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Article

Impact of selected macroeconomic on poverty alleviation in Indonesia: Evidence from NARDL approach

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Abstract: This paper investigates the empirical relationship between economic growth, inflation, foreign direct investment (FDI), and trade on Indonesia's poverty reduction. The analyzed data period is 1970–2022 using the nonlinear autoregressive distributed lag (NARDL) model. In the long term, positive and negative shocks to economic growth and FDI significantly affect poverty in Indonesia. Increased growth and FDI will have a significant effect on poverty alleviation. Likewise, when there are negative shocks from economic growth and FDI, it will increase the percentage of the poverty rate. Meanwhile, the inflation variable has a different effect on the conditions of positive and negative shocks. In positive shocks, inflation has a positive and insignificant effect, while in negative shocks, inflation has a negative and significant effect on poverty. It shows that a decrease in the price of goods significantly impacts poverty alleviation in the long term. Furthermore, trade has no significant effect in the long term in both positive and negative shocks. The short-term estimation results show that all variables are significant for positive and negative shocks, except for positive shocks of inflation and negative shocks of trade. Therefore, it is recommended that the government adopt a poverty reduction program by improving more stable economic growth instruments, increasing foreign investment that is more labor-intensive, and controlling inflation more effectively to avoid unreasonable increases in the price of goods.

Keywords: poverty; growth; inflation; foreign direct investment; asymmetric
JEL Classification: C82; F21; P36

1. Introduction

Poverty is one of the major problems in Indonesia. However, the poverty rate has declined in the last three decades due to various government programs to alleviate poverty. In 1970, poverty in Indonesia was very acute, reaching 60% of the population, and decreased significantly to 15.1% in 1990. Meanwhile, the current poverty rate reached 9.57% in 2022 (BPS Nasional, 2024). The government has taken various measures to reduce the number of poor people, such as life skills training, education scholarships, and health insurance, increase the stability of economic growth, encourage the inflow of foreign investment, and maintain price stability (Balasubramanian et al., 2023; Dewi et al., 2018; Faharuddin et al., 2023).

The relationship between economic growth and poverty alleviation has attracted the interest of researchers and policymakers because of the differences between theory and the results of practical policy implementation (Mulok et al., 2012). Theoretically, economic growth is connected with the real economy through the availability of resources for production factors, increasing employment

opportunities, income distribution, and reducing poverty levels (Dauda, 2016; Lee and Sissons, 2016; Nurjannah et al., 2023; Sotiropoulou et al., 2023). Ironically, some countries experiencing rapid economic growth experience higher income inequality and greater poverty (Elheddad et al., 2021; Škare and Družeta, 2016).

The causal relationship between poverty and macroeconomic indicators has been a hot topic. However, these studies need to pay more attention to the nonlinear approach when examining the relationship between poverty and several macroeconomic determinants. Indonesia, as one of the developing countries, is particularly important in assessing the impact of negative and positive shocks from key macroeconomic determinants on poverty. Positive and negative shocks in these macroeconomic determinants significantly impact poverty in the short and long run. Therefore, this study examines the effect of economic growth, inflation, FDI and trade on poverty reduction in Indonesia using the NARDL model. Previous studies have previously ignored this bifurcation and proposed an overall impact of the determinants on the poverty variable.

Understanding the interaction between poverty, economic growth, inflation, FDI, and trade is complex. Globalization has opened up new avenues for investment, especially in developing countries. Within two decades, the Asian region has become a reliable destination for foreign investors and has witnessed tremendous growth in FDI inflows (Verico and Pangestu, 2021). With ongoing innovation in various sectors, FDI has facilitated increased employment opportunities that can multiplier the economy. However, the literature suggests that to ensure optimal utilization of FDI, the socio-political and economic environment of the FDI-receiving country must be conducive to new investments, as otherwise, it may adversely affect economic growth.

Some economists have long questioned how economic growth reduces poverty, which is an essential question for policy implementers. As policy implementers, the government must differentiate whether it is essential to prioritize economic growth and identify the growth needed to eradicate poverty (Amponsah et al., 2023; Balasubramanian et al., 2023; Lee and Sissons, 2016). Simultaneously, this question is essential because it is one of the Sustainable Development Goals (SDG), namely ending all forms of extreme poverty worldwide by 2030 (Ahmad et al., 2019).

Several studies have found that inflation is one of the causes of increased poverty, especially in developing countries (Afandi et al., 2017; Estrades and Terra, 2012; Faharuddin et al., 2023; Meo et al., 2018; Walinono et al., 2022). Inflation can reduce consumer purchasing power, but it can also increase household expenditure. If household income does not change, inflation will increase the poverty rate. During the 1997–1999 crisis, for example, high inflation contributed to the high poverty rate in Indonesia in the short term (Faharuddin et al., 2023). Meanwhile, empirical studies on the impact of FDI on poverty have found mixed and inconsistent results. Some symmetric studies found that FDI contributes to poverty reduction, especially in developing countries (Afandi et al., 2017; Ahmad et al., 2019; Do et al., 2021; Hanim, 2021; Ucal, 2014). Others found that FDI was insignificant to poverty reduction (Dada and Akinlo, 2021; Magombeyi and Odhiambo, 2018).

Most of these studies implicitly assume that no asymmetric structure exists in the relationship between economic growth, inflation, and poverty. It is not in line

with reality and is a mistake in the current development of econometrics because the symmetric approach provides limited information on the relationship between the various shocks caused by the research variable indicators of growth, inflation, FDI, international trade and poverty (Meo et al., 2018; Olaniyi and Odhiambo, 2024). In addition, the data distribution in reality has asymmetric and non-linear patterns, so symmetric and linear approaches may produce biased results.

After conducting an in-depth review of the relevant literature, it is clear that poverty is a crucial and global issue, and many researchers have researched the determinants of poverty. All these facts provide substantial support for conducting a study to examine the effect of economic growth, inflation, and foreign investment on poverty in Indonesia. In addition, empirical studies on the determinants of poverty show that the impact of economic growth, inflation, and FDI on poverty still needs to be clarified due to different conclusions. Therefore, it is essential to investigate the determinants of poverty in the context of the Indonesian economy. In addition, asymmetric models have received little attention in Indonesia. This study contributes to the literature by considering the asymmetry between poverty and its determinants. Therefore, poverty is modeled in an asymmetric framework. We provide details of our data and methods, which are presented in section 2. We present the empirical results in section 3, and section 4 presents our conclusions and policy implications.

2. Literature review

The controversy over the relationship between poverty and economic growth has spawned many theoretical and empirical studies exploring the link between the two. Some recent studies are based on an endogenous approach and link the two phenomena, but a consensus has yet to be reached in this area. One of the main reasons is the issue's complexity and the need for more methodological exploration of the topic (Akoum, 2008; Amponsah et al., 2023; Balasubramanian et al., 2023; Dauda, 2016; Muda et al., 2020; Santos et al., 2019).

Fosu (2015) provides evidence of the close link between economic growth and poverty reduction in developing countries. Average income growth has been the main driver of poverty reduction in many countries. These results suggest that adopting pro-poor growth strategies will accelerate the reduction of income inequality. Meanwhile, Santos et al. (2019) found that economic growth has a more enormous and significant impact on reducing income poverty than multidimensional poverty. In other words, growth is less pro-poor when poverty is measured from a multidimensional perspective. Hanim (2021) found that economic growth coupled with a reduction in income inequality will significantly reduce poverty.

Meanwhile, the effect of inflation on poverty can be found in the economic literature. These studies mostly show that the poor and the rich are affected by inflation in different ways. Inflation is illustrated as a cruel tax on low-income people, weakening and eroding their purchasing power (Olaniyi and Odhiambo, 2024; Rehman et al., 2022). Several studies have empirically reported the effect of inflation on poverty (Afandi et al., 2017; Faharuddin et al., 2023; Meo et al., 2018). Cardoso (1992) revealed that inflation has a double impact on poverty; first, inflation can reduce real disposable income. Second, the actual price of commodity goods

increases at a higher rate than nominal wage increases.

Some economists argue that rising inflation can stimulate and mobilize investment, thus creating more employment opportunities and income for low-income people (Easterly and Fischer, 2001; Romer and Romer, 1998). Several other studies have also found different results, such as inflation not affecting poverty (Junaidin and Muniarty, 2020). The debate on the relationship between inflation and poverty is still a relevant socioeconomic issue because there has yet to be a consensus. In some developing countries, inflation conditions are getting worse, reaching double digits, which can disrupt economic conditions.

The relationship between FDI and poverty can be explained through social and economic aspects. From a social perspective, FDI can help the government reduce poverty by creating jobs, developing local skills, and stimulating technological progress. On the economic side, the initial point of view is that technological progress is the main driving force behind sustainable economic growth and has an influential impact on the progress of society (Ahmad et al., 2019; Hanim, 2021). FDI indirectly affects poverty through economic growth channels. Increased economic growth is expected to increase employment and investment, impacting poverty alleviation (Hanim, 2021; Tsaurai, 2018).

Most of the theoretical literature supports that FDI indirectly positively influences poverty through its ability to increase economic growth. The three leading theories supporting this argument are endogenous, neoclassical, and modernization theories (Tsaurai, 2018).

On the empirical side, several studies have tried to investigate the direct role of FDI on poverty. Magombeyi and Odhiambo (2018) examined the impact of FDI on poverty in South Africa. Where FDI has a positive effect on poverty reduction in the long term, it has a negative effect in the short term. Meanwhile, Tsaurai (2018) found that FDI in the natural resource sector can significantly reduce poverty in African countries. The study of Ucal (2014) shows that FDI can significantly reduce poverty in several developing countries. Haruna et al. (2023) showed that positive and negative FDI shocks reduced poverty significantly in Nigeria's long and short term.

Meanwhile, Tambunan (2005) stated that FDI positively impacts poverty alleviation in Indonesia through several mechanisms, namely labor-intensive economic growth, innovation spillover and knowledge transfer, and government programs that focus on direct poverty alleviation. In contrast, the study of Afandi et al. (2017) found that FDI hurts poverty in Indonesia. Ahmad et al. (2019) found a positive and highly significant relationship between FDI and poverty alleviation in Asia. However, there are significant differences between South Asia and Southeast Asia. In general, FDI has a more significant impact on poverty in South Asian countries than Southeast Asian countries.

International trade has long attracted research interest, but there has been relatively little analysis of the impact of these trade scenarios on people's welfare. To date, the literature on the potential of international trade to reduce poverty has grown substantially with a variety of views (Agusalim, 2017; Maertens and Swinnen, 2009; Naranpanawa et al., 2011; Suryanta and Patunru, 2023; Winters et al., 2004). Trade affects poverty through a variety of different mechanisms. One such

pathway is a two-step relationship that runs from trade to growth and then from growth to poverty reduction (Babatunde et al., 2012).

Trade liberalization is expected to contribute substantially to poverty reduction in developing countries. In the context of open trade, it can create jobs in the formal and informal sectors, as well as increase the demand for unskilled labor, thereby increasing the real wages of poor workers (Kis-Katos and Sparrow, 2015; Maertens and Swinnen, 2009). According to the neoclassical theory of comparative advantage, a reduction in trade costs is expected to increase specialization in the production of labor-intensive goods that do not require special skills, and this will increase employment opportunities and increase the wages of the unskilled population to reduce poverty (Goff and Singh, 2014; Winters et al., 2004).

Several studies have empirically proven the positive impact of trade on poverty reduction. Ianchovichina et al. (2002), who analyzed the relationship between international trade and poverty in Mexico using the computable general equilibrium (CGE) model, proved that international trade has brought more benefits to the poor than the rich. Meanwhile, McCaig (2011) found that trade liberalization has reduced poverty in Vietnam. Sofjan (2018) reported that international trade can reduce poverty in Indonesia through job creation. Maertens and Swinnen (2009) proved that trade openness reduced poverty in Senegal. Wang and Hu (2018) reported that trade liberalization can increase the income of the people and reduce poverty in rural China through transmission mechanisms such as promoting economic growth and financial spending.

Meanwhile, Babatunde et al. (2012), who studied the case in Nigeria, reported that oil exports boosted economic growth but did not provide the employment needed to reduce poverty. Meanwhile, agricultural exports can reduce poverty and inequality in Nigeria through employment channels and agricultural productivity growth. Naranpanawa and Arora (2014) reported that trade liberalization in India has a positive impact on the income of wealthy areas but a negative impact on residents in poor areas.

3. Data and methods

3.1. Data

The main objective of this investigation is to determine the impact of economic growth, inflation, foreign direct investment and trade on poverty in Indonesia using an annual dataset taken from the World Development Indicator website for the years 1970 to 2022. The details of the research variables are as follows: **Table 1** presents an overview of the research variables, and **Figure 1** illustrates the trend of the data from year to year for each variable.

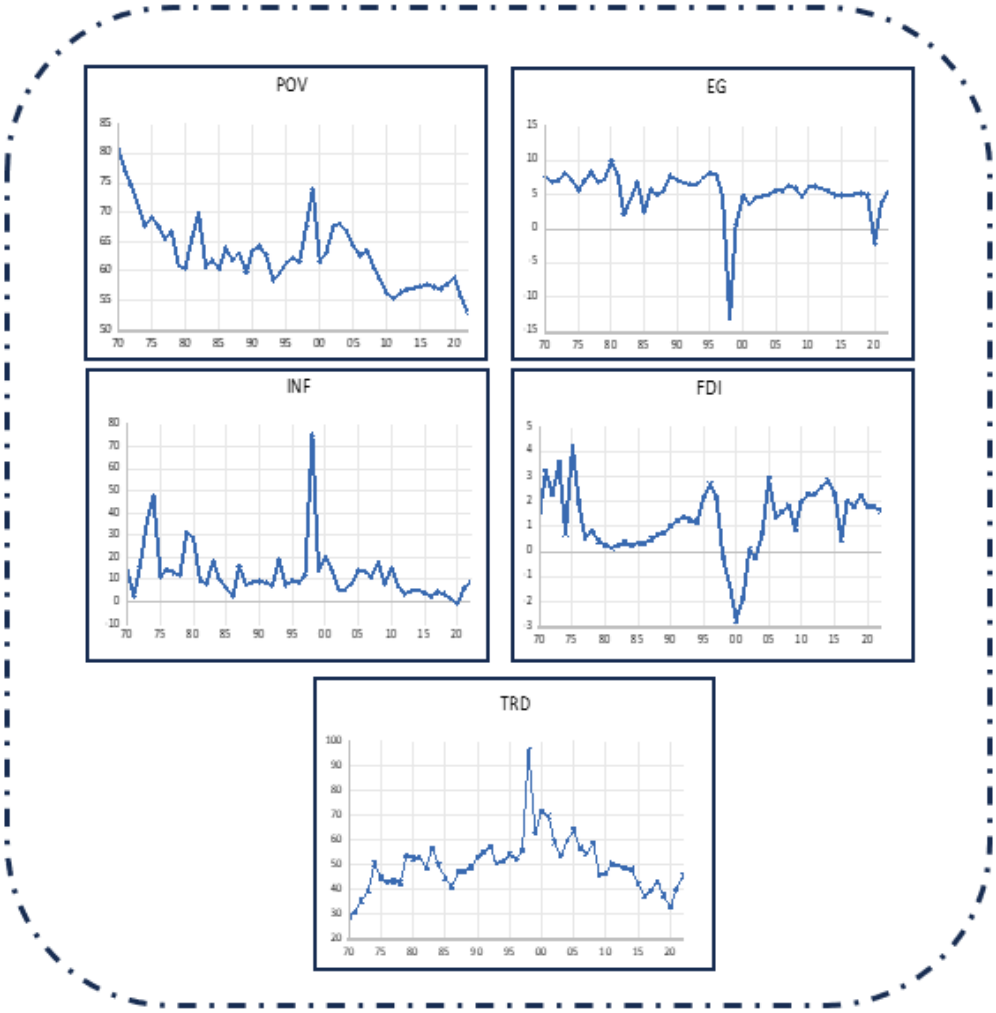

Figure 1. Trends of the research variables. Poverty (POV), economic growth (EG), inflation (INF), foreign direct investment (FDI), trade (TRD).

Table 1. Variable description.

Variable	Description	Unit of measurement	Source
POV	Poverty, measured by households final consumption expenditure (% of GDP)	%	WDI
EG	Economic growth (GDP)	%	WDI
INF	Inflation (annual)	%	WDI
FDI	Foreign direct investment, net inflows (% of GDP)	%	WDI
TRD	Trade, international trade (% of GDP)	%	WDI
DY	Dummy variable, economic crisis in Indonesia, globally and pandemic COVID-19	0 and 1	-

3.2. Method

Data estimation uses the NARDL model to test the proposed framework. This analysis allows disentangling the favourable and unfavourable effects of the independent variable. In this model, variable ω_t is decomposed into (ω_t^+) and (ω_t^-) which is described by Shin et al. (2014) as follows:

$$\omega_t = \omega_0 + \omega_t^+ + \omega_t^- \quad (1)$$

where ω_t^+ and ω_t^- are partial sum positive and negative changes of independent variables.

$$\omega_t^+ = \sum_{j=1}^{t} \max\left(\Delta\omega_{it,j}^+, 0\right) \tag{2}$$

$$\omega_t^- = \sum_{j=1}^{t} \min\left(\Delta\omega_{it,j}^-, 0\right) \tag{3}$$

As a result, the long-term equilibrium's asymmetrical relationship can be written as:

$$y_t = \beta^+\omega_t^+ + \beta^-\omega_t^- + \mu_t \tag{4}$$

where y_t is a dependent variable, denote ω_t is the vector *kx*1 of the regressors' decomposition and β^+ and β^- are asymmetric long term parameters. The nonlinear ARDL model (p, q) is obtained by combining Equation (4) as follows:

$$\Delta y_t = \alpha + \sum_{i=1}^{p} \beta_0\, \Delta y_{t-i} + \sum_{i=0}^{q} \beta_1^+\, \Delta\omega_{t-i}^+ + \sum_{i=0}^{q} \beta_2^-\, \Delta\omega_{t-i}^- + \vartheta_0 y_{t-i} + \vartheta_1^+\omega_{t-i}^+ + \vartheta_2^-\,\omega_{t-i}^- + \mu_t \tag{5}$$

The letters p and q capture the lag orders for the dependent variable (y_t) and the independent variables (ω_t) in the distributed lag section. Substitute $\omega_{t,j}^+$, and $\omega_{t,j}^-$ variables in Equations (2) and (3) similarly (EG^+, EG^-, INF^+, INF^-, FDI^+, FDI^-, TRD^+, TRD^-). We added a dummy variable to the model. The dummy variables are 0 and 1 (0 means economic conditions without Indonesia's economic and financial crisis and the COVID-19 pandemic and 1 after its performance). To get the unrestricted as well as long and short term of the nonlinear autoregressive distributed lag:

$$\begin{aligned}\Delta \mathrm{POV}_t = \alpha &+ \sum_{i=1}^{p} \beta_0\, \Delta \mathrm{POV}_{t-i} + \sum_{i=0}^{q} \beta_1^+\, \mathrm{EG}_{t-i}^+ + \sum_{i=0}^{q} \beta_2^-\, \mathrm{EG}_{t-i}^- + \sum_{i=0}^{q} \beta_3^+\, \mathrm{INF}_{t-i}^+ \\ &+ \sum_{i=0}^{q} \beta_4^-\, \mathrm{INF}_{t-i}^- + \sum_{i=0}^{q} \beta_5^+\, \mathrm{FDI}_{t-i}^+ + \sum_{i=0}^{q} \beta_6^-\, \mathrm{FDI}_{t-i}^- \\ &+ \sum_{i=0}^{q} \beta_7^+\, \Delta \mathrm{TRD}_{t-i}^+ + \sum_{i=0}^{q} \beta_8^-\, \Delta \mathrm{TRD}_{t-i}^- + \vartheta_0 \mathrm{POV}_{t-1} + \vartheta_1^+ \mathrm{EG}_{t-i}^+ \\ &+ \vartheta_2^- \mathrm{EG}_{t-i}^- + \vartheta_3^+ \mathrm{INF}_{t-i}^+ + \vartheta_4^- \mathrm{INF}_{t-i}^- + \vartheta_5^+ \mathrm{FDI}_{t-i}^+ \\ &+ \vartheta_6^- \mathrm{FDI}_{t-i}^- + \vartheta_7^+ \mathrm{TRD}_{t-i}^+ + \vartheta_8^- \mathrm{TRD}_{t-i}^- + D_{t-1} + \mu_t\end{aligned} \tag{6}$$

The variables EG^+, EG^-, INF^+, INF^-, FDI^+, FDI^-, TRD^+, and TRD^- are partial sums of positive and negative shocks in economic growth, inflation, foreign direct investment and international trade ($\vartheta_i, \vartheta_i^+, \vartheta_i^-$) is a vector of long term parameters to be estimated. Moreover, $\sum_{i=0}^{q} \beta_i^+\, \Delta\omega_{it-i}^+$ and $\sum_{i=0}^{q} \beta_i^-\, \Delta\omega_{it-i}^-$ the short term effect, (μ) is residual, Δ is first difference operator of variables. The error correction term of Equation (6) is:

$$\Delta \mathrm{POV}_t = \alpha + \sum_{i=1}^{p} \beta_0 \, \Delta \mathrm{POV}_{t-i} + \sum_{i=0}^{q} \beta_1^+ \, \mathrm{EG}_{t-i}^+ + \sum_{i=0}^{q} \beta_2^- \, \mathrm{EG}_{t-i}^- + \sum_{i=0}^{q} \beta_3^+ \, \mathrm{INF}_{t-i}^+ + \sum_{i=0}^{q} \beta_4^- \, \Delta \mathrm{INF}_{t-i}^- + \sum_{i=0}^{q} \beta_5^+ \, \mathrm{FDI}_{t-i}^+ + \sum_{i=0}^{q} \beta_6^- \, \mathrm{FDI}_{t-i}^- + \sum_{i=0}^{q} \beta_5^+ \, \Delta \mathrm{TRD}_{t-i}^+ + \sum_{i=0}^{q} \beta_6^- \, \Delta \mathrm{TRD}_{t-i}^- + D_{t-1} + \rho \gamma_{t-1} + \mu_t \quad (7)$$

The error correction term (γ_{t-1}) demonstrates the long-term adjustment rate towards equilibrium following a short-term shock in the independent variable. In the long term, towards equilibrium following a short term shock in the independent variable. Wald's test was conducted to test the short term and long term asymmetry hypothesis. The short term symmetry of the null hypothesis (H_0: $\beta_i^+ = \beta_i^- = 0$), and the long term ($H_0$: $\vartheta_i^+ = \vartheta_i^- = 0$). The *F* statistics and critical values are used to explain the null hypothesis. If H_0 is rejected, there is an asymmetric price transmission.

4. Empirical result

The descriptive statistics of the variables employed in this investigation are presented in **Table 2**. The data for economic growth and foreign direct investment is negatively skewed. However, the other variables show a positive skewness. The Jarque-Bera statistics further confirm the non-normal distribution for the variables under study. Non-normality of the data is an important quality for using quantile regression models (Rehman et al., 2023). The unit root test is conducted to determine the order of integration of the variables. The unit root tests utilized are the DF-GLS test proposed by Elliott et al. (1992) and the Phillips and Perron (1988). The Phillips-Perron test has been criticized for its low power when the variables are stationary but have roots close to the non-stationary boundary (Brooks, 2014). According to Elliott et al. (1992), the DF-GLS test has greater power in the presence of an unknown mean or trend than the Phillips-Perron test. The results can be seen in **Table 3**. These variables are stationary at the level (EG, INF, FDI) and the first difference (POV, TRD).

Table 2. Descriptive statistics.

Variables	POV	EG	INF	FDI	TRD
Mean	63.012	5.377	12.831	1.236	49.926
Maximum	80.598	10.000	75.271	4.241	96.186
Minimum	53.037	−13.126	−0.401	−2.757	28.682
Std. Dev.	5.736	3.254	12.419	1.289	11.023
Skewness	0.898	−3.738	3.028	−0.501	1.326
Kurtosis	3.751	21.294	14.303	4.010	7.446
Jarque-Bera	8.385	862.557	363.145	4.476	59.206
Probability	0.015	0.000	0.000	0.106	0.000
Obs	53	53	53	53	53

Table 3. Unit root tests.

Variables	DF-GLS test		PP test	
	Intercept	**Intercept and trend**	**Intercept**	**Intercept and trend**
Level				
POV	0.3047	−2.7979	−3.1176**	−3.8876**
EG	−4.7489***	−5.4160***	−5.0848***	−5.2807***
INF	−5.4653***	−3.4127***	−5.4132***	−5.9307***
FDI	−3.4137***	−3.4559**	−3.4166**	−3.4008**
TRD	−1.5662	−1.9907	−3.4136**	−3.2847*
First difference				
POV	−6.7194***	−7.8673***	−10.7780***	−11.8054***
TRD	−10.1845***	−10.6117***	−11.0079***	−11.7759***

Notes: (***, ** and *) indicate significant at 1%, 5% and 10%, respectively.

Before looking at the short and long-term relationship between the positive and negative variations, we check diagnostic statistics such as serial correlation, heteroscedasticity, and normality to determine the reliability of the dynamic model specification used. The results of these diagnostic tests are reported in **Table 4**. The Jarque-Bera (JB) test determines whether the residual term is normal. Breusch-Godfrey statistics were used in the serial correlation LM for the autocorrelation and heteroscedasticity tests. The residuals' normal distribution indicates that the NARDL model is well-specified. The models exhibit neither serial autocorrelation nor heteroscedasticity.

Table 4. Short term estimation of NARDL.

Variables	**Coefficient**	***t*-stat**	**Probability**
C	49.6151	4.5419	0.0002
POV (−1)	−0.8448***	−5.3285	0.0000
EG-POS	−1.5495***	−2.7583	0.0125
EG-POS (−2)	0.5529	1.4929	0.1519
EG-NEG	−0.7486***	−4.2351	0.0004
EG-NEG (−1)	−0.9158*	−1.8983	0.0729
EG-NEG (−2)	−0.3588	−1.0275	0.3171
INF-POS	0.0128	0.1302	0.8621
INF-NEG	−0.2184***	−3.0200	0.0068
FDI-POS (−1)	1.8028***	2.8592	0.0100
FDI-POS (−2)	2.7079***	3.5756	0.0020
FDI-NEG	−1.7813**	−2.1514	0.0445
FDI-NEG (−2)	−2.5215***	−3.8075	0.0012
TRD-POS (−1)	−0.3047*	−2.0557	0.0538
TRD-POS (−2)	−0.2651***	−2.8931	0.0093
TRD-NEG (−2)	−0.2651***	−2.8931	0.0093
DY	0.8871**	2.7732	0.0281
ECT	−0.8448***	−10.7541	0.0000

Table 4. (*Continued*).

Variables	Coefficient	*t*-stat	Probability
Asymmetric test, long term		***F*-stat**	
$Wald_{LR}EG$	-	0.3551	0.5585
$Wald_{LR}INF$	-	2.5113	0.1295
$Wald_{LR}FDI$	-	3.8482***	0.0041
$Wald_{LR}TRD$	-	0.0302	0.8618
Asymmetric test, short term			
$Wald_{SR}EG$	-	16.0793***	0.0011
$Wald_{SR}INF$	-	8.2653**	0.0208
$Wald_{SR}FDI$	-	28.7442***	0.0000
$Wald_{SR}TRD$	-	7.0971**	0.0153
Diagnostic test			
R square	0.9176	Heteroskadisticity	1.1389 (0.2916)
Cusum	Stable	Jarque-Bera (J-B)	1.8281 (0.4008)
Cusum SQ	Stable	Serial Correlation LM	3.7091 (0.0947)

Notes: ***, **, * significant at 1%, 5%, 10% level.

The *F*-statistic value of 6.888 (**Table 5**) is higher than the upper limit critical value at the 1% significance level, indicating the long-term relationship in the analyzed model. Another way to check the existence of a long-term relationship is the cointegration of the error correction term (ECT). It confirms a long-term relationship if the ECT value is negative and statistically significant.

Table 5. Bounds test for nonlinear cointegration.

F-Statistics	5% level		1% level		Conclusion
	I(0)	*I*(1)	*I*(0)	*I*(1)	
6.888***	2.560	3.490	3.290	4.370	cointegration

Notes: *** significant at 1% level.

The NARDL model's validity uses several diagnostic tests before summarizing the estimation results (**Table 4**). According to the coefficient value of *R*-square (0.917), the independent variable in the model has an impact on 91.7% of poverty in Indonesia. The Wald test shows an asymmetric relationship in all variables in the short term. In contrast, in the long term, only the FDI variable has an asymmetric relationship, and other variables are symmetric. Therefore, this study's use of a nonlinear autoregressive distributed lag approach can provide broader and more accurate information. Model selection method by Akaike info criterion (AIC) and the selection lag used (1, 2, 2, 0, 0, 2, 2, 2, 2, 0).

The error correction term (ECT) is negative and significant at the 1%. The high value of ECT proves there is convergence from short-term to long-term equilibrium (Ridha et al., 2022; Sultanuzzaman et al., 2018). The CUSUM (cumulative sum) and CUSUM-SQ (cumulative sum of squares) tests were used to analyze the structural stability of the estimation model. The results are presented in **Figure 1**, showing that it does not exceed the specified limits. It offers stability to the coefficient estimates

because CUSUM and CUSUM-SQ are at a significance level of 5% in determining bounds.

The long term results are shown in **Table 6**, which is the main result of the NARDL model. **Table 6** shows that a 1% increase in economic growth (EG-POS) can reduce poverty by 1.57 percent at a 1% significant level. It indicates that economic development in Indonesia still favors small communities. Government policies encouraging the growth of labor-intensive industries can open up wider employment opportunities, thereby reducing income inequality and improving welfare, encouraging wider economic growth. This elasticity is almost the same as that detected by Amaliah et al. (2021), Santos et al. (2019) and Balasubramanian et al. (2023), who used a sample of several developing countries. In the short term, EG-POS has a positive effect at the 1% significance level (**Table 4**). It implies that an increase in economic growth will lead to a decrease in the poverty rate. Similar results were also reported by several other studies, such as Akoum (2008), Javid et al. (2013), and Nessa and Imai (2023). In addition, this result is also in line with Fosu's (2015) report that economic growth reduces poverty, which is transformed through a reduction in income inequality. In the short term, faster economic growth will reduce poverty by increasing per capita income. In the long term, growth must be accompanied by effective income distribution to reduce poverty.

The negative shocks in economic growth (EG-NEG) significantly affect poverty in both the long and short term, indicating that slowing economic growth will increase the number of poor people in Indonesia. Although economic growth is the basis for increasing national income, this does not necessarily impact poverty alleviation because policies focusing on growth only see part of the development problem. The results of Afandi et al. (2017), who used a linear error correction model, showed that economic growth has an insignificant effect on poverty.

Table 6. Long term estimation of NARDL.

Variables	Coefficient	*t*-stat	Probability
EG-POS	−1.5715***	−2.4904	0.0172
EG-NEG	1.8173***	2.8909	0.0063
INF-POS	−0.0128	−0.0953	0.9245
INF-NEG	−0.2428**	−2.1255	0.0401
FDI-POS	−3.9439***	−3.9171	0.0000
FDI-NEG	−2.2572***	−3.3056	0.0021
TRD-POS	0.1455	0.6397	0.5262
TRD-NEG	0.1661	0.8412	0.4055

Notes: ***, **, * significant at 1%, 5%, 10% level.

Furthermore, positive shock in inflation (INF-POS) has a positive and insignificant effect on poverty in the long and short term. Inflation does not directly affect poverty in Indonesia. Inflations will reduce purchasing power and increase poverty if household incomes do not change. This result reinforces the studies of Junaidin and Muniarty (2020) and Walinono et al. (2022), which prove that inflation has no significant effect on poverty reduction in Indonesia using a linear approach. It

also backs Romer and Romers (1998) claim that higher inflation will lead to more opportunities for employment and investment, which will reduce unemployment, raise income, and help the impoverished meet their basic needs. It suggests that the fight against poverty is not seriously threatened by inflation.

In addition, Olaniyi and Odhiambo (2024) found that an increase in inflation in some African countries reduces poverty rates. It shows that an increase in inflation can reduce poverty through increased investment and employment opportunities through improving the living standards of the people, in contrast to the results of other studies such as Faharuddin et al. (2023), who examined the impact of rising food prices on poverty in Indonesia which found that rising food prices would increase poverty.

Meanwhile, negative changes (INF-NEG) have a negative and significant effect on the poverty rate in Indonesia. A 1% decrease in inflation will reduce poverty by 0.24% at the 5% significance level. This result proves that a decrease in the price of goods will accelerate the decline in the poverty rate in Indonesia both in the long and short term. A decrease in the price of goods will increase the population's real income that can be consumed. There are several reasons for the negative relationship of negative inflation shocks to poverty; first, a lower inflation rate leads to relatively stable price fluctuations that stimulate economic investment. Second, falling inflation lowers the market price of commodities, increasing money's purchasing power.

Furthermore, negative inflation shocks tend to increase aggregate demand and supply, resulting in increased labor demand and reduced unemployment in the economy. Therefore, as the policymaker, the government must ensure credible and sustainable stabilization policies. These measures are an essential component of the strategy to keep inflation at a desirable level, which can spur economic growth. The results of this study differ from the study conducted by Meo et al. (2018), who used an asymmetric model and reported that an increase in inflation in Pakistan tends to increase poverty, while a decrease in inflation also leads to an increase in poverty in the long term.

In addition, in the long term, positive shock on FDI (FDI-POS) is negative and significantly affects poverty reduction in Indonesia. The FDI variable has a more considerable coefficient value than several other variables. A 1% increase in foreign investment in Indonesia (FDI_POS) will reduce poverty by 3.94% at 1% significance. Meanwhile, if there is a negative shock (FDI_NEG) of 1%, Indonesia's poverty rate will deepen to 2.57% at a 1% significance level. This finding is in line with the findings of Ucal (2014), Magombeyi and Odhiambo (2018), and Haruna et al. (2023).

The following factors can be used to explain how foreign direct investment (FDI) has reduced poverty in Indonesia: Firstly, FDI in Indonesia concentrates on processing, manufacturing, and labor-intensive industries that do not require high skills. Therefore, FDI firms contribute to creating jobs and income for less-skilled workers. In addition to the direct impact through labor recruitment, FDI indirectly impacts employment through economic growth in the regions where it operates and creates jobs for workers due to the economic growth contributed by FDI (Do et al., 2021). Secondly, FDI contributes to local economic growth, and the benefits

eventually spread throughout the economy, helping to solve poverty (Setiawan et al., 2021). Thirdly, the spillover effect. When workers employed by FDI companies return to their hometowns and regions and set up their businesses, they can bring knowledge and skills from the FDI Company. It not only encourages the spread of knowledge from FDI firms to the local economy but also increases the income of local people and contributes to poverty reduction (Haruna et al., 2023).

Meanwhile, a positive shock (TRD-POS) to international trade negatively affects poverty reduction in the short term. A 1% increase in international trade will reduce poverty by 0.26%–0.31% at the 1% significant level. Trade affects poverty through the provision of employment. Increased demand for labor in the sectors that do not require high skills will increase the income of people experiencing poverty (Wang and Hu, 2018). In contrast, negative shocks (TRD-NEG) are insignificant. Likewise, long-term international trade will not significantly affect Indonesia's poverty in positive and negative shocks. It is consistent with several studies, such as (Agusalim, 2017), which used a linear approach to find that international trade does not affect poverty reduction in Indonesia.

International trade is considered an efficient tool to increase economic growth, so it is indirectly felt by people experiencing poverty (Goff and Singh, 2014; Wang and Hu, 2018). In addition, if most people experiencing poverty have low skills, then semi-skilled labor will experience an increase in demand; hence, poverty will not be affected. Skilled labor can benefit unskilled labor (Winters et al., 2004). The dummy variable is that the Indonesian economic crisis in 1998/1999 and the COVID-19 pandemic have positively affected increasing poverty in Indonesia. The increase in poverty can occur because various economic variables are disrupted. However, in the short term, various government policies in reducing poverty during the economic crisis and COVID-19 can reduce poverty. The results of CUSUM and CUSUM-SQ can explain the structural stability of the estimated model. **Figure 2** shows that the model does not cross the specified boundaries, so CUSUM and CUSUM-SQ are at the 5% significance level in determining the boundaries.

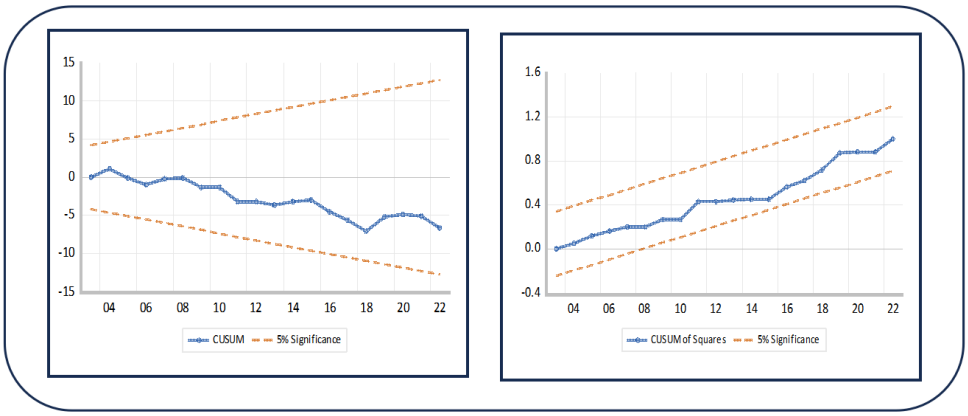

Figure 2. CUSUM and CUSUM-SQ.

5. Concluding remarks

This study investigates the effect of economic growth, inflation, foreign direct investment and trade on poverty using time series data. We use economic crisis and

COVID-19 conditions as dummy variables. To check stationarity, we apply two unit root tests. The Non-linear Autoregressive Distributed Lag method uses short-term and long-term estimates to reveal the relationship between the variables. The results show that economic growth and poverty have different relationships under positive and negative shocks. In the long term and short term, positive shocks to economic growth negatively and significantly affect poverty reduction in Indonesia. Meanwhile, negative shocks to economic growth will deepen the poverty gap in both the long and short term. Economic growth can alleviate poverty by providing more jobs for people in both the long and short term. In the short term, labour-intensive industries can absorb low-skilled labor.

Further, positive inflation shocks have a positive and insignificant effect on increasing the poverty rate. In contrast, negative shocks are negative and significant in reducing poverty. FDI has a vital role in reducing poverty, both in the short and long term. It can be seen from the value of the FDI coefficient, which is the highest compared to other variables. Some reasons for the importance of FDI in poverty alleviation include creating jobs, reducing income inequality, and increasing economic growth in Indonesia. Meanwhile, international trade only affects the short term in alleviating poverty, while in the long term, it has an insignificant effect. A dummy variable shows that the economic crisis and the COVID-19 pandemic can increase poverty in Indonesia. There are several limitations in this study. First, this study does not differentiate between urban and rural poverty rates due to fluctuations in several macroeconomic variables. Second, future research can be tested through asymmetric panel data analysis for more accurate results.

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