

When Rupiah in Crisis: A Lesson Learned of Interest Rates, Inflation, and Exchange Rates as Drivers of Third-Party Funds

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ABSTRACT

Purpose: This study examines whether the deposit interest rate, the inflation rate, and the exchange rate jointly influence third-party funds collected by commercial banks in Surabaya, Indonesia, and which of the three variables has the dominant influence.

Method: A quantitative explanatory design was applied to annual secondary time series data for a fifteen-year period from 2012 to 2024, which covers the Asian crisis and the recovery of the banking sector. The data were analyzed with multiple linear regression using F-tests, t-tests, the coefficient of determination, and partial coefficients of determination, after tests of multicollinearity, autocorrelation, heteroskedasticity, and normality, and were complemented by robustness checks.

Findings: The three variables jointly influence third-party funds, and the model explains a large share of their variation. The deposit interest rate and the exchange rate each have a significant positive partial effect, whereas inflation has no significant effect. The exchange rate is the dominant factor, followed by the deposit interest rate, so the expectation of exchange rate dominance is supported. The diagnostic tests reveal no serious multicollinearity or heteroskedasticity, and the pattern of results is stable when heteroskedasticity and autocorrelation robust errors are used and when the crisis years are removed.

Implications: Bank managers can use deposit rates as an effective funding tool and should build exchange rate scenarios into liquidity planning. Policy makers who wish to mobilize domestic savings should treat exchange rate stability and public confidence in banks as conditions for a stable deposit base.

Originality: The study compares the relative strength of interest rate, inflation, and exchange rate in one model for an urban Indonesian banking market across the crisis period, and it shows that the deposit rate matters mainly once the exchange rate is held constant.

Keywords: bank deposits, third-party funds, deposit interest rate, inflation, exchange rate, commercial banks, Surabaya.

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1. INTRODUCTION

Deposits are the raw material of banking. A commercial bank can extend credit, run a payment system, and support investment in the real economy only to the extent that households and firms are willing to place their money with it, and the funds collected from the public, usually called third-party funds, therefore remain the largest and most stable source of bank funding in most emerging economies (Dalantaibaatar et al., 2026; Banke & Yitayaw, 2022; Zerihun, 2024). How much the public chooses to deposit is not a purely private matter. Deposit mobilization determines how much credit



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can be created, how resilient a bank is to funding shocks, and how far domestic savings can substitute for foreign borrowing in financing development. Recent research has shown that the deposit franchise is also a channel through which monetary policy reaches the economy, because banks adjust the rates they pay on deposits and the volume of deposits they keep in response to the policy stance and to competition from other banks (Drechsler et al., 2017; Egan et al., 2017; Cafiso & Rivolta, 2024).

Indonesia offers an instructive setting for the question of what moves deposits. The banking system passed through a severe crisis from the middle of 2014 to the year 2017. The crisis changed the direction of the economy and of monetary policy, it produced structural problems in macroeconomic management, and it made business conditions and investment uncertain, which in turn damaged the performance of the national banking industry. Weak supervision, policies in the banking sector that did not move in step with fiscal and monetary policy, poor governance, and inefficient funding and lending structures were among the factors that made banks vulnerable. After the crisis the sector recovered, and public confidence in banks as a place to save and invest returned. According to data of the central bank, by April 2022 there were 132 commercial banks in operation, consisting of 5 state owned banks, 34 national private foreign exchange banks, 37 national private banks without foreign exchange status, 26 regional development banks, 19 joint venture banks, and 11 foreign banks. Total banking assets were Rp 1,311.8 trillion, third-party funds reached Rp 978.62 trillion, and outstanding credit was about Rp 594.3 trillion. These figures show that the public trusted banks as an alternative place to keep their money, and that deposits were by far the main source of funds for lending. In January 2021 the central bank had also launched the Indonesian Banking Architecture, which grouped banks into four categories according to their capital strength, namely international banks, national banks, focus banks, and banks with limited activities.

Surabaya is a particularly suitable place to study deposit behavior. It is the capital of East Java, the second-largest city of Indonesia by population, and the main gateway to the eastern part of the country, with a strong concentration of trade, industry, transport, and banking services. Its population reached 2,746,968 people in 2024, and its size and diversity make it a good proxy for an urban market where depositors can choose between many banks and many instruments. In such a market, banks must monitor their environment continuously and use information about savers correctly, in particular about the macroeconomic conditions that influence the decision to place part of income in a bank. National development policy in the 1990s also emphasized that domestic savings should be the main source of development finance, with foreign funds only complementing them, so that the factors that shape public deposits have direct relevance for both bank management and public policy.

2. LITERATURE STUDY

Three macroeconomic variables are usually put forward as determinants of deposits: the interest rate paid on deposits, the rate of inflation, and the exchange rate. The link between the interest rate and saving is the oldest of the three. In the classical loanable funds view, interest is the price of funds that can be lent. Households whose income exceeds their consumption needs supply funds, and firms and investors demand them, so that the interest rate rises until the supply of saving equals the demand for investment. A higher rate therefore encourages households to give up consumption and add to their deposits. The Keynesian view stresses instead that money is held for transaction, precautionary, and speculative motives, and that only the speculative demand depends on the interest rate, which means that a higher rate reduces the amount of money held idle and increases the amount placed in interest bearing assets. Hicks combined the two views in the IS and LM framework, in which the equilibrium interest rate must clear both the market for loanable funds and the market for money. Modern evidence supports the general idea that deposit rates matter, although the size of the effect varies with the type of account, the level of competition, and bank risk (Mushtaq & Siddiqui, 2017; Bikker & Gerritsen, 2018; Egan et al., 2017). Studies of Indonesian banks have concentrated more on the determinants of interest rate spreads than on deposit volumes, and they show that deposit and loan rates are closely linked and depend on bank characteristics and on the macroeconomy (Wijaya et al., 2020; Nugroho et al., 2022).

Inflation is the second variable. It is defined as a general and continuing rise in the prices of goods and services, and it is usually classified by severity, from mild to hyperinflation, and by cause, as demand pull inflation, which results from excessive aggregate demand, or cost push inflation,

which results from rising production costs. Inflation redistributes income, alters the allocation of resources, and can affect output. For depositors the most direct effect is on real value, because inflation reduces the purchasing power of money kept in a bank and of the interest earned on it. At the same time, uncertain prices increase the value of a precautionary reserve, so that theory does not give an unambiguous prediction for the sign of the effect of inflation on nominal deposits (Baiardi et al., 2020). Empirical results reflect this ambiguity, and recent work on the relationship between inflation and bank deposits finds that the connection depends on the macroeconomic setting and on the other variables included in the model (Hasanov et al., 2025; Cafiso & Rivolta, 2024).

The exchange rate, defined here as the number of rupiah needed to buy one United States dollar, is the third variable. In an open economy with a floating exchange rate, the rate is determined by the demand for and supply of foreign currency, which depend on tastes for foreign goods, the prices of exports and imports, the general price level, the interest rate and the expected return on investment, and the pattern of economic growth. A depreciation of the domestic currency raises the prices of imported inputs and goods, and the size and persistence of this pass through to domestic prices increase when a large share of liabilities is denominated in foreign currency (Baharumshah et al., 2017; Kim & Lee, 2026). Exchange rates also move together with interest rate differentials and perceived risk, especially in economies that are exposed to swings in international capital flows (Özmen & Yilmaz, 2017). For bank deposits, at least three channels can be imagined. Depreciation changes the rupiah value of deposits denominated in foreign currency. It changes prices and therefore the nominal income and the nominal savings of households. And it signals macroeconomic stress, which can either drive depositors toward the perceived safety of banks or lead them to move funds elsewhere. The net effect is an empirical question.

Depositors do not respond to prices and returns alone. A large body of research on depositor behavior shows that confidence in the safety of the bank is a central determinant of deposits, particularly in periods of stress. Depositors react to bank solvency risk, uninsured depositors withdraw more readily than insured ones, and relationships between clients and banks reduce withdrawals from distressed banks (Iyer et al., 2016; Brown et al., 2020). Deposit insurance changes this behavior by weakening the incentive to run, although the design of coverage and the uncertainty about it still matter (de Roux & Limodio, 2023; Peia & Vranceanu, 2019; Quintero-V, 2023; Voellmy, 2023). These findings are relevant for a study of the Indonesian banking system from 2012 to 2024, because the period covers the years before the crisis, the crisis itself, and the long recovery. Any model that explains deposits by three macroeconomic variables must therefore be read with the crisis in mind, and the results need to be checked for their sensitivity to the crisis years.

Earlier Indonesian studies of the determinants of deposits in regional and state owned banks, which used regression models with variables such as the deposit interest rate, inflation, income per capita, and the number of bank offices, generally found that the variables jointly explained a large part of the variation in deposits, but they disagreed about the significance and even the sign of individual variables. Deposit rates were found significant in some samples and insignificant in others, inflation was rarely significant, and income and the number of bank offices frequently were. This mixed picture, the strong influence of the crisis, and the wide swings in the exchange rate during the period motivate an analysis that includes the exchange rate explicitly and that compares the strength of the three variables on a common scale.

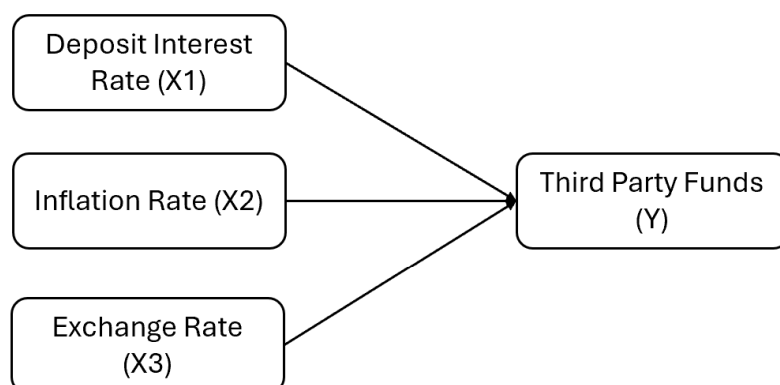


Figure 1. Conceptual Framework

Source: Authors' conceptualization.

The conceptual framework is shown in [Figure 1](#). It proposes that the deposit interest rate, the inflation rate, and the exchange rate all influence third-party funds. A higher deposit rate is expected to attract more deposits. A lower inflation rate is expected to protect the real value of income and savings and therefore to encourage depositing, although the nominal effect can go in the other direction. A change in the exchange rate is expected to influence deposits through prices, valuation, and confidence, and it is expected to be the most powerful of the three forces because it captures the state of the whole economy and its exposure to the outside world. Two hypotheses follow from this framework. The first hypothesis (H1) states that the deposit interest rate, the inflation rate, and the exchange rate partially influence third-party funds of commercial banks in Surabaya. The second hypothesis (H2) states that the exchange rate has the dominant influence on third-party funds.

This study makes three contributions. First, it provides an explicit test of the relative strength of interest rate, inflation, and exchange rate in one model for an urban banking market in Indonesia, covering a period that includes the Asian crisis and the recovery. Second, it does not stop at reporting a regression, but goes on to examine the classical assumptions with more than one test, including tests that are appropriate for small samples, and it checks whether the conclusions survive alternative specifications and the removal of the crisis years. Third, it documents how the effects of the deposit rate and the exchange rate complement each other, since the simple correlation of deposits with the deposit rate is weak, but its partial effect becomes strong once the exchange rate is held constant. The research questions are: (1) Do the deposit interest rate, the inflation rate, and the exchange rate influence third-party funds of commercial banks in Surabaya? (2) Which of the three variables is the most dominant? The objectives are to answer both questions empirically. The results are useful for bank managers who set deposit rates and plan funding, for the monetary authority and government that seek to mobilize domestic savings, and for researchers who study deposit behavior in emerging markets.

3. METHOD

3.1. Research Design

This study uses a quantitative explanatory design based on annual time series data. It tests hypotheses about the effect of three independent variables, namely the deposit interest rate (X1), the inflation rate (X2), and the exchange rate (X3), on one dependent variable, namely third-party funds collected by commercial banks in Surabaya (Y). The design is appropriate because the research questions concern the direction, strength, and relative size of relationships among macroeconomic variables that are observed repeatedly over time, and because a regression model allows the joint and separate effects of the three variables to be estimated and compared. The unit of observation is the calendar year. The study period runs from 2012 to 2024 and produces 15 annual observations, which cover the years before the Asian crisis, the crisis and its immediate aftermath, and the recovery of the banking sector. The period was chosen because it is the longest one for which a consistent set of annual data on all four variables was available to the study.

3.2. Data and Sample

All data are secondary. They were collected from the Central Bureau of Statistics of the Surabaya region and from institutions that are related to the research topic, and they were then processed by the researchers into the forms used in the analysis. Because the study uses the entire annual series for the period, there is no sampling procedure in the usual sense. Every year from 2012 to 2024 is included, and the sample is therefore the whole population of annual observations for the period, with a size of 15. A sample of this size is small, and it limits the precision of the estimates and the power of the diagnostic tests. This limitation is taken into account in the choice of tests and in the interpretation of the results, as explained below, and it is discussed again as a limitation of the study ([Islam & Heiny, 2024](#); [Canepa, 2021](#)).

3.3. Operational Definitions and Measurement

An operational definition gives a variable a meaning by specifying how it is measured. [Table 1](#) lists the four variables, their definitions, their units, and their expected relationship with third-party funds. Third-party funds are the money that the public places in commercial banks in the form of savings deposits, time deposits, and demand deposits, and they are measured in millions of rupiah at the end

of each year. The deposit interest rate is the average rate paid on deposits, in percent per year. The inflation rate is the annual rate of increase of the general price level, in percent. The exchange rate is the value of one United States dollar in rupiah, which measures how much domestic currency is needed to obtain one unit of foreign currency, so that a higher value means a weaker rupiah.

Table 1. Variables, Definitions, and Units of Measurement

Variable	Definition	Unit	Expected relation with Y
Third-party funds (Y)	Public deposits in commercial banks in Surabaya: savings, time deposits, and demand deposits	Rp million	Dependent variable
Deposit interest rate (X1)	Average interest rate paid by banks on deposits	Percent per year	Positive
Inflation rate (X2)	Rate of increase in the general price level over the year	Percent per year	Ambiguous
Exchange rate (X3)	Number of rupiah needed to buy one United States dollar	Rp per USD	Ambiguous

Source: Authors' operationalization based on the research design.

3.4. Model and Hypotheses

The relationship between the variables is analyzed with a multiple linear regression model estimated by ordinary least squares. The model is written as:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + e \dots\dots (1)$$

Where Y is third-party funds, X1 is the deposit interest rate, X2 is the inflation rate, X3 is the exchange rate, b_0 is the constant, b_1 to b_3 are the regression coefficients, and e is the disturbance term, which represents all other factors that affect deposits but are not included in the model. The disturbance is assumed to have a mean of zero, a constant variance, and no correlation across periods. The regression was originally estimated with the SPSS statistical package version 13.0, and all coefficients and test statistics reported in this article were recomputed independently from the annual data to check their consistency. The share of the variation in Y that the three predictors explain jointly is measured by the coefficient of determination (R^2), which is the ratio of the regression sum of squares to the total sum of squares, ranges between zero and one, and cannot be negative (Kim, 2019).

3.5. Classical Assumption Tests

The usual properties of ordinary least squares, that the estimators are the best linear unbiased estimators, rest on several assumptions, and violations make the F and t tests unreliable. Three assumptions were examined. The first is the absence of autocorrelation, which means that disturbances in one period are not correlated with those of another period. This assumption is especially important for time series data. It was tested with the Durbin and Watson statistic, which is computed from the residuals as the sum of squared differences between successive residuals divided by the sum of squared residuals. The statistic is compared with a lower bound (d_L) and an upper bound (d_U) taken from the Durbin and Watson table for 15 observations and three predictors at the 5 percent level, which are 0.82 and 1.75. If d is smaller than d_L or larger than $4 - d_L$, the null hypothesis of no autocorrelation is rejected. If d lies between d_U and $4 - d_U$, the null hypothesis is not rejected. If d falls between d_L and d_U , or between $4 - d_U$ and $4 - d_L$, the test is inconclusive. The literature cautions that decisions based on the Durbin and Watson pretest have consequences for later inference, and that the inconclusive zone deserves supplementary evidence (Kabaila et al., 2021). For this reason, the Breusch and Godfrey test of first and second order serial correlation was added as a supplementary check.

The second assumption is the absence of multicollinearity, which means that the predictors are not strongly linearly related to one another. It was assessed with the tolerance and the variance inflation factor (VIF), defined as one divided by the tolerance, with the customary rule that a VIF above 10, equivalent to a tolerance below 0.10, signals a problem. This cut off is a convention, and the literature notes that the consequences of a given VIF depend on the sample and on the purpose of the model (Kim, 2019). The third assumption is the constancy of the disturbance variance, or homoskedasticity. It was tested by the Spearman rank correlation between the residuals and each predictor, following the original analysis, with a significance value above 0.05 taken to indicate the absence of heteroskedasticity. Spearman coefficients are read with attention to their sign and size and not only to their significance (Schober et al., 2018). Because a stronger version of the test uses

the absolute value of the residuals, the correlation with absolute residuals was also computed, and the Breusch and Pagan and the White tests were added. The normality of the residuals was examined with the Shapiro and Wilk test and the Jarque and Bera test, which are suitable for small samples.

3.6. Hypothesis Testing

Hypothesis H1 was tested with the F test, which assesses the fit of the model as a whole. The null hypothesis is that all slope coefficients are zero, and it is rejected when the calculated F exceeds the critical value at the 5 percent level with 3 and 11 degrees of freedom, where the F statistic is the mean square of the regression divided by the mean square of the residual:

$$F = \text{MS regression} / \text{MS residual} \dots\dots\dots (2)$$

The partial effect of each predictor was tested with the t test, in which the t statistic is the estimated coefficient divided by its standard error. The null hypothesis that a coefficient equals zero is rejected when the absolute value of t exceeds the critical value of 2.201, which corresponds to a two tailed test at the 5 percent level with 11 degrees of freedom. Hypothesis H2, on the dominant factor, was tested by comparing the partial coefficients of determination, as in the original analysis, and the variable with the largest partial coefficient of determination was regarded as dominant. As a complement, the standardized regression coefficients, which express the effect of each predictor in standard deviation units and therefore make the predictors comparable despite their different units, were also compared. All tests used a significance level of 5 percent.

3.7. Robustness Checks

Because the sample is small, the series are measured in levels, and the crisis years contain extreme values, four supplementary checks were run on the same data. First, standard errors that are robust to heteroskedasticity and autocorrelation (the Newey and West estimator) were computed with one and two lags. Second, the model was estimated again after removing the year 2015, when inflation reached its extreme value, and after removing both 2014 and 2015. Third, a specification in natural logarithms was estimated, in which the coefficients can be read as elasticities. Fourth, the residuals were inspected year by year for signs of a structural break. Regressions in levels with trending variables can produce spurious relationships when the variables are nonstationary, and the literature offers methods, such as autoregressive distributed lag models, to deal with this problem when the sample allows it (Ghouse et al., 2021). With only 15 observations these methods cannot be applied reliably, so the robustness checks are used to gauge the stability of the results and not to replace the main model.

4. RESULTS AND DISCUSSION

4.1. Research Setting

Surabaya lies between about 7 degrees 21 minutes south latitude and 112 degrees 36 minutes to 112 degrees 54 minutes east longitude. It is a lowland area with an elevation of 3 to 6 meters above sea level, bordered by the Madura Strait to the north and east, by Sidoarjo Regency to the south, and by Gresik Regency to the west. The total area is about 326.36 square kilometers, divided into five sub regions of the city administration, 28 districts, and 163 villages. The city had 2,746,968 inhabitants in 2024, of whom 1,335,899 were men and 1,411,069 were women, which made it one of the most densely populated cities in Indonesia after the national capital. Two features explain this density. The first is its strategic geographic position as the main gateway to eastern Indonesia, with facilities that support trade, industry, transport, and banking. The second is the growth of large, medium, small, and handicraft industries, which attracts migrants and increases the labor force that must be absorbed by the economic sectors. A dense and economically diverse population, in turn, creates a large potential base for deposits and a competitive market for banks, which is the context in which the relationships analyzed below should be read.

4.2. Development of the Study Variables

Table 2 presents the annual data for the four variables together with their year on year changes, and Figure 2 plots the four series. Third-party funds show a fluctuating but broadly rising path until 2019

and a sharp fall afterward. They increased from Rp 50,854 million in 2012 to Rp 125,743 million in 2014, jumped by about 141 percent to Rp 303,016 million in 2015, stayed near that level until 2017, and reached the highest value of the period, Rp 358,239 million, in 2019. In 2020 they dropped by about 54 percent to Rp 164,238 million and then stayed within a narrow band between Rp 141,070 million and Rp 152,224 million until 2024. The lowest value therefore occurs at the beginning of the series, in 2012, and the largest fall occurs in 2020. The source of the data does not explain the fall, and it is discussed further among the limitations.

Table 2. Third-party Funds, Deposit Interest Rate, Inflation Rate, and Exchange Rate, 2012 to 2024

Year	Y (Rp million)	Growth (%)	X1 (%)	Change (%)	X2 (%)	Change (%)	Growth (%)
2012	88,894	42.5	15.04	15.8	8.69	5.3	4.5
2013	119,165	34.1	16.69	11.0	6.68	-23.1	3.5
2014	125,743	5.5	16.28	-2.5	9.11	36.4	139.0
2015	303,016	141.0	21.84	34.2	95.21	945.1	42.1
2016	301,431	-0.5	27.60	26.4	0.24	-99.7	-11.6
2017	296,885	-1.5	16.15	-41.5	10.46	4,258.3	31.1
2018	348,257	17.3	14.23	-11.9	14.13	35.1	11.3
2019	358,239	2.9	15.95	12.1	9.15	-35.2	-14.6
2020	164,238	-54.2	12.64	-20.8	4.78	-47.8	-4.5
2021	143,356	-12.7	8.21	-35.0	4.88	2.1	9.8
2022	141,070	-1.6	10.95	33.4	14.12	189.3	5.2
2023	152,224	7.9	11.63	6.2	6.71	-52.5	-6.6
2024	147,976	-2.8	8.24	-29.1	11.54	72.0	1.9

Source: Central Bureau of Statistics of Surabaya, processed. Growth and change columns are year on year percentage changes recalculated by the authors; n/a means not available for the first year.

The deposit interest rate changed constantly from year to year, without a stable trend. It rose from 12.99 percent in 2012 to 16.69 percent in 2013, climbed to 21.84 percent in 2015 and to the highest value of the period, 27.60 percent, in 2016, and then fell sharply to 16.15 percent in 2017. After a small recovery in 2019, it moved down to the lowest value, 8.21 percent, in 2021, and it ended the period at 8.24 percent in 2024. The peak in 2015 and 2016 reflects the monetary tightening that followed the crisis, when high rates were used to defend the currency and to keep funds in the banking system, while the low values in the later years reflect the return of stability. The inflation rate shows the largest swings. It stayed between 6.68 and 10.19 percent until 2014, exploded to 95.21 percent in 2015 as the crisis pushed up the prices of goods, in particular imported goods and fuel, and then collapsed to 0.24 percent in 2016. It returned to about 10 to 14 percent in 2017 and 2018, fell to below 5 percent in 2020 and 2021, rose again to 14.12 percent in 2022 after the increase in fuel prices, and was 11.54 percent in 2024. The extreme observation of 2015 is a natural candidate for influencing the regression, and this is examined below.

The exchange rate depreciated in steps. It was close to Rp 2,100 to 2,400 per dollar between 2012 and 2013, moved to Rp 5,700 in 2014, an increase of about 139 percent, and to Rp 8,100 in 2015. It then strengthened slightly to Rp 7,161 in 2016, reached the weakest value of the period, Rp 10,450, in 2018, and fluctuated in a range between Rp 8,500 and Rp 9,850 from 2019 to 2024. The depreciation of 2014 is the largest single move of any of the four series, and its timing coincides with the jump in deposits of 2015. Table 3 summarizes the distributions. Mean third-party funds are Rp 186,915 million with a standard deviation of Rp 104,630 million, the mean deposit rate is 14.98 percent, mean inflation is 14.28 percent with a very large standard deviation of 22.68 percent that is driven by 2015, and the mean exchange rate is Rp 7,003 per dollar.

Table 3. Descriptive Statistics of the Study Variables (n = 15)

Variable	Mean	Median	Standard deviation	Minimum	Maximum
Third-party funds (Rp million)	186,915.33	147,976.00	104,630.05	50,854.00	358,239.00
Deposit interest rate (%)	14.98	15.04	4.95	8.21	27.60
Inflation rate (%)	14.28	9.11	22.68	0.24	95.21
Exchange rate (Rp per USD)	7,003.33	8,528.00	3,172.52	2,118.00	10,450.00

Source: Central Bureau of Statistics of Surabaya, processed.

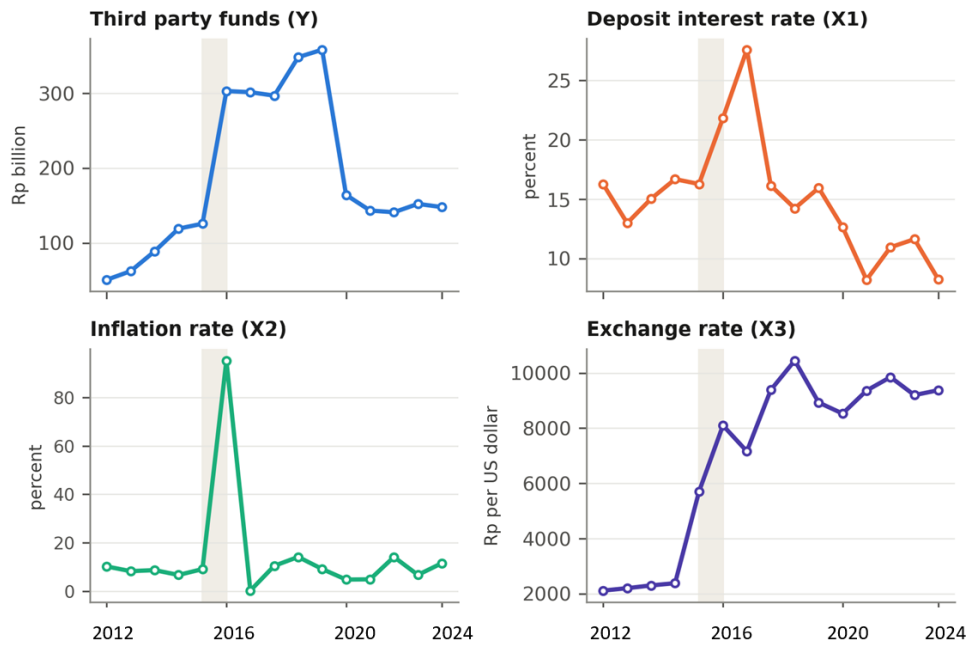


Figure 2. Development of Third-party Funds, Deposit Interest Rate, Inflation Rate, and Exchange Rate, 2012 to 2024

Source: Central Bureau of Statistics of Surabaya, processed.

The simple correlations in Table 4 give a first impression of the relationships. Third-party funds are positively correlated with all three variables. The correlation with the exchange rate is strong at 0.640 and significant, whereas the correlations with the deposit rate (0.441) and with inflation (0.306) are moderate and not significant on their own with 15 observations. The predictors are only weakly correlated with each other, and the correlation between the deposit rate and the exchange rate is slightly negative at -0.224 . This last feature matters for the interpretation of the regression, because it means that the two predictors carry different information about deposits and that each can contribute to the explanation once the other is held constant.

Table 4. Pearson Correlation Matrix

Variable	Y	X1	X2	X3
Third-party funds (Y)	1.000	0.441	0.306	0.640
Deposit interest rate (X1)	0.441	1.000	0.309	-0.224
Inflation rate (X2)	0.306	0.309	1.000	0.123
Exchange rate (X3)	0.640	-0.224	0.123	1.000

Source: Authors' calculation. Only the correlation of Y with X3 ($p = 0.010$) is significant at 5 percent; those of Y with X1 ($p = 0.100$) and with X2 ($p = 0.268$) are not.

4.3. Classical Assumption Tests

4.3.1. Multicollinearity

Table 5 reports the tolerance and the VIF of each predictor. All VIF values are between 1.100 and 1.198, far below the cut off of 10, and all tolerance values are far above 0.10. There is therefore no multicollinearity in the model, and the estimated coefficients can be interpreted separately. This result agrees with the low correlations among the predictors reported in Table 4, and it is the reason why the effects of the three variables can be compared meaningfully (Kim, 2019).

Table 5. Multicollinearity Test

Variable	Tolerance	VIF	Cut off	Conclusion
Deposit interest rate (X1)	0.835	1.198	VIF < 10	No multicollinearity
Inflation rate (X2)	0.866	1.155	VIF < 10	No multicollinearity
Exchange rate (X3)	0.909	1.100	VIF < 10	No multicollinearity

Source: Authors' calculation. Tolerance is the reciprocal of the VIF.

4.3.2. Autocorrelation

The Durbin and Watson statistic of the model is 1.283. With 15 observations and three predictors, the lower and upper bounds at the 5 percent level are 0.82 and 1.75, so that the statistic lies between d_L and d_U , as Figure 3 shows. The decision rule then implies that the test is inconclusive, and it does not allow the conclusion that autocorrelation is absent. This is an important precision, because it means that the original conclusion of no autocorrelation cannot be drawn from this test alone, and the first order autocorrelation of the residuals is estimated at a moderate 0.350. Given the doubtful status of the pretest (Kabaila et al., 2021), two supplementary checks were made. The Breusch and Godfrey test does not reject the absence of serial correlation, either at order one ($LM = 1.985$, $p = 0.159$) or at order two ($LM = 2.440$, $p = 0.295$), as Table 6 shows. In addition, estimating the standard errors again with the Newey and West method, which is robust to autocorrelation, leaves the conclusions of the t tests unchanged, as shown in the robustness analysis below. The evidence therefore suggests that serial correlation is not strong enough to overturn the inference, but it cannot be ruled out with a sample this small, and the standard errors of the baseline model should be regarded as approximate.

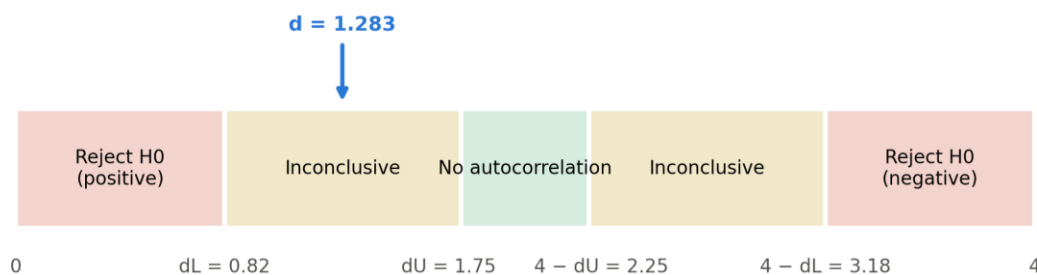


Figure 3. Durbin and Watson Decision Regions and the Calculated Statistic

Source: Authors' calculation.

4.3.3. Heteroskedasticity and normality

The Spearman rank correlations between the residuals and the predictors are 0.136 for the deposit rate ($p = 0.630$), 0.293 for inflation ($p = 0.289$), and 0.043 for the exchange rate ($p = 0.879$). All significance values are far above 0.05, so there is no relationship between the size of the residuals and the explanatory variables, and heteroskedasticity is not detected. Because the correlation between signed residuals and a predictor is a weak way of detecting changes in variance, the correlations with absolute residuals were also computed, and they are 0.093, -0.014 , and 0.357, none of them significant. The Breusch and Pagan test ($p = 0.319$) and the White test ($p = 0.582$) lead to the same conclusion. The residuals also appear to be normally distributed, according to the Shapiro and Wilk test ($p = 0.250$) and the Jarque and Bera test ($p = 0.461$), although the power of these tests with 15 observations is limited. The model therefore shows no violation of the assumptions of multicollinearity, heteroskedasticity, or normality, while the autocorrelation question is left open for the reasons given above.

Table 6. Autocorrelation, Heteroskedasticity, and Normality Diagnostics

Test	Statistic	Significance	Conclusion
Durbin and Watson ($d_L = 0.82$; $d_U = 1.75$)	$d = 1.283$	n/a	Inconclusive zone
Breusch and Godfrey, order 1	$LM = 1.985$	0.159	No serial correlation found
Breusch and Godfrey, order 2	$LM = 2.440$	0.295	No serial correlation found
Spearman, residual with X1	0.136	0.630	No heteroskedasticity
Spearman, residual with X2	0.293	0.289	No heteroskedasticity
Spearman, residual with X3	0.043	0.879	No heteroskedasticity
Spearman, absolute residual with X1	0.093	0.742	No heteroskedasticity
Spearman, absolute residual with X2	-0.014	0.960	No heteroskedasticity
Spearman, absolute residual with X3	0.357	0.191	No heteroskedasticity
Breusch and Pagan	$LM = 3.517$	0.319	No heteroskedasticity
White	$LM = 7.535$	0.582	No heteroskedasticity
Shapiro and Wilk (residuals)	$W = 0.927$	0.250	Normality not rejected
Jarque and Bera (residuals)	$JB = 1.547$	0.461	Normality not rejected

Source: Authors' calculation. The first three Spearman rows follow the original analysis; the absolute residual rows and the remaining tests are supplementary checks.

4.4. Regression Results

Table 7 reports the estimated regression. The estimated equation is as follows. The constant of -185,131 means that when the deposit rate, the inflation rate, and the exchange rate are all zero, third-party funds would be negative by Rp 185,131 million. This value has no economic meaning because the zero point of the predictors lies far outside the range of the data, and it should be read only as the intercept that positions the regression plane.

$$Y = -185,131 + 12,820.289 X_1 + 106.828 X_2 + 25.485 X_3 \dots\dots\dots (3)$$

The coefficient of the deposit rate is 12,820.289, which means that an increase of one percentage point in the deposit rate is associated with an increase of Rp 12,820 million in third-party funds, holding the other variables constant. The coefficient of inflation is 106.828, which suggests that each additional percentage point of inflation is associated with an increase of Rp 107 million, but this value is very small compared with its standard error of 718 and it is not statistically different from zero. The coefficient of the exchange rate is 25.485, which means that each additional rupiah in the price of a dollar is associated with an increase of Rp 25.485 million in third-party funds, or about Rp 25,485 million for a depreciation of Rp 1,000.

Table 7. Results of the Multiple Regression Analysis

Variable	B	Std. error	t	Sig.	Std. Beta	Partial r	Partial r ²
Constant	-185,131.492	67,370.028	-2.748	0.019	n/a	n/a	n/a
Deposit interest rate (X1)	12,820.289	3,349.033	3.828	0.003	0.607	0.756	0.571
Inflation rate (X2)	106.828	718.457	0.149	0.884	0.023	0.045	0.002
Exchange rate (X3)	25.485	5.012	5.085	0.000	0.773	0.838	0.702

Source: Authors' calculation. Dependent variable: third-party funds (Rp million). n = 15; R = 0.877; R² = 0.769; adjusted R² = 0.706; standard error of estimate = 56,723.

The coefficient of determination is 0.769 (R = 0.877), so the three variables together explain 76.9 percent of the variation in third-party funds, and the remaining 23.1 percent is explained by factors outside the model. The adjusted coefficient of determination, which corrects for the small number of observations relative to the number of predictors, is 0.706, which is still a high value for a macroeconomic model with only three predictors. Figure 4 compares actual and fitted deposits. The fitted values follow the general rise until 2015 and the fall after 2019 reasonably well, but they miss the level of deposits during 2017 to 2019, when actual deposits were much higher than fitted, and during 2022 and 2023, when they were lower. The residuals are therefore not randomly scattered over time, which is consistent with the closeness of the Durbin and Watson statistic to the inconclusive zone.

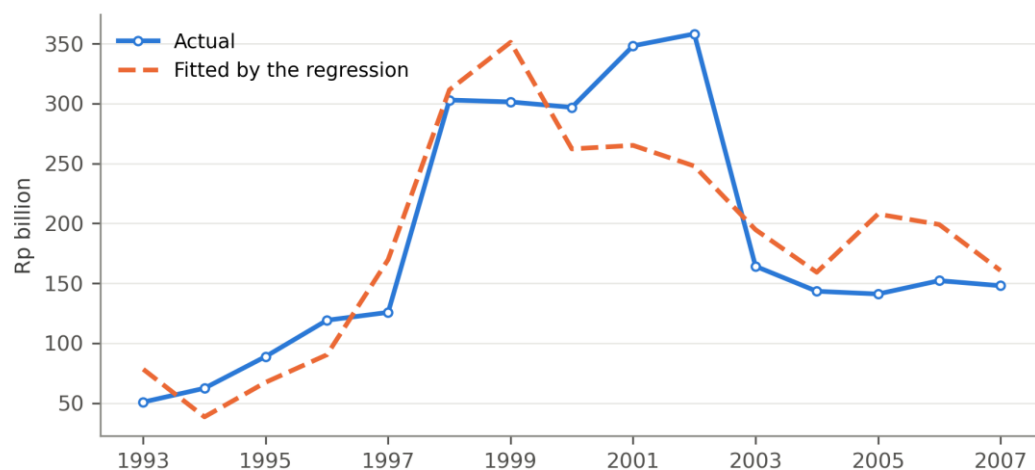


Figure 4. Actual and Fitted Third-party Funds

Source: Authors' calculation.

4.5. Hypothesis Testing

4.5.1. Goodness of Fit Test

The analysis of variance in Table 8 shows a regression sum of squares of 117,871,251,853.747 and a residual sum of squares of 35,393,023,813.587, which give a mean square of 39,290,417,284.583 for the regression and 3,217,547,619.417 for the residual. The calculated F is therefore 12.211. The critical value of F at the 5 percent level with 3 and 11 degrees of freedom is 3.59, so the calculated value lies in the rejection region, as Figure 5 illustrates, and the significance value is about 0.001. The null hypothesis that all slope coefficients are zero is rejected, and the alternative hypothesis is accepted. This means that the regression model can predict the independent variable since it passed the goodness-of-fit test.

Table 8. Analysis of Variance

Source	Sum of squares	df	Mean square	F	F table (5%)	Sig.
Regression	117,871,251,853.747	3	39,290,417,284.583	12.211	3.59	0.001
Residual	35,393,023,813.587	11	3,217,547,619.417			
Total	153,264,275,667.334	14				

Source: Authors' calculation.

3.5.2. Partial tests (H1)

The t-test of the deposit rate gives 3.828, which exceeds the critical value of 2.201, with a significance value of 0.003. The null hypothesis is rejected, and the deposit rate has a significant positive effect on third-party funds. Its partial coefficient of determination is 0.571, which means that, once the other two variables are controlled for, the deposit rate explains 57.1 percent of the remaining variation in deposits. The t test of inflation gives 0.149, which is far below 2.201, with a significance value of 0.884. The null hypothesis cannot be rejected, and inflation has no significant effect. Its partial coefficient of determination is only 0.002, so it explains 0.2 percent of the remaining variation. The t test of the exchange rate gives 5.085, which is far above 2.201, with a significance value of 0.000. The null hypothesis is rejected, and the exchange rate has a significant positive effect. Its partial coefficient of determination is 0.702, so the exchange rate explains 70.2 percent of the variation that the other two variables leave unexplained.

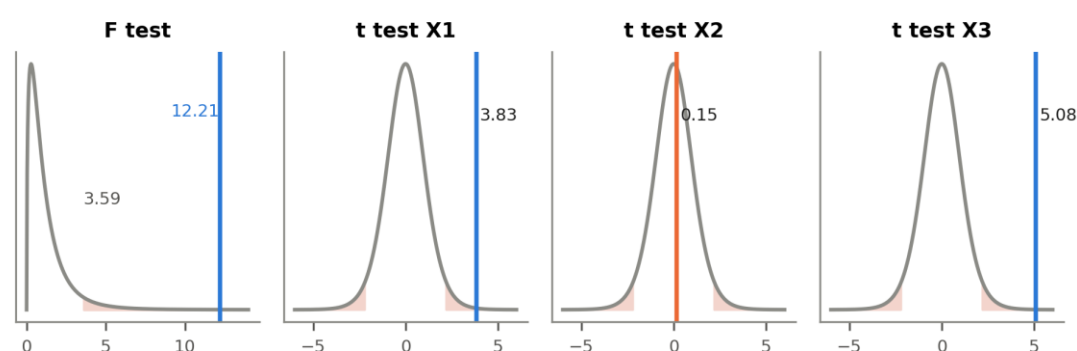


Figure 5. Rejection Regions of the F Test and the Partial t Tests

Source: Authors' calculation. Shaded areas are rejection regions at the 5 percent level.

3.5.3. Dominant variable (H2)

The variable with the largest partial coefficient of determination is the exchange rate (0.702), followed by the deposit rate (0.571) and inflation (0.002). The standardized coefficients give the same ranking, with 0.773 for the exchange rate, 0.607 for the deposit rate, and 0.023 for inflation, as Figure 6 shows. The exchange rate is therefore the dominant factor influencing third-party funds, and hypothesis H2 is supported. Table 9 summarizes the results of the hypothesis tests. The consistency of the two dominance measures is reassuring, since they are computed differently, the first from partial correlations and the second from coefficients scaled by standard deviations.

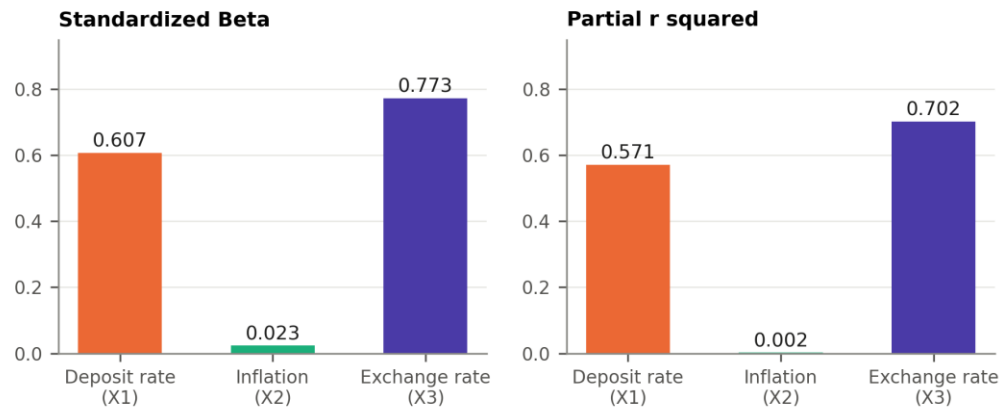


Figure 6. Standardized Coefficients and Partial Coefficients of Determination

Source: Authors' calculation.

Table 9. Summary of Hypothesis Testing

Hypothesis	Test	Result	Decision
H1: X1, X2, and X3 jointly influence Y	F test	$F = 12.211 > 3.59$; $R^2 = 0.769$	Supported
Partial effect of X1 on Y	t test	$t = 3.828 > 2.201$; positive	Significant
Partial effect of X2 on Y	t test	$t = 0.149 < 2.201$	Not significant
Partial effect of X3 on Y	t test	$t = 5.085 > 2.201$; positive	Significant
H2: X3 has the dominant influence on Y	Partial r^2	$X3 = 0.702$, $X1 = 0.571$, $X2 = 0.002$	Supported

Source: Authors' calculation. Significance level 5 percent.

3.6. Robustness of the Results

Table 10 shows that the main conclusions are stable. When standard errors are computed with the Newey and West method with one or two lags, the t values of the deposit rate and the exchange rate become larger, at 4.68 and 5.58 with one lag and 4.51 and 5.50 with two lags, while the t value of inflation remains below 0.4. When the year 2015 is removed, the coefficient of inflation increases from 107 to about 5,469 because the extreme observation no longer dominates the estimate, but it remains insignificant ($t = 1.16$). The results are similar when both 2014 and 2015 are removed, and the coefficients of the deposit rate and the exchange rate stay significant ($t = 4.03$ and 5.01) with R^2 rising to 0.792. In the log linear specification, an increase of 1 percent in the exchange rate is associated with an increase of about 0.86 percent in third-party funds, an increase of 1 percent in the deposit rate with an increase of about 0.98 percent, and inflation has an elasticity of only 0.03, which is not significant. The explanatory power of this specification is 0.843. In every specification the exchange rate is the strongest variable in terms of t values, and inflation is never significant, so both the significance pattern and the dominance ranking are not driven by the crisis years.

Table 10. Robustness of the Regression Results

Specification	X1	X2	X3	R^2
Baseline (t values)	3.83	0.15	5.09	0.769
Newey and West, 1 lag (t values)	4.68	0.37	5.58	0.769
Newey and West, 2 lags (t values)	4.51	0.39	5.50	0.769
Without 2015 (t values)	3.94	1.16	5.13	0.775
Without 2014 and 2015 (t values)	4.03	1.27	5.01	0.792
Log linear model (elasticity)	0.979	0.026	0.856	0.843
Log linear model (t values)	4.12	0.41	7.25	

Source: Authors' calculation. Coefficients of X1 and X3 are significant at 5 percent in every specification and that of X2 is not significant in any.

3.7. Discussion

3.7.1. The deposit interest rate

The positive and significant effect of the deposit rate is consistent with the classical theory of saving and with the liquidity preference view that a higher rate raises the opportunity cost of holding idle money. It is also consistent with the evidence that the deposit rate matters for the amount that households keep in banks, even though its effect depends on the type of account and on competition among banks (Mushtaq & Siddiqui, 2017; Bikker & Gerritsen, 2018; Egan et al., 2017). The mechanism is that a higher rate pays depositors for postponing consumption and attracts funds from other uses, including cash holdings and unproductive investment, into the banking system. Banks that compete for deposits raise their rates to gain market share, and the level of the rate that they offer also determines how far their deposit base responds to changes in the policy rate (Drechsler et al., 2017; Cafiso & Rivolta, 2024). In Indonesia during the crisis, the sharp increase in deposit rates in 2015 and 2016 coincided with the jump in deposits, which suggests that banks used high rates to stop the outflow of funds and to attract funds in a period of uncertainty. The size of the coefficient should be treated with care. An increase of one percentage point in the deposit rate is associated with a Rp 12,820 million increase in deposits, which is about 7 percent of the average level of deposits in the period, and this is a large effect in economic terms.

A noteworthy feature of the results is that the simple correlation between deposits and the deposit rate is only 0.441 and not significant, while the partial effect is strong. The explanation lies in the negative correlation between the deposit rate and the exchange rate. In the years when the exchange rate was high and deposits were high, the deposit rate tended to be low, so that the raw association is masked. Once the exchange rate is held constant, the positive contribution of the deposit rate emerges clearly. This pattern, in which one predictor enhances the contribution of another, means that the deposit rate should not be judged from a bivariate comparison alone, and it supports the use of a multiple regression model for the question at hand.

3.7.2. The inflation rate

The inflation rate has no significant effect on third-party funds, and this result holds in every robustness check. Several reasons can explain it. The first is that the two main channels work in opposite directions. Inflation erodes the real value of income and saving and thereby discourages saving, while it also raises nominal income and increases the demand for money for precautionary purposes, which increases nominal deposits (Baiardi et al., 2020). When the two forces roughly offset each other, no clear net effect appears, and the same conflict has been found in recent studies of the deposit behavior of banks under inflation (Hasanov et al., 2025; Cafiso & Rivolta, 2024). The second reason is that inflation influences deposits partly through the interest rate. When inflation rises, banks raise their rates to compensate savers and to protect their deposit base, and the effect of inflation is then absorbed by the deposit rate that is already in the model. The third reason is statistical. Inflation is dominated by one extreme observation, that of 2015, and outside that year it varies within a narrow range, so that the data contain little independent variation from which to estimate a precise effect. The finding does not mean that inflation is irrelevant to the welfare of savers, but it suggests that, in this market and period, deposit volumes were driven by other forces.

3.7.3. The exchange rate

The exchange rate is the most important explanatory variable, with a positive and highly significant coefficient and the largest standardized coefficient. A positive sign means that a weaker rupiah is associated with higher nominal third-party funds. This result deserves a careful interpretation, because the exchange rate can affect deposits through several channels, and the data do not allow them to be separated. The first is a valuation effect. Deposits denominated in foreign currency, which were common in Indonesian banks, become larger in rupiah when the rupiah depreciates, and this raises measured third-party funds mechanically. The second is the price channel. A depreciation increases the prices of imported inputs and goods, and the extent of the pass through to domestic prices depends on how much of the economy is exposed to foreign currency liabilities and prices (Baharumshah et al., 2017; Kim & Lee, 2026). The increase in the price level raises nominal incomes and nominal cash balances, and part of the additional balances is deposited in banks. The third channel is confidence and portfolio choice. A depreciation is usually accompanied by higher interest rates and by heightened risk perception, and exchange rates move together with the interest differential and with risk premiums in economies that are vulnerable to capital flow reversals (Özmen & Yilmaz, 2017). Depositors who move away from riskier assets or from holding foreign currency in cash toward bank deposits, particularly deposits with banks that they trust, would also raise the

volume of deposits in the banking system. It is well documented that depositors' choices depend on their perception of the safety of the bank and on the availability of deposit insurance ([Iyer et al., 2016](#); [de Roux & Limodio, 2023](#); [Quintero-V, 2023](#)).

Some care is needed with the size of the coefficient. Each Rp 1,000 of depreciation is associated with an increase of about Rp 25,485 million in deposits, and the exchange rate rose by more than Rp 7,000 during the period, so that the exchange rate explains a very large part of the growth of deposits between 2012 and 2018. Because both series trend upward during these years, part of the association can reflect a common trend and the general expansion of the nominal economy and not a direct effect of the exchange rate. The evidence that the exchange rate remains the dominant variable when the crisis years are excluded and in the logarithmic specification indicates that the relationship is not only a crisis phenomenon. However, it does not prove causality, and the statistical approach of this study cannot separate a genuine effect from a shared trend. The practical message is nevertheless clear. In this market, exchange rate developments are closely related to the movement of deposits, and any bank that plans its funding without considering the exchange rate is ignoring the variable that best tracks deposits.

3.7.4. Model fit and unexplained variation

The model explains more than three quarters of the variation in deposits, but the pattern of the residuals shows what it does not capture. The residuals are positive and large in 2017 to 2019, when deposits were above the fitted values by as much as Rp 110,351 million in 2019, and negative from 2020 to 2024, when deposits were below the fitted values, with a shortfall of Rp 66,720 million in 2022. The drop of 54 percent in deposits in 2020 occurred while the three macroeconomic variables did not change abruptly, so it must have been caused by something else. Possible explanations include a change in the coverage or the definition of the reported deposits, the restructuring and consolidation of banks after the crisis, the closure or merger of banks, a transfer of deposits to other cities where head offices are registered, or changes in confidence associated with the reform of deposit guarantees and supervision. Prior studies on regional and state owned banks suggest that the number of bank offices and income per capita also matter for deposits, and neither was included in this model. The results should therefore be understood as the joint and relative influence of three macroeconomic variables and not as a full model of deposit mobilization.

3.8. Implications

For bank managers, the results show that the deposit rate is a lever that works. Raising the deposit rate attracts deposits, even after controlling for macroeconomic conditions, but this lever has a cost, because a higher rate raises the cost of funds and squeezes margins, and the rate must therefore be set together with the loan rate and with the expected volume of deposits ([Wijaya et al., 2020](#); [Nugroho et al., 2022](#)). The dominance of the exchange rate suggests that banks should incorporate exchange rate scenarios in liquidity and funding plans, since large exchange rate movements are associated with large changes in deposits, both upward and downward. Banks with a substantial share of foreign currency deposits should monitor the valuation effect and the currency mix of their liabilities and assets.

For the monetary authority and government, the results indicate that macroeconomic stability, and exchange rate stability in particular, is a condition for a stable deposit base. Efforts to mobilize domestic savings as a source of development finance should therefore be accompanied by a credible exchange rate policy. The findings on the deposit rate also imply that the level of interest rates is an instrument that influences the volume of deposits, although its use must be weighed against its effect on investment and credit. Confidence in the safety of the banking system is also a determinant of deposits, and the design of the deposit guarantee scheme, the transparency of bank condition, and the credibility of supervision are complementary to macroeconomic policy ([Voellmy, 2023](#); [Peia & Vranceanu, 2019](#); [Brown et al., 2020](#)).

3.9. Limitations

Several limitations should be kept in mind. The sample consists of only 15 annual observations, which limits statistical power and the reliability of diagnostic tests, and small sample methods were used where possible ([Canepa, 2021](#); [Islam & Heiny, 2024](#)). The variables are analyzed in levels, and series that trend over time can produce spurious relationships ([Ghouse et al., 2021](#)). The Durbin and Watson test is inconclusive, and although the supplementary tests do not indicate serial correlation, this cannot be ruled out. The residual pattern suggests a structural break in 2020 that the model does

not capture. The data cover the years from 2012 to 2024 and reflect the institutional environment of that time, including the recovery from the crisis, and the results should not be extended without caution to the current banking system, which has different regulation, technology, and competition. The study analyzes aggregate data for one city and does not distinguish among types of banks or types of deposits, so the effects on individual banks or on specific instruments cannot be identified. Finally, the results describe associations and not proven causal effects.

5. CONCLUSION

This study examined how the deposit interest rate, the inflation rate, and the exchange rate influence third-party funds collected by commercial banks in Surabaya, and which of the three is dominant. Using annual data for 15 years from 2012 to 2024 and a multiple regression model, the analysis found that the three variables jointly have a significant influence on third-party funds, with an F value of 12.211 that exceeds the critical value of 3.59 and a coefficient of determination of 0.769, so the model explains 76.9 percent of the variation in deposits. Hypothesis H1 is therefore supported. In the partial tests, the deposit interest rate ($t = 3.828$) and the exchange rate ($t = 5.085$) have significant positive effects, while the inflation rate ($t = 0.149$) has no significant effect.

The exchange rate has the largest partial coefficient of determination (0.702), ahead of the deposit interest rate (0.571) and inflation (0.002), and it also has the largest standardized coefficient (0.773). Hypothesis H2, which expected the exchange rate to be the dominant factor, is therefore supported. The classical assumption tests found no multicollinearity and no heteroskedasticity, and the residuals appear to be normal, while the Durbin and Watson test fell in its inconclusive zone. Supplementary tests did not indicate serial correlation, and the significance pattern and the ranking of the variables were unchanged when heteroskedasticity and autocorrelation robust standard errors were used, when the crisis years were removed, and when the model was estimated in logarithms.

Three conclusions follow. First, the deposit base of commercial banks in an urban market like Surabaya responds to price signals, since a higher deposit rate is associated with higher deposits after the exchange rate is controlled for. Second, exchange rate developments are the strongest correlate of deposits, which reflects valuation, price, and confidence effects that the data cannot separate. Third, inflation does not show a significant net effect, which is consistent with the presence of opposing forces and with the fact that its influence is partly transmitted through interest rates. These conclusions apply to the market and the period studied, and they describe associations and not proven causal effects. Because the model leaves a systematic pattern in the residuals, in particular the sharp fall in deposits in 2020, it should be seen as a partial explanation of deposit mobilization.

Recommendations

For bank managers, the findings recommend the use of the deposit rate as an active tool for mobilizing funds, while balancing the higher cost of funds against the margin that the bank needs. Managers should also include exchange rate scenarios in their liquidity and funding plans, and monitor the composition of deposits by currency, because large exchange rate movements are strongly associated with large changes in deposits.

For the monetary authority and the government, the findings recommend that macroeconomic stability, and exchange rate stability in particular, be treated as a condition for the mobilization of domestic savings. Interest rate policy can support deposits, but it should be combined with measures that maintain public confidence in banks, such as effective supervision and a clear and credible deposit guarantee scheme.

For future researchers, it is recommended to extend the observation period, to use quarterly or monthly data, and to apply methods for nonstationary series such as cointegration and error correction models when the sample size permits. Studies should add variables that earlier research has linked to deposits, such as income per capita, the number of bank offices, the level of bank risk, and the size of foreign currency deposits, and should separate types of banks and types of deposits. A dummy variable for the crisis and for the structural change in 2020 would also improve the model, and panel data of individual banks would allow the effects of the three macroeconomic variables to be identified more precisely.

Generative AI Statement

The authors declare that generative AI was used in the development of this manuscript. Claude (Anthropic) was used to support the restructuring of the authors' research report into a journal article, the drafting and language editing of the text, the recalculation and cross checking of the statistical results, and the verification of reference metadata. The empirical data originate from the authors' research report, and the authors are responsible for the accuracy, originality, and integrity of the content.

Abbreviations

VIF: Variance Inflation Factor

R²: Coefficient of Determination

Beta: Standardized Regression Coefficient

Author Contribution

All authors equally contribute to the research and writing the article.

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Availability of Data and Materials

The annual data used in this study are reported in full in Table 2 of this article, and the calculations can be reproduced from them. All sources are listed in the references.

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