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Examining the Determinants of the Demand for Bitcoin: Is Monetary Policy a Significant Factor?

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Abstract. *This study addresses the escalating Bitcoin trading volumes in Egypt, leading to unprecedented price levels. In the absence of prior studies into the determinants of Bitcoin prices in Egypt, the paper evaluates the impact of monetary policies, specifically those related to money supply and interest rates, on Bitcoin prices. The analysis also incorporates determinants of other local investment assets, such as gold and stocks, considering Bitcoin as an alternative investment avenue. Utilizing time series analysis and co-integration models (ARDL, ECM and GARCH) with monthly data from January 2015 to June 2023, the study reveals a positive correlation with money supply (M2), EGX30 index investments, and global Bitcoin prices. Conversely, no statistically significant relationship is observed for the real interest rate and gold pound price. This outcome suggests that Bitcoin usage in Egypt primarily serves portfolio diversification and seeks quick and substantial returns, rather than functioning as an inflation hedge or haven.*

Keywords: Bitcoin Price, Cryptocurrency, Gold, Investment Assets, Monetary Policy.

JEL Codes: G12, E42, E44.

Introduction

The global financial crisis in 2008 is considered a turning point and part of the reason for the development of financial technology into a new paradigm, with the emergence and appearance of Bitcoin in 2009, by an individual or group known under the pseudonym Satoshi Nakamoto (2008). It was the first cryptocurrency, marking the inception of the first decentralized currency. Designed without the oversight of central banks, Bitcoin relies on Blockchain[1]. The cryptocurrency trading platform Mt.Gox was launched in July 2010. Notably, from 2011 to 2013, Bitcoin successfully reached parity with the U.S. dollar, and over subsequent years, its value surged, reaching $60,000 per unit in 2021, and it has continued to hover around this value until 2024 (Coin Market Cap website, 2024).

The pioneer cryptocurrencies, such as Bitcoin and Ethereum, were launched as an alternative medium of exchange to fiat currency. However, over the past years, Bitcoin has been considered as an alternative investment opportunity to traditional investments for some people. Alternative investments, regarded as non-correlated assets, exhibit performance patterns distinct from traditional asset classes like bonds and shares, according to Wilson (2019). Presently, a subset of private investors perceives cryptocurrencies as non-

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[1] Blockchain technology is a distributed ledger technology (DLT) serving as a protocol for peer-to-peer value exchange. Transactions are independently recorded across decentralized computers without the need for a central intermediary. Blockchain also allows for so-called smart contracts, which utilize code to automatically execute contracts between parties such as buyers and sellers (Youssef and Saleh, 2022).

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correlated assets, viewing them as an effective means to achieve risk balance within their investment portfolios.

The clear expansion of cryptocurrencies, especially Bitcoin, has emerged recently as a result of monetary policies regarding increasing the money supply and lowering long-term interest rates around the world, especially during and after the COVID-19 pandemic. These policies have caused a decline in asset returns in the economy (safest investments, e.g., money market accounts, Treasuries, and corporate bonds) due to inflationary effects. This prompted many investors to move towards more profitable assets, even if they are riskier. Despite its high risk, Bitcoin also has several benefits, such as being separated from the real economic conditions which makes it less vulnerable to inflationary shocks ((Mert and Timur, 2023); (Zhao etal., 2023)).

As for Egypt, there is also great interest in Bitcoin and trading in it. This is demonstrated by the rise in the demand for Bitcoin and trading volume to reach over 2.2 million L.E in 2020. It is also estimated that over 1.7 million people, 1.8% of Egypt's total population, owned cryptocurrency, especially Bitcoin, in 2021 and increased to over 3.0 million people, 2.95% of Egypt's total population, in 2022[2]. Thus, Egypt had the largest number of cryptocurrency users, ranking first in the Arab world. However, in 2024, it ranked second after Saudi Arabia, with more than 3.4 million cryptocurrency holders, representing approximately 3% of the total population, placing it 36th globally. It is also expected that the number of Bitcoin users in Egypt will rise to 11.30 million people in 2025, and the user penetration rate is expected to be 9.72% by 2025 (Statista website, 2024).

It can be noted that this interest may be due to a multitude of factors, encompassing the inclination of individuals to employ it as an investment asset with the objective of attaining substantial returns, and the surge in global prices. In addition to the recent monetary policies implemented by the Central Bank, involving an increase in money supply leading to elevated inflation rates and a negative real interest rate, this has encouraged individuals to explore alternative investments like Bitcoin.

Hence, this paper aims to examine the different determinants of Bitcoin price in Egypt, focusing primarily on whether monetary policies have an impact on changes in those prices.

The significance of this paper comes from the fact that it serves as a reference highlighting the distinctive nature of Bitcoin. Unlike traditional assets, Bitcoin operates independently of any government or central authority, exemplifying a decentralized system where management is open to all. The historical price of Bitcoin emerges as a major factor influencing its value.

Thus, this paper contributes to the relevant literature in two ways. First, testing the relationship between different economic variables, especially monetary policies, and the Bitcoin market. Second, filling a gap by exploring those relationships in Egypt, a context not previously studied, covering the period from January 2015 to June 2023, using monthly data. It can be said that the reason for choosing the period starting from 2015 is due to the initial popularity and spread of Bitcoin in Egypt, along with the increasing demand for trading and using it. In addition to the availability of data for the variables used during this time period.

The main Research question is: "Is there a relationship between the CBE's monetary policy decisions and the demand for Bitcoin in Egypt?" This question includes several sub-questions:

-What is the nature of that relationship if it exists?

-What is the motivation of individuals in Egypt to invest in Bitcoin?

-Is Bitcoin considered a diversification tool for the investment portfolio, a hedging tool, or a safe haven in Egypt?

So, the paper is divided into two main parts, other than the introduction and conclusion. The first section reviews the most important relevant economic theories and previous studies that dealt with the relationship between Bitcoin prices and their various determinants. The second section focuses on the descriptive and econometric methods to analyze the relationship between Bitcoin prices and monetary policies in Egypt

[2] According to published data by Triple A, a crypto consultancy firm.

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using the time series and cointegration methods. The paper ends by explaining the most important results of that measurement and how to benefit to come up with some recommended policies for policymakers and investors in Egypt.

1. Literature Review:

Whether cryptocurrencies are money or financial assets, there is no clear definition for them. The distinctive terminology associated with cryptocurrencies introduces confusion, as certain terms are often used interchangeably, adding complexity to the matter. A universally agreed-upon list of terms is yet to surface, aiming to delineate distinctions among "digital currency," "virtual currency," and "cryptocurrency."

Digital currency is broadly defined as a digital representation of value denominated in legal tender. This term refers to both a digital representation of fiat currency (e-money) and a non-fiat currency. Virtual currencies are "digital representations of value, issued by private developers and denominated in their own unit of account." On the other hand, the term "Cryptocurrency" is more specific, referring to "a math-based, decentralized convertible virtual currency protected by cryptography" (Wilson, 2019). Bitcoin is one of the thousands of cryptocurrencies available globally. It can be used as a store of value, a way to exchange value, or as a speculative investment.

The price of Bitcoin and other cryptocurrencies fluctuates wildly, making them unreliable and highly volatile. Nevertheless, many investors see Bitcoin as an efficient speculative asset to hold over time, rather than make payments with, and it often draws comparisons to gold (Katsiampa et al., 2019). This causes a strong increase in demand for crypto assets and Bitcoin, leading to a substantial rise in prices. Besides, some see Bitcoin as a hedge against inflation because the supply is permanently fixed[3], unlike that of fiat currencies, which central banks can expand indefinitely.

In fact, some cryptocurrencies have gained their importance, or have even been developed, specifically for use in Fintech industries. The most famous of these is Yearn. Finance (YFI)[4]. Although the developers implicitly state that this cryptocurrency has no value outside its use in the yearn finance ecosystem, investors and traders have greatly magnified its price in less than a year. This supports the idea that the price of cryptocurrency depends on the behavior of people and their greed to make a quick profit, not on main economic variables or policies (Siripurapu and Berman, 2023).

Hence, it can be said that the determinants of Bitcoin prices stem primarily from within it, in the extent of individuals' confidence or the rates of return achieved over previous periods, in addition to supply and demand, mining costs, capital manipulation, market news, and regulatory policies. Monetary policies, which can affect investors' demand for hedging and diversified investments, may influence Bitcoin prices indirectly through portfolio balance channels (Zhao et al., 2023).

However, despite the expansion and the advantages that Bitcoin may achieve as an asset, there are a significant number of criticisms and disadvantages associated with Bitcoin. The most important of them are: first, Bitcoin has no intrinsic value, its value only depends on market strength and the belief from users (Šurda, 2014). Second, its high volatility is based on the laws of market demand and supply. Third, the lack of regulation raises concerns about fraud, tax evasion, and cybersecurity.

1.1 Theoretical Background:

(Santoni, 1987) examines two theories that aim to elucidate stock prices: the Efficient Market Hypothesis and the Greater Fool theory. The Efficient Market Hypotheses posit that all pertinent information is already reflected in current stock prices, and price adjustments occur solely in response to new information about fundamentals. According to this theory, past price fluctuations do not offer valuable insights into future price

[3] Bitcoins are created at a steady but diminishing rate until an arbitrary limit of 21 million has been reached (Grinberg, 2012).

[4] Yearn Finance is a suite of products in Decentralized Finance (DeFi) that provides lending aggregation, yield generation, and insurance on the Ethereum blockchain. It started out to automate the process of switching capital between lending platforms in search of the best yield offered, as the lending yield is a floating rate rather than fixed rate (Forbes, 2023).

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changes. On the other hand, the Greater Fool theory suggests that investors perceive fundamental information as inconsequential. This approach centers around speculation and the anticipation of sustained price increases solely based on historical uptrends. Bitcoin's price is often cited as an example of the greater fool theory.

Momentum in the financial market is an empirically observed phenomenon where rising asset prices tend to continue rising, and declining asset prices tend to further decrease. Momentum theory hinges on short-term market movements rather than fundamental factors. Therefore, the origin of it is attributed to cognitive biases and irrational investor behavior (Kjærland et al., 2018).

Besides, volatility analysis proves beneficial in the processes of price determination, portfolio construction, and risk management, aiding investors in their decision-making. When volatility is high, investors typically aim to divest their assets to mitigate risks. However, elevated volatility indicates that prices are prone to experiencing rapid fluctuations, presenting opportunities for both substantial returns and risks. This phenomenon is commonly referred to in financial terms as "high risk, high return".

In this context, one can differentiate between a diversifier, a hedge, and a safe haven asset, following (Baur and Lucey, 2010) and (Ratner and Chiu, 2013). A diversifier is an asset that has a weak positive correlation with another asset on average. A weak (strong) hedge is an asset that is uncorrelated (negatively correlated) with another asset on average. A weak (strong) safe haven is an asset that is uncorrelated (negatively correlated) with another asset on average during times of stress.

As for technology in financial markets, the theory of innovation diffusion attempts to explain the dynamics through which new ideas and technology spread across a social system. According to this theory, the process of technology adoption fundamentally relies on the level of human capital development (Rogers, 1995). One of the hypotheses from this theory is “Financial Innovation Fragility Hypothesis”, which examines financial technology skeptically, i.e., the expansion in the use of cryptocurrencies, may be accompanied by the emergence of financial bubbles that pose a significant risk to financial stability if strong unchecked growth is allowed without institutional and legal restraints (Da-Silva, 2018). As cryptocurrencies become more widespread, the effects may extend globally, affecting the international monetary system as a whole (Georgieva, 2020).

1.2 Empirical Studies:

Previous studies varied in their objectives when measuring the determinants of Bitcoin. Some have focused on macroeconomic determinants, especially inflation and exchange rates. Other studies aim to ascertain whether Bitcoin serves as a diversification tool in investment portfolios, emphasizing the connection between its prices and other assets in the economy. Besides, some studies focus on the impact of monetary variables.

The majority of these studies have been conducted in developed countries, notably the United States, the United Kingdom, and Japan. A limited number of studies have ventured into measuring these relationships in developing countries, such as Indonesia.

In essence, previous studies can be categorized into three groups based on the fundamental variables they focused on studying.

1.2.1 Studies that addressed the relationship between Bitcoin prices and macroeconomic determinants:

(Urquhart and Zhang, 2019) discovered that Bitcoin could be used as a hedge against certain currencies and that Bitcoin functions as a form of investment. Similarly, (Blau et al., 2021) offered strong evidence that a sudden surge in the price of Bitcoin is linked to a large increase in the inflation rate. This supports the idea that Bitcoin can function as a hedge against inflation.

In contrast, (Canh et al., 2019) found that economic factors do not exert significant influences on cryptocurrencies by examining the relationship between the prices of the leading seven cryptocurrencies and economic factors like oil price, gold price, interest rate, US dollar and S&P500 index. The same result was also reached by (Bayramoğlu and Başarır, 2019) using a decision tree method. (Basher and Sadorsky, 2022)

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mentioned that inflation is not a strong predictor of the Bitcoin price, suggesting that Bitcoin is not a good hedging asset for inflation. This is also supported by (Srinivasan, et al., 2022) using symmetric and asymmetric versions of ARDL models with structural breaks. The results indicate that Bitcoin cannot be used to hedge against inflation, the Federal funds rate, stock markets and commodity markets. (Wang et al., 2023) Also indicated that economic policy uncertainty negatively impacts the Bitcoin price. Thus, Bitcoin cannot act as a hedge or safe-haven asset.

1.2.2 Studies that focused on the relationship between Bitcoin prices and investment assets:

(Bouri et al., 2018) identified that the Bitcoin price movements can be predicted based on commodity prices and gold prices, using ARDL model (Kjærland et al., 2018) employed ARDL and GARCH approaches, revealing that Bitcoin prices are impacted by S&P 500 returns, historical price performance, optimism, and Google search volume. Moreover, (Kang et al., 2020) explored that there is asymmetric causality between Bitcoin and Treasury bonds, US stock, US dollars, and gold. The results indicate that Bitcoin may strengthen diversification benefits in optimal asset allocation and portfolio risk management.

On the other hand, (Kurka, 2019) acknowledged the connections between cryptocurrencies and traditional assets are negligible. According to (Pirgaip et al., 2019) findings, Bitcoin has no long-term association with any asset and Bitcoin price variation is mostly borne by its prices. (Warsito, 2020) concluded that the volatility of Bitcoin and Ethereum is not influenced by other variables (gold, Dollar Index, and Composite Stock Price Index) but is influenced by past prices of each of them in Indonesia. This shows that the cryptocurrency market is inefficient. Moreover, (Baur et al., 2021) stated that Bitcoin is uncorrelated with other assets, suggesting that while BTC offers great benefits for diversification, it is neither a safe haven nor a reliable hedging instrument.

1.2.3 Studies concerned with measuring the impact of monetary variables on Bitcoin prices:

(Tomás and Ibañez, 2018) mentioned that Bitcoin was not affected by monetary policy news. This result indicates that Bitcoin is a financial asset without any connection to the policies of central banks. (Kusumastuty et al., 2019) indicated that there is no significant influence of monetary variables (inflation, interest rates and the money supply) on the cryptocurrency prices in Indonesia. While the historical price of Bitcoin has become the biggest influence on it.

However, (Ma et al., 2022) found that USA monetary policy shocks contribute to a relatively minor percentage of Bitcoin price volatility. (Mert and Timur, 2023) refers to the causal relationship between Bitcoin prices and central bank money supplies for the Federal Reserve System (FED), European Central Bank (ECB), and Bank of Japan (BOJ). This causal relationship has emerged stronger for the USA, especially after the COVID- 19 pandemic, owing to the rapid increase in the amount of money put into circulation. Besides, (Köse and Ünal, 2023) analyzed the asymmetric effects of the interest rate on the Bitcoin price by using an SVAR model and concluded that negative real interest rates have a positive impact on the Bitcoin price. If this is possible, cryptocurrencies behave like conventional assets, and they can be impacted by conventional economic policies.

From the above, it becomes evident that there isn't a singular nature defining the relationship between various determinants of Bitcoin and its price. It should also be noted that there is an absence of studies estimating these relationships within the context of Egypt.

2. Empirical Analysis

Based on the aim of the study, the paper used the method of time series analysis and cointegration models; the Autoregressive Distributed Lag (ARDL) model and the Error Correction Model (ECM) to examine long-term relationships between variables over time, and also modeling the short-run dynamics of a system, during the period (January 2015: June 2023) monthly data, using the STATA -17 packages.

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2.1 Description and Visualization of data:

The study worked on estimating the model to measure the relationship between the Bitcoin price as a dependent variable and several independent variables, namely: money supply (M2), the real interest rate, EGX30 index, the price of the gold pound, and the price of Bitcoin in the United States of America. This is illustrated by the following model:

$$BP_t = \beta_o + \beta_1 M2_t + \beta_2 RIR_t + \beta_3 EGX30_t + \beta_4 GPP_t + \beta_5 GBP_t + \varepsilon_t \quad (1)$$

Where;

BP_t: Price of Bitcoin variable expressing the demand for Bitcoin in Egypt, estimated in the Egyptian pound.

$M2_t$: Money supply variable expressing the local liquidity in Egypt.[5]

RIR_t: Real interest rate variable as the difference between nominal deposits interest rate (%) and the inflation rate (CPI %).

$EGX30_t$: EGX30 index[6] variable, as an expression of the demand for stocks and bonds, represents one of the forms of investment assets that is directed by the government.

GPP_t: Gold pound price variable represents one of the safest investment assets in Egypt.

GBP_t: global Bitcoin price variable, which is the price of Bitcoin in the United States of America, given that the USA is the country that trades the most Bitcoin.

εt: error term, and t refers to the time varying from January 2015 to June 2023.

All the data are collected from the Central Bank of Egypt website from either time series data or data in monthly statistical bulletins, except the Bitcoin Price data for Egypt and the USA are received from Coinbase and Yahoo Finance, respectively.

The selection of these variables was based on theoretical reasons and applied factors. This can be elucidated by referring to Table 1, accompanied by a graphical representation, Fig.1, of the data for these variables in Egypt throughout the studied timeframe.

Table 1: Reasons behind choosing the model's variables and their expected signs in the case of Egypt:

The variable	The reason for choosing it	Expected sign for the relation
Bitcoin Price	The Bitcoin price variable stands out as the predominant indicator for gauging the demand for Bitcoin, complemented by the constrained supply that establishes a direct and robust correlation between price and demand for this contemporary asset. Moreover, Numerous empirical studies frequently utilize the Bitcoin price variable and explore its associations with diverse determinants.	It is the dependent variable.
Money Supply (M2)	Over the past decade, Bitcoin's price has made significant gains during the fast growth of money supply (M2), owing to a reduction in interest rates and fiscal stimulus. Inflation is commonly linked to an overheated economy following the implementation of expansionary monetary and fiscal policies that amplify aggregate demand. These policies that elevate disposable incomes beyond sustainable levels can stimulate investment, including in high-return assets like cryptocurrencies (Polizu et al., 2023). According to previous literature, M2 is the best estimation of	By calculating the correlation between Bitcoin price and M2, it is about 0.834772; indicating that there is a positive and strong relation between the two variables.

[5] M2, according to Central Bank of Egypt definition, consists of M1, representing cash in circulation outside the banking system, and non-governmental current deposits in local currency at all units of the banking system. In addition to quasi-money, which consists of non-current, non-governmental deposits in local currency, and non-current deposits in foreign, non-governmental currencies and non-current deposits at all units of the banking system.

[6] The EGX 30 index is a price index that measures the performance of the top 30 companies in terms of liquidity and activity on the Egyptian Stock Exchange, it is weighted by market capitalization and is adjusted by the ratio of free shares to total shares included in it.

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	overall money supply growth, and the supply growth of other major currencies follows a similar trend.	
Real Interest Rate	Interest rate policy can influence investment decisions around the world. Hence, it is assumed that the interest rate can be a significant tool that can change the perception of investors for cryptocurrencies. Policymakers, portfolio managers, and investors consider the real interest rate in the market, as the nominal interest rate and inflation separately cannot create a convincing result for the analysis. when the disparity between the two variables (nominal interest rate and inflation) expands, this may lead to an increased demand for cryptocurrencies until the interest rate begins to rise and align with the inflation rate.	According to previous studies and the known relation between the interest rate of investment assets and the demand for alternative assets, it is expected that this variable to have a negative sign. That expected negative relation appears from panel (C) in Fig.1 and the correlation factor (-0.06084).
EGX30 Index	The stock exchange indices constitute one of the factors influencing fluctuations in Bitcoin's price. These indices, serving as indicators of macroeconomic conditions, are directly overseen by governmental entities. However, their impact on Bitcoin's price change remains minimal due to the absence of direct connections between Bitcoin, the real economy, and governments. However, this lack of connections also contributed to Bitcoin markets not being directly affected by macroeconomic inflationary shocks, which represents an incentive for retail investors to turn to crypto assets to protect their wealth. This helps to explain why adding crypto to a traditional portfolio increases returns, at the cost of also raising volatility (Polizu et al., 2023). Due to the lack of any previous studies applied to Egypt, this paper relies upon EGX 30 index as an indicator to express the demand for shares on the Egyptian Stock Exchange.	The positive relation between the index and Bitcoin price according to the Correlation factor (0.694249) refers to diversification behavior of investors in the local market, which leads to the expectation of a positive sign of that variable.
Gold Pound Price	Analyzing the relationship between the gold price and the Bitcoin price can help understand whether the cryptocurrency can be a safe haven (Wen et al., 2022). Bitcoin has been suggested to have many similar properties to Gold. The scarcity and high “mining” costs of Bitcoin are like those of gold. So, it is often referred to Bitcoin in the media as ‘‘digital gold’’ (Conlon et al., 2021). But the average monthly volatility of Bitcoin price is greater than that of gold price, which makes Bitcoin unsafe enough as a hedging instrument like gold (Dwyer, 2015). So, (Pho et al., 2021) found that gold was a better safe haven and diversifier than Bitcoin.	This fear of huge fluctuations in Bitcoin price makes people in Egypt don't tend to depend on Bitcoin as a hedging or save heaving tool. This appears through the weak correlation between both variables in Egypt, which equals 0.24433. So, we can expect that there is not a strong effect of the gold pound price on the Bitcoin price in Egypt.
USA Bitcoin price	The US is a country that holds a large part of cryptocurrencies. Trading of cryptocurrencies is generally based on the US dollar (Polizu et al., 2023). So, we can use the Bitcoin price in the USA as the global price to determine the impact of changes in the global market for Bitcoin, due to changes in US monetary policy or the trends of global investors, on the domestic market.	From the panel (F) in Fig.1 and correlation coefficient, which equals 0.944077, we can see that local price for Bitcoin moves in sync with global prices, affected by their rises and falls.

(Source: Authors compilation)

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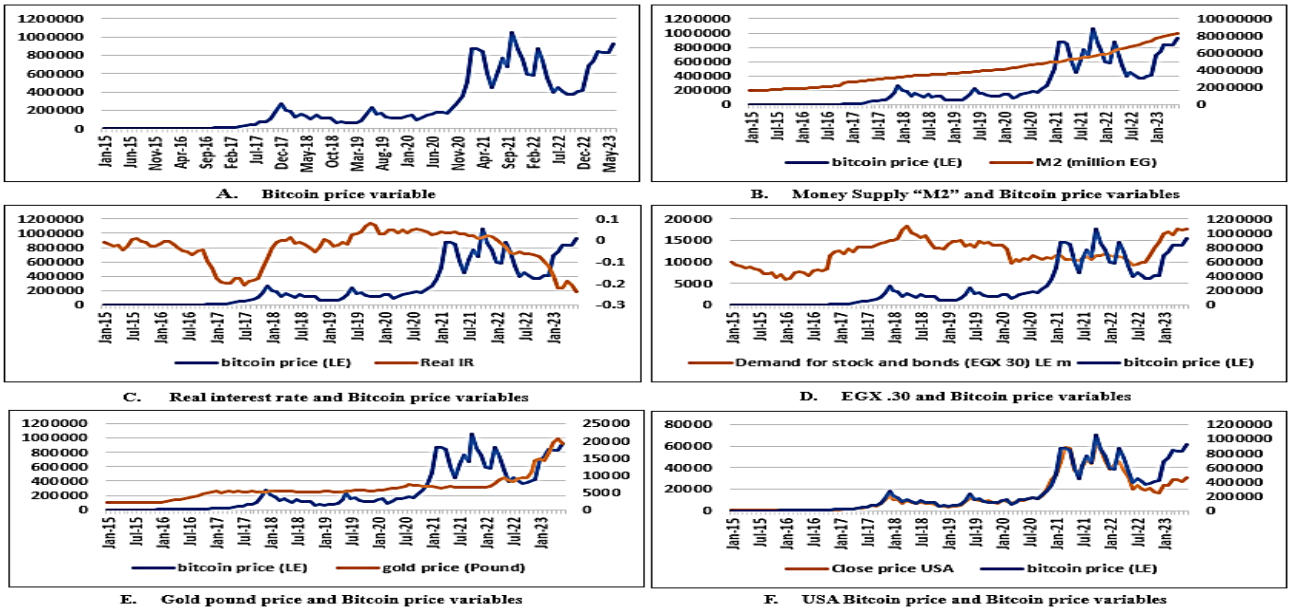


Fig. 1: Changes in the variables during the period (Jan 2015- Jun 2023) in Egypt
(Source: Authors compilation)

Appearing from panel (A) in Fig.1, there is a general increasing trend in Bitcoin price, especially during the years 2020, 2021, and 2023, which can be explained by some factors such as;

A lot of people are still unbanked, and the stock market has high transaction costs, while cryptocurrency is decentralized, and transaction costs are low. It is also the best way for a large segment of young people who do not have sufficient savings to invest in safer and more stable assets, but rather resort to investing in Bitcoin, that has had huge growth over the last years, to make a decent return back from a smaller amount of money (Barakat, 2022).

Egypt prohibits cryptocurrencies and Bitcoin explicitly, not implicitly, a stance clearly articulated in the recent Central Bank Law, No. 194 of 2020, particularly in Article (206). This prohibition is reinforced, from the Central Bank, by numerous warnings and advisories informing investors about potential risks associated with digital currencies. In addition to the amendments to the Terrorism and Anti-Money Laundering Law, No. 15 of 2020, including provisions on the use of cryptocurrencies in financing illicit activities and the penalties associated with that, which means that it implicitly acknowledges the existence of a significant cryptocurrency traded within the country. Simultaneously, Egypt actively promotes various forms of financial technology and digital banks. Besides, many platforms have also become available, like Coinbase and Binance, that facilitate trading with credit or debit cards and Fawry accounts, allowing the conversion of Egyptian pounds into Bitcoin units stored in digital wallets. It appears that the Central Bank's primary concerns revolve around potential currency instability and the associated risks to the Egyptian economy, in addition to the potential adverse effects on traditional investments like real estate, stocks, or bank deposits, in the event of an expansion in Bitcoin investment.

2.2 Tests and appropriate model validation:

The use of the Autoregressive Distributed Lag (ARDL) Model -developed by (Pesaran et al., 2001)- is based on the advantages that it has compared to other cointegration methods. These advantages are: First, it is suitable for estimating the model in small sample size; Second, it does not require prior information about the order of integration of the variables, whereas this is a prerequisite in Engle–Granger (EG) cointegration analysis; Third, the ARDL method can reduce the error when determining the cointegration order of variables. Finally, ARDL gives unbiased and efficient estimates of variables due to integrating long-run and

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short-run dynamics, eliminating problems associated with omitted variables and serial correlation ((Siddiki, 2000); (Motsewakgosi, 2019)).

The ARDL "cointegration equation" version of the model -Equation (1)- can be written as follows:

$$\Delta \ln (BP)_t = \delta_o + \rho (BP)_{t-1} + \beta_1 \ln(M2)_{t-1} + \beta_2 (RIR)_{t-1} + \beta_3 \ln(EGX30)_{t-1} + \beta_4 \ln(GPP)_{t-1} + \beta_5 \ln(GBP)_{t-1} + \Sigma^{p}_{i=1} \delta_{1i} \Delta \ln (BP)_{t-1} + \Sigma^{q}_{i=0} \delta_{2i} \Delta \ln (M2)_{t-1} + \Sigma^{m}_{i=0} \delta_{3i} \Delta (RIR)_{t-1} + \Sigma^{n}_{i=0} \delta_{4i} \Delta \ln(EGX30)_{t-1} + \Sigma^{g}_{i=0} \delta_{5i} \Delta \ln(GPP)_{t-1} + \Sigma^{h}_{i=0} \delta_{6i} \Delta \ln(GBP)_{t-1} + \varepsilon_t \quad (2)$$

Where;

Table 2: The symbols of cointegration equation no. (2) and the meaning of them:

The symbol	Which refers to
Δ	The first difference for variables
ln	The natural logarithm taken for variables
p, q, m, n, g, h	The number of optimal time lag
δ_o	Constant parameter
$\rho, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$	Long-run relation parameters
$\delta_{1i}, \delta_{2i}, \delta_{3i}, \delta_{4i}, \delta_{5i}, \delta_{6i}$	Short run relation parameters
ε_t	Error term
t	The time ranges from January 2015 to June 2023

(Source: Authors'work)

The ARDL model also helps to estimate the error correction parameter as well as identify the short-term effects through the Error Correction Model (ECM). This model can be estimated through the following equation:

$$\Delta \ln (BP)_t = \alpha_o + \Sigma^{p-1}_{i=1} \alpha_{1i} \Delta \ln(BP)_{t-1} + \Sigma^{q-1}_{i=0} \alpha_{2i} \Delta \ln(M2)_{t-1} + \Sigma^{m-1}_{i=0} \alpha_{3i} \Delta (RIR)_{t-1} + \Sigma^{n-1}_{i=0} \alpha_{4i} \Delta \ln(EGX30)_{t-1} + \Sigma^{g-1}_{i=0} \alpha_{5i} \Delta \ln(GPP)_{t-1} + \Sigma^{h-1}_{i=0} \alpha_{6i} \Delta \ln(GBP)_{t-1} + \theta (EC)_{t-1} + \varepsilon_t \quad (3)$$

Where;
(αo, $\alpha 1i$, $\alpha 2i$, $\alpha 3i$, $\alpha 4i$, $\alpha 5i$, $\alpha 6i$): Short run relation parameters.
θ: Short-term error correction parameter to reach a stable equilibrium state.

The study adopted a nonlinear formulation of the Bitcoin price function, aligning with most previous studies like (Kjærland et al., 2018). The use of the logarithm is important in this case because of the high volatility that characterizes most of the economic variables that are used in such models, especially the Bitcoin price variable.

2.2.1 Stationary tests: The stationarity of the model variables must first be verified using unit root tests, where the Augmented Dickey-Fuller test and the Phillips–Perron test, both of which indicated stationarity of all variables after taking the first difference for the natural logarithm (ln) for all variables except the real interest rate (RIR) which exhibit stationarity at first difference without taking the natural logarithm because of its negative values.

2.2.2 Choosing the optimal lag periods for the model variables: To find the appropriate lag length for each of the variables in the ARDL model, we used the Akaike information criterion (AIC), since this criterion is known for having a theoretical advantage over other information criteria (Enders, 2008). Applying this criterion indicates that the optimal model is ARDL (1,0,0,0,0,1).

2.2.3 Short and long-run cointegration tests: To test the cointegration relationship between variables, the ARDL Bounds Test was used (Pesaran et al., 2001), based on the F statistic. The results showed that the calculated F value (=65.927), exceeded the maximum critical value at the highest integration order I(1), at different levels of significance (1%, 5%, and 10%). Therefore, the null hypothesis (Ho) is rejected, meaning

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that there is a strong cointegration between the variables that allows the long and short-term relationships to be estimated. Accordingly, to ensure a close approach to long-term equilibrium, the coefficient of the error correction model (ECM term) -which measures the speed of adjusting any imbalance that deviates from the model's path in the short term to reach long-term equilibrium- must be significant and less than zero. This is achieved in the estimated model, where this coefficient takes the value = -0.281, and is highly statistically significant at a 5%. Thus, the coefficient of the error correction model states that Bitcoin price regains long-run equilibrium with an adjustment speed of 28% every month under the influence of the independent variables used.

2.2.4 Diagnostic tests: Based on different Diagnostic tests applied to the estimated model, it can be said that the estimated model is free of standard problems and therefore its results are not spurious, and that any conclusion reached can be considered highly reliable. These tests include Coefficient of determination (adjusted R2), Multicollinearity test "Variance inflation factors for the independent variables (VIF) test", Heteroscedasticity test "Cameron & Trivedi's decomposition of IM test and Breusch–Pagan–Godfrey (BPG)", Normal distribution of the residuals of the estimated model "the Skewness and Kurtosis normality tests", Autocorrelation test between random error values "the Durbin Watson test and the Breusch–Godfrey LM test for autocorrelation", Functional Form Misspecification Test "Ramsey's regression specification error test (RESET)", and Test to verify the stability of Bitcoin price function "the Cumulative Sum (CUSUM) of Recursive Residuals test".

The GARCH model was utilized alongside the ARDL model to validate its results. GARCH models are commonly used in analyzing macroeconomic variables, especially those linked to financial markets, due to their ability to handle fluctuations and changes in variance.

It is worth noting here the importance of using GARCH models because of their advantages. The GARCH specification offers a key advantage in efficiently identifying conditional variance. Unlike homoscedastic models, which assume constant volatility and are common in basic Ordinary Least Squares (OLS) analysis aimed at fitting data points to a regression line, GARCH processes acknowledge that asset returns' volatility fluctuates over time and is influenced by past variance. This variability renders a homoscedastic model less effective. GARCH models strive to capture this interplay between present and past variability using a mathematical framework that links them together.

When it comes to GARCH, we aim to address homoscedasticity by examining the unconditional variance of the regression. Deviating from this assumption implies that the Gauss-Markov theorem doesn't hold, and the OLS estimators are no longer Best Linear Unbiased Estimators (BLUE). Even when the unconditional variance remains stable, the conditional variance might vary over time. Engle (1982) introduced the Autoregressive Conditional Heteroskedasticity (ARCH) model, acknowledging the distinction between unconditional and conditional variance, allowing the latter to change based on past error terms. This approach captures volatility clustering but requires a model with an extensive lag structure, posing challenges for estimation. To simplify this task, Bollerslev (1986) proposed the GARCH model, which reduces parameters by imposing nonlinear constraints. The GARCH model forecasts unconditional variance with fewer parameters, placing more weight on recent observations for predicting volatility (Kjærland, et al., 2018).

3. Results and discussion:

After it has been reached that there is a long-term equilibrium relationship between the Bitcoin price and independent variables, the impact of these variables can be shown through Table 3:

Table 3: Long run Cointegration Model results:

ARDL Long Run Estimates, ARDL (1, 0, 0, 0, 0, 1)				
Variables	**Coefficient**	**Std. error**	**t- statistics**	**Prob.**
Δln M2	2.7845	0.5869	4.74	0.000**
ΔRIR	-0.5168	0.4547	-1.14	0.259

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Δln EGX30	0.3080	0.1337	2.30	0.024*
Δln GPP	0.0169	0.1738	0.10	0.923
Δln GBP	1.0428	0.0548	19.02	0.000**
Constant	-0.0462	0.0159	-2.89	0.005**

(Source: Prepared by the researcher depending on the STATA results)
Note: * and ** refer to significance levels at 95% and 99% respectively.

Model results indicate that:

- There is a positive relationship between Bitcoin Price and money supply (M2) as it is expected. This relation means that Bitcoin may be a monetary inflation hedge, and when the money supply starts to expand, we can expect the crypto market cap to follow suit. This relationship has become clear in Egypt recently as a result of the increase in the money supply, which was accompanied by an unprecedented rise in inflation rates. This generated fears among many individuals about saving in the usual form of cash, but rather resorting to other assets that are more profitable like Bitcoin. This led to an increase in demand for Bitcoin in the local market and thus contributed to a significant increase in its prices in light of its finite supply.
- Real Interest Rate does not significantly affect the Bitcoin price. This means that the interest rate policy is not effectively determined for the Bitcoin price in Egypt, which satisfies the decentralized characteristics of the cryptocurrency market. This result is not as assumed but consistent with the correlation coefficient between two variables and findings of previous studies like (Canh et al., 2019), (Kusumastuty et al., 2019), and (Srinivasan et al., 2022).
- There is a positive relationship between Bitcoin Price and the volume of EGX30 index. This reflects the diversification behavior of investors in forming a portfolio of various assets that have high profitability but may be at a high degree of risk. However, the effect is weak because Bitcoin does not have any direct ties to the real economy and/or government yet.
- There is no significant relationship between Bitcoin price and gold pound price, as expected. If there is a connection between them, it can be said that the gold price plays an explanatory role in the Bitcoin price, and that is not applicable to the case of Egypt. The fluctuations in gold prices in Egypt are related to global price changes, in addition to being primarily attributed to individual behavior, driven by a desire to consider gold a secure refuge amidst high inflation rates and diminished purchasing power. However, the same desire does not apply in the case of Bitcoin. The heightened volatility in Bitcoin's prices, coupled with concerns about cyber-attacks and fraud, deters individuals from seeking it as a store of value. Consequently, when individuals seek an asset primarily for its stability and not for potential profitability, they tend to gravitate towards gold rather than Bitcoin.
- Bitcoin price in the USA -as a global price for Bitcoin- positively affects the Bitcoin price in Egypt. This relation is assumed because both prices move together, which means that the local Bitcoin market is highly linked to global prices influenced by global changes.
- Bitcoin price is related to its previous values, meaning that when investors buy Bitcoins, they always look at its historical price, which has tended to increase every year. On the other hand, from the investment side, this dependency suggests that the efficient market hypothesis (past returns should have no correlation with present returns) may not be applicable. Behavioral economists attribute imperfections in financial markets to errors in human reasoning and information processing. Given that many investors likely have limited experience with Bitcoins and the surrounding context can be confusing. In this scenario, it is reasonable to assume that investors are influenced by the momentum effect, reacting to the recent rise in prices. This result is consistent with findings of (Kjærland, et al., 2018) and (Warsito, 2020).

As for the short-term relationship, which is evident from Table 4, it reflects the same results that were reached for the long-term relationship.

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Table 4: Error Correction Model results for short run:

ARDL Long Run Estimates, ARDL (1, 0, 0, 0, 0, 1)				
Variables	**Coefficient**	**Std. error**	**t- statistics**	**Prob.**
Δln BP	-0.2813***	0.7700	-3.65	0.000**
Δln M2	3.5679	0.6987	5.11	0.000**
ΔRIR	-0.6622	0.5912	-1.12	0.266
Δln EGX30	0.3947	0.1664	2.37	0.020*
Δln GPP	0.0216	0.2230	0.10	0.923
Δln GBP	0.9193	0.0532	17.27	0.000**
Constant	-0.0462	0.0159	-2.89	0.005**

(Source: Prepared by the researcher depending on the STATA results)
Note: * and ** refer to significance levels at 95% and 99% respectively, *** refers to the ECM term.

In this context, the results obtained from applying the GARCH model align perfectly with those from the previously mentioned ARDL model. Both models reveal a significant positive impact of variables like money supply (M2), the EGX30 index volume, and global Bitcoin price on the Bitcoin price in Egypt as an indicator of demand. Conversely, real interest rate and gold pound price don't exhibit significant influence, as evident from Table 5. These consistent findings between the ARDL and GARCH models highlight the reliability and robustness of the ARDL model.

Regarding the ARCH and GARCH effects, both had positive values, and their combined total was below 1 as per the required conditions. The coefficient for GARCH(2), at 0.133, was not significantly different from zero individually, but when considered together, the coefficients for ARCH(1) and GARCH(2) were significant (with a p-value of 0.045, below the 0.05 threshold).

Table 5: GARCH Model results

GARCH (1, 2)				
Variables	**Coefficient**	**Std. error**	**Z value**	**Prob.**
Δln M2	4.375	1.039	4.21	0.000*
ΔRIR	0.3109	0.4875	0.64	0.524
Δln EGX30	0.4307	0.1497	2.88	0.004*
Δln GPP	-0.2923	0.2030	-1.44	0.150
Δln GBP	0.9182	0.0508	18.07	0.000*
Constant	-0.0518	0.0182	-2.84	0.004*
ARCH Effect	0.5956			0.071**
GARCH Effect	0.1336			0.454

(Source: Prepared by the researcher depending on the STATA results)
Note: * refers to significance at 5% significance level
** refers to significance at 10% significance level

4. Conclusion and Policy Recommendations:

The primary objective of this paper is to investigate the influence of monetary policies and government decisions on Bitcoin prices in Egypt. Employing time series analysis and co-integration models, specifically the Autoregressive Distributed Lag model (ARDL), the Autoregressive Conditional Heteroskedasticity (ARCH) model, and the Error Correction Model (ECM), the research concluded that there is a positive

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correlation between money supply (M2) and Bitcoin prices. This correlation suggests that the surge in money supply, coupled with escalating inflation rates resulting from restricted production and subsequent currency purchasing power decline, has led some individuals to turn to Bitcoin as an alternative income source. This highlights the indirect relationship between monetary policy decisions and rising Bitcoin prices through the aggregate demand behavior of individuals in the economy.

Conversely, no significant relationship was found between the real interest rate and Bitcoin prices, underscoring the decentralized nature of this market and its vulnerability to influences beyond direct monetary policy decisions and tools.

The weak positive correlation observed between Bitcoin prices and trading volume in stock exchange shares suggests that Bitcoin serves as a tool for diversification and profitability in Egypt. However, the absence of a relationship between Bitcoin and gold negates its role as a hedging tool or a safe haven during crises, as Egyptians do not typically turn to it under such circumstances.

Furthermore, the anticipated alignment between local and global Bitcoin prices reinforces the notion that the Egyptian market is closely interconnected with the global market and its fluctuations. Egypt's cryptocurrency market is experiencing steady growth as more Egyptians embrace digital currencies as an alternative form of investment. Despite its volatility, Bitcoin continues to gain popularity, and its elevated prices remain a primary driver for investors.

According to those results, we can recommend a set of policies for target stakeholders, including policymakers and investors, as follows;

- For Policymakers, it is important to anticipate the significant future implications of monetary decisions on the Bitcoin market, which will, in turn, have repercussions on the overall economy. This will be through focusing on the cryptocurrency market by formulating regulatory guidelines in an acceptable manner that does not violate the nature of this decentralized market. These regulations can safeguard the economy against the potential risks stemming from the hypothesis of financial technology fragility. The government must also benefit as much as possible from this already existing and expanding market by, for example, imposing taxes on transactions. At the same time, it must work on fostering innovation, enhancing regulation, and promoting transparency within traditional financial markets to effectively compete with cryptocurrencies and facilitate investment flows, which will improve the efficiency of these markets.
- For investors, profitability goals should not only be reconsidered, but Bitcoin should be one of the forms of portfolio diversification, but with a lower percentage. Rather, investors should rely mainly on assets with government guarantees, such as stocks, bonds, or real estate, to avoid possible losses of Bitcoin due to fraud or cyber-attacks.

Further Research: There is more interest in measuring Bitcoin and its various determinants that change from one period to another according to the extent of the market's expansion and the changes of countries in dealing with it. It is also possible to study the impact of Central Bank Digital Currency (CBDC) on dealing in the original cryptocurrency markets. Bitcoin can also be added as one of the modern factors, which has an impact on macroeconomic functions and variables, such as the demand for money function or the demand for investment assets function. It may also be possible to do forecasting of Bitcoin prices for the coming periods. Studying the impact of using Bitcoin and its mining on energy consumption and climate change if sufficient data is available, especially for advanced countries.

Research Limitations: One of the key limitations of the paper lies in the limited availability of data, which hinders the ability to measure additional relevant determinants, particularly behavioral and financial factors such as risk perception, inflation-hedging motives, and trust in the financial system. Furthermore, applying the analysis to other cryptocurrencies beyond Bitcoin presents additional challenges due to the shorter time span of available data for these currencies. This discrepancy in data availability may result in a reduced number of observations, potentially affecting the robustness and generalizability of the results.

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