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Macroeconomic Determinants of Sustainable Business Financing in Central Kalimantan

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ABSTRACT

Sustainable business financing is a critical channel for translating green economic commitments into bankable investment, particularly in resource-based regions. This study evaluates how interest rates, inflation, and economic growth are associated with sustainable business financing in Central Kalimantan, Indonesia. Quarterly secondary data from 2011Q1 to 2025Q4 provide 60 initial observations obtained from Bank Indonesia, Statistics Indonesia for Central Kalimantan, and the Financial Services Authority. The analysis applies an autoregressive distributed lag framework with unit-root testing, Akaike-based lag selection, bounds cointegration testing, an error correction representation, and residual diagnostics. The selected ARDL(4,4,0,1) model shows that the current interest rate has a negative coefficient of -0.00648 but is not significant at the 5% level. Inflation is insignificant in the level equation, although its first and second short-run lags are positive and significant. Current economic growth is the strongest partial driver, with a coefficient of 0.01111 and a probability below 0.001. The regressors are jointly significant, the bounds statistic confirms cointegration, and the error correction coefficient of -0.01590 indicates a slow quarterly adjustment toward long-run equilibrium. The short-run model explains 75.88% of financing variation and passes normality, autocorrelation, heteroskedasticity, and specification tests. However, CUSUM of squares instability suggests that sustainable financing policy should be reviewed when economic regimes change.

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INTRODUCTION

The architecture of development finance is shifting from a narrow concern with capital accumulation toward a wider obligation to preserve environmental quality, social resilience, and long-term economic capacity. Sustainable finance occupies the hinge of this transition because investment plans do not move merely through declarations, but through credit assessment, portfolio allocation, and the price of funds. Green bonds, green loans, and sustainability-oriented banking can redirect capital toward low-carbon production, renewable energy, efficient infrastructure, and resource conservation when financial incentives are aligned with measurable environmental outcomes (Allen et al., 2022, Flammer, 2021, Fu et al., 2024). This movement has become especially consequential in regions where natural resources remain a dominant foundation of output and public revenue.

Indonesia has gradually institutionalized this agenda through the sustainable finance framework introduced by the Financial Services Authority and later refined through the Indonesian Taxonomy for Sustainable Finance. The framework requires financial institutions to integrate environmental, social, and governance considerations into strategy, risk management, and financing classification (Financial Services Authority, 2017, 2025). Even so, the national policy architecture encounters uneven implementation across regions because local economic structures, banking depth, project readiness, and institutional capacity differ sharply (Setyowati, 2023, Zulbetti et al., 2025). Central Kalimantan therefore provides a revealing regional setting since its economy combines substantial natural-resource activity with an urgent need for cleaner production, sustainable agriculture, forest protection, and more disciplined land use.

The supply of sustainable financing is not insulated from macroeconomic pressure. Interest rates alter the cost of debt and the discount rate used to judge long-lived projects, while inflation changes input costs, nominal working-capital requirements, and the reliability of projected cash flows. Economic growth affects demand, borrower income, collateral quality, and the appetite of banks to expand credit. These channels can reinforce one another, which means that a favorable sustainability label cannot by itself protect a project from monetary tightening, price volatility, or a regional downturn (Aguila & Wullweber, 2024, Azhgaliyeva et al., 2023, Riyanti et al., 2025).

Interest-rate sensitivity is particularly relevant for green investment because many environmental projects demand substantial initial expenditure and recover costs over a long horizon. A higher rate can shrink net present value, weaken debt-service ratios, and postpone investment even when the underlying technology remains environmentally desirable (Van Den Engel et al., 2024). Evidence from renewable energy and green bond markets confirms that financing conditions shape private investment and the yield demanded by investors, although government support and concessional structures can soften the effect (Azhgaliyeva et al., 2023, Endri et al., 2025, Wahyuningsih et al., 2025). The regional banking response may consequently be weaker, delayed, or more heterogeneous than a simple static model implies.

Inflation introduces another layer of ambiguity. Rising prices can enlarge the nominal amount of credit required for machinery, labor, transport, certification, and other project inputs, producing a short-run increase in financing demand. Persistent inflation, however, can reduce real returns, raise uncertainty, provoke monetary tightening, and erode borrower repayment capacity. Research on green finance and renewable energy shows that macroeconomic volatility matters alongside environmental policy because the transition itself remains exposed to material prices, financing costs, and external risk (Aguila & Wullweber, 2024, Lin et al., 2022).

Economic growth may offer a more direct stimulus by improving sales, cash flow, asset values, and the volume of investable projects. Studies across Asian economies and emerging markets show that green finance, capital formation, renewable energy, and economic development are closely intertwined, although the direction and strength of the relationship vary across countries and institutional settings (Liu, 2023, Nawaz et al., 2024, Nguyen et al., 2024, Wang et al., 2022, Zhuang, 2024). Growth can make sustainable projects more bankable, but the environmental quality of the resulting credit still depends on classification, monitoring, and accountability. Expansion alone is not a green outcome.

Existing Indonesian studies largely examine total bank credit, working-capital credit, micro and small enterprise lending, or green bond issuance. Findings remain mixed, with some studies reporting a negative interest-rate effect, others finding weak or insignificant macroeconomic coefficients, and several revealing different responses before and after major shocks (Mamuaja et al., 2024, Munandar & Rimawan, 2019, Nurjanah & Arida, 2021, Sihombing & Sihombing, 2023). International work has moved closer to sustainability indices, green growth, and green financial instruments, but regional sustainable business financing remains rarely modeled as a dynamic time series (Sharma et al., 2021). This gap matters because provincial portfolios are shaped by local sector composition and can react differently from national aggregates.

The present study addresses that gap through quarterly data for 2011Q1-2025Q4 and an autoregressive distributed lag approach. This framework is suitable when variables are integrated at a mixture of I(0) and I(1), and it separates immediate adjustments from longer-run equilibrium relationships (Pesaran et al., 2001). The study evaluates the partial and joint association of interest rates, inflation, and economic growth with sustainable business financing in Central Kalimantan. Its contribution lies in connecting regional macroeconomic dynamics with the practical financing channel of the green transition, while retaining a cautious distinction between statistical association and causal inference.

MATERIAL AND METHODS

Research Design, Scope, and Data

The study used a quantitative associative design with a descriptive-verificative orientation. The descriptive component mapped movements in monetary conditions, prices, output growth, and sustainable financing, while the verificative component estimated their dynamic association. The geographical scope was Central Kalimantan Province and the unit of analysis was quarterly regional time-series information. The observation window covered 2011Q1-2025Q4, producing 60 initial observations and 56 effective observations after the maximum lag was applied.

Secondary data were compiled from Bank Indonesia, Statistics Indonesia for Central Kalimantan, and the Financial Services Authority. The financing measure represented bank funding associated with sustainable business categories and was interpreted within the eleven categories recognized by the Indonesian sustainable finance regulation. Because the financing series was nominal and displayed a persistent upward scale, it was transformed into a natural logarithm before estimation. This transformation reduced scale dominance and allowed coefficients on percentage-point macroeconomic variables to be read approximately as proportional financing changes.

The period predates a fully uniform regional green-finance classification, which creates an important measurement caveat. The regulatory foundation became explicit after the issuance of Regulation No. 51/POJK.03/2017, while historical series necessarily rely on consistent administrative groupings and proxies. The analysis therefore evaluates the macrofinancial behavior of the financing volume rather than claiming that every rupiah produced an independently verified environmental impact. This limitation is retained throughout the interpretation.

Variables and Measurement

Table 1. Operational definitions of research variables

Variable	Role	Measurement	Unit	Source
Sustainable business financing (lnPB)	Dependent	Natural logarithm of regional financing allocated to sustainable business activities	Natural log of IDR billion	Financial Services Authority and Bank Indonesia
Interest rate (IR)	Independent	Bank Indonesia policy rate, including the BI Rate and BI 7-Day Reverse Repo Rate series	Percent	Bank Indonesia
Inflation (INF)	Independent	Year-on-year consumer price inflation in Central Kalimantan	Percent	Statistics Indonesia
Economic growth (EG)	Independent	Quarterly growth of real gross regional domestic product at constant prices	Percent	Statistics Indonesia

Note: Sustainable business financing is transformed into a natural logarithm for estimation.

Econometric Specification

The autoregressive distributed lag model was selected because the variables could be stationary at different orders, provided none was integrated at I(2). The approach also accommodates delayed lending decisions, project appraisal, contract disbursement, and gradual monetary transmission. The general dynamic specification used in this study is expressed in Equation 1, where lnPB is sustainable business financing, IR is the interest rate, INF is inflation, EG is economic growth, and epsilon is the disturbance term.

$$lnPB_t = \alpha_0 + \sum(\phi_i \, lnPB_{(t-i)}) + \sum(\beta_j \, INF_{(t-j)}) + \sum(\gamma_k \, IR_{(t-k)}) + \sum(\delta_l \, EG_{(t-l)}) + \epsilon_t \quad (1)$$

After a long-run relationship was established, the short-run adjustment was represented through an error correction model. The error correction term captures the proportion of disequilibrium removed during one quarter and must carry a negative, statistically significant coefficient to support convergence. The corresponding representation is shown in Equation 2.

$$\Delta lnPB_t = c_0 + \sum(\lambda_i \, \Delta lnPB_{(t-i)}) + \sum(\theta_j \, \Delta INF_{(t-j)}) + \sum(\omega_k \, \Delta IR_{(t-k)}) + \sum(\psi_l \, \Delta EG_{(t-l)}) + \rho \, ECT_{(t-1)} + u_t \quad (2)$$

Estimation Procedure and Diagnostics

The empirical sequence began with descriptive statistics and the Augmented Dickey-Fuller unit-root test (Dickey & Fuller, 1979). Lag order was selected using the minimum Akaike information criterion under a quarterly maximum lag of four. Cointegration was evaluated through the bounds testing procedure developed for autoregressive distributed lag models (Pesaran et al., 2001). The 5% significance level served as the principal decision threshold.

Model adequacy was assessed through complementary diagnostic procedures. Residual normality was evaluated with the Jarque-Bera statistic (Jarque & Bera, 1980), serial correlation with the Breusch-Godfrey test, heteroskedasticity with the Breusch-Pagan-Godfrey procedure, and functional form with the Ramsey RESET test. Variance inflation factors were reviewed with caution because lagged values of the same variable can be mechanically correlated in dynamic models. Parameter stability was examined through CUSUM and CUSUM of squares tests following the recursive-residual framework of Brown et al. (1975).

RESULTS

Descriptive Patterns

Sustainable business financing expanded from IDR 15,860.2 billion in 2011Q1 to IDR 64,743.3 billion in 2025Q4. The ending value was approximately 4.08 times the initial value, revealing a strong nominal expansion despite temporary corrections around several quarters, including the pandemic period. The financing path was more persistent than the macroeconomic indicators, which justified the logarithmic transformation and the subsequent cointegration test. Interest rates averaged 5.61%, inflation averaged 4.10%, and economic growth averaged 5.43%.

Economic growth displayed the widest macroeconomic range, from -3.21% to 10.21%, and its non-normal distribution reflected the severe contraction and recovery around 2020-2022. Inflation ranged from 0.63% to 8.90%, indicating substantial changes in project costs and nominal working-capital pressure. The interest-rate series was comparatively smoother, moving between 3.50% and 7.67%. Table 2 summarizes the central distributional features used to frame the dynamic estimates.

Table 2. Descriptive statistics for quarterly observations, 2011Q1-2025Q4

Statistic	lnPB	Inflation	Interest rate	Economic growth
Mean	10.3992	4.0989	5.6098	5.4257
Median	10.4500	4.0383	5.7500	5.8750
Maximum	11.0800	8.9000	7.6700	10.2100
Minimum	9.6700	0.6300	3.5000	-3.2100
Standard deviation	0.4074	2.0591	1.2387	2.6821
Jarque-Bera probability	0.1719	0.2701	0.3713	0.0000
Observations	60	60	60	60

Source: Author calculation from Bank Indonesia, Statistics Indonesia, and Financial Services Authority data.

Stationarity and Lag Selection

The unit-root results produced the mixed integration pattern required for the autoregressive distributed lag method. Economic growth was stationary at level, while sustainable financing, inflation, and the interest rate became stationary after first differencing. No variable was integrated at I(2), so the bounds procedure remained valid. The Akaike criterion selected ARDL(4,4,0,1), with four lags for financing and inflation, no lag for the interest rate, and one lag for economic growth.

Table 3. Augmented Dickey-Fuller unit-root results

Variable	Test level	ADF statistic	Probability	Decision
lnPB	Level	-0.73204	0.8297	Non-stationary
lnPB	First difference	-3.09150	0.0330	Stationary
Inflation	Level	-2.58286	0.1023	Non-stationary
Inflation	First difference	-6.11418	0.0000	Stationary
Interest rate	Level	-2.51990	0.1161	Non-stationary
Interest rate	First difference	-3.79947	0.0049	Stationary
Economic growth	Level	-3.04545	0.0365	Stationary

The best lag specification was ARDL(4,4,0,1), with an Akaike information criterion of -4.78.

ARDL Estimates

The selected model reveals substantial persistence in the financing series. The first and fourth lags of financing are positive and significant, while the middle lags are not statistically distinguishable from zero. Current economic growth has the largest and most precise macroeconomic coefficient. The current interest-rate coefficient is negative, but its probability of 0.0635 places it outside the 5% threshold.

Table 4. Estimated ARDL(4,4,0,1) coefficients

Regressor	Coefficient	Std. error	t-statistic	Probability
lnPB(t-1)	0.26850	0.10113	2.65491	0.0111
lnPB(t-2)	0.13909	0.10129	1.37311	0.1768
lnPB(t-3)	-0.13188	0.10221	-1.29032	0.2038
lnPB(t-4)	0.70839	0.09806	7.22394	0.0000
INF(t)	0.00282	0.00344	0.81962	0.4170
INF(t-1)	0.00144	0.00462	0.31110	0.7572
INF(t-2)	0.00196	0.00465	0.42126	0.6757
INF(t-3)	-0.00297	0.00464	-0.64007	0.5255
INF(t-4)	-0.00515	0.00340	-1.51569	0.1369
IR(t)	-0.00648	0.00340	-1.90463	0.0635
EG(t)	0.01111	0.00157	7.05379	0.0000
EG(t-1)	-0.00281	0.00166	-1.68983	0.0983
Constant	0.23732	0.12075	1.96542	0.0558

Dependent variable: natural logarithm of sustainable business financing. Effective observations: 56.

The interest-rate coefficient implies that a one-percentage-point increase is associated with an approximately 0.65% decline in financing, other factors held constant. Since the probability exceeds 0.05, the estimate is read as an economically plausible direction rather than conclusive evidence. Inflation is insignificant across the level equation, with signs that shift across lags. By contrast, one percentage point of current economic growth is associated with approximately 1.11% higher sustainable financing in the same quarter.

Cointegration and Short-Run Adjustment

The bounds F-statistic is 24.67394, which exceeds the 5% upper critical value of 3.942 and the 1% upper critical value of 5.200. The null hypothesis of no level relationship is therefore rejected. The negative and highly significant error correction coefficient confirms a return toward equilibrium, although the speed is slow at about 1.59% per quarter. The results support a long-run association without establishing a causal ordering among the variables.

Table 5. Cointegration and selected short-run error correction results

Component	Coefficient or statistic	Probability	Interpretation
Bounds F-statistic	24.67394	-	Cointegration confirmed
5% critical bounds	I(0) = 2.982, I(1) = 3.942	-	F-statistic exceeds upper bound
Error correction term, ECT(t-1)	-0.015902	0.0000	Negative and significant
Delta INF(t)	0.002820	0.3344	Not significant
Delta INF(t-1)	0.006167	0.0371	Positive and significant
Delta INF(t-2)	0.008125	0.0084	Positive and significant
Delta EG(t)	0.011106	0.0000	Positive and

Component	Coefficient or statistic	Probability	Interpretation
			significant

The short-run interest-rate difference is absent because the selected model assigns a zero lag to the interest-rate variable.

Model Diagnostics and Stability

The residual diagnostics support the principal in-sample inference. The Jarque-Bera probability is 0.8835, the Breusch-Godfrey probabilities exceed 0.05, and the heteroskedasticity probabilities are also comfortably above the threshold. The Ramsey RESET result does not indicate functional-form error. CUSUM remains within the 5% bounds, but CUSUM of squares crosses the critical region in part of the sample, which signals volatility instability rather than a uniform collapse of the mean relationship.

Table 6. Diagnostic and model-fit summary

Test or statistic	Result	Probability	Decision
Jarque-Bera normality	0.24772	0.8835	Residuals are normally distributed
Breusch-Godfrey F-statistic	2.04432	0.1425	No serial correlation detected
Breusch-Godfrey Obs*R-squared	5.07809	0.0789	No serial correlation detected
Breusch-Pagan-Godfrey F-statistic	0.73132	0.7133	No heteroskedasticity detected
Ramsey RESET F-statistic	0.10297	0.7499	Functional form accepted
CUSUM	Within 5% bounds	-	Stable mean parameters
CUSUM of squares	Crosses 5% bounds	-	Variance instability
ARDL level R-squared	0.99776	-	High trend-based fit
Transformed ECM R-squared	0.75878	-	Explains 75.88% of short-run variation

The level R-squared is interpreted cautiously because the model contains a persistent nominal series and lagged dependent variables.

DISCUSSION

Interest Rates and Sustainable Financing

The negative sign of the interest-rate coefficient is consistent with the cost-of-capital channel. A higher policy rate can be transmitted into bank funding costs, lending rates, and the discount factor applied to projects whose environmental benefits unfold gradually. This mechanism is particularly restrictive for renewable energy, clean technology, and efficiency investment because large initial expenditure makes project value sensitive to financing conditions (Aguila & Wullweber, 2024, Azhgaliyeva et al., 2023). Evidence from the United States similarly associates higher real interest rates with a lower share of green investment (Van Den Engel et al., 2024).

The lack of 5% significance suggests that this channel was present but not dominant in Central Kalimantan. Sustainable financing can be partially shielded by committed lending programs, refinancing arrangements, long project pipelines, or regulatory incentives that weaken the immediate response to the policy rate. Indonesian green bond evidence also shows heterogeneous behavior between public and corporate issuers, which cautions against treating all green financing as equally rate-sensitive (Endri et al., 2025). Higher market rates may raise green bond yields without automatically producing a proportional fall in every category of bank financing (Wahyuningsih et al., 2025).

The regional result therefore differs from a mechanical interpretation in which every monetary tightening episode instantly curtails sustainable credit. It is closer to a pipeline model, where financing approved in earlier quarters continues to be disbursed while new proposals face stricter appraisal. Persistence in the first and fourth financing lags supports this reading. Policy support that lowers perceived risk, strengthens project preparation, or supplies blended finance can reduce interest-rate sensitivity without ignoring prudent credit standards.

Inflation and Delayed Financing Responses

Inflation does not show a significant level effect, yet its first and second short-run changes are positive and significant. This delayed response can emerge when rising material, labor, transport, and equipment prices enlarge the nominal financing requirement after budgets and credit ceilings are revised. The lag is economically reasonable because firms and banks require time to document cost escalation, renegotiate contracts, and approve additional working capital. A short-run increase in nominal financing is therefore not equivalent to an improvement in real green investment.

Persistent inflation still carries an adverse strategic risk. It can reduce the real value of future cash flows, increase uncertainty, trigger higher interest rates, and narrow the set of projects that satisfy required returns (Aguila & Wullweber, 2024). Research connecting green finance, renewable energy, and volatility likewise shows that macroeconomic risk alters the conditions under which clean investment expands (Lin et al., 2022). The positive lags found here are better interpreted as nominal cost accommodation than as proof that inflation strengthens sustainability.

This distinction explains why results based on financing volume can differ from studies of green bond yields. Yield research observes the price demanded by investors, while the present study observes the amount of funds recorded in regional financing. Inflation may raise both the cost of capital and the nominal amount borrowed, which can generate apparently contradictory coefficients across dependent variables. A policy response should therefore compare nominal portfolio growth with real investment output and environmental performance.

Economic Growth as the Strongest Partial Driver

Economic growth is the strongest partial correlate of sustainable financing in the model. Expansion improves sales, borrower cash flow, collateral values, and the pipeline of investment projects, which can lower perceived default risk and encourage banks to extend credit. At the same time, firms need more funding to expand capacity, modernize equipment, meet certification standards, and improve resource efficiency. The contemporaneous coefficient suggests that banks and businesses react rapidly to regional economic conditions.

The result is consistent with evidence that green finance, capital formation, and economic development reinforce one another in emerging economies (Nawaz et al., 2024, Wang et al., 2022). Asian studies also find that economic recovery and green finance interact with renewable energy and green production, although institutional quality determines whether the resulting expansion is genuinely sustainable (Liu, 2023, Nguyen et al., 2024, Zhuang, 2024). Green credit can further reshape industrial structure and productivity when allocation standards are credible (Chen et al., 2023, Liu & Kang, 2023). Growth expands the financing opportunity set, but taxonomy and monitoring determine its environmental integrity.

The finding should not be read as an invitation to maximize output without ecological conditions. Resource-based growth can increase financing demand while intensifying land, forest, and carbon pressures. The policy priority is to convert cyclical economic strength into a window for cleaner capital expenditure, traceable supply chains, sustainable agriculture, waste management, and energy efficiency. Financing growth becomes developmentally valuable when the destination of funds is as carefully examined as their volume.

Joint Effects, Policy Meaning, and Model Stability

The joint significance of the regressors and the confirmed cointegrating relationship indicate that sustainable financing operates inside a broader macrofinancial system. Interest rates shape the price of credit, inflation alters costs and nominal demand, economic growth changes project viability, and past financing commitments carry forward through the portfolio. This combined structure explains why individual coefficients can be weak while the model remains strongly significant as a whole. Comparable research on sustainability indices and Indonesian banking also emphasizes that macroeconomic effects are distributed across variables and time rather than isolated in a single contemporaneous coefficient (Sharma et al., 2021, Soedarmono et al., 2023).

The slow error correction rate has practical implications. A disturbance to the long-run relationship is not repaired within a few quarters, which means that financing policy cannot rely on rapid automatic normalization. Regulators, regional government, and banks need forward-looking project pipelines, stable classification rules, and monitoring systems that continue through periods of monetary or price stress. Green loans can support sustainable profitability, but their performance depends on underwriting quality and the credibility of environmental targets (Riyanti et al., 2025).

CUSUM of squares instability is a warning that the variance of the relationship changed during the sample. The pandemic contraction, the inflation acceleration around 2022, and shifts in the monetary regime are plausible sources, although the present model does not formally identify a breakpoint. Policy coefficients should therefore be treated as period averages rather than timeless constants. Future work can incorporate structural-break tests, shock dummies, real financing measures, non-performing green loans, sector-level environmental indicators, and out-of-sample forecasting.

The regulatory implication is not to insulate sustainable financing from all market signals, but to reduce avoidable fragility. Clear taxonomy, better project preparation, transparent impact reporting, and risk-sharing instruments can preserve lending when conventional indicators deteriorate, while preventing environmental labels from becoming a substitute for credit discipline. Indonesia has already established a policy base through sustainable finance regulation and taxonomy development (Financial Services Authority, 2017, 2025). The regional challenge is to translate that framework into comparable data and portfolios whose economic and environmental performance can both be audited.

CONCLUSIONS

Sustainable business financing in Central Kalimantan is associated with macroeconomic conditions through a dynamic rather than instantaneous mechanism. The interest rate carries the expected negative direction but does not reach the 5% significance threshold, inflation produces positive delayed short-run responses that likely reflect nominal cost adjustment, and current economic growth emerges as the strongest positive partial driver. The variables are jointly significant and cointegrated, while the negative error correction term confirms gradual convergence toward long-run equilibrium. These results support policies that strengthen sustainable project readiness and risk sharing during periods of high financing costs, distinguish nominal credit expansion from real environmental investment, and use economic upswings to accelerate cleaner capital formation. Because CUSUM of squares indicates instability, the estimated coefficients should be reviewed across structural shifts and should not be treated as permanent causal parameters.

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