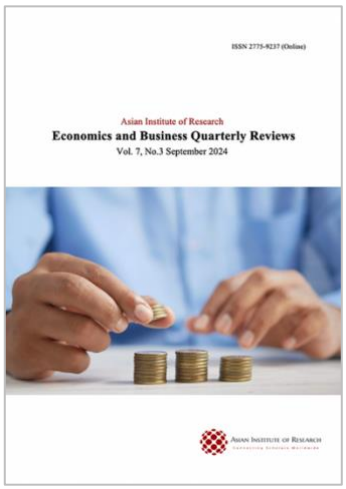

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The Impact of Macroeconomic Factors on the Volatility of Tin Commodity Futures Contract Prices: Empirical Study on Inflation, Interest Rates, and Forward Prices

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Abstract
This research explores the impact of macroeconomic factors on the volatility of tin commodity futures contract prices, with a focus on inflation, interest rates and forward prices. The volatility of tin futures prices is important to investment strategies and risk management. Understanding the influence of these macroeconomic variables helps in making better investment decisions. The independent variables analyzed include inflation (X1), interest rates (X2), and forward prices (X3). Inflation reflects general price increases that can increase production costs and affect commodity prices. Interest rates are borrowing costs that influence investment decisions through the cost of capital. Forward prices reflect market expectations of future commodity prices. The dependent variable is the volatility of the tin commodity futures contract price (Y). This research methodology uses linear regression to analyze historical data from the three macroeconomic variables. Data is collected from economic reports, financial market data, and government publications. Analysis is carried out to determine the influence of each variable on futures price volatility. The research results show that inflation and forward prices have a significant influence on the volatility of tin futures contract prices, while interest rates have no significant influence. Increased inflation leads to increases in production costs and prices of goods, increasing future price uncertainty and volatility. High forward prices reflect expectations of future increases in commodity prices, which also increases volatility. Meanwhile, interest rates do not significantly affect borrowing costs, so they have no impact on futures contract price volatility.

Keywords: Price Volatility, Futures Contracts, Tin Commodities, Inflation, Interest Rates, Forward Prices

1. Introduction

1.1 Introduce the Problem

Futures Contract Agreements carry the potential for profits in line with increasing price changes. Conversely, the associated risk of loss is also in line with the decline in the price of the Futures. A futures contract is an agreement between two parties who agree to carry out a sale and purchase transaction for a number of assets or commodities at a future date. Thus, these contracts allow market participants to hedge against unexpected price fluctuations in the future, as well as providing speculators with the opportunity to take advantage of anticipated price movements. Initially, Futures contracts were usually related to trading agricultural or mining commodities. However, along with the development of financial markets, the scope of Futures contracts has expanded to include financial assets such as interest rates, market price indices and foreign currencies (Tandelilin, 2001:298). This expansion reflects

the dynamics and complexity of modern markets which are increasingly global and integrated. Futures contracts create opportunities for the parties involved to manage price risks that may occur in the future. Gains or losses from these contracts are directly related to changes in the value of the asset or commodity that is the subject of the contract. In this context, market participants can use Futures contracts to protect themselves from adverse price fluctuations or to speculate on profitable price movements. For example, a wheat farmer may sell a Futures contract to lock in the future selling price of his wheat, thereby protecting himself against a potential sudden drop in the market price of wheat.

Initially, Futures contracts were usually related to trading agricultural or mining commodities. However, as financial markets have developed, the scope of Futures contracts has expanded to include financial assets such as interest rates, market price indices and foreign currencies. This expansion reflects the dynamics and complexity of modern markets that are increasingly global and integrated (Hull, J. C. (2017). Thus, Futures contracts not only function as a hedging tool for commodity producers and consumers, but also as an important investment instrument for various financial entities, from banks to hedge funds, who are looking for ways to manage risk and maximize returns in volatile markets.

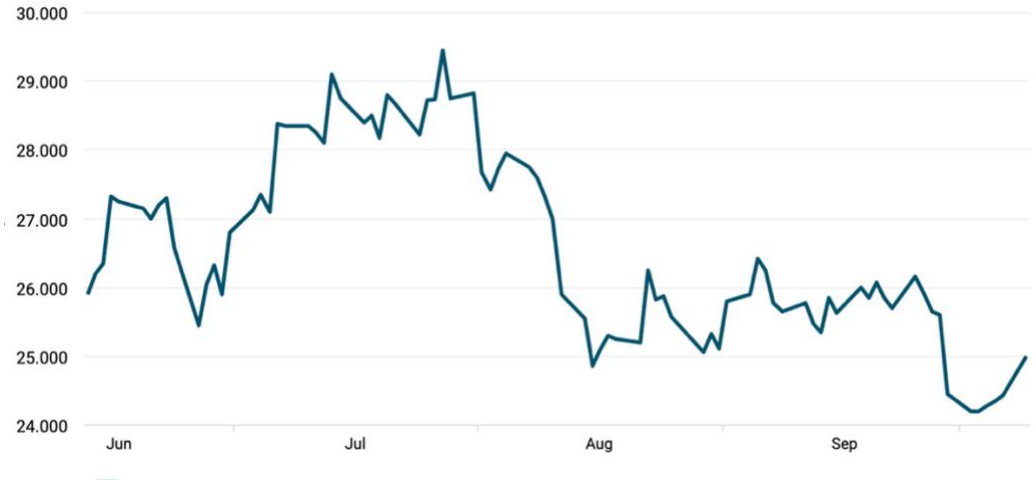

Table 1.1: Tin Commodity Price

In the chart above, we can see that the three-month contract price of tin is currently showing an upward trend. Data monitored by Westmetall on Monday, 09 October 2023, indicated that the three-month contract price for tin commodities had reached US$25,000 per ton. Although there was a decline in trade in tin products of 0.79% since the beginning of the year, overall, this product experienced a decline of 0.75% on an annual basis. The highest peak price for tin commodities during 2023 occurred on January 27, reaching US$32,100 per ton. The average price throughout this year, especially in the period January to October 2023, is around US$26.28 thousand per ton. This price experienced a significant decrease of 15.12% or the equivalent of US$-4,680.26 per ton compared to the previous year's average. This decline reflects the market pressure faced by tin commodities amidst various global economic factors that influence demand and supply.

This data provides an overview of the dynamics of tin commodity prices during 2023 and reflects the challenges and opportunities that market players may face in managing their investments. Information regarding price fluctuations is important for investors and entrepreneurs to carry out appropriate hedging and speculation strategies, so that they can optimize profits and minimize risks in trading tin commodities.

Based on previous research, there are five variables that influence futures contracts, such as spot prices and forward prices (Yanti & Artini, 2013), inflation, interest rates (Dewi, Siregar, Hartoyo, & Manurung, 2011b), and the government bond index (Pramasha & Widyarti, 2015). In conditions of limited supply and constant or increasing

demand, spot prices tend to rise, which also influences futures prices to increase along with increases in spot or cash prices. Wesso (1999) indicates that spot prices have a role as the best predictor for projecting futures prices, with a significant positive correlation to futures price predictions.

In this research, inflation is also identified as one of the main factors influencing futures contract prices. Fluctuations in the Consumer Price Index (CPI), triggered by the dynamics of demand and supply of goods, significantly influence price movements in the market. In this context, inflation is an important consideration because of its broad impact on the value of a country's currency, which directly influences global prices of goods, including commodities such as Tin. When the inflation rate increases, the rupiah exchange rate tends to depreciate, which then results in lower commodity prices such as tin, causing futures contract prices to fall as found in previous research (Dewi et al., 2011).

Inflation is a phenomenon where prices as a whole experience a continuous increase over a certain period of time. Inflation can occur due to an even increase in prices and can be triggered by an increase in public consumption, and excess liquidity in the market which causes an increase in raw material prices, which in turn will raise the price of futures contracts (Pramasha & Widyarti, 2015). A similar opinion was expressed by Adam et al. (2018), which states that inflation has a positive significance on spot futures. However, Pramasha & Widyarti (2015) argue that there is a negative influence between inflation and olein commodity futures contracts. Meanwhile, Dewi et al. (2011) stated that inflation does not significantly affect the gold index rolling contract.

Apart from that, other investment instruments that also have the potential to influence futures contract prices include interest rates. When interest rates rise, investors' tendency to save increases, which has the potential to reduce demand for futures contracts, so that futures contract prices tend to decrease, in accordance with findings in previous research (Dewi et al., 2011b). The negative relationship between interest rates and futures contract prices is supported by the findings of Dewi et al. (2011b), which states that interest rates have a negative and significant impact on futures contracts. However, a different opinion was expressed by Dewi et al. (2011a), which states that interest rates have a positive impact on olein futures contracts. Apart from that, a different approach was also expressed by Adam et al. (2018), which states that interest rates do not have a significant impact on futures contracts.

After interest rates in theory, forward prices and futures prices have a close relationship and influence each other, especially in commodity markets such as tin. The forward price is the currently agreed price for a transaction to be executed in the future, while the futures price is the price of an exchange-traded contract for future delivery.
In the context of the tin commodity, forward prices are used to lock in the purchase or sale price of tin in the future, thereby providing protection against price fluctuations. For example, tin producers can use forward contracts to ensure a certain sales price in the future, which helps them plan revenue and manage price risk (Jens Wimschulte, 2010).

On the other hand, futures prices reflect market expectations of future tin prices, including factors such as supply and demand, interest rates, and global economic conditions. Because futures are traded on exchanges, they offer higher liquidity and price transparency compared to more customized forward contracts traded over-the-counter (OTC) (CFA Institute). In theory, forward and futures prices tend to be highly correlated because they both depend on the underlying spot price and the same fundamental factors. However, differences in trading mechanisms and transaction fees may cause price differences between the two. For example, futures often involve margins that traders must maintain, which can affect price dynamics (CME Group).

Thus, in the context of the tin commodity market, understanding the interaction between forward prices and futures prices is very important for market players to manage risk and make better investment decisions. Based on the phenomenon of fluctuations in tin commodity prices which show different movement trends from futures contract prices, as well as variations in the results of previous research, the aim of this research is to investigate the impact of forward prices, inflation, interest rates on futures contracts on tin commodities. This research is aimed at providing deeper insight, so that investors and hedgers can consider optimal and appropriate investment policies.

1.2. Inflation

According to Fisher, inflation can be explained as a condition in which there is a general and continuous increase in the prices of consumer goods in all economic sectors. Fisher underlined the aspect of price increases that are evenly distributed across all economic sectors, including goods consumed by people on a daily basis.

Friedman defines inflation as "a monetary phenomenon that occurs when the money supply in an economy exceeds the production capacity of goods and services, ultimately causing a general increase in prices." Friedman is famous for his view that inflation is always and everywhere a monetary phenomenon.

Apart from that, inflation is a situation where prices experience continuous increases (Rosyidi, 2009: 131). This refers to a situation where price increases occur simultaneously in various sectors of the economy. To measure inflation, you can use the general quantity of goods and services, and calculate the average price over several time periods (Case & Fair, 2007:57). Bank Indonesia (2018) sets the Consumer Price Index (CPI) as the main indicator for assessing the level of inflation. Changes in the CPI reflect price movements based on people's consumption of various goods and services. The inflation rate is measured in the form of a percentage change in the CPI announced by Bank Indonesia every month. This shows proportional changes in prices of various products consumed by the public, providing an overview of the inflationary pressures currently occurring in the economy.

Inflation is usually measured using the Consumer Price Index (CPI). The formula for calculating the inflation rate is as follows:

$$\text{Inflation Rate} = \left(\frac{\text{CPI}_{\text{current year}} - \text{CPI}_{\text{previous year}}}{\text{CPI}_{\text{previous year}}} \right) \times 100$$

……(1)

1.3. Interest Rates

According to Kasmir (2014: 114), interest can be interpreted as a cost that must be borne by customers to the bank that sells their products, as well as a payment that must be made by customers who take out loans from the bank. Deposit interest and loan interest are two forms of interest applied, where deposit interest functions as an attraction for customers to buy savings products at the bank, while loan interest is an obligation that must be fulfilled by customers in return for the loans they receive.

In his book "The Economics of Money, Banking, and Financial Markets," Mishkin explains that an interest rate is the price paid to borrow money, usually expressed as a percentage of the loan amount. Interest rates influence investment and consumption decisions and have a significant impact on the overall economy.

Meanwhile, Fisher developed the concept of "Quantity Theory of Money" which explains that nominal interest rates consist of real interest rates plus the anticipated inflation rate. According to Fisher, real interest rates are nominal interest rates that have been adjusted for inflation.

The reference interest rate issued by the government for each bank, such as the BI 7-day (Reverse) Repo Rate, is a macroeconomic instrument that determines interest rates. The BI 7-day (Reverse) Repo Rate published by Bank Indonesia every month is a benchmark for measuring interest rates in banking activities.

The general formula for calculating interest is as follows:

$$\text{Interest (I)} = \text{Principal (P)} \times \text{Rate (R)} \times \text{Time (T)}$$

……...……...(2)

1.4. Forward Price

Forward prices refer to the sale and purchase agreement of the underlying asset that will occur at a point in time in the future. This agreement is determined at the time of the underlying buying and selling transaction, and the forward price is the price in effect when the agreement occurs. In the process, the forward contract does not require payment in cash until the asset is delivered.

In his book "Options, Futures, and Other Derivatives," Hull defines a forward price as the price agreed to in a forward contract to buy or sell a specific asset at a specific date in the future. This price is determined based on the current spot price, financing costs, and holding costs, as well as any profits or other carry benefits associated with the asset.

Forward contracts are designed with the hope of eliminating trust risk between the parties involved, thereby minimizing potential uncertainty. The forward price is based on the value stated in the forward contract itself. In the context of tin commodities, forward prices use changes in the forward price of tin commodities on the London Metal Exchange (LME).

The formula for changes in forward prices, as explained by Hull (year), can be calculated using the formula:

$$Forward = \frac{P_t - P_{t-1}}{P_{t-1}} \times 100\%$$

……..(3)

Where :
Forward = change in Forward price in month t
Pt = Forward price of the t-th period
Pt-1 = Forward price for period t-1

1.5. Commodity Futures Contract (Tin)

In his book "Options, Futures, and Other Derivatives," Hull defines a futures contract as a standardized agreement to buy or sell a commodity or financial asset at a specified price in the future. These contracts are traded on exchanges and have standard specifications regarding the quantity, quality and delivery date of the commodity in question (Hull, 2017).

According to Bodie, Kane, & Marcus (2014: 172), a commodity futures contract is an agreement that regulates the process of sending commodities at maturity at an agreed price for payment on the contract's maturity date. A futures contract is an agreement between a seller and a buyer regarding a number of assets or commodities. Futures sellers and buyers agree to sell and buy a certain amount at a predetermined price and within the time limit agreed in the contract (Tandelilin, 2001:298).

The futures price is the price announced by the futures exchange at a certain time. This price is formed based on investors' expectations of commodity supply and demand. Every day, futures prices are announced on the settlement date by the exchange. Futures prices are measured by monitoring changes in end-of-month data on the Indonesian Commodity and Derivatives Exchange (BKDI). Changes in futures contracts can be calculated using formula (1) as follows.

$$Futures = \frac{P_t - P_{t-1}}{P_{t-1}} \times 100\%$$

……..(4)

Information:

Futures = change in futures price in month t
Pt = Futures price for period t
Pt-1 = Futures price for period t-1

2. Research Methods

This research focuses on testing specific hypotheses and analyzing information relationships in the context of conclusive causality research. In obtaining evidence regarding the influence of independent variables such as forward prices, inflation and interest rates on the dependent variable, namely tin commodity futures contracts, researchers used quantitative data. The secondary data used comes from various trusted sources such as the Indonesian Commodity and Derivatives Exchange (www.icdx.co.id), BAPPEBTI (www.bappebti.go.id), London Metal Exchange (www.lme.com), Bank Indonesia (www.bi.go.id), and the Indonesian Securities Price Appraiser (www.ibpa.co.id), ensuring the accuracy and reliability of the analysis carried out. With this approach, this research aims to provide a deeper understanding of the dynamics of the tin commodity market and the factors that influence it empirically.

This research also takes into account the forward contract price factor as one of the independent variables that have the potential to influence tin commodity futures contracts. Through the use of quantitative data from various sources mentioned previously, researchers strive to produce comprehensive and accurate analysis. Thus, the research results are expected to provide a significant contribution to the understanding of the dynamics of the tin commodity market and the factors that influence it empirically, as well as providing valuable guidance for market players and policy makers.

The population considered in this research is tin commodity futures contracts at the settlement date on the Indonesian Commodity and Derivatives Exchange from 2019 to 2023. The analytical method applied in this research is multiple linear regression analysis, which aims to explore how strong the relationship between two or more variables and indicates the direction of the relationship between the dependent variable and the independent variable. To carry out this analysis, SPSS version 18 software was used. Before testing the hypothesis, the validity of secondary data was tested by testing classical assumptions. Some of the classic assumptions tested include normal data distribution, absence of multicollinearity, absence of autocorrelation, and absence of heteroscedasticity.

3. Research design

This research uses a conclusive causality research design to test the relationship between the independent variables (forward prices, inflation, interest rates, and forward contract prices) and the dependent variable (tin commodity futures contracts). This design was chosen because it allows researchers to evaluate causation between the variables studied. With this approach, research can identify the direct influence of independent variables on dependent variables, making it possible to understand more deeply the mechanisms underlying the relationship between economic factors and market behavior of tin commodities. In addition, conclusive causality designs also allow researchers to make stronger conclusions about cause-and-effect relationships than other research designs, so that research results can make more significant contributions to scientific understanding and practical applications in the fields of economics and finance.

3.1. Population and Sample

The population in this research is all tin commodity futures contracts at the settlement date on the Indonesian Commodity and Derivatives Exchange from 2019 to 2023. The research sample was taken purposively from this population by paying attention to the predetermined inclusion criteria. In sampling, researchers considered inclusion criteria such as the availability of complete and accurate data for the period studied and relevance to the research objectives. By selecting samples purposively, it is hoped that the research results can represent the

population as a whole and provide better generalizations about the phenomenon being studied. Additionally, the use of samples that reflect variations in the population can also increase the external validity of research findings.

3.2. Research variable

The research variables in this study consist of dependent variables and independent variables which are the focus of the analysis. The dependent variable used is the price of the tin commodity futures contract, which is a variable that will be influenced by other independent variables. The price of the tin commodity futures contract was chosen as the dependent variable because it is an important measure of tin commodity market performance and is the main focus of this research analysis.

Meanwhile, the independent variables used include forward prices, inflation, interest rates and forward contract prices. The forward price is the agreed contract price for the purchase or sale of an asset in the future, which has the potential to influence the price of the tin commodity futures contract. Inflation and interest rates were chosen as independent variables because they are known to have a significant impact on the prices of financial assets including futures contracts. Meanwhile, the forward contract price is considered as an independent variable because it has a close relationship with the futures contract price and may influence the overall dynamics of the tin commodity market.

By paying attention to the relationship between the dependent variable and the independent variables studied, this research aims to identify and analyze the influence of each independent variable on the price of tin commodity futures contracts.

3.4. Data Collection Instruments and Techniques

The instruments and data collection techniques in this research rely on secondary data obtained from several trusted sources. Main data sources include the Indonesian Commodity and Derivatives Exchange (www.icdx.co.id), BAPPEBTI (www.bappebti.go.id), London Metal Exchange (www.lme.com), Bank Indonesia (www.bi.go. id), and Indonesian Securities Price Appraiser (www.ibpa.co.id). The use of secondary data from these sources was chosen because of its reliability in providing information related to tin commodity futures contracts and other independent variables relevant to this research.

The data collection process is carried out through direct access to websites and databases provided by these sources. The information obtained includes historical data on tin commodity futures contract prices, forward price data, inflation data, interest rate data, and forward contract price data within the time period specified for this research. Data collection was carried out carefully to ensure the completeness and accuracy of the data obtained.
Apart from that, researchers also ensure that the data collection process is carried out by paying attention to the policies and regulations that apply to the use of secondary data from each source. This is done to ensure compliance with ethical standards and integrity in the use of data and to maintain the credibility and validity of research results.

3.5. Data analysis method

The data analysis method used in this research is multiple linear regression. Multiple linear regression is a statistical technique that allows researchers to understand the relationship between one dependent variable and two or more independent variables. In the context of this research, multiple linear regression is used to test the relationship between independent variables, such as forward prices, inflation, interest rates, and forward contract prices, with the dependent variable, namely the price of tin commodity futures contracts.

Multiple linear regression analysis aims to measure how strong the relationship is between the independent variable and the dependent variable, as well as determining how much influence the independent variable has on the dependent variable. By using this technique, researchers can evaluate whether there is a significant relationship between the variables under study, and in what direction the relationship moves.

Data processing and analysis were carried out using the Statistical Package for the Social Sciences (SPSS) software version 18. SPSS is a software that is widely used in statistical data analysis because of its strong ability to process data efficiently and provide reliable analysis results. . By using SPSS, researchers can carry out various types of statistical analysis, including multiple linear regression, in a systematic and standardized way.

3.6. Data Validity and Reliability

Data validity and reliability are important steps in ensuring that the analysis results produced from secondary data are reliable and have accurate interpretations. Before conducting hypothesis analysis, this research tested the validity of secondary data by checking classic assumptions which include normal data distribution, absence of multicollinearity, absence of autocorrelation, and absence of heteroscedasticity.

First, the study checks the distribution of the data to ensure that the data follows a distribution that is close to normal. The normal distribution is important because most statistical methods require assumptions about normal distribution in the data. Furthermore, the study also evaluated multicollinearity, which refers to the existence of high correlation between two or more independent variables. Multicollinearity can interfere with the interpretation of regression analysis results, so it is important to check whether this occurs in the data.

In addition, the study examined the possibility of autocorrelation, that is, correlation between consecutive values in the data. Autocorrelation can occur in time series data and can affect the accuracy of parameter estimates in regression models. Finally, the study examined heteroscedasticity, which indicates that the variance of the error of the regression model varies across the range of values of the independent variables.

By examining these classic assumptions, research can ensure that the secondary data used in the analysis has high validity and reliability. This provides greater confidence in the analysis results produced and ensures that the conclusions drawn from this research can be methodologically justified.

3.7. Research Model

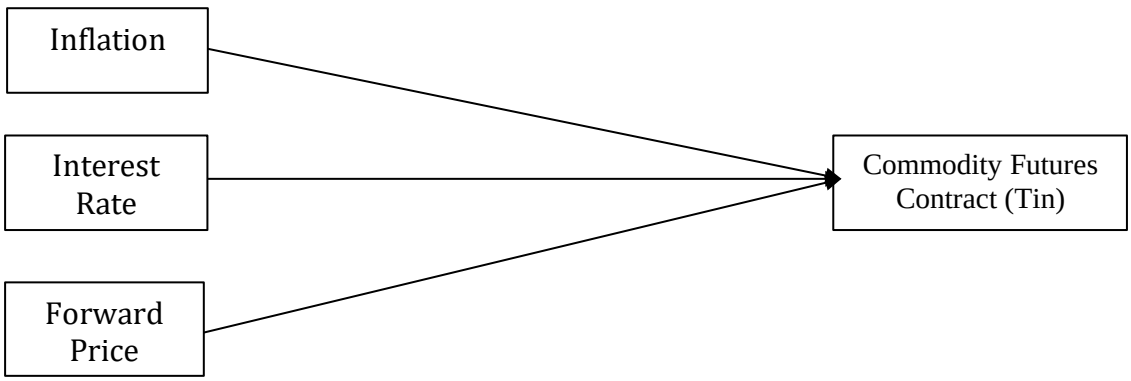

Table 3.1: Research Model

From this research model, the following research hypothesis can be drawn:
H1 : There is a significant relationship between the inflation rate and the price of tin commodity futures contracts.
H2 : There is a significant relationship between interest rates and the price of tin commodity futures contracts.
H3 : There is a significant relationship between the forward price and the price of the tin commodity futures contract.
H4 : There is a significant relationship between the inflation rate, interest rates and forward prices on the futures contract price for the tin commodity.

3.8. Variable Operational Table

No	Variable	Variable Concept	Formula
2.	Forward Price	The forward price is the agreement value to buy or sell an asset at a certain time in the future. This agreement includes the price agreed upon when the transaction is made, and the concept is related to forward contracts in financial markets. (Hull, J. C. 2001).	$Forward = \frac{P_t - P_{t-1}}{P_{t-1}} \times 100\%$
3.	Inflation	A condition in which there is a general and continuous increase in the prices of consumer goods in all economic sectors. (Fisher, 1930)	$\text{Inflation Rate} = \left(\frac{\text{CPI}_{\text{current year}} - \text{CPI}_{\text{previous year}}}{\text{CPI}_{\text{previous year}}} \right) \times 100$
4.	Interest Rates	The interest rate is the price or cost that must be paid or received in relation to the use of money, whether in the form of loans or savings. This interest rate reflects a percentage of the amount of money involved and is often measured over a certain period of time, such as annually. (Fisher, 1930)	$\text{Interest (I)} = \text{Principal (P)} \times \text{Rate (R)} \times \text{Time (T)}$
5.	Commodity Futures Contract (Tin)	A commodity futures contract is an agreement that regulates the purchase or sale of a commodity in the future at a predetermined price. The contract involves obligations for both parties, buyer and seller, to carry out transactions in the future, in accordance with the agreed terms. (Hull, J. C.2001).	$Futures = \frac{P_t - P_{t-1}}{P_{t-1}} \times 100\%$

4. Research Result

4.1. Normality test

The results of the normality test using the Kolmogorov-Smirnov method show that the data distribution for all research variables, including forward prices, inflation, interest rates, forward contract prices, and tin commodity futures contract prices, does not meet the normal distribution assumption at the 5% significance level ($p < 0.05$). This shows that the data used in this research is not normally distributed. The implication of these normality test results is that parametric statistical analyzes that require the assumption of a normal distribution may not be appropriate for use in the context of these data. Instead, non-parametric alternatives or data transformations may need to be considered to ensure the accuracy of the analysis results. However, it is important to remember that research results and their interpretation should be approached with caution and may require careful consideration regarding the limitations of this non-normal data distribution.

Table 4.1: Normality test

	Unstandardized Predicted Value	
Asymp. Sig. (2-tailed)[c]		.200[d]
Monte Carlo Mr. (2-tailed)[It is]	Say.	.662
99% Confidence Interval	Lower Bound	.650
Upper Bound		.674

In this table, the Asymp value is obtained. Sig. (2-Tailed) = 0.200 > 0.05.

So it can be concluded that the residuals are normally distributed.

4.2. Heteroscedasticity Test

The heteroscedasticity test is part of the classic assumption test in linear regression analysis. The heteroscedasticity test aims to test whether in the regression model there is an inequality of variance from the residual value of one observation to another observation. In a linear regression analysis, the expected assumption for the parameter estimation method to be BLUE (Best Linear Unbias Estimator) is to have the same/homogeneous residual (error) value, commonly known as Homoscedasticity. In a linear regression analysis, heteroscedasticity (different residual/error variance) should not occur. One way to find out whether there is heteroscedasticity in a multiple linear regression model is by looking at the scatterplot graph of the predicted value of the dependent variable, namely SRESID, with the residual error, namely ZPRED. If there is no particular pattern and it does not spread above or below zero on the y-axis, then it can be concluded that heteroscedasticity does not occur. Apart from using scatterplot graphs, heteroscedacity testing can also be done using the Glejser Test.

Table 4.2: Heteroscedasticity Test

	t
(Constant)	28.363
Inflation	-3.656
Tribe_Flowers	-.094
Price_Forward	2.464

From the Coefficients Table the following conclusions can be obtained:
In the Inflation Variable, the Sig value is obtained. = 0,178 > 0,05
In the Interest Rate Variable, the Sig value is obtained. = 0,928 > 0,05
In the Forward Price Variable, the Sig value is obtained. = 0,443 > 0,05
In conclusion, there is no heteroscedasticity.

4.3. Autocorrelation Test

A good regression model is a regression model that is free from autocorrelation.

In the classical assumption, autocorrelation is a correlation that occurs between errors/residuals in a certain period (eg t) and errors/residuals in other periods. The autocorrelation problem causes the variance formed in the simple linear regression model to not be minimal. Autocorrelation generally occurs because data in one period is influenced by data in other periods. For example, the rupiah exchange rate today is influenced by the rupiah exchange rate on the previous day.

The autocorrelation assumption is only tested on time series data or cross-sectional data which has a standard sequence pattern between observations. To find out whether there is autocorrelation, you can look at the Durbin Watson value.

The Durbin-Watson test (DW test) uses the following provisions or basis for decision making:
First determine the hypothesis, with the null hypothesis (H0) namely there is no autocorrelation and the alternative hypothesis (H1) namely there is autocorrelation.
- If the DW value < dL or DW > 4-dL
then the null hypothesis is rejected, which means there is autocorrelation.
- If the DW value lies between dU and 4-dU, namely dU < DW < 4-dU then the null hypothesis is accepted, which means there is no autocorrelation.

- If the DW (Durbin Watson) value lies between dL and dU, namely dL < DW < dU or if 4-dU < DW < 4-dL, then it does not produce a definite conclusion.

Table 4.3: Autocorrelation Test

Model Summary	
Model	Durbin-Watson
1	1.822

From the Durbin Watson Table (5% real level), with n = 40 and the number of independent variables (k) = 3, it is obtained that dL = 1.6000 and dU = 1.3384
The Durbin Watson (DW) value = 1.822 is between dU and 4 – dU.
dU< DW <4–dU
1,3384 < 1.822 < 4 – 1,3384
1,3384 < 1.822 < 2,6616
It can be concluded that there is no autocorrelation.

4.4. Multicollinearity Test

Multicollinearity means that the independent variables contained in the regression model have a linear relationship that is close to perfect (the correlation coefficient is high). A good regression model should not have high correlation between the independent variables. There are several multicollinearity test methods, namely:

a. By comparing the individual coefficient of determination (r2) with the simultaneous determination value (R2).
b. By looking at the Variance Inflation Factor (VIF) and Tolerance values in the regression model. Ways to determine whether or not there are symptoms of multicollinearity include looking at the Variance Inflation Factor (VIF) and Tolerance values. If the VIF value is less than 10 and Tolerance is more than 0.1, it is stated that multicollinearity does not occur.

Table 4.4: Multicollinearity Test

Collinearity Statistics	
Tolerance	VIF
.439	2.276
.439	2.276
.439	2.276

In the table above, the VIF value is 2,276 < 10, so it is stated that multicollinearity does not occur.

4.5. Multiple Linear Regression Analysis

Multiple linear regression analysis is a statistical technique used to test and model the relationship between one dependent variable and two or more independent variables. The main objective of this analysis is to understand how the independent variables together influence the dependent variable, as well as to identify the contribution of each independent variable in predicting the value of the dependent variable.
The multiple linear regression model is expressed in equation form:

$Y=\beta 0+\beta 1X1+\beta 2X2+\ldots+\beta nXn+\epsilon$

4.6. SPSS Output and Analysis

4.6.1. Descriptive statistics

Table 4.6.1: Descriptive Analysis

Descriptive Statistics		
	Mean	Std. Deviation
Price_Futures	16018.18	251.270
Inflation	40.218	237.172
Tribe_Flowers	120.255	140.218
Price_Forward	20505.00	4.950.941

1) Average inflation is 40,218 with a standard deviation of 237,172.
2) The average interest rate is 120,255 with a standard deviation of 140,218
3) The average Forward Price is 20505 with a standard deviation of 4,950,941
4) The average Futures Price is 16018 with a standard deviation of 251,270

4.6.2. Regression Model Fit Test (F Test)

The model suitability test (model feasibility test) or what is more popularly known as the F test is the initial stage of identifying a regression model that is estimated to be suitable for use or not. Feasible here means that the regression model is suitable to be used to explain the influence of the independent variable on the dependent variable. The name of this test is called the F test, because it follows the F distribution whose test criteria are like One Way Anova.

Table 4.6.2: Uji F

ANOVA			
Model		F	Say.
1	Regression	9.654	.003
	Residual		

Sig value. in the table above it is 0.003 < 0.05 (the level of significance used). It can be concluded that the linear regression model is suitable to be used to explain the influence of inflation, interest rates and forward prices on futures prices for tin commodities.

4.6.3. Regression Coefficient Test (t Test)

The t test in linear regression is intended to test whether the parameters (regression coefficients and constants) to estimate the linear regression equation/model are the correct parameters or not. In other words, whether these parameters are able to explain the behavior of the independent variable in influencing the dependent variable. The parameters estimated in linear regression include the intercept (constant) and slope (coefficient in the linear equation).

Table 4.6.3: Uji t

Coefficients		
Model		Say.
1	(Constant)	.000
	Inflation	.008
	Tribe_Flowers	.928
	Price_Forward	.043

1) In this table, the sig value is obtained. amounting to 0.008<0.05 on the Inflation variable. It can be concluded that the Inflation variable has a significant effect on the Futures Contract variable.

2) In this table, the sig value is obtained. amounting to 0.928 > 0.05 in the Interest Rate variable. It can be concluded that the Interest Rate variable has no significant effect on the Futures Contract variable.
3) In this table, the sig value is obtained. amounting to 0.043 < 0.05 in the Forward Price variable. It can be concluded that the Forward Price variable has a significant effect on the Futures Contract variable.

4.6.4. Coefficient of Determination

The coefficient of determination explains the variation in the influence of the independent variable on the dependent variable. It can also be said to be the proportion of influence of the independent variable on the dependent variable. The coefficient of determination value can be measured by the Adjusted R Square value.

Table 4.6.4: Coefficient of Determination

Model Summary	
Model	Adjusted R Square
1	.722

The Adj R Square value = 0.722, meaning that the contribution of the Inflation, Interest Rate and Forward Contract variables to the Futures Contract variable is 72.2%, while the remaining 28.8% is influenced by other variables not examined in this research. In other words, 72.2% of variations in Inflation, Interest Rates and Forward Contracts can be explained by variations in Futures Contracts.

4.6.5. Regression Equation or Regression Model

Table 4.6.5: Regression Equation or Regression Model

Coefficients		
Model		Unstandardized Coefficients
		B
1	(Constant)	15.861.336
	Inflation	-72.889
	Tribe_Flowers	-3.592
	Price_Forward	.024

Based on the Coefficients Table above, you can pay attention to the unstandardized coefficients column B, to prepare the following simple linear regression equation:
KF = 15.861.336 – 72.889 INF – 3.592 SB + 0,024 HF
Where :
KF = Futures Contract
INF = Inflation
SB = Interest Quarter
HF = Forward Contract Price

- The regression coefficient for inflation is – 72,889
  The regression coefficient is negative, meaning that when inflation falls, the Futures Contract will experience an increase.
  A decrease in inflation by 1 unit will increase the Futures Contract by 72,889
- The regression coefficient for interest rates is – 3.592
  The regression coefficient is negative, meaning that when interest rates fall, futures contracts will increase.
  A decrease in Interest Rates by 1 unit will increase the Futures Contract by 3,592
- The regression coefficient for Forward Contracts is 0.024

The regression coefficient is positive, meaning that when the Forward Contract rises, the Futures Contract will experience an increase.
An increase in the Forward Contract by 1 unit will increase the Futures Contract by 0.024

5. Conclusions and Recommendations

5.1. Conclusion

Based on the results of data analysis and testing carried out in this research, several main conclusions can be drawn. First, from the results of the F Test, it is known that the significance value (Sig.) is 0.003, which is smaller than the significance level used (0.05). This shows that the linear regression model applied in this research is suitable to be used to explain the influence of independent variables, namely inflation, interest rates and forward prices, on the price of tin commodity futures contracts. This model can be relied on to analyze and predict the influence of these three independent variables on the price of tin commodity futures contracts.

Furthermore, the t test results show that the inflation variable has a significance value of 0.008, which is smaller than 0.05. This means that inflation has a significant effect on the price of tin commodity futures contracts. Thus, it can be concluded that an increase in inflation tends to influence the increase in the price of tin commodity futures contracts. On the other hand, the interest rate variable has a significance value of 0.928, which is greater than 0.05. This shows that interest rates do not have a significant influence on the price of tin commodity futures contracts in this study. Meanwhile, the forward price variable has a significance value of 0.043, which is smaller than 0.05, indicating that the forward price has a significant influence on the price of the tin commodity futures contract.

From the analysis of the coefficient of determination, the Adjusted R Square value of 0.722 indicates that 72.2% of the variation in tin commodity futures contract prices can be explained by variations in inflation, interest rates and forward prices. The remaining 28.8% is influenced by other variables not examined in this research. This indicates that the linear regression model used in this research is quite strong in explaining the relationship between these variables.

5.2. Suggestion

Based on the conclusions outlined, there are several suggestions that can be given for further research as well as practical implications. First, for further research, it is recommended to consider other variables that might influence the price of tin commodity futures contracts, such as geopolitical factors, global supply and demand, as well as government policies regarding commodity trading. By adding these variables, it is hoped that the resulting model can provide a more comprehensive and accurate explanation.

Apart from that, for market players and investors, it is important to pay attention to inflation and forward price variables when analyzing and making decisions regarding investment in tin commodity futures contracts. Considering that inflation and forward prices have a significant influence, monitoring changes in these two variables can help in anticipating futures contract price movements and optimizing investment strategies.

Finally, for policy makers, the results of this research show the importance of controlling inflation in maintaining price stability for tin commodity futures contracts. Effective policies in controlling inflation can have a positive impact on the stability of commodity markets and the economy as a whole.

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