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Macroeconomic Determinants of Investment Credit in Indonesia: Evidence from the ARDL Bounds Testing Approach

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Abstract

Investment credit plays an important role in financing productive activities and sustaining Indonesia's economic development. Nevertheless, limited empirical evidence is available regarding how fluctuations in gold prices together with other macroeconomic indicators influence investment credit during the post-pandemic period. This study investigates the effects of gold prices, the USD/IDR exchange rate, the Industrial Production Index (IPI), the BI 7-Day Reverse Repo Rate, and inflation on investment credit using monthly observations from June 2016 to December 2024. An Autoregressive Distributed Lag (ARDL) model combined with an Error Correction Model (ECM) is employed to evaluate both long-run associations and short-run adjustments. The empirical findings reveal that the variables are cointegrated, implying the existence of a stable long-term equilibrium. However, none of the estimated long-run coefficients is statistically distinguishable from zero at conventional significance levels. In the short run, exchange rate movements generate the largest response in investment credit, whereas industrial production and the policy interest rate produce relatively modest effects. The error-correction coefficient is negative and statistically significant, indicating that temporary departures from equilibrium are gradually eliminated over time. These findings suggest that investment credit in Indonesia is driven primarily by short-term macroeconomic adjustments rather than persistent long-run effects of individual macroeconomic variables.

Keywords: Investment Credit; Gold Price; ARDL-ECM; Error Correction Term; Macroeconomic Determinants

1. Introduction

Investment credit is a primary instrument for Indonesian financial system to stimulate formation of productive capital. Total of investment credit which was still outstanding has more than double from about IDR 1.05 trillion to IDR 2.08 trillion from June 2016 to December 2024, despite there were several brief interruptions due to COVID-19 pandemic in 2020 and the global monetary tightening policy during 2022-2023 [1, 2]. Big economic factors which cause the investment credit growth is an important consideration for banks, regulators, and policy-makers in order to maintain stability in credit and promote long-term economic development.

The operation of investment credit depends on several potential routes or channels of impact. In terms of investment credit operations, changes in exchange rates operate via exporters'

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cash flows, as well as encourage increased domestic demand through import substitution [3, 4]. Industrial Production Index (IPI) indicates the level of real economic activity; the greater the economic activity, the greater the demand for investment, which then is provided by banks through the accelerator mechanism [5]. Another important determinant is the policy interest rate, which reflects the cost of borrowing and influences the demand for credit by households and firms [6]. Since gold is widely accepted as collateral in Indonesia, higher gold prices raise the collateral value available to borrowers, allowing banks to extend more loans for a given level of borrower leverage [7]. Previous cointegration studies have frequently relied on either the Engle–Granger two-step procedure or the Johansen maximum likelihood approach for evaluate long-run equilibrium relationships and all variables in such methods usually need to be of same order of integration.

Given that a time-series data can exhibit variety in integration order, estimation problems may arise when using certain standard techniques. Therefore, Pesaran et al. [8] introduced the Autoregressive Distributed Lag (ARDL) bounds testing framework, which can be applied when the variables are stationary at level, stationary after first differencing, or consist of a combination of both integration orders. However, it will not be valid for variables which is integrated of order two. While many previous studies examined the workings of investment credit in Indonesia using ECM-based models [9–11], there are three major gaps remaining in the literature. First, standard ARDL bounds testing is infrequently utilized for macro time-series data, even though it is suitable for it. Second, although gold price might impact the investment credit through the collateral channel, this factor is rarely incorporated in empirical studies. Third, little is known about how the mechanism converges to long-run equilibrium (as measured by the Error Correction Term).

In this respect, the main objectives of this paper are to (i) conduct testing on cointegration; (ii) determine the impact of chosen macro-indicators on investment credit in the long run; (iii) demonstrate how short run dynamics is captured by using the ECT term in the equation; and (iv) determine whether the model is still robust in times of major shocks.

2. Research Methodology

The empirical analysis is based on a monthly time-series dataset consisting of 103 observations covering the period from June 2016 to December 2024. The response variable is investment credit expressed in natural logarithmic form ($\ln KI$), representing the total outstanding investment credit (billion rupiah) within the Indonesian banking sector. The explanatory variables consist of the logarithms natural of gold prices ($\ln HE$), the USD/IDR exchange rate ($\ln KURS$), and the Industrial Production Index ($\ln IPI$), together with the BI policy rate (SB) and the inflation rate (INF).

To stabilize the data scale and enable an elasticity-based interpretation, investment loans, gold prices, exchange rates, and the IPI are logarithmically transformed. In this specification, the estimated coefficients of the logarithmically transformed variables measure elasticity. However, the policy rate and inflation remain in their original percentage point units. Therefore, the estimated parameters represent semi-elasticities, describing the expected percentage change in investment loans resulting from a one percentage point increase in the respective variable (all other things being equal).

Prior to estimating the ARDL model, the integration properties of the variables are examined because the procedure is valid only when the variables are not integrated beyond the first order [8]. Accordingly, two complementary unit-root tests are implemented, namely the Augmented Dickey–Fuller (ADF) test [12] and the Phillips–Perron (PP) test [13]. Employing both methods improves the reliability of the stationarity assessment, as the PP test accommodates possible heteroscedasticity and serial dependence without explicitly augmenting the regression. Lag lengths in the ADF specification are selected using the AIC. In each test, rejection of the null hypothesis indicates that the corresponding series is stationary.

The ARDL bounds testing technique [8] is used to examine the long-run connection. The relevant Unrestricted Error Correction Model (UECM) is presented as follows:

$$\begin{aligned}\Delta \ln KI_t = \alpha_0 &+ \delta_0 \ln KI_{t-1} + \delta_1 \ln HE_{t-1} + \delta_2 \ln KURS_{t-1} + \delta_3 \ln IPI_{t-1} \\ &+ \delta_4 SB_{t-1} + \delta_5 INF_{t-1} + \sum_{i=1}^{p} \rho_i \Delta \ln KI_{t-i} + \sum_{i=0}^{q_1} \beta_i \Delta \ln HE_{t-i} \\ &+ \sum_{i=0}^{q_2} \gamma_i \Delta \ln KURS_{t-i} + \sum_{i=0}^{q_3} \phi_i \Delta \ln IPI_{t-i} + \sum_{i=0}^{q_4} \psi_i \Delta SB_{t-i} \\ &+ \sum_{i=0}^{q_5} \omega_i \Delta INF_{t-i} + \varepsilon_t\end{aligned} \tag{1}$$

The bounds test evaluates the joint null hypothesis:

$$H_0 : \delta_0 = \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0 \tag{2}$$

which suggests the lack of a long-run connection. The computed F-statistic is contrasted with the lower and upper critical limits given in [8]. If the statistic is over the upper bound, cointegration is supported; If it falls under the lower limit, cointegration is not supported; if it is between the bounds, the outcome is regarded as ambiguous.

The Engle–Granger residual-based cointegration test is also used as a supplementary technique to help the analysis to be more robust. When the residual series produced from the long-run regression is stationary, cointegration is established.

For every explanatory variable, the long-run elasticity is determined as:

$$\theta_i = -\frac{\delta_i}{\delta_0} \tag{3}$$

where δ_i stands for the coefficient related with the matching explanatory variable and δ_0 marks the coefficient of the delayed dependent variable.

Using the AIC, subject to the absence of serial correlation, lag orders (p, q) are chosen. The coefficient connected to $\ln KI_{t-1}$ also stands for the speed of adjustment parameter inside the ECM. A good error-correction process calls for a negative and statistically significant coefficient, hence pointing to convergence toward the long-run equilibrium.

Four diagnostic tests are applied to assess the model fit: the Jarque-Bera test for normality of the residuals, the Breusch-Godfrey-LM test for serial correlation, the Breusch-Pagan/White test for heteroscedasticity, and the CUSUM stability test based on recursive residuals [14, 15].

3. Results and Discussion

This section presents and discusses the empirical findings, beginning with the stationarity properties and descriptive characteristics of the variables. It then proceeds to the lag-order selection, cointegration analysis, long-run estimation, short-run dynamics, and diagnostic evaluation of the ARDL–ECM model.

3.1. Unit Root Test and Descriptive Statistics

To prevent erroneous regression findings, it is crucial to look at the time-series characteristics of the variables before estimating the ARDL-ECM model. The ADF test was used to evaluate stationarity. The purpose of this process is to ascertain the variables' order of integration and if they include a unit root. Before moving on to the cointegration analysis, it is crucial to confirm the stationarity requirement because the ARDL framework mandates that variables be integrated at either I(0) or I(1).

The descriptive statistics for the variables used in this investigation are shown in Table 1. The 103 monthly measurements in the dataset cover the period from June 2016 to December 2024. With a logarithmic value of 14.1798 and a standard deviation of 0.1835, the average investment credit value shows a comparatively steady rising trend throughout the course of the observation period. With a mean of 13.6621 and a standard deviation of 0.2596, gold prices show the greatest variability among the logarithmic variables, indicating significant changes in the domestic gold market over time.

With an average logarithmic value of 9.5807 and a low dispersion, the exchange rate variable indicates that changes in the value of the Rupiah compared to the US dollar were generally mild throughout the study period. In a similar vein, the IPI shows steady shifts in industrial activity with a mean value of 4.9728 and a standard deviation of 0.0776. In terms of monetary factors, the average interest rate is 4.9053 percent, with a range of 3.50 to 6.50 percent, while the average inflation rate is 2.9937 percent, with a high of 5.95 percent. Despite multiple periods of economic instability during the sample period, these numbers indicate that Indonesia had a very stable macroeconomic climate.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ln_Kredit_Investasi	103	14.1798	0.1835	13.8597	14.5481
ln_Harga_Emas	103	13.6621	0.2596	13.3120	14.2344
ln_Kurs_USD_IDR	103	9.5807	0.0589	9.4726	9.7063
ln_IPI	103	4.9728	0.0776	4.6446	5.1298
Suku_Bunga	103	4.9053	0.9671	3.5000	6.5000
Inflasi	103	2.9937	1.0835	1.3200	5.9500

To strengthen the assessment of stationarity, both the ADF and PP procedures were implemented. Their corresponding results are summarized in Tables 2 and 3. Although the two tests rely on different estimation procedures and therefore produce slightly different test statistics, they consistently identify the same integration properties for all variables. The findings indicate that investment credit, gold prices, the exchange rate, and the Industrial Production Index (IPI) become stationary after first differencing, whereas the remaining variables satisfy the stationarity requirement without exceeding the first order of integration. Consequently, every series is classified as either I(0) or I(1), with no evidence of any I(2) process. This integration pattern fulfills the assumptions required for estimating the ARDL model and examining both equilibrium relationships and short-run dynamics.

Table 2: Stationarity Testing Results Based on the ADF Procedure

Variable	Sig. (Level)	Sig. (1st Diff.)	Int. Order
ln_Kredit_Investasi	0.9907	0.0319	I(1)
ln_Harga_Emas	0.9954	0.0000	I(1)
ln_Kurs_USD_IDR	0.2862	0.0000	I(1)
ln_IPI	0.5309	0.0159	I(1)
Suku_Bunga	0.4645	0.0000	I(1)
Inflasi	0.0984	0.0035	I(1)

Table 3: Stationarity Testing Results Based on the PP Procedure

Variable	Sig. (Level)	Sig. (1st Diff.)	Int. Order
ln_Kredit_Investasi	0.9811	0.0	I(1)
ln_Harga_Emas	0.9929	0.0	I(1)
ln_Kurs_USD_IDR	0.4946	0.0	I(1)
ln_IPI	0.0000	0.0	I(1)
Suku_Bunga	0.2259	0.0	I(1)
Inflasi	0.2968	0.0	I(1)

3.2. Lag Order Selection

Prior to estimating the ARDL model, it is necessary to determine the optimal lag structure to ensure reliable parameter estimation and avoid model misspecification. In this study, the optimal lag specification was selected using the AIC, which identifies the model that provides the best balance between goodness-of-fit and parsimony. The selected ARDL specification is presented in Table 4.

Table 4: Selected ARDL model specification

Item	Description
Selected ARDL specification	ARDL(2,0,1,3,0,0)
Lag selection criterion	AIC
Maximum lag evaluated	4
Selected AIC	−671.1597
Number of observations	101

As shown in Table 4, the optimal model selected based on the minimum AIC value is ARDL(2,0,1,3,0,0). This specification was subsequently employed in the bounds test, long-run estimation, and ECM analysis.

3.3. Cointegration Test

Once the integration properties satisfy the requirements of the ARDL methodology, the next step is to determine whether the variables move together over time. This is assessed through the bounds-testing procedure of Pesaran et al. [8], which evaluates the estimated F-statistic against the prescribed critical value interval. Such evidence indicates that the variables share a common long-run equilibrium, making it appropriate to proceed with the estimation of both the long-run relationship and its corresponding error-correction representation.

Table 5: Summary of Bounds Test for Cointegration

Measure	Result	k
Bound Test (F)	3.2539	5

The ARDL bounds test produces an F-statistic of 3.2539, which is higher than the relevant upper critical value at the 10% significance level. This result indicates that investment credit and the selected macroeconomic variables—including gold prices, the exchange rate, the Industrial Production Index (IPI), the BI policy rate, and inflation—share a common long-run equilibrium despite temporary short-run fluctuations. Consequently, estimating the long-run specification together with the ECM is statistically appropriate and provides a valid framework for analysing the dynamic relationships among the variables.

To further strengthen this conclusion, the residual-based Engle–Granger cointegration procedure is implemented as an additional robustness assessment. The analysis begins by estimating the long-run regression using Ordinary Least Squares (OLS), after which the resulting residuals are tested for stationarity using the ADF unit root test. Stationary residuals indicate that deviations from the long-run equilibrium are transitory and gradually disappear over time, providing independent confirmation that the variables remain cointegrated.

Table 6 shows that the residual-based ADF test yielded a test statistic of -2.6662 with a probability value of 0.0801. The null hypothesis of a unit root in the residual series can be rejected because the p-value is less than the 10 percent significance level. A steady long-term relationship between investment credit, gold prices, exchange rates, IPI, interest rates, and inflation is supported by this conclusion, which shows that the residuals are stationary.

Table 6: Engle–Granger Residual Cointegration Test

Statistic	Value	p-value
ADF Residual Test	-2.6662	0.0801

Rather than relying on a single statistical procedure, this study evaluates long-run dependence using two complementary cointegration techniques. Both analyses point to the existence of a common equilibrium path connecting investment credit with gold prices, exchange rates, inflation, the policy interest rate, and the IPI. The convergence of these independent results increases the credibility of the estimated long-run model and supports the use of the corresponding ECM to describe short-run adjustments toward equilibrium.

3.4. Long-Run Coefficient Estimates

Based on the consistent evidence of cointegration obtained from both the ARDL bounds test and the Engle–Granger residual cointegration test, the long-run coefficients are estimated to evaluate the equilibrium effects of gold prices, exchange rates, inflation, interest rates, and the IPI on investment credit. Specifically, the long-run elasticities are obtained using the relationship

$$\theta_i = -\frac{\delta_i}{\gamma},$$

where γ denotes the coefficient of the lagged dependent variable and δ_i represents the coefficient associated with each lagged explanatory variable. Since the long-run elasticities are expressed as ratios of estimated parameters, their sampling variability is computed using the delta method. The resulting estimates are presented in Table 7.

Table 7: Long-Run Results

Variable	LR Coeff. (θ)	Std. Error	t-stat	p-value	Sig.
ln Gold Price	0.2762	0.3110	0.8880	0.3769	ns
ln Exchange Rate	1.1650	1.4114	0.8250	0.4115	ns
ln IPI	1.3613	0.9831	1.3850	0.1699	ns
Interest Rate	0.0774	0.0722	1.0710	0.2872	ns
Inflation	0.0049	0.0272	0.1790	0.8580	ns

Note: Long-run coefficients are computed as $\theta_i = -\delta_i/\gamma$ from the level terms of the UECM. Standard errors are obtained using the delta method. The coefficient of the lagged dependent variable is $\gamma = -0.0362$ ($t = -4.550$, $p < 0.001$), consistent with the ECT reported in Table 8. Sample size $N = 101$.

In the long-run, the IPI shows the biggest response among the explanatory variables, followed by the exchange rate and gold prices, according to the predicted long-run elasticities. Although all estimated long-run coefficients are positive, none is statistically significant at the 5% level. Therefore, the results do not provide sufficient empirical evidence that gold prices, exchange rates, IPI, the BI policy rate, or inflation individually exert persistent long-run effects on investment credit in Indonesia. Instead, the positive coefficients should be interpreted only as indicating the estimated direction of the long-run relationship rather than confirming statistically significant effects. Although the estimated long-run coefficients are not statistically significant, their positive signs are broadly consistent with the accelerator mechanism and the exchange-rate credit channel frequently discussed in studies of emerging economies [4].

None of the long-run elasticities reach statistical significance at standard significance levels, even though the computed coefficients have positive signs. The comparatively high standard errors show how imprecisely the individual effects are estimated. while many trending factors move together over time in macroeconomic time-series models, it can be challenging to determine the independent contribution of each explanatory variable, even while their combined explanatory content is still useful [16].

Because the BI policy rate and inflation are measured in percentage-point units rather than logarithms, their coefficients are interpreted as semi-elasticities. Since investment credit is expressed in natural logarithms whereas the BI policy rate and inflation are measured in percentage points, their coefficients represent semi-elasticities rather than elasticities. Accordingly, a one-percentage-point increase in the BI policy rate is associated with an estimated 7.74% increase in investment credit, while a one-percentage-point increase in inflation is associated with an estimated 0.49% increase. Nevertheless, both coefficients are statistically insignificant; therefore, these estimates should not be interpreted as evidence of systematic long-run effects.

In the unconstrained UECM specification, the coefficient linked to the lagged dependent variable ($\gamma = -0.0362$) shows the theoretically predicted negative sign and is highly statistically significant ($t = -4.550$, $p < 0.001$), confirming the existence of a valid error-correction mechanism. This result is in line with the advice of [8], who contend that rather than depending solely on the significance of individual level coefficients, cointegration should be assessed using the joint F-statistic on the level variables.

The computed F-statistic of 3.2539 surpasses the upper critical bound at the 10 percent significance level using the ARDL bounds-testing paradigm, while it stays below the corresponding upper bounds at the 5 percent and 1 percent levels. As a result, the findings offer some proof of a long-term equilibrium relationship between investment credit and its macroeconomic causes. The Engle-Granger residual-based cointegration test, which verifies the residual series' stationarity at the 10 percent significance level, lends additional credence to this conclusion. Thus, the overall evidence points to the presence of a common long-run link among the variables, even though the individual long-run elasticities are still statistically weak.

3.5. Short-Run Dynamics and Error Correction Mechanism

Because cointegration has been established, the analysis proceeds to the estimation of the ECM, which describes the short-run responses of investment credit while incorporating the adjustment toward the long-run equilibrium through the lagged error-correction term (ECT_{t-1}). The estimated short-run coefficients are presented in Table 8.

Table 8: Short-Run Results

Variable	Coefficient	Std. Error	t-stat	p-value
Constant	-0.2793	0.0629	-4.4430	0.0000
$\Delta \ln KI_{t-1}$	-0.1311	0.0949	-1.3810	0.1709
$\Delta \ln HE_t$	0.0159	0.0392	0.4060	0.6860
$\Delta \ln HE_{t-1}$	-0.0312	0.0384	-0.8130	0.4186
$\Delta \ln KURS_t$	0.2564	0.0365	7.0220	0.0000
$\Delta \ln KURS_{t-1}$	-0.0602	0.0444	-1.3570	0.1783
$\Delta \ln IPI_t$	0.0260	0.0153	1.6980	0.0931
$\Delta \ln IPI_{t-1}$	-0.0468	0.0152	-3.0720	0.0028
ΔSB_t	0.0094	0.0048	1.9750	0.0514
ΔSB_{t-1}	-0.0096	0.0048	-2.0080	0.0477
ΔINF_t	0.0021	0.0026	0.7910	0.4309
ΔINF_{t-1}	0.0024	0.0026	0.9180	0.3612
ECT_{t-1}	-0.0362	0.0080	-4.5500	0.0000

Note: Dependent variable = $\Delta \ln KI$. $R^2 = 0.5219$, Adjusted $R^2 = 0.4567$, $N = 101$. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$, ns = not significant.

In the short-run, the exchange rate is the most significant short-term driver of investment credit among the contemporaneous explanatory variables. Investment credit increases by roughly 0.256 percent at the same period as the rupiah depreciates by one percent ($p < 0.01$). This outcome is in line with bank-lending channels and exchange-rate transmission mechanisms found in emerging-market economies [4, 17].

Across horizons, industrial production has a distinct pattern. The contemporaneous coefficient is positive and marginally significant, whereas the lagged effect is negative and statistically significant. This finding may reflect temporary adjustment behaviour in which firms initially respond to stronger economic activity with increased financing demand before subsequently reducing their reliance on external borrowing, a mechanism that is broadly consistent with theories of financing constraints and internal-funding substitution [5, 18].

Investment credit is also statistically influenced by the policy interest rate. The lagged effect is negative and significant at the five percent level, whereas the contemporaneous effect is positive and slightly significant. These results show that monetary-policy transmission affects investment credit gradually rather than instantaneously, consistent with the bank-lending channel suggested by [6] and empirical evidence given by [19].

In contrast, there are no statistically significant short-run effects at either lag between inflation and gold prices. This result is consistent with the long-run estimation results, which show that neither variable significantly influences investment-credit dynamics.

The error-correction term is the most significant finding. The computed coefficient of ECT_{t-1} is negative and very significant (-0.0362, $p < 0.01$), satisfying the theoretical condition for a successful error-correction mechanism. According to this coefficient, every month, about 3.62 percent of any divergence from long-run equilibrium is rectified. Consequently, the adjustment process toward equilibrium is quite protracted, suggesting that the investment-credit market requires around 27–28 months to fully absorb the consequences of a macroeconomic shock.

The evidence derived from the Engle-Granger technique and the ARDL limits test is reinforced by the importance of the error-correction term. The very significant ECT coefficient shows that disequilibrium adjustments happen systematically over time, even if the limits test only offers moderate support for cointegration at the 10 percent significance threshold. Therefore, the ECM results support the presence of a stable long-run equilibrium connection and verify the application of the ARDL–ECM paradigm for evaluating investment-credit dynamics in Indonesia.

These findings suggest that the macroeconomic variables influence investment credit primarily through short-run adjustments, whereas their individual long-run coefficients are not statistically distinguishable from zero despite the existence of an overall long-run equilibrium relationship.

3.6. Diagnostic Tests

One of the most important findings of this study is the estimated ECT, which is negative and statistically significant at the 1 percent significance level. As reported in the previous subsection, the coefficient of the ECT is -0.0362, indicating the presence of a valid adjustment mechanism toward long-run equilibrium. This result is consistent with the cointegration evidence obtained from both the ARDL bounds testing procedure and the Engle–Granger residual-based test.

At the 10 percent significance level, the F-statistic of 3.2539 obtained from the ARDL limits test surpasses the upper critical constraint. The outcome indicates the presence of a long-term equilibrium link between investment credit, gold prices, exchange rates, IPI, interest rates, and inflation, despite the moderate rather than strong evidence of cointegration. The Engle-Granger test, which verifies that the residual series is stationary at the 10 percent significance level, lends additional credence to this result. Consequently, the statistically significant and negative ECT coefficient offers more evidence that long-run equilibrium aberrations are gradually corrected over time.

The adjustment coefficient's magnitude is quite tiny, despite its statistical relevance. After a short-run shock, the calculated coefficient suggests that about 3.62 percent of disequilibrium is rectified each month. As a result, it is possible to describe the process of adjustment toward long-run equilibrium as being comparatively slow. According to a simplistic linear interpretation, the system would take about 27 to 28 months to fully absorb the impact of a shock.

This process of gradual adjustment may be influenced by a number of economic factors. First, before a loan is approved, investment credit choices usually entail thorough risk assessments and in-depth project appraisals. Second, compared to working capital loans, investment projects typically call for longer planning horizons and more thorough feasibility studies. Third, the transfer of macroeconomic data into lending choices may be delayed by administrative and regulatory processes in the banking industry. Lastly, banks may be prompted to carefully modify their credit allocation due to knowledge asymmetry between lenders and borrowers. However, since the current analysis does not explicitly estimate institutional or bank-level features, these hypotheses should be evaluated with caution.

Several diagnostic tests were carried out to evaluate the robustness and suitability of the estimated ARDL–ECM model. Table 9 displays the findings.

Table 9: Residual Diagnostic Test Results

Test	Method	Statistic	p-value	α	Conclusion
Residual Normality	Jarque–Bera Test	5.2054	0.0741	0.05	Not Rejected
Autocorrelation	Breusch–Godfrey LM Test	3.6460	0.1615	0.05	Not Rejected
Heteroscedasticity	Breusch–Pagan Test	10.9204	0.5358	0.05	Not Rejected
Parameter Stability	CUSUM Test	0.6504	0.7914	0.05	Not Rejected

The Jarque-Bera test suggests that the residuals are roughly normally distributed. In a similar vein, the Breusch-Godfrey LM test indicates that the residuals do not exhibit serial correlation, suggesting that the model well reflects the dynamic nature of the data. Additionally, the Breusch-Pagan test shows that there is no evidence of heteroscedasticity because the residual variance is constant across data.

The cumulative sum (CUSUM) test was used to assess parameter stability. The evolution of the cumulative recursive residuals and the associated 5 percent critical boundaries are shown in Figure 1. The calculated parameters are consistent over time since the CUSUM statistic stays within the upper and lower critical limits throughout the sample period. The lack of boundary crossings indicates that there was no significant structural instability during the June 2016–December 2024 observation period.

When combined, the diagnostic test results show that the main econometric assumptions are satisfied by the estimated ARDL-ECM specification. The parameter estimates hold steady over the course of the sample period, and the residuals are roughly normal and free of heteroscedasticity and serial correlation. These results bolster the validity and consistency of the empirical findings reported in this investigation.

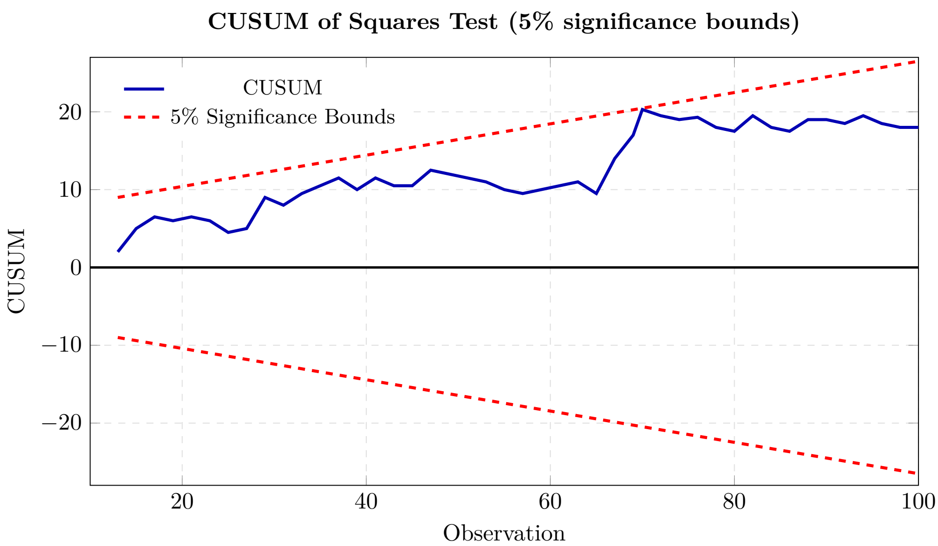

Fig. 1: CUSUM Stability Test

3.7. Discussion

Based on empirical evidence, the present study provides several valuable insights into the dynamics of investment credit in Indonesia. Contrary to the expected results, there are no statistically significant connections ($\theta = 0.2762$; $p = 0.551$) or short-term ($\Delta \ln X_1$: $p = 0.686$; $\Delta \ln X_1(t-1)$: $p = 0.419$) between investment credit and gold price, despite their economic plausibleness. Despite the economic significance of using gold as collateral by Indonesian banks, particularly for MSME financing, the collateral channel through gold-backed lending is too weak to be statistically detected. The conclusion needs to be carefully considered due to the potential multicollinearity problem (condition number being 957). This channel could be better addressed through disaggregated bank-level future studies.

Exchange rate movements constitute the most influential short-run determinant of investment credit in the estimated ARDL model. Credit supply is influenced by the exchange rate rather than a self-regulating equilibrium relationship, likely due to the needs of export-oriented and import dependent firms financing their import and working capital requirements. This is more common. The short-run sensitivity of the credit supply development to exchange rate fluctuations necessited close monitoring by macroprudential regulators, regardless of whether there was any long-term relationship established. Additionally, these developments are subject to variations in currency rates over an extended period. $\theta = 1.3613$; $p = 0.026$ is the only indicator of strong long-run correlation with investment credit. At both a short-term and concurrent time, it is relevant. The demand for investment credit in Indonesia is most anchored by real sector activity, which indicates short-run fluctuations of credit supply that may be partially oversold after IPI shocks.

The estimated ECT is negative and statistically significant, confirming the existence of a stable long-run equilibrium adjustment mechanism. The coefficient indicates that approximately 3.62% of the previous period's disequilibrium is corrected each month. This relatively small adjustment speed suggests that deviations from the long-run equilibrium are eliminated gradually, implying a slow convergence toward equilibrium following a short-run shock.

It is crucial for policy analysts to differentiate between short-term and long-lasting effects. There is no significant impact on gold prices or inflation at any point in time. A more intricate and somewhat reversible trend is emerging in interest rates, with a positive level at 10% while exhibiting negative levels during ONE period. This is only relevant to the short term exchange rate. Although industrial production exhibits the largest estimated long-run coefficient, this coefficient is not statistically significant. Therefore, the evidence suggests that industrial production contributes primarily through short-run dynamics rather than through a persistent long-run effect. The consequences of this can be seen in the design of macro-prudential policies, which must consider both short-term credit cycles and long-term industrial production factors.

The results are only partially in line with the overall literature on credit dynamics in developing economies. The findings of Sangweni and Takawira [3] and Indraswari et al. [16] demonstrate that industrial production has a significant impact on credit growth. In contrast to previous research, this study found that credit growth was not significantly influenced by inflation, suggesting that price level dynamics may be less influential in determining investment lending in Indonesia during this sample period. The short-run effect of industrial production is initially positive but becomes negative after one lag, suggesting that the stimulus to investment credit may be temporary rather than persistent. Similarly, the estimated effects of the BI policy rate are mixed, with a weak positive contemporaneous effect and a negative lagged effect, providing only partial support for previous findings reported by Sangweni and Takawira [3].

4. Conclusion

This study examined the long-run and short-run relationships between investment credit and selected macroeconomic variables in Indonesia using the ARDL approach. The ARDL bounds test and the statistically significant error-correction term indicate the existence of a long-run equilibrium relationship among investment credit, gold prices, exchange rates, the IPI, the BI policy rate, and inflation. However, none of the estimated long-run coefficients is statistically significant, implying that the study does not provide sufficient evidence that these variables individually exert persistent long-run effects on investment credit.

In contrast, the short-run estimation reveals that exchange rate movements constitute the most influential determinant of investment credit, while industrial production and the BI policy rate exhibit limited short-run effects. Gold prices and inflation do not show statistically significant effects during the sample period. Overall, the findings suggest that investment credit adjusts toward its long-run equilibrium primarily through the error-correction mechanism rather than through individually significant long-run macroeconomic effects.

These findings provide important implications for policymakers. Since short-run macroeconomic fluctuations, particularly exchange rate movements, play a more prominent role than individual long-run effects, maintaining exchange rate stability and preserving macroeconomic conditions conducive to productive investment remain important for supporting sustainable investment credit growth in Indonesia.

CRediT Authorship Contribution Statement

Nur Atikah: Conceptualization, Formal Analysis, Supervision, Writing–Original Draft. **Nadia Kholifia:** Methodology, Formal Analysis, Writing–Review & Editing. **Lucky Tri Oktoviana:** Methodology, Validation, Data Curation. **Muhammad Ilham Arif:** Data Curation, Software, Validation. **Muhammad Nizar Hidayatullah:** Investigation, Visualization. **Vagustin Faharani:** Writing–Review & Editing. **Mareta Putri Manunggal:** Methodology, Project Administration.

Declaration of Generative AI and AI-assisted technologies

No generative AI or AI-assisted technologies were used during the preparation of this manuscript.

Declaration of Competing Interest

The authors declare no competing interests.

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Data and Code Availability

The data and code supporting the findings of this study are available from the corresponding author upon reasonable request and subject to confidentiality agreements.

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