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ASYMMETRIC NEXUS OF EXPORT, EXCHANGE RATE, FDI, AND ECONOMIC DEVELOPMENT IN INDONESIA

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ABSTRACT

This study examines whether exports, exchange rates, and foreign direct investment respond asymmetrically to positive and negative shocks in Indonesia's gross domestic product (GDP) over the period 1973 to 2022, using the Nonlinear Autoregressive Distributed Lag (NARDL) model. We estimate three different models where exports, exchange rate and FDI are used as dependent variables with GDP as the key explanatory variable. The results suggest asymmetric responses in two of the three models. In the case of exports, positive GDP shocks are associated with a significant positive response in exports, whereas negative shocks have an insignificant impact, suggesting that export commodity dependence in Indonesia is not vulnerable to domestic recessions. For FDI, positive GDP growth attracts long-run investment inflows while economic contractions produce a modest but significant negative effect, consistent with threshold-based investor behaviour. For the exchange rate, both positive and negative GDP shocks are insignificant, implying that exchange rate movements are largely influenced by monetary and capital movements, rather than output. The results are consistent with the use of asymmetric modelling for the Indonesian macroeconomy, as positive and negative GDP shocks produce markedly different responses across the three models, with implications for growth-enhancing policies that account for the non-linearity of macroeconomic transmission.

1. INTRODUCTION

Indonesia is Southeast Asia's largest economy and has enjoyed one of the most consistent growth performances among emerging democracies since the late 1990s (Fahmi et al., 2016; Isik et al., 2018). But it has been plagued by external shocks, including commodity price shocks, bouts of severe depreciation and abrupt swings in foreign direct investment (FDI). The shocks are centred on three macroeconomic external variables: exports, exchange rate and foreign direct investment (FDI). Exports bring in foreign exchange and boost domestic output, with Indonesia's overall export value amounting to US$323 billion in 2022 (World Bank, 2023). FDI introduces capital, technology and management skills to boost productivity and long-term growth (Asian Development Bank, 2023). The exchange rate affects exports, imports and the domestic-currency value of foreign debt (Mundell, 1963). While the importance of these channels has been acknowledged, a key empirical question remains: are exports, exchange rates, and foreign direct investment symmetric or asymmetric in response to positive and negative shocks to Indonesian GDP?

This paper draws on four complementary theoretical frameworks to explain why the effects of economic growth on these variables might be asymmetric. The long-run level of output in the Solow (1956) economic growth model, as modified by Mankiw et al., (1990), depends on capital and productivity. In this view, FDI inflows are influenced by economic growth through market expansion and investment opportunities, while abrupt FDI outflows may not reduce output by the same magnitude because of substitution from domestic investment - a source of asymmetry. Dunning (1980) Eclectic Paradigm adds that FDI is determined by ownership, location, and internalisation (OLI) advantages, such that the factors driving investment may not be the same as those driving disinvestment - another element of asymmetry. The Mundell-Fleming model (Mundell, 1963) introduces another element: economic growth can influence exchange rate dynamics through capital flows and macroeconomic stability, but it also increases the cost of imported inputs and external debt servicing, impacts that are not symmetrical with appreciation. In the context of exports, the export-led growth hypothesis (Hausmann et al., 2005) explains how exports contribute to productivity improvements through learning-by-doing and economies of scale. This study reverses the analytical direction by examining how economic growth asymmetrically affects export performance in Indonesia. Taken together, these four frameworks, Solow's growth model, Dunning's Eclectic Paradigm, the Mundell-Fleming model, and the export-led growth hypothesis, converge on a common prediction: the transmission of GDP shocks to exports, exchange rates, and FDI is inherently asymmetric, making a nonlinear empirical framework essential for accurate analysis (Nguyen & Do, 2020). All of this suggests that shocks to economic growth will have different magnitudes and time-varying effects on exports, exchange rates, and FDI, depending on whether they are positive or negative.

Asymmetry analysis is particularly relevant for Indonesia for three reasons, linked to historical macroeconomic experiences. First, Indonesia’s exports consist mainly of primary commodities - such as coal, palm oil and mineral ores - whose world prices have been subject to asymmetric booms and busts. Prices increase more and decrease less in commodity booms and busts, respectively, and the relationship between trade and production is non-linear. Second, Indonesia’s rupiah depreciates asymmetrically. From 1997 to 1998, the rupiah depreciated from around Rp 2,342 per USD to Rp 10,014 per USD (a depreciation of more than 75 per cent), and GDP shrank by more than 55 per cent in USD terms (World Bank, 2023). This decline was much larger than expected by a linear symmetric model, as the currency crisis simultaneously led to corporate debt crisis, capital outflows and the collapse of local demand. The recovery was protracted and asymmetric, with the currency only gradually recovering over the next decade. Third, Indonesian FDI inflows respond to threshold effects (political stability, regulation reform, and confidence), with sudden positive jumps (such as during the post-reform liberalisation period) potentially resulting in productivity-enhancing effects, while sudden disinvestments do not have a proportionate negative effect. We need to avoid the possibility that symmetry assumptions bias the estimates of the model’s coefficient and policy conclusions.

Existing empirical evidence has contributed to this discussion, but it is incomplete. Arthur & Addai (2022) demonstrated that FDI and competitive real exchange rates are key factors influencing economic growth in Ghana, confirming the importance of both channels, but their linear model cannot capture different impacts of positive and negative shocks on growth. Shafaai & Masih (2020) found that Malaysia's FDI, exports and exchange rates are endogenously co-integrated, but their analysis is based on the symmetry assumption. Other studies that have used the Nonlinear Autoregressive Distributed Lag (NARDL) model have found that the symmetry assumption must be relaxed. Kumar et al. (2023) showed that the Indian stock market is asymmetrically affected by crude oil prices and the exchange rate. Ali et al. (2020) report that positive agricultural trade shocks support economic growth in Pakistan, while negative shocks constrain growth, a pattern that cannot be captured by a linear model. Mwiya et al. (2024) showed that exchange rate stability has asymmetric effects on GDP in Zambia. Udemba & Yalçıntaş (2021) found nonlinear relationships among economic growth, FDI, and the environment in Algeria. More recently, Amraoui et al. (2025) used

the NARDL approach to show that exchange rate appreciations have more pronounced and immediate effects on FDI and exports than depreciations in Morocco, offering direct empirical evidence of the asymmetric responses of the exchange rate in an open emerging market.

A few studies have applied NARDL in Indonesia, but none have examined the question at hand. Jufri et al. (2021) used NARDL to model foreign direct investment (FDI) determinants in Indonesia over the period 1970-2020, and find long-run asymmetric effects of trade openness and market size on investment; however, they model FDI rather than GDP, so the asymmetric growth effects of FDI are not assessed. Hannafi Ibrahim et al. (2024) use NARDL to examine the symmetric and asymmetric effects of exchange rate volatility on Indonesia's trade of 16 food products with its major trading partners; however, their model is limited to sectoral trade effects and does not model Indonesia's GDP. Parianom et al. (2024) verify the asymmetric exchange rate effects on trade balance and GDP in eight ASEAN economies via NARDL; however, their panel model is not suitable for inference on Indonesia, and exports and FDI are omitted as regressors. Most recently, NARDL analysis on FDI's asymmetric effect on real GDP in Indonesia (Elian, 2025) confirms this effect in a seven-country Asian panel; however, the analysis is limited to FDI and excludes exports and exchange rates as co-determinants. There is no single-country time-series work that has applied NARDL to jointly investigate the asymmetric responses of exports, exchange rates, and FDI to changes in economic growth from a demand-driven perspective in Indonesia in a single framework - the gap that the present study fills. The current study fills this gap by using the NARDL approach proposed by Shin et al., (2014) to analyse annual data for Indonesia from 1973 to 2022. The NARDL model formalises the decomposition of explanatory variables into positive and negative partial sums to allow estimation of the impact of positive and negative shocks to growth in the short run and the long run. The 50-year sample period covers several exchange rate regimes, commodity price cycles, and investment policies (including the fixed exchange rate regime before 1978, the managed float regime from 1978 to 1997, the Asian financial crisis 1997-1998 and the post-crisis flexible exchange rate regime), ensuring ample variation for the NARDL model to detect asymmetry. The models are estimated by alternately specifying exports, exchange rate, and FDI as dependent variables, with GDP as the main explanatory variable, all from the World Bank World Development Indicators.

Motivated by the integrated theory above, three directional hypotheses are tested in the study. From a demand-driven perspective, positive GDP shocks are expected to increase export performance more strongly than negative GDP shocks reduce it, due to asymmetric learning-by-doing effects and commodity cycles (H1). Based on the Mundell–Fleming framework and evidence from Indonesia’s balance-sheet vulnerabilities during the 1997–1998 crisis, positive and negative GDP shocks may affect exchange rate dynamics asymmetrically through changes in capital flows, investor expectations, and macroeconomic stability, leading to asymmetric exchange rate adjustments (H2). Based on Dunning’s Eclectic Paradigm and the threshold effects of FDI location decisions, positive GDP growth is expected to attract FDI inflows more strongly and persistently than negative GDP shocks discourage or reverse investment inflows, as reported for Indonesia by the Journal of Business and Socio-economic Development (Elian, 2025) (H3).

This paper adds to the empirical evidence in three ways. First, it is the first single-country time-series study that simultaneously applies NARDL to investigate the asymmetric effects of economic growth on exports, exchange rates and FDI, which complements studies that either only focus on one of these variables, employ linear models, or are panel studies that do not allow inference specific to Indonesia. Second, it uses Solow's growth theory, Dunning's Eclectic Paradigm, Mundell-Fleming's model, and the export-led growth hypothesis to provide a sound analytical framework that produces testable and directional predictions - rather than using theory as a normative argument with no operational implications. Third, the 50-year study period captures structural breaks, regime changes and crises that are not obvious in short-run analyses, enabling more certainty regarding the long-run asymmetric adjustment. The insights are aimed to guide policy initiatives that account for how economic growth asymmetrically influences external sector dynamics in Indonesia that take into account the inherently asymmetric nature of macroeconomic shocks.

2. RESEARCH METHODS

This paper uses a quantitative time-series approach to assess Indonesia's economic growth by looking at exports, exchange rates and foreign direct investment. The time series data range from 1973 to 2022, and include Indonesia. GDP is treated as the main explanatory variable, while EX, EXR, and FDI are alternately specified as dependent variables in the NARDL models. This study is based on annual time-series data from the World Bank World Development Indicators (WDI). GDP, exports, exchange rates, and FDI are measured in US dollars and transformed into natural logarithms to stabilise variance and allow coefficient interpretation as elasticities. The dataset consists of fifty annual observations covering the period 1973–2022.

The empirical analysis uses the Nonlinear Autoregressive Distributed Lag (NARDL) model proposed by Shin et al. (2014). We choose this framework for its ability to estimate asymmetric effects in terms of positive and negative changes in the explanatory variables. Furthermore, the NARDL approach allows the use of a combination of stationary I(0) and non-stationary I(1) variables and the investigation of short-run and long-run dynamics in one model.

The analysis proceeds in several steps. First, the Augmented Dickey-Fuller (ADF) test is used to check the stationarity of the variables. Second, the ARDL bounds testing is applied to determine the long-run relationship between the variables. Third, the NARDL model is used to estimate short-run and long-run asymmetric effects. Optimal lag length is selected using the Schwarz Bayesian Criterion (SBC). Wald tests are then used to test for both short-run and long-run asymmetry. All estimations are conducted using Microfit software.

Following Shin et al. (2014), GDP is decomposed into its positive and negative partial sum processes:

$$GDP_t^+ = \sum_{j=1}^{t} \Delta GD\,P_j^+ = \sum_{j=1}^{t} \max\left(\Delta GD\,P_j, 0\right) \quad (1)$$

$$GDP_t^- = \sum_{j=1}^{t} \Delta GD\,P_j^- = \sum_{j=1}^{t} \min\left(\Delta GD\,P_j, 0\right) \quad (2)$$

where GDP_t^+ and GDP_t^- capture the cumulative positive and negative shocks in GDP, respectively. Three different NARDL models are estimated where exports (EX), exchange rate (EXR) and foreign direct investment (FDI) are used as dependent variables and GDP as the key independent variable.

Model 1 - Exports:

$$\Delta EX_t = \beta_0 + \beta_1 EX_{t-1} + \beta_2 GDP_{t-1}^+ + \beta_3 GDP_{t-1}^- + \sum_{i=1}^{p} \phi_i\,\Delta EX_{t-i} + \sum_{i=0}^{q}(\theta_i^+ \Delta GDP_{t-i}^+ + \theta_i^- \Delta GDP_{t-i}^-) + u_t \quad (3)$$

Model 2 - Exchange Rate:

$$\Delta EXR_t = \beta_0 + \beta_1 EXR_{t-1} + \beta_2 GDP_{t-1}^+ + \beta_3 GDP_{t-1}^- + \sum_{i=1}^{p} \phi_i\,\Delta EXR_{t-i} + \sum_{i=0}^{q}(\theta_i^+ \Delta GDP_{t-i}^+ + \theta_i^- \Delta GDP_{t-i}^-) + u_t \quad (4)$$

Model 3 - FDI:

$$\Delta FDI_t = \beta_0 + \beta_1 FDI_{t-1} + \beta_2 GDP_{t-1}^+ + \beta_3 GDP_{t-1}^- + \sum_{i=1}^{p} \phi_i\,\Delta FDI_{t-i} + \sum_{i=0}^{q}(\theta_i^+ \Delta GDP_{t-i}^+ + \theta_i^- \Delta GDP_{t-i}^-) + u_t \quad (5)$$

In all three models, β_2 and β_3 represent the long-run asymmetric coefficients of positive and negative GDP shocks, respectively, while θ_i^+ and θ_i^- capture the corresponding short-run asymmetric effects. The parameter ϕ_i denotes the coefficients on lagged differences of the dependent variable, p and q are the optimal lag lengths selected by the Schwarz Bayesian Criterion (SBC), and u_t is the error term. Long-run asymmetry is tested using a Wald test of the null hypothesis $H_0: \beta_2 = \beta_3$, and short-run asymmetry is tested under $H_0: \sum\theta_i^+ = \sum\theta_i^-$.

3. RESULTS AND DISCUSSION

3.1. RESULT

Time-series analysis requires identifying the order of integration of each variable, as this determines whether the series are stationary I(0) or non-stationary I(1) (Tjøstheim, 2012). In this study, the variables in logarithmic form are tested using the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests. The ADF test extends the traditional Dickey–Fuller procedure by incorporating lagged dependent variables to control for serial correlation and improve estimation reliability (Dickey & Fuller, 1981). Optimal lag length is determined using information criteria such as the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC), which consider both goodness of fit and complexity of the model. Table 1 reports the ADF test results in log-level form, showing that only lnGDP is non-stationary at levels. lnEX and lnEXR are stationary at levels under both SBC and AIC criteria, while lnFDI shows mixed results depending on lag selection, stationary under SBC but non-stationary under AIC. Given that SBC is preferred in small samples for its parsimony, lnFDI is treated as I(0) in the baseline analysis. Together, this yields a mixture of I(0) and I(1) variables. Table 2 presents the ADF test results after first differencing, where all variables become stationary, as indicated by the test statistics exceeding the critical values in absolute terms. This confirms lnGDP becomes stationary after first differencing, consistent with its I(1) classification, while lnEX, lnEXR, and lnFDI, already stationary at levels, are confirmed as I(0).

Table 1. ADF test

	Variable	ADF	Value	T-Stat.	C.V.	Result
Log Form	LGDP	ADF(1)=SBC	9.997	-2.319	-3.514	Non-Stationary
		ADF(1)=AIC	13.566	-2.319	-3.514	Non-Stationary
	LEX	ADF(4)=SBC	20.836	-4.436	-3.514	Stationary
		ADF(5)=AIC	27.761	-4.846	-3.514	Stationary
	LEXR	ADF(1)=SBC	-46.841	-3.554	-3.514	Stationary
		ADF(1)=AIC	-43.272	-3.554	-3.514	Stationary
	LFDI	ADF(1)=SBC	-57.693	-4.235	-3.514	Stationary
		ADF(4)=AIC	-53.541	-3.178	-3.514	Non-Stationary

Source: Processed data (2026)

Table 2. ADF test (First Differenced Form)

	Variable	ADF	Value	T-Stat.	C.V.	Result
1st Diff. Form	DGDP	ADF(1)=SBC	8.6534	-5.044	-2.930	Stationary
		ADF(1)=AIC	11.2952	-5.044	-2.930	Stationary
	DEX	ADF(1)=SBC	19.5605	-5.410	-2.930	Stationary
		ADF(1)=AIC	22.2023	-5.410	-2.930	Stationary
	DEXR	ADF(3)=SBC	-48.115	-6.276	-2.930	Stationary
		ADF(3)=AIC	-43.712	-6.276	-2.930	Stationary
	DFDI	ADF(2)=SBC	-57.9008	-7.344	-2.930	Stationary
		ADF(2)=AIC	-54.3784	-7.344	-2.930	Stationary

Source: Processed data (2026)

These findings are further validated using the Phillips–Perron (PP) test, which corrects for heteroskedasticity and autocorrelation using Newey–West adjusted standard errors (Phillips & Perron, 1988). Table 3 shows the PP test results in log-level form, where all variables appear non-stationary. This contrasts with the ADF results for ln EX, lnEXR and lnFDI; however, given that the ADF test with lag selection via SBC is more reliable in small samples, the ADF results are preferred for determining integration order.

Table 3. PP test (Log Form)

	Variable	T-Stat.	C.V.	Result PP
Log Form	LGDP	-1.605	-2.935	Non-Stationary
	LEX	-2.440	-2.935	Non-Stationary
	LEXR	-1.998	-2.935	Non-Stationary
	LFDI	-1.690	-2.935	Non-Stationary

Source: Processed data (2026)

Table 4 presents the PP test results after first differencing, confirming that all variables become stationary at this stage. The PP tests at first difference all confirm stationarity, supporting the validity of the unit root tests. Given that the variables are a mixture of I(0) and I(1) and none is integrated of order two, the ARDL/NARDL modelling framework is particularly appropriate, as it is specifically designed to accommodate such combinations of integration orders (Pesaran et al., 2001; Shin et al., 2014).

Table 4. PP test (First Differenced Form)

	Variable	T-Stat.	C.V.	Result PP
1st Diff Form	DGDP	-8.044	-3.041	Stationary
	DEX	-12.151	-3.041	Stationary
	DEXR	-19.907	-3.041	Stationary
	DFDI	-15.152	-3.041	Stationary

Source: Processed data (2026)

The research uses the Autoregressive Distributed Lag (ARDL) model because it allows the analysis of time-series data regardless of whether the variables are integrated of order I(0) or I(1). Under this framework, a linear symmetrical relationship among variables is assumed. The ARDL bounds testing procedure proposed by Pesaran et al. (2001) is used to test for the presence of a long-run cointegrating relationship between the variables. The hypothesis to be tested is that no long-run cointegration exists.

The hypothesis is tested based on the comparison of the calculated F-statistic with the critical bounds. If the F-statistic is higher than the upper critical bound, the null hypothesis is rejected and it is concluded that a long-run relationship exists. If it falls below the lower critical bound, the null hypothesis cannot be rejected, implying no cointegration. If the value lies between the two bounds, the result is inconclusive.

Table 5 presents the results of the ARDL bounds test. F-statistic values for three of the four models (GDP, EX, EXR) fall below the lower critical bound at the 5% significance level, indicating no cointegration. The FDI model is the exception, producing an F-statistic of 4.278 that lies between the lower and upper critical bounds (3.539–4.667), yielding an inconclusive result.

Table 5. Test of long-run relationship in ARDL

Model	F-stat	p-value	95% Critical Lower Bound	95% Critical Upper Bound	Outcome
GDP (GDP, EX, EXR, FDI)	1.0714	[.392]	3.539	4.667	No Cointegration
EX (GDP, EX, EXR, FDI)	1.4368	[.252]	3.539	4.667	No Cointegration
EXR (GDP, EX, EXR, FDI)	0.68385	[.610]	3.539	4.667	No Cointegration
FDI (GDP, EX, EXR, FDI)	4.2778	[.009]	3.539	4.667	Inconclusive

Source: Processed data (2026)

Given the absence of cointegration, the estimated coefficients cannot be interpreted as evidence of a stable long-run equilibrium relationship. Therefore, the analysis focuses on the estimated coefficients as conditional relationships rather than confirmed long-run effects.

Table 6 presents the coefficient estimates obtained from the ARDL model. Given that the bounds test does not provide evidence of cointegration, these results should be interpreted as conditional relationships rather than confirmed long-run equilibrium effects.

Table 6. Test of long-run coefficients in ARDL

Regressor	Coefficient	Standard Error	T-Ratio	p-value
LEX	1.1079	0.17389	6.3713	[.000]
LEXR	-0.1329	0.080873	-1.6434	[.108]
LFDI	0.046572	0.083458	0.55802	[.580]
INPT	-1.1298	2.5588	-0.44154	[.661]

Source: Processed data (2026)

The results indicate that LEX is the only variable that shows a statistically significant association with the dependent variable, with a coefficient of 1.1079 ($p < 0.01$) This indicates that a 1% increase in exports is associated with an approximate 1.11% increase in the dependent variable within the sample period, rather than representing a confirmed long-run elasticity. Meanwhile, LEXR has a negative coefficient, suggesting a negative association, although this relationship is not statistically significant and does not imply a stable long-run effect. However, LFDI has a positive coefficient, but the effect is also statistically insignificant, meaning that foreign direct investment does not have a statistically significant effect in the model. The constant term is likewise statistically insignificant.

Given the absence of cointegration, these findings do not indicate the presence of a stable long-run relationship, and therefore should not be interpreted as long-run equilibrium effects. Instead, they reflect model-based associations within the sample period. To further explore potential nonlinear and asymmetric dsynamics that cannot be captured by a linear ARDL specification, the analysis proceeds with the NARDL model.

The NARDL model is estimated separately with EX, EXR, and FDI as dependent variables and GDP as the decomposed regressor, thereby identifying how GDP growth and contractions asymmetrically transmit into each macroeconomic outcome. Table 7 reports the estimation results.

The EX model reveals a statistically significant asymmetric relationship between GDP and exports. The long-run multiplier for positive GDP changes ($L\_lnGDP^{+} = 0.1300$, $p < 0.01$) is substantially larger than that for negative changes ($L\_lnGDP^{-} = 0.0470$, $p = 0.211$), with the latter being statistically insignificant. This asymmetry indicates that economic growth reliably stimulates export expansion through enhanced production capacity and international competitiveness, whereas GDP contractions do not translate into equivalent export reductions. This resilience is statistically supported by the insignificant long-run multiplier for negative GDP shocks ($L\_lnGDP^{-} = 0.0470$, $p = 0.211$), confirming that export volumes do not respond significantly to domestic downturns. In the short run, positive GDP shocks exert immediate and persistent effects across multiple lags ($\Delta lnGDP^{+}$ at lag 0: 0.2985, $p < 0.01$; lag 2: 0.1606, $p < 0.01$; lag 3: 0.2128, $p < 0.01$; lag 6: 0.0995, $p < 0.10$), while negative GDP shocks produce smaller and statistically insignificant short-run responses, confirming short-run asymmetry.

The FDI model similarly confirms significant asymmetric transmission. Positive GDP growth ($L\_lnGDP^{+} = 0.0140$, $p = 0.011$) attracts FDI inflows in the long run, reflecting investor confidence in Indonesia's economic stability and growth potential. Negative GDP changes ($L\_lnGDP^{-} = -0.0290$, $p = 0.030$) are significant but carry a negative sign, indicating that economic downturns modestly reduce FDI but do not destabilise the investment climate, consistent with Indonesia's reputation as a stable investment destination (Chenaf-Nicet & Rougier, 2016).

Table 7. NARDL Estimation Results

EX		EXR		FDI	
NARDL with LR asymmetry		NARDL with LR asymmetry		NARDL with LR asymmetry	
$\ln EX_{t-1}$	-1.3927*** [0.0000]	$\ln EXR_{t-1}$	-1.0463*** [0.0000]	$\ln FDI_{t-1}$	-0.8880* [0.0960]
$\ln GDP^{+}_{t-1}$	0.1816*** [0.0000]	$lnGDP^{+}_{t-1}$	0.0919 [0.7940]	$lnGDP^{+}_{t-1}$	0.0121 [0.2830]
$lnGDP^{-}_{t-1}$	-0.0651 [0.2230]	$lnGDP^{-}_{t-1}$	-0.9639 [0.6080]	$lnGDP^{-}_{t-1}$	0.0258* [0.0860]
$\Delta\ln EX_{t-1}$	0.7586*** [0.0000]	$\Delta lnGDP^{+}_{t}$	0.5194 [0.7720]	$\Delta lnFDI_{t-1}$	-0.7499 [0.1110]
$\Delta\ln GDP^{+}_{t}$	0.2985*** [0.0000]	$\Delta lnGDP^{+}_{t-5}$	0.0500 [0.9800]	$\Delta lnFDI_{t-2}$	-1.0423** [0.0110]
$\Delta\ln GDP^{+}_{t-1}$	-0.0191 [0.7670]	$\Delta lnGDP^{-}_{t}$	-1.3038 [0.7080]	$\Delta lnFDI_{t-3}$	-1.2332*** [0.0010]
$\Delta\ln GDP^{+}_{t-2}$	0.1606*** [0.0090]	$\Delta lnGDP^{-}_{t-1}$	0.4518 [0.8980]	$\Delta lnFDI_{t-4}$	-1.1157*** [0.0010]
$\Delta\ln GDP^{+}_{t-3}$	0.2128*** [0.0010]	$\Delta lnGDP^{-}_{t-2}$	0.3430 [0.9210]	$\Delta lnFDI_{t-5}$	-0.8407*** [0.0010]
$\Delta\ln GDP^{+}_{t-4}$	0.1786*** [0.0030]			$\Delta lnFDI_{t-6}$	-0.5933*** [0.0030]
$\Delta lnGDP^{+}_{t-5}$	0.1263** [0.0270]			$\Delta lnGDP^{+}_{t-1}$	0.0168 [0.3350]
$\Delta lnGDP^{+}_{t-6}$	0.0995* [0.0700]			$\Delta lnGDP^{+}_{t-2}$	0.0348** [0.0230]
$\Delta lnGDP^{-}_{t}$	0.0490 [0.5140]			$\Delta lnGDP^{+}_{t-3}$	0.0808*** [0.0000]
$\Delta lnGDP^{-}_{t-1}$	0.1228 [0.1640]			$\Delta lnGDP^{+}_{t-4}$	0.0879*** [0.0000]
$\Delta lnGDP^{-}_{t-3}$	0.0605 [0.5000]			$\Delta lnGDP^{+}_{t-5}$	0.0579*** [0.0070]
$\Delta lnGDP^{-}_{t-4}$	0.0769 [0.3670]			$\Delta lnGDP^{-}_{t}$	0.0294 [0.1190]
$\Delta lnGDP^{-}_{t-5}$	0.1395 [0.1120]			$\Delta lnGDP^{-}_{t-1}$	0.0159 [0.4800]
$\Delta lnGDP^{-}_{t-6}$	0.0653 [0.4750]			$\Delta lnGDP^{-}_{t-4}$	0.0288 [0.2000]
				$\Delta lnGDP^{-}_{t-5}$	0.0618*** [0.0080]
				$\Delta lnGDP^{-}_{t-6}$	0.0606*** [0.0080]
Constant	1.24E+10*** [0.0010]	Constant	-0.3149 [0.2620]	Constant	-1.03E+09 [0.1350]
L^{+}_{lnGDP}	0.1300*** [0.0000]	L^{+}_{lnEXR}	0.0880 [0.7940]	L^{+}_{lnGDP}	0.0140** [0.0110]
L^{-}_{lnGDP}	0.0470 [0.2110]	L^{-}_{lnEXR}	0.9210 [0.6070]	L^{-}_{lnGDP}	-0.0290** [0.0300]
R-squared	0.9377	R-squared	0.5386	R-squared	0.8889
Adj R-squared	0.8622	Adj R-squared	-0.0200	Adj R-squared	0.7545

Source: Processed data (2026)

Notes: L^{+} and L^{-} denote the long-run multipliers for positive and negative shocks, respectively. P-values in brackets. ∗p<0.10, ∗∗p<0.05, ∗∗∗p<0.01.

The EXR model presents a different pattern. The adjusted R-squared of −0.020 indicates that the model specification lacks explanatory power, and the long-run multipliers for both positive and negative GDP changes are statistically insignificant (L_lnGDP^{+} = 0.0880, p = 0.794; L_lnGDP^{-} = 0.9210, p = 0.607). The short-run coefficients for both positive and negative GDP shocks are likewise statistically insignificant, further confirming that GDP fluctuations do not systematically influence exchange rate dynamics in this model. This finding is consistent with the Mundell–Fleming framework's emphasis on monetary policy and capital flows as the primary determinants of exchange rate movements, rather than output fluctuations (Mundell, 1963). Evidence from open economies further confirms that economic policy uncertainty shocks systematically drive exchange rate adjustments through capital flow channels rather than output-side mechanisms (Nilavongse et al., 2020).

Figure 1 shows the dynamic multiplier effects of GDP shocks on exports (EX), exchange rates (EXR), and foreign direct investment (FDI) in Indonesia. The findings show that the effects of positive rather than negative GDP shocks are larger and last longer. In the exporting economy, a positive growth shock boosts export volumes into a gradual upward trend and a negative growth shock causes relatively small responses in export volumes. The exchange rate model shows that positive as well as negative effects of GDP shock have short-term oscillations around the steady state but ultimately move toward the equilibrium state in the long-run. In the FDI model, positive GDP shocks lead to continuing growth in flows of FDI and negative shocks lead to temporary, limited reductions in FDI flows. Overall, the findings agree with the evidence of asymmetric effect of macroeconomic transmission in Indonesia.

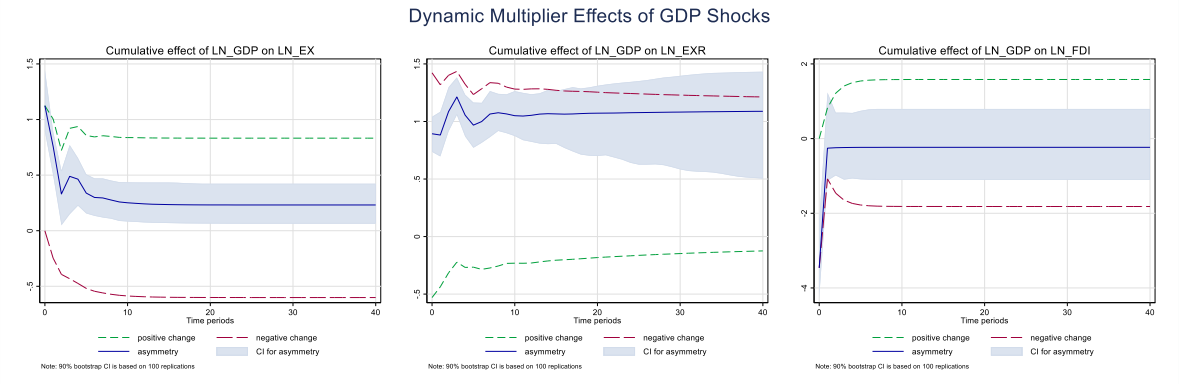

Figure 1. Dynamic Multiplier Effects of GDP Shocks on Exports (EX), Exchange Rates (EXR), and Foreign Direct Investment (FDI) in Indonesia

3.2. DISCUSSION

The findings suggest that linear relationships cannot fully explain Indonesia's macroeconomic relationships. But these results should be taken with caution because the bounds test does not support cointegration. This means that the analysis reflects conditional relationships and asymmetric responses, rather than a confirmed long-run equilibrium among the variables.

The most robust result is the positive response of exports to GDP growth. Exports are the only variable that is statistically significant in the preliminary linear ARDL estimates. The NARDL estimates show that the magnitude of the effect of GDP changes on exports is greater and significant for positive than for negative changes. This implies that economic expansion increases the export capacity more than economic contraction decreases it. This finding is consistent with the view that economic expansion strengthens export performance through higher production capacity and competitiveness (Ikhsan et al., 2021). But given the absence of cointegration, this can't be taken as a long-run effect.

The results for FDI are more mixed. The linear ARDL estimates do not reveal a significant direct impact of GDP on FDI and the exchange rate, but a significant conditional impact on exports. The NARDL results, which account for asymmetry, indicate that GDP changes are associated with asymmetric movements in FDI. Positive GDP changes attract FDI inflows, while negative GDP changes produce a modest but significant reduction in FDI (Jahen F. Rezki et al., 2024). This is consistent with recent assessments suggesting that Indonesia's macroeconomic fundamentals continue to attract investor interest during periods of positive growth (PwC Indonesia, 2024). This suggests that investors respond more strongly to positive economic conditions than to downturns. Still, this interpretation remains conditional on the model and should be treated with caution.

The exchange rate results are the least strong. The coefficient from the linear ARDL estimates is negative but insignificant. The NARDL model similarly shows weak and insignificant asymmetric effects, confirming that exchange rate movements are not driven by GDP fluctuations. There are other variables that might affect the exchange rate, which are not accounted for in the model. These findings point to three main conclusions. First, exports show a strong positive association with GDP in the preliminary linear ARDL estimates. Second, the NARDL results confirm asymmetric responses, particularly for exports and FDI, where positive GDP shocks produce stronger effects than negative ones. Third, exchange rate results remain weak and insignificant across both specifications. Most importantly, because there is no clear evidence of cointegration, the findings should be understood as conditional relationships and dynamic responses, rather than stable long-run relationships.

4. CONCLUSION

This study examines the relationship between Indonesia's GDP, exports, exchange rate, and foreign direct investment using the NARDL approach. The findings indicate asymmetric effects in exports and FDI, while exchange rate movements do not show significant responses to GDP shocks. Positive GDP growth is associated with higher export performance and stronger FDI inflows, reflecting improved production capacity, market competitiveness, and investor confidence in Indonesia's economic conditions. In contrast, negative GDP shocks have relatively limited effects on exports and FDI, suggesting that Indonesia's export structure remains relatively resilient during economic downturns, particularly due to the dominance of primary commodities such as coal, palm oil, and rubber.

The results also indicate that exchange rate movements are not significantly influenced by GDP fluctuations, implying that exchange rate dynamics are more closely related to monetary conditions and capital flows than to domestic output changes. Overall, the findings highlight the importance of sustaining economic growth to support exports and attract foreign investment. Policies aimed at strengthening economic fundamentals, improving investment conditions, and encouraging export diversification are therefore essential to support Indonesia's long-term economic stability and development. Future research may incorporate additional macroeconomic variables, including inflation, government expenditure, and trade policy, to provide a broader understanding of Indonesia's macroeconomic dynamics.

5. REFERENCES

Ali, I., Khan, I., Ali, H., Baz, K., Zhang, Q., Khan, A., & Huo, X. (2020). The impact of agriculture trade and exchange rate on economic growth of pakistan: An nardl and asymmetric analysis approach. *Ciencia Rural*, *50*(4), 1–15. https://doi.org/10.1590/0103-8478CR20190005

Amraoui, K. (2025). Asymmetric Effects Of Exchange Rate Volatility On Trade and Investment : A Nonlinear Approach. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, *9*(4), 1403–1417.

Arthur, B., & Addai, B. (2022). The dynamic interactions of economic growth, foreign direct investment, and exchange rates in Ghana. Cogent Economics & Finance, 10(1). https://doi.org/10.1080/23322039.2022.2148361

Asian Development Bank. (2023). *Indonesia's Economic Growth to Moderate in 2023, 2024*. https://www.adb.org/news/indonesia-economic-growth-moderate-2023-2024

Chenaf-Nicet, D., & Rougier, E. (2016). The effect of macroeconomic instability on FDI flows: A gravity estimation of the impact of regional integration in the case of Euro-Mediterranean agreements. *International Economics*, *145*(0), 66–91. https://doi.org/10.1016/j.inteco.2015.10.002

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica, 49(4), 1057–1072.

Dunning, J. H. (1980). Toward an Eclectic Theory of International Production: Some Empirical Tests. *Journal of International Business Studies*, *11*(1), 9–31. https://doi.org/10.1057/palgrave.jibs.8490593

Elian, M. (2025). *FDI and sustainable GDP for select Asian countries : the role of nonlinear analysis*. https://doi.org/10.1108/JBSED-03-2025-0061

Fahmi, F. Z., Koster, S., & van Dijk, J. (2016). The location of creative industries in a developing country: The case of Indonesia. *Cities*, *59*, 66–79. https://doi.org/10.1016/j.cities.2016.06.005

Hannafi Ibrahim, K., Dwi Handoyo, R., Dwi Kristianto, F., Kusumawardani, D., Ogawa, K., Azlan Shah Zaidi, M., Erlando, A., Haryanto, T., & Sarmidi, T. (2024). Exchange rate volatility and COVID-19 effects on Indonesia's food products' trade: Symmetric and asymmetric approach. *Heliyon*, *10*(12). https://doi.org/10.1016/j.heliyon.2024.e32611

Hausmann, R., Hwang, J., & Rodrik, D. (2005). What you export matters. NBER Working Paper No. 11905. National Bureau of Economic Research. https://doi.org/10.3386/w11905

Ikhsan, M., Indrawati, S. M., Virananda, I. G. S., Abdi, Z., & Can, C. K. (2021). The Productivity and Future Growth Potential of Indonesia. *Economics and Finance in Indonesia*, *67*(2), 235. https://doi.org/10.47291/efi.v67i2.996

Isik, C., Dogru, T., & Turk, E. S. (2018). A nexus of linear and non-linear relationships between tourism demand, renewable energy consumption, and economic growth: Theory and evidence. *International Journal of Tourism Research*, *20*(1), 38–49. https://doi.org/10.1002/jtr.2151

Jahen F. Rezki, P. D., Riefky, T., Maizar, F. A., Yuliana, T., & Adriansyah, M. (2024). Ilusi Pertumbuhan yang Stabil: Indonesia Economic Outlook Q2-2024. *LPEM FEB UI*, 3–16. https://lpem.org/ilusi-pertumbuhan-yang-stabil-indonesia-economic-outlook-q2-2024/

Jufri, A., Mulyadi, S., Wibowo, M. G., & Rafiqi, I. (2021). Determinan Penanaman Modal Asing di Indonesia Periode 1970-2020: Pendekatan NARDL. *Jurnal Dinamika Ekonomi Pembangunan (JDEP)*, *4*(3), 232–244. https://ejournal.undip.ac.id/index.php/dinamika_pembangunan/index

Kumar, S., Kumar, A., & Singh, G. (2023). Causal relationship among international crude oil, gold, exchange rate, and stock market: Fresh evidence from NARDL testing approach. *International Journal of Finance and Economics*, *28*(1), 47–57. https://doi.org/10.1002/ijfe.2404

Mankiw, N. G., Romer, D., & Weil, D. N. (1990). A Contribution to the Empirics of Economic Growth. *The Quarterly Journal of Economics*, *107*(2), 407–437. https://doi.org/10.2307/2118477

Mundell, R. A. (1963). Capital mobility and stabilization policy under fixed and flexible exchange rates. *Canadian Journal of Economics and Political Science*, *29*(4), 475–485.

Mwiya, T., Simaundu, B. M., Nyau, M., & Phiri, J. (2024). Assessing the Effects of Exchange Rate Volatility on Zambia's Economic Growth: Evidence from ARDL and NARDL Models. *Economies*, *12*(9), 224. https://doi.org/10.3390/economies12090224

Nguyen, V. C., & Do, T. T. (2020). Impact of exchange rate shocks, inward FDI and import on export performance: A cointegration analysis. *Journal of Asian Finance, Economics and Business*, *7*(4), 163–171. https://doi.org/10.13106/JAFEB.2020.VOL7.NO4.163

Nilavongse, R., Rubaszek, M., & Uddin, G. S. (2020). Economic policy uncertainty shocks, economic activity, and exchange rate adjustments. *Economics Letters*, *186*, 108765. https://doi.org/10.1016/j.econlet.2019.108765

Parianom, R., Utami, K., & Hidayati, S. (2024). Differential Impacts of Exchange Rate Fluctuations on Trade Balance and Economic Output. *Pakistan Journal of Life and Social Sciences*, *22*, 24199–24214.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics*, *16*(3), 289–326. https://doi.org/10.1002/jae.616

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335–346. https://doi.org/10.1093/biomet/75.2.335

PwC Indonesia. (2024). *PwC Indonesia Economic Update: First Quarter of 2024*. https://www.pwc.com/id/en/publications/general/indonesia-economic-update-2024-q1.pdf

Shafaai, S., & Masih, M. (2020). The dynamics of growth, exports, exchange rate and foreign direct investment: evidence from Malaysia. *Munich Personal RePEc Archive*, (100375).

Shin, Y., Yu, B., & Greenwood-nimmo, M. (2014). Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. In *Festschrift in Honor of Peter Schmidt*. https://doi.org/10.1007/978-1-4899-8008-3

Solow, R. M. (1956). A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics*, *70*(1), 65–94. https://doi.org/10.2307/1884513

Tjøstheim, D. (2012). Modelling Nonlinear and Nonstationary Time Series. In *Handbook of Statistics* (Vol. 30). Elsevier B.V. https://doi.org/10.1016/B978-0-444-53858-1.00004-1

Udemba, E. N., & Yalçıntaş, S. (2021). Interacting force of foreign direct invest (FDI), natural resource and economic growth in determining environmental performance: A nonlinear autoregressive distributed lag (NARDL) approach. *Resources Policy*, *73*(February). https://doi.org/10.1016/j.resourpol.2021.102168