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Exploring the Interplay of Nickel and Gold Price Dynamics an their Impact on Cryptocurrency Markets: A Comprehensive Analysis From 2018 to October 2023

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Abstract

The growing demand for mining raises environmental and energy efficiency concerns. Researchers are investigating the potential impact of nickel, a crucial component in batteries used for mining, on cryptocurrency prices. This is significant because the rise of cryptocurrencies and the global adoption of blockchain technology present challenges and opportunities for the energy sector, driven by the higher energy demand for mining activities. The associated blockchain technology creates challenges and opportunities for the energy sector due to increased energy demand for mining activities, potentially straining local power capacity and escalating electricity rates. Using quantitative methods, this research evaluates the impact of nickel and gold prices, either simultaneously or partially on cryptocurrency prices spanning from 2018 to October 2023. Daily closing prices of Nickel Futures (NICKELc1 Index), Gold (GCZ3 Index), and Bitcoin, were collected, forming a dataset with 1213 entries. esearchers, using a multiple regression model, found that both nickel and gold prices together significantly influence cryptocurrency prices by 80%. Individually, both nickel and gold prices also have a significant impact on cryptocurrency prices. In future research, consider incorporating other renewable commodities that play a crucial part in promoting sustainability, reducing dependence on finite resources, and fostering a cleaner energy ecosystem.

Keywords: *Cryptocurrency, Bitcoin, Nickel, Gold*

1. Introduction[1]

The desire for economic growth shared by every country is closely linked to the importance of investment or capital. Economic theory emphasizes that investment plays a pivotal role in fostering growth by accumulating capital from the financial sector. The development of the financial sector becomes crucial as it serves to channel funds into the productive sector to cover investment costs, ensuring efficient resource allocation that contributes to increased productivity (Ikhsan & Satrianto, 2023). This connection is particularly relevant when considering the global shift toward low-carbon energy, where nickel emerges as one of the crucial metals (Wang et al., 2022). In recent years, there has been a significant increase in global temperatures as a result of the growth in the load and consumption of fossil fuels. The two main sources of pollution that contribute to climate change are conventional power plants and vehicles. Various studies suggest solutions to overcome this environmental problem through replacing conventional vehicles with electric and hybrid vehicles (EV and HV), as well as increasing the use of renewable energy (Jirdehi & Tabar, 2023).

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New Energy Vehicles (NEV), such as Electric Vehicle (EV), become more widely used, the need for batteries with high energy density is growing. In 2021, global electric vehicle (EV) purchases recorded to 6.6 million units from 3 million in the previous year, putting the electric vehicle market share at 9%, according to data from the International Energy Agency (IEA). These statistics contributed to the growth in total car sales worldwide which reached 66.7 million that year, an increase of 63.8 million in 2020 (World Economic Forum, 2022). Global demand for Li-ion batteries is projected to increase rapidly from around 700 GWh in 2022 to around 4.7 TWh in 2030, with electric vehicles (EVs) playing a major role in the increase (Fleischmann et al, 2023). The rise in nickel content within nickel-rich materials results in greater battery capacity, but it also introduces a range of issues that impact battery performance (Li et al.,2023). The use of nickel as a crucial component in electric vehicle lithium-ion batteries recorded global demand of around 60,000 metric tons in 2018, with a projected tenfold increase to around 665,000 tons in 2025 (Statista, 2023).

Currently, global trade protectionism and geopolitical conflicts are increasing which have an impact on the development of the nickel trade network. Over the 2001–2021 period, there has been an increase in structural resilience in the nickel trading network, however, the network is at risk of being paralyzed if 10%–20% of its nodes are intentionally attacked (Yu et al.,2023). Global demand for Nickel is increasing with the transition to a zero-emission economy, especially related to electric vehicles and batteries related to renewable energy. A deep understanding of current Nickel mining and resources is critical to supporting this transition, addressing potential environmental, social and governance challenges that may arise in future and current Nickel mining development and operations (Mudd & Jowitt, 2022).

Deep transformation in the electricity sector towards the use of alternative and renewable energy involves more than simple decentralization efforts. Blockchain technology, although often associated with cryptocurrencies such as Bitcoin (BTC), has great potential in responding to energy sector challenges, including the push for decentralization, the need for continuous configuration, and increased resilience (Teufel et al, 2019). The blockchain technology that is the basis of cryptocurrencies has expanded its functionality and is applied in a variety of contexts, including smart contracts, trading and data management, governance, and digital ownership. The blockchain system adopts distributed ledger technology which allows cryptocurrency transactions to be carried out directly between buyers and sellers. This transaction data is stored digitally in a distributed ledger that can be accessed by the public permanently without requiring authorization from any central party (Hasani et al., 2018).

Bitcoin (BTC), as the first cryptocurrency, was launched in 2008 by an entity using the pseudonym Satoshi Nakamoto. The presentation of this new concept at the same time as the epicenter of the 2008–2010 global financial crisis does not appear to have occurred by chance. This incident was related to the central bank's response to increasing the monetary base by printing money massively, which then increased confidence in conventional fiat currencies. Bitcoin (BTC) adopts the familiar peer-to-peer network protocol and public and private key cryptography techniques, and introduces a new context mechanism called "Proof of Work". The philosophy behind Bitcoin (BTC) is to provide a tool that allows people to make transactions and trust each other over the internet without relying on a central management institution. This concept shifts trust from the state or central bank to the technology itself. (Wątorek et al., 2021).

The rising popularity of cryptocurrencies, notably Bitcoin (BTC), and the associated blockchain technology create challenges and opportunities for the energy sector due to increased energy demand for mining activities, potentially straining local power capacity and escalating electricity rates (Clark & Greenley, 2019). Although energy consumption associated with the cryptocurrency industry has been the focus of significant attention in recent years, literature covering the assessment of the impact of mining activities and cryptocurrency transactions on environmental degradation is still limited (Erdogan et al., 2022). The number of publications about blockchain technology in the energy sector has increased, especially since 2018, indicating that combining blockchain technology with the energy sector is a new cross-cutting research area that is gaining increasing attention (Wang & Su, 2020).

Bitcoin (BTC), as one of digital commodities (Rotta & Paraná, 2022), presents unique opportunities and challenges in the evolving landscape of global finance. Examining its connection to nickel, especially in the context of renewable energy and technological advances, adds another layer of complexity to the narrative. In 2022, Siraj Raval gained attention for utilizing his electric car (Tesla Model 3) for cryptocurrency mining (Sigalos, M., 2022), while Tesla, Block, and Blockstream collaborated to establish a solar-powered Bitcoin (BTC) mining facility in Texas. Tesla is constructing the solar infrastructure and supplying Megapack batteries. This follows Block and Blockstream's June 2022 announcement about creating a solar-driven Bitcoin (BTC) mining facility in the U.S. The energy-intensive nature of Bitcoin (BTC) mining led Tesla to suspend Bitcoin (BTC) payments for cars in May 2021 (Sriram, A., 2022). This phenomenon has piqued the researcher's interest in investigating the relationship between nickel as a primary raw material in electric car batteries and cryptocurrency prices. In academic fronts, the importance of cross-disciplinary research is crucial in fully understanding the complex and diverse dynamics between alternative energy and cryptocurrency markets; Interdisciplinary collaboration between financial, economic, environmental, and computer scientists is needed to develop innovative methodologies capable of integrating data from multiple sources, including energy markets and blockchain transactions (Naeem et al., 2023).

In response to the environmental and energy efficiency concerns associated with mining, researchers have introduced the gold indicator. Gold is regarded as a commodity that not only influences economic activity but also offers investment benefits, demonstrating resistance to inflation. Moreover, there exists a significant relationship between the price movements of gold and Bitcoin (BTC) in the intraday period (Mensi et al., 2019). The inclusion of gold in the study is motivated by its effectiveness in providing diversification within an investment portfolio (Šoja, 2019). This addition is crucial as it expands the scope of considerations in addressing the challenges and opportunities posed by the growing demand for mining in the cryptocurrency and blockchain sectors.

2. Literature Review

Mining digital currencies, such as Bitcoin, through financial technology applications carries potential risks related to "energy consumption and environmental impact." This mining process requires powerful computers with high computing power and consumes significant electricity, which can raise environmental sustainability concerns. Non-renewable energy sources, such as fossil fuels, are often used in mining, causing greenhouse gas emissions and exacerbating climate change. Additionally, the use of mining hardware can also lead to the extraction of raw materials with environmental impacts, including habitat destruction and

pollution. Evaluations of the extent of renewable energy use in Bitcoin mining vary, with a December 2019 report indicating that around 73% of Bitcoin's energy consumption is carbon neutral, while CCAF's September 2020 estimate was closer to 39%. The Bitcoin network's large power consumption, especially in areas where most mining facilities are located that use coal-fired electricity, could lead to a significant carbon footprint and serious environmental consequences in the long term.

In 2020, there was a significant paradigm shift in the cryptocurrency market in line with the Covid-19 pandemic. Previously, cryptocurrencies showed no correlation with traditional markets, but during the year, Bitcoin (BTC) and Ethereum prices suddenly correlated with conventional financial instruments such as fiat currencies, stock indices, and commodities. This correlation initially emerged in supposedly safe instruments, such as the Japanese yen, but also extended to riskier instruments such as the S&P500 and conventional currencies, even during the recovery and slowdown phases of the pandemic. This phenomenon indicates a shift in the market's perception of crypto, no longer as a haven, but rather as an integral part of the global market network, and important questions arise about whether this change is temporary or reflects market maturity that will continue in the future (Wątorek et al., 2021).

Cryptocurrencies attract many investors to engage in various crypto investments. This also make for some researchers who conduct numerous studies due to the volatility of the crypto market. For instance, some reason that volatility in Bitcoin (BTC) Market happened, by Bakas et al. (2022) say that the most important factors are Google trends, total circulation of Bitcoin (BTC)s, US consumer confidence and the S&P500 index. There is also research on similar asset classes as non-traditional assets, conducted by Kristjanpoller et al. (2019), found heterogeneity in the cross-relationships between different cryptocurrencies and stocks in the stock exchange. However, Ferreira et al. (2019) discovered that despite the considerable heterogeneity within cryptocurrencies, it differs significantly from the traditional equity market, which follows a random walk behaviour.

According to Stoll et al. (2017), the booming of cryptocurrency price in 2017 reached all-time highs, with the value of a mined Bitcoin (BTC) around $1.000 in the early 2017 but peaked at $20.000 by the end of the year. The high prices, driven by the increasing number of people engaging in mining, lead to the development of mining equipment aimed at improving mining efficiency itself. However, the development of these mining tools gives rise to energy consumption, De Vries (2018). The rising of energy consumption has caused concern for some researchers to research about new energy of Nickel impact to cryptocurrency prices because Nickel is the main ingredients for making battery. For example, Symitsi and Chalvatzis (2018) see the return and volatility transfer from technology and renewable energy equities to Bitcoin (BTC) prices. The findings point to the existence of bidirectional volatility linkages, in which short-term volatility flows from technology stocks to Bitcoin (BTC) and long-term volatility flows from Bitcoin (BTC) to underlying stock indices. Ji et al. (2019) also uses a variety of centrality measures to investigate the information spillovers between cryptocurrency markets and several commodity markets, including energy commodities. The findings show that there are temporal variations in the information spillovers between cryptocurrency and commodities.

In particular, the results highlight the tenuous relationships that exist between cryptocurrencies and energy commodities including natural gas, heating oil, crude oil, and unleaded gas. Likewise, Rehman & Vo (2020) make research about cryptocurrency and precious metals commodities (gold, silver, copper, platinum, palladium, nickel with 6 cryptocurrencies) under different

market conditions. Positive correlations are found in normal markets, potentially reducing diversification benefits, while negative correlations in extreme negative returns suggest increased diversification benefits. Breaking correlations into quantiles provides insights for investors, showing dynamic distribution patterns. Besides that research, Naeem et al. (2023), investigate the dependence between cryptocurrencies and the alternative energy market (clean energy metals such as Copper, Cobalt, Nickel, and aluminium), this research shows that there must be a new methodologies to understand the linkages between cryptocurrencies and alternative energy markets.

All these Research, made us want to analyse the relationship between nickel, gold and Bitcoin (BTC) as a cryptocurrency in more depth using the multiple regression analysis method. From the description above, a hypothesis can be made:

H1: *Nickel prices positive and significant effect on Bitcoin (BTC) prices.*
H2: *Gold prices positive and significant effect on Bitcoin (BTC) prices*
H3: *Nickel and gold prices jointly positive and significant effect on Bitcoin (BTC) prices*

3. Research Methodology

This research uses quantitative data, which was obtained through quantitative application research methods with random sampling, research instruments for data collection, and statistical analysis to test hypotheses and present data in numerical form (Sugiyono, 2014).

Data collection was carried out through literature observation and documentation methods. The Library Study Method is used to study theories and related materials in books, journals, articles and other relevant references related to the research title. Meanwhile, the Documentation Method is used to collect data or documents. In this context, the data collected includes, among other things, the daily closing price of Bitcoin (BTC) from coinmarketcap.com, as well as the daily closing price of Nickel (NICKELc1 Index) and Gold (GCZ3 Index) from Investing.com.

The analysis technique applied in this research is the Multiple Regression Analysis model, which is used to distribute the relationship between several independent variables and the dependent variable. Through this method, the research aims to understand the impact of various factors on the dependent variable, providing comprehensive insight into the interconnections in the data analyzed.

4. Result and Discussion

4.1. Multiple Regression Analysis

According to Tufte, et al. (1979), multiple regression analysis is a statistical method used to model a quantitative outcome variable from one or more regressor variables in the behavioural, educational, and social sciences. It is an extension of the simple linear regression model and is commonly used to analyse relationships between variables when there are multiple regressors involved. Researchers using this tool to understand its various aspects that crucial for obtaining accurate and reliable results. In this scenario, multiple regression analysis is utilized to investigate whether nickel and gold prices have an impact on the price of Bitcoin (BTC). Below are the results of the multiple regression analysis test that the researcher has conducted.

Table 4.1: Multiple Regression Analysis Test Result.

Coefficients[a]					
Model	**Unstandardized B**	**Coefficients Std. Error**	**Standardized Coemcients Beta**	**t**	**Sig.**
(Constant)	-213.371	6.036		-35.349	.000
SORT_NICKEL	1.017	0.032	0.547	31.582	.000
SQRT_GOLD	4.931	0.198	0.431	24.897	.000

a. Dependent Variable: Sqrt_Btc.

Based on the Table Above, the Regression Equation We Get is.

Y= -213.371 + 1.017X1 + 4.931X2

The equation above shows the influence of the independent variables (nickel price (X1) and gold price (X2)) on the dependent variable (Bitcoin (BTC) price (Y)). The equation above illustrates the influence of independent variables (nickel prices, denoted as X1, and gold prices, denoted as X2) on the dependent variable (Bitcoin (BTC) prices, denoted as Y). The constant term (a) has a negative value of 213.371, indicating an inverse relationship between the independent and dependent variables. When both nickel (X1) and gold (X2) prices are zero, the average Bitcoin (BTC) price (Y) is estimated to be -213.371. The regression coefficients for both X1 and X2 are positive, the positive sign indicates a positive relationship between the independent variables and the dependent variable, with values of 1.017 and 4.931, respectively. This suggests that a 1% increase in nickel or gold prices is associated with an expected increase in Bitcoin (BTC) prices by 1.017 or 4.931, respectively. If we observe a specific month and notice that the price of nickel (X1) increases by 1%, we can use the coefficient to estimate its impact on the price of Bitcoin (BTC) (Y). With 1.017 × 1, we estimate that the price of Bitcoin (BTC) will increase by approximately 1.017%. Conversely, if we observe that the price of gold (X2) increases by 1%, we can use the coefficient for X2 to estimate its impact on the price of Bitcoin (BTC) (Y). With 4.931 × 1, we estimate that the price of Bitcoin (BTC) will increase by approximately 4.931%.

Simultaneous Regression Test (F-Test)

ANOVA[a]						
	Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	1480857.894	2	740428.947	2418.971	.000[b]
	Residual	370371.946	1210	306.093		
	Total	1851229.840	1212			

a. Dependent Variable: Sqrt_Btc,
b. Predictors: (Constant), Sqrt_Gold, Sqrt_Nickel.

The F-test is used to determine whether the independent variables have an influence together or simultaneously on the dependent variable. Based on the table above, the p-value (sig.) of Nickel is 0.000 < 0.05 so, it can be concluded that H0 is rejected and shows that the independent variables (nickel and gold prices) simultaneously influence the price of Bitcoin (BTC). Therefore, the requirements for interpreting the value of the coefficient of determination in multiple regression analysis have been fulfilled.

4.2. Hypothesis Testing

Coefficient of Determination (R^2)

Quantifying the percentage of the dependent variable's variation that can be predicted from the independent variables is known as the coefficient of determination, or R-squared or R2. It

gauges the model's goodness of fit and is clearly defined in linear regression models. R-squared has a range of 0 to 1, with 1 being an ideal match. It is frequently used in regression analysis to evaluate the model's performance. To account for heteroscedasticity and covariance among observations, there are several suggestions and discussions over how to extend the R2 statistic to various regression models, such as generalized linear mixed models. (Chicco, et al., 2021). Below are the results of the coefficient of determination that the researcher has conducted.

Table 4.4: Parameter Estimation.

Model Summary									
Model	**R**	**R Square**	**Adjusted R Square**	**Std Error of the Estimate**	**R Square Change**	**Change Stanstics**			**Sig. F Change**
						F Change	df1	df2	
1	0,894[a]	0.800	0.800	17.49550	0.800	2418.971	2	1210	.000

a. Predictors: (Constant) Sqrt_Gold. Sqrt_Nickel.

Based on the table above, we can extract several important pieces of information regarding the relationship between nickel and gold prices with Bitcoin (BTC) prices. Firstly, the correlation coefficient (R) value of 0.894 indicates a strong correlation between nickel and gold prices with Bitcoin (BTC) prices. The positive regression coefficients affirm a positive relationship between the dependent variable (Bitcoin (BTC) prices) and the independent variables (nickel and gold prices). Furthermore, the R Square value (coefficient of determination) of 0.800 explains that collectively, nickel and gold prices can account for 80% of the variation in Bitcoin (BTC) prices. The remaining approximately 20% might be influenced by other unobserved factors not included in the model. Adjusted R Square provides similar information, indicating that around 80% of the variability in Bitcoin (BTC) prices can be explained by nickel and gold prices, assuming relevant variables have been included in the model. Lastly, the standard error value of 17.49550 provides insight into how well the model can predict Bitcoin (BTC) prices. A lower standard error implies a better ability of the model to predict actual values. Therefore, this value indicates that the regression assumption error in predicting Bitcoin (BTC) prices is around 17.49550.

Partial Regression Test (T-Test)

Table 4.4: T-Test Result.

Coefficients[a]					
Model	**Unstandardized B**	**Coefficients Std. Error**	**Standardized Coemcients Beta**	**t**	**Sig.**
(Constant)	-213.371	6.036		-35.349	.000
SORT_NICKEL	1.017	0.032	0.547	31.582	.000
SQRT_GOLD	4.931	0.198	0.431	24.897	.000

a. Dependent Variable: SQRT_BTC.

Statistical Test t the t-test is used to determine whether the independent variables have an individual or partial influence on the dependent variable. Based on the t-statistic results in the table above, we can assess the individual influence of independent variables on the dependent variable. Firstly, for the variable SQRT_NICKEL (nickel prices), a p-value (sig.) of 0.000 was obtained, which is below the significance level of 0.05. This indicates the rejection of the null hypothesis (H0), and therefore, it can be concluded that there is a significant influence of nickel

prices on Bitcoin (BTC) prices. This finding also aligns with prior research conducted by Naeem et al. (2023), indicating a high correlation between nickel and cryptocurrency through econometric estimation methods. Dependency is estimated using a conditional joint distribution that varies across the entire market.

Furthermore, for the variable SQRT_GOLD (gold prices), the p-value (sig.) is also 0.000, which is below the 0.05 significance level. Thus, the null hypothesis (H0) for the gold variable can also be rejected. The conclusion is that there is a significant influence of gold prices on Bitcoin (BTC) prices. With these findings, we can infer that both nickel and gold prices have a significant individual influence on Bitcoin (BTC) prices. This finding also supports previous research conducted by Jareño et al. (2020), where the non-linear ARDL analysis revealed a consistently positive and statistically significant correlation between Bitcoin (BTC) and gold price returns across various time periods. Furthermore, the study observed cointegration in both long-term and short-term relationships, with asymmetrical responses and a significant impact of cumulative changes in gold prices on Bitcoin (BTC) returns.

These results not only validate but also complement the existing knowledge in the academic literature regarding the correlation between Bitcoin (BTC) and gold prices. This analysis supports the earlier results from the simultaneous test (F-Test) and regression coefficients, indicating that both variables contribute positively and significantly to changes in Bitcoin (BTC) prices.

5. Conclusion

Based on the multiple regression analysis of Bitcoin (BTC) prices with the independent variables of nickel and gold prices, it can be concluded that there is a significant positive influence from both factors on Bitcoin (BTC) prices, individually. The regression coefficient for nickel prices indicates that a 1% increase in nickel prices is followed by approximately a 1.017% increase in Bitcoin (BTC) prices, while gold prices have a stronger impact with an increase of about 4.931% under similar circumstances. The simultaneous F-test verifies that, collectively, this regression model has high significance in explaining the variation in Bitcoin (BTC) prices. Although this model can account for around 80% of the variation in Bitcoin (BTC) prices, the remaining portion is likely influenced by external factors not included in this study.

For future research, it is recommended to consider the inclusion of additional variables such as macroeconomic factors or market sentiment to enhance the complexity and accuracy of the model. Analysis during specific periods experiencing significant market changes could be an interesting research area. The development of a dynamic model that considers changes in market trends over time is expected to provide a more accurate picture of Bitcoin (BTC) prices. Causality testing and the development of investment strategies based on this model could also offer deeper insights and added value for investors. Thus, further research is expected to deepen the understanding of the factors influencing the dynamics of Bitcoin (BTC) prices in the context of their relationship with nickel and gold prices. Additionally, including other renewable commodities in this research will play an important role in promoting sustainability, reducing dependence on limited resources, and fostering a cleaner energy ecosystem. Further research is expected to deepen understanding of the factors that influence Bitcoin (BTC) price dynamics in the context of its relationship with nickel and gold prices.

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