

The Effect of Christmas on the Cryptocurrency Market with a Data Science Case Study

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Abstract: *This paper investigates the impact of the Christmas period on the prices of five cryptocurrencies Bitcoin, Ethereum, Ripple, Litecoin and Dogecoin from 2017 to 2021. By employing statistical and data science analysis, the study aims to enhance the understanding of seasonality anomalies in the cryptocurrency market. The results reveal significant price fluctuations during the Christmas period, highlighting the potential for seasonal effects in digital currencies.*

Keywords: Cryptocurrencies, Seasonality, Anomalies, Fluctuations of Cryptocurrency Prices, Christmas Effect

1. Introduction

Seasonal and event anomalies in financial markets demonstrate how certain times of the year and events can affect financial market prices. Due to the importance of understanding seasonality and event anomalies, they received great attention in the past decades.

Seasonality anomalies have not been studied extensively for cryptocurrencies. In contrast, to traditional financial securities for which extensive literature exists and will be presented briefly, there are limited studies for seasonality and event anomalies for cryptocurrencies. Moreover, when seasonality and event anomalies are studied, focus is mainly given on Bitcoin and Ethereum.

For example, **Baur et al. (2017)** took a closer look at seasonality patterns in Bitcoin prices and trading volume from seven global crypto exchanges but did not identify evidence of seasonality patterns in the Bitcoin prices between December 2010 and October 2017. However, they observed a significant weekend effect in trading volume, which aligns well with previous evidence on currency markets. However, currently the truly minimal research on how seasonality anomalies affect the prices of cryptocurrencies only focuses on Bitcoin and then Ethereum.

As cryptocurrencies become increasingly important and popular also as investment assets, it is important to also investigate seasonality and event anomalies on cryptocurrencies. Their exploitability can be a topic strongly related to the nature of the asset itself, which has been more than once considered a speculative asset rather than a commodity or a currency, as highlighted in **Baek and Elbeck (2015)**, **Baur, Dimpfl, and Kuck (2018a)**, **Corbet, Lucey, Peat, Vigne (2018b)** and **Baur, Hong, and Lee (2018c)**, with no relevant correlation with the traditional securities, as confirmed by **Liu and Tsyvinski (2021)**.

One of the anomalies studied in the literature is the impact of holidays on the financial markets, especially Western holidays like Christmas. This effect, called the holiday effect, has been well - studied in traditional stock markets but not much in cryptocurrencies. Christmas, as a major holiday, creates unique market behaviors because of increased

investor excitement and trading. Understanding how Christmas affects cryptocurrency prices is important because cryptocurrencies are becoming more popular as investments. Unlike traditional markets, cryptocurrencies trade 24/7, so they might react differently to the holiday compared to other markets.

This paper aims to enhance the understanding of the Christmas effect on five cryptocurrencies (Bitcoin, Ethereum, Litecoin, Ripple, and Dogecoin) through Statistical and Data Science analysis of their prices throughout the December month in the years 2017 - 2021. The Data Science and Statistical analysis provided on this paper is prepared in the R software.

Section 2 of the paper is an introduction to cryptocurrencies and the crypto market. Following that, in Section 3 seasonality and event anomalies are discussed with examples. In the next section, Section 4, the results and findings of the statistical analysis of the five cryptocurrencies' prices are presented. Finally, Section 5 provides a brief conclusion of the paper's findings.

2. Foundations of cryptocurrencies

Cryptocurrencies are digital currencies in which transactions are verified and records maintained by a decentralized system using cryptography, rather than by a centralized authority.

They operate by offering benefits and investments outside of centralized financial institutions as discussed in **(Ciaian, Rajcaniova, and Kancs 2017)**. While offering a less expensive alternative to mainstream currencies in terms of transaction costs, the prices of these currencies are developing considerably more erratically and fluctuate much wider than those of standard currencies. Although the technology is widely misunderstood, many central banks are considering launching their own national cryptocurrency. Unlike most financial economics data, detailed data on the history of every transaction in the cryptocurrency complex are freely available **(Hardle, Harvey and Reule 2020)**.

Created in 2009, Bitcoin was the first decentralized ledger currency and the most famous to date **(Vejačka, 2014)**. Since then, Bitcoin continues to be the most widely used virtual

currency and is the largest in terms of the market value, the total virtual currency market capitalization, and the number of daily transactions. In 2008, the pseudonymous "Satoshi Nakamoto" posted a white paper describing an implementation of a digital currency called bitcoin that used blockchain technology. A cryptocurrency like Bitcoin can be thought of as a decentralized autonomous organization (DAO), an open - source peer - to - peer digital network that enforces the rules it is set up with (**Hardle, Harvey, Reule 2020**). While Bitcoin has always occupied a major share of the market for cryptocurrencies, Bitcoin represented over 85% of total market capitalization at the beginning of 2017, by the end, this had fallen to less than 40% (**Coin Market Cap, 2018**).

After the launch of Bitcoin, many other cryptocurrencies followed, each bringing new ideas and features to the digital money world. For example, Ethereum introduced smart contracts, which are agreements written in code that automatically execute themselves. Ripple (XRP) aimed to make international payments faster and cheaper for banks. Litecoin, often called the silver to Bitcoin's gold, offered faster transaction times. Other cryptocurrencies like Cardano and Polkadot have focused on making blockchains more scalable, secure, and able to work together. These new cryptocurrencies show how the market is always changing, as creators keep trying to improve and expand what digital currencies can do (**Burnie, 2018**). Several factors contribute to this phenomenon. First, because Bitcoin dominates (market size) the virtual currency market with around 80% of the market share. Second, the strong dominance of Bitcoin as a medium of exchange in altcoin sales transactions (trading currency composition) suggests a further source of inter - dependencies between Bitcoin and Altcoin prices. The market size of virtual currencies has shown a strong growth over the last years. The total market capitalization represented around \$12.6 billion at the end of 2016, increasing by around eightfold from the beginning of 2013 (from \$1.5 billion). The main driver behind this rapid growth is Bitcoin, as the Bitcoin market share represents around 80% (**Ciaian, Rajcaniova, Kancs 2017**).

Cryptocurrencies can send as many transactions as desired. There is also no limit on the number of transactions and the amount of money that will be sent if the wallet has enough balance in it (**Blockchain Expert, 2018**).

Another important feature of cryptocurrency is that the cost of transferring the cryptocurrency is considerably less than the commission or the fees provided by the financial institutions such as banks in performing transactions (**Syed, Moge and Siddiqui, 2016**). Opening an account in a bank requires several documents so that the relevant application could be approved. Banks sometimes refuse to open an account for some people with no criminal record, only based on the central bank guidelines. Cryptocurrency, on the other hand, requires only a computer that has access to the internet to open a wallet. Most cryptocurrencies, including Bitcoin, have set a limit for their currencies that when all currencies are mined, the process of issuing and generating money is over. In the case of Bitcoin, for example, 21 million bitcoins were fixed as a limit, hence, after reaching the 21 million the demand will increase, but no supply will be available, therefore, the chance of inflation is limited in this case

(**Ivashchenko, 2016**). This is why cryptocurrencies are being preferably used over centralized currencies.

The fast - growing nature of cryptocurrencies and their anonymity created huge challenges for the governments. The anonymity provided by cryptocurrency has allowed people individually or in a group to use cyberspace without being obligated to expose their identities to either the government or any third party. Cryptocurrencies are still in their early stages. The prices of cryptocurrencies are fluctuating daily (**Bansal, 2018**). Therefore, investing in cryptocurrencies carries a high level of risks, especially in the medium and long - term investment. The anonymity of the cryptocurrencies provides a way for criminals to commit various types of criminal activities such as money laundering, tax evasion, drug sales and many other illegal actions in which cryptocurrencies are used as a shield to hide their real identity (**Regional Organized Crime Information Center, 2018**). Silk Road website represents an example of using cryptocurrency to commit illegal activities (**Janze, 2017**). In a study made in January 2019, it was stated that the possibility for cryptocurrency being used for criminal activities remains one of the main issues. It was also stated that utilizing cryptocurrencies has become more complex lately. The study indicated that 2018 has seen one of the largest volumes of the dark - net transactions using cryptocurrency amounting to around 600 million (**Chainalysis, 2019**). Another study made in 2018, showed that 1 out of 4 Bitcoin users and half of the Bitcoin transactions are linked with some kind of illegal activities (**Foley, et al., 2019**). Even though the cryptocurrencies market is growing significantly, the problem of recognition and the absence of regulations for cryptocurrencies also represent a significant drawback (**Massad, 2019**). Governments worldwide have different opinions, definitions, and legal approaches to deal with cryptocurrencies. Some countries have not even made any statement declaring their legal position yet. International bodies also have different views regarding cryptocurrencies. This is why there is still some hesitation over using cryptocurrencies.

Cryptocurrencies can be used to make safe and secure transactions where data is stored securely in data folders that are safe and secure enough to protect the data from being accessed by third parties. To be able to use Cryptocurrency, there must be an agreement to use Cryptocurrency without using other third parties. There is a minimum number of 3 members who agree to use the cryptocurrency system. Notes can only be added and cannot be changed or deleted arbitrarily. Every transaction made will generate a Hash which is used as transaction data validation. Transactions using Cryptocurrencies currently there is no law that is certain to regulate it (**Agarwal, Faturahman, and Lukita 2021**).

3. Seasonality and Event Anomalies

Seasonal anomalies in equity markets (whether daily, weekly, monthly, or even yearly) have attracted widespread attention among researchers and practitioners in academia and industry for several decades with the earliest research traced back to the work by **Tooke (1824)** and **Kemmerer (1911)**. Seasonal anomalies refer to the tendency of financial asset returns to display systematic patterns at certain times of the day, week,

month, or year (Lobão, 2019). The study of seasonality and event anomalies suggests that investors could employ the anomaly finding to predict the rise or fall of the prices in the financial markets, like the stock and the cryptocurrency markets (Fama, 1965). Several researchers, including, but not limited to, Gultekin & Gultekin (1983) exhibited the existence of observed anomalies with their evidence in different stock exchanges of the world (Latif et al.2011). In the following subsections the efficient market hypothesis is discussed, and some examples of seasonality and event anomalies are described.

3.1 Efficient Market Hypothesis vs. Seasonality Anomalies

Security markets are a good place to look for anomalies for several reasons. First, data on such markets abound: monthly price data for stocks listed on the New York Stock Exchange are available back to the 1920's. Second, security markets are thought to be the most efficient of all markets. Anomalies here are difficult to blame on transaction costs or other market failures. According to efficient market hypothesis markets are rational and prices of stocks fully reflect all available information. The securities prices quickly adjust to new information as readily as that information is available. But according to behavioral finance this kind of efficient market cannot explain the observed anomalies in Market anomalies are the unusual occurrence or abnormality in smooth pattern of stock market.

A capital market is said to be efficient if it fully and correctly reflects all relevant information in determining security prices. Formally, the market is said to be efficient with respect to some information set, ϕ , if security prices would be unaffected by revealing that information to all participants. Moreover, efficiency with respect to an information set, ϕ , implies that it is impossible to make economic profits by trading based on ϕ . It has been customary since Roberts (1967) to distinguish three levels of market efficiency by considering three different types of information sets, which are the weak, the semi - strong and the strong forms as described below.

The weak form of the Efficient Market Hypothesis (EMH) asserts that prices fully reflect the information contained in the historical sequence of prices. Thus, investors cannot devise an investment strategy to yield abnormal profits based on an analysis of past price patterns (a technique known as technical analysis). It is this form of efficiency that is associated with the term 'Random Walk Hypothesis'.

The semi - strong form of EMH asserts that current stock prices reflect not only historical price information but also all publicly available information relevant to a company's securities. If markets are efficient in this sense, then an analysis of balance sheets, income statements, announcements of dividend changes or stock splits or any other public information about a company (the technique of fundamental analysis) will not yield abnormal economic profits.

The strong form of EMH asserts that all information that is known to any market participant about a company is fully

reflected in market prices. Hence, not even those with privileged information can make use of it to secure superior investment results. There is perfect revelation of all private information in market prices (Malkiel 1989).

3.2 The January Effect

One of the most famous seasonal anomalies is the January Effect. The January effect is known as the tendency of small cap stocks to outperform large cap stocks in the month of January. Rozeff and Kinney (1976) showed that equally weighted indices of all the stocks on the NYSE had significantly higher returns in January than in the other eleven months during 1904 - 1974. Keim (1983) documented the magnitude of the size effect by month using 1963 - 1979 data. He found that half the annual size premium was in January. Blume and Stambaugh (1983) showed that, after correcting for an upward bias in mean returns for small stocks that was common to earlier size effect studies, the size effect was only in January.

Several subsequent analyses built on Keim's study and considered the possibility that the January Effect was diminishing based on the inclusion of later years of data, but Easterday, Sen, and Stephan (2008) also expanded their study to include years before Keim's analysis, which allowed them to better assess trends in the January Effects magnitude. They included the years from 1946 - 2007, performing a time series analysis according to the three sub - periods in relation to Keim's 1963 - 1979 window: before, during, and after. Over this period, they studied NYSE and AMEX firms and, from 1971 onwards, they also considered NASDAQ firms, which allowed them to consider more small cap stocks in their analysis. Contrary to studies based on the Keim period and later years, Easterday et al. do not conclude that the January effect is declining. In other words, they do not find evidence that investors are acting on the arbitrage opportunity and internalizing it into higher prices. Instead, they find that the January Effect continues to be robust in small firms and that, in recent years, it has not so much diminished as returned to a level like the effect exhibited prior to 1963. Easterday et al. also considered trading volume in January, which should be higher if investors are actively arbitraging the January Effect opportunity, but they did not find any evidence of higher trading volumes.

3.3 The Holidays Effect

One aspect, the holiday effect, remains underexplored in this context. Characterized by heightened returns during holiday periods, the holiday effect is a pronounced calendar anomaly and a pivotal indicator of market inefficiency (Barone 1990). Holidays are perceived as public information that can induce asset price fluctuations (Kim and Park 1994). The elated mood of investors during holidays may trigger impulsive behaviors, consequently influencing their investment decisions (Lahav et al.2016; Deldin and Levin 1986). While some studies have identified the existence of holiday effects in the cryptocurrency market, most are centered on Western holidays, such as Christmas and Halloween, and the research has predominantly focused on a limited subset of cryptocurrencies such as Bitcoin and Ethereum (Kinateder and Papavassiliou 2021; Qadan et al.2022). There is a

research gap examining the impact of holidays on a broader cryptocurrency sample, and the influence of investor sentiment on these holiday effects remains unexplored. Let us take one such Western Holiday, Halloween.

One of the oldest and most famous calendar anomalies is the Halloween effect. The Halloween effect is based on the tendency of stock markets to perform better during the winter half of a year that lasts from November to April than during the summer half of a year lasting from May to October (Agrawal and Tandon 1994). The Halloween effect got its name because the more positive half of the year starts around Halloween. The Halloween effect is not a new phenomenon. According to Bouman and Jacobsen (2002), it can be traced back to 1694 on the British stock market. They also discovered the Halloween effect on share markets in 35 out of 37 investigated countries. In 20 cases, the difference between the winter period and summer period returns was statistically significant. A similar study was also conducted by Andrade et al. (2013), who investigated the same group of stock markets with newer data. They confirmed the results of Bouman and Jacobsen and concluded that the average difference between the winter and summer period returns tends to be around 10 percentage points. Various authors investigated the possibility of utilization of the Halloween effect in investment strategies. While Dichtl and Drobetz (2014) concluded that an investment strategy based on the Halloween effect is unable to generate notably higher returns compared to a simple buy and hold strategy, Swagerman and Novakovic (2010); Haggard and Witte (2010); and Andrade et al. (2013) concluded that a strategy of switching between the stock investment during the winter periods and T-bills during the summer periods is able to beat the buy and hold strategy significantly (Arendas, Malacka and Shwarzova 2018).

4. Case Study: Data Science analysis on Five Crypto Coins in December 2017 - 2021

The case study and the statistical analysis presented in the paper involves the prices of five cryptocurrencies. The five cryptocurrencies are Bitcoin (acronym as BTC), Ethereum (acronym as ETH), Litecoin (acronym as LTC), Ripple (acronym as XRP), and Dogecoin (acronym as DOGE). The prices analyzed are during the Christmas period, considering the daily prices from the 1st of December up to the 31st of December in the years 2017 - 2021.

In the first year considered, which is 2017, all the cryptocurrencies experienced a big increase in their price during the period of Christmas, with the biggest increases being 134.44% increase for Litecoin, and 799.49% increase for Ripple, as presented on Table 1.

Table 1: Percentage change over the December month for the 5 cryptocurrencies over the years 2017 - 2021.

Year/ Crypto	BTC	ETH	LTC	XRP	DOGE
2017	+28.9	+62.2	+134.4	+799.5	+317.6
2018	- 11.2	+12.4	- 11.3	- 5.4	+4.3
2019	- 3.1	- 14.2	- 13.4	- 14.3	- 11.5
2020	+54.2	+25.6	+45.9	- 64.1	+40.3
2021	- 19.1	- 19.7	- 29.9	- 16.1	- 18.6

It is very interesting to notice that all five cryptocurrencies faced a strangely alike percentage increase or decrease in their price value in December 2018, such as 12.4% increase for Ethereum, 11.3% decrease for Litecoin, and 11.2% decrease for Bitcoin.

The price of Dogecoin kept fluctuating, thus making it potentially unsafe to invest in due to its volatility, as shown on Figure 1. Moreover, the price of Ripple kept falling after 2017, as shown on Figure 2. According to crypto news, Ripple faced legal issues involving the US Securities and Exchange Commission (SEC) and a civil lawsuit against its CEO, Brad Garlinghouse. In addition to the SEC case, Ripple faced a civil securities lawsuit for allegedly misleading statements made by Garlinghouse in a 2017 interview. The founder of Ripple, Brad, and others in the company, were accused by the SEC of gaining millions in profit through the unauthorized sales of securities. This caused a drop in the price that is not entirely a December or Christmas effect.

Additionally, Ethereum is continuously successful throughout the Christmas period in the years 2017 - 2021 as shown on Figure 3 and can thus be trusted to be invested before or during the Christmas holiday season. Meanwhile, it is risky to invest in Ripple, as its value has continuously been falling throughout the years, particularly in the Christmas holiday season. Meanwhile Bitcoin and Litecoin are experiencing random fluctuations and a clear conclusion for the effect of the Christmas holiday season is difficult to be drawn, as shown on Figure 4 and Figure 5.

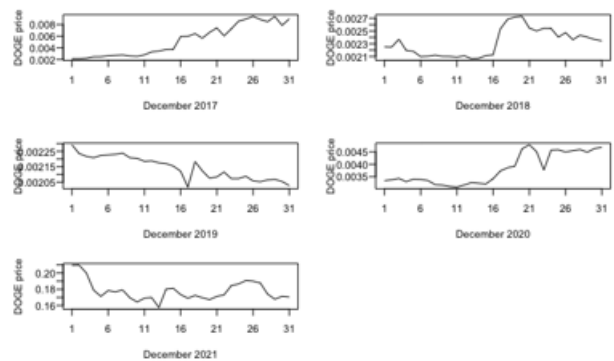


Figure 1: Dogecoin prices over the month December month in years 2017 - 2021.

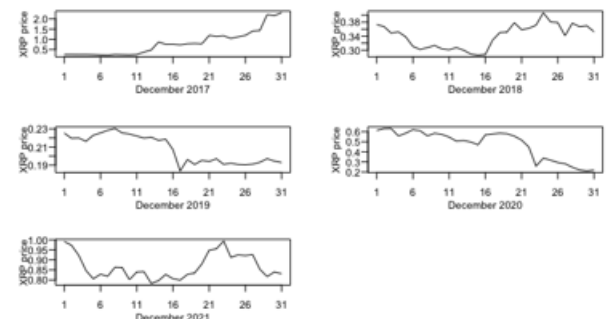


Figure 2: Ripple prices over the month December month in years 2017 - 2021.

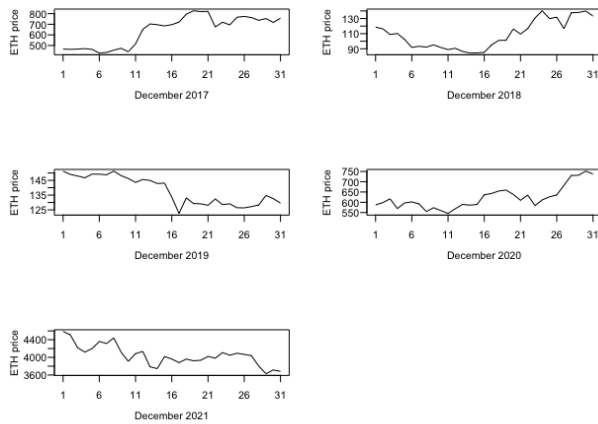


Figure 3: Ethereum prices over the month December month in years 2017 - 2021.

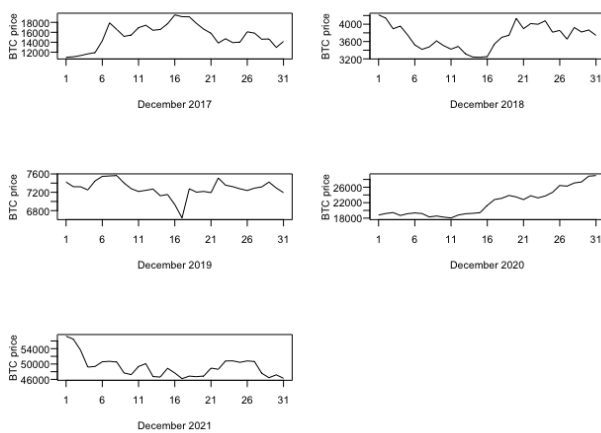


Figure 4: Bitcoin prices over the month December month in years 2017 - 2021.

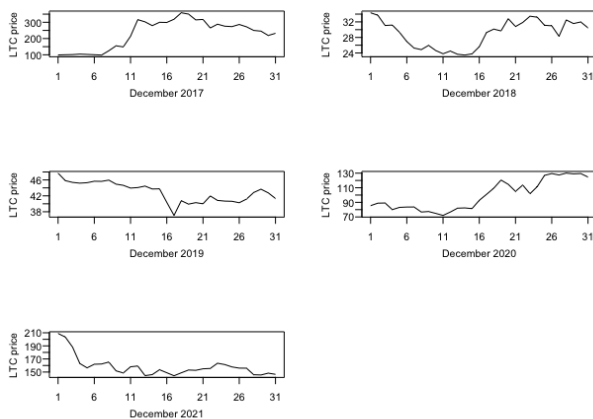


Figure 5: Litecoin prices over the month December month in years 2017 - 2021.

5. Conclusion

This study examined the Christmas Effect on five major cryptocurrencies from 2017 to 2021. Significant price fluctuations were observed in this period, highlighting the potential for seasonal anomalies in the cryptocurrency market. These findings contribute to the broader understanding of how major holidays can impact digital cryptocurrency prices.

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