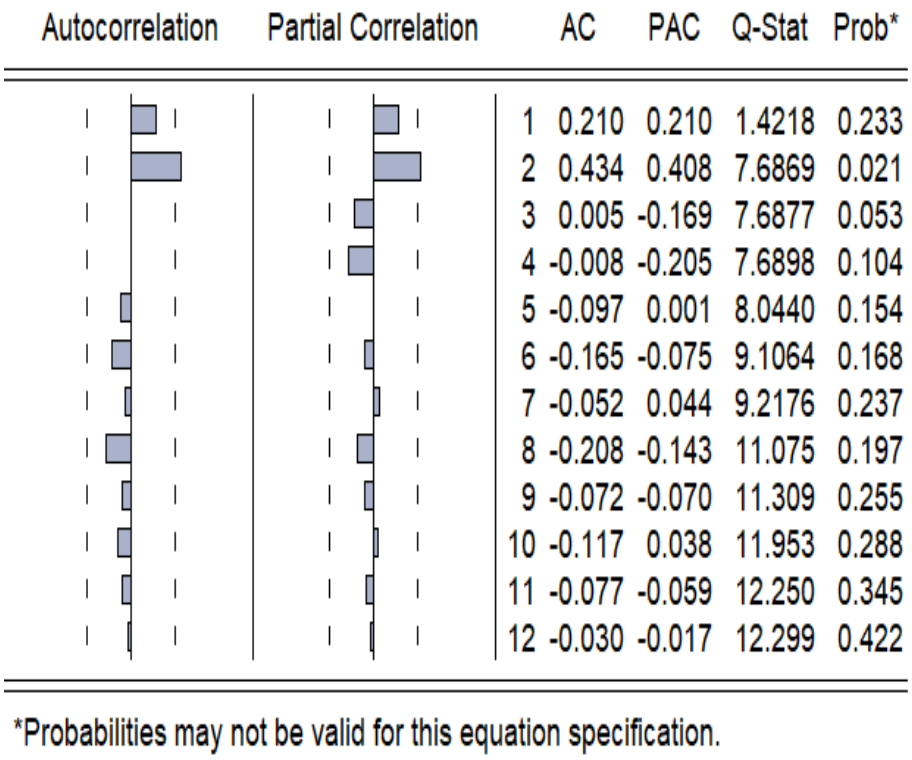
Residual Correlogram

Based on the analysis of the correlogram results below, all bars representing the correlation coefficients fall within the confidence interval limits. This confirms the stability of the model's residuals over time.

Table 10. Residual Correlogram



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.210	0.210	1.4218	0.233
		2	0.434	0.408	7.6869	0.021
		3	0.005	-0.169	7.6877	0.053
		4	-0.008	-0.205	7.6898	0.104
		5	-0.097	0.001	8.0440	0.154
		6	-0.165	-0.075	9.1064	0.168
		7	-0.052	0.044	9.2176	0.237
		8	-0.208	-0.143	11.075	0.197
		9	-0.072	-0.070	11.309	0.255
		10	-0.117	0.038	11.953	0.288
		11	-0.077	-0.059	12.250	0.345
		12	-0.030	-0.017	12.299	0.422

*Probabilities may not be valid for this equation specification.

Source : Compiled by us on Eviews 12

After analyzing the correlogram results below, we observe that all bars representing the correlation coefficients fall within the confidence interval limits, ensuring the stability of the model's residuals over time.

Model Stability

The two figures below, representing the CUSUM test results, show that both blue curves remain within the 5% confidence bounds. This confirms the model's stability over the study period, reinforcing the findings from the correlogram analysis. Moreover, it indicates the absence of significant cumulative deviations or structural changes in the model coefficients.

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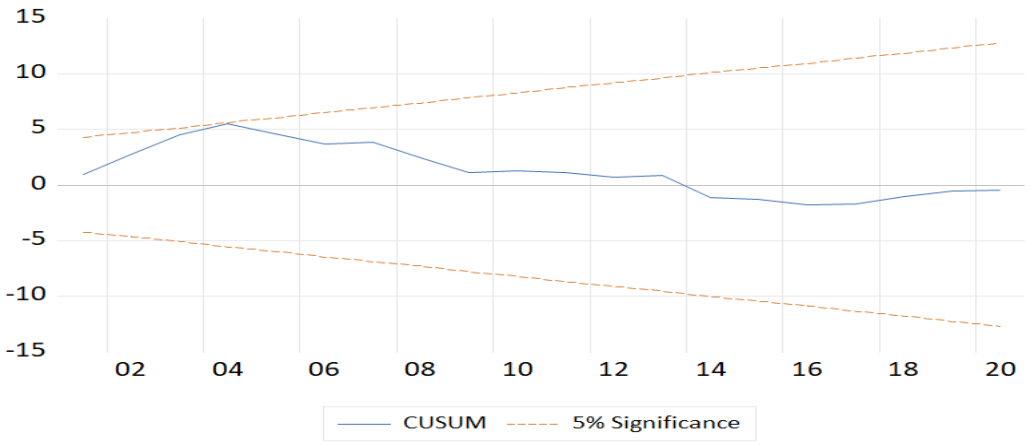
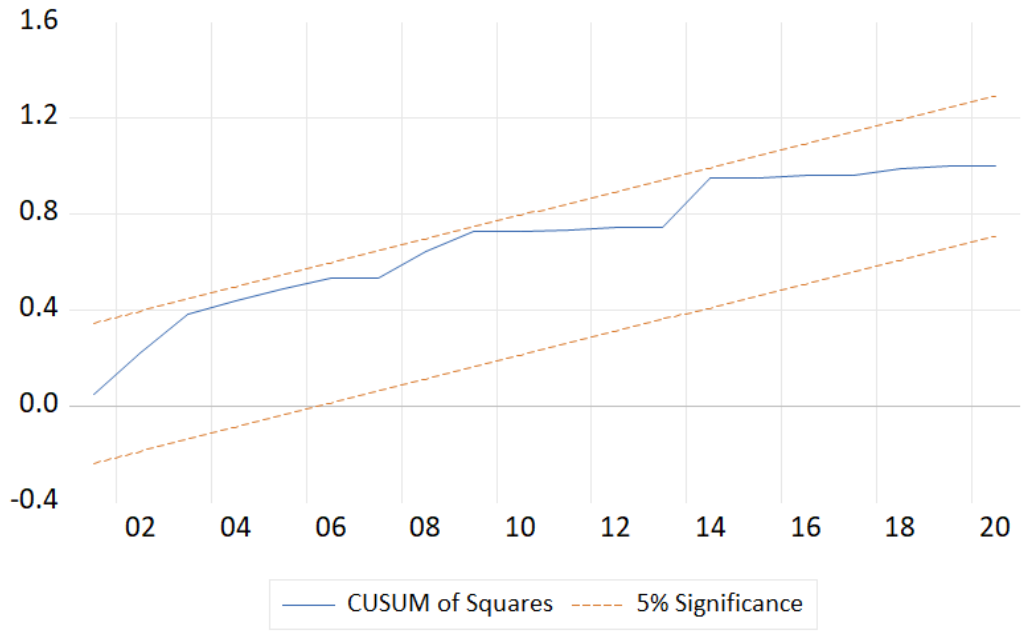
Figure 4. Cumulative Sum of Recursive Residuals



Source: Compiled by us on Eviews 12

Figure 5. Cumulative Sum of Squares of Recursive Residuals



Source: Compiled by us on Eviews 12

Conclusion

This study examines how socio-economic inequalities respond to macroeconomic shocks using an ARDL model. The findings reveal that unemployment, inflation, social transfers, and economic growth exert distinct influences on the Gini coefficient in both the short and long run. In the short term, fluctuations in unemployment have a significant impact on inequality, whereas social transfers play a mitigating role. In the long term, the presence of a cointegrating relationship suggests a gradual worsening of inequality in response to economic shocks, highlighting the necessity of a comprehensive strategy to counteract social imbalances.

This underscores the need for a more nuanced economic policy framework that integrates active labor

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market policies, effective inflation control, and well-targeted social transfers. With appropriate policy measures, a substantial reduction in socio-economic disparities may be achievable, particularly during periods of sustained economic growth. However, a more in-depth analysis incorporating structural factors such as education, taxation, and access to basic services could enhance the understanding of the underlying drivers of social inequality.

Based on these conclusions, several policy recommendations can be proposed to mitigate the impact of macroeconomic shocks on social inequalities:

- Enhancing dynamic employment policies: Reducing unemployment should be pursued alongside active labor market policies, such as incentivizing entrepreneurship and investment in job-generating sectors.

- Improving the targeting of social assistance programs: Greater efficiency in redistribution policies is crucial to supporting the most vulnerable households and mitigating economic inequalities, particularly during downturns.

- Strengthening inflation control mechanisms: Low-income households are disproportionately affected by price fluctuations. Effective monetary and fiscal policies, combined with regulatory measures to stabilize the prices of essential goods, can help protect relative incomes and curb inequality.

- Promoting inclusive economic growth: Policies should foster investment in education, healthcare, infrastructure, and other development sectors with potential spillover effects in reducing long-term inequalities.

- Expanding the analysis of structural inequalities: Future research should incorporate additional structural determinants such as taxation, the provision of essential services, and demographic shifts to gain deeper insights into persistent socio-economic disparities.

- These recommendations aim to promote more equitable and resilient economic growth while enhancing social inclusion and reducing economic inequalities in the face of macroeconomic shocks.

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