Chapter III

METHODOLOGY

A. Research Desain

This study is an associative type of research with causal relationships, where there are independent and dependent variables. Based on the data obtained, this is a quantitative research type because it involves the calculation of research data in the form of numbers. The research variables include both dependent and independent variables.

1. Dependent Variable (Y):

   The dependent variable is a type of variable that is explained or influenced by the independent variables (Creswell & Creswell, 2018), In this research, the dependent variable is monthly average Bitcoin Price .

2. Independent Variables (X):

   The independent variable is a variable that is not influenced or dependent on other variables (Creswell & Creswell, 2018),

   In this research, the independent variables are:

   a. U.S. Interest Rate (X1):

      U.S. Interest Rate includes decisions and actions by the Federal Reserve, such as adjustments in the federal funds rate and other monetary policy measures. Data on interest rates is obtained from the Federal Reserve offical website.

   b. U.S. Consumer Price Index (X2):

      The Consumer Price Index (CPI) measures the weighted average of prices of a basket of consumer goods and services. CPI data is obtained from the offical website Bureau of Labor Statistics.

B. Operational Definition

An operational definition is a set of guidelines on how to measure a variable. It serves as instructions for implementing the measurement of a variable. Operational definitions are crucial pieces of information for research employing the same variables. Below is the operational definitions for the upcoming study:

No	Variabel	Operational Variable	Indicator
1.	Dependent Variable: Bitcoin Price	Bitcoin is evaluated based on the financial metrics of Bitcoin in the market, reflecting its market value, trading volume, and volatility. (CoinMarketCap Bitcoin Historical Data) In this research, Bitcoin monthy average price data would be used From 2022	Monthly Average price, Shaen Corbet, et al (2020).
2.	Independent Variable: U.S. Interest Rate	US interest rate changes refer to adjustments in the federal funds rate set by the Federal Reserve. The federal funds rate represents the interest rate at which depository institutions lend reserve balances to other depository institutions overnight. (Mishkin, F. S. (2007). In this research, the interest rate announcements data would be used From 2022.	Monthly Federal Funds Rate, Elias Atmander (2021).
3.	Independent Variable: U.S.Consumer Price Index (CPI)	The Consumer Price Index (CPI) tracks the average price changes over time in the cost of a market basket of goods and services purchased by urban consumers. It is extensively	Monthly Consumer Price Index Rate, Roman Matkovskyy, et al. (2020).

No	Variabel	Operational Variable	Indicator
		used as an indicator of inflation and reflects the cost of living in an economy (Mankiw, N. G. (2014). In this research, the monthly rate announcements of Consumer Price Index would be used From 2022.	

C. Population and Sample:

1- Research Population

The population encompasses the entirety of all elements within a given research area (Zikmund, Wet al. (2013). Based on this definition, the population used in this study includes:

Bitcoin Prices: Monthly Bitcoin price data from January 2022 to December 2022.

U.S. Interest Rates: Announcements of U.S. interest rates by the Federal Reserve during the year 2022.

U.S. Consumer Price Index (CPI): Monthly CPI data from January 2022 to December 2022.

2- Research Sample

A sample is a subset or representative portion of the population being studied (Bryman, A., & Bell, E., 2015). This study employs time series sampling. Time series sampling is a technique of collecting data points sequentially over time at regular intervals to analyze patterns and trends (Box et al., 2015; Hamilton, 1994).

The criteria for sample selection in this study are as follows:

1. **Daily Bitcoin prices are aggregated into monthly average prices**. Monthly averages are calculated to provide a consistent time frame for comparison with CPI and interest rate data.

2. **Interest rates announced by the Federal Reserve**.
   Interest rates, which are announced by the Federal Reserve seven times in 2022, are recorded. For months without announcements, linear interpolation is used to estimate the interest rates, ensuring a continuous monthly dataset.
3. **U.S. Consumer Price Index (CPI)**.
   Monthly CPI values are taken as published to provide a regular measure of inflation.

Based on that, the sample comprises:

a. 12 Months Average Bitcoin Prices: One for each month from January 2022 to December 2022.

b. 12 Months Interest Rate Values: Including interpolated values for months without announcements : From January 2022 to December 2022.

c. 12 Months consumer price index values: From January 2022 to December 2022.

This results in a total of 36 data points used in the analysis and by incorporating these methods and referencing relevant sources, the research ensures that the data is accurate, consistent, and suitable for analyzing the impact of U.S. monetary policy changes on Bitcoin price.

D. Data Collection Methods:

a. This research was conducted through a documentation study by collecting supporting data from literature, journals, the internet, and reference books to obtain a comprehensive understanding of the researched problem. Additionally, relevant secondary data were gathered from reports published by the official following sources:

1. Federal Reserve: Interest rate announcements obtained from the official website https://www.federalreserve.gov/monetarypolicy/openmarket.htm

2. U.S. Bureau of Labor Statistics: Consumer Price Index (CPI) data accessed through their official website https://www.bls.gov/cpi/
3. Cryptocurrency Market Data: Monthly Bitcoin prices collected from reliable cryptocurrency market platform of coin marekt cap https://www.bls.gov/cpi/

b. Data Preprocessing

Data preprocessing is a crucial step in preparing the dataset for analysis. This process involves organizing, transforming, and structuring the collected data to ensure it is ready for statistical analysis. The following subsections detail the steps taken to preprocess the data on Bitcoin prices, Consumer Price Index (CPI), and Interest Rates for the year 2022.

1- Linear Interpolation for Interest Rates

Linear interpolation is a mathematical method used to estimate unknown values that fall between two known values. This method is particularly useful in financial analysis when dealing with data reported at different frequencies (Burden, R. L, et al. (2010). Linear interpolation assumes that the change between two known values is linear and uses this assumption to fill in the gaps. The formula for linear interpolation is:

$$Interpolated\ Value = Value\ previous + ((Value\ next - Value\ previous)/2)$$

In this research, linear interpolation was applied to align the bimonthly interest rate data with the monthly Consumer Price Index (CPI) and Bitcoin price data. Since the Federal Reserve announces interest rate changes bimonthly, there are gaps in the monthly data series. By using linear interpolation, these gaps were filled to create a complete set of 12 monthly interest rate values for the year 2022. This approach ensures that the interest rate data is consistent with the monthly frequency of the CPI and Bitcoin price data, allowing for a comprehensive analysis of their combined effects on Bitcoin price.

2- Monthly Aggregation of Bitcoin Prices

Monthly aggregation is a technique used to summarize daily data into monthly data points. This process is commonly used in financial and economic research to reduce the complexity of data analysis and to align data with other monthly indicators (Jolliffe, I. T. (2002). The formula for calculating the monthly average price is:

Monthly Average= ∑Daily Prices / Number of Days in Month

In this study, the daily Bitcoin prices from January 2022 to December 2022 were aggregated to calculate the monthly average prices. This aggregation aligns the Bitcoin price data with the monthly CPI and interpolated interest rate data, providing a single representative price for each month. This method simplifies the analysis by reducing the number of data points and making the data comparable across the different variables.

E. Data Analysis Techniques

The data analysis was conducted by directly examining and understanding the available data. Additionally, the analysis was performed using the computer software SPSS 25.0 for Windows.

1. Classical Assumption Test

The multiple regression model previously described must meet the classical assumption requirements, which include:

a. Normality Test

The normality test assesses whether the independent and dependent variables, or both, in a regression model follow a normal distribution. The ideal model is characterized by data distributions that are normal or close to normal. Normality in the data can be identified by examining the shape of the histogram curve,which should be symmetrically balanced on the left and right sides and bell-shaped.

Alternatively, normality can be assessed by examining the data points' distribution around the diagonal line in a Normal P-Plot (Field, A. (2013).

b. Multicollinearity Test

This test is employed to ascertain whether there exists a correlation among the independent variables within a regression model. The presence of such correlation indicates multicollinearity. A robust regression model should ideally not exhibit significant correlation among its independent variables. (Kutner, M. H. et al., 2005). Multicollinearity is assessed using the Variance Inflation Factor (VIF) method, which follows these criteria:

1- If VIF > 10, there is a multicollinearity problem.
2- If VIF < 10, there is no multicollinearity problem.

d. Autocorrelation Test

The autocorrelation test evaluates whether there is a correlation between the residuals in a linear regression model at time t and the residuals at time t-1 (Durbin, J., & Watson, G. S. (1950)). A robust regression model should ideally not show autocorrelation. The Durbin-Watson test is employed to diagnose the presence of autocorrelation in a regression model. According to Durbin, J., & Watson (1950, 37(3-4), the decision rules for the presence of autocorrelation are as follows:

1. A D-W value below -2 indicates positive autocorrelation.
2. A D-W value between -2 and +2 indicates no autocorrelation.
3. A D-W value above +2 indicates negative autocorrelation.

e. Heteroscedasticity Test

Heteroscedasticity refers to the condition where the variance of the residuals is not constant across observations, violating the assumption of homoscedasticity, which states that the variance should be constant. Heteroscedasticity can be tested using the Glejser test, which involves checking the significance values. If the

significance value is above the α=5% levelTherefore, we can conclude that the regression model does not exhibit heteroscedasticity. (Glejser, H. 1969: 64 (325).

2, Analysis Multiple Linear Regression

Multiple linear regression is used to test the third hypothesis, which aims to determine the impact of the Consumer Price Index (CPI), Interest Rates, and their combined effect on Bitcoin Price. This analysis seeks to find the functional relationship between all predictors and the criterion variable. Additionally, it It evaluates the relative and effective contribution of each predictor variable to the criterion variable (Kutner, M. H. et al., 2005). Multiple linear regression is employed to analyze how independent variables influence the dependent variable, specifically : the level of CPI, Interest Rates, and their combined effect on Bitcoin Price. The regression model used is:

$$Y=a+b_1X1+b_2X2+e$$

Explanation:

1- **Y** = Bitcoin Price
2- **a** = Constant term (value of Y when X = 0)
3- **b1 =** Regression coefficient of Interest Rate
4- **b2** = Regression coefficient of CPI
5- **X1** = First independent variable (Interest Rates)
6- **X2** = Second independent variable (CPI)
7- **e** = Standard error

4. Hypothesis Testing

The steps for hypothesis testing are as follows:

A. Partial Test (t-test)

The reliability of multiple regression as an estimation tool is significantly determined by the significance of the parameters, specifically the regression coefficientsThe t-test is utilized to assess the

significance of individual regression coefficients for the independent variables (Wooldridge, J. M. (2013).

$$t = \frac{r(\sqrt{n} - 2}{(\sqrt{1} - r^2)}$$

Explanation:

1- **t** = t-value
2- **r** = correlation coefficient
3- **n** = sample size

The formulation for the t-test is as follows:

1- If the calculated $\mathbf{t}_{calculated} \geq \mathbf{t}_{critical}$, then the null hypothesis (Ho) is rejected. This means the independent variable has a significant partial effect on the Bitcoin price.
2- If the calculated $\mathbf{t}_{calculated} < \mathbf{t}_{critical}$, then the null hypothesis (Ho) is accepted. This means the independent variable does not have a significant partial effect on the Bitcoin price.

B. Simultaneous Test (F-test)

The significance of multiple regression is evaluated using the F-test. The F-test assesses the collective impact of all independent variables on the dependent variable simultaneously. The formula for the F-test, as proposed by Greene, W. H. (2012:7), is as follows:

$$F_{reg} = \frac{R^{2\,(N-m-1)}}{m(1-R^2)}$$

Where:

1- ***F*** = F-value
2- ***N*** = number of samples
3- ***m*** = number of predictors

4- ***R*** = correlation coefficient between the criterion and predictors.

B. The F-test is formulated as follows:

1- If the calculated $\mathbf{F}_{calculated} \geq \mathbf{F}_{critical}$, then the null hypothesis (H0) is rejected, indicating that the independent variables collectively have a significant simultaneous effect on the dependent variable.

2- If the calculated $\mathbf{F}_{calculated} < \mathbf{F}_{critical}$, , the null hypothesis is accepted, indicating that the independent variables collectively do not have a significant simultaneous effect on the dependent variable.

C. The coefficient of determination (R^2)

is used to assess the extent to which independent variables collectively explain the dependent variable and their potential influence can be determined by the magnitude of the R^2 value. This value is formulated as:

$$R^2 = 1 - \frac{\sum(Y - Y)^2}{\sum(Y - Y)^2}$$

The R^2 value is utilized to understand the contribution of the independent variables studied to the dependent variable. If R^2 increases (approaching one), then the contribution of the independent variables to the dependent variable increases. Conversely, if R^2 decreases (approaching zero), then the contribution of the independent variables to the dependent variable diminishes. Therefore, the R^2 value ranges between 0 - 1, or $0 < R^2 < 1$ (Cohen, J.,2003:3rd).