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# Are cryptocurrencies a better safe haven than gold during the COVID-19 pandemic?

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## Internship Thesis

**Are cryptocurrencies a better safe haven than gold during the COVID-19 pandemic?**

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## Abstract

This paper examines the safe haven properties of cryptocurrencies and gold for stock market indices during the COVID-19 outbreak. Using the OLS regression, we find that Bitcoin and Ethereum act as diversifiers only during the COVID-19 pandemic. Moreover, before the pandemic, Ripple, Binance Coin, Tether and Dogecoin act as diversifiers and kept this property during the breakdown except for Tether which was the only one suitable to act as a safe haven. Our findings also reveal that gold acts as a hedge before the pandemic and as a diversifier during the COVID-19 outbreak. Besides, the results indicate that the growth rate of COVID-19 confirmed cases harms the stock market. Finally, the regression results robustly support the safe haven features and uncover that Tether is possibly a better safe haven than gold.

**Keywords:** Cryptocurrencies, Gold, Safe Haven, COVID-19, Stock Market

**Jel classification:** G11, G15, G17, C5

## Table of content

<b>ABSTRACT</b>	5
<b>ACKNOWLEDGEMENTS</b>	6
<b>TABLE OF CONTENT</b>	7
<b>LIST OF TABLES</b>	9
<b>1. INTRODUCTION</b>	10
<b>2. LITERATURE REVIEW</b>	13
2.1. BLOCKCHAIN	13
2.1.1. <i>What is blockchain?</i>	13
2.1.2. <i>Blockchain advantages</i>	14
Autonomy	14
Security	14
Transparency	15
Traceability	15
Automation	15
Accountability	16
2.1.3. <i>Blockchain applications</i>	16
Financial applications	16
Integrity verification	16
Governance	17
Internet of things	17
Privacy and security	18
Healthcare management	18
2.2. CRYPTOCURRENCIES	18
2.2.1. <i>What is cryptocurrency?</i>	18
2.2.2. <i>The main cryptocurrencies</i>	20
Bitcoin (BTC)	20
Ethereum (ETH)	20
Binance Coin (BNB)	21
Tether (USDT)	21
Ripple (XRP)	21
Dogecoin (DOGE)	22
2.2.3. <i>Challenges faced by cryptocurrencies</i>	22
Crash and Bubble	22
Electricity Bills	22
Law	23
2.2.4. <i>Opportunities and advantages of cryptocurrencies</i>	23
High security	23
Cost of Transaction	24
High Return	24
2.3. GOLD	25
2.3.1. <i>Background information</i>	25
2.3.2. <i>The Role of Gold as an Investment Asset</i>	26
Diversification benefits of gold	26
Protection against inflation	26
Gold and Economic activity	26
Gold and gain of time	27

2.4.	SAFE HAVEN, HEDGE AND DIVERSIFICATION PROPERTIES	27
2.4.1.	<i>Theoretical Framework</i>	27
	Hedge	27
	Diversifier	28
	Safe Haven	28
	Safe Asset vs Safe Haven Asset	28
	Prospect Theory	28
	Modern Portfolio Theory	29
2.4.2.	<i>Empirical studies of cryptocurrencies</i>	29
2.4.3.	<i>Empirical Studies of Gold</i>	33
2.5.	STOCK MARKET AND COVID-19	35
<b>3.</b>	<b>RESEARCH PROBLEM</b>	<b>39</b>
<b>4.</b>	<b>RESEARCH METHODOLOGY</b>	<b>44</b>
4.1.	HYPOTHESIS DEVELOPMENT	44
4.2.	DATA SET	45
4.3.	EMPIRICAL MODELS AND VARIABLES MEASUREMENT	45
4.4.	VOLATILITY	47
<b>5.</b>	<b>DESCRIPTIVE STATISTICS</b>	<b>49</b>
<b>6.</b>	<b>RESULTS AND FINDINGS</b>	<b>51</b>
6.1.	ANALYSIS OF REGRESSION RESULTS BEFORE THE COVID-19 PANDEMIC	51
6.2.	ANALYSIS OF REGRESSION RESULTS DURING THE COVID-19 PANDEMIC	53
<b>7.</b>	<b>ROBUSTNESS TEST</b>	<b>55</b>
<b>8.</b>	<b>CONCLUSION</b>	<b>62</b>
<b>9.</b>	<b>REFERENCES</b>	<b>64</b>
<b>10.</b>	<b>APPENDIX</b>	<b>81</b>

## List of tables

TABLE 1: BRIEF DESCRIPTION OF VARIABLES.....	46
TABLE 2: DESCRIPTIVE STATISTICS STUDY FOR STOCK MARKET RETURNS BEFORE COVID-19 OUTBREAK.....	49
TABLE 3: : DESCRIPTIVE STATISTICS STUDY FOR STOCK MARKET RETURNS DURING COVID-19 OUTBREAK.....	50
TABLE 4: REGRESSION ANALYSIS FOR STOCK MARKET RETURNS BEFORE COVID-19 OUTBREAK.....	51
TABLE 5: REGRESSION ANALYSIS FOR STOCK MARKET RETURNS DURING COVID-19 OUTBREAK .....	53
TABLE 6: REGRESSION ANALYSIS FOR FRENCH RETURNS BEFORE COVID-19 OUTBREAK.....	56
TABLE 7: REGRESSION ANALYSIS FOR FRENCH RETURNS DURING COVID-19 OUTBREAK .....	57
TABLE 8: REGRESSION ANALYSIS FOR AMERICAN RETURNS BEFORE COVID-19 OUTBREAK.....	59
TABLE 9: REGRESSION ANALYSIS FOR AMERICAN RETURNS DURING COVID-19 OUTBREAK .....	60

## 1. Introduction

The novel coronavirus, designated "coronavirus disease 2019 (COVID-19)" by the World Health Organization, is the disease that is caused by the virus's most recent discovery. It was identified for the first time in late December 2019 in central China's Hubei Province. Numerous studies have concluded that COVID-19 is extremely contagious, which explains why it has spread rapidly over the world via human-to-human transmission. On 30 January 2020, the WHO formally declared the COVID-19 epidemic as a public health emergency of worldwide concern due to the outbreak's size and trajectory. COVID-19 was declared a pandemic on March 11th. Not only is this pandemic a global health issue, but it is also causing a severe global economic downturn. As a result of several countries' severe quarantine rules in response to an unknown pandemic, their economic operations are abruptly halted.

Multiple channels are triggered by the epidemic, including job markets, global supply networks, and consumption habits, all of which have an effect on the global economy. Without a doubt, one of the most critical components of these channels is the stock market (see, for example, Al-Awadhi et al., 2020). In March 2020, the world's largest economy, the US stock market, hit the circuit breaker mechanism four times in ten days (Zhang et al., 2020). On March 12, 2020, the leading index in the United Kingdom, the FTSE, fell by more than 10%. (Zhang et al., 2020). Additionally, in their study (Shehzad et al., 2020) discovered a detrimental effect of the COVID-19 on the S&P 500 and Nasdaq composite index stock returns. In comparison to earlier financial crises, the fundamental dynamics driving the current one is more complex than ever. According to Gates (2020), the COVID-19 pandemic is a "once-in-a-century" event, while Georgieva (2020) noted that the COVID-19 pandemic has brought the entire world dangerously close to financial difficulties comparable to the Global Crisis of 2007–2008. Following significant losses, the desire for safe-haven properties has revived for practitioners and researchers alike.

A safe haven asset can be easily interpreted as one that shields investors' wealth from financial turbulence. Thus, an asset with a consistent real worth, or at the very least a stable nominal value, is an unquestionably safe haven, as it enables its owner to dispose it without incurring a loss at any moment. Given the belief that "safe haven" assets provide protection against market declines, one would anticipate a major portfolio shift toward these assets during each financial crisis, resulting in an increase in their return co-movements. Hence, despite its original role as natural money or a store of value, gold was



considered a haven asset (Bouri et al., 2020). In fact, Reboredo (2013) affirmed that gold can serve as a hedge as well as a safe haven. While Baur and McDermott (2010) stated that gold serves as a hedge and a safe haven in the US and most European countries' stock markets. Even though gold does not appear to be a safe haven at first glance, as it is a risky investment with extremely variable returns, merging two assets with perfect inverse correlation results in a portfolio with a variance of zero around the mean return. As a consequence, if a risky asset has an inverse correlation to stocks, adding it to a stock portfolio offers an excellent hedge. Within this perspective, some volatile assets, such as cryptocurrency, may be deemed safe havens if their correlations with the other assets in the investor's portfolio are negative.

Indeed, cryptocurrency is another well-known safe-haven asset. For example, Bouri et al. (2019) demonstrated that cryptocurrencies can be utilized as downside risk hedges in equities investments. This property is applicable both during normal times and during times of crisis, which qualifies Bitcoin as a haven, while Bouri et al (2017b) studied the safe haven properties of Bitcoin against several assets and found that the latter's safe haven property actually changes over horizons. Additionally, Bouri et al (2020) demonstrated that Bitcoin, Ripple and Stellar are safe havens for all US equity indices.

Since the onset of COVID-19, a small number of studies have been published on the safe haven features of cryptocurrencies and gold during this crisis (e.g., Dutta et al. (2020), Mariana et al. (2021), Conlon et al. (2020), and Jeribi and Manzli (2020)). However, these analyses compared the safe haven features of cryptocurrencies and gold separately; no empirical evidence supporting such a comparison during the epidemic has been revealed to date. Additionally, these studies were conducted over a short period of time; no one examined the influence in the year 2021; all of them concluded in April 2020. Furthermore, as Baur and McDermott (2010) noted, the safe haven properties differ by country. This fact piqued the interest of researchers from all around the world. While some studies explored the safe haven features of Gold or Cryptocurrencies in relation to the American Stock Market, none, to my knowledge, studied the French Stock Market which is what we explored in our robustness test.

This dissertation addresses a research gap by examining the safe haven features of cryptocurrencies and gold in light of COVID-19 and conducting an effect analysis. Additionally, we widen the scope of the research by addressing the following two questions: Are cryptocurrencies a safer

haven than gold for stocks during the COVID-19 pandemic? And how do cryptocurrency, gold, oil, and the number of COVID-19 cases affect the stock markets?

Using daily data from 29/01/2019 to 19/01/2021 which was divided in two subperiods (before and during the COVID-19 pandemic) to reflect the impact of the 2020 global pandemic, we find that before the COVID-19 cryptocurrencies (Binance Coin, Ripple, Tether and Dogecoin) as well as the Oil index (WTI) act as diversifiers while gold acts as a hedge. However, during the pandemic the cryptocurrencies (Bitcoin, Binance Coin, Ripple, Ethereum and Dogecoin), gold and the Oil index (WTI) act as diversifiers while Tether acts as a safe haven. In addition, our results indicates that the growth rate of COVID-19 confirmed cases hurts the stock market returns.

The rest of the paper is structured as follows: The next section reviews relevant literature that explains further the theories, the previous studies as well as the results found by researchers while the third section examines the research problem in which we deeply explain the research question and the different gaps found in the literature. The fourth section is about the methodology in which we present the hypothesis, the data set, the variables measurement as well as the volatility; as for the fifth section, it reveals the descriptive statistics. The sixth section presents the empirical results and the main findings while the seventh discusses the robustness test. The eighth and the last session is reserved for the conclusion.

## 2. Literature review

### 2.1. Blockchain

In this section we will explain blockchain technology and its different types. Furthermore, we will highlight its advantages with explanation of where it can be applied.

#### 2.1.1. What is blockchain?

Global interest in Blockchain has developed significantly over the last several years, as many analysts and experts realize that it has the potential to fundamentally transform a wide variety of corporate operations (Wright and Filippi, 2015).

It is true that many people associate blockchain technology with bitcoin. While this was initially the intent of blockchain, it is capable of so much more. Contrary to popular belief, there is not a single blockchain. The term "blockchain" refers to a collection of distributed ledger technologies that can be used to record and track virtually anything of value, from financial transactions to medical information to land titles. By enabling individuals to transfer a unique piece of digital property or data to another in a safe, secure, and immutable manner, the technology enables the creation of: digital currencies that are not backed by any government; self-enforcing digital contracts (dubbed smart contracts), the execution of which does not require human intervention; and decentralized marketplaces that aim to operate independently of any centralized authority (Benkler 2006).

The term "blockchain" refers to a decentralized transaction and data management technology (Yli-Huumo et al., 2016) that facilitates data exchange across multiple members in a network (Xu et al., 2017).

In other words, blockchain technology is a method of data structuring that does not require the intervention of a central authority. Prior to the blockchain's inception, it was simply not possible to coordinate individual Internet activity without a centralized entity verifying that the data was not tampered with. Without relying on a central authority to verify that this particular transaction was neither fraudulent or invalid, a collection of unrelated persons could not confirm that an event occurred (Wright and Filippi, 2015). Indeed, Blockchain technology is based on the peer-to-peer network concept, in which each node receives a copy of the previous node (Zheng et al 2017) In such a way that each node in the network must verify the other node, this technique eliminates the need for a middleman (Karafiloski 2017).

Additionally, blockchain is referred to as a database that securely saves and manages client information. Rather than a single register, a blockchain stores information in batches called blocks. Each block is then "chained" to the next in a sequential, linear space to form a chain of blocks. Each block contains information about a specified number of transactions, a reference to the block preceding it on the blockchain, and an answer to a complex mathematical puzzle that is used to confirm the data included in that block. Each computer in the network stores a copy of the blockchain, and these machines periodically synchronize to ensure that they all have the same shared database. Once a block is uploaded to the blockchain, it cannot be erased, and the transactions contained within can be read and validated by everyone on the network. It creates a permanent record that can be accessed by any computers on the network to coordinate actions or verify events. (Wright and Filippi, 2015).

Blockchain technology is regarded as extremely safe because it compels information going over a network of computers to become more transparent and verifiable by solving mathematical problems that demand significant processing power. This makes it more difficult for potential attackers to compromise a shared database by inserting false data. (Wright and Filippi, 2015). Thus, in summary, data altering is not simple in this technique (Ekblaw et al 2016).

### **2.1.2. Blockchain advantages**

Blockchain technology has a large set of advantages that can present to individuals and businesses. They are generally clustered in seven groups: autonomy, security, transparency, trustworthy, traceability, automation and accountability.

#### **Autonomy**

The blockchain technology is a decentralized system, which is its primary advantage. Collaboration with a third-party organization or the central administrator is not required. (Bahga 2016) This indicates that the system operates without the use of an intermediary, which safeguards the system against corrupted nodes.

#### **Security**

The high secure of the Blockchain technology is achieved on the individual entry into the network. Because each person who enters the Blockchain is provided with the unique identity which is linked to

his account. Another reason of the Blockchain security is the reliable chain of the cryptographic hash. When new block is created, it is necessary to calculate hash value for the new block. The new hash surely includes the previous hash's value. In general, the hash consists of the type, the block's ID number, the previous hash's value, the time when block was created, the user ID number, the miner's level and the Merkle root where is stored the information about previous transactions and its hashes. This hash is generated automatically by the node-key. In this case, it is impossible to change any information in the hash value. (DataFlair 2018)

Additionally, transactions must be agreed upon prior to recording. Once a transaction is accepted, it is encrypted and associated with the preceding one. This, combined with the fact that data is stored on a network of computers rather than a single server, makes it extremely difficult for hackers to corrupt transaction data. In any business where sensitive data protection is vital — financial services, government, healthcare — blockchain technology has the potential to fundamentally alter how essential information is exchanged by assisting in the prevention of fraud and illegal activity (PwC, 2017).

### **Transparency**

Each action is recorded on the Blockchain, and the data associated with those recordings is accessible to all Blockchain participants and cannot be altered or deleted (Bahga 2016). Indeed, the adoption of blockchain technology makes the history of transactions more transparent. Due to the fact that blockchain is a distributed ledger, all network participants have individual copies of the same documents. This collaborative version is only modifiable by agreement, which means that everyone agrees on it (IBM, 2018). Transparency, immutability, and trustworthiness are all attributes of the Blockchain as a result of this recording.

### **Traceability**

The Blockchain is designed in such a way that it can detect and repair any errors. This advantage enhances the traceability of the Blockchain technology (Data Flair 2018)

### **Automation**

By establishing rules upstream via smart contracts, blockchain participants can automate settlement and transaction execution (PwC, 2017).

## **Accountability**

“Each blockchain participant has rights and obligations with regard to the blockchain community” (PwC, 2017). Each transaction in this system must be acknowledged by other nodes, which results in the blockchain's accountability. (Karafiloski 2017)

### **2.1.3. Blockchain applications**

#### **Financial applications**

Digital currencies such as Bitcoin were one of the first implementations of blockchain technology. Bitcoin, which was launched in 2009 by Satoshi Nakamoto (a pseudonymous individual or group), relies on a decentralized blockchain to create a digital currency that, unlike the US dollar, is not backed by any bank or government. (Nakamoto, 2008).

At the moment, blockchain technology is being applied to a broad range of financial sectors, including business services, asset settlement, prediction markets, and economic transactions (Haferkorn and Quintana Diaz, 2015). Blockchain is projected to play a critical role in the global economy's sustainable development, benefiting customers, the current banking system, and society as a whole (Nguyen, 2016).

Additionally, financial-related topics may include syndicated loans contingent convertible bonds, commercial property and casualty claims processing, automated compliance, proxy voting, asset rehypothecation, and over-the-counter market (McWaters et al., 2016). Finally, the financial sector's adoption of blockchain technology will result in cost savings in areas such as centralized operations, central finance reporting, compliance and business operations (Accenture, 2017).

#### **Integrity verification**

Integrity verification is one of the newest blockchain-related fields (Bhowmik and Feng, 2017). Applications for blockchain integrity verification hold data and transactions relating to the development and lifecycle of items or services. There are several potential uses, including (i) provenance and counterfeit detection, (ii) insurance, and (iii) intellectual property (IP) management.

IP protection apps are a subset of blockchain applications that require integrity verification (Kishigami et al., 2015). As Swan (2015) states, the phrase "digital art" relates to intellectual property (IP), not simply to online artworks, and so blockchain technology can be understood to encompass all of

these cases (McConaghy et al., 2017). Advanced systems such as Ascribe (Ascribe, 2014) and Media chain (Labs, 2016) leverage the Bitcoin blockchain to connect digital content creators to their content.

Kim and Laskowski (2016) offer an ontology for automatically storing and interpreting data in the context of data provenance and integrity. The authors assert that SCs are inextricably linked to ontologies and that such systems can be tailored to a particular topic. Counterfeit systems such as Everledger (Lomas, 2015) and Blockverify (Blockverify, 2015) leverage blockchain and SCs to protect banks and insurers from fraud and to increase supply chain transparency, respectively.

The insurance business has recently increased its focus on blockchain technology in a range of sectors, including sales, underwriting, customer onboarding, claims processing, payments, asset transfers, and reinsurance (Cognizant, 2017). For example, European insurers recently created the B3i-a blockchain industry effort dedicated to examining how blockchain technology may be utilized to build processes and standards for widespread adoption and to expedite efficiency advantages in the insurance business (Cognizant, 2017).

## **Governance**

Throughout history, governments have been charged with the responsibility of managing and preserving official records pertaining to both residents and/or businesses.

By disintermediating transactions and record keeping, blockchain-enabled applications have the potential to fundamentally alter how governments operate at the local or state level (Hou, 2017). The accountability, automation, and security that blockchain provides for the management of public documents may someday hinder corruption and improve the efficiency of government services. Blockchain technology, in particular, has the potential to act as a secure communication platform for integrating physical, social, and business infrastructures in a smart city setting (Jaffe et al., 2017).

## **Internet of things**

The growing interest in and investment in decentralized IoT platforms (Novo, 2018) is primarily motivated by blockchain technology and its inherent potential (Christidis and Devetsikiotis, 2016). The central concept is to enable secure and auditable data sharing in heterogeneous context-aware scenarios (Casino et al., 2017) involving a large number of connected smart devices (Crosby et al., 2016).

Additionally, operating in an automated and decentralized form enables the network to be very scalable and manageable (Sharma et al., 2018).

## Privacy and security

When paired with other efficient storage systems that employ data mining methods, blockchain is viewed as a potential for boosting the security and scalability of big data (Puthal et al., 2018; Bozic et al., 2016). As a result, the literature contains applications centered on privacy and security that utilize blockchain technology (Anjum et al., 2017).

Through hardware and software solutions, blockchain technology can also be utilized to improve the security and stability of distributed networks (Suzuki and Murai, 2017). For example, SIRIN LABS (Labs, 2014) created the world's first blockchain-based smartphone capable of rapid, fee-free, and secure transactions.

## Healthcare management

Blockchain technology has numerous applications in the healthcare industry, including public health management, longitudinal health records, automated health claims adjudication, online patient access, patient data sharing, user-oriented medical research, drug counterfeiting, clinical trials, and precision medicine (Mytis-Gkometh et al., 2017). In particular, blockchain technology and the use of SCs have the potential to address issues related to the scientific credibility of clinical trial findings (missing data, endpoint switching, data dredging, and selective publication) (Nugent et al., 2016), as well as issues related to patient informed consent (Benchoufi et al., 2017)

## 2.2. Cryptocurrencies

### 2.2.1. What is cryptocurrency?

Cryptocurrencies are a new sort of digital asset that works as currency through the use of distributed cryptographic protocols rather than physical material and a centralized authority. Although Bitcoin (BTC) was the first cryptocurrency to acquire popularity, hundreds of other cryptocurrency coins (dubbed "altcoins") have been developed subsequently. (Krafft et al., 2018).

In fact, Nakamoto created Bitcoin in 2009 and first issued 50 Bitcoins. During this early stage, the excitement was dismissed by all but the most ardent computer aficionados worldwide (Wallace, 2011).



A cryptocurrency is a digital token created by cryptographic algorithms. Following that, this token is distributed throughout cyberspace using peer-to-peer networking protocols. Its value is governed mostly by the demand and supply of such tokens, and a big part of its appeal originates from the decentralized nature of the system. The broader debate about cryptocurrencies has resulted in varying degrees of support for the creation, with certain regulators being extremely dubious, while the Financial Technology community has raised questions about cryptocurrencies' eventual general adoption (Bryans, 2014).

According to Bohme et al. (2015), the scarcity of bitcoin determines its value. It establishes the foundation for valuing any sort of money. For instance, in the usual approach of deploying fiat currency, the monetary authority or central bank keeps and reserves the money. The central bank of a country has the jurisdiction to regulate both the circulation and actual quantity of money. The bank can only print a finite number of these paper currencies for the purpose of managing a country's fiscal economics, thereby generating scarcity. The bank's bookkeeping will reflect this shortage, which will be protected by legal obligations.

Bohme et al. (2015) also suggested that cryptocurrency, notably Bitcoin, is more of a payment platform than a currency, owing to its real-time conversion to a traditional currency with a set value. This cryptocurrency is unique in comparison to other assets because to its portfolio analysis, risk management, and sentiment analysis capabilities (Dyhrberg, 2016). In comparison to other assets such as gold, real estate, stocks, and equities, cryptocurrency does have a similar portfolio in terms of value. However, cryptocurrency is similar to human feeling in that its value increases as more people accept it as payment. These distinctions generate a plethora of opportunities for investors and stakeholders alike. As such, recognizing Bitcoin as a viable alternative to fiat money in contemporary economics is premature and requires additional application, conceptual, and practical understanding.

Cryptocurrency and other forms of digital money, such as bank deposits, are often files on computers that people believe have a specific value and are therefore considered money. Money's nature is based on the establishment of trust between strangers who trade with it. One must have confidence that people will take their money in the future and that the money will retain a certain worth to be used in future transactions (Camera, 2017). Money serves three purposes. Asmundson and Oner (2012) define these functions as a store of value, which is saving, a unit of account, which provides a common basis for prices, and a medium of exchange, which is trading.

Given the prospect of such a rapid rise, Gans and Halaburda (2013) examine whether these cryptocurrencies require regulation and control. According to the authors, the majority of these company-issued cryptocurrencies are essentially subsidies for customers to join in the network or platform, such as Amazon coins and Kindle. Additionally, this approach is less expensive for the business, as these currencies must be spent on products on the platform, such as Amazon, rather than on an external object or service. For non-platform-specific cryptocurrencies, such as Bitcoin, Gans and Halaburda (2013) note that these currencies can have an effect on price stability, financial stability, and payment stability. As a result, there may be a basis for additional regulation.

### **2.2.2. The main cryptocurrencies**

#### **Bitcoin (BTC)**

Following its invention, Bitcoin became the most talked-about cryptocurrency. It was a leader in the cryptocurrency sector, gaining widespread attention throughout 2014. The currencies that emerged following the invention of Bitcoin are frequently referred to as "altcoins" or "silver Bitcoins." In fact, Bitcoin is the most widely acknowledged cryptocurrency, and it is also the most valuable of all digital currencies. Additionally, Bitcoin is a wholly electronic virtual currency that is not backed by tangible commodities or government obligations; rather, it is protected by cryptography and relies on a peer-to-peer system for witnessing settlements. (Meiklejohn et al. 2016). Additionally, Bitcoin is the most widely used virtual currency that utilizes digital currency units and works directly between users without the involvement of a bank or other institution. (Abboushi 2017). Finally, we may state that Bitcoin is an "open platform for value exchange, a protocol-based system on which multiple applications can be developed." (Pirjan et al. 2015)

#### **Ethereum (ETH)**

Ethereum, the first Bitcoin alternative on our list, is a decentralized software technology that allows the development and execution of Smart Contracts and Decentralized Applications (DApps) free of downtime, fraud, control, or intervention from a third party. Ethereum's goal is to establish a decentralized suite of financial products that anybody on the planet can access regardless of nationality, ethnic origin, or religious affiliation. This feature strengthens the ramifications for those living in certain countries, as

those lacking governmental infrastructure and identification can obtain bank accounts, loans, insurance, and a number of other financial items.

### **Binance Coin (BNB)**

Binance Coin is a utility cryptocurrency that may be used to pay for trading costs on the Binance Exchange. Those who pay with the token can trade at a discount. Binance Coin's blockchain also serves as the foundation for Binance's decentralized exchange. Changpeng Zhao developed the Binance exchange, which is one of the most widely utilized in the world in terms of trade volume. (Investopedia,2021)

### **Tether (USDT)**

Tether was one of the first and most popular stable coins, which are cryptocurrencies that attempt to decrease volatility by pegging their market value to a currency or other external reference point. Due to the fact that the majority of digital currencies, including large ones like Bitcoin, have undergone regular times of extreme volatility, Tether and other stable cryptocurrencies seek to smooth out price variations in order to attract consumers who may otherwise be skeptical. Tether's price is exactly proportional to the value of the US dollar. The mechanism enables users to make transfers from other cryptocurrencies to US dollars more easily and quickly than they could by actually converting to regular currency. (Investopedia, 2021)

### **Ripple (XRP)**

Although Ripple is best recognized for its digital payment network and protocol, the company also has its own cryptocurrency, XRP. Ripple's primary procedure is a payment settlement asset exchange and remittance system comparable to the SWIFT system used by banks and financial middlemen for international money and security transfers. Rather than relying on blockchain mining, Ripple confirms transactions using a consensus mechanism involving a group of computers. Ripple transactions consume less energy than Bitcoin transactions, are confirmed in seconds, and have a low transaction cost, in comparison to Bitcoin transactions, which consume more energy, take longer to process, and have a high transaction cost. (Investopedia, 2021)

## **Dogecoin (DOGE)**

Jackson Palmer and Billy Markus founded Dogecoin, an open-source cryptocurrency, in 2013. Dogecoin began as a joke, but quickly garnered a following. By late 2017, it had been a participant in the cryptocurrency bubble that saw the value of numerous cryptocurrencies skyrocket. Dogecoin's value plummeted in the aftermath of the 2018 bubble crash, but it retains a core of fans who trade it and use it to tip content on Twitter and Reddit. On digital currency exchanges, users can purchase and sell Dogecoin. They can store their Dogecoin either on an exchange or in a Dogecoin wallet. (Investopedia, 2021)

### **2.2.3. Challenges faced by cryptocurrencies**

#### **Crash and Bubble**

According to Fama (1970), an efficient market exists when sufficient historical information is available to adequately reflect historical pricing. Cryptocurrency is considered a weak kind of commodity since investors are unable to forecast the future due to a lack of historical data (Urquhart, 2016). This is especially true given that bitcoin only began in 2009, over a decade ago. An investment made in this short period of time has no precedent, and investors cannot rely on history to determine whether the investment will be profitable. According to Fry and Cheah (2015) and Urquhart (2016), if cryptocurrencies had a proper form of account and a means of storing value, it would be less volatile. For example, the risk of crashes and bubbles. Cryptocurrency is expected to reach its bubble peak in the near future. Despite this, no real bubble has formed that would eventually devalue Bitcoin or any other cryptocurrency. (Muhammad Ashraf Fauzi and Norazha Paiman, 2020)

#### **Electricity Bills**

Apart from the initial investment in technology, the other significant expense a miner incurs is energy consumption (Hayes, 2017). It has been determined that mining digital currency consumes more electricity than the rewards associated with solving a block (O'Dwyer & Malone, 2014).

Vranken (2017) emphasized the long-term viability of cryptocurrencies. He discovered that proof of work mining these digital currencies consumes a lot of energy and takes a lot of computing power. Nonetheless, these advanced machines, which include CPUs and GPUs, are required for mining within the blockchain in order to avoid double spending, which is a security concern.

Becker et al. (2013) quantified the cost of bitcoin mining. Due to the fact that the great majority of these currencies use proof of work, they require a significant amount of power to perform the mathematical work required by the hardware involved. This is particularly detrimental in large-scale mining operations. This, in turn, will portray cryptocurrency mining as the villain, as it will contribute to carbon dioxide emissions and ultimately destroy the globe due to global warming.

## Law

The central bank has complete authority over all policies and the results of a country's monetary policy. In terms of cryptocurrency, anyone can create several accounts at no cost. There are no centralized screening procedures in place, and participants are not required to use their true names (Böhme et al., 2015). This method is quite ambiguous, as the assumption of illegal activity behind all bitcoin registration and trade could be a hoax in some way. Being anonymous on the internet provides the ideal environment for thieves and fraudsters to commit their crimes. Cybercriminals would exploit this trading site to conduct illegal activities, including scamming and cheating. According to Kethineni et al. (2017), cryptocurrency is more likely to be utilized by criminals in money laundering and drug trafficking. Despite the fact that blockchain technology was designed to make life easier for consumers worldwide, criminals will always find methods to profit.

### 2.2.4. Opportunities and advantages of cryptocurrencies

#### High security

Cryptocurrency algorithms are more secure and efficient than credit card transactions. Even though it is still in its infancy, Bitcoin boasts significantly cheaper transaction fees due to the safe transactions it enables. Van Alstyne (2014) argued that using Bitcoin makes transactions safer. The methodology for transferring Bitcoin is through buyer and seller authentication. Both parties' authentication will prevent fraudsters from creating new transactions or delaying refund operations. In comparison to credit cards, these forges have occurred and will continue to occur due to the credit card's system (Van Alstyne, 2014).

Chokun (2014) emphasized that bitcoins are entirely anonymous and private when used in specific bitcoin transactions. The author continued by stating that, unlike bank-to-bank payments, which can be recorded and recognized, bitcoin transactions cannot be tracked or traced. According to him, the only addresses that can be known are those of the bitcoin wallets to which the payment was delivered and

received. He also said that; nonetheless, the owners of these addresses remain unknown. It's similar to how payments to a certain bank account may be tracked but the owners of these accounts are unknown. However, if a person uses the same bitcoin address for all transactions for an extended length of time, the person can be followed.

### **Cost of Transaction**

Due to the low transaction costs associated with cryptocurrency and Bitcoin, they are less expensive than other conventional currencies. With the major characteristics of bitcoin, decentralization and deregulation, which contribute to its low transaction costs (Kim, 2017). There have been numerous problems with the present payment system, which is based on credit and payroll cards. Interest charges on late payments are far too expensive, and can plunge a user into financial despair (Angel & McCabe, 2015). This has not been the case with cryptocurrencies, where trading takes place only if end-to-end users agree, and only then is money sent.

Additionally, cryptocurrency can be operated 24 hours a day, seven days a week, 365 days a year. The data pricing is available immediately, allowing everyone in the world to trade for free as long as they have access to the internet (Pieter & Vivanco, 2017).

Bitcoin transactions, according to Blatchford (2015), are extremely rapid when compared to traditional banking channels. He continued by stating that a bitcoin transaction is as quick as an e-mail and can be completed in less than ten minutes. Christin (2012) backed this up by stating that bitcoins can be handled instantly if they are “zero-confirmation” transactions, which means the merchant assumes the risk of accepting a transaction that has not been validated by the bitcoin blockchain. Feuer (2015) stated that while Credit Card and digital wallet services offer rapid accepted transfers, they typically require a high cost, which is not the case with Bitcoin. Bitcoin has extremely cheap transaction costs, despite its lightning-fast processing speed.

### **High Return**

The special characteristics of cryptocurrencies and its adaptability to economic functions make it a one-of-a-kind asset (Briere et al., 2015). Bitcoin's history demonstrates that it is a highly volatile currency with a high rate of return for investors. Apart from that, the risk associated with Bitcoin is modest due to its inclusion in numerous and diverse portfolios.

Ha and Moon (2018) applied genetic programming to analyze the profit pattern associated with cryptocurrency investing. The finding indicates that the pattern analyzed contained numerous profitable

signals. It was also simulated in trading with the pattern, and the signals indicate that it can be beneficial for any given bitcoin portfolio. Hong (2017) demonstrated the significance of Bitcoin's recovery using time series momentum. For a period of eight weeks, it was discovered that Bitcoin offered a high rate of return. The prediction was supported by evidence of empirical return continuance and reversal, as well as the predictability of the time series.

The special characteristics of cryptocurrencies and its adaptability to economic functions make it a one-of-a-kind asset (Briere et al., 2015). Bitcoin's history demonstrates that it is a highly volatile currency with a high rate of return for investors. Apart from that, the risk associated with Bitcoin is modest due to its inclusion in numerous and diverse portfolios. As investors are well aware, the only way to earn from investment is to purchase commodities at a discount and sell them at a premium. For individuals who invested in Bitcoin during its early stages of development, they may have harvested and profited from 1000-10000 percent returns on their investment (Bohme et al., 2015).

## 2.3. Gold

### 2.3.1. Background information

For numerous reasons, gold has been acknowledged as a worldwide medium of exchange. Gold's characteristics include its indestructibility, beauty, and rarity in comparison to other metals (Mani and Vuyyuri 2005). Additionally, the presence of enormous aboveground reserves distinguishes gold as a unique commodity, as it may be readily reintroduced to the market in response to excess demand or supply shocks. Another advantage of gold is its low cost of storage (Theal, 2009).

Moreover, we must mention that gold stands out among all precious metals and is the most popular investment choice. It has stood the test of time and performed admirably in times of market downturn, currency failure, severe inflation, and war. Gold is largely used to make jewelry, coins, medals, and electronic components. However, governments, organizations, and individuals worldwide use it as an investment to protect real value against inflation, financial crises, and other risks (Wang et al., 2011) For example, although financial markets in the United States fell precipitously between July 2007 and March 2009, gold prices increased by 42% during the same period (Baur and McDermott, 2010).

Although gold is no longer a major pillar of the international monetary system, as a so-called 'asset without a country' (Dooley et al., 1995), it continues to garner substantial interest from investors and

researchers. Due to the increased instability in financial markets, portfolio diversification through hedging becomes increasingly critical (Beckmann et al., 2015).

### **2.3.2. The Role of Gold as an Investment Asset**

#### **Diversification benefits of gold**

Gold enables investors to diversify their asset allocation by including assets that fit their risk profile. By incorporating a commodity component into the portfolio, it creates an optimally diversified portfolio. Numerous studies have been conducted on gold as an investment asset. For instance, Chua et al. (1990) investigated the possibilities of diversifying a portfolio using gold stocks and concluded that investors can rely on gold as a valuable asset for portfolio diversification in both the short and long term. Dempster and Artigas (2010) examined the investment viability of gold in comparison to commodities, real estate, and inflation-linked bonds and concluded that gold is the most effective portfolio diversifier among these assets, which are commonly referred to as inflation hedges by US investors. Additionally, Dempster and Artigas (2010) observed that the strategic rationale for gold is mostly based on its efficacy as a portfolio diversifier.

#### **Protection against inflation**

Adrangi et al. (2003) examined the relationship between the returns on gold and silver and inflation in the United States. They discovered a positive link between projected inflation and the price of gold. The positive association is explained by the fact that gold prices rise as a result of increased demand generated by inflationary fears. This indicates that gold's value will tend to rise in tandem with inflation, thereby preserving its purchasing power over time. This protects the portfolio against the negative effects of inflation and depreciation of buying power. There appears to be widespread agreement on the positive correlation between gold and inflation.

#### **Gold and Economic activity**

Worldwide, economies undergo cycles. Investors should be aware of when it is advantageous to hold gold in order to avoid significant losses and when it is better to reduce exposure to the metal in order to profit from rising equity prices. Riley (2010) showed, for example, that financial assets (such as stocks and property) outperform commodities (such as gold and silver) during periods of economic expansion and those financial assets outperform commodities during periods of economic collapse. Constable and



Wright (2011) argued that investors should avoid gold purchases when the economy is strong, the financial system is stable, and the world is not undergoing big upheavals. As a result, gold can be used as a barometer of emotions. As a result, the gold price is recognized as a leading economic indicator.

### **Gold and gain of time**

Commodity investing does not require extensive study, as it is typically done to profit from long-term market trends rather than focusing on specific individual investments. In comparison, when individuals buy in stocks and bonds, they frequently must evaluate numerous research papers and, for more involved investors, examine financial statements and possibly perform proprietary research (Frush, 2008)

## **2.4. Safe Haven, Hedge and Diversification Properties**

### **2.4.1. Theoretical Framework**

The theoretical argument that serves as the foundation for the accompanying study was stated as follows by Baur and Lucey (2010) which is when investors add an asset to their portfolios that explicitly reduces losses during periods of market stress or upheaval by a greater percentage than hedge or diversifier assets, the severity of shocks lessens, hence boosting capital market stability. This is the fundamental concept underlying a safe haven asset.

Indeed, Baur and Lucey (2010) recognized three distinct characteristics: hedge, diversification, and safe haven.

### **Hedge**

On average, a hedged asset is uncorrelated or negatively associated with another asset or portfolio. It lacks the feature of mitigating losses during periods of market stress or turbulence, as the asset may have a positive correlation at such times and a negative correlation during normal times, with a negative correlation on average.

## Diversifier

On average, a diversifier is an asset that is positively associated with another asset or portfolio (although not exactly). As with the hedge, the diversifier does not have the property of mitigating losses under really severe market conditions, as the correlation property is necessary only on an average basis.

## Safe Haven

The primary characteristic of a safe haven asset is its negative correlation with a portfolio during periods of market stress. On average, an asset is not compelled to be either negative or positive. It will never be zero or negative save for brief intervals. Thus, under normal market conditions, the probability of a correlation exists in either direction. If the haven asset is negatively associated with other assets or portfolios, the probability of compensating the investor for losses is increased during unfavorable market conditions. The compensation is necessary since the price of the haven asset increases every time the price of the other asset or portfolio declines. In other terms, a haven asset is a safe haven that assists investors with protection (i.e., non-negative returns) during times of market stress.

## Safe Asset vs Safe Haven Asset

It is critical also to understand the distinction between a "safe haven asset" and a "safe asset." The concept of a "safe asset" - defined by Gorton et al. (2012) as an asset whose value is unaffected by information - can be easily identified from that of a "safe haven" asset, which, as previously stated, is defined by its relationship to other assets over time and is thus dependent on information flows. As mentioned above, the safe haven effect is primarily a transitory phenomenon in comparison to the long-term features of secure assets. In other words, a safe asset is secure at all times, whereas a safe haven asset is secure (and must be secure) only during moments of crisis or chaos.

## Prospect Theory

Actually, the focus of a haven asset during times of market stress suggests that investors react differently during normal times and during periods of significant market stress. Prospect theory provides an almost natural framework for such a study, as it openly evaluates gains and losses. Prospect theory postulates that individuals value gains and losses differently, and hence make decisions based on perceived rewards rather than actual losses. Also known as "loss aversion," the broad premise is that when an individual is faced with two equal alternatives, one offered in terms of prospective profits and the other offered in terms

of prospective losses, the former option will be chosen (Investopedia, 2021). Indeed, Baur and Lucey (2010) demonstrated that an investor's utility increases when she adds a safe haven asset to her portfolio.

They demonstrated that this is valid both in terms of expected value and prospect theory. Additionally, their findings suggested that the evidence is stronger when viewed through the lens of prospect theory. Thus, prospect theory provides an advantageous theoretical foundation for analyzing the presence of a safe haven.

### **Modern Portfolio Theory**

Modern portfolio theory (MPT) is a theory that describes how risk-averse investors might create portfolios that maximize anticipated return given a certain amount of market risk. (1952, Markowitz). According to this theory, exposure to individual asset risks can be mitigated by investing in a diverse portfolio of assets; the less linked (or independent) the assets, the lower the portfolio's systematic risk and the more diversified the portfolio. In reality, a frequent method of portfolio diversification is worldwide diversification (Heston and Rouwenhorst 1994), which is accomplished by simply holding global equities. However, because the global stock market continues to share some risk variables and stock market collapses are contagious, this diversification may not be sufficient to eliminate systematic severe risks.

Due to the fact that cryptocurrencies are considered a new class of investment assets or alternative assets, investors should pay close attention to the investment risks associated with them, as well as their relationship to other assets, most notably their diversification and safe haven capabilities during times of financial crisis.

#### **2.4.2. Empirical studies of cryptocurrencies**

Numerous researches on the investment benefits of cryptocurrencies, including their hedging and diversification features, have been conducted in response to their growing popularity. Indeed, Bouri et al. (2017a) examined whether Bitcoin may be used to hedge global uncertainty from 17 March 2011 to 1 January 2016. They demonstrated unequivocally that Bitcoin is capable of hedging against both extremes of the Bitcoin market and global uncertainty over shorter investment horizons.

Several researches evaluated bitcoin's hedging capabilities against stock markets, such as Dyhrberg (2015), who examined Bitcoin's hedging capabilities against equities in the Financial Times Stock Exchange Index and the US dollar from 19/07/2010 to 22/05/2015. The results demonstrated

unequivocally that Bitcoin possesses hedging capabilities against the FTSE Index and indicated that Bitcoin can be utilized as a short-term hedge against the dollar. Additionally, Chan et al. (2018) investigated whether Bitcoin might dynamically diversify and hedge risk against the Euro STOXX, Nikkei, Shanghai A-Share, S&P500, and TSX indexes. They indicated that Bitcoin is an effective strong hedge for all indices with monthly (respectively, daily and weekly) data.

Other authors desired to investigate similar qualities in relation to a variety of assets and commodities. For example, Bouri et al. (2017b) demonstrated that Bitcoin was a poor hedge against various assets (e.g., major international stock indices, bonds, gold, and oil) for the period 07/2011–12/2015 and might be deemed an effective diversifier in the majority of cases. While Wang et al. (2019b) investigated the spillover effects of Bitcoin on other assets in China and evaluated Bitcoin's hedging capabilities. They discovered that it is possible to hedge Bitcoin against bonds, stocks, and the Shanghai Interbank Offered Rate (SHIBOR). Additionally, Corbet et al. (2018) examined the correlations between cryptocurrencies and a variety of financial assets. They reported that bitcoin markets can be regarded a new financial asset class due to its interconnected nature and resemblance to other asset classes' patterns of connectivity. Moreover, Ghabri et al. (2020) analyzed the relationship between Bitcoin and certain financial assets (MSCI world stock index, gold, crude oil and GEISAC Index). They showed unequivocally the existence of a possible benefit in diversifying liquidity risk through the use of Bitcoin rather than traditional assets. Furthermore, Rehman (2020) studied the excessive reliance on and risk spillover between Bitcoin and commodities (gold, silver, copper, wheat, platinum, and palladium) from 04/2013 to 01/2018. The empirical evidence demonstrated gold's ability to act as a hedge against Bitcoin.

It should also be mentioned that some researchers investigated the hedging and diversification probabilities against world currencies. For example, Majdoub et al. (2021) explored the feasibility of hedging Bitcoin with selected fiat currencies (EUR, JPY, and GBP) in light of Bitcoin's high and persistent volatility. Further, the data indicated that hedge ratios varied over time, implying a constant need for rebalancing hedged holdings under various parameters. Indeed, employing multiple models that account for distinct features of volatility and correlation structures enables the implementation of dynamic hedging techniques to be improved. On the other hand, Urquhart and Zhang (2019) examined whether Bitcoin can be used as a hedge or as a counter-currency to global currencies. They proved, using the ADCC model, that Bitcoin can be used as an intraday hedge for the CHF, EUR, and GBP, as well as a diversifier for the AUD, CAD, and JPY.

Whereas much research has largely investigated the diversifier and hedge capabilities of cryptocurrencies, some papers have focused on its safe haven property. For instance, Bouri et al. (2016) demonstrated that Bitcoin possessed safe haven characteristics throughout the pre-crash era. Such propriety, though, tends to fade away following the 2013 price drop.

Same as with the hedging and diversification properties, we find that some authors focused on the safe haven of cryptocurrencies against stocks, some studied them against different kinds of assets while others investigated the properties against world currencies.

Feng et al. (2018), for example, employed an extreme-value theory-based technique to assess the extreme characteristics of seven typical cryptocurrencies between 08 August 2015 and 01 August 2017. They observed that both Bitcoin and Ethereum's left tails are statistically tail independent of the left tails of all six indexes, implying that some of the cryptocurrencies' safe-haven quality is inherent in their left tails. The estimation results indicated that a major shortage in one stock market indicates a greater likelihood of a shortfall in another stock market, but not in cryptocurrencies. Christy et al. (2020) also examined the use of Bitcoin and Ethereum as stock market safe havens. They discovered that the two major cryptocurrencies provide good short-term safe havens. The DCC and cDCC data indicate that their daily returns tend to correlate negatively with the S&P500's daily return during a pandemic. Additionally, the regression results substantially validated the safe-haven characteristics and revealed that Ethereum may be a superior safe-haven than Bitcoin. They did highlight, however, that both coins had a considerable degree of volatility. Kliber et al. (2019) also examined Bitcoin's hedge, diversifier, and safe haven properties on several stock markets. They did so by estimating the dynamic conditional correlation between the major stock indices and the Bitcoin price (in local currencies), as well as the dynamic conditional correlation between the major stock indices and the Bitcoin price (in the US dollar). Bitcoin appears to play a variety of roles depending on the state of the stock market. Furthermore, Bouri et al. (2020) investigated the safe haven and hedging properties of many digital currencies in the face of adverse market volatility in the S&P500 and ten equity sectors. They argued that Bitcoin, Ripple, and Stellar are safe haven assets for all US equities indexes, whereas Litecoin and Monero are safe haven assets for the aggregate US equity index and certain sectors.

When it comes to Bitcoin's safe haven properties in comparison to various assets (e.g., major international stock indices, bonds, gold, and oil), Bouri et al. (2017b) discovered that, in a few cases, Bitcoin's safe haven properties vary across time horizons. While Wang et al. (2019b) examined the

spillover effects between Bitcoin and other assets in China and assessed Bitcoin's safe haven and hedging properties, they discovered that Bitcoin appears to be a safe haven against adverse price changes caused by monetary policy. They used the VARGARCH-BEKK model to analyze the mean and volatility spillover effects and correlation structure between Bitcoin and other assets. In addition, Selmi et al. (2018) investigated the relationship between Bitcoin and crude oil in order to determine Bitcoin's safe haven and hedging properties. They demonstrated that both Bitcoin and gold may act as hedges, safe havens, and diversifiers against the volatility of oil prices. Such proprieties appear to be conditional on the state of the Bitcoin, gold, and crude oil markets (bear, bull and normal phases).

Moving on to safe-haven against foreign currencies, Urquhart and Zhang (2019) investigated the interactions between Bitcoin and other currencies on an hourly basis, owing to Bitcoin's extreme volatility. They demonstrated, using the ADCC model, that Bitcoin can be used as an intraday hedge for the CHF, EUR, and GBP, as well as a diversifier for the AUD, CAD, and JPY. Further, they used the non-temporal Hansen (2000) test to determine Bitcoin's safe-haven characteristics, concluding that Bitcoin is a safe haven currency during moments of high market upheaval for the CAD, CHF, and GBP.

In contrast, we find some studies that argued against cryptocurrencies being a safe haven. Indeed, Smales (2019) argued that Bitcoin is more volatile, less liquid, and more expensive to transact than other assets, and that these characteristics preclude it from serving as a safe haven asset. Klein et al. (2018) compared the hedging and safe haven features of gold and Bitcoin, discovering that the latter is positively correlated with declines in developed markets. Certain skeptics have emphasized the danger of using cryptocurrencies as financial assets in the first place, owing to the product's immaturity, the prevalence of unlawful transactions, and financial misappropriation (Corbet et al., 2019a, b). The evidence for speculative behavior in cryptocurrencies, as manifested by bubbles (Gandal et al., 2018; Corbet et al., 2018), may further cast doubt on their potential to function as a safe haven.

Last but not least, we found some studies that studied that tried to know if cryptocurrencies are in fact safe haven during the covid 19 pandemic or not. Indeed, Conlon and McGee (2020) examined Bitcoin during the Covid-19 bear market to determine whether it acts as a safe haven or a harmful hazard. They observed that Bitcoin does not operate as a safe haven, but rather declines in price in lockstep with the S&P 500 as the crisis progresses. Their empirical findings raised doubt on Bitcoin's ability to provide a haven from traditional market turmoil. Also, Conlon et al. (2020) attempted to address the study question of whether or not cryptocurrencies constitute a safe haven for equities markets. They conducted an international analysis of the covid-19 epidemic and revealed that Bitcoin and Ethereum are not a safe

haven for the majority of the foreign equity markets they analyzed, with their inclusion increasing portfolio downside risk. Only investors in China's CSI 300 index benefitted from slight downside risk reduction (contingent on very limited allocations to Bitcoin or Ethereum). Finally, Shahzad et al. (2020) evaluated gold and Bitcoin as safe haven and hedging assets for the G7 stock markets, concluding that gold and Bitcoin have distinct safe haven and hedging characteristics. Gold is unquestionably a safe haven and a hedge for numerous G7 stock indices, whereas Bitcoin serves the same function in Canada.

### **2.4.3. Empirical Studies of Gold**

Among commodities, gold has long been regarded as a safe haven, but this hypothesis has not been tested until lately.

In fact, throughout eras of economic and political stability, gold was frequently regarded as a safe haven (Adrangi et al 2003). We come across Baur and McDermott (2010), who examined the effects of gold on financial markets prior to the financial crisis, spanning the years 1979 to 2009. Their findings demonstrated that gold functions as a hedge and a safe haven in the US and most European countries' stock markets. Ibrahim (2012) also analyzed the relation between gold and stock market returns from a Malaysian perspective. He investigated the variability of gold and stock market returns during repeated periods of negative market returns by using an autoregressive distributed model to link gold and stock market returns using the TGARCH/EGARCH error specification. He examined daily data from August 2001 to March 2010 and discovered a large positive association between gold and stock returns but a poor correlation between gold and stock returns. Additionally, he noted that when the gold market has successive market dips, it surges.

Other studies were initiated by Baur and Lucey following the global financial crisis and the widespread use of safe haven and hedge (2010). The authors examined whether gold and hedge funds may serve as a decent safe haven in the stock and bond markets of the United States, the United Kingdom, and Germany. Baur and Lucey (2010) discovered that while gold may operate as a hedge for the US and UK stock markets, it was considered obsolete in the German stock market. On the other hand, whereas gold could not be used as a hedge in the US or UK bond markets, it worked extremely effectively in the German bond market. Additionally, it was believed that gold may serve as a safe haven for the stock and bond markets in the United States, the United Kingdom, and Germany. This study implies that the presence of a safe haven contributes to the stability and resilience of financial markets by mitigating investors' losses during times of stress. Robiyanto (2017a) also investigated the possibility for

commodities market instruments such as gold and West Texas Intermediate (WTI) crude oil to act as hedges and safe havens against certain stock markets in South East Asia, including those in Indonesia, Singapore, Malaysia, the Philippines, and Thailand. Gold and WTI were found to be ineffective as hedging instruments for five South East Asian capital markets. WTI may serve as a stable haven for the majority of South East Asian capital markets, whilst gold may serve as a stable haven in Singapore and Malaysia. Moreover, we have Baur and McDermott (2016) who evaluated a representative sample of the most prominent safe haven assets, their dynamic responses to major shocks, their interactions with one another, and their feedback effects. Two of these safe haven assets, US government bonds and gold, provide investors with various types of "protection," providing insight into why investors purchase safe haven assets. Gold was an especially powerful safe haven in the aftermath of September 11, 2001, and the Lehman bankruptcy in September 2008.

Moreover, Robiyanto (2017b) assessed gold's role as a safe haven and hedge for Indonesian sharia stocks. The monthly closing prices of the Jakarta Islamic Index (JII) on the Indonesian Stock Exchange and the monthly closing price of gold in the international market were utilized in this analysis from May 2008 to September 2017. OLS and QREG were used to analyze the data. The analysis concluded that gold might be used as a hedge against sharia stocks in Indonesia during the research period. Also, the study discovered that when the Indonesian stock market experiences severe shocks, gold might act as a safe haven asset for sharia stocks in Indonesia. Investors suggested diversifying their holdings into gold in order to protect their investment in the event that stock market conditions deteriorate significantly.

However, some studies revealed that gold acted as a weak safe haven and sometimes it did not act as a safe haven at all. For starters, Farinha et al. (2020) examined whether gold and silver will continue to be a safe haven for portfolio diversification in the financial markets of Germany, the United States of America, France, Italy, the United Kingdom, Hong Kong, China, and Japan from 1 January 2019 to 2 September 2020. The findings indicated that neither gold nor silver serve as safe havens for portfolio diversification in these equity markets. Coudert (2011) also investigated gold's role as a safe haven asset in times of recession and bear markets. He discovered that the link between gold and stocks is near zero during recessions, indicating that gold is a "poor safe haven." This is also true during bad markets in comparison to the stock indices of the majority of the countries analyzed, however gold appears to be a significant hedge against the US stock index. In the long run, there is a negative correlation between gold and certain stock markets (France, UK, US). It does not, however, enable the building of a hedged portfolio that is impervious to all crises. In general, despite its utility in portfolio diversification, gold remains a dangerous investment, especially during crises. Furthermore, Hood and Malik (2013) studied



the hedging ability of a variety of precious metals, including gold, silver, and platinum, as well as a volatility index, against the US stock market. They analyzed data from November 1995 to November 2010 and determined that, unlike other precious metals, gold exhibits both hedge and weak safe-haven characteristics for stock returns. Lastly, Bhanja and Dar (2015) used a fractal market-based technique to compare gold's hedging and safe haven properties to stocks. Their findings indicated that gold performs poorly as a hedge and a safe haven against stocks in the three largest gold-consuming countries.

## 2.5. Stock Market and Covid-19

The stock markets in a number of regions are fluctuating in response to the news of COVID-19. These remarkable alterations have piqued the interest of a large number of researchers worldwide. As a result, an increasing number of studies have been done recently to determine the impact of the COVID-19 outbreak on various financial markets worldwide.

COVID-19, as a public issue, is wreaking unparalleled worldwide economic havoc (Phan and Narayan 2020). According to a recent pioneering study, Goodell (2020) indicated that COVID-19 may have a broad impact on financial sectors, including stock markets. In fact, empirical evidence supports the statement. For example, Ashraf (2020) discovered that stock markets react negatively to COVID-19 and that this reaction fluctuates over time depending on the stage of the outbreak. Topcu and Gulal (2020) have classified the impact of COVID-19 on emerging economy stock markets by region. Their data indicate that the outbreak had the greatest impact on Asian developing markets, whereas it had the least impact on European emerging markets. Emerging market economies are experiencing a credit crunch, commonly known as capital flows (Ahmed et al., 2020).

Indeed, numerous researches have been conducted on the effects of COVID-19 on stock markets in many parts of the world. Singh et al. (2020) studied the effect of the COVID-19 epidemic on the G-20 countries' stock markets. The data suggested that following the COVID-19 outbreak, global stock markets underperformed and incurred negative returns, as shown by positive CARs. Panel data regression analysis also revealed evidence in favor of the stock market's rebound following the negative effects of COVID-19. Overall, the findings indicated that initial panic selling in stock markets around the world was triggered by future uncertainty generated by the COVID-19 outbreak. Now, stock markets are enjoying a capital inflow, which is assisting in their recovery.

Awadhi et al. (2020) used a panel regression methodology to examine the influence of the COVID-19 pandemic on the Chinese stock market. The findings indicate that both metrics have a significant negative effect on stock returns across all businesses included in the Hang Seng Index and Shanghai Stock Exchange Composite Index from January 10 to March 16, 2020. Additional analysis show that certain industries performed better than others during the COVID-19 pandemic, most notably information technology and pharmaceutical production. Further, their data indicate that the COVID-19 epidemic has a greater impact on the returns of B-shares (intended for foreign investors) and large market capitalization equities than on A-shares (mostly traded by Chinese citizens) and low market capitalization companies.

When extending data to 77 countries' main indices, Liu et al. (2020) investigated the impact of the COVID-19 outbreak on the most affected countries' stock markets using the event study method. They emphasized that the pandemic implies that the stock markets have reacted poorly to the COVID-19 outbreak, which has harmed their performance.

Osagie et al. (2020) showed that the COVID-19 had a negative effect on stock returns in Nigeria and proposed that a stable political climate, incentives for indigenous enterprises, economic diversification, and a flexible exchange rate regime be introduced to strengthen the financial sector.

Hyun-Jung (2020) conducted research on South Korea's stock market, another leading growing economy. According to his view, the economy has been on a roller-coaster ride. The monthly export data indicates a downward trend in January, an improvement in February, and then a decline in March and June. The country's export volume decreased by 11.2 percent year on year.

Shehzad et al. (2020) used the asymmetric power GARCH model to evaluate the nonlinear behavior of the financial markets in the United States, Italy, Japan, and China. The study established that COVID-19 had a detrimental effect on the S&P 500's stock returns. It had, however, a negligible effect on the Nasdaq composite index. Cepoi (2020) did an empirical study on the association between COVID-19-related news and stock market returns in the most severely affected countries. This study discovered that the stock market exhibits asymmetric dependence on COVID-19-related information using panel quantile regression.

He et al. (2020) analyzed daily return data from the People's Republic of China, Italy, South Korea, France, Spain, Germany, Japan, and the United States of America stock markets. Their empirical findings indicate that COVID-19 has a negative but temporary effect on the stock markets of impacted nations, and that this effect has bidirectional spillover effects between Asian and European and American

countries. However, there is no indication that COVID-19 has a more detrimental effect on the stock markets of these countries than on the world average.

To provide an understanding of the effects of the novel coronavirus pandemic on GCC, Bahrini and Filfilan (2020) examined the impact of COVID-19 confirmed cases and deaths on the daily returns of the major stock market indices in the Gulf Cooperation Council (GCC) countries from April 1, 2020 to June 26, 2020. They discovered that stock markets in the GCC countries responded negatively and significantly to new and total COVID-19 confirmed deaths, but not to the number of COVID-19 confirmed cases. As a result, daily returns on the GCC's major stock market indices dropped as the number of verified deaths climbed during the COVID-19 outbreak.

Harjoto et al. (2020) used the event study approach, employing the WHO announcement on 11 March 2020 and the Federal Reserve Bank release on 9 April 2020 as the shock and stimulus, respectively. The results indicate that COVID-19 had a detrimental effect on global stock markets, particularly in emerging nations and on small businesses. Additionally, when compared to other developed countries and emerging markets, the US stock market enjoyed positive anomalous returns as a result of the Fed's stimulus. Additionally, their investigation discovers that the stimulus's favorable abnormal returns accrued to major enterprises in the United States rather than small ones.

Trang and Gan (2020) investigated the effects of the COVID-19 epidemic and subsequent pandemic lockdown on daily stock returns in Vietnam, a fast-growing emerging market that recovered well following the pandemic lockdown. The study supports the detrimental effect on stock returns in Vietnam of the daily increasing number of COVID-19 cases. Additionally, the analysis reveals that the Vietnam stock market performed differently before and after the statewide shutdown. While COVID-19 had a substantial negative impact on Vietnam's stock returns before to the lockdown, the lockdown period had a major favorable impact on the overall market and several economic sectors in Vietnam. The financial industry took the brunt of the COVID-19 outbreak on the Vietnam stock market.

Takyi and Bentum-Ennin (2020) assessed the possible impact of the COVID-19, which began in Wuhan, China and has spread throughout the continent, including Africa, on stock market performance in thirteen African countries, including Ghana, Nigeria, South Africa, Kenya, Tanzania, Tunisia, Mauritius, Morocco, Zambia, Namibia, Botswana, Cote D'Ivoire, and Uganda. The COVID-19 considerably impacted Mauritius' stock market performance in relative terms, by roughly 21%, followed by Morocco (17%), Kenya (15%), Nigeria (13%), Tanzania (11%), Tunisia (9.1%), Ghana (6.5%), and Zambia (3.6%), with Botswana having the least (2.7 percent). However, they discovered that the COVID-19 has had no

discernible effect on the stock markets of South Africa, Côte d'Ivoire, and Uganda, despite the fact that the repercussions are unfavorable.

Last but not least, Adenomon et al. (2020) used Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models to assess the effects of the COVID-19 epidemic on Nigeria's stock exchange performance. They discovered that COVID-19 had a detrimental effect on Nigeria's stock market performance.

### 3. Research Problem

Gold has been utilized as natural money and a store of value throughout its long and illustrious history. It functions as a portfolio stabilizer and a source of liquidity during periods of market volatility. Gold is a hedge against inflation in the United States of America and the United Kingdom (Hoang et al., 2016). It reacts anti-cyclically to macroeconomic news (Elder et al., 2012) and behaves differently than other assets, most notably stocks. When equities market indexes fall, gold retains or occasionally gains in value. The empirical literature provides evidence of the gold's traditional role as a hedge against equity markets in normal times and as a safe haven against equity markets during times of crisis (Baur and Lucey., 2010)

Recently, emphasis has switched away from gold and toward a newly emergent asset, Bitcoin, which is frequently compared to gold in terms of hedging and safe haven features. Bitcoin has frequently been portrayed as a haven from sovereign risk and the instability of the global financial system (Bouri et al., 2017b). This was demonstrated during the 2010 European debt crisis (Luther & Salter, 2017). Bitcoin's independence from economic and financial variables (Corbet et al., 2018) makes it an attractive diversifier (Bouri et al., 2017c; Briere et al., 2015), particularly during stock market downturns (Bouri et al., 2017b).

In April 2017, roughly eight years after its creation, one Bitcoin surpassed the value of an ounce of gold. As of December 2018, a single Bitcoin was more than three times the value of an ounce of gold, and debate has centered on its capacity to replicate or outperform gold's hedging capabilities against stock market returns. While several studies empirically analyzed both gold and Bitcoin (Bouri et al., 2017b; Corbet et al., 2018; Ji et al., 2018), there is a dearth of evidence on which of the two (cryptocurrencies or gold) serve as a better safe haven against stock market index movements during adverse market conditions when hedging benefits are most needed. So, this brings us to the “general research question”: **Are cryptocurrencies a better safe haven than gold?**

As indicated in the literature review, various studies on safe haven and hedge have flourished and became quite popular in the aftermath of the 2008 global financial crisis. Since 2020, we've been experiencing a new economic shock as a result of the novel COVID-19 pandemic. The fast spread of COVID-19 and the worldwide implementation of stringent containment measures have had a significant impact on global economic activity. According to the International Monetary Fund's (IMF) April 2020 World Economic Outlook (WEO), the global economy fell by 3% in 2020, significantly worse than during

the 2008–2009 financial crisis. While recent vaccine approvals have fueled hope for a resolution to the epidemic later this year, recurrent waves and new strains of the virus cast doubt on the prospects. Global economic growth is anticipated to be 5.5 percent in 2021 and 4.2 percent in 2022, despite extreme uncertainty.<sup>1</sup>

Not only has the COVID-19 pandemic has caused a staggering number of lives, but it has also wreaked havoc on the nation's economy. Between April and June 2020, the US economy contracted at a 32.9 percent annual pace as the country struggled with lockdowns and spending cuts during the pandemic. It was the worst fall since the government began collecting data in 1947, and more than three times as severe as the previous record of 10% established in 1958. However, the US economy expanded at a 4% annual pace in the final three months of 2020, while the International Monetary Fund forecasts 5.1 percent growth this year and 2.5 percent in 2022. Additionally, we observe a considerable fall in the employment-to-population ratio in the United States in April 2020. Historical patterns anticipated a ratio of 61.3 percent, but the actual figure was 51.5 percent. In April 2020, this extra national drop was 9.9 per 100 persons. This suggests that fewer people were employed than projected prior to the epidemic. <sup>2</sup> When it comes to France, we find that in the last quarter of 2020, France's GDP shrank by 1.4 percent on a seasonally adjusted quarterly basis. Meanwhile, economic activity contracted by 4.9 percent year on year in Q4 following a contraction of 3.7 percent in Q3. GDP fell 8.2 percent in 2020 (earlier reported: -8.3 percent), the lowest reading since at least 1950 and in stark contrast to 2019's 1.5 percent rise.<sup>3</sup> However, the IMF estimates that its GDP would grow to 5.8 percent in 2021.

In addition, the new coronavirus has wreaked havoc on financial markets worldwide. It introduced an unprecedented level of risk, resulting in substantial losses for investors in a matter of days. The US stock market tripped the circuit breaker mechanism four times in ten days in March 2020. The Dow Jones

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<sup>1</sup>IMF (2021) Policy Support and Vaccines Expected to Lift Activity available at:

<https://www.imf.org/en/Publications/WEO/Issues/2021/01/26/2021-world-economic-outlook-update>

<sup>2</sup> UDALOVA.V (2021) Pandemic Impact on Mortality and Economy Varies Across Age Groups and Geographies available at: <https://www.census.gov/library/stories/2021/03/initial-impact-covid-19-on-united-states-economy-more-widespread-than-on-mortality.html>

<sup>3</sup> Focus Economics (2021) France: Economy contracts at marginally sharper pace than initially reported in Q4 2020 available at: <https://www.focus-economics.com/countries/france/news/gdp/economy-contracts-at-marginally-sharper-pace-than-initially-reported-in->

q4#:~:text=France%3A%20Economy%20contracts%20at%20marginally,initially%20reported%20in%20Q4%202020&text=A%20second%20GDP%20release%20showed,the%20flash%20estimate%20of%201.3%25.

Industrial Average (DJIA) and Standard & Poor's 500 Index (S&P500) have both fallen dramatically in the United States of America (Wagner, 2020). Numerous equity markets throughout the world have had their steepest price decline in history. Europe's, Africa's, and Asia's stock markets have all taken a dive (Singh et al., 2020; Trang Anh et al., 2020; Liu et al., 2020).

As previously stated, the COVID-19 pandemic is the first worldwide health event since the Great Financial Crisis of 2008. The events serve as a backdrop for determining if cryptocurrencies and gold act as safe havens for stocks during this time period or not. This leads us to our “specific research question”:  
**Are cryptocurrencies a better safe haven than gold for the Stock Markets during the Covid 19?**

This research question was also built after a deep analysis of the literature review and the several gaps found. In fact, we noticed that results obtained by empirical studies about cryptocurrencies and gold being safe haven differ across periods. In fact, Shahzad et al. (2019) examined whether Bitcoin possesses a safe-haven characteristic for stock market investments during periods of excessive market volatility, and whether this property is comparable to or distinct from that of gold and the broad commodity index. Indeed, they compared the safe-haven features of Bitcoin, gold, and commodities to some global and nation stock market indices from 20 July 2010 to 22 February 2018. Their primary finding is that Bitcoin, gold, and commodities all have similar weak safe-haven attributes when compared to the world stock market index, but not for the developed, emerging, US, or Chinese stock markets. In fact, gold is the only marginal safe-haven asset in industrialized stock markets, whereas gold and commodities both serve this function in emerging stock markets. To summarize their findings, they discovered that the safe haven roles of Bitcoin, gold, and commodities fluctuate across time and across the stock market indices studied. Chen and Wang (2018) published another research report demonstrating that hedging and safe haven features do really vary significantly over time. They examined gold's hedging and safe haven characteristics in comparison to Dow Jones stock industry indices using a quantile-GARCH technique. Their findings demonstrated that gold's hedge and safe haven characteristics are dynamic. Gold was not a hedge for Oil&Gas, Basic Materials, or Utilities for the entire period 1980–2017; however, during that period gold was a safe haven for practically all sectors except Technology. While gold was not a hedge for Oil&Gas in sub-period I (1980–1995), it was a powerful safe haven for all sectors during that era. When it comes to the sub-period II (1996–2017), when it comes to the sub-period II (1996–2017), the yellow metal was not a hedge for Oil&Gas, Basic Materials, Utilities, Telecom, and Technology nor a safe haven for Oil&Gas, Basic Materials, Utilities, Telecom, and Technology. Bouri et al. (2017b) also

discovered that Bitcoin's hedging and safe haven characteristics varied with time horizon. Indeed, they investigated if Bitcoin may serve as a hedge and safe haven for major global stock indexes, bonds, oil, gold, the general commodity index, and the US dollar index. Between July 2011 and December 2015, daily and weekly data were studied. Their findings indicated that when weekly data is used, Bitcoin's hedging role for Japanese markets diminishes. By comparison, with weekly data, Bitcoin's daily hedging position for Asia Pacific markets has evolved into a safe haven position. Similarly, especially in response to weekly swings in Chinese stock prices, Bitcoin has developed hedging and safe haven characteristics that were not evident in daily data. These findings indicated that between the two data frequencies, there were significant changes in how investors used Bitcoin to hedge against declines in Japanese and Chinese markets.

In addition, some research papers showed that the safe haven properties also vary across countries. Indeed, as indicated previously in the literature review, Baur and McDermott (2010) evaluated the role of gold in the global financial system and evaluated the theory that gold acts as a safe haven against the stocks of important emerging and developing economies. They demonstrated that gold is a hedge and a safe haven for major European stock markets and the US, but not for Australia, Canada, Japan, or large emerging markets such as the BRIC countries, and that gold was a strong safe haven for the majority of developed markets during the recent financial crisis's peak. Wang et al. (2019a) investigated whether cryptocurrency could be used as a hedge or a safe haven for certain international indices during particular periods. They concluded that while cryptocurrency is not a hedge, it can act as a safe haven for certain international indices. The safe haven effect is more prominent in subgroups with a higher market size and liquidity, as well as in developed markets.

Furthermore, most of the research papers that studied the safe haven properties of gold and cryptocurrencies during the covid-19 crisis focused a limited period of time and they didn't study the effect during the year 2021. For instance, we find that Dutta et al. (2020) used a sample period ranging from December 2014 to March 2020 in order to investigate the time-varying correlations between gold and oil markets and to examine whether gold is a safe haven asset for the international crude oil markets during the COVID-19 period. While, Mariana et al (2021) when testing Bitcoin and Ethereum as safe-havens for stocks chose the data to be from July 1, 2019, until April 6, 2020. In order to isolate the impact of the COVID-19 pandemic. Conlon et al (2020) chose a data sample was from 11th April 2019 to 9th April 2020 to tested safe haven properties of Bitcoin, Ethereum and Tether from the perspective of international equity index investors. Another example worth mentioning is the research paper of Jeribi



and Manzli (2020) who test the safe haven properties of cryptocurrencies for Tunisian Stock Market returns during the pandemic. They chose to do a comparison between results two months before the COVID-19 and two months during the pandemic so their studied period is between the 31st of December and the 30th of April.

Last but not least, in our research we will have a look on the effect of covid on the stock market returns since our dependent variable is the return and the period studied is before and after the pandemic and through the literature, we notice that this effect changes from a stock market to another. In fact, Topcu and Gulal (2020) classified the impact of COVID-19 on emerging economy stock markets by area. Their findings indicated that the outbreak had the greatest impact on Asian developing markets, whereas it had the least impact on European emerging markets. Another study is the one of Takyi and Bentum-Ennin (2020) who examined the COVID-19's possible impact on stock market performance in thirteen African countries. The analysis revealed that, in relative terms, Mauritius' stock market performance because of COVID-19 has been greatly and substantially lowered by roughly 21%, followed by Morocco (17%), Kenya (15%), and others. However, the stock markets in South Africa, Côte d'Ivoire, and Uganda do not appear to be much impacted by the pandemic, despite the fact that the implications are unfavorable.

To sum up, all of the results imply the need to revise the empirical methodologies used by these studies. Well, since cryptocurrencies and gold being safe havens differ across periods, we decided to have two subperiods: Before COVID-19 pandemic from 29/01/2019 to 24/01/2020; and during COVID-19 pandemic from 25/01/2020 to 19/01/2021. This time period of 361 days can provide us with a deeper understanding of the effect of the pandemic on stock markets, cryptocurrencies and gold. Adding to that, since studies showed that the safe haven property of gold and cryptocurrencies against stocks vary across countries, we chose to study for the robustness test the stock markets of the USA and France and compare their results to have a better overview.

## 4. Research methodology

### 4.1. Hypothesis development

In recent years, the growing popularity of cryptocurrencies has inspired numerous studies for their diversification, hedging and safe haven properties. (Dyhrberg (2015), Chan et al. (2018), Urquhart and Zhang (2019), Feng et al (2018), Wang et al. (2019b), Urquhart and Zhang (2019) etc.). In fact, a lot of the results revealed that cryptocurrencies act as safe havens for stock market indices. (Christy et al (2020), Bouri et al. (2020), Wang et al. (2019a)). Mariana et al (2021), in particular found that Bitcoin and Ethereum, the largest cryptocurrencies are suitable as short-term safe-havens. Adding to that Hansen (2020) found that Bitcoin acts as a safe haven during periods of extreme market turmoil.

Subsequently, the first hypothesis could be presented as follows:

H<sub>0</sub>:  $\beta_1 = \beta_2$ : Cryptocurrencies act more as a safe haven for the stock market investors during the COVID-19 pandemic than before the outbreak.

H<sub>1</sub>:  $\beta_1 > \beta_2$ : Cryptocurrencies does not act more as a safe haven for the stock market investors during the COVID-19 pandemic than before the outbreak.

The hedge and safe heaven potentials of gold have been also extensively analyzed during market fluctuations (Baur and McDermott (2010), Baur and Lucey (2010), Coudert (2011), Robiyanto (2017a), Baur and McDermott (2016), Robiyanto (2017b), Hood and Malik (2013)). In fact, since this ongoing COVID-19 has shacked the global financial markets and has encouraged several researchers to look into its effects, we ended up finding two research papers that examined the safe haven properties of gold during this pandemic. Dutta et al (2020) as well as Akhtaruzzaman et al. (2020) found that in fact gold is considered as a safe haven asset for the studied markets during the COVID-19 outbreak.

Given this background, the second hypothesis could be presented as follows:

H<sub>0</sub>:  $\beta_1 = \beta_2$ : Gold acts more as a safe haven for the stock market investors during the COVID-19 pandemic than before the outbreak.

H1:  $\beta_1 > \beta_2$ : Gold does not act more as a safe haven for the stock market investors during the COVID-19 pandemic than before the outbreak.

## 4.2. Data Set

The sample used for this research study is the top three stock market indices in France: CAC40, CAC NEXT20 and SBF80, and the top three stock market indices in the United States of America which are Dow Jones Industrial Average, S&P 500 and NASDAQ Composite. The data consists of 4332 daily observations on daily closing prices (Pt). The cryptocurrencies prices (Bitcoin, Ethereum, Ripple, Binance Coin, Tether and Dogecoin) were collected from the Coin Market Cap basis while GOLD and WTI prices were collected from Investing database. The stock market indexes SBF80, Dow Jones Industrial Average and S&P 500 were collected from investing database while CAC40 and CAC NEXT20 were collected from yahoo finance and NASDAQ Composite from its official NASDAQ website. Finally, the number of confirmed cases was collected from the European Center for Disease Prevention and Control.

The study period is ranging from 29/01/2019 to 19/01/2021 and divided in two subperiods. The first subperiod is the period preceding the COVID-19 pandemic and it goes from 29/01/2019 to 24/01/2020 (361 days). The second subperiod is the period during the COVID-19 pandemic and it goes from 25/01/2020 to 19/01/2021 (361 days)

## 4.3. Empirical Models and Variables Measurement

Several methodologies were used to examine the safe haven properties of either the gold or the cryptocurrencies. For instance, we find that some researchers chose to use the GARCH- based techniques (Ibrahim (2012), Chen and Wang (2018), Wang et al., (2019b)) others used ARDL model (Shakil et al., (2018)) while some preferred the regression model (Baur et al (2017), Jeribi and Manzli., (2020), Bouri et al., (2017))

In order to study the safe haven properties of cryptocurrencies and gold for the stock market returns as well as the effect of the number of cases and deaths caused by the Coronavirus pandemic; we used a linear regression model from the literature (Jeribi and Manzli., 2020).

$$\text{INDEX}_t = \beta_0 + \beta_1 \text{CRYPTO}_t + \beta_2 \text{GOLD}_t + \beta_3 \text{WTI}_t + \varepsilon_t \quad (1)$$

$$\text{INDEX}_t = \beta_0 + \beta_1 \text{CRYPTO}_t + \beta_2 \text{GOLD}_t + \beta_3 \text{WTI}_t + \beta_4 \text{COVIDC}_t + \varepsilon_t \quad (2)$$

With INDEX (the studied index) as dependent variable, while the CRYPTO (cryptocurrencies: Bitcoin, Ethereum, Ripple, Binance Coin, Tether and Dogecoin), GOLD (gold), WTI (crude oil) and COVIDC (number of Covid cases), represent the independent variables. All variables are indexed on t, which represent the time (day).

A detailed description and construction of all variables used in the study is provided in the table below.

*Table 1: Brief description of variables*

<b>Variables</b>	<b>Measurement</b>
<b>INDEX</b>	The daily return of the studied index
<b>CRYPTO</b>	The daily return of Bitcoin, Ethereum, Ripple, Binance Coin, Tether and Dogecoin at a time
<b>GOLD</b>	The daily return of gold
<b>WTI</b>	The daily return of WTI crude oil
<b>COVIDC</b>	The growth rate of Covid-19 confirmed cases

Daily returns are defined with logarithmic returns such that:

$$r_t = \ln\left(\frac{p_t}{p_{t-1}}\right) \quad (3)$$

Where:

$r_t$ : The logarithmic return

$p_t$ : The price at time t

$p_{t-1}$ : The price at time t-1

## 4.4. Volatility

As illustrated in the eight figures, this data transformation is typically employed to create stationary series. These results demonstrate that the series are very volatile, but more so during the COVID-19 outbreak than in the period preceding the pandemic. Notably, all series returns have hit negative maxima since the beginning of March and into April 2020, generating a financial bubble throughout the collapse. This can be supported by the fact that fear-based news triggered by the COVID-19 pandemic raised the return volatilities of all series relative to the period preceding the pandemic. Indeed, it was the virus's increasing spread that began to erode investors' confidence, precipitating a historic drop in the global markets. Volatility is a significant concern for both investors and policymakers, as both rely on the relative stability of particular financial markets and the global economy when making choices. Additionally, volatility estimate is a critical component of many models and has a broad application to organizations' market risk management methods.

We observe that cryptocurrencies are more volatile and irregular during the COVID-19 pandemic than in the period preceding the outbreak. Bitcoin and Ethereum are considered to be the least volatile cryptocurrencies, whilst Ripple and Dogecoin are believed to be the most volatile.

Despite being the ideal safe-haven asset, gold, like everything else, eventually fell as it became clear that COVID-19 would become a global epidemic. Through March 2020, gold has demonstrated substantial volatility, indicating that it is no longer serving as a haven as it has historically done.

Prior to the pandemic, the WTI oil index experienced one spike in volatility in September 2019, followed by a massive decrease in March and April 2020. Apart from that, figure 4 demonstrates a rather tranquil low volatility.

When it comes to the effect of the COVID-19 on the stock market indices we find that, Baker et al. (2020) pointed out to the fact that “COVID-19 has resulted in the highest stock market volatility among all recent infectious diseases including the Spanish Flu of 1918”. Sharma (2020) further demonstrated that COVID-19 has a statistically significant influence on stock volatility, but the effect differs by country, with markets in higher income countries initially overreacting and then recovering, as was the case in France and the United States of America.

Concerning the French stock market indices, we notice that the lowest volatility was approximately -0.025 before the pandemic, then on March 2020 and April 2020 it dropped to -0.10, afterwards it returned to the pattern that it had before the outbreak. The same thing happened with the American stock market indices. For instance, Dow Jones Industrial Average reached a low volatility of -0.031 in August 2019 and when the Coronavirus hit the USA it dropped to -0.14 in March 2020 then it bounced back.

## 5. Descriptive Statistics

*Table 2: Descriptive Statistics Study for Stock Market returns before COVID-19 Outbreak*

Variable	Mean	Std. Dev.	Min	Max
INDEX	0.0004961	0.0068042	-0.0353537	0.0261251
GOLD	0.0004732	0.0084699	-0.0421064	0.0544135
BITCOIN	0.0025628	0.0354292	-0.1518193	0.1600432
ETHEREUM	0.0013144	0.0403837	-0.1832531	0.1449933
BINANCECOIN	0.0008059	0.0409337	-0.2594255	0.2285972
RIPPLE	0.0012388	0.0398371	-0.1929473	0.2285972
TETHER	-0.000023	0.00591	-0.0198026	0.0166729
DOGECOIN	0.0006511	0.0344993	-0.1155547	0.1803065
WTI	0.0001158	0.0174321	-0.0823357	0.136944

The dependent and independent variables are initially examined with exploratory data analysis based on the descriptive statistics. For each variable, the mean, minimum, maximum and standard deviation values have been presented in table 2.

The descriptive statistics show that the stock market indices as well as, GOLD, WTI, and all the studied cryptocurrencies: BITCOIN, ETHEREUM, BINANCECOIN, DOGECOIN and RIPPLE have positive mean value except for TETHER that has negative mean value. We also notice that BITCOIN has the highest mean value (0.0025) with a maximum of (0.1600) and a minimum of (-0.1518) while TETHER has the lowest value (-0.000023) with a maximum of (0.0166) and a minimum of (-0.0198).

The standard deviations for all series are higher than their mean suggesting a higher level of risk in these markets. Between all the cryptocurrencies studied we notice that TETHER shows the lowest risk (0.59%) followed by DOGECOIN (3.44%) and BITCOIN (3.54%) while BINANCECOIN presents the highest risk (4.09%). For the assets, we notice that GOLD presents a lower risk (0.84%) than WTI (1.74%) this explains why GOLD is usually referred to as a safe haven. When it comes to the stock market indices, we notice that they have a risk of (0.68%) before the COVID-19 outbreak.

*Table 3: Descriptive Statistics Study for Stock Market returns during COVID-19 Outbreak*

Variable	Mean	Std. Dev.	Min	Max
<b>INDEX</b>	0.0003266	0.0185728	-0.1521988	0.1076433
<b>GOLD</b>	0.0003892	0.0117062	-0.0511396	0.0561174
<b>BITCOIN</b>	0.0040217	0.0413766	-0.4647298	0.1671036
<b>ETHEREUM</b>	0.0059109	0.0548209	-0.5507137	0.230704
<b>BINANCECOIN</b>	0.0025489	0.0512653	-0.5428087	0.1934583
<b>RIPPLE</b>	0.0007685	0.0636893	-0.5504032	0.3342056
<b>TETHER</b>	-1.46e-18	0.0056832	-0.0491902	0.0499909
<b>DOGECOIN</b>	0.0038383	0.0626155	-0.3513256	0.6239658
<b>WTI</b>	-0.0000577	0.0583603	-0.6016758	0.3196337
<b>COVIDC</b>	0.0472123	0.1094157	0.000	1.111111

Table 3 shows that INDEX during the COVID-19 outbreak as well as GOLD, COVIDC, and most cryptocurrencies have a positive mean value except for TETHER and WTI. We notice that the COVIDC which is the growth rate of COVID-19 confirmed cases has the highest mean value (0.047) with a maximum of (1.11) and a minimum of (0.000) while WTI has the lowest value ( -0.0000577) with a maximum of (0.3196) and a minimum of (-0.6016).

The standard deviations for all series are higher than their mean suggesting a higher level of risk in these markets. Between all the cryptocurrencies studied we notice that TETHER shows the lowest risk (0.568%) followed by BITCOIN (4.13%) and BINANCECOIN (5.12%) while RIPPLE presents the highest risk (6.36%). For the assets, we notice that GOLD presents a lower risk (1.17%) than WTI (5.83%) and when it comes to the INDEX during the pandemic, it shows a risk of (1.85%)

Compared to the results of the preCOVID-19 pandemic we notice that the risk level of all the variables increased except for the cryptocurrency TETHER that actually decreased from 0.591% to 0.568%



## 6. Results and findings

### 6.1. Analysis of regression results before the COVID-19 Pandemic

Table 4: Regression analysis for Stock Market Returns before COVID-19 Outbreak

VARIABLES	INDEX	INDEX	INDEX	INDEX	INDEX	INDEX
GOLD	-0.138*** (0.0167)	-0.139*** (0.0167)	-0.141*** (0.0167)	-0.141*** (0.0167)	-0.140*** (0.0167)	-0.142*** (0.0167)
BITCOIN	-0.00436 (0.00400)					
WTI	0.0785*** (0.00810)	0.0787*** (0.00811)	0.0796*** (0.00810)	0.0797*** (0.00810)	0.0797*** (0.00811)	0.0786*** (0.00809)
ETHEREUM		0.000621 (0.00350)				
BINANCECOIN			0.00911*** (0.00345)			
RIPPLE				0.00939*** (0.00354)		
TETHER					0.0491** (0.0239)	
DOGECOIN						0.0127*** (0.00409)
Constant	0.000563*** (0.000142)	0.000552*** (0.000141)	0.000546*** (0.000141)	0.000542*** (0.000141)	0.000554*** (0.000141)	0.000546*** (0.000141)
Observations	2,166	2,166	2,166	2,166	2,166	2,166
R-squared	0.069	0.069	0.072	0.072	0.070	0.073

Note: \*\*\*, \*\* and \* means significant at 1%, 5% and 10% level of significance respectively.

Based on the categorization of Baur and Lucey (2010), the results of table 4 show that there is a positive significant relationship between the INDEX and the cryptocurrencies BINANCECOIN, RIPPLE, TETHER, and DOGECOIN. For instance, a one unit increase in BINANCECOIN's return leads to 0.0091 increase in the stock market return at a 1% significance level and a one unit increase in TETHER's return leads to 0.0491 increase in the stock market return at a 5% significance level. These results suggest that these cryptocurrencies act as a diversifier. This is

similar to the finding of Feng et al (2018) who evaluated the characteristics of seven representative cryptocurrencies and found that the latter can serve as a great diversification asset for stocks.

When it comes to GOLD, we notice that it has a negative significant relationship with the INDEX before the outbreak at a 1% significance level suggesting that this yellow metal acts as a hedge. This result is similar to the results of Hood and Malik (2013) and Robiyanto (2017b) who found that gold can serve as a hedge for sharia stocks in Indonesia during his research period.

Moving on the WTI, we find that the positive significant effect that it has with INDEX suggests that it actually acts as a diversifier.

## 6.2. Analysis of regression results during the COVID-19 Pandemic

Table 5: Regression analysis for Stock Market Returns during COVID-19 Outbreak

VARIABLES	INDEX	INDEX	INDEX	INDEX	INDEX	INDEX
GOLD	0.0479 (0.0314)	0.0714** (0.0313)	0.139*** (0.0318)	0.0678** (0.0312)	0.166*** (0.0319)	0.141*** (0.0324)
BITCOIN	0.151*** (0.00894)					
WTI	0.0680*** (0.00622)	0.0735*** (0.00623)	0.0789*** (0.00640)	0.0740*** (0.00620)	0.0790*** (0.00644)	0.0794*** (0.00650)
COVIDC	-0.0177*** (0.00327)	-0.0179*** (0.00329)	-0.0200*** (0.00339)	-0.0182*** (0.00328)	-0.0212*** (0.00341)	-0.0203*** (0.00344)
ETHEREUM		0.108*** (0.00669)				
RIPPLE			0.0632*** (0.00580)			
BINANCECOIN				0.119*** (0.00711)		
TETHER					-0.615*** (0.0652)	
DOGECOIN						0.0432*** (0.00602)
Constant	0.000555 (0.000396)	0.000516 (0.000398)	0.00117*** (0.000408)	0.000841** (0.000395)	0.00128*** (0.000410)	0.00106** (0.000415)
Observations	2,166	2,166	2,166	2,166	2,166	2,166
R-squared	0.212	0.203	0.154	0.209	0.143	0.128

Note: \*\*\*, \*\* and \* means significant at 1%, 5% and 10% level of significance respectively

From table 5, results show that during the COVID-19 outbreak, there is a positive significant relationship between the stock market indices, and most of the cryptocurrency's BITCOIN, ERHEREUM, RIPPLE, BINANCECOIN, and DOGECOIN which indicates that they act as diversifiers. The diversification benefits that emerge from using Bitcoin against all the assets under study can be explained by the results reported by Bouri et al. (2017b) who demonstrated that Bitcoin was a poor hedge against various assets (e.g., major international stock indices, bonds, gold, and oil) but deemed an effective diversifier in the majority of cases.

However, we find that TETHER on the other hand has a negative significant relationship with the studied indices suggesting its use as a safe haven during the COVID-19 pandemic. This finding implies that during times of crisis in the stock markets, investors seem to put money into TETHER. Investors' preference for TETHER can be explained by the fact that, unlike conventional currencies, it is completely decentralized and independent of any central authorities; when the financial system is not functioning properly or is threatened, investors seek refuge in TETHER, which is decentralized and independent of the financial system and its underlying technology.

The yellow metal also has a positive significant relationship with INDEX which implies that it acts as a diversifier. This result is inconsistent with the results of Baur and McDermott (2016), Robiyanto (2017b).

Moving on the WTI, we find that the positive significant effect that it has with INDEX is also reported by Jeribi and Menzli (2020) suggesting that it acts as a diversifier for the studied indices.

Finally, the OLS regression results indicate that the growth rate of the COVID-19 confirmed cases harms the stock market indices which is consistent with the results of Liu et al. (2020), Harjoto et al. (2020), Trang and Gan (2020) and Adenomou et al (2020). This is linked to the high level of uncertainty and risk perceived by investors on the economic and social consequences of the COVID-19 outbreak in the country, as well as the unprecedented actions implemented by governments (containment measures, border closures, etc.).

When comparing the OLS regression results during the COVID-19 pandemic and before, we notice that TETHER is the only cryptocurrency that acts a safe haven during this financial and global crisis. In addition, GOLD acts as a hedge before the COVID-19 outbreak and as a diversifier during this pandemic.

## 7. Robustness Test

For the robustness test, we tested the safe haven properties of cryptocurrencies and gold on French Stock Market Indices and American Stock Market Indices each at a time. In this case, we divided our sample by region to measure the severity of COVID-19 in each country.

The French study period is ranging from 25/01/2019 to 25/01/2021 and divided in two subperiods. The first subperiod is the period preceding the COVID-19 pandemic and it goes from 25/01/2019 to 24/01/2020 (364 days). The second subperiod is the period during the COVID-19 pandemic and it goes from 27/01/2020 (the first case of Coronavirus reported in France was on the 25th of January but it is a Saturday) to 25/01/2021 (364 days).

The American study period is ranging from 18/01/2019 to 19/01/2021 and divided in two subperiods. The first subperiod is the period preceding the COVID-19 pandemic and it goes from 18/01/2019 to 17/01/2020 (364 days). The second subperiod is the period during the COVID-19 pandemic and it goes from 21/01/2020 (the first case of Coronavirus reported in USA) to 19/01/2021 (364 days).

Tables 6 and 8 display the estimated results of French and American stock market indices before the COVID-19 pandemic; they show the robustness of our conclusion that the TETHER, DOGECOIN, RIPPLE, BINCANCECOIN and WTI act as diversifiers while GOLD acts as a hedge.

Tables 7 and 9 report the estimated results of the French and American stock market indices during the COVID-19 pandemic; the alternative indicators during this period for the two countries have the same results as that obtained in the benchmark regression making the benchmark results robust.

Table 6: Regression analysis for French returns before COVID-19 Outbreak

	C	BITCOIN	ETHEREUM	BINANCECOIN	RIPPLE	TETHER	DOGECOIN	GOLD	WTI	R <sup>2</sup>
<b>CAC 40</b>	0.000567	0.00164						-0.103**	0.0734***	0.048
	0.000568		0.00328					-0.102**	0.0731***	0.048
	0.000539			0.0121				-0.103**	0.0743***	0.053
	0.000587*				0.0159*			-0.105**	0.0744***	0.055
	0.000574					0.103*		-0.103**	0.0755***	0.055
	0.000572						0.0164	-0.106**	0.0732***	0.055
<b>CAC NEXT 20</b>	0.000439	-0.00276						-0.114***	0.0457**	0.030
	0.000437		-0.00339					-0.115***	0.0460**	0.030
	0.000420			0.00546				-0.115***	0.0462**	0.031
	0.000448				0.0144			-0.117***	0.0468**	0.036
	0.000437					0.108*		-0.116***	0.0480**	0.038
	0.000435						0.0177*	-0.119***	0.0456**	0.038
<b>SBF80</b>	0.00115	-0.0375*						-0.151*	0.0884**	0.027
	0.00108		-0.000441					-0.164*	0.0896**	0.019
	0.00106			0.00719				-0.165*	0.0901**	0.019
	0.00110				0.0162			-0.167*	0.0907**	0.021
	0.00101					0.120		-0.165*	0.0895**	0.013
	0.00100						-0.0406*	-0.168*	0.0876**	0.019

Note: \*\*\*, \*\* and \* means significant at 1%, 5% and 10% level of significance respectively.

From the table 6, the results of the OLS regression analyses show that there is a negative significant relationship between BITCOIN and SBF80, and between DOGECOIN and SBF80 before the Coronavirus pandemic suggesting that these two cryptocurrencies act as hedges.

Also, there is a positive significant relationship between RIPPLE and CAC40, between TETHER CAC40, and CAC NEXT20 and between DOGECOIN and CACNEXT20 which indicates that these three cryptocurrencies act as diversifiers.

When it comes to GOLD, we notice that it has a negative significant relationship with the three studied French indices before the outbreak meaning that it acts as a hedge, whereas the WTI shows a positive significant relationship with the three French indices implying that it acts as a diversifier.

Table 7: Regression analysis for French returns during COVID-19 Outbreak

	C	BITCOIN	ETHEREUM	RIPPLE	BINANCECOIN	TETHER	DOGECOIN	GOLD	WTI	COVIDC	R <sup>2</sup>
<b>C</b>	0.0006	0.133***						0.00886	0.0655***	-0.0225***	0.212
<b>A</b>	0.0005		0.0876***					0.0329	0.0712***	-0.0223***	0.192
<b>C</b>	0.0010			0.0496***				0.0865	0.0752***	-0.0239***	0.147
<b>40</b>	0.0007				0.106***			0.0213	0.0710***	-0.0226***	0.208
	0.0011					-0.531***		0.1040	0.0765***	-0.0247***	0.144
	0.0009						0.0343**	0.0884	0.0760***	-0.0242***	0.130
<b>C</b>		0.140***						0.0281	0.0646***	-0.0266***	0.200
<b>A</b>	0.0007		0.0947***					0.0542	0.0702***	-0.0263***	0.186
<b>C</b>	0.0006			0.0557***				0.1110	0.0745***	-0.0280***	0.145
<b>N</b>	0.0011				0.113***			0.1200	0.0710***	-0.0271***	0.197
<b>E</b>	0.0009					-0.394**		0.1350*	0.0762***	-0.0288***	0.124
<b>X</b>	0.0012						0.0413***	0.1120	0.0752***	-0.0284***	0.128
<b>T</b>	0.0010										
<b>20</b>											
<b>SB</b>	0.0007	0.144***						0.0300	0.0618***	-0.0245***	0.204
<b>F</b>	0.0006		0.0961***					0.0584	0.0677***	-0.0241***	0.187
<b>80</b>	0.0012			0.0551***				0.1170	0.0721***	-0.0259***	0.141
	0.0009				0.113***			0.0475	0.0677***	-0.0246***	0.199
	0.0013					-0.486***		0.1410*	0.0737***	-0.0267***	0.128
	0.0011						0.0390***	0.1180	0.0730***	-0.0263***	0.123

Note: \*\*\*, \*\* and \* means significant at 1%, 5% and 10% level of significance respectively.

From table 7, results show that during the 2020 pandemic there is a positive significant relationship between the three studied French indices CAC40, CAC NEXT20 and SBF80, and these cryptocurrencies BITCOIN, ERHEREUM, RIPPLE, BINANCECOIN, and DOGECOIN which indicates that they are act as diversifiers. For market participants, this result indicates that BITCOIN, ERHEREUM, RIPPLE, BINANCECOIN, and DOGECOIN's diversification capabilities are very fruitful in France.

The yellow metal also has a positive significant relationship with CAC NEXT20 and SBF80 which implies that it acts as a diversifier for these French stock market indices.

However, we find that TETHER on the other hand has a negative significant relationship with CAC40, CAC NEXT20 and SBF80 suggesting its use as a safe haven during the COVID-19 pandemic.

Finally, inconsistency with Baig et al. (2020) results in Table 5 indicate that the growth rate of the COVID-19 confirmed cases harms the French stock market indices.



Table 8: Regression analysis for American returns before COVID-19 Outbreak

	C	BITCOIN	ETHEREUM	BINANCECOIN	RIPPLE	TETHER	DOGECOIN	GOLD	WTI	R <sup>2</sup>
<b>JTI</b>	0.0006*	-0.0114	-0.0016	0.0084	0.0051	-0.0043	0.0048	-0.141***	0.103***	0.135
	0.0006*							-0.144***	0.103***	0.131
	0.0005*							-0.146***	0.104***	0.134
	0.0005*							-0.145***	0.104***	0.132
	0.0006*							-0.144***	0.103***	0.131
	0.0006*							-0.145***	0.103***	0.132
<b>S&amp;P 500</b>	0.0007**	-0.0082	0.0006	0.0107	-0.0016	-0.0042	0.0065	-0.134***	0.0978***	0.123
	0.0007**							-0.137***	0.0977***	0.117
	0.0007**							-0.139***	0.0986***	0.121
	0.0007**							-0.137***	0.0976***	0.117
	0.0007**							-0.137***	0.0976***	0.117
	0.0007**							-0.138***	0.0976***	0.118
<b>NASDAQ</b>	0.0008**	-0.0068	0.0054	0.0194*	0.0002	-0.0169	0.0153	-0.164***	0.111***	0.103
	0.0008**							-0.166***	0.110***	0.102
	0.0008**							-0.170***	0.112***	0.109
	0.0008**							-0.166***	0.111***	0.101
	0.0008**							-0.166***	0.110***	0.101
	0.0008**							-0.168***	0.110***	0.105

Note: \*\*\*, \*\* and \* means significant at 1%, 5% and 10% level of significance respectively.

The results from table 8 show that before the COVID-19 outbreak, BINANCECOIN is a diversifier only against movements within NASDAQ stock indices, given that the coefficient 0.0194 is significantly positive.

In addition, significant negative coefficient of the GOLD with all three studied American Stock market indices implies that it acts as a hedge. For market participants, this result indicates that GOLD's hedging capabilities are very fruitful in America.

Furthermore, results show a significant positive relationship between the WTI, Dow Jones Industrial Average, S&P 500 and NASDAQ Composite stock market indices, suggesting the use of Oil as a diversifier.

Table 9: Regression analysis for American returns during COVID-19 Outbreak

	C	BITCOIN	ETHEREUM	RIPPLE	BINANCECOIN	TETHER	DOGECOIN	GOLD	WTI	COVIDC	R <sup>2</sup>
J T I	0.0001	0.157***	0.123***	0.0718***	0.131***	-0.746***	0.0494***	0.0727	0.0795***	-0.0104	0.217
	0.0002							0.0877	0.0846***	-0.0112	0.226
	0.0007							0.167**	0.0909***	-0.0129	0.171
	0.0003							0.0873	0.0851***	-0.0107	0.227
	0.0008							0.198**	0.0895***	-0.0139*	0.161
	0.0006							0.169**	0.0910***	-0.0131	0.139
S P 5 0 0	0.0002	0.149***	0.111***	0.0661***	0.117***	-0.755***	0.0473***	0.0029	0.0582***	-0.0134	0.188
	0.0002							0.0220	0.0634***	-0.0142*	0.188
	0.0009							0.0935	0.0691***	-0.0159*	0.137
	0.0005							0.0227	0.0640***	-0.0146*	0.185
	0.0010							0.1240	0.0674***	-0.0155*	0.136
	0.0007							0.0939	0.0691***	-0.0157*	0.107
N A S D A Q	0.0005	0.168***	0.124***	0.0731***	0.130***	-0.769***	0.0512***	0.156**	0.0855***	-0.0114	0.259
	0.0013							0.236***	0.0918***	-0.0133	0.201
	0.0009							0.157**	0.0862***	-0.0118	0.256
	0.0014							0.270***	0.0903***	-0.0130	0.191
	0.0012							0.238***	0.0919***	-0.0131	0.166
	0.0006							0.134*	0.0796***	-0.0105	0.261

Note: \*\*\*, \*\* and \* means significant at 1%, 5% and 10% level of significance respectively

The results from Table 9 show that BITCOIN, ERHEREUM, RIPPLE, BINANCECOIN, and DOGECOIN cannot be regarded as safe haven against extreme movements like the COVID-19 breakdown in our case; the positive and significant coefficients for the case of American stocks only indicate that these cryptocurrencies are no more than effective diversifiers.

Regarding the safe haven role of TETHER, statistical evidence at the 1% level clearly indicates that this cryptocurrency can be regarded as a safe haven against extreme movements in American stocks.

Our results show a positive and significant relationship between the yellow metal and Dow Jones Industrial Average, and NASDAQ suggesting its use as a diversifier. The OLS regression also shows the diversification property of the Oil.

When it comes to the effect of the growth rate of COVID-19 cases we find that in fact the higher the number of people affected with the virus the lower the stock market returns in America.

## 8. Conclusion

COVID-19's rapid spread and the global adoption of strict containment measures have had a substantial impact on global economic activity. We began this thesis by examining the volatility of the cryptocurrencies, gold, oil index and stock markets. We discovered that the series are extremely volatile, but more so during the COVID-19 outbreak than in the pre-pandemic period. Indeed, since the beginning of March and continuing into April 2020, all series returns have reached negative maxima, establishing a financial bubble throughout the collapse. Prior to the pandemic, the cryptocurrency market was largely stable, with reduced volatility. However, with the introduction of COVID-19, the volatility of these digital assets increased. Bitcoin and Ethereum are the least volatile cryptocurrencies, while Ripple and Dogecoin are the most volatile. Gold is typically regarded an excellent safe haven during times of market stress; however, during the Coronavirus outbreak, it has demonstrated substantial volatility, implying that gold is no longer serving as the usual safe haven.

Using the OLS regression, results reveal that Bitcoin and Ethereum cannot generate benefits from portfolio diversification and hedging strategies for the financial investors before the COVID-19, however during the pandemic, they act as diversifiers for the studied stock markets. While, Binance Coin, Ripple and Dogecoin act as a diversifier before and during the COVID-19 outbreak. In addition, from acting as a diversifier before the outbreak, the only cryptocurrency that shows a safe haven property during the pandemic is Tether. Findings also reveal that gold acts as a hedge before the pandemic but neither a hedge nor a safe haven during the outbreak. Moreover, we find that the Oil index acts as a diversifier before and during the COVID-19 outbreak. Finally, results show that the growth rate of the confirmed COVID-19 cases harms the stock market returns.

In order to test the robustness of the results, we test the safe haven properties of cryptocurrencies and gold across two different regions so we split our sample into French stock markets and American stock markets. Results of French and American stock market indices before the COVID-19 pandemic show the robustness of our conclusion that the Tether, Binance Coin, Dogecoin, Ripple and WTI act as diversifiers while gold acts as a hedge. When it comes to the estimated results of the French and American stock market indices during the COVID-19

pandemic, findings reveal that the alternative indicators during this period for the two countries have the same results as that obtained in the benchmark regression making the benchmark results robust.

The results thus provide support for the acceptance of the first hypothesis that cryptocurrencies act more as a safe haven during the COVID-19 pandemic than before. The findings also provide support for the rejection of the second hypothesis that gold act more as a safe haven during the COVID-19 pandemic than before. Actually, now we have the answer to our research problem which is cryptocurrencies are in fact a better safe haven than gold for stocks during the COVID-19 pandemic.

It should be mentioned that our thesis has two limitations. The first one is the very limited number of articles that studied the safe haven properties of cryptocurrencies and gold at the same time. This limitation made it hard to formulate a hypothesis that compared the safe haven properties of cryptocurrencies and gold during and before the outbreak. The second limitation is that despite the growing interest in cryptocurrencies, the current economics and finance literature is still lacking empirical evidence on its diversification, hedging and safe haven properties against other assets.

It should be emphasized that our paper can add to the existing literature by generally investigating the relationships between cryptocurrencies, gold and stock market returns. Our analysis is also valuable for investors and financial advisors looking for a safe-haven asset, particularly during the COVID-19 period, when commodities in general, and gold in particular, as well as cryptocurrencies, can help offset losses. As such, economic actors may consider our empirical study and portfolio analysis when evaluating the relative merits of cryptocurrencies and gold as potential safe-haven assets for stock market indices.

In the light of these findings, since the research was done in the context of developed countries' stock markets, it would be interesting to do a study for emerging countries' stock markets and explore other potential safe haven assets such as Silver, Platinum, Palladium and world currencies.

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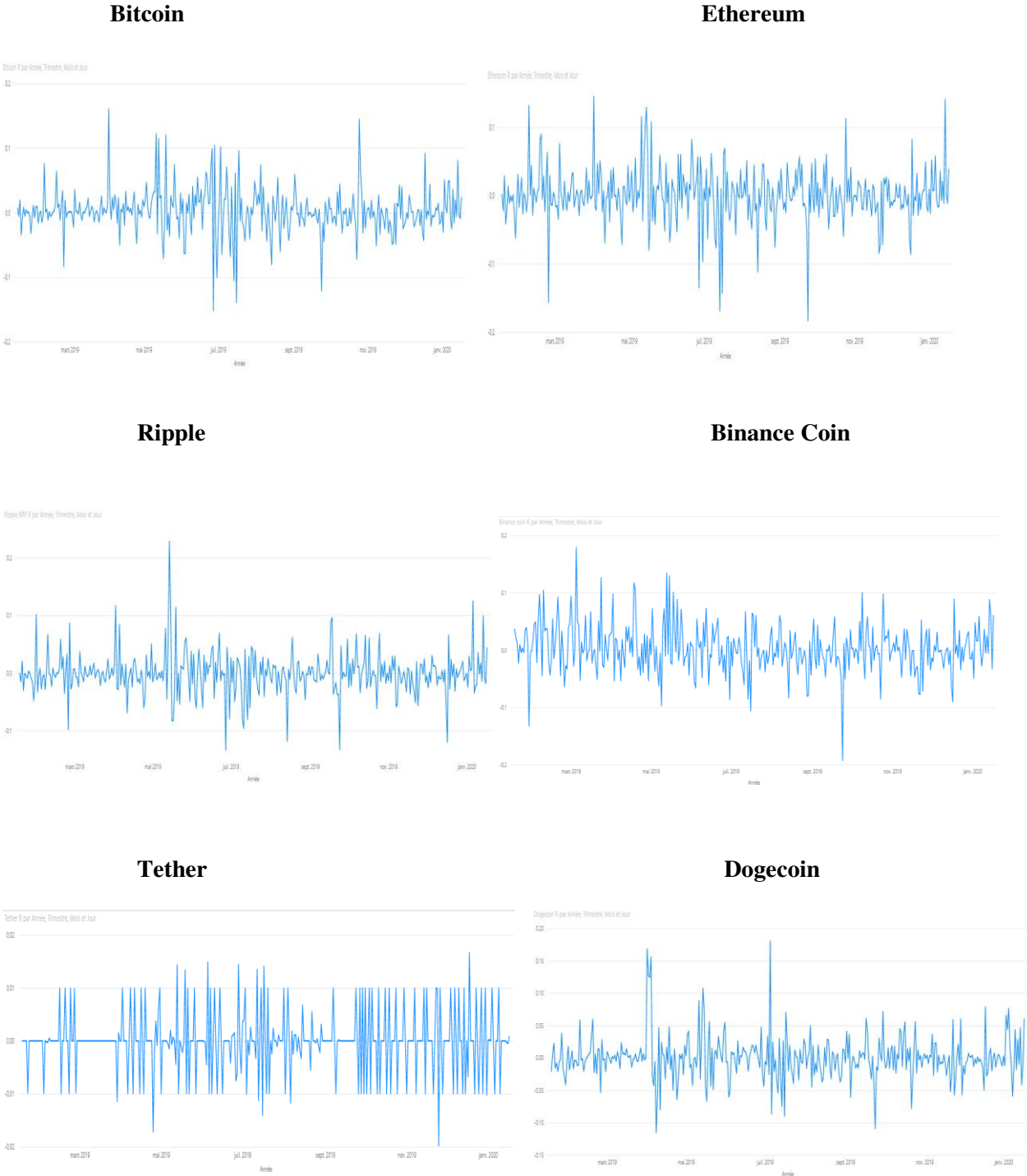
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# 10. Appendix

Figure 1 : Cryptocurrencies' Volatility before the COVID-19 Pandemic



**Figure 2 : Cryptocurrencies' Volatility during the COVID-19 Pandemic**

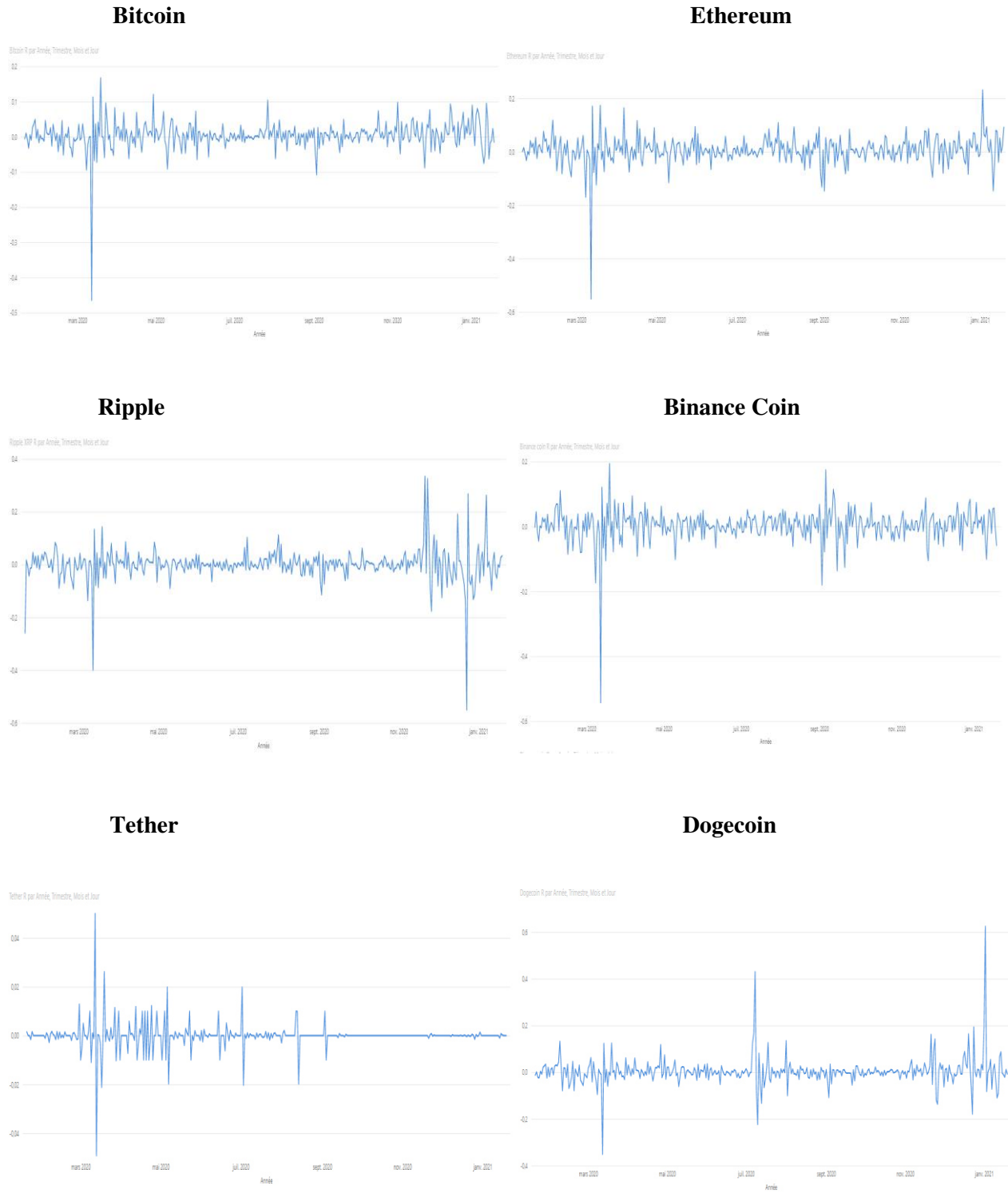




Figure 3 : Gold,WTI's Volatility before the COVID-19 Pandemic

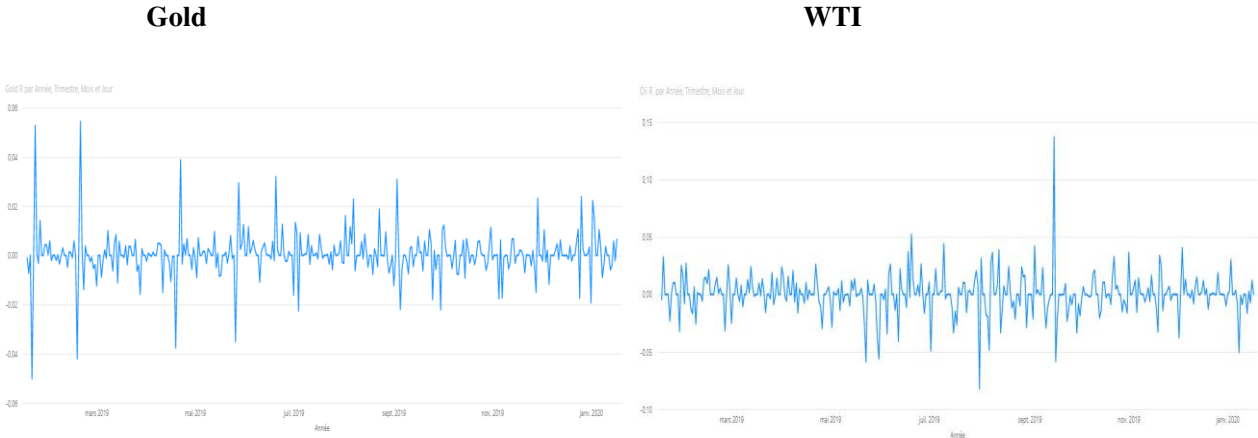
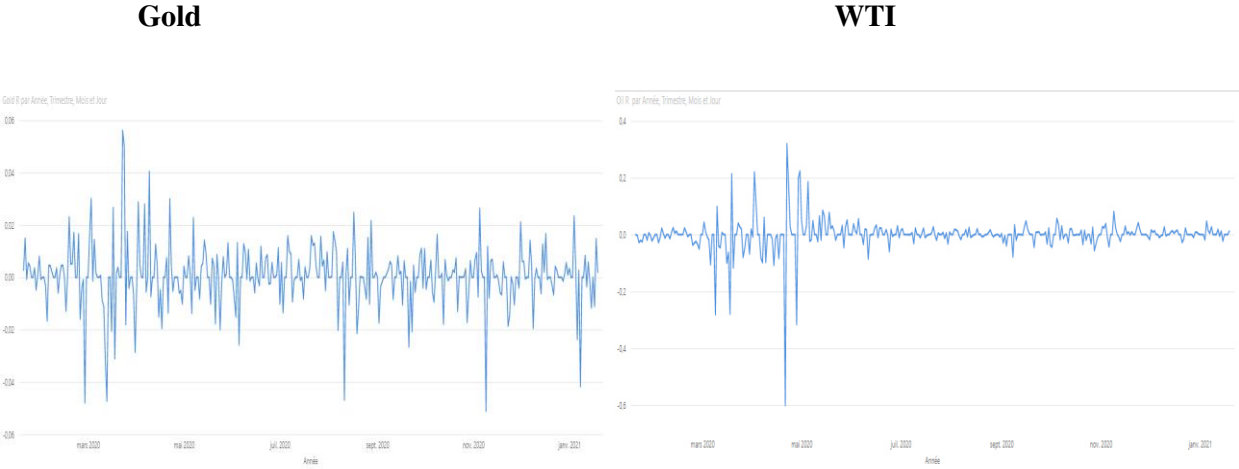
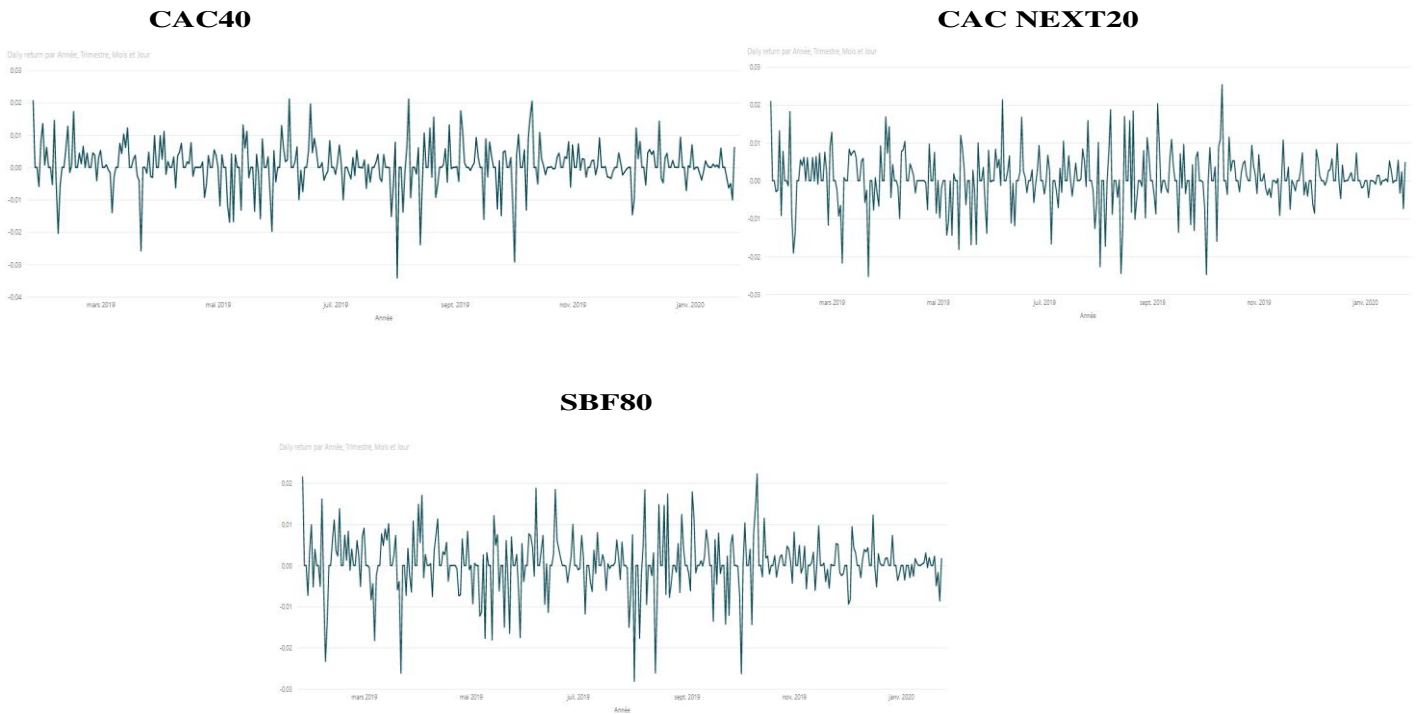


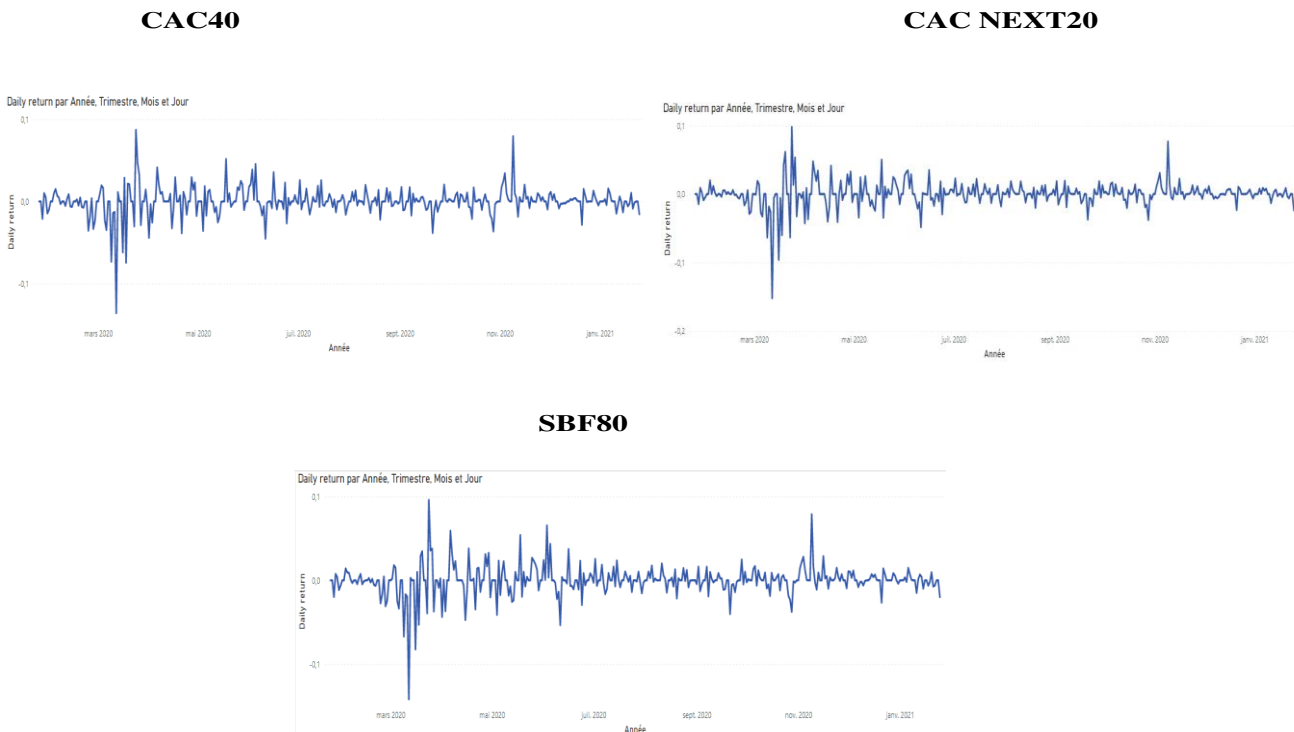
Figure 4 : Gold,WTI's Volatility during the COVID-19 Pandemic



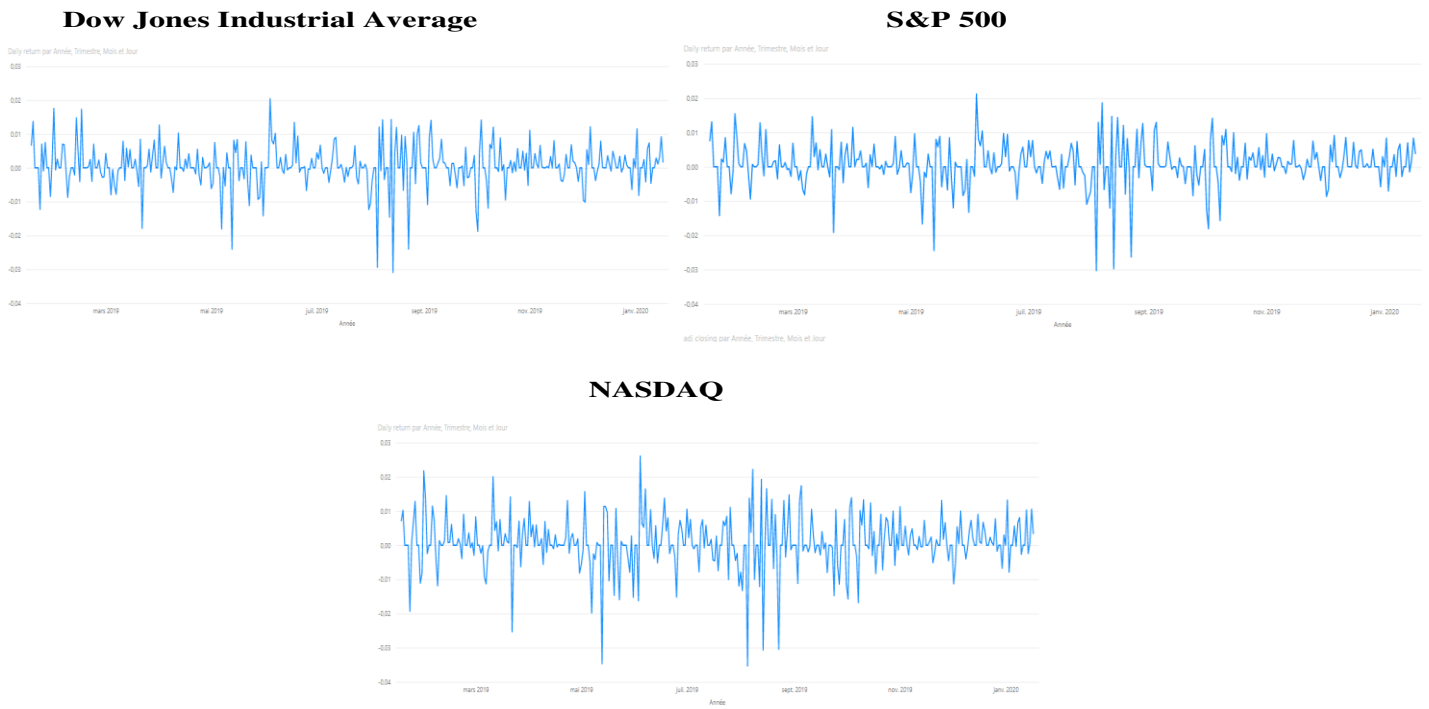
**Figure 5 : French Stock Market Indices' Volatility before the COVID-19 Pandemic**



**Figure 6 : French Stock Market Indices' Volatility during the COVID-19 Pandemic**



**Figure 7 : American Stock Market Indices' Volatility before the COVID-19 Pandemic**



**Figure 8 : American Stock Market Indices' Volatility during the COVID-19 Pandemic**

