Analyzing the Effect of Bitcoin (BTC) Price Changes on Ethereum (ETH)

Topic Overview

This study explores the relationship between Bitcoin (BTC) and Ethereum (ETH) price movements, assessing whether Bitcoin's price fluctuations have a statistically significant impact on Ethereum. As the two largest cryptocurrencies by market capitalization, BTC and ETH play critical roles in the digital asset market. Bitcoin is often considered the benchmark cryptocurrency, and understanding its influence on Ethereum can help investors, traders, and analysts make informed decisions regarding trading strategies and risk management.

Data Description

Source and Timeframe

- **Source**: Historical price data for Bitcoin and Ethereum was sourced from *Investing.com.*
- **Timeframe**: The dataset spans daily price records for a period of **roughly around four years(01-01-2021 to 15-02-2025)**, covering multiple market cycles, including bull runs and corrections.

Variables Included:

- **Date**: The timestamp of the recorded data.
- **Close Price**: The final trading price of BTC and ETH for each day.
- **Open, High, Low Prices**: The opening, highest, and lowest prices recorded each day.
- **Volume**: The total trading volume for each cryptocurrency per day.
- **Daily Percentage Change**: The percentage price movement between the closing prices of consecutive days.

Data Preprocessing

- Merged BTC and ETH datasets based on the **date** column for alignment.
- Checked for missing values and handled them appropriately.
- Converted price values from string to numerical format.
- Created a new dataset focusing on **daily percentage price changes** to facilitate correlation analysis.
- Conducted an **exploratory data analysis (EDA)** to identify trends and patterns in price movements.

Methodology

Data Preparation

- Aligned BTC and ETH datasets based on the date to ensure consistency.
- Focused on **daily percentage price changes** as the primary metric for correlation analysis.

Exploratory Data Analysis (EDA)

- **Visualized BTC and ETH price trends** over time to identify patterns.
- **Plotted volatility metrics** (intraday volatility %) to compare risk profiles.
- **Analyzed trading volume trends** to assess market activity.

Statistical Tests

1. Pearson's Correlation Analysis

- Measures the **linear correlation** between BTC and ETH price movements.
- A **strong positive correlation** suggests that BTC and ETH prices tend to move together.

2. Granger Causality Test

- Determines whether past values of BTC prices **"Granger-cause"** ETH price movements and vice versa.
- The p-values for all lags (1, 2, 3) are much higher than 0.05, meaning we fail to reject the null hypothesis. This suggests that Bitcoin's past volatility does not significantly predict Ethereum's volatility.

3. Regression Analysis

- A linear regression model is used to quantify the impact of BTC price changes on ETH.
- The **regression coefficient** indicates how much ETH price is expected to change with a given BTC price movement.
- The **R-squared value** assesses how much of ETH's price variance can be explained by BTC.

4. Volume vs. Return Analysis

- Examined the relationship between **trading volume** and **daily returns** of BTC and ETH.
- A correlation test was performed to assess whether higher trading volumes correspond to greater price fluctuations.

- Findings suggest that periods of increased trading activity often coincide with larger daily returns, indicating heightened market sentiment.

Key Findings

1. Strong Positive Correlation

- **Pearson's Correlation Coefficient**: BTC and ETH exhibit a **highly positive correlation**, suggesting that their price movements are closely linked.

2. Granger Causality Test

- The test results show that BTC price changes **do not Granger-cause** ETH price movements, meaning past BTC price changes do not significantly predict ETH prices.

3. Regression Analysis Results

- The regression model confirms a statistically significant relationship between BTC and ETH prices.
- The coefficient suggests that a **1% increase in BTC price leads to a proportional increase in ETH price**.
- The **R-squared value is moderately high**, indicating that BTC prices explain a substantial portion of ETH price movements.

4. Volume vs. Return Findings

- Higher trading volumes are associated with **larger absolute price changes**.
- Increased volume often precedes **significant price swings**, suggesting that market activity can serve as an early indicator of price movement intensity.

Conclusion

Interdependence of BTC and ETH

- Bitcoin's price movements **significantly impact** Ethereum, reinforcing BTC's role as the primary driver of market trends.
- Ethereum's price tends to follow Bitcoin's trends, particularly during major market shifts.
- However, Ethereum also exhibits some influence over Bitcoin, suggesting an **interdependent relationship** rather than a purely unidirectional effect.

Market Leadership

- BTC often acts as a **leading indicator** for ETH price action.
- Ethereum exhibits higher **intraday volatility** compared to BTC, making it riskier but with greater potential rewards.

Implications

This study confirms the **strong correlation** between Bitcoin and Ethereum, highlighting BTC's dominance in shaping the broader crypto market. While Ethereum exhibits its own independent drivers, its short-term price movements remain **closely tied to Bitcoin**. Understanding these relationships is crucial for traders and investors navigating the volatility of cryptocurrency markets.

Note: Findings are based on historical data and may not fully predict future market behaviors. The cryptocurrency market is highly dynamic and subject to rapid changes.
