CRYPTO-CURRENCIES:
DOES SENTIMENT PLAY A ROLE?

BY

João Nuno Marchão Casal Simões

Submitted Dissertation as a partial requisite to obtain the academic degree of:

Master in Management

Supervisor:

Prof. Doutor Carlos Manuel Pinheiro, Invited Assistant Professor, Universidade Europeia,

School of Business and Social Sciences

January 2021

Universidade Europeia
LAUREATE INTERNATIONAL UNIVERSITIES

CRYPTO-CURRENCIES:
DOES SENTIMENT PLAY A ROLE?

BY

João Nuno Marchão Casal Simões

Submitted Dissertation as a partial requisite to obtain the academic degree of:

Master in Management

Supervisor:

Prof. Doutor Carlos Manuel Pinheiro, Invited Assistant Professor, Universidade Europeia,

School of Business and Social Sciences

January 2021

Universidade Europeia
LAUREATE INTERNATIONAL UNIVERSITIES

Authorship Statement

The content of this report is the sole responsibility of the author. I further declare that I have not included in this work material or data from other sources or authors without their correct reference. In this regard, I declare that I have read the student's guide on plagiarism and the disciplinary implications that may arise from the non-compliance of the current standards.

Date: 18/January/2021 **Signature:** 

Acknowledgements

I want to start by thanking my Finance teacher and Master Thesis Advisor, Professor Carlos Manuel Pinheiro. Thank you for being always ready to jump on a call or answer emails at any time of the day (or night!) and to the amazing information and insights given on the finance topics. Professor Carlos also showed an immense enthusiasm about my thesis and topic that let me believe that I can always improve myself and pursue with all my energy the finest standards for my work.

I also want to thank my family, close friends and girlfriend for being supportive throughout these long months of thinking, researching and writing, and for understanding my long days and nights locked inside my room to accomplish this final work.

I want to thank too, my former colleagues, friends and managing partners at BitMasters, because without our Bitcoin company, 5 years ago, my enthusiasm and will of continuing to pursuit my passion for cryptos, technology and finance would not exist, so a big thank you for my team for the help on that (crazy) journey and venture.

My journey throughout Silicon Valley and San Francisco also helped me to enhance my passion and knowledge that I have now about Fintechs, Cryptos, BlockChain and VC (Venture Capital), and for that I want to thank my former boss, Brett Noyes, of Unbank Ventures for showing me and giving me the opportunity to learn more about what Fintech, Cryptos and VC (on steroids) is all about!

Finally, I want to send my corporate thanks to the World Bank and to the ITU (International Telecommunication Union) for answering all my emails and for helping me with data collection for my Master Thesis.

A big thank you to all again and I hope you enjoy this reading!

Disclaimer

This work is based on data collected in the last quarter of the year 2019.

Because of the extreme volatility of the crypto currencies' market, when the reader starts to indulge and appreciate this work, the market could already be significantly different and because of that, the coins mentioned here could already not have any value and/ or be extinct. Nonetheless, no major changes in the results and/ or conclusions of this research are expected.

Abstract

This Master Thesis addresses the relationship between Market/ Investor Sentiment and the Crypto-Currencies Market using a database with 28 variables, such as the Crypto-Currencies Prices (Crypto-Currencies that had more than one Billion USD in Market Cap were selected), the S&P500 Index stock prices, the GDP of the US or Europe, Internet World Statistical data, among others, but most importantly Investor/ Market Sentiment data, gathered from Duke's University surveys. All this data was then entered into SPSS and analyzed as Panel Data.

The time period for this research spans from 2013 to 2019, 2013 because it is the first year were the market prices of Crypto-Currencies are available. Even though Bitcoin was created in 2008 (Nakamoto, 2008), market data about Crypto-Currencies only appeared in 2013.

We run OLS and 2SLS regressions to test the significance, causality and the relationship between Sentiment and Crypto-Currencies. For the 2SLS, two Lagged variables were added. Additional Robustness tests were done including regressions with only Bitcoin and Litecoin. With this we find that there is a strong correlation and significance between the level of optimism and/ or pessimism in the financial markets and in Crypto-Currencies and that the relationship between them is mostly non-linear according to our research and analysis.

Our results suggest that the price of Crypto-Currencies is an increasing function of sentiment, which calls for considering Behavioral Economics tenets when analyzing Crypto-Currencies markets'. Our findings are confirmed by robustness tests deploying alternative measures of the variable of interest – Sentiment – as well as alternative controls.

The findings suggest that more regulation in the market is needed to avoid extreme volatility for investors. Crypto-Currencies show bigger growth when the sentiment towards the market is pessimistic, such as when there is a crisis either a monetary or a political one, because Crypto-Currencies are still associated with somewhat non-deterministic movements. It is now our job to pursue regulation and to attract more corporate investors so that Crypto-Currencies could start to be more accepted as financial assets, and not to be seen as just "internet money", as unfortunately they are still perceived by many nowadays.

Keywords: Bitcoin, Ethereum, Crypto-Currency, Behavioral Finance, Investor Sentiment.

Table of Contents

List of Figures

List of Tables

List of Abbreviations, Symbols and Acronyms

2SLS Two-Stage Least Squares

ADA Cardano (Cardano/ Cardano Coin)

BCH Bitcoin Cash

BNB Binance Coin

BSV Bitcoin SV (Satoshi Vision)

BTC Bitcoin

DAPP Decentralized APP

DEX Decentralized Exchange

DPOS/ DPoS Delegated Proof-of-Stake

ECB European Central Bank

EOS EOS

ETH Ethereum

LTC Litecoin

OLS Ordinary Least Squares

POS/ PoS Proof-of-Stake

POW/ PoW Proof-of-Work

TRX TRON

UN United Nations

XLM Stellar (Stellar Coin/ Stellar Lumens)

XRP Ripple

1 Introduction

This work aims to study Investor Sentiment and Crypto Currencies and how these two topics are related. To the best of our knowledge this is one of the first works tackling this issue. We started by collecting data from Duke's University database on Investor/ Market Sentiment, then we proceeded to collect data from the current Crypto Currencies that had (in the beginning of this study – last Quarter of 2019) more than 1 Billion USD in Market Cap. The decision of adding only Cryptos with more than 1 Billion USD Market Cap was made because at the moment thousands of different Crypto Currencies exist. So, we decided to focus on the most valuable and more relevant in the Crypto market today, to avoid confounding effects.

Below we present a figure representing the evolution of BTC (Bitcoin), the most valuable and the first crypto-currency ever created (Nakamoto, 2008).

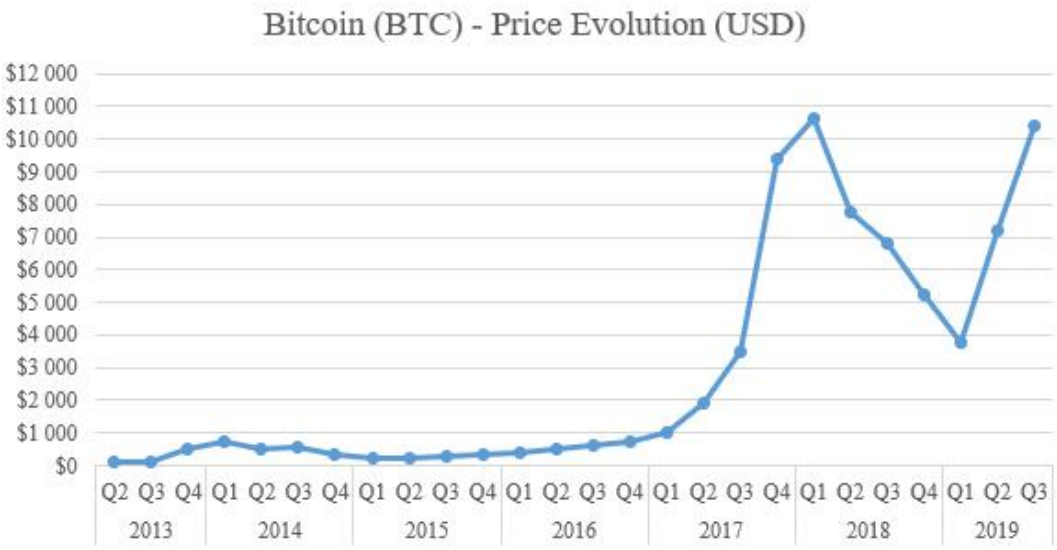


Figure 1 – Bitcoin (BTC) (Stock) Price Growth Over Time (Source: Own elaboration).

This figure helps answering the question "Why did the majority of Crypto-Currencies only appear in the last few years?" Here we can see that the "Crypto-Currency hype" started in the end of 2015. Following that year, the majority of Alt-Coins that we know today were created (Buterin, 2014; Grigg, 2017; Kiayias, Russell, David, & Oliynykov, 2017; Mazières, 2016; TRON, 2018).

The following figure was created by joining two graphs. A graph with the Market Cap of our selected 11 Cryptos, and a more "zoomed" graph in the area between 0 and 20 Billion Market Cap, as the majority of our Cryptos are below the mark of the 20 Billion. Here we can see that Bitcoin is still today (in the 4th quarter of 2019) responsible for a big part of the Crypto-Currencies market but we can also observe that Ethereum a new and very prominent Alt-Coin is quickly gaining territory in the Crypto-Currencies world (Buterin, 2014).

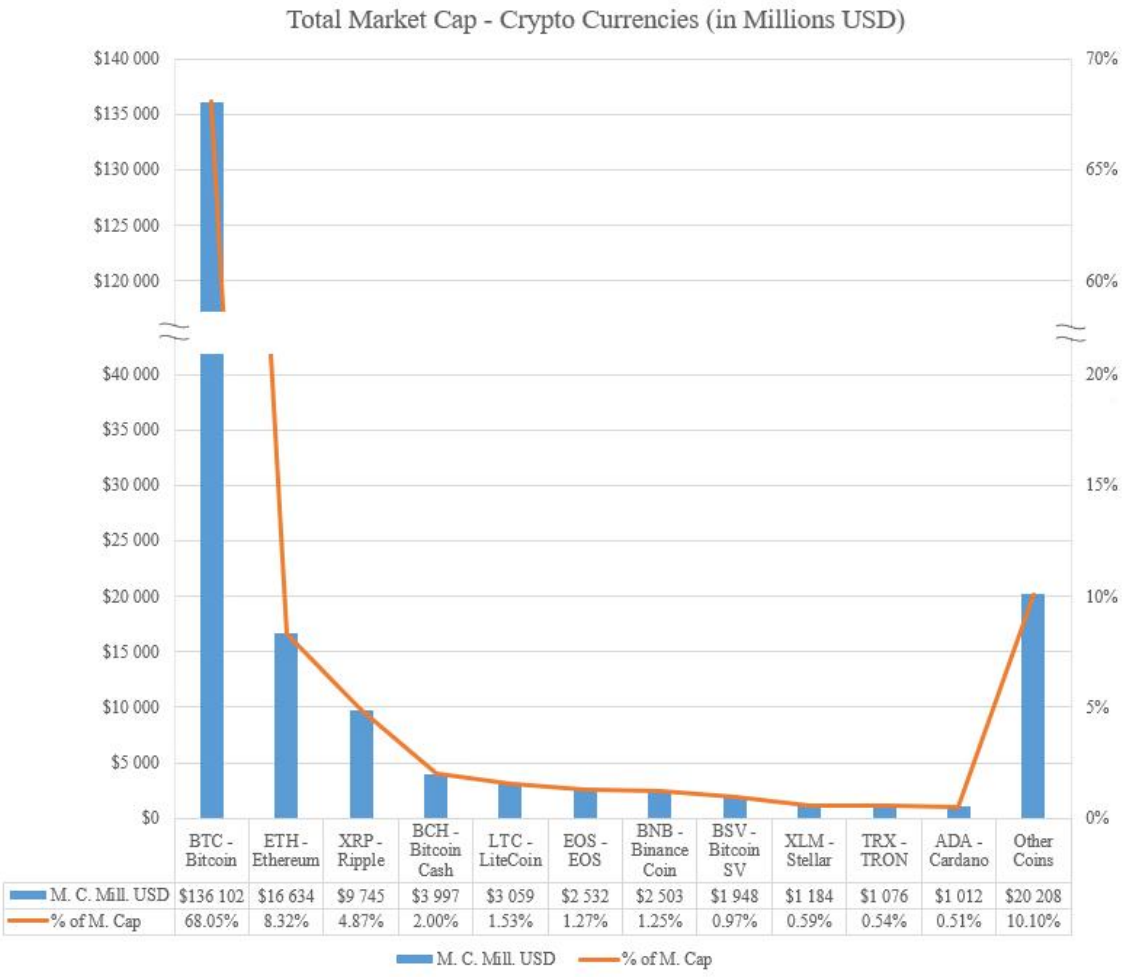


Figure 2 – Total Market Cap of the 11 Crypto Currencies Studied (Source: Own elaboration).

The first data available from Cryptos in terms of stock price is only starting early 2013, even though Bitcoin was invented in 2008 (Nakamoto, 2008). So, the period of analysis of this study spans from 2013 (the beginning date of data available regarding Crypto Currencies) until 2019 (when this study started). Since the Sentiment data available at Duke's University database is in quarters, the

data of the Crypto Currencies and all the other data added subsequently was then converted to quarters or gathered in quarters already when possible. All this data was then organized into Panels and then analyzed this way (Panel Data Analysis) (Namouri, Jawadi, Ftiti, & Hachicha, 2018; Senner & Sornette, 2019; Zouaoui, Nouyrigat, & Beer, 2011).

But, why Cryptos? Why Bitcoin?

Bitcoin appeared in 2008 amidst a world financial crisis and brought hope for a new reform of the financial world. Bitcoin brought the BlockChain Technology, brought a new way of doing payments, a new way of storing money and even a new way of creating money with its natural inflation model (mining), printed within its *script* (Pacheco, 2018).

So, Bitcoin (or the first of a large set of Crypto-Currencies) was brought to the world when the Market Sentiment was at its lowest because of the Financial Crisis (Kaygin, Topcuoglu, & Ozkes, 2019; Manimuthu, Raja Sreedharan, Rejikumar, & Marwaha, 2019). Does this suggest that Crypto Currencies and Market/ Investor Sentiment are related with each other? Does Sentiment play a role in the Crypto-Currencies Market? This study aims to answer these questions, or at least to foster the debate on correlating Behavioral Finance and Crypto Currencies.

This study is one of many that could be done on this still very new topic. Here we are poised at answering the question in a quantitative way by deploying an econometric model. First by gathering data on Market Sentiment and Cryptos as stated above and then collecting additional data on technological access such as Internet Statistics gathered from both the World Bank and the ITU (International Telecommunication Union) that helped me personally on this matter by making data available on demand. I also gathered GDP data of both the US and Europe, S&P500 Index stock data, money indicators data such as M1 and M2, collected from the Federal Reserve Economic Data from the Federal Reserve Bank of St. Louis among others. A long period of data gathering and hundreds of hours in Excel organizing data resulted in a data base with 28 variables, all ready to be used for our future research and statistical/ mathematical models. After this and with the help of the statistical software SPSS, several analyzes were carried out such as Descriptive analyses and OLS Linear Regressions. After defining the BASE models, extra robustness tests were performed to bring more certainty to our results (Ang, Piazzesi, & Wei, 2006; Drobetz, Momtaz, & Schröder, 2019; G. He, Zhu, & Gu, 2020; Hribar, Melessa, Small, & Wilde, 2017; Sifat, Mohamad, & Mohamed Shariff, 2019).

After running our Baseline model and several additional tests, nine new variables were created after by joining and/ or modifying existent variables in order to create new ones for further, more focused, robustness tests, which ended up being a success too. Then, several Two Stage Least Squares Regressions (2-Stage LS Regression) were run to validate our results. With this new test two new LAGGED variables were also created (Campbell, Lo, & MacKinlay, 1997; Murray & Nelson, 2000; Platt, 1987; Polasik, Piotrowska, Wisniewski, Kotkowski, & Lightfoot, 2015).

To complete our study, several additional regressions, both OLS and 2SLS were run with only BTC, Bitcoin and LTC, Litecoin. This decision was made because BTC is responsible for the majority of the Crypto-Currencies market and LTC was included because it is one of the first Crypto-Currencies created (Chan, Chu, Nadarajah, & Osterrieder, 2017) prior to the 2015 (when the majority of the new Alt-Coins were created).

All these tests confirmed that Sentiment and Cryptos are highly correlated and their relationship is significant, but mostly non-linear.

In Chapter 2 an extensive Literature Review is included introducing our 11 Crypto-Currencies and also topics such as Behavioral Finance and Economics, Investor Sentiment, Behavioral Management and how Crypto-Currencies and Sentiment are related (Bruce & Nyland, 2011; Gurdgiev & O'Loughlin, 2020; Thaler, 2016).

Sentiment as a topic has been under the spotlight in the last few years because of the Nobel prizes awarded to scientists who were contributing to Social Sciences, most specifically in the field of Behavior Economics, such as Richard Thaler (Appelbaum, 2017; Thaler, 2017).

The methodology for this research is featured in chapter 3, then, in Chapter 4 we present the analysis and discussion of our results. With several Tables with OLS and 2SLS tests as described above.

In Chapter 5 we deploy our conclusions and debate how to proceed to progress this study. The conclusions are very positive, confirming a significant correlation between Crypto-Currencies and Market/ Investor Sentiment.

2 Literature Review

2.1 What is/are Crypto-Currencies

First let me briefly explain what virtual currencies are and review the concept of virtual money. Then making the transition to the modern virtual-currencies that are denoted crypto-currencies.

All crypto-currencies are virtual currencies but not all virtual-currencies are crypto-currencies (Eken & Baloglu, 2017; Glaser, Zimmermann, Haferkorn, Weber, & Siering, 2014).

The first virtual-currency was E-Gold, created in 1996 by Douglas Jackson. This virtual currency was 100% pegged to gold (E-Gold, 1998b, 1998a, 1998c). After E-Gold, another currency called Beenz appeared focusing more on the virtual part of online shopping and the concept of internet money (Beenz, 2001). Eventually they both failed, same as other coins that appeared in the early 90s and 2000s but all paved the way and opened the appetite for a better and improved currency, which was later known as Bitcoin (Miller, 2014).

Nowadays when we talk about virtual money, that same money is not associated with gold nor to a bank account as it was in the E-Gold era, for example. Nowadays it might be associated with gaming. The online game community is now huge and because of that it is normal to trade our fiat money for any time of "game coins" that can then be used to trade for something online (Eken & Baloglu, 2017).

Crypto-currencies are different. Virtual money does not need to be mined, crypto-currencies (normally) do. Virtual money does not need to be anonymous, crypto-currencies (normally) are.

The concept of mining was created because, when Bitcoin was invented by Satoshi Nakamoto (Nakamoto, 2008), the fact that it is and was a currency not regulated (DESCENTRALIZED) by any central bank/ governmental authority (Parashar & Rasiwala, 2019), the need of having something to control transactions was necessary, thus (bitcoin) mining was invented. There is a network around the world of miners called "nodes". These nodes help to verify Bitcoin transactions using the Proof of Work Concept (Bhat & Vijayal, 2017; Bouri, Jalkh, Molnár, & Roubaud, 2017; Bridle, 2019; Caginalp & Caginalp, 2018; Chan et al., 2017; Chapron, 2017; Corbet, Lucey, & Yarovaya, 2018; Cvetkova, 2018; Hammi, Hammi, Bellot, & Serhrouchni, 2018; Kaygin et al., 2019; Koblitz & Menezes, 2016; Kugler, 2018; Lacity, Sabherwal, & Sørensen, 2019; Leonberger

& Feldt, 2020; Manimuthu et al., 2019; McGinnis & Roche, 2019; Minor, 2020; Nair, 2019; Parashar & Rasiwala, 2019; Ryabova & Henderson, 2019; Sathyanarayana & Gargesa, 2019; C. Smith & Kumar, 2018; Spithoven, 2019; Strawn, 2019; Thakor, 2020) . All transactions are public, and stored in the BlockChain but the issuer and the target are not public. Bitcoin & BlockChain technology uses the hashing algorithm SHA-256 for its cryptography, and to keep its users anonymous, with the help of a Private and Public Key system (Bhat & Vijayal, 2017; Chase & MacBrough, 2018; Dickson, 2019; Foley, Karlsen, & Putnins, 2019; Hammi et al., 2018; Hayes, 2019; Hughes, Park, Kietzmann, & Archer-Brown, 2019; Kaygin et al., 2019; Koblitz & Menezes, 2016; Linoy, Stakhanova, & Matyukhina, 2019; Minor, 2020; Mohanta et al., 2019; Nair, 2019; Nakamoto, 2008; Nizamuddin, Salah, Ajmal Azad, Arshad, & Rehman, 2019; Ruslina, 2019; Small, 2015; Sun Yin, Langenheldt, Harlev, Mukkamala, & Vatrapu, 2019; Waldo, 2019; Xu et al., 2020; Z. Zhang, Yin, Liu, & Liu, 2020).

2.1.1 Bitcoin & LiteCoin (Often referred as Main-Coins)

Bitcoin, the first ever crypto-currency created, presented in a paper entitled “Bitcoin: A Peer-to-Peer Electronic Cash System” by Satoshi Nakamoto in 2008, started to change the world of money as we know it today and it still amazes us every day by its details and technology. Technology, that would be denoted later as blockchain.

It is worth noting that one of the most important features of Bitcoin is the fact that it uses a concept of PROOF of WORK, initially created by Cynthia Dwork and Moni Naor to find a solution to control and access junk mail (Dwork & Naor, 1993) but then popularized by Satoshi, who uses specifically SHA-256 for its hashing operations (Nakamoto, 2008).

Then, later down the road LiteCoin appeared, created by Charlie Lee in 2011 (McMillan, 2013; Russell, 2017) and was created with a different way or working, but nonetheless with big popularity. If Bitcoin was considered similar to Gold (the commodity), LiteCoin was definitively considered Silver, in comparison.

Litecoin uses script algorithm, not SHA-256. This way Bitcoin needs an ASIC (Application-Specific Integrated Circuit) machine so that the mining can be done whereas Litecoin mining can

be done via GPU (Graphics Processing Unit) which is a normal graphics card used in any home computer. These are the main differences regarding Bitcoin and Litecoin (Bouri, Jalkh, et al., 2017; Kugler, 2018; Sukharev, 2020; Tetu, Trudeau, Van Beirendonck, Balatsoukas-Stimming, & Giard, 2020; Tu & Xue, 2019).

Unfortunately Litecoin does not have an official White Paper (type of document used by the crypto-currency community to explain and present the functioning of each now coin that appears of the market) (Graham, 2014), but a similar document written by members of the crypto-currency community can be found online: http://zioncoins.co.uk/wp-content/uploads/2015/06/Lite-Coin-Whitepaper.pdf (ZionCoins, 2015) . Bitcoin's white paper (not called an white paper at the time, just an academic paper) is the one written by Satoshi Nakamoto already mentioned in this document.

Bitcoin is considered a "mother-coin"[1] or main coin[1]. Sometimes Litecoin and/or Ethereum are also called "main-coins", but in the majority of the times are called "alt-coins"[1] (alt = alternative) because they came after Bitcoin (Foley et al., 2019; Sifat et al., 2019). Litecoin introduced script mining and a lot of code changes in relation to BTC (Bitcoin), and Ethereum is considered often as Bitcoin 2.0, because Ethereum is similar to Bitcoin but a lot of times considered better because it is an improved version of BTC (Buterin, 2014). And one thing that was improved is the fact that while Bitcoin is predicted to end in the next 100 years because of the limitations of the mining capacity, what it is called "mining difficulty", with Ethereum that problem doesn't exist (Bariviera, Basgall, Hasperué, & Naiouf, 2017; Hajric & Kharif, 2019; Kauflin, 2020; Waldo, 2019).

2.1.2 Ethereum (An Alt-Coin that with time became a Main-Coin)

Vitaly Dmitriyevich "Vitalik" Buterin, a Russian-Canadian computer scientist born in 1994, in 2009 wrote the white paper that changed the crypto-space forever. Some love him, some hate him, but he is undoubtfully a genius in his own way (Brownell, 2017; Buterin, 2020b, 2020a; Melendez,

[1] The terms "main-coin", "mother-coin" and/ or "alt-coin" where created online by the crypto-currency community and it is a way to identify these different types of coins.

2014; M. Peck, 2016; Snyder, 2017) . Inspired by Satoshi Nakamoto he created Ethereum (Buterin, 2014).

Ethereum is different from all the coins prior, Ethereum enhanced the crypto-space giving this way the possibility to developers all over the world to work on enhancements for the coin, mainly via GITHUB[2] (https://github.com/ethereum), but also providing the possibility to create programs in the "Ethereum platform" (https://studio.ethereum.org/) . This includes an Ethereum Virtual Machine (EVM) (Wood, 2014), a possibility to create smart contracts that are compiled to the EVM and then deployed to the Ethereum blockchain, applications that can run inside Ethereum (Harm, Obregon, & Stubbendick, 2016), etc..

Vitalik wrote about Bitcoin limitations, such as the fact that Bitcoin lacked a Turing-completeness (Turing, 1937), which was a big limitation and was necessary to be corrected/ improved to then give the user the possibility to write smart contracts "where they can create their own arbitrary rules for ownership, transaction formats and state transition functions" (Buterin, 2014, p. 13). The idea of smart contracts was first proposed in the 90s by a man called Nick Szabo (Szabo, 1997), a computer scientist, legal scholar and cryptographer, but only nowadays with blockchain and Ethereum the idea is being implemented and used, both in the private user spectrum and also at an enterprise level (Chapron, 2017; Cvetkova, 2018; Drożdż, Minati, Oświęcimka, Stanuszek, & Wątorek, 2019; Fang et al., 2020; Griggs et al., 2018; Harm et al., 2016; Hegedűs, 2019; Hlaing & Nyaung, 2019; Kauflin, 2020; Linoy et al., 2019; Mselmi, 2020; Nizamuddin et al., 2019; Notland, 2019; Pãnescu & Manta, 2018; C. H. Park, Mejia Barlongo, & Kim, 2019; Rikken, Janssen, & Kwee, 2019; Ruoti, Kaiser, Yerukhimovich, Clark, & Cunningham, 2019; Schmeiss, Hoelzle, & Tech, 2019; Schulpen, 2018; Spithoven, 2019; Strawn, 2019; Thakor, 2020; Tikhomirov et al., 2018; Waldo, 2019; Wood, 2014).

To wrap out this chapter on Ethereum, there is one more important thing to emphasize. Although Bitcoin miners receive BTC by mining blocks, thus helping the BTC blockchain system, in Ethereum, the miners receive 2 types of incentives. They receive ETH (Ethereum) by mining ETH blocks, but also receive ETH by helping in performing tasks inside the EVM. The miner by

[2] A place where developers can gather ideas and develop new programs, a lot of times these programs are "Open-Source" meaning that it is open for the community and normally non-profit. It is also a place to share and store code for a lot of developers.

providing computation power to the system is rewarded with GAS. GAS is a unit of measurement used in the Ethereum system to account for computational power and its rewards inside the system (Rosic, 2018). After GAS is received it can be then traded to ETH. GAS price fluctuates with the need of computation power, the more power is needed, the more the price of GAS goes up, or if there is a lot of computer power available and not so much demand, the GAS value decreases (Bhat & Vijayal, 2017; Buterin, 2014; Chen et al., 2019; Dagher, Mohler, Milojkovic, & Marella, 2018; Grech et al., 2018; Hammi et al., 2018; Harm et al., 2016; Pãnescu & Manta, 2018; C. H. Park et al., 2019; Tikhomirov et al., 2018; Wood, 2014).

2.1.3 Alt-Coins

After Bitcoin, Litecoin and Ethereum, we turn to a more in-depth analysis of the concept of Alt-Coin or Alternative-Coin. Although sometimes the crypto-currency community refers to Litecoin or Ethereum as main coins because of their importance to the crypto-space. One possible definition of what an alt-coin is could be something like this:

Altcoins are the other cryptocurrencies launched after the success of Bitcoin. The term "altcoins" refers to all cryptocurrencies other than or *alternative* to Bitcoin (Lee, Guo, & Wang, 2018).

This study addresses 11 crypto-currencies. These 11 currencies were picked because they represented at the time of the beginning of the research (last quarter of 2019) the ones with more than 1$ Billion of market cap, according to the website CoinMarketCap.com.

After Bitcoin, Litecoin and Ethereum, let’s discuss further the details of the other coins, in this case, all alt-coins, such as XRP (Ripple), EOS, Binance Coin, Bitcoin SV, Stellar, TRON and Cardano.

2.1.3.1 XRP (Ripple)

Let us start with Ripple. XRP or Ripple (Schwartz, Youngs, & Britto, 2014) was released in 2012 by Jed McCaleb, together with Arthur Britto, David Schwartz, latter with Chris Larsen, Jessie

Powell and later the "superstar" Ryan Fugger, who in 2005 launched Ripplepay[3], that was described as "a financial service that allows you to extend credit lines to your friends, family, and associates and make secure payments in traditional and online currencies" (Coinmonks, 2018, para. 9), that was in its essence the beginning and core of what Ripple is today (Andrews, 2013; Ben & Xiaoqiong, 2019; Binance, 2018b; Chan et al., 2017; Liu, 2013; M. E. Peck, 2013; Skalex, 2018).

Ripple is now famous because of its protocol that banks like to use. RTXP (Ripple Transaction Protocol) is a cross-border network that can be used for currency transfers. It is stable, scalable, fast and low cost and the banks love it (Bhatia, Kumar, Bansal, & Rawat, 2018; BlackwellGlobal, 2018; Kauflin, 2020; Prewett, Dorsey, & Kumar, 2019; C. Smith & Kumar, 2018; Yi, Xu, & Wang, 2018).

Ripple is also very criticized inside the crypto-currency community because it has a centralized system, with pre-mined coins. This means that this currency does not rely on miners for its wellbeing and decentralization. All these processes are made by the Ripple Labs Inc. in the headquarters of the company (Kugler, 2018; Nikolaev, 2019).

2.1.3.2 Bitcoin Cash

The first Bitcoin FORK happened in 1st of August of 2017. The result of this fork was the creation of Bitcoin Cash, based on Bitcoin, but making a new currency: Bitcoin Cash (Irrera & Chavez-Dreyfuss, 2017; McGinnis & Roche, 2019; Spithoven, 2019; Tu & Xue, 2019).

But first we have to understand what a fork is. In the crypto-currency world a fork can be one of two types, a soft fork or a hard fork. A soft fork means that the software is backward compatible and a hard fork means that the new version of the software is NOT backwards compatible (Agrawal, 2019). Bitcoin Cash is a hard fork.

This "new" Bitcoin was not received with open harms, since that Bitcoin Cash advocates defend that it is a better version, but (original) Bitcoin enthusiasts say that they are the ones with the best version and that no updates are necessary for Bitcoin (Clifford, 2018; C. Smith & Kumar, 2018).

[3] In which the old website is still online: https://classic.ripplepay.com/

"Forks may allow a cryptocurrency to create new currencies that are better optimized for different uses. In this case, bitcoin cash may be better suited to buying goods and services and bitcoin itself better suited to being held as an investment. Bitcoin cash more easily accommodates a greater number of transactions while bitcoin, with its more decentralized group of miners, might be thought less easy to manipulate." (McGinnis & Roche, 2019, p. 43).

The main aspect of BCH (Bitcoin Cash) is that the block[4] size was increased from an average of 1MB per block (Bitcoin) to 8MB per block in the BCH. Allowing this way more transactions to happen inside the blockchain of the coin and increasing this way the speed of the coin, making it more reliable (Reiff, 2020; O. Smith, 2018). This also made the coin more volatile, and because of that it is considered a better financial instrument than BTC (Fakhfekh & Jeribi, 2020).

2.1.3.3 EOS

Next on the line is EOS. EOS.IO (protocol) or simply EOS (cryptocurrency) (Grigg, 2017) was developed by the private company block.one (Kauflin, 2020) mainly by Daniel Larimer and Brendan Blumer (Fakhfekh & Jeribi, 2020; Kauflin, 2018) who with the help of some other people inside the crypto-currencies community created EOS.IO (EOS.IO, 2018). The white paper with all the technical information can be found on GITHUB: https://github.com/EOSIO/Documentation/blob/master/TechnicalWhitePaper.md and accessed and downloaded for free.

EOS was introduced to the world only in 2017, but its creator also brought to the table a big novelty, that was DPOS (Delegated Proof-Of-Stake) (Larimer, 2017).

There are right now 3 important models: POW (Proof-of-Work), POS (Proof-of-Stake) and DPOS (Delegated Proof-of-Stake). Pow is what Bitcoin, Ethereum and what almost every crypto-currency uses. PoS was invented by Sunny King and Scoot Nadal in 2012, which the main objective is to make crypto-currency mining more "green" and "fair" (King & Nadal, 2012). After that in 2017

[4] Blocks are pieces of data that miners mine inside the Blockchain, of in this case a coin's blockchain. Mining as stated previously is the computation of complex algorithmic problems by computer hardware (ASIC, GPU and/ or CPU).

Daniel Larimer presented to the world a new concept and idea, the DPOS, which brings even more "fairness" to the crypto world:

"Delegated Proof-of-Stake and Proof-of-Stake are two different animals; in a POS system, every wallet that contains coins is able to participate in process of validating transactions and forming consensus, thus the more coins in your wallet, the more coins you will eventually receive. With DPOS system every wallet that contains coins is able to vote for representatives. These representatives validate transactions, form consensus and are paid for their efforts through the system. This avoids a pitfall of POS, which is that, just like in POW, consolidation will eventually occur." (Roman, 2018, para. 7).

Another thing that EOS brought to the table is *Ricardian Contracts*. Created by Ian Grigg, Ricardian Contracts are similar to the smart contracts of Ethereum, but significantly improved, with extra characteristics and , most importantly, extra layers of security (Grigg, 2004; Koteshov, 2018), using PGP (Pretty Good Privacy) for signing and to encrypt data, which is the most secure protocol in the world to sign documents on the web safely (Zimmermann, 1995).

Apart from that, much like Ethereum, EOS also has its own DAPP (Decentralized APP) (Blockgeeks, 2019) development platform/ studio and the plan is to make it the most user-friendly possible and with the most features as possible in the future (Falk, 2019).

2.1.3.4 Binance Coin

Binance Coin, was released in 2017, by one of the world's largest virtual currency exchanges (Binance, 2017), after a successful ICO (Initial Coin Offering – the equivalent of an IPO in the stock market (Ben & Xiaoqiong, 2019)) that took place between 26th of June to 3rd of July, raising successfully 15 million USD (Beedham, 2019; ICORating, 2020).

BNB (Binance Coin) was first issued as an ERC-20 (Somin, Gordon, Pentland, Shmueli, & Altshuler, 2020; Victor & Lüders, 2019), which is the Ethereum token, inside the Ethereum platform, which became a popular method for raising money for ICOs. But even though, Binance is planning to eventually move its coin to their main Binance Chain (Binance, 2018a).

BNB uses are mainly focused on the Binance Exchange (https://www.binance.com/) ecosystem, such as allowing the users to receive discounts when paying for their trading fees. It can also be used to pay for travel expenses and to shop online, for example. In addition, users can also make donations to charity thought the BCF (Binance Charity Foundation) (Binance, 2018a).

Binance also wants to use BNB in the future as GAS[5] (Binance, 2017) on its Binance Chain and on their Binance Decentralized Exchange[6] (DEX) (Binance, 2018a; Kauflin, 2020).

In 2020, Binance also announced the Binance Card:

"(…) the Binance Card works like a conventional debit card, but in this case it is linked to the user's account at the exchange. To use it, the user only needs to top up the Binance Card with funds via the Binance Card app. The funds will be available in Bitcoin (BTC) or Binance Coin (BNB). All payments made with the card are simply debited from the balance." (Marquez, 2020, para. 2).

2.1.3.5 Bitcoin SV (Satoshi Vision)

Bitcoin SV or Bitcoin Satoshi Vision is another Bitcoin fork. It was named Satoshi Vision because the creators believe that this Bitcoin (version) remains true or it is the only (version) that follows best the original paper about Bitcoin by Satoshi Nakamoto.

Just like Bitcoin Cash, the white paper used for this coin (Bitcoin SV) is the original paper published by Satoshi Nakamoto[7] in 2008.

And again, same as Bitcoin Cash, here with Bitcoin SV we are in the presence of a hard fork (Auer, 2019). This fork happened on the 15th of November of 2018 because of the block sizes again, which is a similar problem that happened with Bitcoin Cash too (Kwon, Kim, Shin, & Kim, 2019).

A "crypto-war" between Team ABC, also known as Bitcoin ABC, a full node implementation for the Bitcoin Cash protocol (BitcoinABC, 2017) defended the "Adjustable Blocksize Cap" and eventual removal of blocksize limits, and an opposing team called Bitcoin SV defended the set of

[5] For a more detailed explanation on the GAS subject, please refer to the "Ethereum" title inside this thesis.
[6] "A decentralized exchange is an exchange market that does not rely on a third-party service to hold the customer's funds. Instead, trades occur directly between users (peer-to-peer) through an automated process." (Madeira, 2019, para. 8).
[7] Original BTC paper: https://bitcoin.org/bitcoin.pdf

the block size at 128 MB in order to scale the BTC (Huang, 2018), and because both disagreed, Bitcoin SV fork was created (Reiff, 2020).

In the official Bitcoin SV website[8] the creators describe their vision for the new coin in 4 different pillars being: 1- Stability, 2- Scalability, 3- Security and 4- Safe Instant Transactions (BitcoinSV, 2019).

Bitcoin SV also defend that they are with the miners and that BSV (Bitcoin SV) is better for mining (BitMart, 2019; Kwon et al., 2019), but nowadays everyone says that their fork is the best and that they are doing the best job but it is unclear if this "crypto-war" is improving or damaging the crypto ecosystem.

"The debate about the future of bitcoin appears to show no signs of being resolved." (Reiff, 2020, para. 10).

2.1.3.6 Stellar (Stellar Coin/ Stellar Lumens/ XLM)

This story starts with a bit of controversy. In the beginning, some say that Stellar was actually a fork of the Ripple protocol, and that after that it was created a completely new version, with new code. But some say that Stellar started from scratch, without any forking or inspiration taken from the Ripple protocol (BitDegree, 2019b). But anyway, Stellar is a decentralized protocol made to facilitate money transactions around the world (Fakhfekh & Jeribi, 2020; Mazières, 2016; Stellar, 2014a).

Inside its platform, very similarly to what happens with Ripple, the Stellar exchange also run their own crypto-currency, named Stellar Lumens or for short XLM (Guia Do Bitcoin, 2018).

Because Stellar is a direct competitor of Ripple (Williams, 2018), it has drawn some more attention to the currency. But besides being a competitor and somewhat similar, they are actually different. Ripple (XRP) is a centralized currency, Stellar (XLM) is not. Stellar is more towards open source, Ripple is not. Stellar is more about the community and bringing open source finance for all

[8] Bitcoin SV official website: https://bitcoinsv.io/

(Mazières, 2016; Stellar, 2014a), Ripple is more concerned with targeting Wall Street like companies and banks, thus more corporate driven (Vold, 2019).

XLM is not mineable, and does not use PoW, instead it uses a SCP (Stellar Consensus Protocol), which is the first implementation of the FBA (Federal Byzantine Agreement) (Lamport, Shostak, & Pease, 1982; Mazières, 2016), a consensus agreement, providing this way a new avenue for distributed networks to reach consensus (Majuri, 2018; Metz, 2015).

"SCP simultaneously enjoys four key properties: decentralized control, low latency, flexible trust, and asymptotic security." (Stellar, 2016, para. 1).

Stellar is also registered as a non-profit organization (Stellar, 2014a, 2014b), being one of the few in the crypto-space, but already joined by other projects like ZCash Foundation or Swarm for example (Frumkin, 2018).

2.1.3.7 TRON

TRON was founded in 2017 by the Chinese entrepreneur Justin Sun. TRON is a decentralized protocol with its own crypto-currency, TRX (Moore, 2018; TRON, 2018).

The purpose of this (decentralized) protocol is a global **free digital entertainment ecosystem**, in which the creators have the power to control their own creations and can interact directly with their own consumers (Seth, 2019; Sun, 2017).

TRON was accused of plagiarism in their white paper. Some people on the crypto community like Vitalik Buterin, creator of Ethereum, was one of them (Wilmoth, 2018b). The plagiarism happened on TRON's white paper, because this one apparently is plagiarizing FileCoin and IFPS white papers. Justin Sun, TRON's creator defended himself by saying that this was just a translation issue and that no plagiarism was done or ever intended (Wilmoth, 2018a).

TRX, TRON's coin can be used for several purposes like to pay for content inside TRON's network or to pay for the variety of blockchain services that TRON network offers too (Seth, 2019).

For the moment TRON can **only** be purchased with other cryptos like ETH or BTC. At the moment it is not possible to buy TRX directly with EUR or USD for example (BitDegree, 2019a).

Like Binance Coin, TRX (or Tronix) (TRON, 2018) is also based on the ERC20 Ethereum Standard (Chen et al., 2019; Victor & Lüders, 2019), but the TRON company now already migrated the coin from the Ethereum blockchain to their own mainnet blockchain (TRON's Blockchain) (Exodus, 2020; TRON Foundation, 2018).

And regarding mining, TRON uses now DPOS (Delegated Proof-of-Stake) as an algorithm, same as EOS, for example (Batabyal, 2020; TRON, 2018).

Because TRON is a game and entertainment network and community, the company has now an immense number of casino-like games on their platform, from dice games to poker, sports betting etc. And the search for more games (casino related or not) is growing, making TRON also a growing platform inside the online gaming community. TRON wants to be seen as the future of the gaming market, focusing on providing as much support as possible to game developers (BoVegas, 2019; Crypto Gambling News, 2020; De Castro, 2019; Juan, 2020).

In 2018, TRON announced the acquisition of BitTorrent, one of the biggest P2P (peer-to-peer) file sharing platform in the world (Holt, 2018; TRON, 2017, 2018).

As it can be read in BitTorrent's Twitter post:

"It's official. BitTorrent is now part of #TRON. We pioneered the world's largest decentralized p2p protocol, now we're joining forces with TRON to build the future of the decentralized internet. Read more at http://blog.bittorrent.com . @Tronfoundation @justinsuntron" (Holt, 2018, para. 5).

And in the BitTorrent's blog also reads:

"With this acquisition, BitTorrent will continue to provide high quality products to over 100M users around the world. We believe that joining the TRON network will further enhance BitTorrent and accelerate our mission of creating an Internet of options, not rules." (BitTorrent, 2018, para. 3).

Both the staff of TRON and BitTorrent are now working in San Francisco together in TRON's headquarters (BitTorrent, 2018).

One last very interesting point about TRON is that, Justin Sun, TRON's founder paid 4.5 million USD to Warren Buffet (the money was then given to charity) to have a dinner with him to discuss cryptos and strategies for the future of TRON (Baker, 2020; Kharif & Chiglinsky, 2019).

2.1.3.8 Cardano (Cardano/ Cardano Coin)

Cardano is a decentralized platform that was created in 2017 by IOHK (Blockchain Development Output Hong Kong) (Allison, 2018; Kiayias et al., 2017), with a team headed by Charles Hoskinson (one of the former co-founders of Ethereum) (Damiani, 2017; TrustNodes, 2017) aiming smart contracts, decentralized APPs and metadata. Inside this platform there is its own crypto currency, ADA or Cardano Coin, (Downs, 2018) which similarly to Binance Coin or TRON can be bought through crypto exchanges such as Binance or Bittrex (Castor, 2017b). The coins then need to be stored on its own particular wallet, called the Daedalus wallet (Simmons, 2020b).

This platform works with a PoS (Proof-of-Stake) algorithm called Ouroboros (Allison, 2018; Cardano, 2020a; Castor, 2017a; Fairley, 2019; Kiayias et al., 2017), and its white paper was written by academics and it is one of the few in the crypto community to be *peer-reviewed* (Cardano, 2020b; Downs, 2018; IOHK; Cardano, 2018).

From this paper two layers were created, the CSL (Cardano Settlement Layer) which is mainly a layer of security and protection where the PoS is used to generate new blocks and to confirm transactions, and CCL (Cardano Computation Layer), which is a second layer were information about transactions is and were the Cardano smart contracts run (Buchko, 2018; CryptoNinjas, 2020; Olszewicz, 2020).

Apart from this, Cardano's team is also developing a new programing language to use on their smart contracts (on the CCL) called Plutus (Olszewicz, 2020). But if the user wants to use Solidity (the language behind Ethereum smart contracts), this one can also be used for Cardano's smart contracts (Buchko, 2018).

The Cardano Coin, ADA, grew more than 1500% since its inception in September 2017 (Chaudhary, 2019). Until now more than 30 billion coins were issued from the total of 45 billion coins (maximum limit supply of ADA coins) (Das, 2020).

Cardano has its own supervisory body, Cardano Foundation. This company standardizes, protects and promotes the Cardano Protocol and its applications (Rikken et al., 2019). It is also responsible

for the communication of the company, partnerships and for the Cardano Coin project (Kaiser & Pfeifer, 2020; MoneyTimes, 2020).

Inside the Cardano ecosystem exists also a VC (Venture Capital) company called Emurgo. This company's goal is to help applications build on Cardano Technology to be funded and to raise their potential, boosting this way Cardano's innovations and potential (CryptoSlate, 2019; Phillips, 2018; Simmons, 2020a).

Cardano receives frequently external auditions, by companies such as Grimm or RPI Cryptography Group to assure the quality of its products (ForexRatings, 2018).

Cardano's future and its "RoadMap"[9] are not property of IOHK, the Cardano Foundation and/ or Emurgo, the VC company, Cardano's future belong to the crypto currency community and its creators respect and are always looking for new and insightful ideas and commentaries about Cardano's technology so it can be in constant improvement (Bowater, 2020).

[9] "A Roadmap is a business planning technique which lays out the short and long term goals of a particular project within a flexible estimated timeline. For an emerging product or a startup, the roadmap should articulate the goals and vision of the project, while laying out the development milestones with a rough time estimate for achieving these milestones." (Ma, 2019, para. 1).

2.2 Behavioral Finance & Behavioral Economics

In 2002, 2013 and 2017, Nobel prizes in Economic Sciences were awarded to scientists who were contributing to greater insights about psychology in economics. The most recent, in 2017, Richard Thaler contributed with his work "(…) in establishing that people are predictably irrational (…)" (Appelbaum, 2017, para. 3). Consumers sometimes act in a manner that is not consistent with economic theory. Thaler's insights including psychology into economics appeared first in its own article in the 80s "Toward a positive theory of consumer choice" (Thaler, 1980). After that Thaler continued to search and to write about this topic, specifically about decision making, cognitive limitations, self-control problems and social preferences of the consumer (Thaler, 2016, 2017).

Behavioral economics studies in general the effects of psychological, cognitive, emotional and cultural/ social background of people on their decision making (Lin, 2011). The models used are normally integrated with insights from psychology, neuroscience and microeconomic theory (Filbeck et al., 2017; Thaler, 2017; Haizhong Wang, Yuan, Li, & Li, 2019).

The three themes that normally prevail in behavioral economics are Heuristics, Framing (of the events) and Market inefficiencies, which include misunderstanding prices of goods or services and/ or non-rational decisions towards buying/ consuming something (Shefrin, 2002).

The psychologist (and Nobel Laureate for Economics) Daniel Kahneman, also contributed to behavioral finance, with the invention of Prospect Theory (with the help of Amos Tversky, a mathematical psychologist), which many consider the birth or the founding theory to be more precise, of behavioral finance and economics (Kahneman & Tversky, 1979).

Prospect Theory is one of the first economic theories built using experimental methods. It shows how individuals behave themselves in the face of loss and/ or gain and how they act upon that. This theory can also be applied to predict certain behaviors and/ or decisions. It also develops on concepts such as loss or risk aversion, expectations and even over confidence effects that can happen after certain decisions and/ or behaviors (Kahneman & Tversky, 1979, 1984; Shiller, 1999).

After some time, a new theory was developed, named Cumulative Prospect Theory, or just CPT, which is an improvement on top of the main Prospect Theory. Here Daniel Kahneman and Amos Tversky added weighting to the cumulative probability distribution function, but not applied to the

probabilities of individual outcomes. Just like in rank-dependent expected utility theory, here cumulative probabilities are transformed, instead of the probabilities themselves. With this change the violation of the first order stochastic dominance is avoided and makes the generalization to an arbitrary outcome distributions easier (Tversky & Kahneman, 1992). In 2002, Daniel Kahneman, was awarded the Nobel Prize in Economic Sciences for his contributions to the world of behavioral economics, in which the development of CPT (Cumulative Prospect Theory) played a big part (Nobel Media AB, 2002).

Robert J. Shiller, an economist and also a Nobel Laureate (2013) (Nobel Media AB, 2013) is responsible for outstanding work in forecasting asset prices, but also in the field of Behavioral Finance where Shiller studied investors and stock traders and what motivates them to trade and/ or invest. In 2003 Shiller wrote a paper entitled "From Efficient Markets Theory to Behavioral Finance", where the author describes how the "efficient market theory" or the rational and supposedly precise financial models start to show flaws under certain circumstances. This circumstances show and/ or turn into market inefficiencies where investors can find extra volatility not intended to in the first place, creating this way, ways to earn or lose more money than what was intended by the trader/ investor (Shiller, 1980, 2003). Shiller noticed the importance of studying fluctuations in finance after taking inspiration in the work of John Y. Campbell, Andrew W. Lo and A. Craig MacKinlay, in the book entitled "The Economics of Financial Markets", in which in-depth financial theory, econometric methods and their applications are studied and explained in detail (Campbell et al., 1997; Shiller, 2003).

Theories like the Random Walks Theory raise a lot of questions, because it challenges directly most of the times technical analysis regarding stock behavior (Fama, 1965). Which can then in some cases prove that there is more than what meets the eye in traditional finance. Thus the existence and study of Behavioral Finance, where we can see that sometimes the technical behavior of an investment cannot be predicted with classical theories such as the Modern Portfolio Theory (MPT) and and/ or the Efficient Market Hypothesis (EMH) (Fama, 1965; H. Park & Sohn, 2013).

Efficient Market Hypothesis supposes that investors and traders with the right kind of information and skill will end up making the right investment decisions, but recent evidence shows that this is not always the case. Differences in human behavior exist, and play a big role. Overconfidence is a bias very present (Shiller, 1999), specially in younger and more inexperienced traders who

sometimes trade and overtrade way more than older more skilled investors. Noise trade also plays a big part in behavior because when a trader is trading relying on fundamental analysis, sometimes following a trail of news and/ or trades just because other investors online recommended the buy or the sell makes big room for more mistakes to happen, showing this way several market anomalies that may indicate irrational trading and investments (H. Park & Sohn, 2013; Ramiah, Xu, & Moosa, 2015; Haizhen Wang, Chatpatanasiri, & Sattayatham, 2017).

But at the same time, Behavioral Economics (and Behavior Finance) does not absolutely reject the neoclassical approach of focusing on the maximization of the utility, because it also lays ground for a theoretical framework that can be applied on the subject in question (Finance or Economics) (Camerer & Loewenstein, 2004).

Following the same path as Behavior Economics, Behavior Finance tends to incorporate a more psychological aspect in the decision making, but also developed itself into proving that emotional, cognitive and behavioral aspects of human beings have a deep burden in the determination of the behavior of individuals in their relation to how to acquire and use (Financial/ Economical) information, for example (Costa, Carvalho, & Moreira, 2019).

In a nutshell, "Behavioral finance is to finance what behavioral economics is to economics." (Tomer, 2007, p. 474). According to the author John F. Tomer and although Behavior Finance is an entirely different field from Behavior Economics, it is at the same time an applied branch of Behavioral Economics. And this is because both have close connections, specially to psychological Economics. Behavioral Finance scholars, although they use quantitative methods, they tend to avoid formalistic mathematical models (Tomer, 2007).

"Because BF practitioners borrow heavily from the social sciences, especially psychology, their characterization of human behavior in financial markets does not suffer from mechanicalness. On the contrary, they tend to see the human participants in financial realms as fallible. BF is certainly not separate from other social science disciplines (…) Although BF researchers do focus on individual decision making and the factors that cause it to be rational or not, the societal and market context is considered in BF. Therefore, it is relatively low on individualism." (Tomer, 2007, p. 474). Therefore, social sciences, specially psychology, walks hand-in-hand with Behavioral Finance (Costa et al., 2019; Shiller, 1999; Tomer, 2007).

2.3 Managerial/ Investor Sentiment

"Investor or market sentiment is defined in the financial literature as the prevailing attitude or feeling in the market as revealed by movements of stock prices." (Salhin, Sherif, & Jones, 2016, p. 24). Investor sentiment has to do with prices and to do with the market. Similarly to behavioral finance, investor sentiment or market sentiment is about attitudes, "feelings" and the mood of the investor towards the markets. These feelings lead to actions and the action leads then to a result (Dowling & Lucey, 2004; Hribar & Quinn, 2013). Evidence shows that the higher the investor sentiment, most of the times, the higher the results, and the lower the investment sentiment the lower the results (Hribar & McInnis, 2012; Simpson, 2013). These results are heavily linked to the psyche of the investor and his/ her mood when investing (Baker & Wurgler, 2007; Edmans, García, & Norli, 2007; Miwa, 2016) and it is influenced by several factors as I will explain further below.

Nicholas Barberis and Richard Thaler on their work "A Survey On Behavioral Finance" addressed the importance of the attention of investors. The authors analyze why the investor is drawn by this or that investment and what could trigger certain reactions to an investment, either a good reaction (giving more attention to one specific investment) or a bad reaction or no reaction at all, and simply ignore an investment opportunity, because that same opportunity didn't catch the investor's attention (Barberis & Thaler, 2003).

When making forecasts, investors tend to focus on the strength of the evidence, but ascribe little attention to the statistical weight of that same evidence, defend the authors of the paper "A Model of Investor Sentiment", Nicholas Barberis, Andrei Shleifer and Robert Vishny. There are news that have high-strength and low-weight and others the other way around. One example of this is the stock crash of 1987. One interpretation of this same crash was that investors overreacted in relation to the news of panic by selling, and because of that, even though there was only a few fundamental news, some traders started selling and the market followed. Authors also defend that the stronger the news piece, the stronger the volatility of the price of a certain stock gets (Barberis, Shleifer, & Vishny, 1998; Hribar et al., 2017).

In a nutshell, there are several ways of measurement of the investor's attention, all of them are different and all of them originate a series of different actions, decisions and particular results (Zaremba, Szyszka, Long, & Zawadka, 2020; C. Zhang, 2008). In financial market-based measures

we have factors like stock prices or trading volume of a certain stock, like stated in the first paragraph of this sub-chapter. The more a stock is traded and the more visibility it gets, normally the more its price rises just because of its extra visibility, making it more interesting for investors (Gervais, Kaniel, & Mingelgrin, 2001). Another measure of attention or investor sentiment are surveys. Surveys can be an important source of information, because it is a direct source (Z. He, Zhou, Xia, Wen, & Huang, 2019). A survey allows for the quantification of the investors' confidence in the market, providing this way valuable information (Z. He, He, & Wen, 2019; C. Zhang, 2008). At the same time, this kind of measure could be limited in some cases because it normally provides information weekly, monthly or even with wider time horizons, making it this way not a daily source of information (Z. He, Zhou, et al., 2019; McGurk, Nowak, & Hall, 2020). Text mining and/ or data mining methods are also used to predict, measure and collect information about investors' emotions (McGurk et al., 2020). The authors Xue Zhang, Hauke Fuehres and Peter A. Gloor wrote a paper entitled "Predicting Stock Market Indicators Through Twitter "I hope it is not as bad as I fear"", in which the authors tried to predict the stock market just by searching specific "moody" words on Twitter, such as "fear", "worry", "hope" (X. Zhang, Fuehres, & Gloor, 2011). With this data the authors reached the following conclusion: "To put it in simple words, when the emotions on twitter fly high, that is when people express a lot of hope, fear, and worry, the Dow goes down the next day. When people have less hope, fear, and worry, the Dow goes up. It therefore seems that just checking on twitter for emotional outbursts of any kind gives a predictor of how the stock market will be doing the next day." (X. Zhang et al., 2011, pp. 61–62). Nowadays with the internet, data mining for investor sentiments and/ or moods is never been so easy, and Twitter is not the only place where this is possible, websites such as "Google Trends" can be used for predictions of the stock market and measure market sentiment too (Bordino et al., 2012). Finally, if we remove from the equation, the financial and economic data, we have the "non-economic" or "non-financial" data, which is also important because they can surely dictate a big number of trends and with that, change investors' opinions on certain investment decisions. The authors David Hirshleifer and Tyler Shumway on their paper "Good Day Sunshine: Stock Returns and the Weather" defend that because the sun light affects the mood of the trader or the investor (Dowling & Lucey, 2004), it can surely influence their trading and therefore their returns (Hirshleifer & Shumway, 2003). With this we have examples of several other causalities that can affect the stock market such as sports' outcomes, that can affect the mood and therefore affect the

traders and then the markets and their results and returns. When poor results are documented in major soccer, international cricket, rugby, and basketball national tournaments, the losing country's stock markets suffer from a significant negative effect and incurs into several losses (Edmans et al., 2007). Another proof of "outside", "non-economic" events is for example, plane crashes, when they happen, it creates fear and anxiety among traders, making it bad for the markets. Pessimist and mood swings are normal emotions among traders after these kind of events, according to the authors Guy Kaplanski and Haim Levy who conduct a study about how investor sentiment and aviation crashes are connected (Kaplanski & Levy, 2010).

2.4 Behavioral Management

Behavioral management is about managing actions of people so they could act productively, normally as a group. Early studies about this matter were conducted by Jere Brophy in how to effectively control and manage a classroom full of students. By applying behavior modification and management, the teacher could then produce high rates of student work and at the same time minimize the classroom disruption (Brophy, 1986).

Positive reinforcement and mild punishments are also studied on these matters, on how they can contribute more to the results of the group or the individual (Daddario, Anhalt, & Barton, 2007). Reinforcements try to increase behavior, for example, rewarding a person for a good achievement. When we talk about a kind of punishment, the objective is to try to decrease the person's behavior towards something or to try to remove a bad habit and/ or behavior that that same person experiences (Kendall, 2015; Midlarsky, Bryan, & Brickman, 1973).

The classical management theory lacks some substance, especially in the human side. Having a manager that most of the time makes uninformed management decisions, but with a satisfactory behavior is no good for any company. A manager does not have the ability to assimilate all the available information like a machine, but classical theories do not consider a manager a "human", they consider a manager a super rational being almost without any emotions, which could lead to big mistakes for the company down the line (Kendall, 2015; Mandysová, 2019; Mandysová & Kubanová, 2019). Classic Management Theories also do not have in account employees behavior and happiness whereas newer theories do (Feinberg, 1976).

Maximization of value is key, but assuming that all the entities inside the company are thinking the same way, can lead to serious mistakes. Managers and employees can have private interests, fostering a conflict of interests inside the company. Employees and managers work in different environments and have different life experiences and motivations. Behavioral theories defend that when a conflict arises this can re-rise over and over again, and therefore can turn to a major problem for the firm. When there are different interests inside the firm, these can originate a situation difficult to sustain. This situation could also happen because most of the times, the owner of the company hires managers to pursue its interests, but managers have their own will and have opinions and could have had different life experiences and/ or different opinions on different types of scenarios. They can manage the company in a totally different way that the original owner intended. The presence of the owner and good communication is key for the success of any firm (Feinberg, 1976; Mandysová, 2019; Mandysová & Kubanová, 2019).

Elton Mayo, a psychologist and sociologist, discovered within his studies at Hawthorne, that people's work performance is dependent on issues like job satisfaction, social interactions, monetary incentives and of course good working conditions in general. These findings were very important to support later on the neoclassical management theories, because now the managers and employees are for the first time seen as human and not just "workers" (Bendix & Fisher, 1949; Bruce, 2006; Bruce & Nyland, 2011; Sachau, 2007; Story, 2001).

The neoclassical theory is divided in the Human Relations and in the Behavioral approach. The Human Relations approach defends that a company is a social system and that it has a social environment with complex group dynamics. In the Behavioral approach things like the individuals' interpersonal and social relationships with each other are taken into consideration. Individual differences, life experiences, beliefs, values and personality are considered (Bendix & Fisher, 1949; Bruce, 2006; Bruce & Nyland, 2011; Feinberg, 1976; Mandysová, 2019; Mandysová & Kubanová, 2019; Sachau, 2007; Story, 2001). On top of this approach, different scholars developed several theories and models, such as the "Managerial Grid" by Robert Blake and Jane Mouton, which takes into consideration the person's concern for the others and their concern for productivity, quantifying this way both of those fields in terms of numerical data to reach conclusions about what type of employee or manager the person is (Cai, Fink, & Walker, 2019).

Apart from all the good that the neoclassical theory brought to the table it also shows weaknesses, such as putting too much weight on the satisfaction of the worker, which means that a super satisfied worker is not the same that a super productive worker, satisfaction and productivity are different. The theory focusses too much on relationships and less about the actual work. It also assumes, for example, that the monetary reward is not so important as other rewards which can seriously damage the performance of the firm or of a specific employee who cares more about financial compensation and connects that to his or her job performance and personal happiness (Bendix & Fisher, 1949; Bruce, 2006; Bruce & Nyland, 2011; Korajczyk, 1961; Mandysová, 2019; Mandysová & Kubanová, 2019; Van Fleet, 1973).

2.5 Crypto Currencies vs Financial Markets

Crypto Currencies are now a global phenomenon that is spreading for some time, through the markets worldwide. Governmental institutions, financial institutions, the media and specially investors worldwide are witnessing the rapid expansion of cryptos (Glaser et al., 2014). Since Bitcoin's appearance, cryptos have been known for their volatility, speculation and high returns (or losses) (Bouri, Azzi, & Dyhrberg, 2017). Extreme risk attracted several types of investors and curious people on board, because high risk means high returns (Osterrieder, Strika, & Lorenz, 2017), but with that cryptos are also susceptible to speculative bubbles (Cheah & Fry, 2015).

Crypto Currencies have been also gaining popularity and with that comes the importance of adding cryptos to any investment portfolio. Cryptos provide an excellent way to diversify an investment portfolio and this is becoming more and more popular nowadays within professional investors (Bouri, Azzi, et al., 2017; Eisl, Gasser, & Weinmayer, 2015; Gil-Alana, Abakah, & Rojo, 2020).

During the last few years, more efforts have been made to analyze the risk-return, volatility and benefits for investors. For example, the authors of the paper "Exploring the Dynamic Relationships between Cryptocurrencies and Other Financial Assets" found evidence that because crypto currencies are so apart from the norm in the financial world, these assets can actually offer benefits for investors with short term investment horizons (Corbet, Meegan, Larkin, Lucey, & Yarovaya, 2018).

The authors of the paper "Caveat Emptor: Does Bitcoin Improve Portfolio Diversification" also defend that Bitcoin investments are more feasible for both institutional and private investors, and that this coin specifically can contribute to the risk-return ratio of optimal portfolios. Of course that including BTC in any portfolio will also increase the portfolio's risk, but also its expected return. However the authors defend that the return contribution to the portfolio outweighs the additional risks faced by the investor (Eisl et al., 2015).

Another relevant topic here are ICOs (Initial Coin Offerings). This information was already introduced on the topic "2.1.3.4 – Binance Coin". ICOs are for crypto currencies the equivalent of what IPOs (Initial Public Offerings) are for traditional companies going public. ICOs appeared so that more investment could be made, and with that to give the possibility for new coins/ companies in the crypto world to emerge. ICOs have been responsible for a large share of funding of normally tech startups that use blockchain based business models. The way that an ICO works shows a more liquid and efficient way to access capital in comparison to fiat money, by allowing peer-to-peer transactions and avoiding the intermediation banks. This could be seen as a great opportunity for SMEs (Small and Medium Enterprises) to access capital faster (Ben & Xiaoqiong, 2019; Giudici, Milne, & Vinogradov, 2020).

Then after ICOs we have to understand what TOKENS are. With TOKENS, the buyer has certain privileges such as the right to use certain services or products of the issuer or to share sometimes profits, in which case tokens resemble much of the times equity. The difference of a crypto and a token is that a token has embedded a kind of liability or commitment, which then determines its value, weather a crypto currency is seen as an investment in a coin, such as FOREX, but also a lot of times associated with a commodity (such as comparing Bitcoin to Gold) (Giudici et al., 2020). An ICO is normally seen as a "Token sale" but a "Token sale" could be more than just an ICO. An ICO is a "launch" or "release" of a new coin into the market. The appeal of the ICO is the "pre-sale" so that when the coin is released the buyer can earn money on that same asset by selling the coin or keeping it for extra valuation growth along time. A Token sale, normally associated with Ethereum is more complex, because a Token can be programable, which means that a lot of different type(s) of information can be offered with a Token. Tokens are generated through a smart contract and simply transcend in terms of complexity the release of the new coin (Cvetkova, 2018;

Hayes, 2019; Kim & Laskowski, 2018; McGurk et al., 2020; SingularDTV, 2017; Somin et al., 2020; Wood, 2014).

"A "Token Launch" is an Ethereum thing. An "ICO" is a bitcoin/altcoin thing." (SingularDTV, 2017, para. 2).

To wrap up this chapter another very important thing to mention is that ICOs also produced a mass appearance of online scams related to cryptos. As the Coin Offering isn´t regulated a lot people created Online Offerings for made-up coins and then just vanished into thin air. And because the transactions are online, anonymous, and non-regulated the majority of times the authors of these crimes cannot be traced. Nowadays the "hysteria" of ICOs already passed and it is not so common to find ICOs online as it used to be. Investors fell into this trap looking for quick and high returns, but criminals also saw it as an easy way into stealing money online. Some countries even completely banned ICOs such as China or South Korea to avoid online scams and illegal online fundraisings (Ben & Xiaoqiong, 2019; Cvetkova, 2018; Drożdż et al., 2019; Foley et al., 2019; Kugler, 2018; Mansfield-Devine, 2018; Pasztor, 2018; Prewett et al., 2019).

2.6 Crypto Currencies vs Behavioral Finance/ Investor Sentiment

Crypto Currencies unlike other assets are purely digital, so they are hard to compare to other assets and to comprehend sometimes. As a result of that a lot of the market volatility involving crypto currencies is driven mainly by investor sentiment. Because cryptos are new to the markets and just made their introduction with Bitcoin a few years ago, their market size is still developing and their long-term maturity as an investment is yet to be known. But one thing is certain, though, that until now big part of the crypto market has been heavily influenced by investor sentiment (Baker & Wurgler, 2006; Lee et al., 2018).

Another source of information where the relation between Crypto Currencies and Investor Sentiment can be clearly found and studied is on Twitter, the social media platform. Olivier Kraaijeveld and Johannes De Smedt, wrote about it, in 2020, on their paper entitled: "The predictive power of public Twitter sentiment for forecasting cryptocurrency prices". In this study we can notice that because Twitter is a platform that gives live updates of what is happening in the

world about a certain topic, if we search the topic “Cryptocurrency” or “Bitcoin” or “Ethereum”, we get the live updates of what is happening and WHAT PEOPLE THINK about that same topic. Now what people think, especially what investors think is what we are really interested to know, because investors’ sentiment can have later on a profound effect on the markets. Twitter can gather large amounts of information and is a rich source of emotional intelligence. Twitter can be sometimes used to forecast price fluctuations of cryptocurrencies according to the author’s study. Twitter data also transcends investors since that we can also gather data from other regular (non-investor) users that because of their opinion, can later on influence an opinion, a trade or an investment by an investor (Kraaijeveld & De Smedt, 2020; Sifat et al., 2019).

Several studies have been conducted in the past few years that correlate Bitcoin’s returns (or any specific crypto and/ or cryptos) with market sentiment. From newspapers or media trends to Google trends all this data is a product of investor sentiment and all this data influences the market (Polasik et al., 2015; Sifat et al., 2019; C. Smith & Kumar, 2018). Studies show that a positive sentiment in the crypto markets has a positive effect on the price of the cryptos and this also happens when the sentiment towards the crypto’s technology is also positive. This effect can be observed for both positive and negative effects on the market. If the sentiment is positive, as stated above, the market prices show an increase (bullish effect). If on other hand the sentiment is negative, the market prices will show a decrease (bearish effect). Crypto Currencies also reflect the normal adversities of an “early stage” type of alternative investment, loaded with volatility, uncertainty, complexity and an increase of risk, which can create also resistance and biases within investors, revealing uncertainty and doubt of when and/ or how to invest in a certain crypto or cryptos. The market is uncertain, but investing in a new technology can bring an extra challenge to the table for investors. Nowadays the internet is useful for crypto-market-prediction and to be attentive to trends such as Twitter trends or Google trends as already stated above. But also to more “underground” community forums such as Bitcointalk.org, where professionals and non-professionals meet everyday to discuss all about cryptos with new information and inputs from all over the world. With this information available it is easier to predict market trends in this “still small” world of crypto currencies. Behavioral finance and sentiment analysis in the crypto currency world is still growing and progressing but a good method to test price direction of cryptos, without going for very exotic or unexplored methods, is to compare or hedge cryptos against the stock market. Major world events that influence cryptos will certainly influence stocks and vice-versa, but in moments of fear, investors

tend to first drop the most volatile assets. So during an overall negative sentiment period cryptos cannot be a safe heaven, but when there is an overall positivity within the market, when the investors feel better and more willing to take risks crypto currencies prices tend certainly to rise (Baker & Wurgler, 2006; Bouri, Azzi, et al., 2017; Brown & Cliff, 2005; Gurdgiev & O'Loughlin, 2020; Lee et al., 2018; Rathan, Sai, & Manikanta, 2019; Schumaker, Zhang, Huang, & Chen, 2012; Zouaoui, Nouyrigat, & Beer, 2011).

Another relevant issue for the debate is the ICOs and how they affect and are affected by the investors' sentiment. One thing that is very important to state is that because ICOs happen online, most of the ICOs marketing and activities also happen online and via social media, with traditional news having minor influence. The ICOs create a "window of opportunity" for the investor and are normally listed when there is a positive investor sentiment happening in the market. It is known that companies that do coin ICOs tend to avoid periods of low investor sentiment, as it may hurt the investments and their "window of opportunity" may quickly be seen as something "too good to be true". Companies doing ICOs try to appeal to the good side of the coin they are offering and the technology and benefits behind it, increasing this way the positive investor sentiment and also the confidence of that same investor. Making it although a risky and volatile investment, seen also as a highly lucrative and positive investment (in terms of profit and sentiment). The values of ICOs and the coin(s) involved are highly subjective so normally a first day of negative sentiment is expected when investors are still evaluating the opportunity. But the following days the return tends to become positive. The ICO market is heavily affected and almost exclusively affected by the crypto currencies market. So, evidence suggests that broader capital markets become almost irrelevant for an ICO performance or study/ analysis (Burns & Moro, 2018; Drobetz et al., 2019; Hayes, 2019; Minor, 2020).

3 Methodology

3.1 Design

The methodology builds on a quantitative approach, as this research is based on the analysis of numerical data (Given, 2008) collected through several sources such as stock market data bases, statistical data from Duke University's Market Sentiment studies, and world (statistical) stats about demographics and their internet access and usage.

The data were cleaned for inconsistencies and entered into the statistical software from IBM, SPSS (Statistical Package for the Social Sciences) (IBM Corp., 2019).

The purpose is to understand the correlation and implications that human sentiment has in the financial markets, specifically in the crypto-currency markets, and finally to understand whether there is a significant relationship between cryptos' performance and market/ investor's sentiment, also controlling for factors used in traditional finance and economical studies.

3.2 Data

Regarding data, many months of work were put into it, as a lot of financial (and statistical) data can be chosen and its access is not always straightforward. After testing the validity and importance of each financial (and statistical) instrument, the ones below were selected as the most appropriate and with most relevance for this study:

-All the cryptos stock market data (open ticket): Bitcoin, Ethereum, XRP, Bitcoin Cash, Litecoin, EOS, Binance Coin, Bitcoin SV, XLM, TRX and ADA;

-The Market Cap of all the coins above;

-The CFO/ Manager's Market Sentiment: Europe (Mean and Median) and USA (Mean and Median);

-SP500 stock market data (open ticket and variation);

-GDP (Gross Domestic Product) and REAL GDP of Europe (plus its Variation) and USA (plus its Variation);

-M1 and M2 money measurement indicators;

-Euribor (€), Libor ($) and T-Bills ($);

-EONIA (€) and LIBOR-OIS ($);

-Internet Stats: % of Households with Internet Access (World (general) statistics, Developed Countries and Developing Countries), % of Mobile-Cellular Subscriptions (World (general) statistics, Developed Countries and Developing Countries) and % of Individuals using the Internet (World (general) statistics, Developed Countries and Developing Countries).

3.3 Descriptive Statistics

3.3.1 Dependent Variable

In the beginning when I started to gather information regarding Crypto-currencies to plug into this academic work, I decided to start looking in Yahoo Finance where at the time it was the place that I normally used to check stock related data. But regarding crypto-currencies I immediately noticed upon some more research that the website Coin Market Cap (https://coinmarketcap.com/) had better and more in-depth data regarding the cryptos that I intended to study. Starting with Bitcoin, I started gathering data, and taking Bitcoin data as the "standard". Regarding date the time span for the rest of the data became from 2013 to 2019. Crypto-currency stock data can be found on Figures 3 to 13 in the Annexes. Since this study was intended to be done in Quarters all the data gathered was then converted to Quarters in the most appropriate way or gathered on a quarterly basis whenever possible. The reason that the last quarter of 2019 is absent from all tables is because the majority of this data was gathered in November of 2019. The last quarter of 2019 lacked data (the December data) so it could not be converted in a full quarter. In some crypto-currencies for example TRX (Figure 12 - Annexes) the first (stock market) data available is from September 2017, and because of that the data considered for this study regarding TRX starts in October (4th quarter of 2017), because for the 3rd quarter of 2017 we only have one month of data, making this way impossible to have a full quarter for the study. All this collected data is in USD.

Apart from Stock Market daily ticket data about our 11 cryptos, the Market Cap was also retrieved to be used as an extra study instrument. This data is also available on the right side of the tables of every crypto studied in this paper (Figures 3 to 13 in the Annexes). Again, all this data is in USD.

3.3.2 Independent Variables

CFO & (Top) Manager's Market Sentiment data are retrieved from Duke's University, a University in North Carolina that conducts every year surveys[10] to CFOs and Managers around the world namely about Market Optimist. Specifically in this case the question chosen from the yearly survey was the question 1b: "Rate your optimism about the your country's economy on a scale from 0-100, with 0 being the least optimistic and 100 being the most optimistic." And then data for Europe and USA for all the periods necessary for this study. The data chosen from the survey answers were the mean and median.

Next, was collected data such as S&P500, an index known worldwide that translates to "Standard & Poor's 500". This index is composed by 500 large companies that are listed in the US stock exchanges such as NYSE or NASDAQ (Cizeau, Liu, Meyer, Peng, & Stanley, 1997; Ritala, Huotari, Bocken, Albareda, & Puumalainen, 2018). To transform the daily data into quarters instead of a normal (arithmetic) mean, a geometric mean is used, so that the capitalizations of the previous periods were also accounted in the final numbers in quarters. Then a variation of those same numbers was calculated to represent the percentage of increase or decrease in each situation. Example: If Q1 is 10, and Q2 is 11, there was an increase of 10%. The S&P500 data gathered and all the final figures are depicted in Figure 14 in the Annexes.

Next we have represented the GDP and REAL GDP of Europe and US, plus their variation (like the number variation added on the S&P500, Figure 14) (Ang et al., 2006; Banerjee & Marcellino, 2006; Broadberry & Klein, 2012; Gallo & Ertur, 2005; Murray & Nelson, 2000; Perron & Wada, 2009). These numbers are expressed in Millions. These numbers were gathered by accessing to government public statistics[11], and then an arithmetic mean was done via pivot tables in Excel to reach the final results of having all data by quarters. After this calculation, an extra computation was made to reach the variation of those same variables, similarly to what was done for S&P500

[10] Here: https://cfosurvey.fuqua.duke.edu/release/ surveys since 2004 until today (2020) can be found.
[11] All the government data gathered here: https://fred.stlouisfed.org/

in Figure 14. The choice of the geographies was done to match the objective of the study, that is to (mainly) check the differences in market sentiment regarding cryptos in the European and in the US markets.

As we are dealing with currencies, we have decided to add also as an additional variable, the figures regarding M1[12] and M2[12], money measurement indicators (Haug & Tam, 2007; Hsiao, 1981; Parhizgari & Nguyen, 2011). M1 includes all the forms of liquid money such as cash, M2 includes M1 and extra less liquid forms of money such as savings accounts, certificates of deposits and money market mutual funds. These values are all expressed in USD.

EURIBOR and LIBOR are considered, to proxy for the variation in monetary markets. EURIBOR stands for Euro Interbank Offered Rate and it is a daily reference rate based on the average interest rates at which the Eurozone banks offer to lend unsecured funds to other banks in the euro money market (Bernoth & von Hagen, 2004; Eisl, Jankowitsch, & Subrahmanyam, 2017). LIBOR or London Inter-bank Offered Rate is an interest-rate average calculated from estimates submitted by the leading banks in London (Abrantes-Metz, Kraten, Metz, & Seow, 2012; Andersen & Andreasen, 2000; Björk & Björk, 2005; Eisl et al., 2017; Michaud & Upper, 2008).

Although this data are released daily there are several time frames. The data chosen here was the 3-month figures, the most standard ones. So, the EURIBOR and LIBOR 3-month daily data, that was then converted to quarters.

To proxy for market risk, a 3-month T-Bill daily data[12] was also added to this database (available on Figure 15 in the Annexes). This data was added to have a reference regarding a risk-free rate, since this is a bond backed by the US Government (Burger, Lang, & Rasche, 1977; Hall, Anderson, & Granger, 1992; Shen & Starr, 1998). A Treasury bill, or T-Bill(s), are normally long-term government bonds, and their yield is normally used as the risk-free rate.

Adding an Overnight Index Rate and Swap was also considered.

Figure 16 represents the EONIA[13] (Euro Overnight Index Average), which is computed as a weighted average of all overnight unsecured lending transactions in the interbank (internal bank)

[12] M1, M2 and T-bills data retrieved from: https://fred.stlouisfed.org/
[13] EONIA is being replaced by €STR, but since we need data starting from 2013 and €STR was only available since 2019, the idea of using and keeping EONIA as the Overnight Rate for Euro was made.

market, done in the European Union (Beirne, 2012; Hassler & Nautz, 2008; Soares & Rodrigues, 2013). These rates are calculated by the ECB (European Central Bank), where the data for these same rates can be obtained (ECB Databases).

Maintaining the same line of thought, adding a LIBOR-OIS, which is the calculated difference between the LIBOR (in this case USD based LIBOR) and an OIS (Overnight Index Swap) was also considered (Douglas & Pugachevsky, 2013; Hull & White, 2013; Lloyd, 2017; D. J. Smith, 2013). Figure 17 shows these numbers. The OIS was calculated from taking the Federal Funds Rate (the equivalent of EONIA in the US)[14], computing then a geometric average for quarters, thus taking in consideration capitalization along time. Then the LIBOR (USD) data were transformed from daily values to quarters using in this case an arithmetic average. Then, we subtracted the OIS values from the main LIBOR values.

The LIBOR-OIS spread is considered to be a measure of health of the banking system and it is an important measure of risk and liquidity in the markets. This is why this measure was entered in the database.

Again, the data for EONIA and LIBOR-OIS can be found in Figures 16 and 17 in the Annexes.

And with this we reach the final part of data, but a very important one nevertheless, the internet data. Since this is a study that connects financial markets with technology, namely crypto-currencies, this data base would not be complete unless data regarding internet usage was gathered (Askitas & Zimmermann, 2015; Buchanan & Smith, 1999; Ganz, Barnaghi, & Carrez, 2013; Setti, Wanto, Syafiq, Andriano, & Sihotang, 2019; Wallsten, 2003; Wellman & Chen, 2004).

In Figures 18, 19 and 20 we have 9 pieces of important data. In Figure 18 we have the Percentage (%) both in the whole World, in Developed and in Developing Countries of the Households with Internet Access. In Figure 19, in the Annexes, we have the Percentage (%), again, of both in the World, in Developed and in Developing Countries of the Mobile-phones subscriptions. This information specifically is very important as a lot of people nowadays use more their cellphone than their computer or they don't even have a computer and use their cellphone or smartphone to

[14] Nowadays the Federal Funds Rate is being replaced by SOFR (Secured Overnight Financing Rate), but since that we need data stating from 2013, and the SOFR was only available starting 2018, the decision of using its old equivalent was done. Same as what happened with why using EONIA for this database.

do everything, including possibly business, going online, and maybe even buying and selling crypto-currencies online.

Finally, in Figure 20 in the Annexes there is the Percentage (%) of Individuals in the World, in Developed and in Developing Countries using the internet, which is general and important data to include in this study.

Some data were publicly available and some granted access by the ITU (International Telecommunication Union), which after a lot of research I realized that is the most complex data base of internet data. Even the World Bank redirected me to the ITU, as the best source of material of this matter. ITU provided me the necessary data on request.

It is important to recognize the difference between "Developed Countries" and "Developing Countries" since that is not a general statement and needs to be justified. We used the classification of the ITU website about this matter (https://www.itu.int/en/ITU-D/Statistics/Pages/definitions/regions.aspx): Developed/ Developing countries, according to the UN M49[15].

The distinction between Developed and Developing Countries is important to validate the difference in the usage of internet. The way individuals use internet in Developed Countries is different from individuals using it in Developing Countries. The definitions provided by the ITU website based on the M49 standard used by the UN for statistics translate these differences. Again, all these numbers are reflected in Figures 18, 19 and 20 of the Annexes.

[15] More information at the Annexes in the page 104 of this document.

4 Discussion of Results

This chapter discusses our findings.

The results stem from a large data base containing 28 variables (one will be used as dependent and 27 as independent variables) and 286 observations, running a panel data analysis model (with fixed effects) (Namouri et al., 2018; Senner & Sornette, 2019; Zouaoui et al., 2011). These 286 observations relate to 11 crypto coins. Each observation represents 1 quarter of a year. This study was conducted taking into consideration information from the 2nd quarter of 2013 until the 3rd quarter of 2019, amounting to 26 observations per coin (26 x 11 coins = 286 observations).

Unfortunately because some of this cryptos are very recent technology, not all coins considered had the full spectrum of observations available, even though all these 11 coins are crypto coins (at the date of the beginning of this study) with 1 billion USD market cap (the criterion for choosing this 11 coins). Some of these coins were presented to the market only in 2017, 2018 or even in 2019, so during the linear regressions and other runs the final number of observations dropped to 158.

This chapter is divided into several sections, starting from more basic tests such as normality tests and correlation tests, followed by OLS Regressions and Robustness tests. It will end with 2SLS (Two-Stage Least Squares) Regressions with LAGGED variables and also an extra Robustness test involving only the oldest Crypto-Currencies, Bitcoin and Litecoin (Ang et al., 2006; G. He et al., 2020; Platt, 1987).

4.1 Descriptive Analysis

4.1.1 Exploratory Analysis (Descriptive Statistics and Tests of Normality)

Table 1
Descriptive Statistics.

	Mean	Median	Std. Deviation	Minimum	Maximum	Interquartile Range
All Crypto Coins-Price (USD)	536.334	4.108	1,771.787	0.002	10,648.572	196.873
Market_Cap_All_Coins (USD in Millions)	13,046.265	2,601.171	31,225.200	7,743.013	185,592.791	7,884.440
Sentim_Eur_Mean	59.603	58.400	4.467	53.000	68.520	4.690
Sentim_Eur_Median	62.459	60.000	4.456	54.000	70.000	5.000
Sentim_USA_Mean	65.147	65.690	3.968	57.200	71.170	6.120
Sentim_USA_Median	67.089	70.000	5.564	60.000	75.000	10.000
SP500_Open	2,450.626	2,601.854	378.493	1,608.460	2,958.578	660.371
SP500_Var (%)	2.48%	2.86%	3.41%	-5.05%	6.43%	4.89%
GDP_Eur_Var (%)	0.79%	0.88%	3.32%	-5.86%	4.82%	5.47%
GDP_Real_Eur_Var (%)	0.54%	0.65%	2.92%	-4.79%	3.77%	3.37%
GDP_USA_Var (%)	1.11%	1.59%	2.70%	-3.79%	4.60%	2.01%
GDP_Real_USA_Var (%)	0.66%	1.34%	2.73%	-4.34%	4.10%	1.49%
M1 (USD in Billions)	10,311.528	10,858.200	1,102.331	7,584.300	11,582.800	1,821.600
M2 (USD in Billions)	40,180.428	41,488.900	3,524.512	31,841.100	44,729.500	5,282.200
Euribor_€ (%)	-0.22%	-0.32%	0.19%	-0.40%	0.30%	0.14%
Libor_$ (%)	1.49%	1.46%	0.91%	0.23%	2.69%	1.71%
T_Bills_$ (%)	1.18%	1.21%	0.90%	0.02%	2.39%	1.78%
EONIA_€ (%)	0.36%	0.36%	0.10%	0.12%	0.76%	0.02%
LIBOR_OIS_$ (%)	0.28%	0.26%	0.16%	0.01%	0.60%	0.25%
Household-Internet-WORLD (%)	51.87%	52.36%	4.46%	41.74%	56.96%	5.07%
Household-Internet-DEVELOPED (%)	83.35%	83.34%	2.86%	77.50%	86.97%	3.54%
Household-Internet-DEVELOPING (%)	40.86%	41.55%	5.20%	28.77%	46.65%	5.77%
Mobile-Subscriptions-WORLD (%)	102.56%	103.62%	4.14%	93.08%	108.01%	3.29%
Mobile-Subscriptions-DEVELOPED (%)	126.34%	126.82%	2.49%	118.22%	128.93%	0.17%
Mobile-Subscriptions-DEVELOPING (%)	97.75%	98.96%	4.60%	87.75%	103.84%	3.96%
Individuals-Using-Internet-WORLD (%)	47.88%	49.04%	5.24%	37.01%	53.56%	6.60%
Individuals-Using-Internet-DEVELOPED (%)	82.11%	81.92%	3.98%	73.81%	86.57%	3.85%
Individuals-Using-Internet-DEVELOPING (%)	40.97%	42.42%	5.64%	29.26%	47.04%	7.30%

Table 2
Tests of Normality.

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
All Crypto Coins	0.381	158	0.000	0.330	158	0.000
Market_Cap_All_Coins	0.338	158	0.000	0.442	158	0.000
Sentim_Eur_Mean	0.194	158	0.000	0.889	158	0.000
Sentim_Eur_Median	0.361	158	0.000	0.736	158	0.000
Sentim_USA_Mean	0.086	158	**0.006**	0.952	158	0.000
Sentim_USA_Median	0.231	158	0.000	0.843	158	0.000
SP500_Open	0.209	158	0.000	0.909	158	0.000
SP500_Var	0.161	158	0.000	0.880	158	0.000
GDP_Eur_Var	0.212	158	0.000	0.888	158	0.000
GDP_Real_Eur_Var	0.206	158	0.000	0.826	158	0.000
GDP_USA_Var	0.216	158	0.000	0.863	158	0.000
GDP_Real_USA_Var	0.273	158	0.000	0.806	158	0.000
M1	0.215	158	0.000	0.877	158	0.000
M2	0.170	158	0.000	0.911	158	0.000
Euribor_€	0.359	158	0.000	0.691	158	0.000
Libor_$	0.182	158	0.000	0.874	158	0.000
T_Bills_$	0.166	158	0.000	0.860	158	0.000
EONIA_€	0.327	158	0.000	0.699	158	0.000
LIBOR_OIS_$	0.133	158	0.000	0.948	158	0.000
Household-Internet-WORLD	0.198	158	0.000	0.889	158	0.000
Household-Internet-DEVELOPED	0.189	158	0.000	0.911	158	0.000
Household-Internet-DEVELOPING	0.200	158	0.000	0.882	158	0.000
Mobile-Subscriptions-WORLD	0.240	158	0.000	0.889	158	0.000
Mobile-Subscriptions-DEVELOPED	0.342	158	0.000	0.741	158	0.000
Mobile-Subscriptions-DEVELOPING	0.243	158	0.000	0.886	158	0.000
Indiv.-Using-Internet-WORLD	0.226	158	0.000	0.862	158	0.000
Indiv.-Using-Internet-DEVELOPED	0.220	158	0.000	0.868	158	0.000
Indiv.-Using-Internet-DEVELOPING	0.241	158	0.000	0.858	158	0.000

a. Lilliefors Significance Correction
Values highlighted in bold show normality at $p \geq 0.05$.

Apart from Table 1 and Table 2, the Descriptive Statistics table and the Tests of Normality table, respectively, extra Graphic data can be consulted in the Annexes. The extra data provided is the following:

-Numeric frequency in histogram graph with normality curve (Annexes from page 106 to page 110 of this document);

-Normality plots with respective tests (Annexes from page 111 to page 120 of this document).

4.1.2 Correlations

Table 3
Correlation matrix.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	All Crypto Coins	1																					
2	Market Cap All Coins	**0.000**	1																				
3	Sentim Eur Mean	**0.039**	**0.001**	1																			
4	Sentim Eur Median	0.080	**0.004**	**0.000**	1																		
5	Sentim USA Mean	**0.040**	**0.001**	**0.000**	**0.000**	1																	
6	Sentim USA Median	0.077	**0.003**	**0.000**	**0.000**	**0.000**	1																
7	SP500 Open	**0.019**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	1															
8	SP500 Var	0.561	0.468	0.845	**0.044**	0.276	0.466	0.294	1														
9	GDP Eur Var	0.982	0.830	0.855	**0.000**	0.952	0.446	0.326	0.365	1													
10	GDP Real Eur Var	0.962	0.794	0.763	**0.001**	0.413	0.959	0.323	0.392	**0.000**	1												
11	GDP USA Var	0.873	0.887	0.212	**0.000**	0.914	0.308	0.884	**0.012**	**0.000**	**0.000**	1											
12	GDP Real USA Var	0.964	0.937	0.476	**0.000**	0.412	0.676	0.810	0.106	**0.000**	**0.000**	**0.000**	1										
13	M1	**0.033**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.027**	0.243	0.380	0.912	0.639	1									
14	M2	**0.041**	**0.002**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.021**	0.142	0.266	0.659	0.448	**0.000**	1								
15	Euribor €	0.081	**0.007**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.029**	0.159	0.534	0.689	0.572	**0.000**	**0.000**	1							
16	Libor $	**0.049**	**0.002**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.032**	0.246	0.259	0.951	0.563	**0.000**	**0.000**	**0.000**	1						
17	T Bills $	**0.048**	**0.002**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	0.057	0.354	0.310	0.927	0.698	**0.000**	**0.000**	**0.000**	**0.000**	1					
18	EONIA €	0.892	0.828	**0.016**	**0.015**	0.111	0.398	**0.000**	**0.000**	0.059	0.137	**0.013**	**0.027**	**0.000**	**0.000**	**0.000**	0.119	0.212	1				
19	LIBOR OIS $	0.492	0.136	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	0.268	0.409	0.178	0.064	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.014**	1			
20	H-Internet-WORLD	**0.046**	**0.002**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.016**	**0.002**	**0.005**	0.120	**0.036**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	1		
21	Mobile-Sub-WORLD	0.063	**0.005**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	0.134	**0.001**	**0.003**	0.108	**0.032**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	1	
22	Individuals-Internet-WORLD	**0.037**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	0.085	**0.004**	**0.009**	0.193	0.060	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	1

Numbers in bold represent significance at p-value ≤ 0.05.

Within the Internet variables, the DEVELOPED and DEVELOPING variables were removed because of high collinearity (as they reduce degrees of freedom and entail low explanatory power). The Internet variables that remain in the model are: Households with Internet Access in the World (%), Mobile Subscriptions in the World (%) and Individuals using the Internet in the World (%).

Clarifying now the Tables shown above, Table 1, 2 and 3:

Table 1 shows a basic descriptive analysis of the data presented, such as median, standard deviation, minimums and maximums. Here we can have an initial grasp of the numbers representing each variable involved in this study.

On **Table 2**, we include a test of normality for our variables. Here we can see that all variables show NON-normal behavior, except for the variable "Sentiment_USA_Mean" which shows normality by having a significance ≥ than 0.05, in this case showing 0.06 of significance (value highlighted in BOLD) at the test Kolmogorov-Smirnov, in Table 2. But, the fact that the majority of the variables show non-normal behavior is mitigated by a large sample size, and studies reveal that with a large (>50 observations) sample size showing normality or not is not a problem, because the larger the sample size, the better we can explain with accuracy the results of our study (Ahad, Yin, Othman, & Yaacob, 2011; Bee Wah & Mohd Razali, 2011; Ghasemi & Zahediasl, 2012; Lilliefors, 1967; Royston, 1982; Saculinggan & Balase, 2013).

More data about normality tests, such as histograms and normality plots can be found in the Annexes for consultation purposes.

Table 3 depicts the Correlation matrix. From the 28 variables, only 22 were chosen to stay in the final table as explained above. The removal of this 6 Internet (Developed & Developing Countries) variables doesn't interfere with the result, because as stated above they showed less than 1% significance levels with the Internet-World variables.

From all these 22 variables, the majority of them show high significance values with one another, but I have to drive your attention to the Internet variables with mostly $p<0.01$ significance with all the variables shown, also the M1, M2 money indicators and also Euribor and Libor, showing here high significance levels with the majority of the variables. It is worth noting that the variable "Sentiment Eur Mean" shows mostly $p<0.05$ or $p<0.01$ significance levels with all the variables within this Table.

4.2 Linear Regressions and Further Tests

We run OLS Regressions using the variables shown below, followed by 2SLS Regressions with Lag variables (Ang et al., 2006; G. He et al., 2020; Hribar et al., 2017; Platt, 1987).

Linear regression:

$$Y_{it} = \beta_0 + \beta_{1i}X_{1it} + \beta_{2i}X_{2it} + \cdots + \beta_{ki}X_{kit} + e_{it} \quad (1)$$

Dependent variable (Y):

All Crypto Currencies (Price): Bitcoin, Ethereum, XRP, Bitcoin Cash, Litecoin, EOS, Binance Coin, Bitcoin SV, XLM, TRX and ADA.

Independent variables (X):

The following variables are considered:

Market Cap of all the coins above; CFO/ Manager's Market Sentiment of Europe and USA; SP500 stock market data; GDP REAL GDP of both Europe and USA; M1 and M2 money measurement indicators; Euribor (€), Libor ($) and T-Bills ($); EONIA (€) and LIBOR-OIS ($); And lastly several Internet stats considering the World as general data and Developed and Developing Countries data[16].

The variables above represent the full data base of the research conducted for this master thesis. Bellow we can find tables with linear regressions were not all variables were selected simultaneously for the same linear regression, but instead, entered accordingly when adequate.

[16] More detailed information about data can be found in the Chapter 3 of this Master Thesis.

4.2.1 Baseline Model and Alternatives

Table 4
Baseline Model and Alternatives.

	(1) BASE		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.
Sentim-US-Mean	-30.776**		-31.094**		-30.196**		-17.392		-30.161**		-17.391					
	(13.540)		(13.581)		(13.954)		(19.454)		(14.017)		(19.521)					
Sentim-US-Median													-19.214**		-9.817	
													(9.075)		(12.843)	
M. Cap-All-Coins	0.000***		0.000***		0.000***		0.000***		0.000***		0.000***		0.000***		0.000***	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
SP500-Open	-0.478		-0.433		-0.526		-0.667		-0.526		-0.667		-0.677		-0.730	
	(0.425)		(0.433)		(0.535)		(0.494)		(0.537)		(0.499)		(0.520)		(0.480)	
M1	0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Ind.-Internet-W.			-2507.224		-3272.551		-1765.347		-3431.947		-1768.004		-3515.552		-1241.167	
			(4396.445)		(5107.280)		(4461.110)		(6075.710)		(5139.348)		(6075.917)		(5104.499)	
T-Bills $					4454.321				4635.346				9130.219			
					(14996.273)				(15496.082)				(15178.599)			
LIBOR-OIS $							-38382.815				-38383.846				-42140.209	
							(39015.679)				(39157.778)				(38975.732)	
GDP-USA-Var									-87.249		-1.820		262.043		236.311	
									(1786.864)		(1730.498)		(1803.707)		(1765.136)	
Constant	2000.793**		2047.674**		2205.150**		1234.481		2214.122**		1234.513		1833.112*		822.261	
	(869.226)		(875.019)		(1025.359)		(1203.782)		(1045.044)		(1208.167)		(967.894)		(903.791)	
Adj. R-square	0.919		0.919		0.918		0.919		0.918		0.918		0.918		0.918	
Num. of observations	158		158		158		158		158		158		158		158	

Standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, ** and *, respectively.

Table 4 features one of the most important tables in this Master Thesis. Here it is shown the BASELINE Model for this regression and 7 other regressions, with variations starting from the Baseline model.

In the Baseline Model, the selected variables are the "Sentiment_US_Mean", the "MarketCap_All_Coins", the "SP500_Open" and the M1 money indicator. The Sentiment variable US was chosen because US is one of the biggest economies in the world with a very high representation worldwide. The Market Cap variable was chosen by its relevance and high significance level with the Crypto Coins (Price). S&P500 and M1 are used as representations of business and trade in the world.

Looking closely to the first linear regression we note that the Adjusted R-Square is 0.919, a very high and positive value showing that within our model our independent variables are explaining 91.9% of our dependent variable variation. The Market Cap variable is statistically significant at 1% level and our regression itself also shows significance at 1%. Other than that, we can note that the variable Sentiment is significant at 5%.

Then for the second regression showed at Table 4, apart from the variables present at the BASE line regression, we added the variable "Individuals using the Internet - % World". This variable was entered for being the most general and more representative in numeric terms of the 9 total "Internet" variables presented on the data base created for this research. Plugging in this new variable, the significances of the other variables stayed the same and the Adjusted R-square too. Then, for regression number 3 the T-Bills variable was added and for regression number 4 the Libor-OIS was added. In regression number 3 there are no significant changes apart from a slight drop in the Adjusted R-Square from 0.919 to 0.918. But in the regression 4 with the addiction of Libor-OIS, and REMOVAL of T-Bills the Adj. R-Square returned to 0.919. In regression 4 we also observe a drop in the significance levels, from 3 significant variables to only 1 significant variable.

In regression 5, Sentiment and Market Cap remain statistically significant.

In regression number 6 the GDP variable was maintained, and T-Bills was replaced by the Libor-OIS. Only Market Cap remained statistically significant.

In regressions number 7 and 8 we replace "Sentiment-US-Mean" by "Sentiment-US-Median". Apart from the Base line model, the variables "Individuals using the Internet - % World" was added, together with the T-Bills and "GDP-USA-Var". Regressions 7 and 8 use "Individuals using the Internet - % World", Libor-OIS and "GDP-USA-Var". The previous results are confirmed.

In Table 4 we can also observe that most of the Coefficients present positive values, but some show negative values too. The bigger negative values belong to the variable Libor-OIS, presented in both regression 4, 6 and 8 is economically more significant compared to the other estimates, although not statistically significant.

4.2.2 Robustness Tests

Table 5
Robustness Tests.

	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.
Sent.-Eur-Median	-25.074***		-27.832***		-28.440***		-22.178**		-31.004***		-29.976***		-22.673**		-22.878**	
	(9.489)		(9.773)		(10.411)		(10.666)		(11.007)		(10.793)		(10.738)		(10.871)	
M. Cap-All-Coins	0.000***		0.000***		0.000***		0.000***		0.000***		0.000***		0.000***		0.000***	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
SP500-Open	-0.665		-0.572		-0.518		-0.722*		-0.413		-0.493		-0.748*		-0.737*	
	(0.410)		(0.418)		(0.522)		(0.432)		(0.542)		(0.525)		(0.437)		(0.436)	
M1	0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Ind.-Internet-W.			-5205.434		-4806.562		-4011.445		-261.332		-2996.388		-2067.502		-3182.285	
			(4488.169)		(5054.757)		(4569.889)		(8045.767)		(6019.669)		(6003.737)		(5126.940)	
T-Bills $					-2675.461				-10223.926		-5458.854					
					(15409.228)				(18602.132)		(16233.356)					
LIBOR-OIS $							-38518.596						-38432.069		-37537.677	
							(29458.605)						(29532.446)		(29668.632)	
GDP-Eur-Var									1445.388				822.731			
									(1988.555)				(1642.259)			
GDP-USA-Var											1017.737				627.012	
											(1827.778)				(1737.720)	
Constant	1819.367**		2032.538***		1944.612**		1590.994*		1680.508*		1874.389**		1582.860*		1615.330*	
	(747.653)		(769.096)		(922.905)		(838.328)		(993.201)		(933.578)		(840.571)		(843.453)	
Adj. R-square	0.920		0.920		0.920		0.920		0.919		0.919		0.920		0.920	
Num. of observations	158		158		158		158		158		158		158		158	

Standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, ** and *, respectively.

In **Table 5** we present the results of Robustness Tests. In these tests the variables used were similar to the previous ones (Table 4) except that the Sentiment variable, the variable of interest in our study was replaced by the "Sentiment-Eur-Median", the Sentiment variable that measures the Investors' Sentiment in Europe. The "Median" is less influenced by extreme values.

The goodness-of-fit of the models remains high.

We use the European investor sentiment variable instead of the U.S. one, and added the "Market Cap-All Coins" variable, the S&P500 variable and the M1. Then for the second regression "Individuals using the Internet - % World" variable is entered. The 3rd regression uses T-Bills. The previous results are confirmed, when using the above mentioned alternative control variables.

For the 4th test, the T-Bills were removed and added the variable Libor-OIS. The previous results are confirmed. For regression number 5, T-Bills was entered, the Libor-OIS removed and entered the variable "GDP-Eur-Var", the European GDP variation variable.

Regarding Coefficients, the results are similar to those of Table 4.

4.2.3 Additional Robustness Tests

Table 6
Additional Robustness Tests.

	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.	Coeff. (s.d.)	Sig.
Sentim-USA-Mean	-6.261		741.427*		-9.090		10.351		841.133*		8.930		-3.247	
	(18.218)		(383.262)		(12.207)		(23.376)		(473.283)		(23.490)		(16.755)	
M. Cap-All-Coins	0.000***		0.000***		0.000***		0.000***		0.000***		0.000***		0.000***	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
SP500-Open	0.202		-0.444		-0.850*		-0.188		-0.326		-0.839*		-0.713*	
	(0.642)		(0.534)		(0.458)		(0.543)		(0.530)		(0.502)		(0.426)	
M1	0.000		0.000		0.000		0.000		0.000		0.000		0.000	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Ind.-Internet-W.	-2442.742		93.531		-2227.457		-2839.007		297.458		-3014.646		1256.905	
	(6033.729)		(6264.122)		(5158.624)		(5107.067)		(5225.803)		(5129.520)		(4401.653)	
T-Bills $	-5651.429		659.233		14570.263									
	(16158.174)		(15466.931)		(13214.170)									
LIBOR-OIS $							-44426.215		17167.522		-46351.412		-25584.749	
							(38824.411)		(49461.890)		(38994.959)		(33441.225)	
GDP-USA-Var	911.040		271.606		691.655		695.505		342.962		705.200		1045.302	
	(1836.140)		(1777.868)		(1519.822)		(1742.870)		(1727.873)		(1751.085)		(1482.453)	
Sent-Eur-Med.-SP500-Op	-0.011**						-0.011**							
	(0.005)						(0.005)							
Sentim-US-Mean-Square			-5.899**						-6.708*					
			(2.928)						(3.695)					
Market-Cap-Square					0.000***								0.000***	
					(0.000)								(0.000)	
Sentim-Eur-Median-Square											-0.203**			
											(0.103)			
Constant	381.322		-22696.116*		1194.354		-332.613		-25754.614*		475.483		152.395	
	(1374.627)		(12408.471)		(896.731)		(1407.790)		(14914.243)		(1256.971)		(1040.354)	
Adjusted R-square	0.919		0.919		0.941		0.920		0.919		0.920		0.940	
Number of observations	158		158		158		158		158		158		158	

Standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, ** and *, respectively.

Table 6 presents the results of our Additional Robustness Tests in which new variables were added to the main data base.

Apart from the 28 main variables, 9 new variables were added, making the data-base total variables 37.

The new variables added are the following:

-**Market_Cap_GDP_US_Var** = Market_Cap_All_Coins * GDP_USA_Var

-**Market_Cap_GDP_Eur_Var** = Market_Cap_All_Coins * GDP_Eur_Var

-**Market_Cap_Sentim_US_Mean** = Market_Cap_All_Coins * Sentim_USA_Mean

-**Market_Cap_Sentim_Eur_Median** = Market_Cap_All_Coins * Sentim_Eur_Median

-**Sentim_US_Mean_SP500_Open** = Sentim_USA_Mean * SP500_Open

-**Sentim_Eur_Median_SP500_Open** = Sentim_Eur_Median * SP500_Open

-**Sentim_US_Mean_Square** = (Sentim_USA_Mean) ²

-**Sentim_Eur_Median_Square** = (Sentim_Eur_Median) ²

-**Market_Cap_Square** = (Market_Cap_All_Coins) ²

In the first run presented in Table 6, the Base model includes the Internet variable, T-Bills, the "GDP-USA-Var" and one of the new variables, the "Sentim_Eur_Median_SP500_Open", which is the product of the multiplication of "Sentim_Eur_Median" times "SP500_Open".

Next the new variable is replaced by: "Sentim_US_Mean_Square" which is the square product of the variable "Sentim_USA_Mean". In our 3rd regression, we have the replacement of "Sentim_US_Mean_Square" by one new variable, "Market_Cap_Square" which is the product of the square of the "Market_Cap_All_Coins" variable.

In regression number 4, we replaced T-Bills by the Libor-OIS, removed the "Market_Cap_Square" and added again the "Sentim_Eur_Median_SP500_Open".

In the 5th regression the "Sentim_Eur_Median_SP500_Open" variable is substituted by "Sentim_US_Mean_Square", maintaining all the rest the same as in the previous regression. Here we find and Adjusted R-Square of 0.919 and 3 significant variables, "Sentim_USA_Mean", Market Cap and "Sentim_US_Mean_Square". Market Cap shows 1% of significance and "Sentim_USA_Mean" and "Sentim_US_Mean_Square" show 10% of significance.

On the next regression, regression number 6, the variable "Sentim_US_Mean_Square" is removed and added by the first time the variable "Sentim_Eur_Median_Square" which is the product of the square of the variable "Sentim_Eur_Median". Finally, the variable "Sentim_Eur_Median_Square" is substituted by the variable "Market_Cap_Square". In terms of significances, we have 3 significant variables. Both Market Cap variables show significances of 1% and the variable SP500 shows a significance level of 10%.

With these additional robustness test, entering alternative control variables and most importantly the square of our interest variable – Sentiment – and the square of the persistently statistically significant variable Market Cap, we intend to unveil non-linear effects. In fact when entering the square of the covariates both are statistically significant, the variable in levels and the square, with opposite signs. These results suggest a non-linear relationship. As the squares are negative and the estimates for the variables in levels are positive, we are faced with inverted U-shape relationships. That is, the influence of sentiment on cryptos prices attains a maximum for intermediate values and the same is suggested for the effect of Market capitalization.

4.2.4 Two Stage Least Squares Regressions

Table 7
Two Stage Least Squares Regressions (2-Stage LS Regression) with LAG 1 & 2.

	(1)			(2)			(3)			(4)			(5)			(6)		
	Type of Variable	Coeff. (s.d.)	Sig.	Type of Variable	Coeff. (s.d.)	Sig.	Type of Variable	Coeff. (s.d.)	Sig.	Type of Variable	Coeff. (s.d.)	Sig.	Type of Variable	Coeff. (s.d.)	Sig.	Type of Variable	Coeff. (s.d.)	Sig.
S-US-Mean LAG1				Inst.						Inst.			Inst.			P. & I.	0.266 (32.005)	
S-US-Mean LAG2							Inst.			Inst.			Inst.			P. & I.	5.043 (22.659)	
S.-USA-Mean	P. & I.	-30.776** (13.540)		Pred.	-28.315 (19.489)		Pred.	-14.982 (51.501)		Pred.	-29.996* (18.072)		P. & I.	-30.992** (13.761)		P. & I.	-32.366 (21.367)	
M. Cap-All-Coins	P. & I.	0.000*** (0.000)		P. & I.	0.000*** (0.000)		P. & I.	0.000*** (0.000)		P. & I.	0.000*** (0.000)		P. & I.	0.000*** (0.000)		P. & I.	0.000*** (0.000)	
SP500-Open	P. & I.	-0.478 (0.425)		P. & I.	-0.490 (0.440)		P. & I.	-0.572 (0.580)		P. & I.	-0.457 (0.445)		P. & I.	-0.449 (0.436)		P. & I.	-0.481 (0.454)	
M1	P. & I.	0.000*** (0.000)		P. & I.	0.000*** (0.000)		P. & I.	0.000*** (0.000)		P. & I.	0.000*** (0.000)		P. & I.	0.000*** (0.000)		P. & I.	0.000*** (0.000)	
Constant	Dep.	2000.793** (869.226)		Dep.	1905.788* (1117.133)		Dep.	1302.370 (2654.534)		Dep.	2055.749* (1089.580)		Dep.	2105.720** (917.416)		Dep.	1947.154* (1046.280)	
Adjusted R-square	0.919			0.919			0.918			0.919			0.919			0.918		
Number of observations	158			156			154			154			154			154		

Standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, ** and *, respectively. The types of variables presented are denominated by Dep., Pred., Inst., and P. & I., which stand for Dependent, Predictor, Instrumental and Predictor & Instrumental, respectively.

Next, so that the study could have more robustness, the decision of doing Two Stage Least Squares Regressions (2-Stage LS Regressions) was made.

Here **two new variables were created**:

-"Sentim_USA_Mean_LAG1" = **Lag (t-1)**

-"Sentim_USA_Mean_LAG2" = **Lag (t-2)**

These two new variables were created from our main Sentiment variable "Sentim_USA_Mean". These two variables are LAGGED variables. One is LAGGED 1 period (in this case 1 Quarter) and another one is LAGGED 2 periods (2 Quarters).

$$\boldsymbol{Y_{it} = \beta_0 + \beta_{1i} X_{1i(t-1)} + \beta_{2i} X_{2it} + \cdots + \beta_{ki} X_{kit} + e_{it}} \quad (2)$$

$$\boldsymbol{Y_{it} = \beta_0 + \beta_{1i} X_{1i(t-2)} + \beta_{2i} X_{2it} + \cdots + \beta_{ki} X_{kit} + e_{it}} \quad (3)$$

The LAG variables are plugged in the regressions as Instrumental variables.

In Table 7 the Sentiment variable "Sentim_USA_Mean", the Market Cap variable, the M1 are statistically significant. The Market Cap variable and M1 are significant at the 1% level, the Sentiment variable is significant at the 5%.

In the regression number 2, we inserted the first LAG variable, "Sentim_USA_Mean_LAG1", and turned also our main Sentiment variable into the Predictor type variable only, instead of being Predictor and Instrumental. All the other variables stayed the same as in the previous regression.

On our 3rd regression, our LAG1 variable was replaced by our LAG2 variable, variable "Sentim_USA_Mean_LAG2" as Instrumental variable and all the other variables kept their type exactly the same as in regression number 2.

Next on regression number 4 we included both LAG variables, variable LAG1 and LAG2 in our regression as instrumental variables and kept the other variables the same type as in the previous regression, regression 3.

In regression 5, our Sentiment variable's type was turned into both Predictor and Instrumental, as it was in our regression number 1. Then all the other variable's types were kept the same as in our previous regression, regression 4.

In our last regression, regression number 6, all the variables were entered as Predictor and Instrumental for further testing.

The results are similar to the previous ones suggesting that Sentiment determines the price of crypto-currencies, in the sense that when CFOs are more pessimistic the crypto market seems to benefit acting as an alternative investment and a refuge.

4.2.5 Additional Robustness Tests with Only BTC & LTC

Table 8
OLS & 2SLS Regressions with Only BTC (Bitcoin) & LTC (Litecoin).

	(1)		(2)		(3)		(4)		(5)	
	Coeff. (s.d.)	Sig.	Type of Variable	Coeff. (s.d.)	Sig.	Type of Variable	Coeff. (s.d.)	Sig.	Type of Variable	Coeff. (s.d.)	Sig.
S-US-Mean LAG1			Inst.						Inst.		
									P. & I.	3.595	
										(11.254)	
S-US-Mean LAG2						Inst.			Inst.		
									P. & I.	7.464	
										(8.112)	
S.-USA-Mean	11.697**		Pred.	18.985**		Pred.	83.521		P. & I.	12.831**	
	(5.204)			(8.178)			(101.259)			(5.175)	
M. Cap-All-Coins	0.000***		P. & I.	0.000***		P. & I.	0.000***		P. & I.	0.000***	
	(0.000)			(0.000)			(0.000)			(0.000)	
SP500-Open	-0.639***		P. & I.	-0.705***		P. & I.	-1.253		P. & I.	-0.632***	
	(0.155)			(0.163)			(0.951)			(0.153)	
M1	0.000*		P. & I.	0.000***		P. & I.	0.000***		P. & I.	0.000***	
	(0.000)			(0.000)			(0.000)			(0.000)	
Constant	-186.166		Dep.	-426.666		Dep.	-3362.720		Dep.	-55.342	
	(290.088)			(407.718)			(4753.982)			(296.334)	
Adjusted R-square	0.999		0.999			0.994			0.999		
Number of observations	52		50			48			48		

Standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, ** and *, respectively. The types of variables presented are denominated by Dep., Pred., Inst., and P. & I., which stand for Dependent, Predictor, Instrumental and Predictor & Instrumental, respectively.

In this last Table, **Table 8**, we decided to include as an additional test, the idea of running regressions using instead of all coins in the panel data, only the 2 oldest coins so that we can benefit from a wider time frame for our regressions. Many new coins were only created in 2018 or even in 2019, and because both BTC and LTC were created prior to 2013 (even though stock data is only available starting 2013), here we are certain that we can have the full time spectrum from 2013 to 2019 (the date of the beginning of this study).

Here, we have 5 regressions, the first one, regression (1), is our Baseline model, but in this case we enter BTC and LTC instead of all coins. The following runs from 2 to 5 are 2SLS Regressions. These regressions also use BTC and LTC as constant instead of all 11 crypto coins.

These last runs intend to recognize the dominance of Bitcoin and Litecoin in the crypto-currencies market.

The previous results are confirmed and even reinforced in these runs, which confers an extra layer of robustness to the findings of our research.

5 Conclusions

5.1 Conclusion

Crypto-Currencies market is growing steadily and the price of coins in this market has experienced market volatility since the inception of Bitcoin. One recent example pertains to the financial crisis of 2008, during which the economic agents turned rather pessimistic. This study builds on Behavioral Economics to unveil the effect of Sentiment on Crypto-Currencies' market. To the best of our knowledge this is the first study done exploring both of these subjects together.

We deploy a set of 11 crypto currencies, using daily prices from 2003 to 2009, controlling for their market capitalization alongside a set of control variables pertaining to the macroeconomic environment and digital market proxies. Our results suggest that Sentiment is not only highly correlated with the Crypto-Currency world but also that it has a big impact on it. The high volatility experienced on the Crypto stocks everyday can be better explained by the optimism or pessimism of investors.

Sentiment determines crypto-currencies prices, but the relationship is non-linear as our runs suggest. Other factors such as the variation found on the S&P500 Index or the GDP of the USA or Europe can also help explain why the Crypto-Currency prices fluctuate on a daily basis. Our results are robust running different models, and the Adjusted R-Square values exhibit a good fit.

We run Regressions using only the oldest crypto-coins such as Bitcoin and Litecoin and our results are confirmed once again.

With these results we can positively say that, for example, if a Whale[17] has a negative sentiment towards the market and decides to sell or if it has a positive sentiment towards the market and decides to buy, based on sentiment, this can change the market completely. Our results illustrate how the Crypto market is highly influenced by Investor Sentiment, becoming so unpredictable and volatile. Investors are trading based on Sentiment and the majority of the Crypto traders are still non-professional traders which makes the market even more volatile and unpredictable.

[17] A Whale is considered a big investor that has control of a big part of the market in question (Bouri et al., 2019).

The findings recommend more regulation to avoid extreme volatility in the market. Looking for Cryptos as an investment means to face a very volatile asset that shows bigger growth when the sentiment towards the market is pessimistic, such as when there's a crisis either monetary or a political one. Cryptos might be still associated with somewhat anarchist movements and seen as an "anti-system" monetary instrument. So, we need to change that view, by making Crypto-Currencies an asset more respected in the Finance world instead of just being seen as digital money or an "Internet product", which is not the case by casting the holistic view proposed in this study.

5.2 Considerations and Avenues for Future Research

For further research and tests I would like to keep researching on this topic maybe by instead of just focusing on Investor Sentiment (Sentiment of CFOs, Managers and Professional Investors) also open the research to the population at large.

Because Crypto Currencies continue to be traded specially by non-professional traders, the market movements might be explained even better if the research has a broader spectrum.

By analyzing the "#Bitcoin" or "#CryptoCurrency" hashtag on Twitter we can then formulate a way to analyze what everyone is thinking all the time regarding Cryptos and then correlate all that data with the market and then compare the tests. Maybe it is more significant or less significant, but either way the results would bring even more enlightenment to answer this big question: "Is Sentiment Influencing the Crypto Currencies Market?" or "Does Sentiment Play a Role in the Crypto Currencies Market?". Not just the finance professional's sentiment, but everyone that deals and trades Cryptos. With Behavioral Finance gaining more importance day by day in the finance and investments world, these broader questions need to be questioned and researched.

The Behavioral Finance research inside the Crypto Currencies world is still in the beginning but I hope that with this Master Thesis researchers can be inspired to do even more and to continue researching even further into this topic because there is still a lot to be done in order to know more about Behavioral Finance in the Crypto Currencies world, especially when bubbles are temporarily formed.

6 References

Abrantes-Metz, R. M., Kraten, M., Metz, A. D., & Seow, G. S. (2012). Libor manipulation? *Journal of Banking and Finance*, *36*(1), 136–150. https://doi.org/10.1016/j.jbankfin.2011.06.014

Agrawal, H. (2019). What does fork mean in cryptocurrency? *CoinSutra*. Retrieved from https://coinsutra.com/fork-meaning-cryptocurrency/

Ahad, N. A., Yin, T. S., Othman, A. R., & Yaacob, C. R. (2011). Sensitivity of normality tests to non-normal data. *Sains Malaysiana*, *40*(6), 637–641.

Allison, I. (2018). Cardano's Ouroboros: Proving Proof-of-Stake can work in the wild. *International Business Times*. Retrieved from https://www.ibtimes.co.uk/cardanos-ouroboros-proving-proof-stake-can-work-wild-1663150

Andersen, L., & Andreasen, J. (2000). Volatility skews and extensions of the Libor market model. *International Journal of Phytoremediation*, *21*(1), 1–32. https://doi.org/10.1080/135048600450275

Andrews, E. (2013). Chris Larsen: Money without borders. *Stanford Business*. Retrieved from https://www.gsb.stanford.edu/insights/chris-larsen-money-without-borders

Ang, A., Piazzesi, M., & Wei, M. (2006). What does the yield curve tell us about GDP growth? *Journal of Econometrics*, *131*(1–2), 359–403. https://doi.org/10.1016/j.jeconom.2005.01.032

Appelbaum, B. (2017). Nobel in economics is awarded to Richard Thaler. *New York Times*. Retrieved from https://www.nytimes.com/2017/10/09/business/nobel-economics-richard-thaler.html

Askitas, N., & Zimmermann, K. F. (2015). The internet as a data source for advancement in social sciences. *International Journal of Manpower*, *36*(1), 2–12. https://doi.org/10.1108/IJM-02-2015-0029

Auer, R. (2019). Beyond the doomsday economics of "Proof-of-Work" in cryptocurrencies. *Federal Reserve Bank of Dallas, Globalization Institute Working Papers*, *2019*(355). https://doi.org/10.24149/gwp355

Baker, M., & Wurgler, J. (2006). Investor sentiment and the cross-section of stock returns. *Journal of Finance*, *61*(4), 1645–1680. https://doi.org/10.1111/j.1540-6261.2006.00885.x

Baker, M., & Wurgler, J. (2007). Investor sentiment in the stock market. *Journal of Economic Perspectives*, *21*(2), 129–151. https://doi.org/10.1257/jep.21.2.129

Baker, P. (2020). Tron's Justin Sun (finally) gets $4.5M dinner with Warren Buffett. *CoinDesk*. Retrieved from https://www.coindesk.com/trons-justin-sun-finally-gets-4-5m-dinner-with-warren-buffett

Banerjee, A., & Marcellino, M. (2006). Are there any reliable leading indicators for US inflation and GDP growth? *International Journal of Forecasting*, *22*(1), 137–151. https://doi.org/10.1016/j.ijforecast.2005.03.005

Barberis, N., Shleifer, A., & Vishny, R. (1998). A model of investor sentiment. *Journal of Financial Economics*, *49*(3), 307–343. https://doi.org/10.1016/S0304-405X(98)00027-0

Barberis, N., & Thaler, R. (2003). Chapter 18 - A survey of behavioral finance. In *Advances in Behavioral Finance* (Vol. 2, pp. 1053–1128). https://doi.org/10.1016/S1574-0102(03)01027-6

Bariviera, A. F., Basgall, M. J., Hasperué, W., & Naiouf, M. (2017). Some stylized facts of the Bitcoin market. *Physica A: Statistical Mechanics and Its Applications*, *484*, 82–90. https://doi.org/10.1016/j.physa.2017.04.159

Batabyal, A. (2020). Tron mining - Best Tron mining guide for beginners. *CoinSwitch*. Retrieved from https://coinswitch.co/news/tron-mining-can-you-mine-trx-everything-you-need-to-know-trx-mining-guide

Bee Wah, Y., & Mohd Razali, N. (2011). Power comparisons of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors and Anderson-Darling tests. *Journal of Statistical Modeling and Analytics*, *2*(November), 21–33.

Beedham, M. (2019). Here's how Binance Coin performed in Q1 2019. *TheNextWeb (TNW)*. Retrieved from https://thenextweb.com/hardfork/2019/04/26/heres-how-binance-coin-performed-in-q1-2019/

Beenz. (2001). Beenz - Homepage. Retrieved May 20, 2020, from https://web.archive.org/web/20011014231958/http://www.beenz.com/

Beirne, J. (2012). The EONIA spread before and during the crisis of 2007-2009: The role of liquidity and credit risk. *Journal of International Money and Finance*, *31*(3), 534–551. https://doi.org/10.1016/j.jimonfin.2011.10.005

Ben, S., & Xiaoqiong, W. (2019). Are cryptocurrencies good investments? *Studies in Business and Economics*, *14*(2), 181–192. https://doi.org/10.2478/sbe-2019-0033

Bendix, R., & Fisher, L. H. (1949). The perspectives of Elton Mayo. *The Review of Economics and Statistics*, *31*(4), 312. https://doi.org/10.2307/1928657

Bernoth, K., & von Hagen, J. (2004). The Euribor futures market: Efficiency and the impact of ECB policy announcements. *International Finance*, *7*(1), 1–24. https://doi.org/10.1111/j.1367-0271.2004.00127.x

Bhat, M., & Vijayal, S. (2017). A probabilistic analysis on crypto-currencies based on Blockchain. In *2017 International Conference on Next Generation Computing and Information Systems (ICNGCIS)* (pp. 69–74). IEEE. https://doi.org/10.1109/ICNGCIS.2017.37

Bhatia, R., Kumar, P., Bansal, S., & Rawat, S. (2018). Blockchain - The technology of crypto currencies. In *2018 International Conference on Advances in Computing and Communication Engineering (ICACCE)* (pp. 372–377). IEEE. https://doi.org/10.1109/ICACCE.2018.8441738

Binance. (2017). Binance exchange Whitepaper. *URL: Https://Lexicoin.Wiki/Whitepaper/Docs/BNB.Pdf*. Retrieved from

https://lexicoin.wiki/Whitepaper/Docs/BNB.pdf

Binance. (2018a). BNB - Definition - Binance Academy. *Binance Academy*. Retrieved from https://academy.binance.com/glossary/bnb

Binance. (2018b). O que é Ripple? *Binance Academy*. Retrieved from https://www.binance.vision/pt/economics/what-is-ripple

BitcoinABC. (2017). Bitcoin ABC - Software for Bitcoin Cash nodes. Retrieved May 28, 2020, from https://www.bitcoinabc.org/

BitcoinSV. (2019). Vision – BitcoinSV. Retrieved May 28, 2020, from https://bitcoinsv.io/vision/

BitDegree. (2019a). How to buy Tron Coin: Complete guide. Retrieved June 1, 2020, from https://www.bitdegree.org/tutorials/how-to-buy-tron-coin/

BitDegree. (2019b). Stellar vs Ripple: What's the better choice? Retrieved May 31, 2020, from https://www.bitdegree.org/tutorials/stellar-vs-ripple/#Bottom_Line_of_Stellar_Lumens

BitMart. (2019). Bitcoin SV (BSV) – BitMart. Retrieved May 28, 2020, from https://bitmart.zendesk.com/hc/en-us/articles/360013291053-Bitcoin-SV-BSV-

BitTorrent. (2018). It's official: BitTorrent is now part of TRON! Retrieved June 1, 2020, from https://www.bittorrent.com/blog/2018/07/23/its-official-bittorrent-is-now-part-of-tron/

Björk, T., & Björk, T. (2005). LIBOR and Swap market models. *Arbitrage Theory in Continuous Time*, *330*(January 1996), 368–388. https://doi.org/10.1093/0199271267.003.0025

BlackwellGlobal. (2018). Why do banks like Ripple? Retrieved May 23, 2020, from https://www.blackwellglobal.com/why-do-banks-like-ripple/

Blockgeeks. (2019). What are DAPPs? The new decentralized future. Retrieved May 27, 2020, from https://blockgeeks.com/guides/dapps/

Bordino, I., Battiston, S., Caldarelli, G., Cristelli, M., Ukkonen, A., & Weber, I. (2012). Web search queries can predict stock market volumes. *PLoS ONE*, *7*(7). https://doi.org/10.1371/journal.pone.0040014

Bouri, E., Azzi, G., & Dyhrberg, A. H. (2017). On the return-volatility relationship in the Bitcoin market around the price crash of 2013. *Economics*, *11*, 1–17. https://doi.org/10.5018/economics-ejournal.ja.2017-2

Bouri, E., Gupta, R., & Roubaud, D. (2019). Herding behaviour in cryptocurrencies. *Finance Research Letters*, *29*, 216–221. https://doi.org/10.1016/j.frl.2018.07.008

Bouri, E., Jalkh, N., Molnár, P., & Roubaud, D. (2017). Bitcoin for energy commodities before and after the December 2013 crash: Diversifier, hedge or safe haven? *Applied Economics*, *49*(50), 5063–5073. https://doi.org/10.1080/00036846.2017.1299102

BoVegas. (2019). Tron (TRX) in gambling. Retrieved June 1, 2020, from https://bovegas.com/blog/cryptogaming/tron-trx-in-gambling/

Bowater, J. (2020). When moon? A momentous last week. *CityAM*. Retrieved from https://www.cityam.com/when-moon-a-momentous-last-week/

Bridle, J. (2019). Bitcoin and the money myth. *New Statesman*, (July), 32–37.

Broadberry, S., & Klein, A. (2012). Aggregate and per capita GDP in Europe, 1870-2000: Continental, regional and national data with changing boundaries. *Scandinavian Economic History Review*, *60*(1), 79–107. https://doi.org/10.1080/03585522.2012.651306

Brophy, J. (1986). Classroom management techniques. *Education and Urban Society*, *18*(2), 182–194. https://doi.org/10.1177/0013124586018002005

Brown, G. W., & Cliff, M. T. (2005). Investor sentiment and asset valuation. *Journal of Business*, *78*(2), 405–440. https://doi.org/10.1086/427633

Brownell, C. (2017). Vitalik Buterin: The cryptocurrency prophet. *Financial Post*. Retrieved from https://business.financialpost.com/feature/the-cryptocurrency-prophet

Bruce, K. (2006). Henry S. Dennison, Elton Mayo, and human relations historiography. *Management and Organizational History*, *1*(2), 177–199. https://doi.org/10.1177/1744935906064095

Bruce, K., & Nyland, C. (2011). Elton mayo and the deification of human relations. *Organization Studies*, *32*(3), 383–405. https://doi.org/10.1177/0170840610397478

Buchanan, T., & Smith, J. L. (1999). Using the internet for psychological research: Personality testing on the World Wide Web. *British Journal of Psychology*, *90*(1), 125–144. https://doi.org/10.1348/000712699161189

Buchko, S. (2018). What is Cardano (ADA)? - The all-inclusive guide. *CoinCentral*. Retrieved from https://coincentral.com/cardano-beginner-guide/

Burger, A. E., Lang, R. W., & Rasche, R. H. (1977). The Treasury Bill futures market and market expectations of interest rates. *Federal Reserve Bank of St. Louis*, *June*, 1–9. https://doi.org/10.20955/r.59.2-9.yzi

Burns, L., & Moro, A. (2018). What makes an ICO successful? An investigation of the role of ICO characteristics, team quality and market sentiment. *SSRN Electronic Journal*, 1–42. https://doi.org/10.2139/ssrn.3256512

Buterin, V. (2014). A next generation smart contract & decentralized application platform. *White Paper*, 1–36. Retrieved from https://blockchainlab.com/pdf/Ethereum_white_paper-a_next_generation_smart_contract_and_decentralized_application_platform-vitalik-buterin.pdf

Buterin, V. (2020a). vbuterin · GitHub. Retrieved May 20, 2020, from https://github.com/vbuterin

Buterin, V. (2020b). Vitalik Buterin's website. Retrieved May 20, 2020, from https://vitalik.ca/

Caginalp, C., & Caginalp, G. (2018). Opinion: Valuation, liquidity price, and stability of cryptocurrencies. *Proceedings of the National Academy of Sciences*, *115*(6), 1131–1134. https://doi.org/10.1073/pnas.1722031115

Cai, D. A., Fink, E. L., & Walker, C. B. (2019). Robert R. Blake, with recognition of Jane S. Mouton. *Negotiation and Conflict Management Research*, *0*(0), 1–9.

https://doi.org/10.1111/ncmr.12151

Camerer, C. F., & Loewenstein, G. (2004). Behavioral economics: Past, present, future. In *Advances in Behavioral Economics* (pp. 3–52). Princeton University Press. https://doi.org/10.2307/j.ctvcm4j8j.6

Campbell, J. Y., Lo, A. W., & MacKinlay, A. C. (1997). *The econometrics of financial markets*. Princeton University Press. https://doi.org/10.2307/j.ctt7skm5

Cardano. (2020a). Ouroboros - Cardano. Retrieved June 2, 2020, from https://www.cardano.org/en/ouroboros/

Cardano. (2020b). What is Cardano? - Cardano. Retrieved June 2, 2020, from https://www.cardano.org/en/what-is-cardano/

Castor, A. (2017a). At a major crypto conference, Blockchain projects tighten security with math. *Forbes*. Retrieved from https://www.forbes.com/sites/amycastor/2017/08/23/at-crypto-2017-blockchain-presentations-focus-on-proofs-not-concepts/#2328f9237b70

Castor, A. (2017b). IOHK launches Cardano Blockchain; ADA now trading on Bittrex. *Bitcoin Magazine*. Retrieved from https://bitcoinmagazine.com/articles/iohk-launches-cardano-blockchain-ada-now-trading-bittrex

Chan, S., Chu, J., Nadarajah, S., & Osterrieder, J. (2017). A statistical analysis of cryptocurrencies. *Journal of Risk and Financial Management*, *10*(2), 12. https://doi.org/10.3390/jrfm10020012

Chapron, G. (2017). The environment needs crypto-governance. *Nature*, *545*(7655), 403–405. https://doi.org/10.1038/545403a

Chase, B., & MacBrough, E. (2018). Analysis of the XRP ledger consensus protocol. *ArXiv:1802.07242*, 1–25. Retrieved from http://arxiv.org/abs/1802.07242

Chaudhary, V. (2019). Cardano price prediction 2020, 2025, 2018. *Coinnounce*. Retrieved from https://coinnounce.com/cardano-price-prediction-2020-2025-2018/

Cheah, E.-T., & Fry, J. (2015). Speculative bubbles in Bitcoin markets? An empirical investigation into the fundamental value of Bitcoin. *Economics Letters*, *130*, 32–36. https://doi.org/10.1016/j.econlet.2015.02.029

Chen, T., Hu, T., Chen, J., Zhang, X., Li, Z., Zhang, Y., … Deng, S. (2019). DataEther: Data exploration framework for Ethereum. In *2019 IEEE 39th International Conference on Distributed Computing Systems (ICDCS)* (Vol. 2019-July, pp. 1369–1380). IEEE. https://doi.org/10.1109/ICDCS.2019.00137

Cizeau, P., Liu, Y., Meyer, M., Peng, C. K., & Stanley, H. E. (1997). Volatility distribution in the S&P500 stock index. *Physica A: Statistical Mechanics and Its Applications*, *245*(3–4), 441–445. https://doi.org/10.1016/S0378-4371(97)00417-2

Clifford, T. (2018). BKCM's Brian Kelly: "Crypto civil war" slams Bitcoin but not for long. *CNBC*. Retrieved from https://www.cnbc.com/2018/11/14/bkcm-brian-kelly-crypto-civil-war-slams-bitcoin-but-not-for-long.html

Coinmonks. (2018). A brief(ish) history of XRP. *Medium*. Retrieved from https://medium.com/coinmonks/a-brief-ish-history-of-xrp-6fb434a35208

Corbet, S., Lucey, B., & Yarovaya, L. (2018). Datestamping the Bitcoin and Ethereum bubbles. *Finance Research Letters*, *26*, 81–88. https://doi.org/10.1016/j.frl.2017.12.006

Corbet, S., Meegan, A., Larkin, C., Lucey, B., & Yarovaya, L. (2018). Exploring the dynamic relationships between cryptocurrencies and other financial assets. *Economics Letters*, *165*, 28–34. https://doi.org/10.1016/j.econlet.2018.01.004

Costa, D. F., Carvalho, F. de M., & Moreira, B. C. de M. (2019). Behavioral economics and behavioral finance: A bibliometric analysis of the scientific fields. *Journal of Economic Surveys*, *33*(1), 3–24. https://doi.org/10.1111/joes.12262

Crypto Gambling News. (2020). Best TRON casinos. Retrieved June 1, 2020, from https://www.cryptogamblingnews.com/cryptocurrencies/best-tron-casinos-and-trx-gambling-dapps-reviews-and-bonuses/

CryptoNinjas. (2020). What you need to know about Cardano powered by the ADA Coin. Retrieved June 3, 2020, from https://www.cryptoninjas.net/2020/05/14/what-you-need-to-know-about-cardano-powered-by-the-ada-coin/

CryptoSlate. (2019). EMURGO CEO talks Cardano development, important ADA milestones and what the future holds. Retrieved June 3, 2020, from https://cryptoslate.com/emurgo-ceo-talks-cardano-development-important-ada-milestones-and-what-the-future-holds/

Cvetkova, I. (2018). Crypto-currencies legal regulation. *BRICS Law Journal*, *5*(2), 128–153. https://doi.org/10.21684/2412-2343-2018-5-2-128-153

Daddario, R., Anhalt, K., & Barton, L. E. (2007). Differential reinforcement of other behavior applied classwide in a child care setting. *International Journal of Behavioral Consultation and Therapy*, *3*(3), 342–348. https://doi.org/10.1037/h0100810

Dagher, G. G., Mohler, J., Milojkovic, M., & Marella, P. B. (2018). Ancile: Privacy-preserving framework for access control and interoperability of electronic health records using Blockchain technology. *Sustainable Cities and Society*, *39*(December 2017), 283–297. https://doi.org/10.1016/j.scs.2018.02.014

Damiani, J. (2017). Crypto watch: Cardano (ADA) price leaps 117% in 22 hours, surging past IOTA with $10.4B market cap. *Forbes*. Retrieved from https://www.forbes.com/sites/jessedamiani/2017/12/16/crypto-watch-cardano-ada-price-leaps-117-in-22-hours-surging-past-iota-with-10-4b-market-cap/#18c8f0948abe

Das, A. (2020). Cardano reaches development milestone. *Brave New Coin*. Retrieved from https://bravenewcoin.com/insights/cardano-reaches-development-milestone

De Castro, A. (2019). Best TRON casinos 2019: Top TRON gambling DAPPS reviewed. *Steemit*. Retrieved from https://steemit.com/best/@alexis051892/best-tron-casinos-2019-top-tron-gambling-dapps-reviewed

Dickson, B. (2019). How to keep your Bitcoin safe. *PC Magazine*, (October), 37–40.

Douglas, R., & Pugachevsky, D. (2013). Overnight index swap and integrated credit valuation

adjustment discounting. *Journal of Securities Operations & Custody*, *5*(3), 262–275.

Dowling, M. M., & Lucey, B. M. (2004). The role of feelings in investor decision-making. *SSRN Electronic Journal*, (October). https://doi.org/10.2139/ssrn.346302

Downs, C. (2018). The cryptocurrency disrupted by science. *Daily Dot*. Retrieved from https://www.dailydot.com/debug/what-is-cardano/

Drobetz, W., Momtaz, P. P., & Schröder, H. (2019). Investor sentiment and initial coin offerings. *Journal of Alternative Investments*, *21*(4), 41–55. https://doi.org/10.3905/jai.2019.1.069

Drożdż, S., Minati, L., Oświęcimka, P., Stanuszek, M., & Wątorek, M. (2019). Signatures of the crypto-currency market decoupling from the forex. *Future Internet*, *11*(7), 154. https://doi.org/10.3390/fi11070154

Dwork, C., & Naor, M. (1993). Pricing via processing or combatting junk mail. In *Advances in Cryptology — CRYPTO' 92* (Vol. 740 LNCS, pp. 139–147). Berlin, Heidelberg: Springer Berlin Heidelberg. https://doi.org/10.1007/3-540-48071-4_10

E-Gold. (1998a). E-Gold® Blog. Retrieved May 20, 2020, from https://blog.e-gold.com/

E-Gold. (1998b). E-Gold - Questions and answers. Retrieved May 20, 2020, from https://web.archive.org/web/19980627133917/http://www.e-gold.com/unsecure/faq.htm

E-Gold. (1998c). E-Gold Homepage. Retrieved May 20, 2020, from https://web.archive.org/web/19980627133859/http://www.e-gold.com/

Edmans, A., García, D., & Norli, Ø. (2007). Sports sentiment and stock returns. *Journal of Finance*, *62*(4), 1967–1998. https://doi.org/10.1111/j.1540-6261.2007.01262.x

Eisl, A., Gasser, S. M., & Weinmayer, K. (2015). Caveat Emptor: Does Bitcoin improve portfolio diversification? *SSRN Electronic Journal*, 1–21. https://doi.org/10.2139/ssrn.2408997

Eisl, A., Jankowitsch, R., & Subrahmanyam, M. G. (2017). The manipulation potential of Libor and Euribor. *European Financial Management*, *23*(4), 604–647. https://doi.org/10.1111/eufm.12126

Eken, M. H., & Baloglu, E. (2017). Crypto currencies and their destinies in the future. *International Journal of Finance & Banking Studies*, *6*(4), 1–11. https://doi.org/10.20525/ijfbs.v6i3.810

EOS.IO. (2018). Documentation/TechnicalWhitePaper.md at master · EOSIO/Documentation · GitHub. *Github.Com*. Retrieved from https://github.com/EOSIO/Documentation/blob/master/TechnicalWhitePaper.md

Exodus. (2020). Guide to swap Tron (TRX) to Mainnet - Exodus support. Retrieved June 1, 2020, from https://support.exodus.io/article/778-guide-to-swap-trx-to-mainnet

Fairley, P. (2019). Ethereum will cut back its absurd energy use. *IEEE Spectrum*, *56*(1), 29–32. https://doi.org/10.1109/MSPEC.2019.8594790

Fakhfekh, M., & Jeribi, A. (2020). Volatility dynamics of crypto-currencies' returns: Evidence from asymmetric and long memory GARCH models. *Research in International Business*

and Finance, *51*(June 2019), 101075. https://doi.org/10.1016/j.ribaf.2019.101075

Falk, T. (2019). Bitcoin vs EOS: A feature-by-feature breakdown. *Finder*. Retrieved from https://www.finder.com/bitcoin-vs-eos

Fama, E. F. (1965). Random walks in stock market prices. *Financial Analysts Journal*, *21*(5), 55–59. https://doi.org/10.2469/faj.v21.n5.55

Fang, W., Chen, W., Zhang, W., Pei, J., Gao, W., & Wang, G. (2020). Digital signature scheme for information non-repudiation in Blockchain: A state of the art review. *EURASIP Journal on Wireless Communications and Networking*, *2020*(1), 56. https://doi.org/10.1186/s13638-020-01665-w

Feinberg, M. R. (1976). *Effective psychology for managers*. Simon & Schuster (Paper) (February 1976).

Filbeck, G., Ricciardi, V., Evensky, H. R., Fan, S. Z., Holzhauer, H. M., & Spieler, A. (2017). Behavioral finance: A panel discussion. *Journal of Behavioral and Experimental Finance*, *15*, 52–58. https://doi.org/10.1016/j.jbef.2017.07.008

Foley, S., Karlsen, J. R., & Putnins, T. J. (2019). Sex, drugs, and Bitcoin: How much illegal activity is financed through cryptocurrencies? *Review of Financial Studies*, *32*(5), 1798–1853. https://doi.org/10.1093/rfs/hhz015

ForexRatings. (2018). Cardano very bearish below 6 cents. Retrieved June 3, 2020, from https://www.forex-ratings.com/btc-usd-forecast/?id=27569

Frumkin, D. (2018). 4 Nonprofit companies in the cryptocurrency world. *Invest In Blockchain*. Retrieved from https://www.investinblockchain.com/nonprofit-companies-cryptocurrency/

Gallo, J., & Ertur, C. (2005). Exploratory spatial data analysis of the distribution of regional per capita GDP in Europe, 1980-1995. *Papers in Regional Science*, *82*(2), 175–201. https://doi.org/10.1111/j.1435-5597.2003.tb00010.x

Ganz, F., Barnaghi, P., & Carrez, F. (2013). Information abstraction for heterogeneous real world internet data. *IEEE Sensors Journal*, *13*(10), 3793–3805. https://doi.org/10.1109/JSEN.2013.2271562

Gervais, S., Kaniel, R., & Mingelgrin, D. H. (2001). The high-volume return premium. *Journal of Finance*, *56*(3), 877–919. https://doi.org/10.1111/0022-1082.00349

Ghasemi, A., & Zahediasl, S. (2012). Normality tests for statistical analysis: A guide for non-statisticians. *International Journal of Endocrinology and Metabolism*, *10*(2), 486–489. https://doi.org/10.5812/ijem.3505

Gil-Alana, L. A., Abakah, E. J. A., & Rojo, M. F. R. (2020). Cryptocurrencies and stock market indices. Are they related? *Research in International Business and Finance*, *51*(April 2020), 101063. https://doi.org/10.1016/j.ribaf.2019.101063

Giudici, G., Milne, A., & Vinogradov, D. (2020). Cryptocurrencies: Market analysis and perspectives. *Journal of Industrial and Business Economics*, *47*(1), 1–18. https://doi.org/10.1007/s40812-019-00138-6

Given, L. M. (2008). *The SAGE encyclopedia of qualitative research methods*. Los Angeles: SAGE Publications, Inc. https://doi.org/10.4135/9781412963909.n453

Glaser, F., Zimmermann, K., Haferkorn, M., Weber, M. C., & Siering, M. (2014). Bitcoin - Asset or currency? Revealing users' hidden intentions. *Twenty Second European Conference on Information Systems, Tel Aviv 2014*, 1–14. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2425247

Graham, G. (2014). The White Paper FAQ (Frequently Asked Questions). *That White Paper Guy*. Retrieved from https://thatwhitepaperguy.com/white-paper-faq-frequently-asked-questions/#what_is

Grech, N., Kong, M., Jurisevic, A., Brent, L., Scholz, B., & Smaragdakis, Y. (2018). MadMax: Surviving out-of-GAS conditions in Ethereum smart contracts. *Proceedings of the ACM on Programming Languages*, *2*(OOPSLA), 1–27. https://doi.org/10.1145/3276486

Grigg, I. (2004). The Ricardian contract. *First IEEE International Workshop on Electronic Contracting, (WEC) 6th July 2004*, 1–8. Retrieved from https://iang.org/papers/ricardian_contract.html

Grigg, I. (2017). EOS - An introduction. *EOS.IO White Paper*, 1–8. Retrieved from https://pdfs.semanticscholar.org/c7a9/22dffb06ee1a75e1a5527c557da21b3c1d90.pdf?_ga=2.260875400.4425255.1598385612-1362400405.1594925071

Griggs, K. N., Ossipova, O., Kohlios, C. P., Baccarini, A. N., Howson, E. A., & Hayajneh, T. (2018). Healthcare Blockchain system using smart contracts for secure automated remote patient monitoring. *Journal of Medical Systems*, *42*(7), 130. https://doi.org/10.1007/s10916-018-0982-x

Guia Do Bitcoin. (2018). O que é Stellar Lumens (XLM)? Retrieved May 31, 2020, from https://guiadobitcoin.com.br/stellar/

Gurdgiev, C., & O'Loughlin, D. (2020). Herding and anchoring in cryptocurrency markets: Investor reaction to fear and uncertainty. *Journal of Behavioral and Experimental Finance*, *25*, 100271. https://doi.org/10.1016/j.jbef.2020.100271

Hajric, V., & Kharif, O. (2019). Hype over Litecoin's halving leaves owners holding the bag. *Bloomberg*. Retrieved from https://www.bloomberg.com/news/articles/2019-08-02/crypto-hype-over-halving-leaves-litecoin-owners-holding-the-bag

Hall, A. D., Anderson, H. M., & Granger, C. W. J. (1992). A cointegration analysis of Treasury Bill yields. *The Review of Economics and Statistics*, *74*(1), 116. https://doi.org/10.2307/2109549

Hammi, M. T., Hammi, B., Bellot, P., & Serhrouchni, A. (2018). Bubbles of trust: A decentralized Blockchain-based authentication system for IoT. *Computers & Security*, *78*, 126–142. https://doi.org/10.1016/j.cose.2018.06.004

Harm, J., Obregon, J., & Stubbendick, J. (2016). Ethereum vs. Bitcoin. *Creighton University*, 1–15. Retrieved from https://www.economist.com/sites/default/files/creighton_university_kraken_case_study.pdf

Hassler, U., & Nautz, D. (2008). On the persistence of the Eonia spread. *Economics Letters*, *101*(3), 184–187. https://doi.org/10.1016/j.econlet.2008.08.004

Haug, A. A., & Tam, J. (2007). A closer look at long-run U.S. money demand: Linear or nonlinear error-correction with M0, M1, or M2? *Economic Inquiry*, *45*(2), 363–376. https://doi.org/10.1111/j.1465-7295.2006.00007.x

Hayes, A. (2019). The socio-technological lives of Bitcoin. *Theory, Culture and Society*, *36*(4), 49–72. https://doi.org/10.1177/0263276419826218

He, G., Zhu, S., & Gu, H. (2020). The nonlinear relationship between investor sentiment, stock return, and volatility. *Discrete Dynamics in Nature and Society*, *2020*, 1–11. https://doi.org/10.1155/2020/5454625

He, Z., He, L., & Wen, F. (2019). Risk compensation and market returns: The role of investor sentiment in the stock market. *Emerging Markets Finance and Trade*, *55*(3), 704–718. https://doi.org/10.1080/1540496X.2018.1460724

He, Z., Zhou, F., Xia, X., Wen, F., & Huang, Y. (2019). Interaction between oil price and investor sentiment: Nonlinear causality, time-varying influence, and asymmetric effect. *Emerging Markets Finance and Trade*, *55*(12), 2756–2773. https://doi.org/10.1080/1540496X.2019.1635450

Hegedűs, P. (2019). Towards analyzing the complexity landscape of Solidity based Ethereum smart contracts. *MDPI - Technologies*, *7*(1), 6. https://doi.org/10.3390/technologies7010006

Hirshleifer, D., & Shumway, T. (2003). Good day sunshine: Stock returns and the weather. *Journal of Finance*, *58*(3), 1009–1032. https://doi.org/10.1111/1540-6261.00556

Hlaing, K. M., & Nyaung, D. E. (2019). Electricity billing system using Ethereum and Firebase. In *2019 International Conference on Advanced Information Technologies (ICAIT)* (pp. 217–221). IEEE. https://doi.org/10.1109/AITC.2019.8920931

Holt, K. (2018). Blockchain company Tron buys BitTorrent. *Engadget*. Retrieved from https://www.engadget.com/2018-07-25-blockchain-company-tron-buys-bittorrent.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAHCSEKDhBMWdKsHHNXVPJO8ITqiIK9ApxX8lXpDIl0ShkZN1chXFZKEqN6L6TPfr_0HhlBiLPzVrEqIJLlmZ9BkM0snK0

Hribar, P., & McInnis, J. (2012). Investor sentiment and analysts' earnings forecast errors. *Management Science*, *58*(2), 293–307. https://doi.org/10.1287/mnsc.1110.1356

Hribar, P., Melessa, S. J., Small, R. C., & Wilde, J. H. (2017). Does managerial sentiment affect accrual estimates? Evidence from the banking industry. *Journal of Accounting and Economics*, *63*(1), 26–50. https://doi.org/10.1016/j.jacceco.2016.10.001

Hribar, P., & Quinn, P. (2013). Managers and investor sentiment. *SSRN Electronic Journal*, 41. https://doi.org/10.2139/ssrn.2240631

Hsiao, C. (1981). Autoregressive modelling and money-income causality detection. *Journal of Monetary Economics*. https://doi.org/10.1016/0304-3932(81)90053-2

Huang, Z. (2018). Bitcoin cash "hard fork": Everything you need to know about the latest

cryptocurrency civil war. *South China Morning Post*. Retrieved from https://www.scmp.com/tech/blockchain/article/2173389/bitcoin-cash-hard-fork-everything-you-need-know-about-latest

Hughes, A., Park, A., Kietzmann, J., & Archer-Brown, C. (2019). Beyond Bitcoin: What blockchain and distributed ledger technologies mean for firms. *Business Horizons*, *62*(3), 273–281. https://doi.org/10.1016/j.bushor.2019.01.002

Hull, J., & White, A. (2013). LIBOR vs. OIS. *Journal Of Investment Management*, *11*(3), 14–27. Retrieved from https://www-2.rotman.utoronto.ca/~hull/DownloadablePublications/LIBORvsOIS.pdf

IBM Corp. (2019). IBM SPSS statistics for Windows, version 26.0. Armonk, NY: IBM Corp.

ICORating. (2020). Binance ICO review, all information about token sale Binance (BNB). Retrieved May 28, 2020, from https://icorating.com/ico/binance-bnb/

IOHK; Cardano. (2018). Academic papers - Cardano. Retrieved June 2, 2020, from https://www.cardano.org/en/academic-papers/

Irrera, A., & Chavez-Dreyfuss, G. (2017). Bitcoin "clone" sees a slow start following split. *The Independent*. Retrieved from https://www.independent.co.uk/news/business/news/bitcoin-cash-latest-news-clone-digital-currency-encrypted-privacy-dark-web-a7872081.html

Juan, N. S. (2020). Tron casino guide – Top 5 Tron gambling sites 2020. *Inside Bitcoins*. Retrieved from https://insidebitcoins.com/tron-casino

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, *47*(2), 263. https://doi.org/10.2307/1914185

Kahneman, D., & Tversky, A. (1984). Choices, values, and frames. *American Psychologist*, *39*(4), 341–350. https://doi.org/10.1037/0003-066X.39.4.341

Kaiser, N., & Pfeifer, H. (2020). Showing up, taking part and driving conversations is vital. *CityAM*. Retrieved from https://www.cityam.com/the-importance-of-showing-up-taking-part-and-driving-conversations/

Kaplanski, G., & Levy, H. (2010). Sentiment and stock prices: The case of aviation disasters. *Journal of Financial Economics*, *95*(2), 174–201. https://doi.org/10.1016/j.jfineco.2009.10.002

Kauflin, J. (2018). Dan Larimer's path from working on weapons to minting crypto riches. *Forbes*. Retrieved from https://www.forbes.com/sites/jeffkauflin/2018/02/07/fintech-crypto-billionaires-dan-larimer/

Kauflin, J. (2020). Question everything. *Forbes*, (March), 40–42.

Kaygin, E., Topcuoglu, E., & Ozkes, S. (2019). Investigating the Bitcoin system and its properties within the scope of business ethics. *Turkish Journal of Business Ethics*, *11*(2), 186–192. https://doi.org/10.12711/tjbe.2018.11.2.0020

Kendall, L. T. (2015). *Academic practices to gain and maintain student-teacher connectedness and classroom behavioral management , related to educator demographics*. *Doctoral*

dissertation. Lindenwood University, MO, USA.

Kharif, O., & Chiglinsky, K. (2019). Chinese crypto pioneer pays $4.57 million for lunch with Warren Buffett. *Bloomberg*. Retrieved from https://www.bloomberg.com/news/articles/2019-06-03/crypto-pioneer-pays-4-57-million-for-lunch-with-warren-buffett

Kiayias, A., Russell, A., David, B., & Oliynykov, R. (2017). Ouroboros: A provably secure Proof-of-Stake Blockchain protocol. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *10401 LNCS*, 357–388. https://doi.org/10.1007/978-3-319-63688-7_12

Kim, H. M., & Laskowski, M. (2018). Toward an ontology-driven Blockchain design for supply-chain provenance. *Intelligent Systems in Accounting, Finance and Management*, *25*(1), 18–27. https://doi.org/10.1002/isaf.1424

King, S., & Nadal, S. (2012). PPCoin: Peer-to-peer crypto-currency with Proof-of-Stake. *URL: Https://Decred.Org/Research/King2012.Pdf*, 1–6. Retrieved from https://decred.org/research/king2012.pdf

Koblitz, N., & Menezes, A. J. (2016). Cryptocash, cryptocurrencies, and cryptocontracts. *Designs, Codes and Cryptography*, *78*(1), 87–102. https://doi.org/10.1007/s10623-015-0148-5

Korajczyk, R. W. (1961). *The human relations approach and its critics*. *Master thesis*. Loyola University Chicago, IL, USA. Retrieved from https://ecommons.luc.edu/luc_theses/1613/

Koteshov, D. (2018). Smart vs. Ricardian contracts: What's the difference? *EliNext*. Retrieved from https://www.elinext.com/industries/financial/trends/smart-vs-ricardian-contracts/

Kraaijeveld, O., & De Smedt, J. (2020). The predictive power of public Twitter sentiment for forecasting cryptocurrency prices. *Journal of International Financial Markets, Institutions and Money*, *65*, 101188. https://doi.org/10.1016/j.intfin.2020.101188

Kugler, L. (2018). Why cryptocurrencies use so much energy and what to do about it. *Communications of the ACM*, *61*(7), 15–17. https://doi.org/10.1145/3213762

Kwon, Y., Kim, H., Shin, J., & Kim, Y. (2019). Bitcoin vs. Bitcoin Cash: Coexistence or downfall of Bitcoin Cash? In *2019 IEEE Symposium on Security and Privacy (SP)* (Vol. 2019-May, pp. 935–951). IEEE. https://doi.org/10.1109/SP.2019.00075

Lacity, M., Sabherwal, R., & Sørensen, C. (2019). Special issue editorial: Delivering business value through enterprise Blockchain applications. *MIS Quarterly Executive*, *18*(4), Article 3. Retrieved from https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1447&context=misqe

Lamport, L., Shostak, R., & Pease, M. (1982). The Byzantine generals problem. *ACM Transactions on Programming Languages and Systems (TOPLAS)*, *4*(3), 382–401. https://doi.org/10.1145/357172.357176

Larimer, D. (2017). DPOS consensus algorithm - The missing White Paper. *URL: Https://Steemit.Com/Dpos/@dantheman/Dpos-Consensus-Algorithm-This-Missing-White-Paper*. Retrieved from https://steemit.com/dpos/@dantheman/dpos-consensus-algorithm-

this-missing-white-paper

Lee, D. K. C., Guo, L., & Wang, Y. (2018). Cryptocurrency: A new investment opportunity? *Journal of Alternative Investments*, *20*(3), 16–40. https://doi.org/10.3905/jai.2018.20.3.016

Leonberger, G., & Feldt, B. Von. (2020). Cryptoassets: A viable asset for pension funds? *Benefits Magazine*, (February), 14–19. Retrieved from https://www.ifebp.org/Resources/magazines/benefits-magazine/Pages/default.aspx

Lilliefors, H. W. (1967). On the Kolmogorov-Smirnov Test for normality with mean and variance unknown. *Journal of American Statistics*, *62*(318), 399–402.

Lin, T. C. W. (2011). A behavioral framework for securities risk. *Seattle University Law Review*, *34*(325), 325–378. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2040946

Linoy, S., Stakhanova, N., & Matyukhina, A. (2019). Exploring Ethereum's Blockchain anonymity using smart contract code attribution. In *2019 15th International Conference on Network and Service Management (CNSM)* (pp. 1–9). IEEE. https://doi.org/10.23919/CNSM46954.2019.9012681

Liu, A. (2013). Ripple, a peer-to-peer financing network, could make Bitcoin great (or destroy it). *Vice - Motherboard*. Retrieved from https://web.archive.org/web/20140207195306/http://motherboard.vice.com/blog/the-ripple-economy-could-make-bitcoin-great

Lloyd, S. P. (2017). Overnight Indexed Swap market-based measures of monetary policy expectations. *Bank of England and University of Cambridge*, 1–39. https://doi.org/https://doi.org/10.17863/CAM.15503

Ma, J. (2019). Roadmap - Definition - Binance Academy. *Binance Academy*. Retrieved from https://academy.binance.com/glossary/roadmap

Madeira, A. (2019). What is a Decentralized Exchange (DEX)? *CryptoCompare*. Retrieved from https://www.cryptocompare.com/exchanges/guides/what-is-a-decentralized-exchange/

Majuri, Y. (2018). Simply explained: Stellar consensus protocol. *Medium*. Retrieved from https://medium.com/london-blockchain-labs/blockchain-definition-of-the-week-stellar-consensus-protocol-5006f42203b0

Mandysová, I. (2019). Classical management biases and behavioral apporach comprehension. *Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration*, *27*(46), 114–123.

Mandysová, I., & Kubanová, J. (2019). Managers' response towards business environment - Behavioral management. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, *67*(5), 1297–1307. https://doi.org/10.11118/actaun201967051297

Manimuthu, A., Raja Sreedharan, V., Rejikumar, G., & Marwaha, D. (2019). A literature review on Bitcoin: Transformation of crypto currency into a global phenomenon. *IEEE Engineering Management Review*, *47*(1), 28–35. https://doi.org/10.1109/EMR.2019.2901431

Mansfield-Devine, S. (2018). Crypto-currencies hit by hacking attacks, theft and fraud. *Network*

Security, *2018*(2), 1–2. https://doi.org/10.1016/S1353-4858(18)30011-4

Marquez, R. (2020). Binance will launch a debit card for Bitcoin and BNB payments. *Crypto News Flash*. Retrieved from https://www.crypto-news-flash.com/binance-will-launch-a-debit-card-for-bitcoin-and-bnb-payments/

Mazières, D. (2016). The Stellar consensus protocol: A federated model for internet-level consensus. *Stellar Development Foundation*, 1–32. Retrieved from https://assets.website-files.com/5deac75ecad2173c2ccccbc7/5df2560fba2fb0526f0ed55f_stellar-consensus-protocol.pdf

McGinnis, J. O., & Roche, K. (2019). Bitcoin: Order without law in the digital age. *Indiana Law Journal*, *94*(4), 1496–1554. https://doi.org/10.2139/ssrn.2929133

McGurk, Z., Nowak, A., & Hall, J. C. (2020). Stock returns and investor sentiment: Textual analysis and social media. *Journal of Economics and Finance*, *44*(3), 458–485. https://doi.org/10.1007/s12197-019-09494-4

McMillan, R. (2013). Ex-Googler gives the world a better Bitcoin. *Wired*. Retrieved from http://www.wired.com/2013/08/litecoin/

Melendez, S. (2014). Could this 20-year-old kid make Bitcoin obsolete? *Fast Company*. Retrieved from https://www.fastcompany.com/3026271/could-this-20-year-old-kid-make-bitcoin-obsolete

Metz, C. (2015). An algorithm to make online currency as trustworthy as cash. *Wired*. Retrieved from https://www.wired.com/2015/04/stanford-prof-builds-algorithm-internet-money/

Michaud, F.-L., & Upper, C. (2008). What drives interbank rates? Evidence from the Libor panel. *BIS Quarterly Review*, (March), 47–58.

Midlarsky, E., Bryan, J. H., & Brickman, P. (1973). Aversive approval: Interactive effects of modeling and reinforcement on altruistic behavior. *Child Development*, *44*(2), 321. https://doi.org/10.2307/1128054

Miller, M. (2014). *The ultimate guide to Bitcoin*. Indianapolis, IN: Que Publishing.

Minor, A. (2020). Cryptocurrency regulations wanted: Iterative, flexible, and pro-competitive preferred. *Boston College Law Review*, *61*(3), 1149–1182. Retrieved from https://lawdigitalcommons.bc.edu/bclr/vol61/iss3/7/

Miwa, K. (2016). Investor sentiment, stock mispricing, and long-term growth expectations. *Research in International Business and Finance*, *36*, 414–423. https://doi.org/10.1016/j.ribaf.2015.10.003

Mohanta, B. K., Sahoo, A., Patel, S., Panda, S. S., Jena, D., & Gountia, D. (2019). DecAuth: Decentralized authentication scheme for IoT device using Ethereum Blockchain. In *TENCON 2019 - 2019 IEEE Region 10 Conference (TENCON)* (Vol. 2019-Octob, pp. 558–563). IEEE. https://doi.org/10.1109/TENCON.2019.8929720

MoneyTimes. (2020). Cardano dá detalhes sobre atualização Shelley e recompensas de tokens ADA. *Money Times*. Retrieved from https://www.moneytimes.com.br/fast/cardano-da-detalhes-sobre-atualizacao-shelley-e-recompensas-de-tokens-ada/

Moore, J. (2018). What is Tron? Cryptocurrency's budding founder Justin Sun wants to change the internet. *Newsweek.* Retrieved from https://www.newsweek.com/what-tron-cryptocurrencys-budding-founder-justin-sun-wants-change-internet-786035

Mselmi, A. (2020). Blockchain technology and systemic risk. *International Journal of Economics and Financial Issues*, *10*(2), 53–60. https://doi.org/10.32479/ijefi.9069

Murray, C. J., & Nelson, C. R. (2000). The uncertain trend in U.S. GDP. *Journal of Monetary Economics*, *46*(1), 79–95. https://doi.org/10.1016/S0304-3932(00)00018-0

Nair, D. A. (2019). The Bitcoin innovation, crypto currencies and the Leviathan. *Innovation and Development*, *9*(1), 85–103. https://doi.org/10.1080/2157930X.2018.1502249

Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. *White Paper*, 1–9. Retrieved from https://bitcoin.org/bitcoin.pdf

Namouri, H., Jawadi, F., Ftiti, Z., & Hachicha, N. (2018). Threshold effect in the relationship between investor sentiment and stock market returns: A PSTR specification. *Applied Economics*, *50*(5), 559–573. https://doi.org/10.1080/00036846.2017.1335387

Nikolaev, K. (2019). Is Ripple decentralized or not? Blockchain expert ends the debate. *CCN*. Retrieved from https://www.ccn.com/ripple-decentralized-or-not/

Nizamuddin, N., Salah, K., Ajmal Azad, M., Arshad, J., & Rehman, M. H. (2019). Decentralized document version control using Ethereum Blockchain and IPFS. *Computers & Electrical Engineering*, *76*, 183–197. https://doi.org/10.1016/j.compeleceng.2019.03.014

Nobel Media AB. (2002). The Sveriges Riksbank prize in economic sciences in memory of Alfred Nobel 2002. *Nobelprize.Org*. Retrieved from http://nobelprize.org/nobel_prizes/economics/laureates/2002/index.html

Nobel Media AB. (2013). The prize in economic sciences 2013 - Press release. *Nobelprize.Org*. Retrieved from http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2013/press.html

Notland, J. S. (2019). Smart contract history and law. *Medium*. Retrieved from https://medium.com/@jrgensvenneviknotland/smart-contract-history-and-law-9b2f3331d1a

Olszewicz, J. (2020). Cardano price analysis - Shelley mainnet release scheduled for later this year. *Brave New Coin*. Retrieved from https://bravenewcoin.com/insights/cardano-price-analysis-shelley-mainnet-release-scheduled-for-later-this-year

Osterrieder, J., Strika, M., & Lorenz, J. (2017). Bitcoin and cryptocurrencies—Not for the faint-hearted. *International Finance and Banking*, *4*(1), 56–94. https://doi.org/10.5296/ifb.v4i1.10451

Pacheco, A. V. (2018). *Bitcoin*. (Editora Self, Ed.), *Editora Self* (2018th ed.). Lisboa: Editora Self.

Pãnescu, A. T., & Manta, V. (2018). Smart contracts for research data rights management over the Ethereum Blockchain network. *Science and Technology Libraries*, *37*(3), 235–245. https://doi.org/10.1080/0194262X.2018.1474838

Parashar, N., & Rasiwala, F. (2019). Bitcoin – Asset or currency? User's perspective about. *IUP Journal of Management Research*, *XVIII*(1), 102–123.

Parhizgari, A., & Nguyen, D. (2011). M1, M2, and the US equity exchanges. *Frontiers in Finance and Economics*, *8*(2), 112–135. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2012500

Park, C. H., Mejia Barlongo, I., & Kim, Y. (2019). A market place solution for energy transaction on Ethereum Blockchain. In *2019 IEEE 10th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON)* (pp. 1–5). IEEE. https://doi.org/10.1109/IEMCON.2019.8936157

Park, H., & Sohn, W. (2013). Behavioral finance: A survey of the literature and recent development. *Seoul Journal of Business*, *19*(1), 3–42.

Pasztor, J. (2018). Bitcoin investing — An ethical and regulatory quandary. *Society of Financial Service Professionals*, *72*(2), 30–33.

Peck, M. (2016). The uncanny mind that built Ethereum. *Wired*. Retrieved from https://www.wired.com/2016/06/the-uncanny-mind-that-built-ethereum/

Peck, M. E. (2013). Ripple credit system could help or harm Bitcoin. *IEEE Spectrum*. Retrieved from https://spectrum.ieee.org/telecom/internet/ripple-credit-system-could-help-or-harm-bitcoin

Perron, P., & Wada, T. (2009). Let's take a break: Trends and cycles in US real GDP. *Journal of Monetary Economics*, *56*(6), 749–765. https://doi.org/10.1016/j.jmoneco.2009.08.001

Phillips, R. (2018). Emurgo VC in search for blockchain start-ups from emerging economies. *Busiweek.Com*. Retrieved from https://www.busiweek.com/emurgo-vc-in-search-for-blockchain-start-ups-from-emerging-economies/

Platt, H. D. (1987). Determinants of executive compensation: The neoclassical model versus concept formation. *Journal of Economic Psychology*, *8*(2), 255–272. https://doi.org/10.1016/0167-4870(87)90023-7

Polasik, M., Piotrowska, A. I., Wisniewski, T. P., Kotkowski, R., & Lightfoot, G. (2015). Price fluctuations and the use of bitcoin: An empirical inquiry. *International Journal of Electronic Commerce*, *20*(1), 9–49. https://doi.org/10.1080/10864415.2016.1061413

Prewett, K., Dorsey, R. W., & Kumar, G. (2019). A primer on taxation of investment in cryptocurrencies. *Journal of Taxation of Investments*, *36*(4), 3–16. Retrieved from https://www.ccn.com/bitcoin-in-2019-analysts-

Ramiah, V., Xu, X., & Moosa, I. A. (2015). Neoclassical finance, behavioral finance and noise traders: A review and assessment of the literature. *International Review of Financial Analysis*, *41*, 89–100. https://doi.org/10.1016/j.irfa.2015.05.021

Rathan, K., Sai, S. V., & Manikanta, T. S. (2019). Crypto-currency price prediction using decision tree and regression techniques. In *2019 3rd International Conference on Trends in Electronics and Informatics (ICOEI)* (Vol. 2019-April, pp. 190–194). IEEE. https://doi.org/10.1109/ICOEI.2019.8862585

Reiff, N. (2020). Bitcoin vs. Bitcoin Cash: What is the difference? *Investopedia*. Retrieved from https://www.investopedia.com/tech/bitcoin-vs-bitcoin-cash-whats-difference/

Rikken, O., Janssen, M., & Kwee, Z. (2019). Governance challenges of Blockchain and decentralized autonomous organizations. *Information Polity*, *24*(4), 397–417. https://doi.org/10.3233/IP-190154

Ritala, P., Huotari, P., Bocken, N., Albareda, L., & Puumalainen, K. (2018). Sustainable business model adoption among S&P 500 firms: A longitudinal content analysis study. *Journal of Cleaner Production*, *170*, 216–226. https://doi.org/10.1016/j.jclepro.2017.09.159

Roman, K. (2018). Understanding EOS and Delegated-Proof-of-Stake. *Steemit*. Retrieved from https://steemit.com/eos/@eosgo/understanding-eos-and-delegated-proof-of-stake

Rosic, A. (2018). What is Ethereum GAS? [The most comprehensive step-by-step guide ever!]. *Blockgeeks*. Retrieved from https://blockgeeks.com/guides/ethereum-gas/

Royston, J. P. (1982). An extension of Shapiro and Wilk's W Test for normality to large samples. *Applied Statistics*, *31*(2), 115. https://doi.org/10.2307/2347973

Ruoti, S., Kaiser, B., Yerukhimovich, A., Clark, J., & Cunningham, R. (2019). Blockchain technology. *Communications of the ACM*, *63*(1), 46–53. https://doi.org/10.1145/3369752

Ruslina, E. (2019). Legal protection for Bitcoin users in e-commerce transactions. *Journal of Internet Law*, *23*(4), 3–6. Retrieved from http://eds.a.ebscohost.com/eds/pdfviewer/pdfviewer?vid=0&sid=d0c9d817-785c-4b32-b351-76ce80a1587f%40sdc-v-sessmgr03

Russell, J. (2017). Litecoin founder Charlie Lee has sold all of his LTC. *TechCrunch*. Retrieved from https://techcrunch.com/2017/12/20/litecoin-charlie-lee-conflict-of-interest/?guccounter=1&guce_referrer=aHR0cHM6Ly9lbi53aWtpcGVkaWEub3JnLw&guce_referrer_sig=AQAAAH8Ql295wPLJTSzYbi1Fn4NONJpojRufArsRHkXPgiGKNxXBZBRLNvBfOjJjGcswuf4iu3aLdnr3mWN81AtyycxGL03oj9

Ryabova, T. S., & Henderson, S. (2019). Integrating cryptocurrency into intermediate financial accounting curriculum: A case study. *Journal of Accounting and Finance*, *19*(6), 167–180. https://doi.org/10.33423/jaf.v19i6.2322

Sachau, D. A. (2007). Resurrecting the motivation-hygiene theory: Herzberg and the positive psychology movement. *Human Resource Development Review*, *6*(4), 377–393. https://doi.org/10.1177/1534484307307546

Saculinggan, M., & Balase, E. A. (2013). Empirical power comparison of goodness of fit tests for normality in the presence of outliers. *Journal of Physics: Conference Series*, *435*(1), 012041. https://doi.org/10.1088/1742-6596/435/1/012041

Salhin, A., Sherif, M., & Jones, E. (2016). Managerial sentiment, consumer confidence and sector returns. *International Review of Financial Analysis*, *47*, 24–38. https://doi.org/10.1016/j.irfa.2016.06.009

Sathyanarayana, S., & Gargesa, S. (2019). Modeling cryptocurrency (Bitcoin) using vector autoregressive (Var) model. *SDMIMD Journal of Management*, *10*(2), 47–64.

https://doi.org/10.18311/sdmimd/2019/23181

Schmeiss, J., Hoelzle, K., & Tech, R. P. G. (2019). Designing governance mechanisms in platform ecosystems: Addressing the paradox of openness through Blockchain technology. *California Management Review*, *62*(1), 121–143. https://doi.org/10.1177/0008125619883618

Schulpen, R. (2018). *Smart contracts in the Netherlands*. *Master thesis*. Tilburg University, Netherlands.

Schumaker, R. P., Zhang, Y., Huang, C. N., & Chen, H. (2012). Evaluating sentiment in financial news articles. *Decision Support Systems*, *53*(3), 458–464. https://doi.org/10.1016/j.dss.2012.03.001

Schwartz, D., Youngs, N., & Britto, A. (2014). The Ripple protocol consensus algorithm. *Ripple Labs Inc White Paper*, 1–8. Retrieved from http://www.naation.com/ripple-consensus-whitepaper.pdf

Senner, R., & Sornette, D. (2019). The holy grail of crypto currencies: Ready to replace fiat money? *Journal of Economic Issues*, *53*(4), 966–1000. https://doi.org/10.1080/00213624.2019.1664235

Seth, S. (2019). What is Tron? *Investopedia*. Retrieved from https://www.investopedia.com/tech/what-tron-trx/

Setti, S., Wanto, A., Syafiq, M., Andriano, A., & Sihotang, B. K. (2019). Analysis of backpropagation algorithms in predicting world internet users. *Journal of Physics: Conference Series*, *1255*(1). https://doi.org/10.1088/1742-6596/1255/1/012018

Shefrin, H. (2002). Behavioral decision making, forecasting, game theory, and role-play. *International Journal of Forecasting*, *18*(3), 375–382. https://doi.org/10.1016/S0169-2070(02)00021-3

Shen, P., & Starr, R. M. (1998). Liquidity of the treasury bill market and the term structure of interest rates. *Journal of Economics and Business*, *50*(5), 401–417. https://doi.org/10.1016/s0148-6195(98)00012-5

Shiller, R. J. (1980). *Do stock prices move too much to be justified by subsequent changes in dividends? Cambridge university Press* (Vol. 53). Cambridge, MA. https://doi.org/10.3386/w0456

Shiller, R. J. (1999). Chapter 20 Human behavior and the efficiency of the financial system. In *Handbook of Macroeconomics* (Vol. 1, pp. 1305–1340). https://doi.org/10.1016/S1574-0048(99)10033-8

Shiller, R. J. (2003). From efficient markets theory to behavioral finance. *Journal of Economic Perspectives*, *17*(1), 83–104. https://doi.org/10.1257/089533003321164967

Sifat, I. M., Mohamad, A., & Mohamed Shariff, M. S. Bin. (2019). Lead-Lag relationship between Bitcoin and Ethereum: Evidence from hourly and daily data. *Research in International Business and Finance*, *50*(June), 306–321. https://doi.org/10.1016/j.ribaf.2019.06.012

Simmons, J. (2020a). Cardano: Emurgo enters into strategic partnership with Uzbek government. *Crypto News Flash*. Retrieved from https://www.crypto-news-flash.com/cardano-emurgo-enters-into-strategic-partnership-with-uzbek-government/

Simmons, J. (2020b). Cardano: Friends & family testnet successfully launched. *Crypto News Flash*. Retrieved from https://www.crypto-news-flash.com/cardano-friends-family-testnet-successfully-launched/

Simpson, A. (2013). Does investor sentiment affect earnings management? *Journal of Business Finance and Accounting*, *40*(7–8), 869–900. https://doi.org/10.1111/jbfa.12038

SingularDTV. (2017). What's the difference between an "ICO" and a "Token Launch"? *Medium*. Retrieved from https://medium.com/@SingularDTV/whats-the-difference-between-an-ico-and-a-token-launch-d892d4d689a4

Skalex. (2018). What the hell is Ripple? The ultimate beginner's guide. Retrieved May 23, 2020, from https://www.skalex.io/what-is-ripple/

Small, S. (2015). Bitcoin: The Napster of currency. *Houston Journal of International Law*, *37*(2), 581–641. Retrieved from http://www.hjil.org/articles/hjil-37-2-small.pdf

Smith, C., & Kumar, A. (2018). Crypto-currencies - An introduction to not-so-funny moneys. *Journal of Economic Surveys*, *32*(5), 1531–1559. https://doi.org/10.1111/joes.12289

Smith, D. J. (2013). Valuing interest rate swaps using overnight indexed swap (OIS) discounting. *Journal of Derivatives*, *20*(4), 49–59. https://doi.org/10.3905/jod.2013.20.4.049

Smith, O. (2018). Bitcoin price rival: Cryptocurrency "faster than Bitcoin" will challenge market leaders. *Express*. Retrieved from https://www.express.co.uk/finance/city/907536/cryptocurrency-bitcoin-market-leader-cash-ripple-ethereum

Snyder, B. (2017). Meet Vitalik Buterin, the founder of Bitcoin rival Ethereum. *CNBC*. Retrieved from https://www.cnbc.com/2017/06/22/meet-vitalik-buterin-the-founder-of-bitcoin-rival-ethereum.html

Soares, C., & Rodrigues, P. M. M. (2013). Determinants of the EONIA spread and the financial crisis. *Manchester School*, *81*(SUPPL3), 82–110. https://doi.org/10.1111/manc.12010

Somin, S., Gordon, G., Pentland, A., Shmueli, E., & Altshuler, Y. (2020). ERC20 Transactions over Ethereum Blockchain: Network analysis and predictions. *ArXiv ID: 2004.08201*, 1–12. Retrieved from http://arxiv.org/abs/2004.08201

Spithoven, A. (2019). Theory and reality of cryptocurrency governance. *Journal of Economic Issues*, *53*(2), 385–393. https://doi.org/10.1080/00213624.2019.1594518

Stellar. (2014a). About SDF - Stellar. *Stellar Development Foundation*. Retrieved from https://www.stellar.org/foundation

Stellar. (2014b). FAQ - Stellar. Retrieved May 30, 2020, from https://www.stellar.org/community/faq

Stellar. (2016). Stellar consensus protocol - Stellar developers. Retrieved May 30, 2020, from

https://www.stellar.org/developers/guides/concepts/scp.html

Story, H. (2001). Douglas McGregor, Revisited: Managing the human side of the enterprise. *Quality Management Journal*, *8*(4), 75–76. https://doi.org/10.1080/10686967.2001.11918990

Strawn, G. (2019). Blockchain. *IT Professional*, *21*(1), 91–92. https://doi.org/10.1109/MITP.2018.2879244

Sukharev, P. V. (2020). Hardware overclocking to improve the efficiency of Ethereum cryptocurrency mining. In *2020 IEEE Conference of Russian Young Researchers in Electrical and Electronic Engineering (EIConRus)* (pp. 1873–1877). IEEE. https://doi.org/10.1109/EIConRus49466.2020.9039491

Sun, J. (2017). TRON - Decentralize the web. *TRON*. Retrieved from https://tron.network/

Sun Yin, H. H., Langenheldt, K., Harlev, M., Mukkamala, R. R., & Vatrapu, R. (2019). Regulating cryptocurrencies: A supervised machine learning approach to de-anonymizing the Bitcoin Blockchain. *Journal of Management Information Systems*, *36*(1), 37–73. https://doi.org/10.1080/07421222.2018.1550550

Szabo, N. (1997). The idea of Smart Contracts. Retrieved May 21, 2020, from http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/idea.html

Tetu, J.-F., Trudeau, L.-C., Van Beirendonck, M., Balatsoukas-Stimming, A., & Giard, P. (2020). A standalone FPGA-Based miner for Lyra2REv2 cryptocurrencies. *IEEE Transactions on Circuits and Systems I: Regular Papers*, *67*(4), 1194–1206. https://doi.org/10.1109/TCSI.2020.2970923

Thakor, A. V. (2020). Fintech and banking: What do we know? *Journal of Financial Intermediation*, *41*(July), 100833. https://doi.org/10.1016/j.jfi.2019.100833

Thaler, R. H. (1980). Toward a positive theory of consumer choice. *Journal of Economic Behavior & Organization*, *1*(1), 39–60. https://doi.org/10.1016/0167-2681(80)90051-7

Thaler, R. H. (2016). Behavioral economics: Past, present, and future. *American Economic Review*, *106*(7), 1577–1600. https://doi.org/10.1257/aer.106.7.1577

Thaler, R. H. (2017). Richard H. Thaler: Integrating economics with psychology. *Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2017*, 1–39. Retrieved from https://www.nobelprize.org/prizes/economic-sciences/2017/advanced-information/

Tikhomirov, S., Voskresenskaya, E., Ivanitskiy, I., Takhaviev, R., Marchenko, E., & Alexandrov, Y. (2018). SmartCheck: Static analysis of Ethereum smart contracts. In *Proceedings of the 1st International Workshop on Emerging Trends in Software Engineering for Blockchain - WETSEB '18* (pp. 9–16). New York, New York, USA: ACM Press. https://doi.org/10.1145/3194113.3194115

Tomer, J. F. (2007). What is behavioral economics? *Journal of Socio-Economics*, *36*(3), 463–479. https://doi.org/10.1016/j.socec.2006.12.007

TRON. (2017). TRON - Decentralize the web - About. Retrieved June 1, 2020, from https://tron.network/about?lng=en

TRON. (2018). TRON - Advanced decentralized Blockchain platform - Whitepaper version: 2.0. *TRON Foundation*, 1–40. Retrieved from https://tron.network/static/doc/white_paper_v_2_0.pdf

TRON Foundation. (2018). Guide to independence: TRX token migration. *Medium*. Retrieved from https://medium.com/tron-foundation/guide-to-independence-trx-token-migration-269302b6655c

TrustNodes. (2017). Cardano eyes Ethereum smart contracts, grabs half a billion market cap. Retrieved June 2, 2020, from https://www.trustnodes.com/2017/10/02/cardano-eyes-ethereum-smart-contracts-grabs-half-billion-market-cap

Tu, Z., & Xue, C. (2019). Effect of bifurcation on the interaction between Bitcoin and Litecoin. *Finance Research Letters*, *31*(December 2018), 382–385. https://doi.org/10.1016/j.frl.2018.12.010

Turing, A. M. (1937). On computable numbers, with an application to the Entscheidungsproblem. *Proceedings of the London Mathematical Society*, *s2-42*(1), 230–265. https://doi.org/10.1112/plms/s2-42.1.230

Tversky, A., & Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty*, *5*(4), 297–323. https://doi.org/10.1007/BF00122574

Van Fleet, D. D. (1973). The need-hierarchy and theories of authority. *Human Relations*, *26*(5), 567–580. https://doi.org/10.1177/001872677302600502

Victor, F., & Lüders, B. K. (2019). Measuring Ethereum-based ERC20 token networks. In I. Goldberg & T. Moore (Eds.), *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)* (Vol. 11598 LNCS, pp. 113–129). Springer International Publishing. https://doi.org/10.1007/978-3-030-32101-7_8

Vold, F. (2019). SWIFT's moves and EU banks target ripple business. *Crypto News*. Retrieved from https://cryptonews.com/news/swift-s-moves-and-eu-banks-target-ripple-business-4128.htm

Waldo, J. (2019). A hitchhiker's guide to the Blockchain universe. *Communications of the ACM*, *62*(3), 38–42. https://doi.org/10.1145/3303868

Wallsten, S. (2003). Regulation and internet use in developing countries. *The World Bank - Development Research Group - Investment Climate*, (March), 1–18.

Wang, Haizhen, Chatpatanasiri, R., & Sattayatham, P. (2017). Stock trading using PE Ratio: A dynamic Bayesian network modeling on behavioral finance and fundamental investment, 1–34. Retrieved from http://arxiv.org/abs/1706.02985

Wang, Haizhong, Yuan, H., Li, X., & Li, H. (2019). The impact of psychological identification with home-name stocks on investor behavior: An empirical and experimental investigation.

Journal of the Academy of Marketing Science, *47*(6), 1109–1130. https://doi.org/10.1007/s11747-019-00677-3

Wellman, B., & Chen, W. (2004). The global digital divide – Within and between countries. *IT & Society*, *1*(7), 18–25. Retrieved from http://scholar.googleusercontent.com/scholar?q=cache:S4jAhm9hfqUJ:scholar.google.com/&hl=en&as_sdt=0,23

Williams, S. (2018). Ripple's biggest competitor isn't Ethereum -- It's this. *The Motley Fool*. Retrieved from https://www.fool.com/investing/2018/03/29/ripples-biggest-competitor-isnt-ethereum-its-this.aspx

Wilmoth, J. (2018a). TRON's Whitepaper appears to plagiarize from Filecoin and IFPS. *CCN*. Retrieved from https://www.ccn.com/trons-whitepaper-appears-plagiarize-filecoin-ifps/

Wilmoth, J. (2018b). Vitalik Buterin continues to troll Tron over Whitepaper plagiarism allegations. *CCN*. Retrieved from https://www.ccn.com/vitalik-buterin-continues-to-troll-tron-over-whitepaper-plagiarism-allegations/

Wood, G. (2014). Ethereum: A secure decentralised generalised transaction ledger. *Ethereum Project Yellow Paper*, 1–32.

Xu, L., Chen, L., Gao, Z., Carranco, L., Fan, X., Shah, N., … Shi, W. (2020). Supporting Blockchain-Based cryptocurrency mobile payment with smart devices. *IEEE Consumer Electronics Magazine*, *9*(2), 26–33. https://doi.org/10.1109/MCE.2019.2953734

Yi, S., Xu, Z., & Wang, G.-J. (2018). Volatility connectedness in the cryptocurrency market: Is Bitcoin a dominant cryptocurrency? *International Review of Financial Analysis*, *60*, 98–114. https://doi.org/10.1016/j.irfa.2018.08.012

Zaremba, A., Szyszka, A., Long, H., & Zawadka, D. (2020). Business sentiment and the cross-section of global equity returns. *Pacific-Basin Finance Journal*, *61*(March), 101329. https://doi.org/10.1016/j.pacfin.2020.101329

Zhang, C. (2008). *Defining, modeling, and measuring investor sentiment*. *U.C. Berkeley Honors Thesis*. University of California, Berkeley, CA, USA.

Zhang, X., Fuehres, H., & Gloor, P. A. (2011). Predicting stock market indicators through Twitter "I hope it is not as bad as I fear." *Procedia - Social and Behavioral Sciences*, *26*(2007), 55–62. https://doi.org/10.1016/j.sbspro.2011.10.562

Zhang, Z., Yin, J., Liu, Y., & Liu, J. (2020). Deanonymization of Litecoin through transaction-linkage attacks. In *2020 11th International Conference on Information and Communication Systems (ICICS)* (pp. 059–065). IEEE. https://doi.org/10.1109/ICICS49469.2020.239510

Zimmermann, P. (1995). *The official PGP user's guide*. Cambridge, MA: MIT Press.

ZionCoins. (2015). Lite Coin White Paper. *White Paper*, 1–4. Retrieved from http://zioncoins.co.uk/wp-content/uploads/2015/06/Lite-Coin-Whitepaper.pdf

Zouaoui, M., Nouyrigat, G., & Beer, F. (2011). How does investor sentiment affect stock market crises? Evidence from panel data. *Financial Review*, *46*(4), 723–747. https://doi.org/10.1111/j.1540-6288.2011.00318.x

7 Glossary

ADA – Please refer to the word "Cardano" in this Glossary for further explanation.

Altcoin – Altcoins are the other cryptocurrencies launched after the success of Bitcoin. The term "altcoins" refers to all cryptocurrencies other than or alternative to Bitcoin (Lee et al., 2018).

Behavioral Economics – Behavioral economics studies in general the effects of psychological, cognitive, emotional and cultural/ social background of people and how that affects or not their decision making (Lin, 2011). The models used are normally integrated with insights from psychology, neuroscience and microeconomic theory (Filbeck et al., 2017; Thaler, 2017; Haizhong Wang et al., 2019).

Binance Coin (BNB) – Binance Coin, was released in 2017, by one of the world's largest virtual currency exchanges (Binance, 2017), after a successful ICO (Initial Coin Offering – the equivalent of an IPO in the stock market (Ben & Xiaoqiong, 2019). BNB (Binance Coin) was first issued as an ERC-20 (Somin et al., 2020; Victor & Lüders, 2019), which is the Ethereum token, inside the Ethereum platform, which became a popular method for raising money for ICOs. BNB uses are mainly focused on the Binance Exchange (https://www.binance.com/) ecosystem, such as allowing the users to receive discounts when paying for their trading fees, it can also be used to pay for travel expenses and to shop online for example. In addition to that, users can also make donations to charity thought the BCF (Binance Charity Foundation) (Binance, 2018a).

Bitcoin (BTC) – Bitcoin is the world's first crypto-currency, invented in 2008 (Nakamoto, 2008). Bitcoin appeared in the middle of a world financial crisis and brought hope for a new reform of the financial world. Bitcoin brought the BlockChain Technology, brought a new way of doing payments, a new way of storing money and even a new way of creating money with its natural inflation model (mining), printed within its *script* (Pacheco, 2018).

Bitcoin Cash (BCH) – The first Bitcoin FORK happened in 1st of August of 2017. The result of this fork was the creation of Bitcoin Cash, based on Bitcoin, but making a new currency: Bitcoin Cash (Irrera & Chavez-Dreyfuss, 2017; McGinnis & Roche, 2019; Spithoven, 2019; Tu & Xue, 2019). This "new" Bitcoin was not received with open harms, since that Bitcoin Cash advocates

defend that it is a better version, but (original) Bitcoin enthusiasts say that they are the ones with the best version and that no updates are necessary for Bitcoin (Clifford, 2018; C. Smith & Kumar, 2018).

Bitcoin SV (Satoshi Vision) (BSV) – Bitcoin SV or Bitcoin Satoshi Vision is another Bitcoin fork. It was named Satoshi Vision because the creators believe that this Bitcoin (version) remains true or it is the only (version) that follows best the original paper about Bitcoin by Satoshi Nakamoto. Just like Bitcoin Cash, the white paper used for this coin (Bitcoin SV) is the original paper published by Satoshi Nakamoto in 2008.

Block – Blocks are pieces of data that miners mine inside the Blockchain, of in this case a coin's blockchain. Mining is the computation of complex algorithmic problems by computer hardware (ASIC, GPU and/ or CPU) (Reiff, 2020; O. Smith, 2018).

Blockchain – Blockchain Technology, brought a new way of doing payments/ financial transactions (Pacheco, 2018). All transactions are public, and stored in the Blockchain but the issuer and the target are not public. Bitcoin & BlockChain technology uses the hashing algorithm SHA-256 for its cryptography, and to keep its users anonymous, with the help of a Private and Public Key system (Bhat & Vijayal, 2017; Chase & MacBrough, 2018; Dickson, 2019; Foley et al., 2019; Hammi et al., 2018; Hayes, 2019; Hughes et al., 2019; Kaygin et al., 2019; Koblitz & Menezes, 2016; Linoy et al., 2019; Minor, 2020; Mohanta et al., 2019; Nair, 2019; Nakamoto, 2008; Nizamuddin et al., 2019; Ruslina, 2019; Small, 2015; Sun Yin et al., 2019; Waldo, 2019; Xu et al., 2020; Z. Zhang et al., 2020).

Cardano (Cardano/ Cardano Coin) (ADA) – Cardano is a decentralized platform that was created in 2017 by IOHK (Blockchain Development Output Hong Kong) (Allison, 2018; Kiayias et al., 2017), with a team headed by Charles Hoskinson (one of the former co-founders of Ethereum) (Damiani, 2017; TrustNodes, 2017) with aim in smart contracts, decentralized APPs and metadata. Inside this platform there is its own crypto currency, ADA or Cardano Coin, (Downs, 2018) which similarly to Binance Coin or TRON can be bought through crypto exchanges such as Binance or Bittrex (Castor, 2017b). The coins then need to be stores on its own particular wallet, called the Daedalus wallet (Simmons, 2020b). This platform works with an PoS (Proof-of-Stake) algorithm called Ouroboros (Allison, 2018; Cardano, 2020a; Castor, 2017a; Fairley, 2019; Kiayias

et al., 2017), and its white paper was written by academics and it is one of the few in the crypto community to be *peer-reviewed* (Cardano, 2020b; Downs, 2018; IOHK; Cardano, 2018).

Consensus Agreement/ Protocol – Stellar (XLM) is not mineable, and does not use PoW, instead it uses a SCP (Stellar Consensus Protocol), which is the first implementation of the FBA (Federal Byzantine Agreement) (Lamport et al., 1982; Mazières, 2016), which is a consensus agreement, providing this way a new direction for distributed networks to reach consensus (Majuri, 2018; Metz, 2015).

Crypto-Currency – All crypto-currencies are virtual currencies but not all virtual-currencies are crypto-currencies (Eken & Baloglu, 2017; Glaser et al., 2014). Crypto-currencies are different when compared to virtual money. Because virtual money does not need to be mined, crypto-currencies (normally) do. Virtual money does not need to be anonymous, crypto-currencies (normally) are. The concept of mining was created because, when Bitcoin was invented by Satoshi Nakamoto (Nakamoto, 2008), the fact that it is and was a currency not regulated (DESCENTRALIZED) (Parashar & Rasiwala, 2019) by any central bank/ governmental authority, the need of having something to control transactions was necessary, thus (bitcoin) mining was invented. There is a network around the world of miners called "nodes". These nodes help to verify Bitcoin transactions using the Proof of Work Concept (Bhat & Vijayal, 2017; Bouri, Jalkh, et al., 2017; Bridle, 2019; Caginalp & Caginalp, 2018; Chan et al., 2017; Chapron, 2017; Corbet, Lucey, et al., 2018; Cvetkova, 2018; Hammi et al., 2018; Kaygin et al., 2019; Koblitz & Menezes, 2016; Kugler, 2018; Lacity et al., 2019; Leonberger & Feldt, 2020; Manimuthu et al., 2019; McGinnis & Roche, 2019; Minor, 2020; Nair, 2019; Parashar & Rasiwala, 2019; Ryabova & Henderson, 2019; Sathyanarayana & Gargesa, 2019; C. Smith & Kumar, 2018; Spithoven, 2019; Strawn, 2019; Thakor, 2020).

Cryptography – Cryptography is a computer algorithm that enables secure payments and avoids slow and costly intermediaries. In our case Bitcoin & BlockChain technology uses the hashing algorithm SHA-256 for its cryptography, and to keep its users anonymous, with the help of a Private and Public Key system (Koblitz & Menezes, 2016; Manimuthu et al., 2019; McGinnis & Roche, 2019).

Decentralized APP (DAPP) – Ethereum and EOS have their own DAPP (Decentralized APP) which is a development platform/ studio inside their decentralized environment (either Ethereum's or EOS's environment/ platform). This platform works as a (decentralized) studio/ platform for the users to create new (decentralized) applications inside the decentralized space that Ethereum and EOS provide. With an environment constantly in development so it can be the most user-friendly as possible and with the most features as possible (Blockgeeks, 2019; Falk, 2019).

Decentralized Exchange (DEX) – "A decentralized exchange is an exchange market that does not rely on a third-party service to hold the customer's funds. Instead, trades occur directly between users (peer-to-peer) through an automated process." (Madeira, 2019, para. 8).

Decentralized Platform – An example of a Decentralized Platform is Cardano, which was created in 2017 by IOHK (Blockchain Development Output Hong Kong) (Allison, 2018; Kiayias et al., 2017), with a team headed by Charles Hoskinson (one of the former co-founders of Ethereum) (Damiani, 2017; TrustNodes, 2017) with aim in Smart Contracts, Decentralized APPs (DAPPs) and metadata. Inside this platform there is its own crypto currency, ADA or Cardano Coin, (Downs, 2018) which similarly to Binance Coin or TRON can be bought through crypto exchanges such as Binance or Bittrex (Castor, 2017b). The coins then need to be stores on its own particular wallet, called the Daedalus wallet (Simmons, 2020b).

Decentralized Protocol – TRON, founded in 2017 by the Chinese entrepreneur Justin Sun is an example of a Decentralized Protocol with its own crypto-currency, TRX (Moore, 2018; TRON, 2018). The purpose of this (decentralized) protocol is a global free digital entertainment ecosystem, where the creators have the power and control of their own creations and can interact directly with their own consumers (Seth, 2019; Sun, 2017).

Delegated Proof-of-Stake (DPOS/ DPoS) – EOS was introduced to the world only in 2017, but its creator also brought to the table a big novelty, that was DPOS (Delegated Proof-Of-Stake) (Larimer, 2017). There are right now 3 important models: POW (Proof-of-Work), POS (Proof-of-Stake) and DPOS (Delegated Proof-of-Stake). Pow is what Bitcoin, Ethereum and what almost every crypto-currency uses. PoS was invented by Sunny King and Scoot Nadal in 2012, which the main objective is to make crypto-currency mining more "green" and "fair" (King & Nadal, 2012). After that in 2017 Daniel Larimer presented to the world a new concept and idea, the DPOS, which

brings even more "fairness" to the crypto world: "Delegated Proof-of-Stake and Proof-of-Stake are two different animals; in a POS system, every wallet that contains coins is able to participate in process of validating transactions and forming consensus, thus the more coins in your wallet, the more coins you will eventually receive. With DPOS system every wallet that contains coins is able to vote for representatives. These representatives validate transactions and form consensus, and are paid for their efforts through the system. This avoids a pitfall of POS, which is that, just like in POW, consolidation will eventually occur." (Roman, 2018, para. 7).

Digital/ Virtual Money – All crypto-currencies are virtual currencies but not all virtual-currencies are crypto-currencies (Eken & Baloglu, 2017; Glaser et al., 2014). The first virtual-currency was E-Gold, created in 1996 by Douglas Jackson. This virtual currency was 100% pegged to gold (E-Gold, 1998b, 1998a, 1998c). After E-Gold, another currency called Beenz appeared focusing more on the virtual part of online shopping and the concept of internet money (Beenz, 2001). Eventually they both failed, same as other coins that appeared in the early 1990's and 2000's but all paved the way and opened the appetite for a better and improved currency, which was later known as Bitcoin (Miller, 2014). Nowadays when we talk about virtual money, that same money is not associated with gold nor to a bank account as it was in the E-Gold era for example. Nowadays it might be associated with games. The online game community is now huge and because of that it is normal to trade our fiat money for any type of "game coins" that can then be used to trade for something online (Eken & Baloglu, 2017). Crypto-currencies are different. Virtual money does not need to be mined, crypto-currencies (normally) do. Virtual money does not need to be anonymous, crypto-currencies (normally) are.

Efficient Market Hypothesis – Efficient Market Hypothesis supposes that investors and traders with the right kind of information and skill will end up making the right investment decisions, but recent evidence shows that this is not always the case. Differences in human behavior, such as overconfidence exist, and play a big role (Shiller, 1999).

EONIA – EONIA (Euro Overnight Index Average), which is computed as a weighted average of all overnight unsecured lending transactions in the interbank (internal bank) market, done in the European Union (Beirne, 2012; Hassler & Nautz, 2008; Soares & Rodrigues, 2013). These rates are calculated by the ECB (European Central Bank), where the data for these same rates can be obtained (ECB Databases). EONIA is being replaced by €STR, but since we needed data starting

from 2013 and €STR was only available since 2019, the idea of using and keeping EONIA as the Overnight Rate for Euro was made, in regard to this specific study.

EOS – EOS.IO (protocol) or simply EOS (cryptocurrency) (Grigg, 2017) was developed by the private company block.one (Kauflin, 2020) mainly by Daniel Larimer and Brendan Blumer (Fakhfekh & Jeribi, 2020; Kauflin, 2018) who with the help of some other people inside the crypto-currencies community created EOS.IO (EOS.IO, 2018). EOS was introduced to the world only in 2017, but its creator also brought to the table a big novelty, that was DPOS (Delegated Proof-Of-Stake) (Larimer, 2017).

ERC-20 – ERC-20 is the Ethereum token, inside the Ethereum platform, which became a popular method for raising money for ICOs (Binance, 2018a; Somin et al., 2020; Victor & Lüders, 2019).

Ethereum (ETH) – Vitaly Dmitriyevich "Vitalik" Buterin, a Russian-Canadian computer scientist born in 1994, in 2009 wrote the white paper that changed the crypto-space forever (Brownell, 2017; Buterin, 2020b, 2020a; Melendez, 2014; M. Peck, 2016; Snyder, 2017). Inspired by Satoshi Nakamoto he created Ethereum (Buterin, 2014). Ethereum is different from all the coins prior, Ethereum enhanced the crypto-space giving this way the possibility to developers all over the world to work on enhancements for the coin, also providing the possibility to create programs in the "Ethereum platform" (https://studio.ethereum.org/) (Harm et al., 2016; Wood, 2014). Vitalik wrote about Bitcoin limitations, such as the fact that Bitcoin Lacked a Turing-completeness (Turing, 1937), which was a big limitation and was necessary to be corrected/ improved to then give the user the possibility to write smart contracts "where they can create their own arbitrary rules for ownership, transaction formats and state transition functions" (Buterin, 2014, p. 13).

Fiat Money – "The processing and accounting of money – fiat money, created by decree rather than having inherent value – is essentially the manipulation of symbols. Money, then, is a belief system backed by state infrastructure which, for a long time, assured centralized power." (Bridle, 2019, p. 34).

Fork – As an example, the first Bitcoin FORK happened in 1st of August of 2017. The result of this fork was the creation of Bitcoin Cash, based on Bitcoin, but making a new currency: Bitcoin Cash (Irrera & Chavez-Dreyfuss, 2017; McGinnis & Roche, 2019; Spithoven, 2019; Tu & Xue, 2019). In the crypto-currency world a fork can be one of two types, a soft fork or an hard fork. A

soft fork means that the software is backward compatible and a hard fork means that the new version of the software is NOT backwards compatible (Agrawal, 2019).

Framing – Framing is the way that you view the world, which essentially means that you react differently to information based on whether it is presented to you in a positive or negative way. The way you see things, directly impacts the decisions that you make. We often talk about seeing circumstances as a glass half full or half empty. Seeing reality as a "glass half full" means you are viewing reality from an optimistic frame. Seeing reality as a "glass half empty" means you are viewing reality from a negative frame (Kahneman & Tversky, 1984; Shefrin, 2002; Shiller, 1999; Thaler, 2017).

GAS – GAS is a unit of measurement used in the Ethereum system to account for computational power and its rewards inside the system (Rosic, 2018). After GAS is received this can be then traded to ETH. GAS price fluctuates with the need of computation power, the more power is needed, the price of GAS goes up, or if there is a lot of computer power available and not so much demand, the GAS value decreases (Bhat & Vijayal, 2017; Buterin, 2014; Chen et al., 2019; Dagher et al., 2018; Grech et al., 2018; Hammi et al., 2018; Harm et al., 2016; Pãnescu & Manta, 2018; C. H. Park et al., 2019; Tikhomirov et al., 2018; Wood, 2014).

Heuristics – A heuristic, or a heuristic technique, is when you use a simpler approach or practical approach to try solving a problem. Normally not in the best way possible but in a sufficient way of obtaining the best answers possible given normally a limited timeframe and/ or deadline presented (Cheah & Fry, 2015; Costa et al., 2019; Filbeck et al., 2017; Thaler, 2016).

ICO – ICOs (Initial Coin Offerings) are for crypto currencies the equivalent of what IPOs (Initial Public Offerings) are for traditional companies going into the stock market. ICOs appeared so that more investment could be made and with that to give the possibility for new coins/ companies in the crypto world to emerge. ICOs have been responsible for a big number of funding's of normally tech startups that use blockchain based business models. The way that an ICO works shows a more liquid and efficient way to access capital in comparison to fiat money, by allowing peer-to-peer transactions and avoiding the intermediation banks. This could be seen as a great opportunity for SMEs (Small and Medium Enterprises) to access capital faster (Ben & Xiaoqiong, 2019; Giudici et al., 2020).

Investor Sentiment – "Investor or market sentiment is defined in the financial literature as the prevailing attitude or feeling in the market as revealed by movements of stock prices." (Salhin et al., 2016, p. 24). Investor sentiment has to do with prices and to do with the market. Similarly to behavioral finance, investor sentiment or market sentiment is about attitudes and the mood of the investor towards the markets. This then leads to actions and the action leads to a result (Dowling & Lucey, 2004; Hribar & Quinn, 2013). Evidence shows that the higher the investor sentiment, most of the times, higher the results, and the lower the investment sentiment the lower the results (Hribar & McInnis, 2012; Simpson, 2013). These results are heavily tied to the psyche of the investor and to their mood when investing (Baker & Wurgler, 2007; Edmans, García, & Norli, 2007; Miwa, 2016).

LIBOR – Libor or London Inter-bank Offered Rate is an interest-rate average calculated from estimates submitted by the leading banks in London (Abrantes-Metz et al., 2012; Andersen & Andreasen, 2000; Björk & Björk, 2005; Eisl et al., 2017; Michaud & Upper, 2008).

Litecoin (LTC) – LiteCoin was created by Charlie Lee in 2011 (McMillan, 2013; Russell, 2017). If BTC would be compared to Gold, the commodity, then LTC would be Silver. Litecoin uses script algorithm, not SHA-256. This way Bitcoin needs an ASIC (Application-Specific Integrated Circuit) machine so that the mining can be done whereas Litecoin mining can be done via GPU (Graphics Processing Unit) which is a normal graphics card used in any home computer. These are the main differences regarding Bitcoin and Litecoin (Bouri, Jalkh, et al., 2017; Kugler, 2018; Sukharev, 2020; Tetu et al., 2020; Tu & Xue, 2019). Unfortunately Litecoin does not have an official White Paper (type of document used by the crypto-currency community to explain and present the functioning of each now coin that appears of the market) (Graham, 2014) but a similar document written by members of the crypto-currency community can be found online: http://zioncoins.co.uk/wp-content/uploads/2015/06/Lite-Coin-Whitepaper.pdf (ZionCoins, 2015). Bitcoin is considered a "mother-coin" or main coin. Sometimes Litecoin and/or Ethereum are also called "main-coins", but in the majority of the times are called "alt-coins"[1] (alt = alternative) because they came after Bitcoin (Foley et al., 2019; Sifat et al., 2019). Litecoin introduced script mining and a lot of code changes in relation to BTC (Bitcoin), too.

M1 – M1 and M2, money measurement indicators (Haug & Tam, 2007; Hsiao, 1981; Parhizgari & Nguyen, 2011). M1 includes all the forms of liquid money such as cash, M2 includes M1 and

extra less liquid forms of money such as savings accounts, certificates of deposits and money market mutual funds.

M2 – Please refer to the word "M1" in this Glossary for further explanation.

Main Coin – Bitcoin is considered a "Mother-Coin" or "Main Coin". Sometimes Litecoin and/or Ethereum are also called "main-coins", but in the majority of the times are called "alt-coins"[1] (alt = alternative) because they came after Bitcoin (Foley et al., 2019; Sifat et al., 2019). The terms "main-coin", "mother-coin" and/ or "alt-coin" where created online by the crypto-currency community and it is a way to identify these different types of coins. "Main" or "Mother" is because BTC (and LTC) were the first crypto-currencies to exist and ETH because it started a new trend too with Smart Contracts and the implementation of new technology into the crypto space.

Market Capitalization – Market capitalization refers to how much a company is worth as determined by the stock market. It is defined as the total market value of all outstanding shares. If we want to calculate a company's market cap, we need to multiply the number of outstanding shares by the current market value of one share and that's it (Abrantes-Metz et al., 2012; Chan et al., 2017; Fairley, 2019; McGinnis & Roche, 2019).

Market Inefficiencies – The three themes that normally prevail in behavioral economics are Heuristics, Framing (of the events) and Market inefficiencies, which include misunderstanding prices of goods or services and/ or non-rational decisions towards buying/ consuming something (Shefrin, 2002). Professor Shiller studied investors and stock traders and what motivates them to trade and/ or invest. In 2003, Shiller wrote a paper entitled "From Efficient Markets Theory to Behavioral Finance" where the author describes how the "efficient market theory" or the rational and supposedly precise financial models start to show flaws under certain circumstances. This circumstances show and/ or turn into market inefficiencies where investors can find extra volatility not intended in the first place, creating this way, ways to earn or lose more money than what was intended by the trader/ investor (Shiller, 1980, 2003).

Mining – The concept of mining was created because, when Bitcoin was invented by Satoshi Nakamoto (Nakamoto, 2008), the fact that it is and was a currency not regulated (DESCENTRALIZED) (Parashar & Rasiwala, 2019) by any central bank/ governmental authority, the need of having something to control transactions was necessary, thus (bitcoin) mining was

invented. There is a network around the world of miners called "nodes". These nodes help to verify Bitcoin transactions using the Proof of Work Concept (Bhat & Vijayal, 2017; Bouri, Jalkh, et al., 2017; Bridle, 2019; Caginalp & Caginalp, 2018; Chan et al., 2017; Chapron, 2017; Corbet, Lucey, et al., 2018; Cvetkova, 2018; Hammi et al., 2018; Kaygin et al., 2019; Koblitz & Menezes, 2016; Kugler, 2018; Lacity et al., 2019; Leonberger & Feldt, 2020; Manimuthu et al., 2019; McGinnis & Roche, 2019; Minor, 2020; Nair, 2019; Parashar & Rasiwala, 2019; Ryabova & Henderson, 2019; Sathyanarayana & Gargesa, 2019; C. Smith & Kumar, 2018; Spithoven, 2019; Strawn, 2019; Thakor, 2020).

Ouroboros – Please refer to the word "Cardano" in this Glossary for further explanation.

Overnight Index Swap (OIS) & LIBOR-OIS – LIBOR-OIS, which is the calculated difference between the LIBOR (in this case USD based LIBOR) and an OIS (Overnight Index Swap) (Douglas & Pugachevsky, 2013; Hull & White, 2013; Lloyd, 2017; D. J. Smith, 2013). In this study, the OIS was calculated from taking the Federal Funds Rate (the equivalent of EONIA in the US), doing then a geometric average for quarters, transforming the data this way in an OIS, by taking in consideration its capitalization during time and then with the LIBOR (USD) data transformed from daily values to quarters using in this case an arithmetic average. Then, the calculation of subtracting the OIS values from the main LIBOR values was done. The LIBOR-OIS spread is considered to be a measure of health of the banking system and it is an important measure of risk and liquidity in the markets.

Plutus – Cardano's team is developing a new programing language to use on their smart contracts (on the CCL - Cardano Computation Layer) called Plutus (Olszewicz, 2020). But if the user wants to use Solidity (the language behind Ethereum smart contracts) this one can also be used for Cardano's smart contracts (Buchko, 2018).

Proof-of-Stake (POS/ PoS) – Please refer to the word/ expression "Delegated Proof-of-Stake (DPOS/ DPoS)" in this Glossary for further explanation.

Proof-of-Work (POW/ PoW) – Please refer to the word/ expression "Delegated Proof-of-Stake (DPOS/ DPoS)" in this Glossary for further explanation.

Prospect Theory – Prospect Theory is one of the first economic theories built using experimental methods. It shows how individuals behave themselves in the face of loss and/ or gain and how they

act upon that. This theory can also be applied to predict certain behaviors and/ or decisions. It also develops on concepts such as loss or risk aversion, expectations and even over confidence effects that can happen after certain decisions and/ or behaviors (Kahneman & Tversky, 1979, 1984; Shiller, 1999). After some time, a new theory was developed, named Cumulative Prospect Theory, or just CPT, which is an improvement on top of the main Prospect Theory. Here Daniel Kahneman and Amos Tversky added weighting to the cumulative probability distribution function, but not applied to the probabilities of individual outcomes. Just like in rank-dependent expected utility theory, here cumulative probabilities are transformed, instead of the probabilities themselves. With this change the violation of the first order stochastic dominance is avoided and makes the generalization to an arbitrary outcome distributions easier (Tversky & Kahneman, 1992). In 2002, Daniel Kahneman, was awarded the Nobel Prize in Economic Sciences for his contributions to the world of behavioral economics, in which the development of CPT (Cumulative Prospect Theory) played a big part (Nobel Media AB, 2002).

Random Walks Theory – "A market where successive price changes in individual securities are independent is, by definition, a random walk market. Most simply the theory of random walks implies that a series of stock price changes has no memory-the past history of the series cannot be used to predict the future in any meaningful way. The future path of the price level of a security is no more predictable than the path of a series of cumulated random numbers." (Fama, 1965, p. 56).

Ricardian Contract – Another thing that EOS brought to the table is *Ricardian Contracts*. Created by Ian Grigg, Ricardian Contracts are similar to the smart contracts of Ethereum, but significantly improved, with extra characteristics and , most importantly, extra layers of security (Grigg, 2004; Koteshov, 2018), using PGP (Pretty Good Privacy) for signing and to encrypt data, which is the most secure protocol in the world to sign documents on the web safely (Zimmermann, 1995).

Ripple (XRP) – XRP or Ripple (Schwartz et al., 2014) was released in 2012 by Jed McCaleb, together with Arthur Britto, David Schwartz, latter with Chris Larsen, Jessie Powell and later the "superstar" Ryan Fugger (Andrews, 2013; Ben & Xiaoqiong, 2019; Binance, 2018b; Chan et al., 2017; Liu, 2013; M. E. Peck, 2013; Skalex, 2018). Ripple is now famous because of its protocol that banks like to use. RTXP (Ripple Transaction Protocol) is a cross-border network that can be used for currency transfers. It is stable, scalable, fast and low cost and the banks love it (Bhatia et al., 2018; BlackwellGlobal, 2018; Kauflin, 2020; Prewett et al., 2019; C. Smith & Kumar, 2018;

Yi et al., 2018)! Ripple is also very criticized inside the crypto-currency community because it has a centralized system, with pre-mined coins. This means that this currency does not rely on miners for the wellbeing and decentralization of this coin. All these processes are made by the Ripple Labs Inc. in the headquarters of the company (Kugler, 2018; Nikolaev, 2019).

Ripplepay – Ryan Fugger, who in 2005 launched Ripplepay, which was described as "a financial service that allows you to extend credit lines to your friends, family, and associates and make secure payments in traditional and online currencies" (Coinmonks, 2018, para. 9), was in its essence the beginning and core of what Ripple is today (Andrews, 2013; Ben & Xiaoqiong, 2019; Binance, 2018b; Chan et al., 2017; Liu, 2013; M. E. Peck, 2013; Skalex, 2018).

Script – A computer script is a list of commands/ actions executed by a certain program/ machine. Scripts can be written in several different types of languages depending on the action necessary and the machine used for the action. Normally a script is used to automate or to create a function/ action inside the software/ machine desired. For example Bitcoin is known to be very limited, because its limited scripting language enables little beyond financial transactions, while Ethereum because of its completeness allows much more than financial transactions, bringing a totally new platform for software engineers to create their own DAPPs and bringing also the novelty of the smart contracts (Buterin, 2014; Cvetkova, 2018; Grech et al., 2018; Ruoti et al., 2019; Schulpen, 2018).

Sentiment – Please refer to the words "Investor Sentiment" in this Glossary for further explanation.

Smart Contract – Vitalik (Ethereum's creator) wrote about Bitcoin limitations, such as the fact that Bitcoin Lacked a Turing-completeness (Turing, 1937), which was a big limitation and was necessary to be corrected/ improved to then give the user the possibility to write smart contracts "where they can create their own arbitrary rules for ownership, transaction formats and state transition functions" (Buterin, 2014, p. 13). The idea of smart contracts were first proposed in the 90's by a man called Nick Szabo (Szabo, 1997), a computer scientist, legal scholar and cryptographer, but only nowadays with blockchain and Ethereum the idea is being implemented and used, both in the private user spectrum but also at an enterprise level (Chapron, 2017; Cvetkova, 2018; Drożdż et al., 2019; Fang et al., 2020; Griggs et al., 2018; Harm et al., 2016; Hegedűs, 2019; Hlaing & Nyaung, 2019; Kauflin, 2020; Linoy et al., 2019; Mselmi, 2020;

Nizamuddin et al., 2019; Notland, 2019; Pãnescu & Manta, 2018; C. H. Park et al., 2019; Rikken et al., 2019; Ruoti et al., 2019; Schmeiss et al., 2019; Schulpen, 2018; Spithoven, 2019; Strawn, 2019; Thakor, 2020; Tikhomirov et al., 2018; Waldo, 2019; Wood, 2014).

Stellar (Stellar Coin/ Stellar Lumens) (XLM) – Some say that Stellar was actually a fork of the Ripple protocol, and that after that it was created a completely new version, with new code. But some say that Stellar started from scratch, without any forking or inspiration taken from the Ripple protocol (BitDegree, 2019b). But anyway, Stellar is a decentralized protocol made to facilitate money transactions around the world (Fakhfekh & Jeribi, 2020; Mazières, 2016; Stellar, 2014a). Inside its platform, very similarly to what happens with Ripple, the Stellar exchange also run their own crypto-currency, named Stellar Lumens or for short XLM (Guia Do Bitcoin, 2018). XLM is not mineable, and does not use PoW, instead it uses a SCP (Stellar Consensus Protocol), which is the first implementation of the FBA (Federal Byzantine Agreement) (Lamport et al., 1982; Mazières, 2016), which is a consensus agreement, providing this way a new direction for distributed networks to reach consensus (Majuri, 2018; Metz, 2015). "SCP simultaneously enjoys four key properties: decentralized control, low latency, flexible trust, and asymptotic security." (Stellar, 2016, para. 1).

Token – With TOKENS, the buyer has certain privileges such as the right to use certain services or products of the issuer or to share sometimes profits, in which this case tokens resemble much of the times equity. The difference of a crypto and a token is that a token has a kind of liability or commitment behind, which then determines its value, weather a crypto currency is seen as an investment in a coin, such as FOREX, but also a lot of times associated to a commodity (such as comparing Bitcoin to Gold) (Giudici et al., 2020). An ICO is normally seen as a "Token sale" but a "Token sale" could be more than just an ICO. An ICO is a "launch" or "release" of a new coin into the market. The appeal of the ICO is the "pre-sale" so that when the coin is released the buyer can earn money on that same asset by selling the coin or keeping it for extra valuation growth with time. A Token sale, normally associated with Ethereum is more complex, because a Token can be programable, which means that a lot of different type(s) of information can be offered with a Token. Tokens are generated through a smart contract and simply transcend in terms of complexity the release of the new coin (Cvetkova, 2018; Hayes, 2019; Kim & Laskowski, 2018; McGurk et al.,

2020; SingularDTV, 2017; Somin et al., 2020; Wood, 2014). "A "Token Launch" is an Ethereum thing. An "ICO" is a bitcoin/altcoin thing." (SingularDTV, 2017, para. 2).

TRON (TRX) – TRON was founded in 2017 by the Chinese entrepreneur Justin Sun. TRON is a decentralized protocol with its own crypto-currency, TRX (Moore, 2018; TRON, 2018). The purpose of this (decentralized) protocol is a global free digital entertainment ecosystem, where the creators have the power and control of their own creations and can interact directly with their own consumers (Seth, 2019; Sun, 2017). TRX, TRON's coin can be used for several purposes like to pay for content inside TRON's network or to pay for the variety of blockchain services that TRON network offers too (Seth, 2019). Because TRON is a game and entertainment network and community, the company has now an immense number of casino-like games on their platform, from dice games to poker, sports betting etc., and the search for more games (casino related or not) is growing, making TRON also a growing platform inside the online gaming community. TRON wants to be seen as the future of the gaming market, focusing themselves on developing as much support as possible to game developers (BoVegas, 2019; Crypto Gambling News, 2020; De Castro, 2019; Juan, 2020).

Virtual Currency – Please refer to the words "Digital/ Virtual Money" in this Glossary for further explanation.

Wallet – A wallet is a software program that allows each user to store crypto-currency. A user must have his/ her own wallet to take part in any crypto-currency transaction. Wallets will contain a public key that is used to receive funds (Manimuthu et al., 2019; Polasik et al., 2015; Ruslina, 2019).

Whale – A Whale is considered a big investor that has control of a big part of the market in question (Bouri, Gupta, & Roubaud, 2019).

XLM – Please refer to the word "Stellar" in this Glossary for further explanation.

XRP – Please refer to the word "Ripple" in this Glossary for further explanation.

8 Annexes

Data Figures:

Figure 3 – Bitcoin – Stock Market (Open tickets) (Fig. 3A) & Market Cap data in Quarters (Fig. 3B) (Source: Own elaboration).

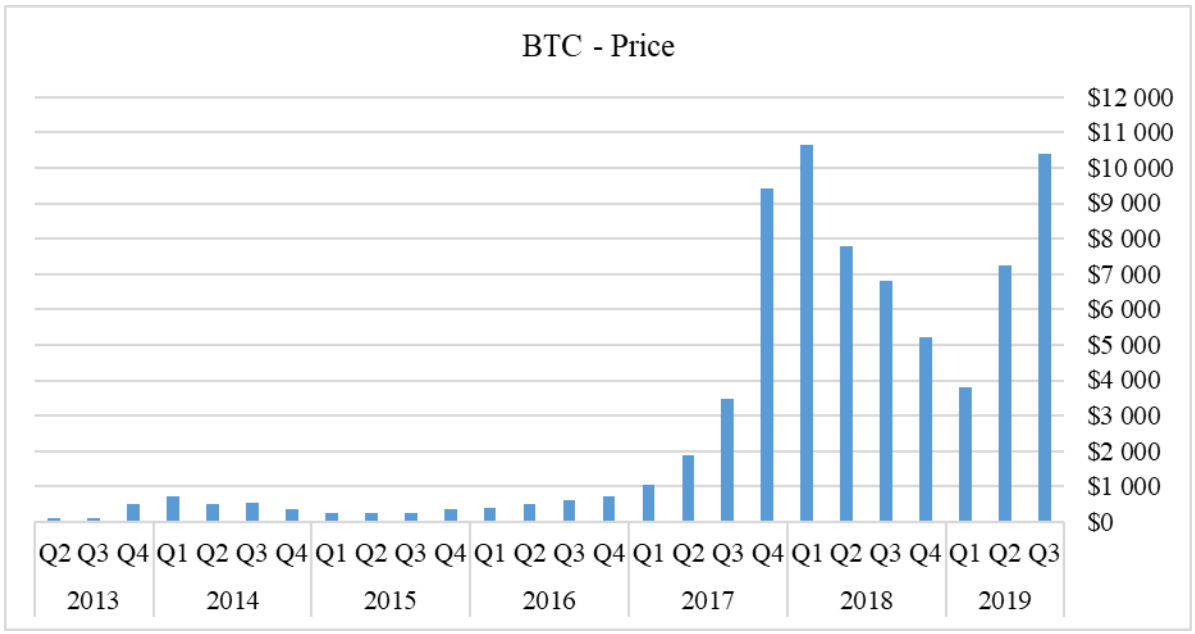


Fig. 3A

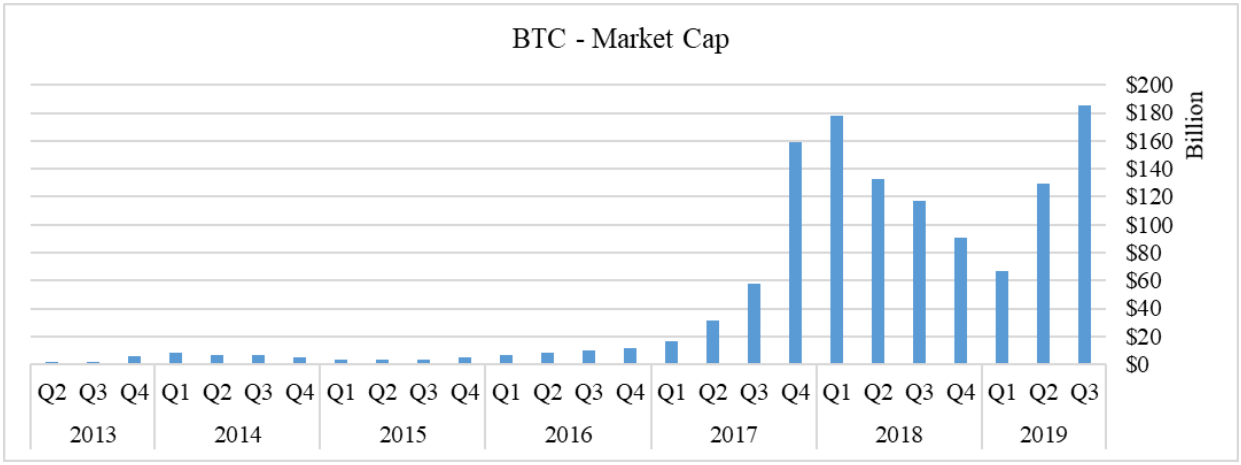


Fig. 3B

Figure 4 – Ethereum – Stock Market (Open tickets) (Fig. 4A) & Market Cap data in Quarters (Fig. 4B) (Source: Own elaboration).

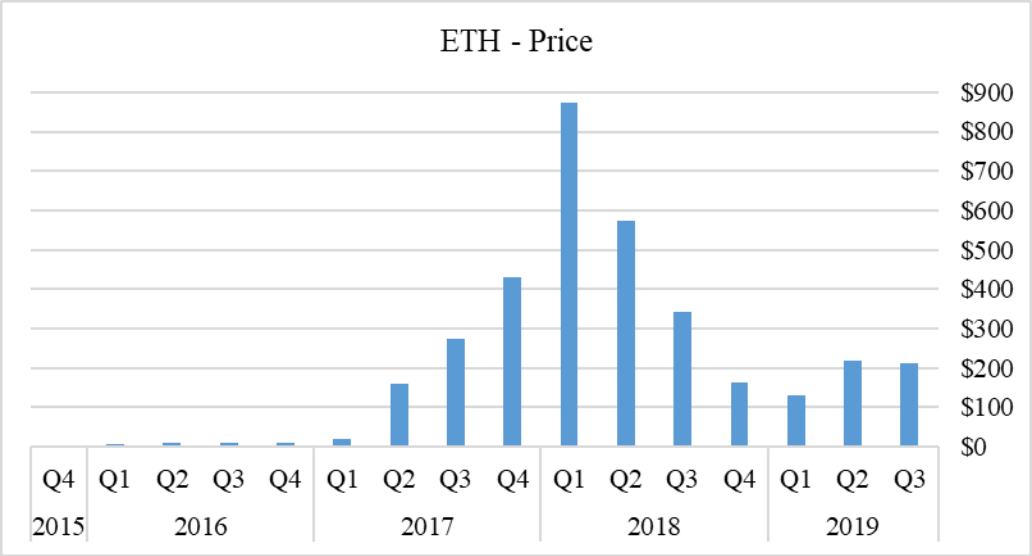


Fig. 4A

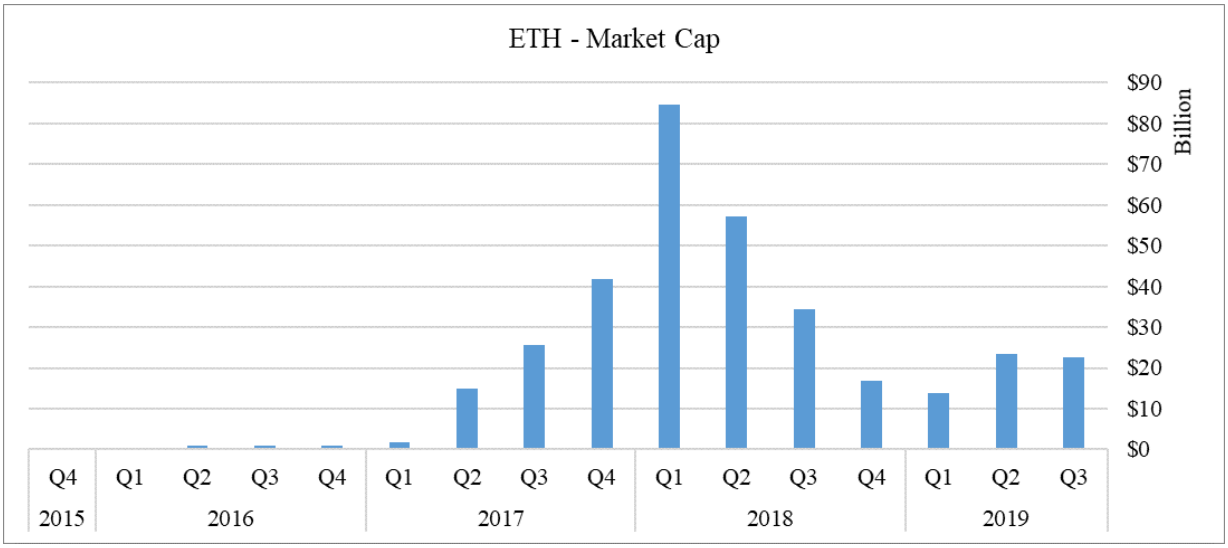


Fig. 4B

Figure 5 – XRP – Stock Market (Open tickets) (Fig. 5A) & Market Cap data in Quarters (Fig. 5B) (Source: Own elaboration).

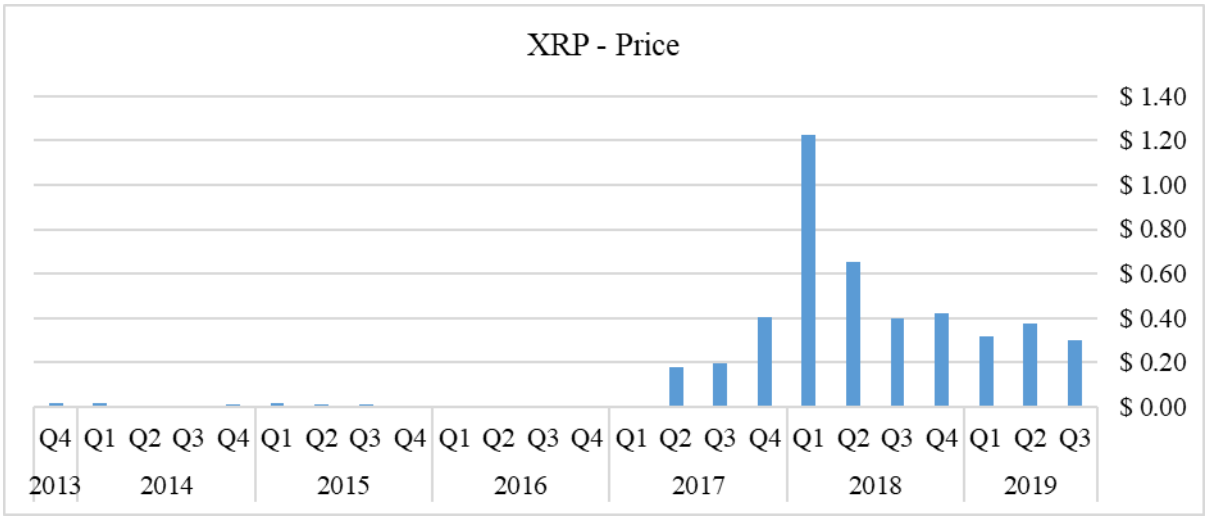


Fig. 5A

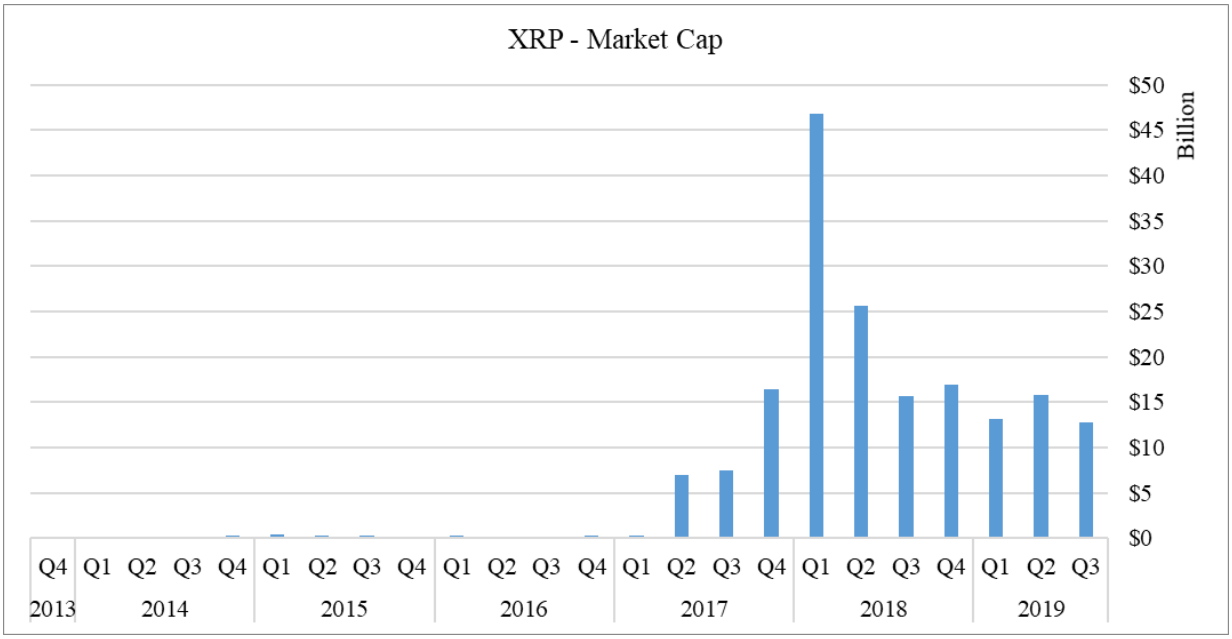


Fig. 5B

Figure 6 – Bitcoin Cash – Stock Market (Open tickets) (Fig. 6A) & Market Cap data in Quarters (Fig. 6B) (Source: Own elaboration).

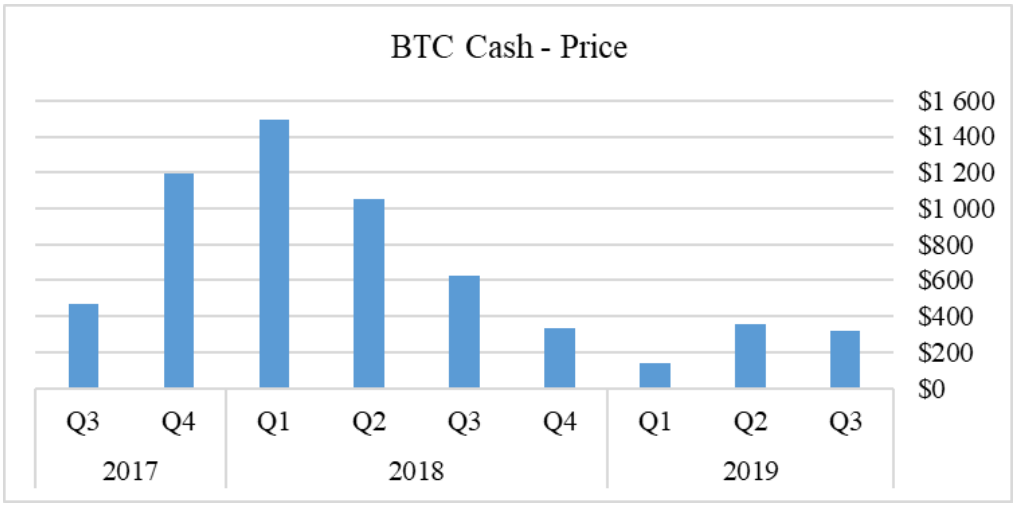


Fig. 6A

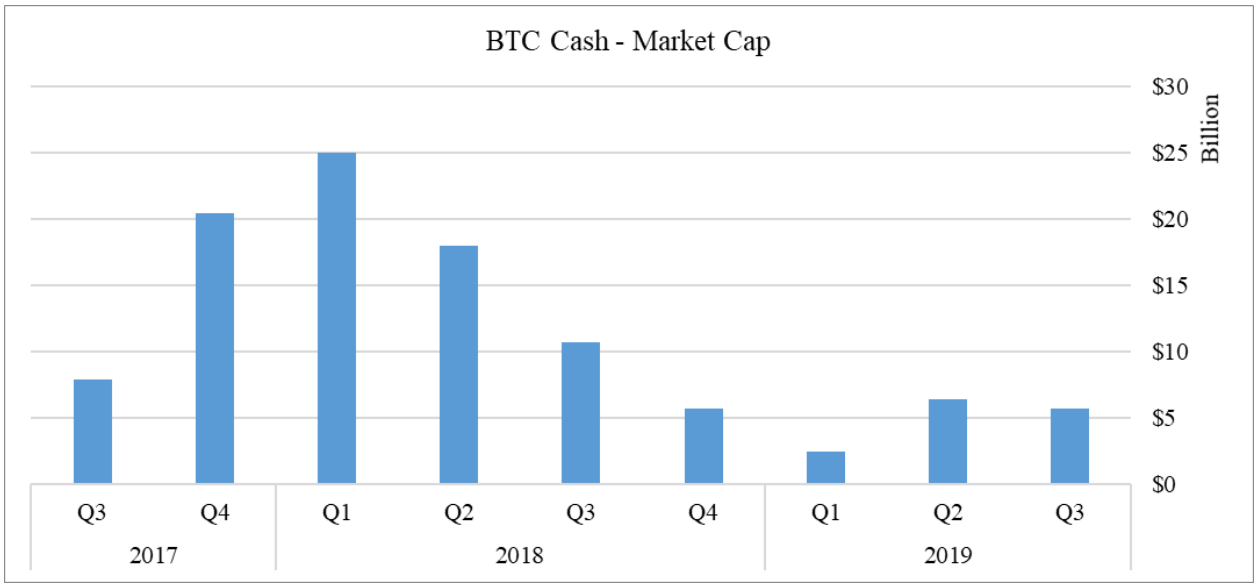


Fig. 6B

Figure 7 – Litecoin – Stock Market (Open tickets) (Fig. 7A) & Market Cap data in Quarters (Fig. 7B) (Source: Own elaboration).

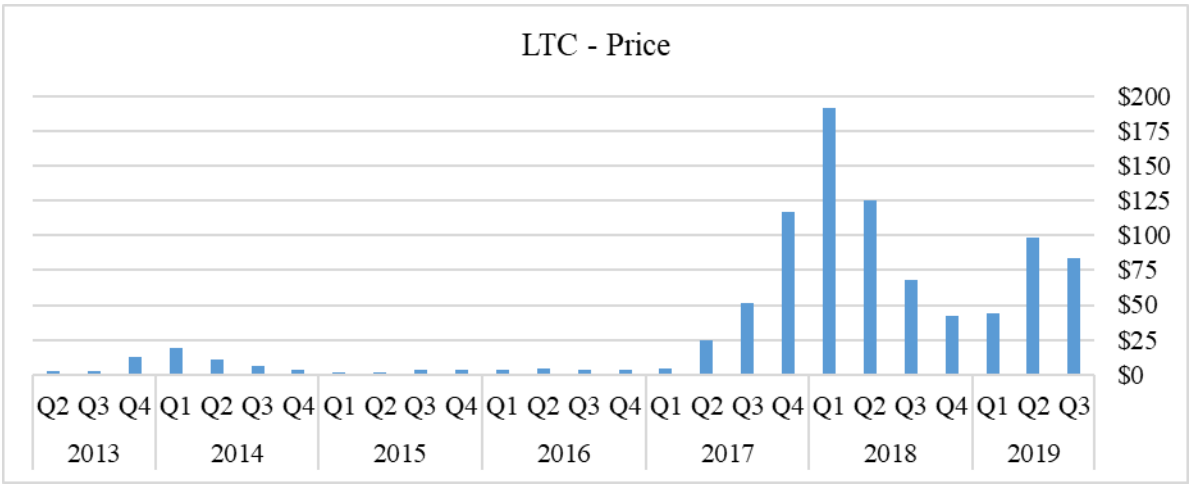


Fig. 7A

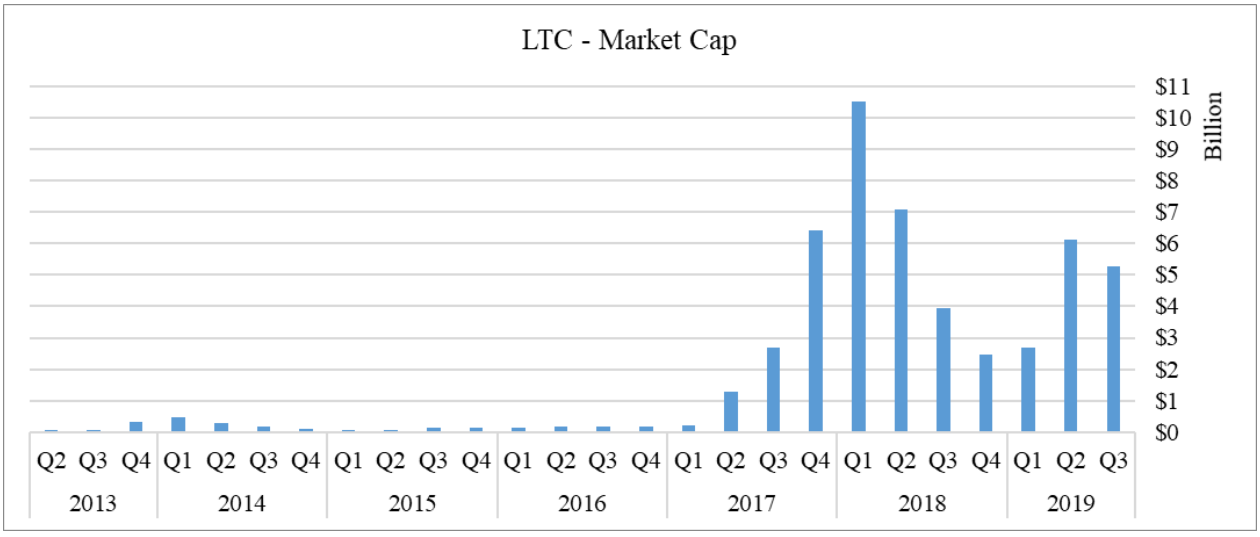


Fig. 7B

Figure 8 – EOS – Stock Market (Open tickets) (Fig. 8A) & Market Cap data in Quarters (Fig. 8B) (Source: Own elaboration).

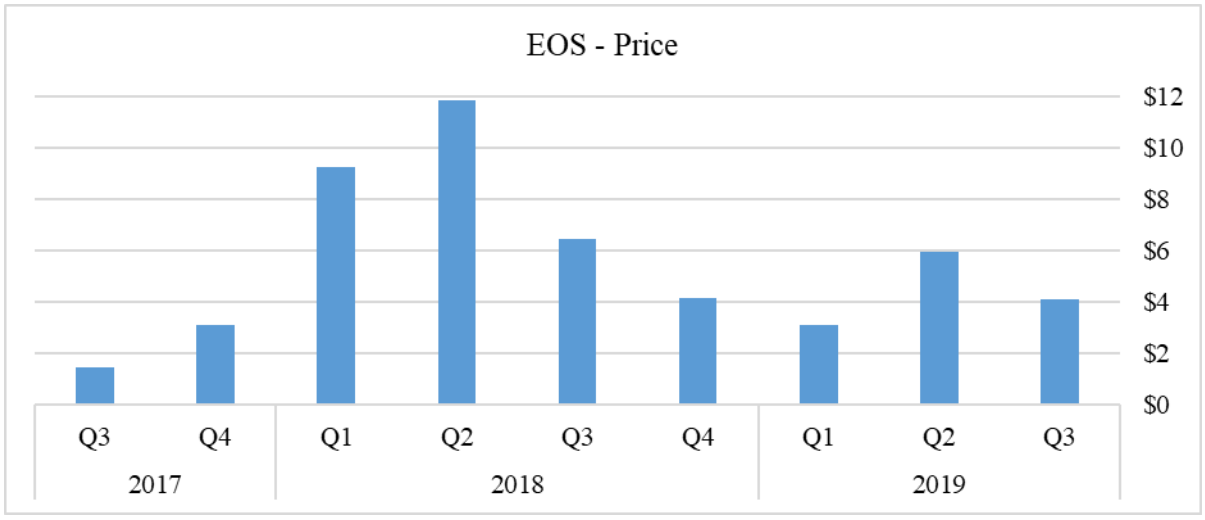


Fig. 8A

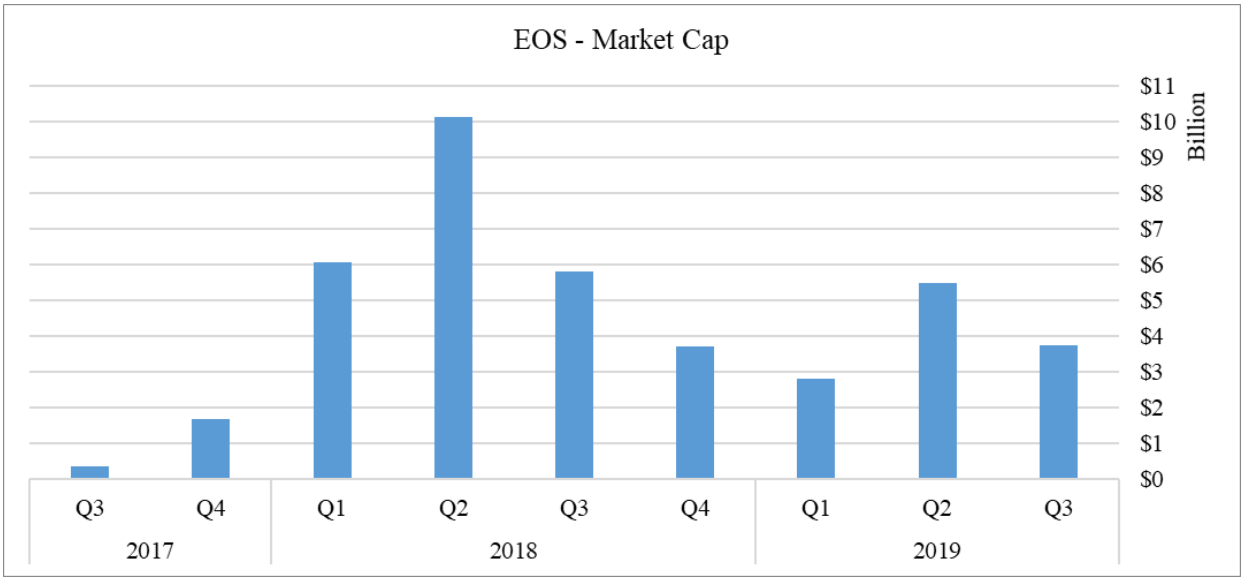


Fig. 8B

Figure 9 – Binance Coin – Stock Market (Open tickets) (Fig. 9A) & Market Cap data in Quarters (Fig. 9B) (Source: Own elaboration).

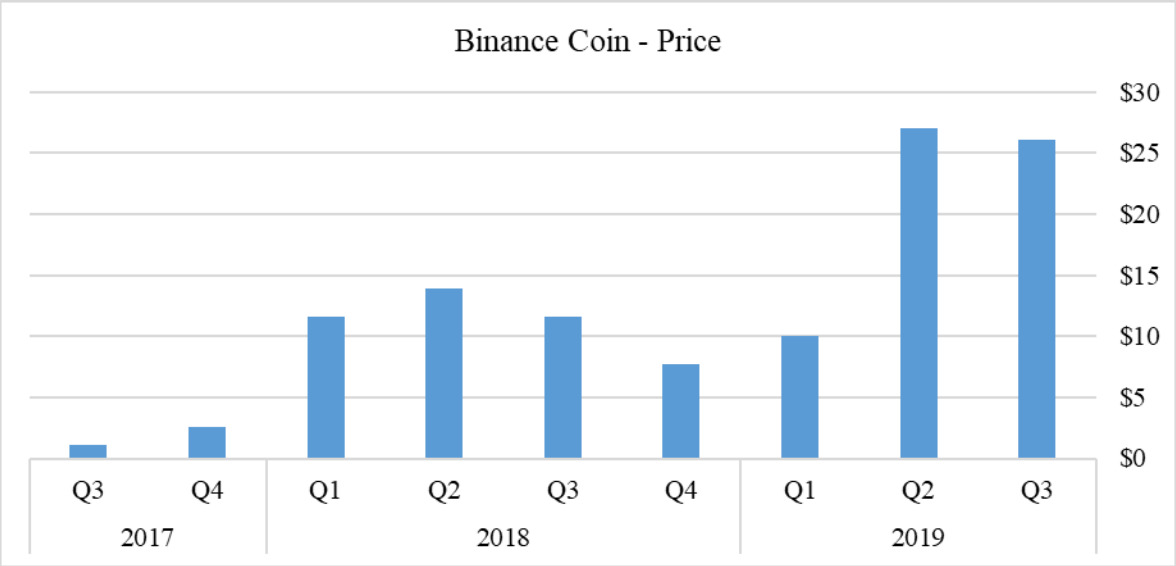


Fig. 9A

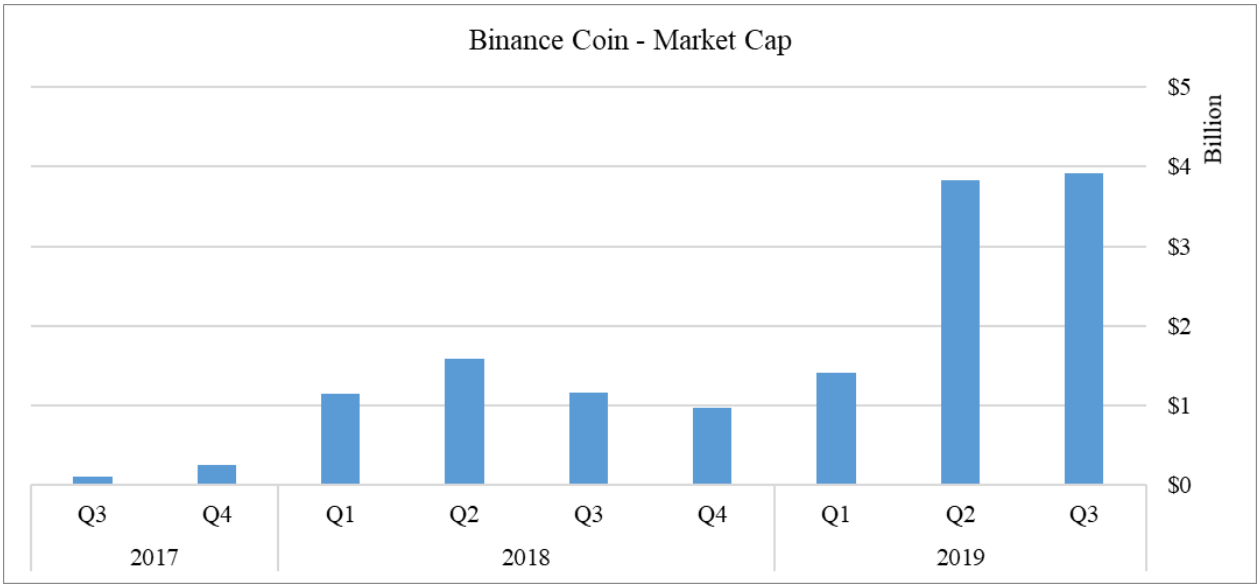


Fig. 9B

Figure 10 – Bitcoin SV – Stock Market (Open tickets) (Fig. 10A) & Market Cap data in Quarters (Fig. 10B) (Source: Own elaboration).

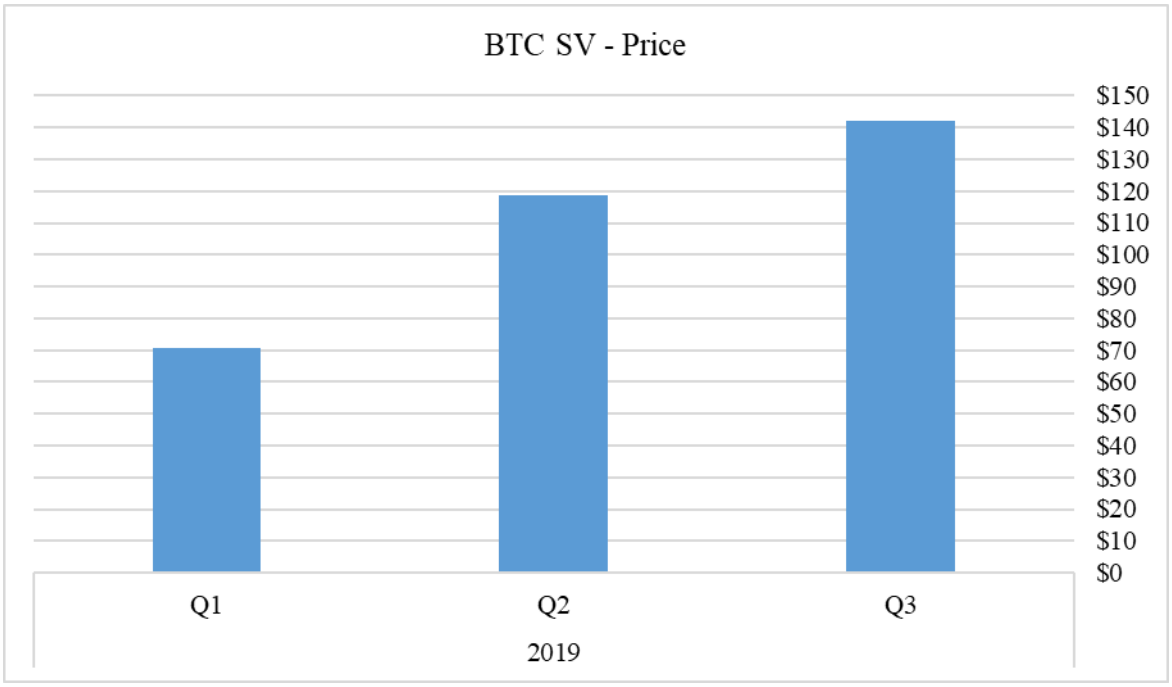


Fig. 10A

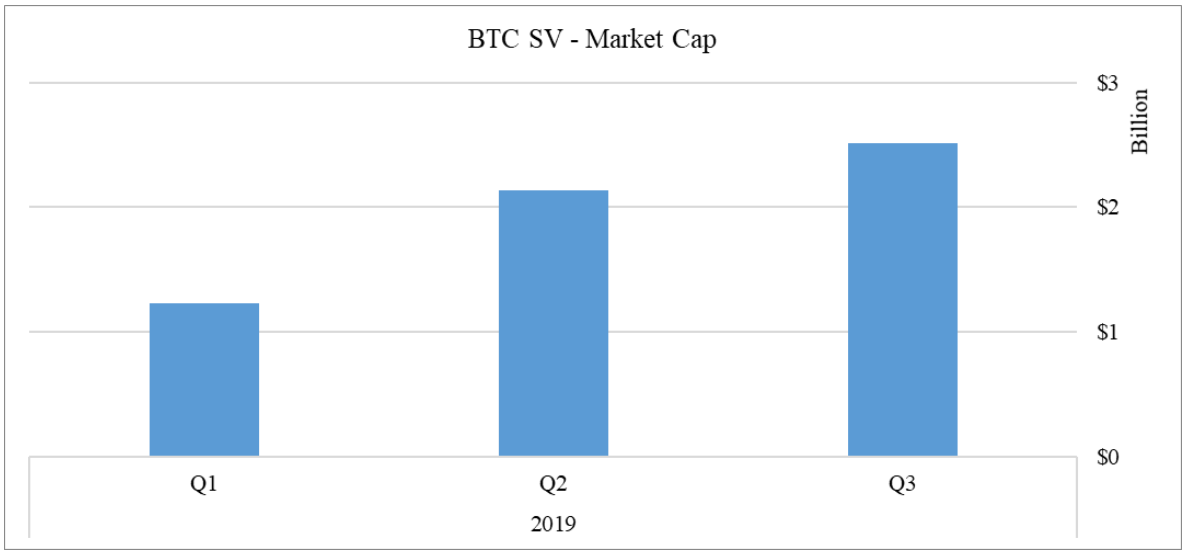


Fig. 10B

Figure 11 – XLM – Stock Market (Open tickets) (Fig. 11A) & Market Cap data in Quarters (Fig. 11B) (Source: Own elaboration).

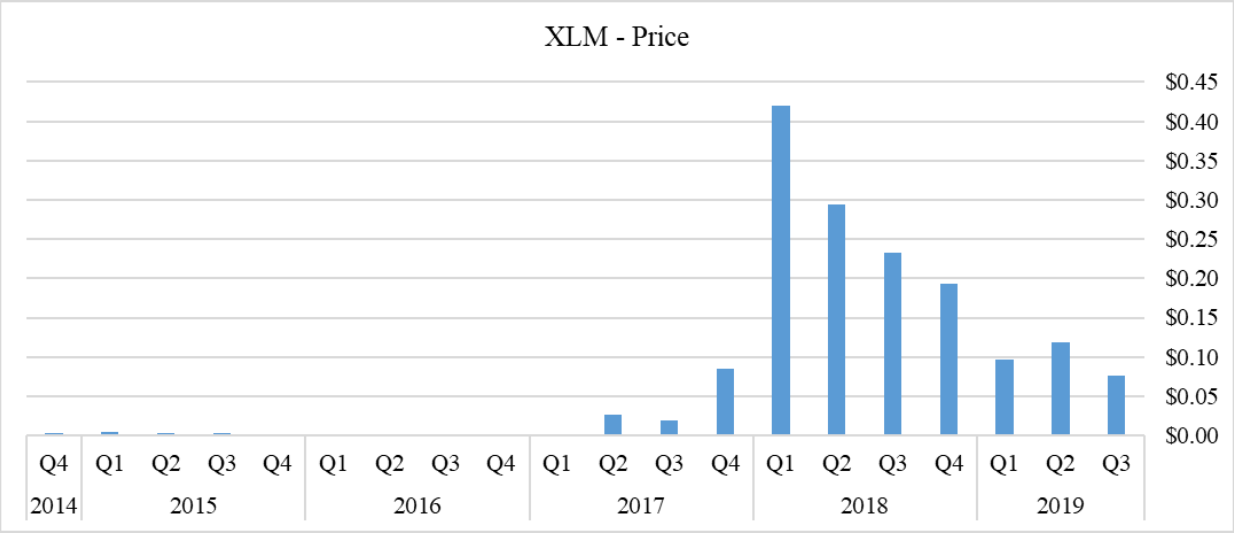


Fig. 11A

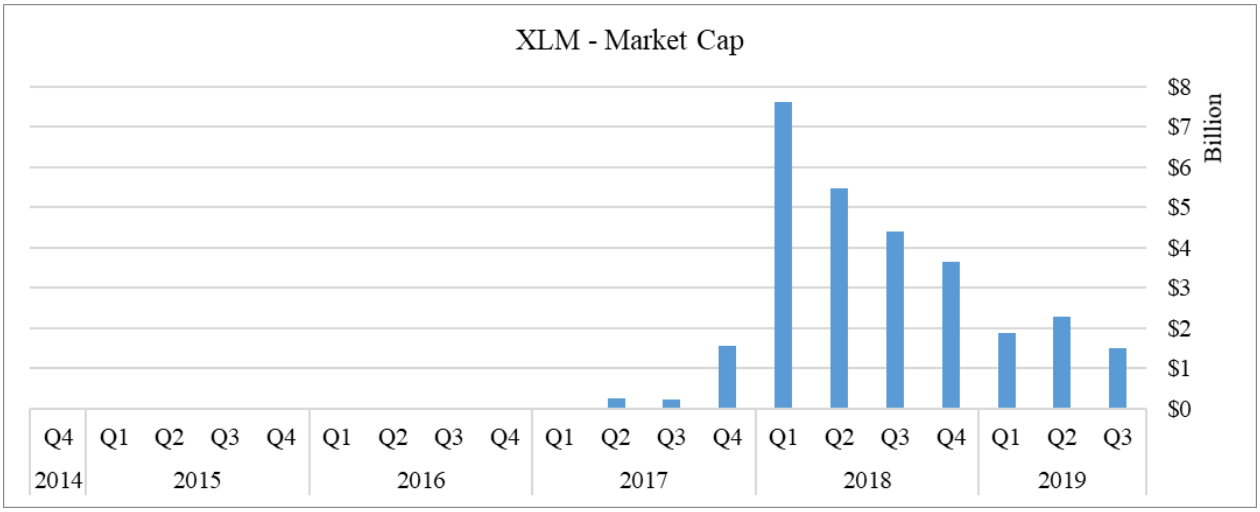


Fig. 11B

Figure 12 – TRX – Stock Market (Open tickets) (Fig. 12A) & Market Cap data in Quarters (Fig. 12B) (Source: Own elaboration).

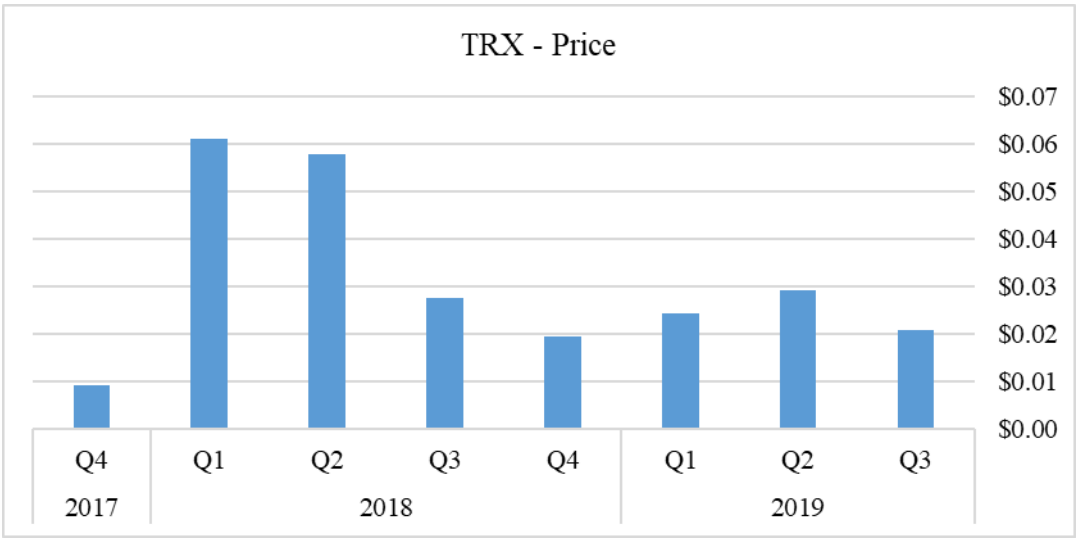


Fig. 12A

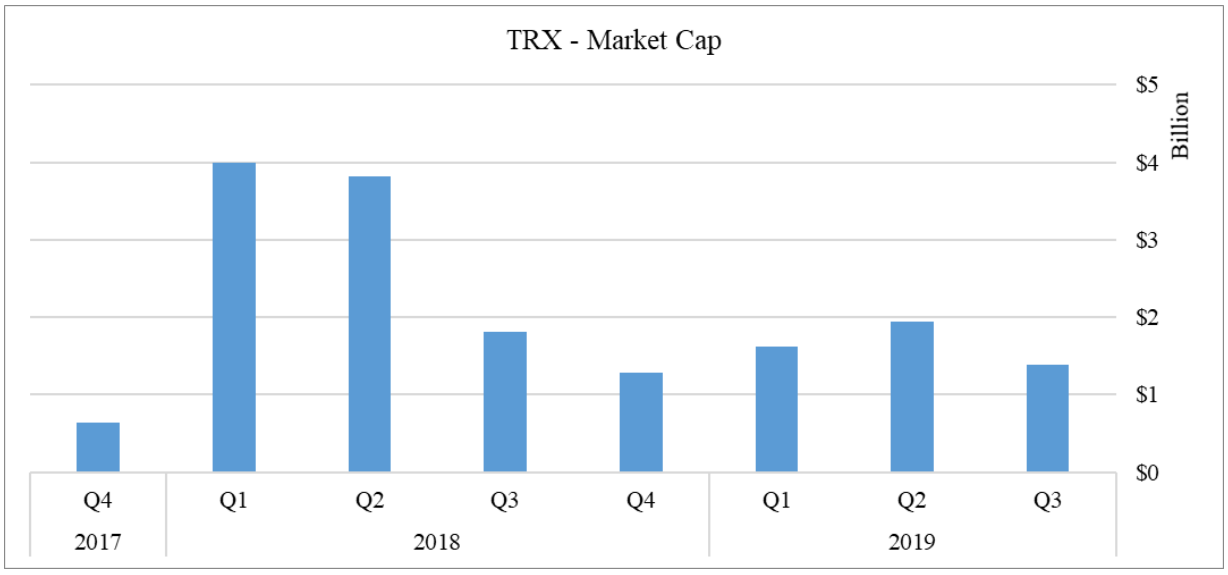


Fig. 12B

Figure 13 – ADA – Stock Market (Open tickets) (Fig. 13A) & Market Cap data in Quarters (Fig. 13B) (Source: Own elaboration).

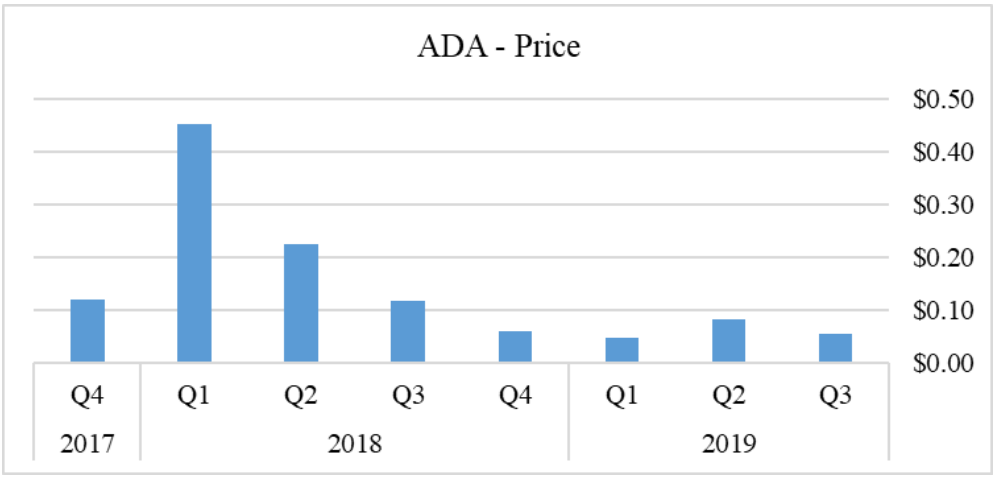


Fig. 13A

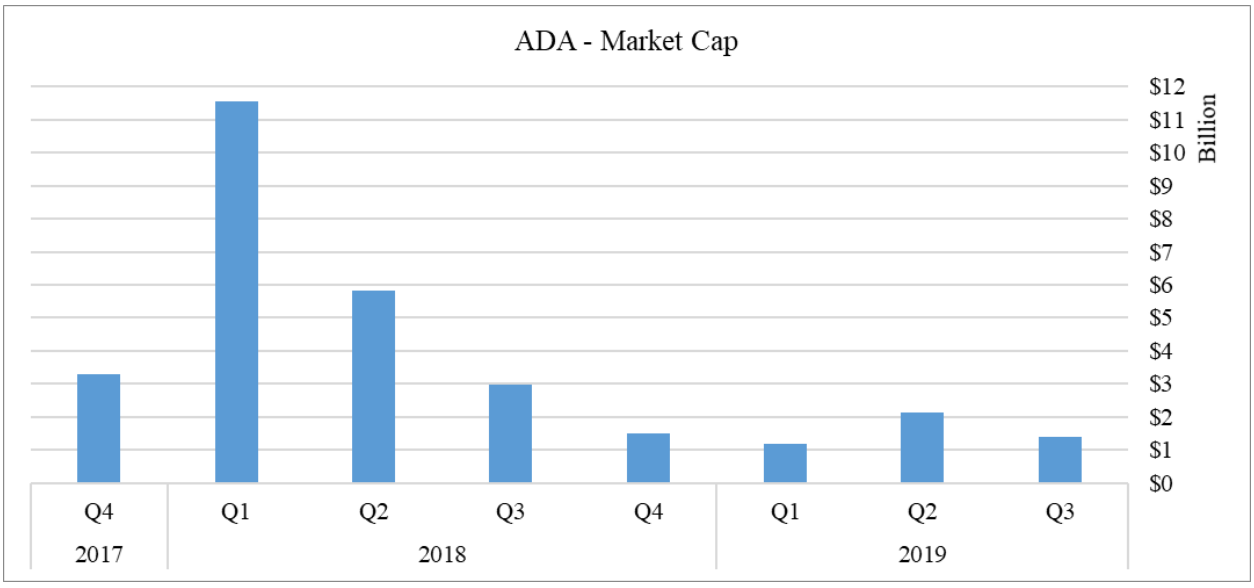


Fig. 13B

Figure 14 – SP500 stock market data (open ticket (Fig. 14A) and variation (Fig. 14B)) (Geometric Mean used, for capitalization consideration), in Quarters (Source: Own elaboration).

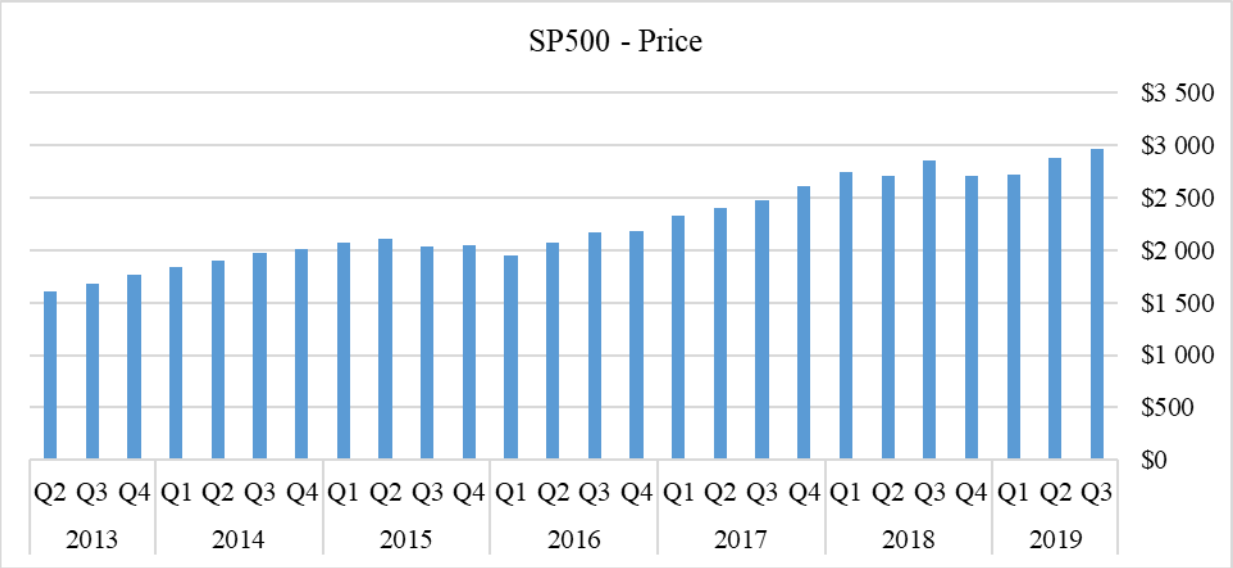


Fig. 14A

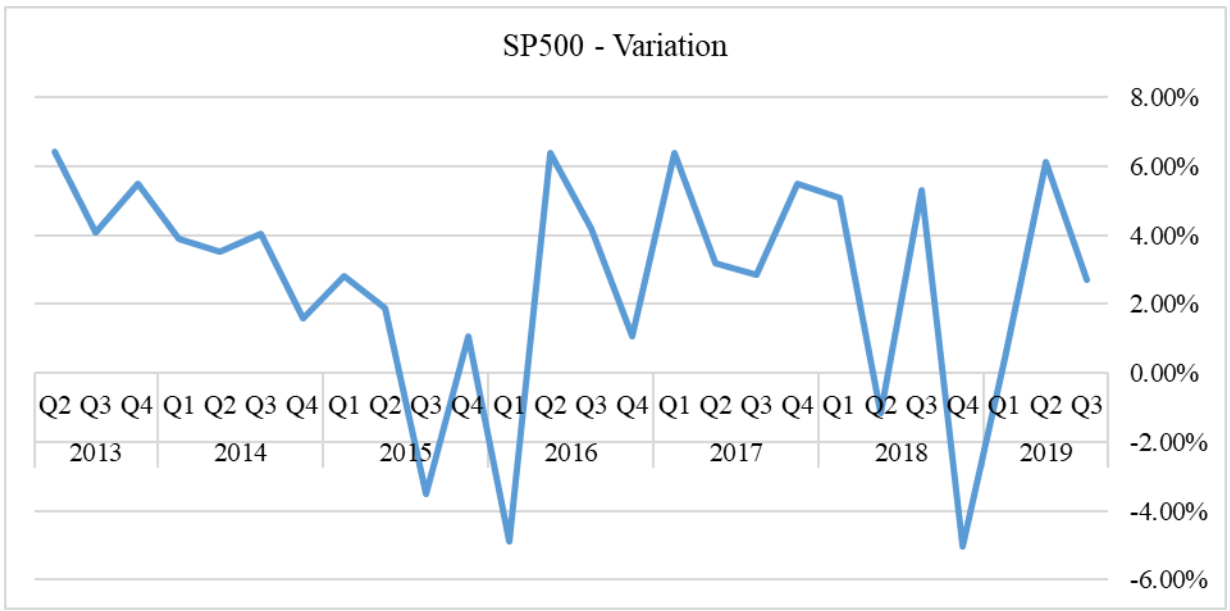


Fig. 14B

Figure 15 – T-BILLS (Data: Average of 3 Month T-BILLS – Daily Values), in Quarters (Source: Own elaboration).

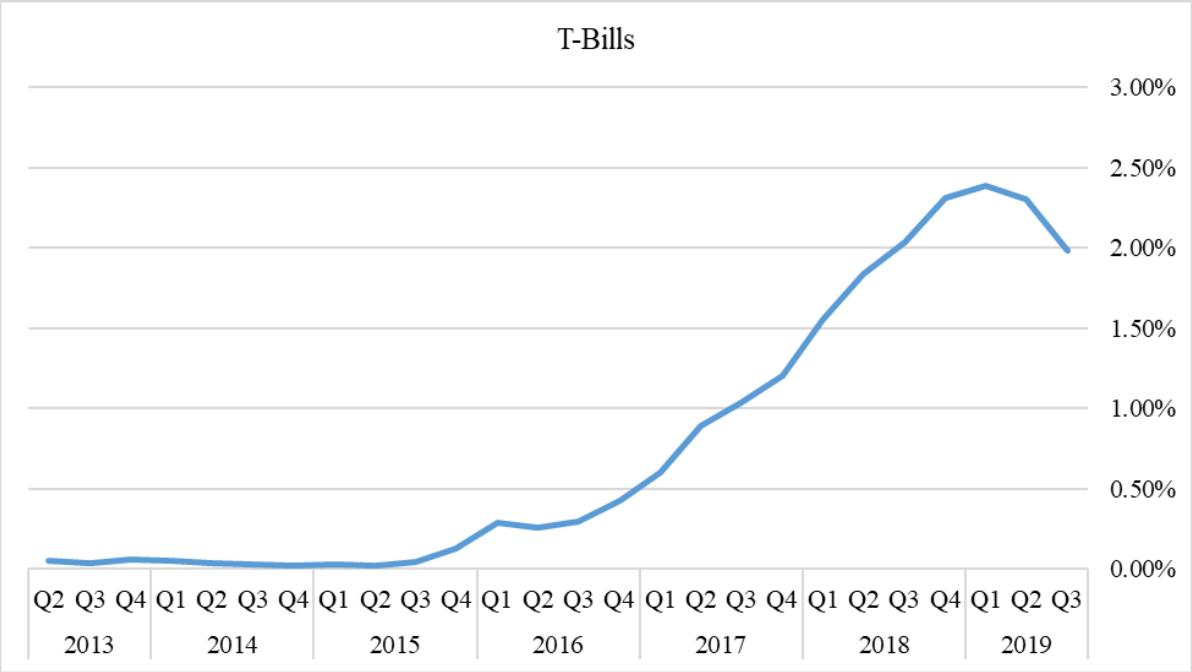


Figure 16 – EONIA (Data: Average of 3 Month EONIA – Daily Values), based on Euro, in Quarters (Source: Own elaboration).

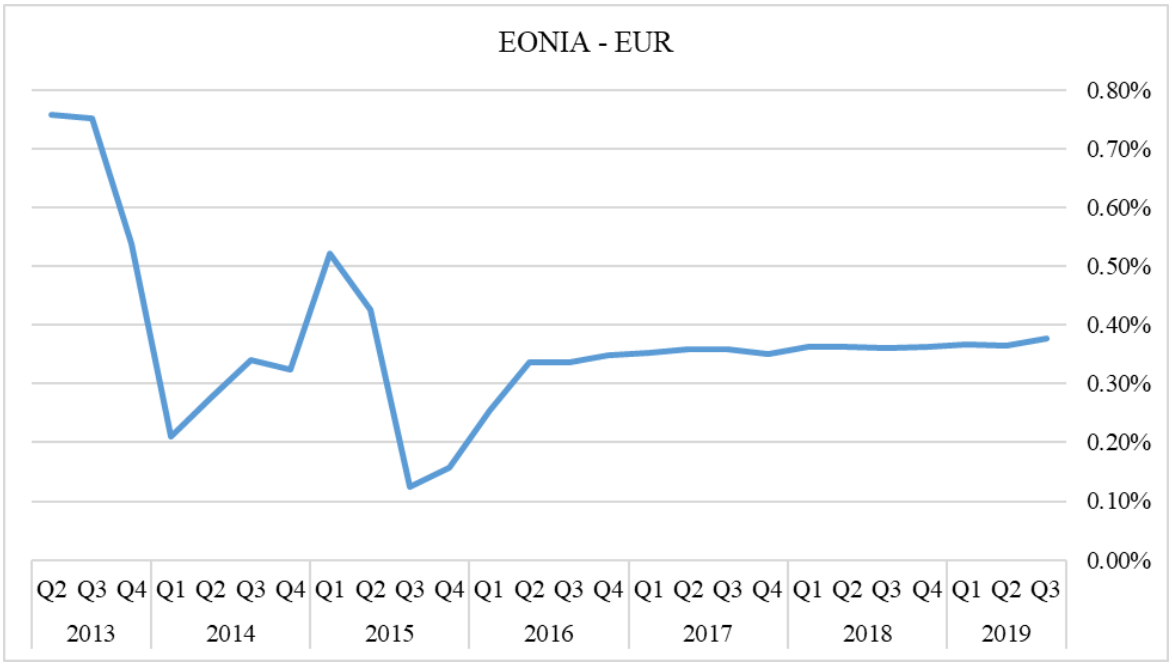


Figure 17 – LIBOR-OIS (Data: Arithmetic Mean of 3 Month LIBOR – Daily Values subtracted to the Geometric Mean of 3 Month Federal Funds Rate – Daily Values (LIBOR - OIS = LIBOR-OIS)), based on USD and US Market, in Quarters (Source: Own elaboration).

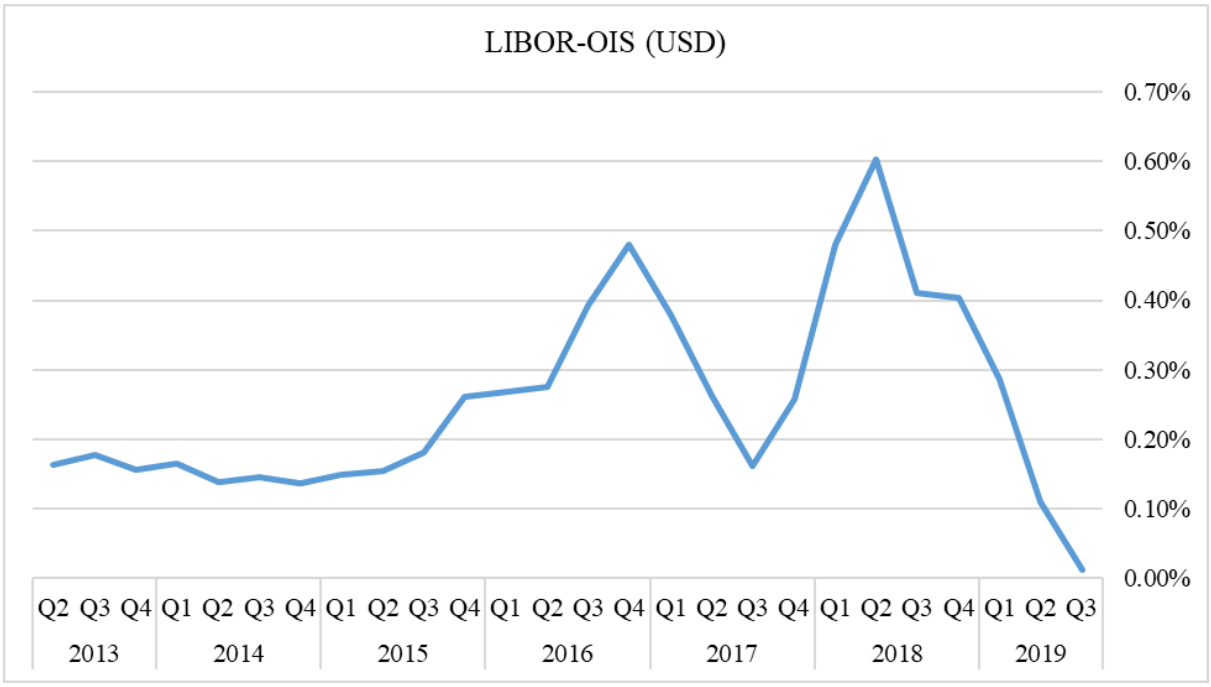


Figure 18 – Percentage (%) of Households with Internet Access in the World, in Developed Countries and in Developing Countries, by Year (Source: Own elaboration).

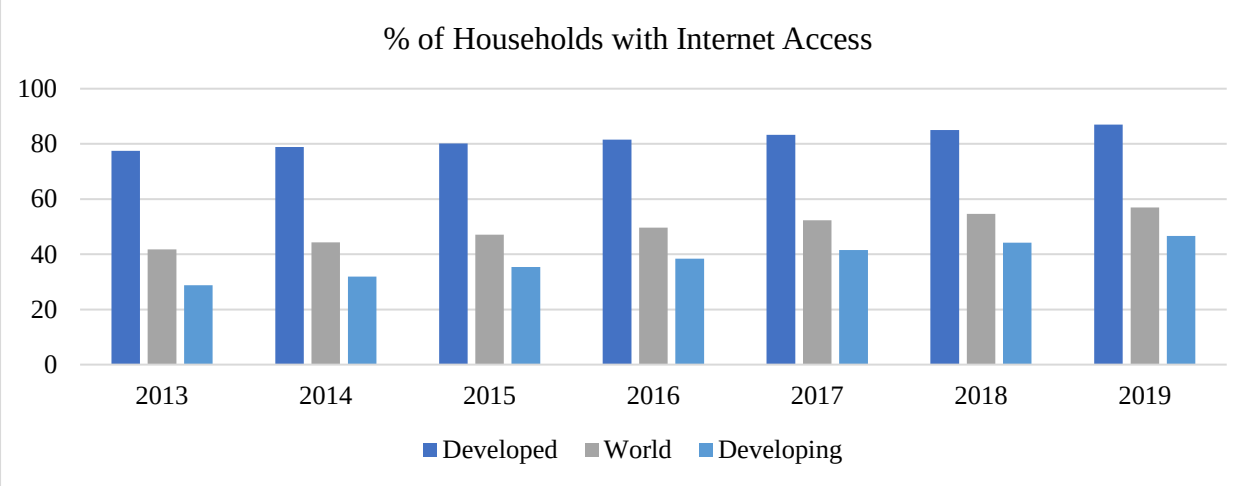


Figure 19 – Percentage (%) of Mobile-cellular Subscriptions in the World, in Developed Countries and in Developing Countries, by Year (Source: Own elaboration).

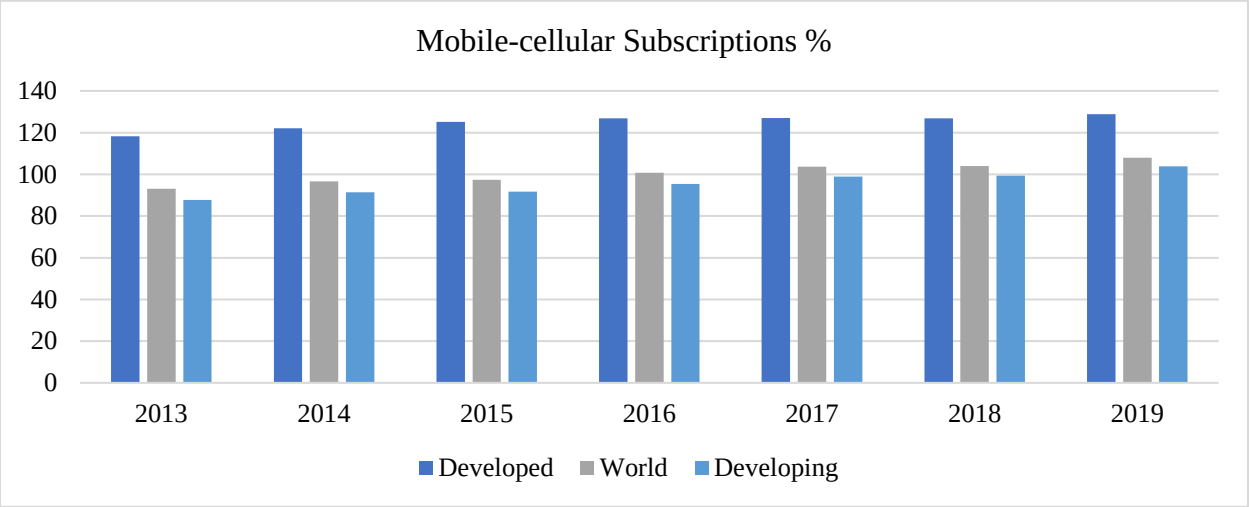
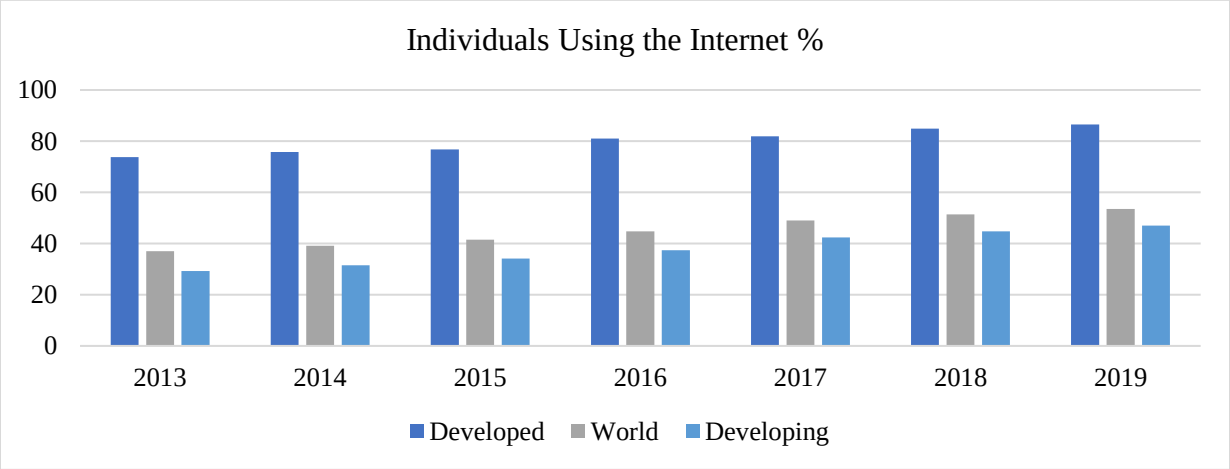


Figure 20 – Percentage (%) of Individuals Using the Internet in the World, in Developed Countries and in Developing Countries (Source: Own elaboration).



Developed/ Developing countries, according to the UN M49:

Developed:

Albania, Andorra, Australia, Austria, Belarus, Belgium, Bermuda, Bosnia and Herzegovina, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Faroe Islands, Finland, France, Germany, Greece, Greenland, Hungary, Iceland, Ireland, Israel, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Moldova, Monaco, Montenegro, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Rep. of North Macedonia, Ukraine, United Kingdom, United States.

Developing:

Afghanistan, Algeria, American Samoa, Angola, Anguilla, Antigua and Barbuda, Argentina, Armenia, Aruba, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia (Plurinational State of), Botswana, Brazil, British Virgin Islands, Brunei Darussalam, Burkina Faso, Burundi, Cambodia, Cameroon, Cabo Verde, Cayman Islands, Central African Rep., Chad, Chile, China, Cocos Keeling Islands, Colombia, Comoros, Congo (Rep. of the), Cook Islands, Costa Rica, Côte d'Ivoire, Cuba, Cyprus, Dem. People's Rep. of Korea, Dem. Rep. of the Congo, Djibouti, Dominica, Dominican Rep., Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Falkland (Malvinas) Is., Fiji, French Polynesia, Gabon, Gambia, Georgia, Ghana, Grenada, Guam, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hong Kong, China, India, Indonesia, Iran (Islamic Republic of) , Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Korea (Rep. of), Kuwait, Kyrgyzstan, Lao P.D.R., Lebanon, Lesotho, Liberia, Libya, Macao, China, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands, Mauritania, Mauritius, Mayotte, Mexico, Micronesia, Mongolia, Montserrat, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal (Republic of), Neth. Antilles, New Caledonia, Nicaragua, Niger, Nigeria, Niue, Northern Marianas, Oman, Pakistan, Palau, Palestine**, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Puerto Rico, Qatar, Rwanda, Sao Tome and Principe, Samoa, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Solomon Islands, Somalia, South Africa, Sri Lanka, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Sudan, Suriname, Syrian Arab Republic, Taiwan, Province of China***, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tokelau, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Turks & Caicos Is., Tuvalu, Uganda, United Arab Emirates, Uruguay, Uzbekistan, Vanuatu, Venezuela, Viet Nam, Virgin Islands (US), Yemen, Zambia, Zimbabwe.

* Note: The M49 is a standard for area codes used by the United Nations for statistical purposes, developed and maintained by the United Nations Statistics Division. Based on the M49, countries are classified according to macro geographical regions and sub-regions, and selected economic and other groupings, see: http://unstats.un.org/unsd/methods/m49/m49regin.htm

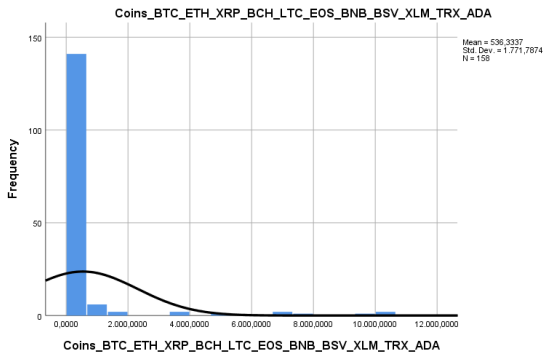
** Palestine is not an ITU Member State; the status of Palestine in ITU is the subject of Resolution 99 (rev. Dubai, 2018) of the ITU Plenipotentiary Conference.

*** Taiwan, Province of China, is not listed separately in the UN M49 but included in China. It is shown separately here since ITU data on China do not include Taiwan, Province of China, data.

Extra Graphic Data:

-Numeric frequency in histogram graph with normality curve:

Figure 21 – Num. Frequency: All Crypto Currency Coins (Price) (Left Figure); Figure 22 – Num. Frequency: Market Cap All Crypto Coins (Right Figure) (Source: Own elaboration, using SPSS).



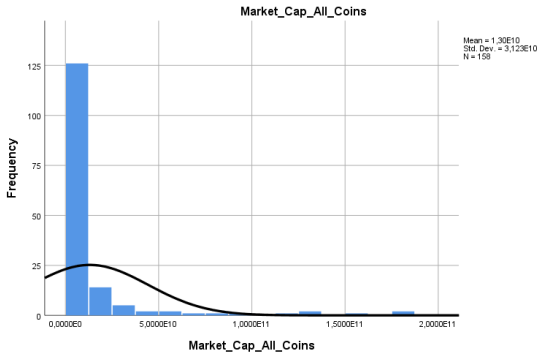
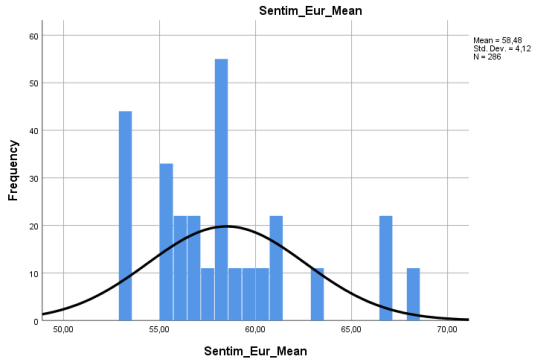


Figure 23 – Num. Frequency: Sentiment Europe Mean (Left Figure); Figure 24 – Num. Frequency: Sentiment Europe Median (Right Figure) (Source: Own elaboration, using SPSS).



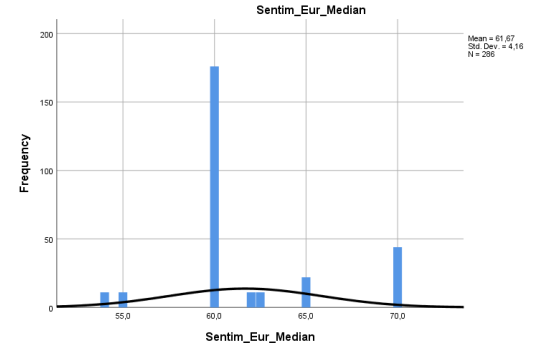
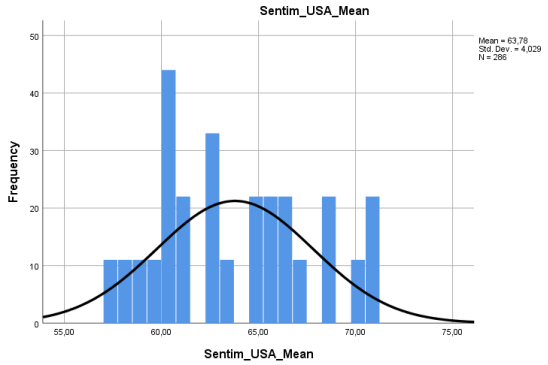


Figure 25 – Num. Frequency: Sentiment USA Mean (Left Figure); Figure 26 – Num. Frequency: Sentiment USA Median (Right Figure) (Source: Own elaboration, using SPSS).



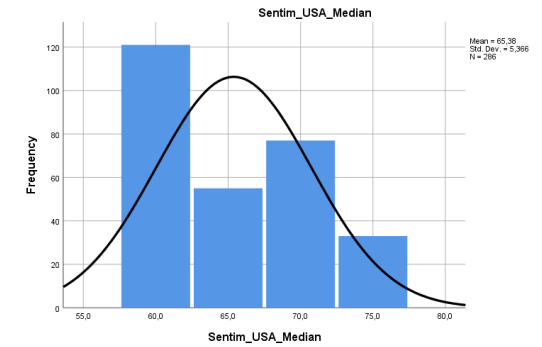
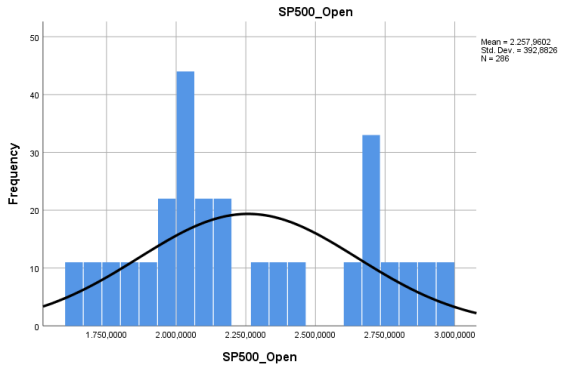


Figure 27 – Num. Frequency: SP500 Open Ticket – Stock Price (Left Figure); Figure 28 – Num. Frequency: SP500 Open Ticket – Stock Price – Variation (Right Figure) (Source: Own elaboration, using SPSS).



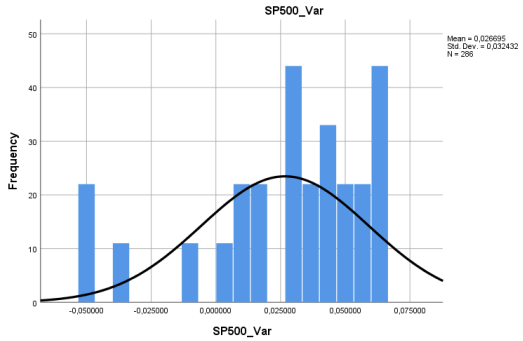
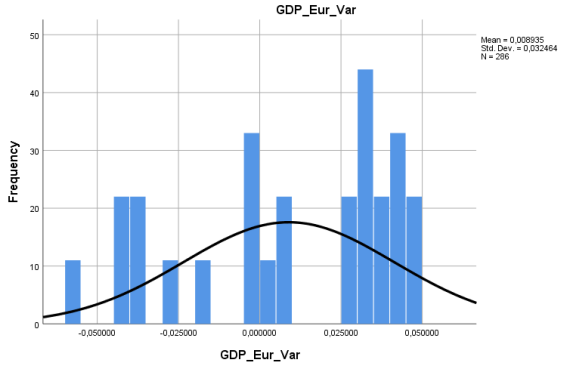


Figure 29 – Num. Frequency: GDP Europe – Variation (Left Figure); Figure 30 – Num. Frequency: Real GDP Europe – Variation (Right Figure) (Source: Own elaboration, using SPSS).



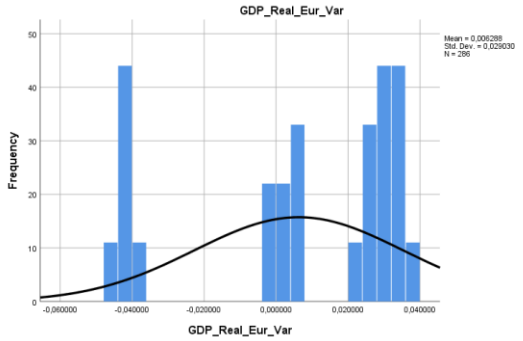
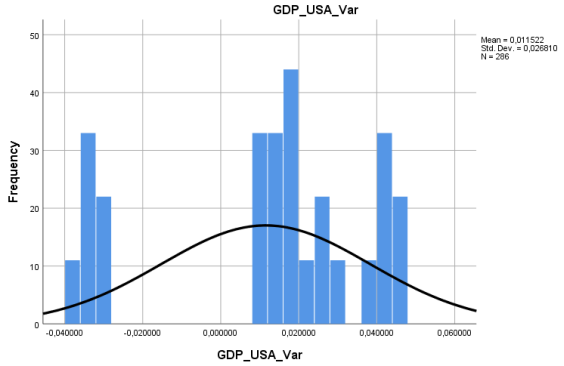


Figure 31 – Num. Frequency: GDP USA – Variation (Left Figure); Figure 32 – Num. Frequency: Real GDP USA – Variation (Right Figure) (Source: Own elaboration, using SPSS).



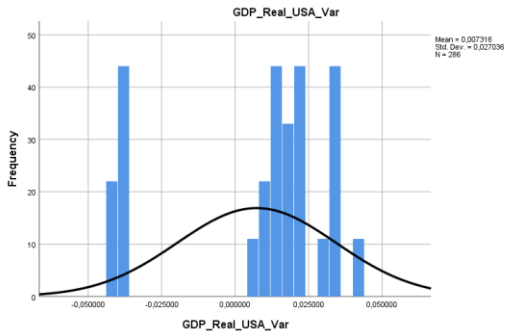
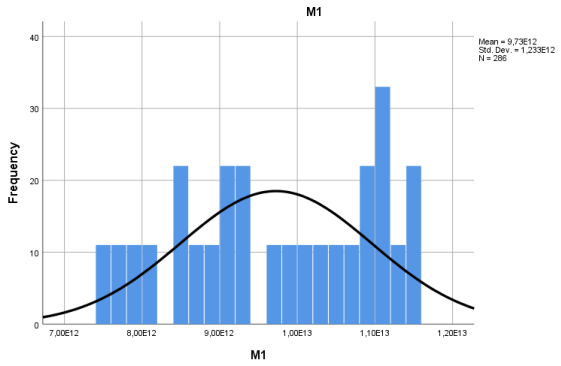


Figure 33 – Num. Frequency: M1 – Money Measurement Indicator (Left Figure); Figure 34 – Num. Frequency: M2 – Money Measurement Indicator (Right Figure) (Source: Own elaboration, using SPSS).



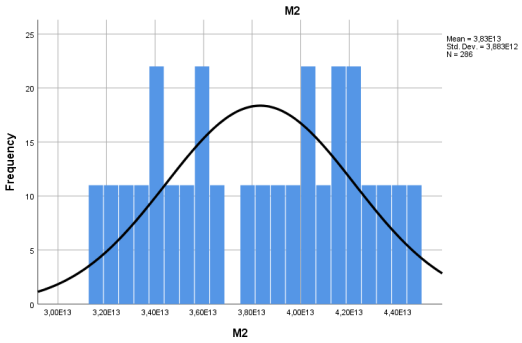
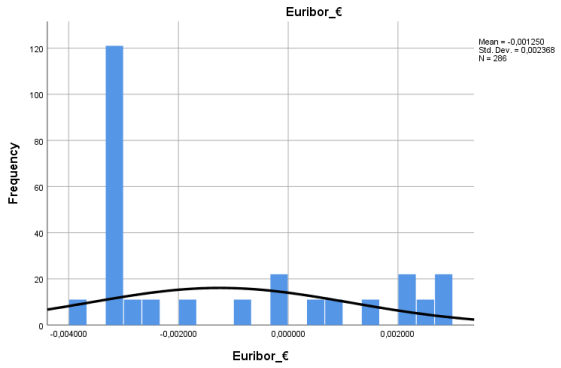


Figure 35 – Num. Frequency: Euribor € (Left Figure); Figure 36 – Num. Frequency: Libor $ (Right Figure) (Source: Own elaboration, using SPSS).



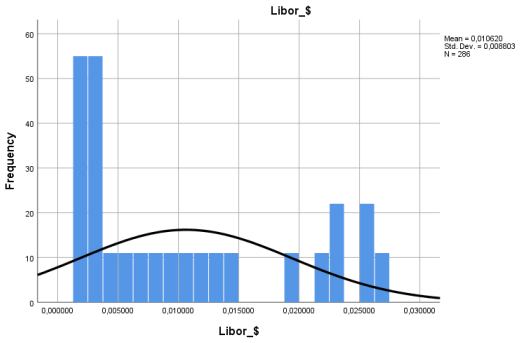
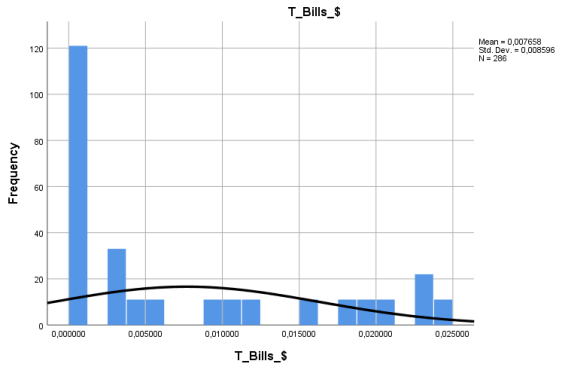


Figure 37 – Num. Frequency: T-Bills $ (Left Figure); Figure 38 – Num. Frequency: EONIA € (Right Figure) (Source: Own elaboration, using SPSS).



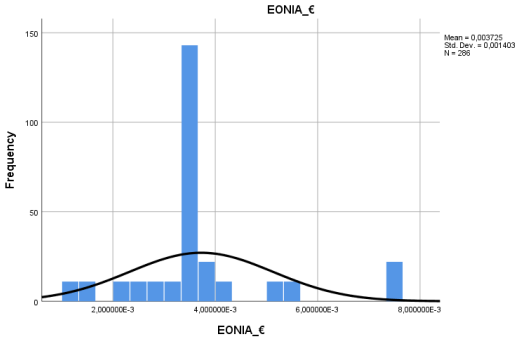
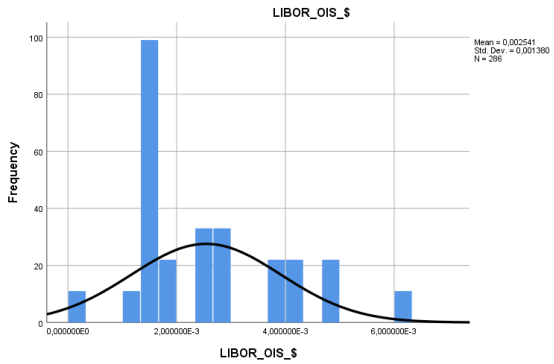


Figure 39 – Num. Frequency: LIBOR OIS $ (Left Figure); Figure 40 – Num. Frequency: Percentage (%) of Households with Internet Access in the World (Right Figure) (Source: Own elaboration, using SPSS).



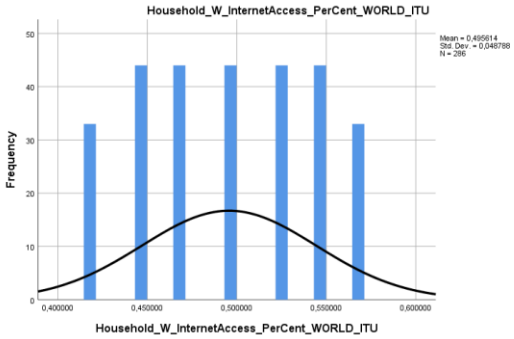
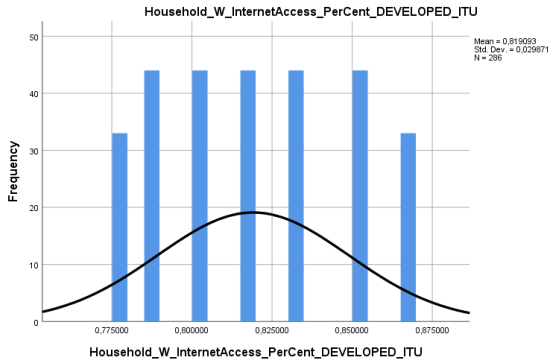


Figure 41 – Num. Frequency: Percentage (%) of Households with Internet Access in Developed Countries (Left Figure); Figure 42 – Num. Frequency: Percentage (%) of Households with Internet Access in Developing Countries (Right Figure) (Source: Own elaboration, using SPSS).



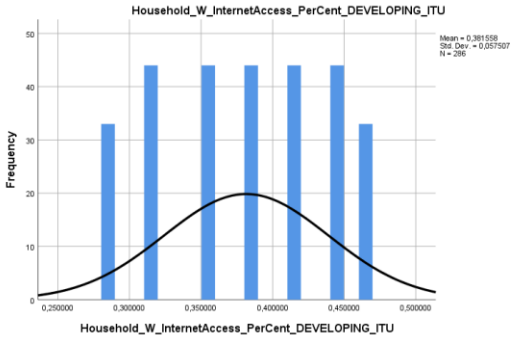
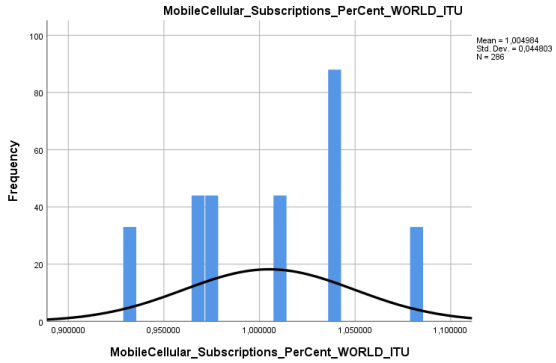


Figure 43 – Num. Frequency: Percentage (%) of Mobile-cellular Subscriptions in the World (Left Figure); Figure 44 – Num. Frequency: Percentage (%) of Mobile-cellular Subscriptions in Developed Countries (Right Figure) (Source: Own elaboration, using SPSS).



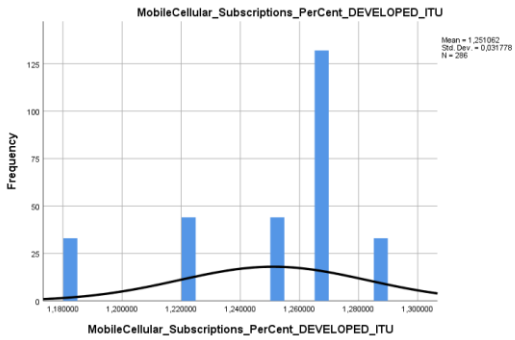
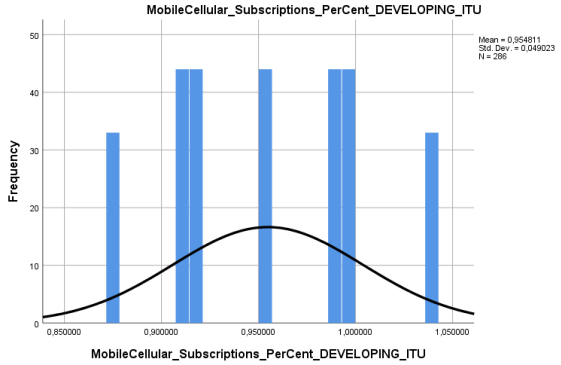


Figure 45 – Num. Frequency: Percentage (%) of Mobile-cellular Subscriptions in Developing Countries (Left Figure); Figure 46 – Num. Frequency: Percentage (%) of Individuals Using the Internet in the World (Right Figure) (Source: Own elaboration, using SPSS).



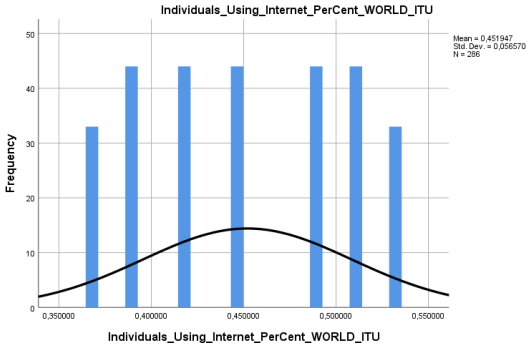
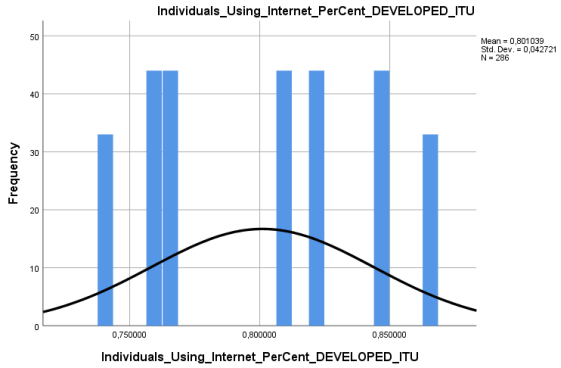
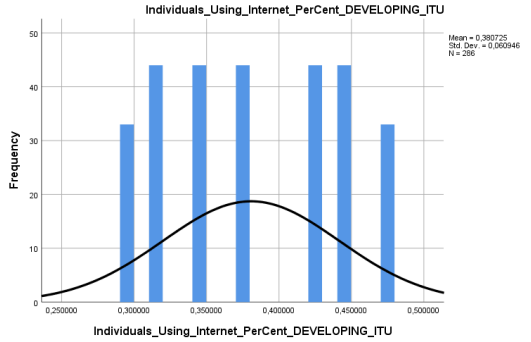


Figure 47 – Num. Frequency: Percentage (%) of Individuals Using the Internet in Developed Countries (Left Figure); Figure 48 – Num. Frequency: Percentage (%) of Individuals Using the Internet in Developing Countries (Right Figure) (Source: Own elaboration, using SPSS).





-Normality plots with respective tests:

Figure 49 (49A, 49B and 49C) – Normality Plots with Tests: **All Crypto Coins (Price)** (Source: Own elaboration, using SPSS).

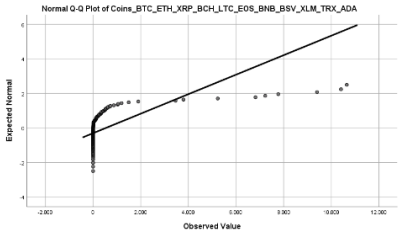


Fig. 49A

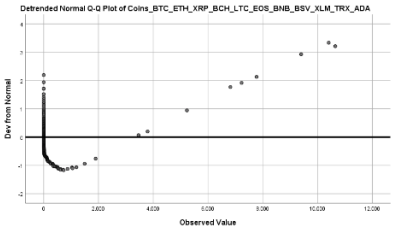


Fig. 49B

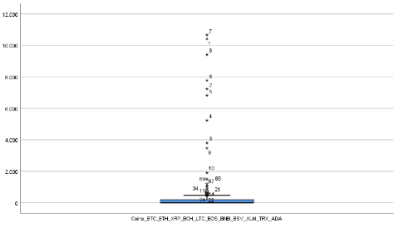


Fig. 49C

Figure 50 (50A, 50B and 50C) – Normality Plots with Tests: **Market Cap All Crypto Coins** (Source: Own elaboration, using SPSS).

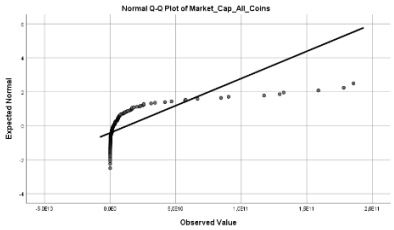


Fig. 50A

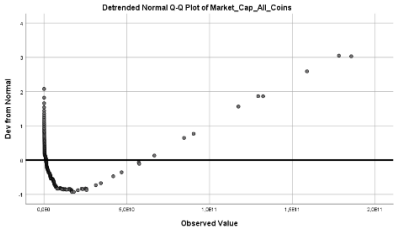


Fig. 50B

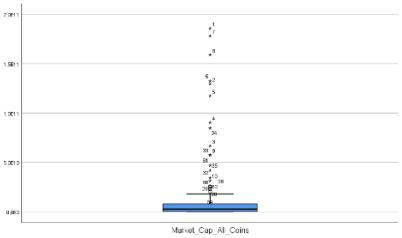


Fig. 50C

Figure 51 (51A, 51B and 51C) – Normality Plots with Tests: **Sentiment Europe Mean** (Source: Own elaboration, using SPSS).

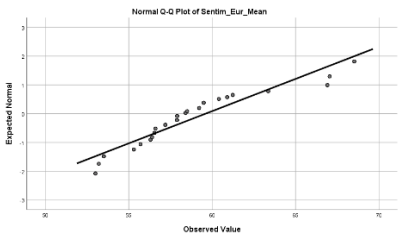


Fig. 51A

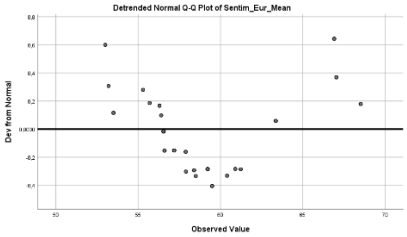


Fig. 51B

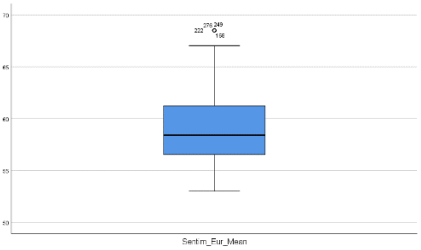


Fig. 51C

Figure 52 (52A, 52B and 52C) – Normality Plots with Tests: **Sentiment Europe Median** (Source: Own elaboration, using SPSS).

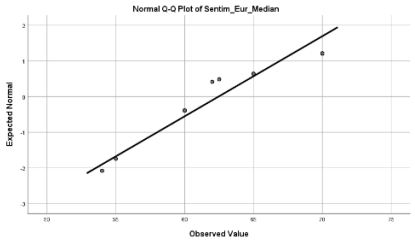


Fig. 52A

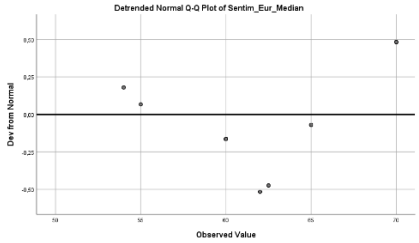


Fig. 52B

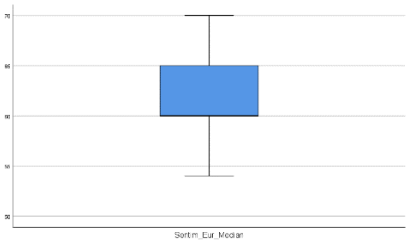


Fig. 52C

Figure 53 (53A, 53B and 53C) – Normality Plots with Tests: **Sentiment USA Mean** (Source: Own elaboration, using SPSS).

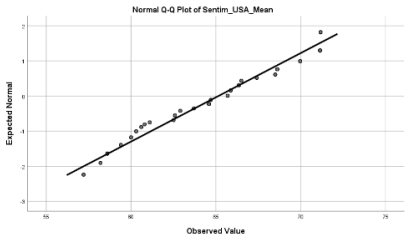


Fig. 53A

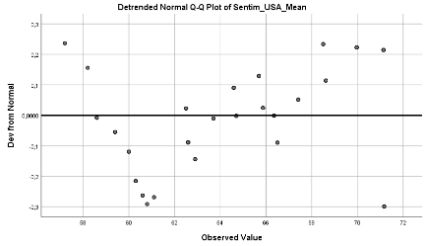


Fig. 53B

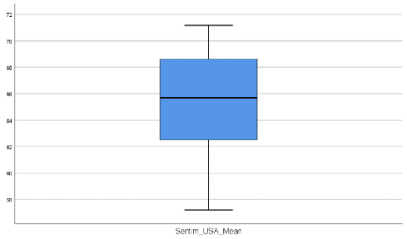


Fig. 53C

Figure 54 (54A, 54B and 54C) – Normality Plots with Tests: **Sentiment USA Median** (Source: Own elaboration, using SPSS).

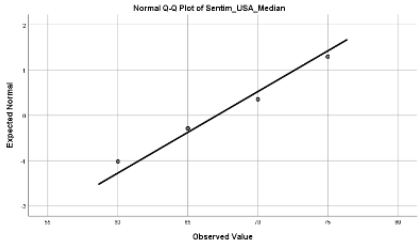


Fig. 54A

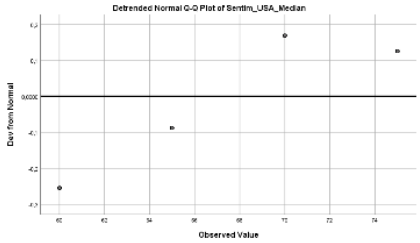


Fig. 54B

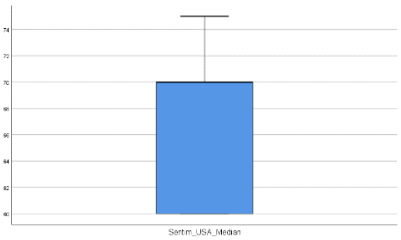


Fig. 54C

Figure 55 (55A, 55B and 55C) – Normality Plots with Tests: **SP500 Open Ticket – Stock Price** (Source: Own elaboration, using SPSS).

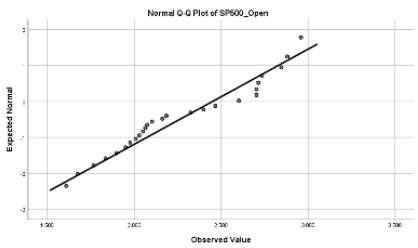


Fig. 55A

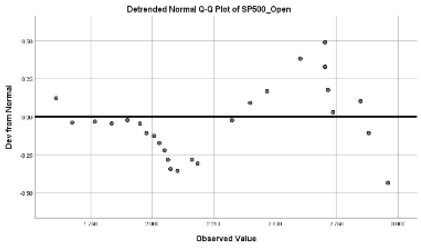


Fig. 55B

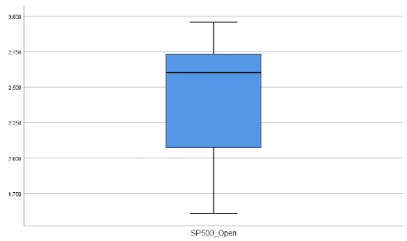


Fig. 55C

Figure 56 (56A, 56B and 56C) – Normality Plots with Tests: **SP500 Open Ticket – Stock Price – Variation** (Source: Own elaboration, using SPSS).

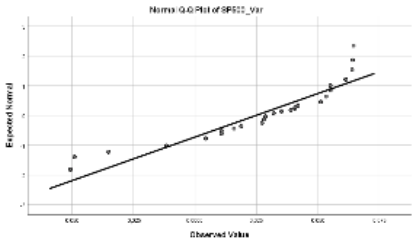


Fig. 56A

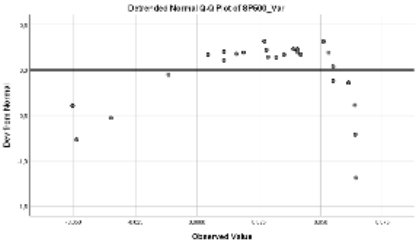


Fig. 56B

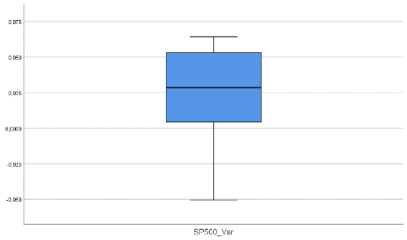


Fig. 56C

Figure 57 (57A, 57B and 57C) – Normality Plots with Tests: **GDP Europe – Variation** (Source: Own elaboration, using SPSS).

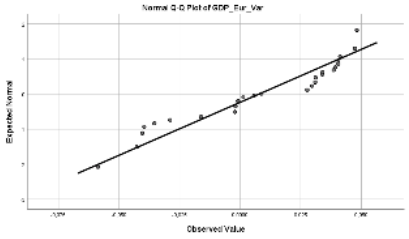


Fig. 57A

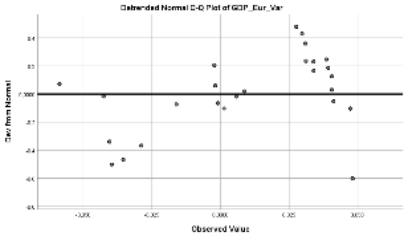


Fig. 57B

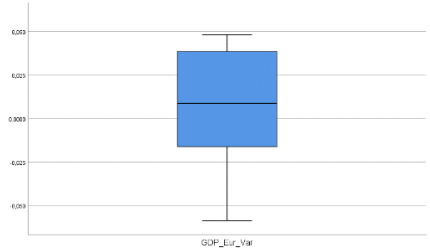


Fig. 57C

Figure 58 (58A, 58B and 58C) – Normality Plots with Tests: **Real GDP Europe – Variation** (Source: Own elaboration, using SPSS).

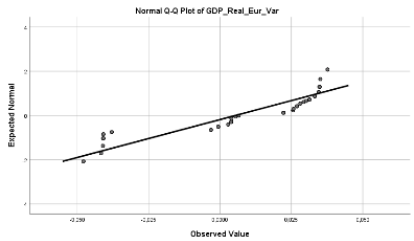


Fig. 58A

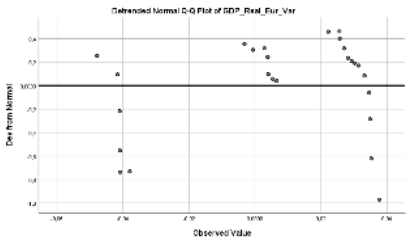


Fig. 58B

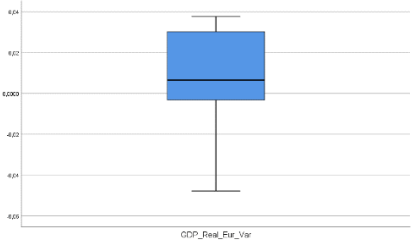


Fig. 58C

Figure 59 (59A, 59B and 59C) – Normality Plots with Tests: **GDP USA – Variation** (Source: Own elaboration, using SPSS).

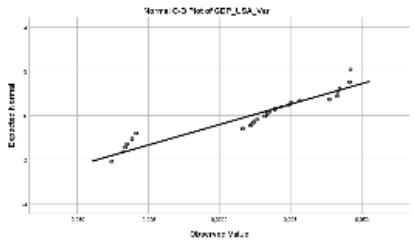


Fig. 59A

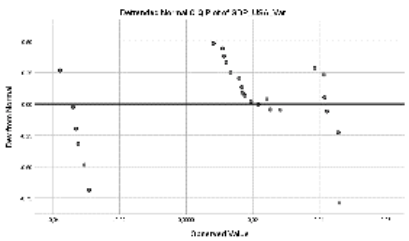


Fig. 59B

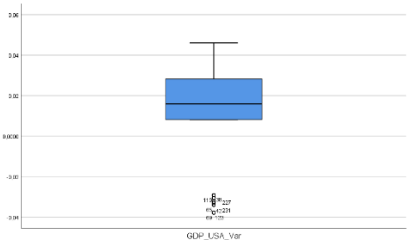


Fig. 59C

Figure 60 (60A, 60B and 60C) – Normality Plots with Tests: **Real GDP USA – Variation** (Source: Own elaboration, using SPSS).

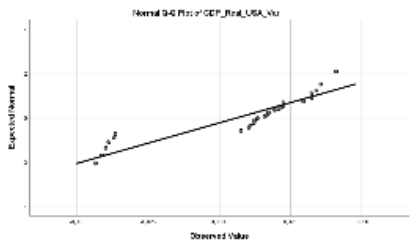


Fig. 60A

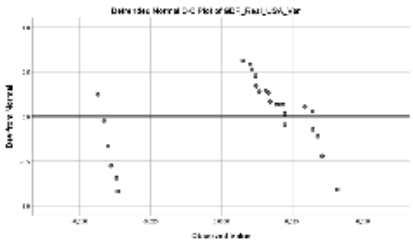


Fig. 60B

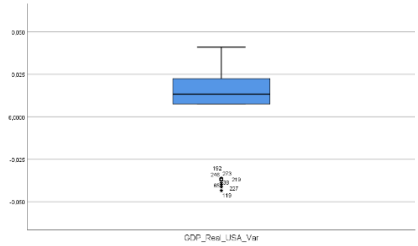


Fig. 60C

Figure 61 (61A, 61B and 61C) – Normality Plots with Tests: **M1 – Money Measurement Indicator** (Source: Own elaboration, using SPSS).

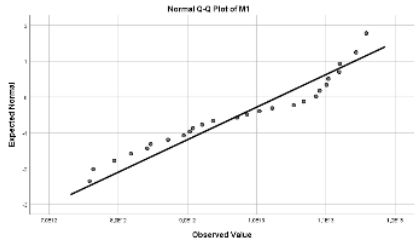


Fig. 61A

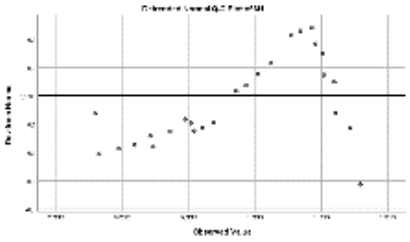


Fig. 61B

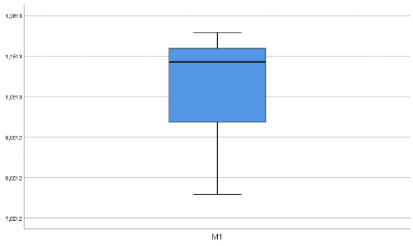


Fig. 61C

Figure 62 (62A, 62B and 62C) – Normality Plots with Tests: **M2 – Money Measurement Indicator** (Source: Own elaboration, using SPSS).

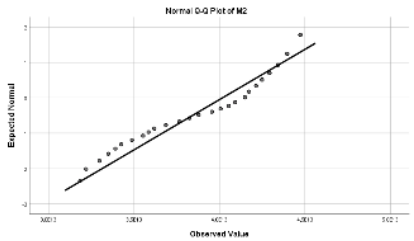


Fig. 62A

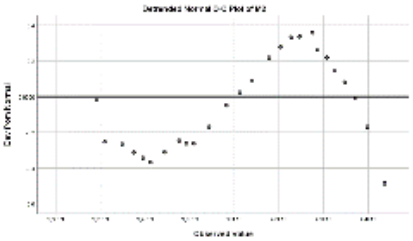


Fig. 62B

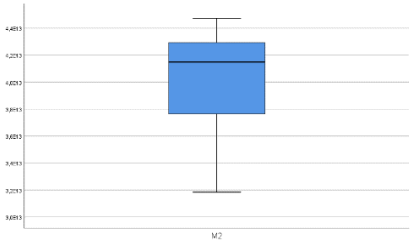


Fig. 62C

Figure 63 (63A, 63B and 63C) – Normality Plots with Tests: **Euribor €** (Source: Own elaboration, using SPSS).

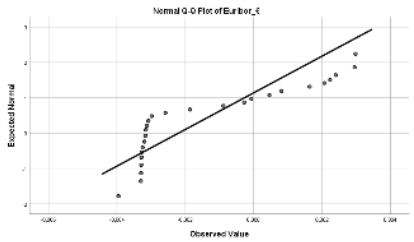


Fig. 63A

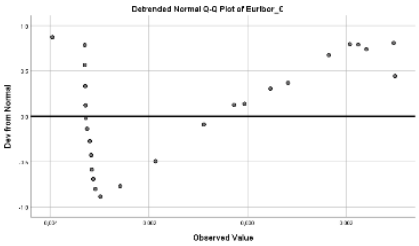


Fig. 63B

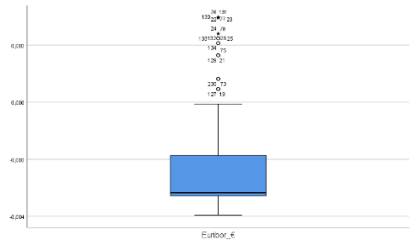


Fig. 63C

Figure 64 (64A, 64B and 64C) – Normality Plots with Tests: **Libor $** (Source: Own elaboration, using SPSS).

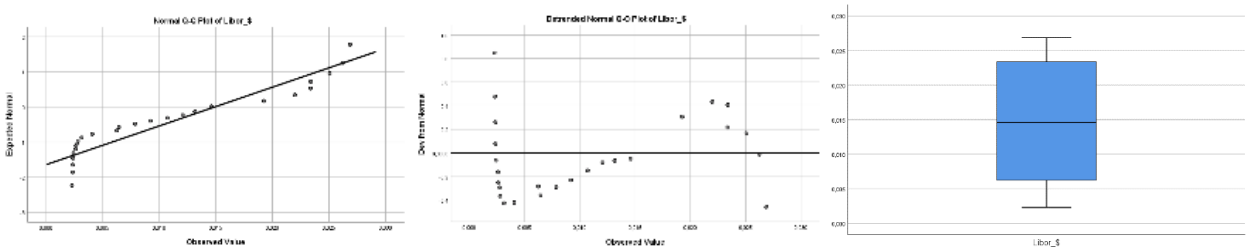


Fig. 64A Fig. 64B Fig. 64C

Figure 65 (65A, 65B and 65C) – Normality Plots with Tests: **T-Bills $** (Source: Own elaboration, using SPSS).

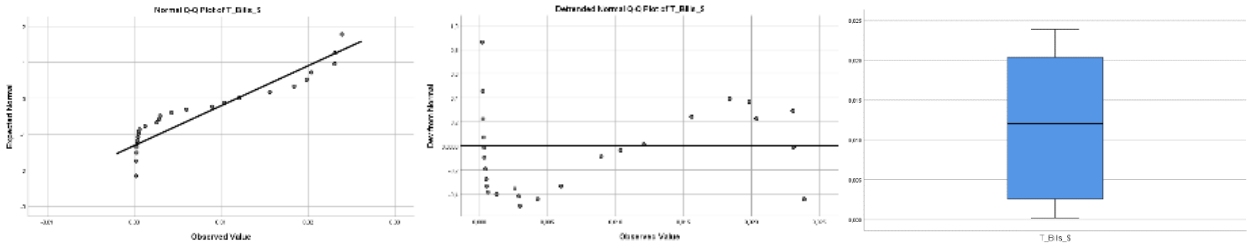


Fig. 65A Fig. 65B Fig. 65C

Figure 66 (66A, 66B and 66C) – Normality Plots with Tests: **EONIA €** (Source: Own elaboration, using SPSS).

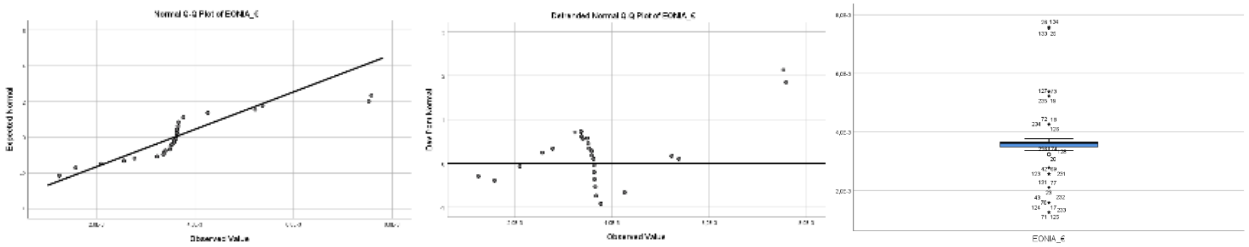


Fig. 66A Fig. 66B Fig. 66C

Figure 67 (67A, 67B and 67C) – Normality Plots with Tests: **LIBOR OIS $** (Source: Own elaboration, using SPSS).

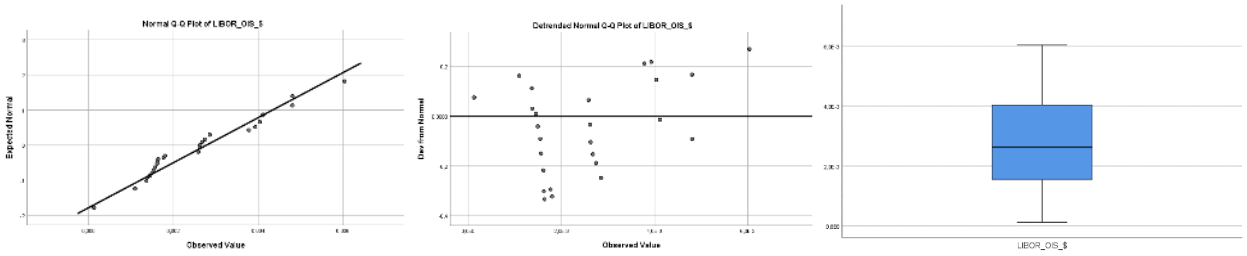


Fig. 67A Fig. 67B Fig. 67C

Figure 68 (68A, 68B and 68C) – Normality Plots with Tests: **Percentage (%) of Households with Internet Access in the World** (Source: Own elaboration, using SPSS).

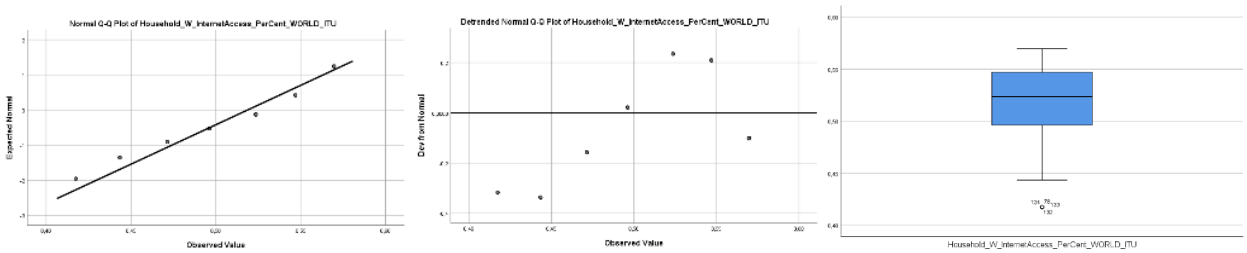


Fig. 68A Fig. 68B Fig. 68C

Figure 69 (69A, 69B and 69C) – Normality Plots with Tests: **Percentage (%) of Households with Internet Access in Developed Countries** (Source: Own elaboration, using SPSS).

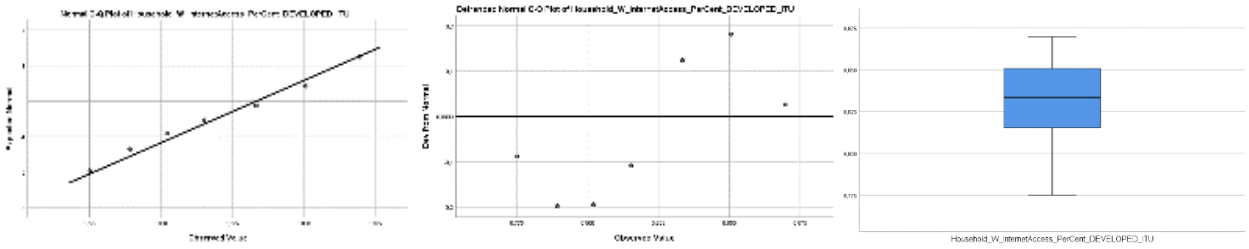


Fig. 69A Fig. 69B Fig. 69C

Figure 70 (70A, 70B and 70C) – Normality Plots with Tests: **Percentage (%) of Households with Internet Access in Developing Countries** (Source: Own elaboration, using SPSS).

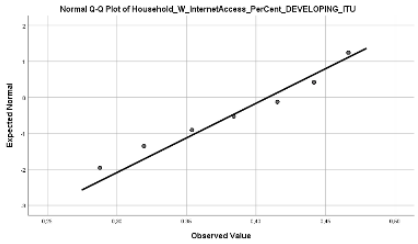


Fig. 70A

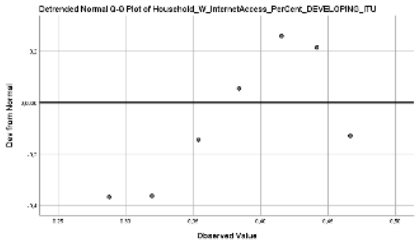


Fig. 70B

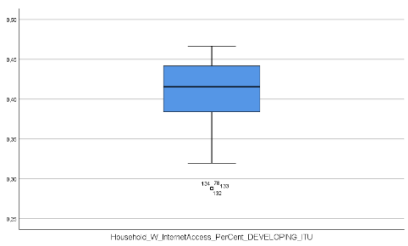


Fig. 70C

Figure 71 (71A, 71B and 71C) – Normality Plots with Tests: **Percentage (%) of Mobile-cellular Subscriptions in the World** (Source: Own elaboration, using SPSS).

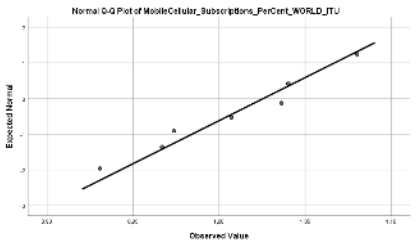


Fig. 71A

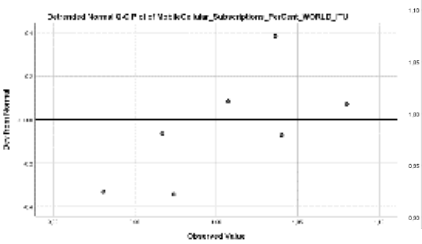


Fig. 71B

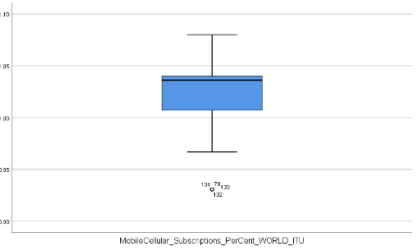


Fig. 71C

Figure 72 (72A, 72B and 72C) – Normality Plots with Tests: **Percentage (%) of Mobile-cellular Subscriptions in Developed Countries** (Source: Own elaboration, using SPSS).

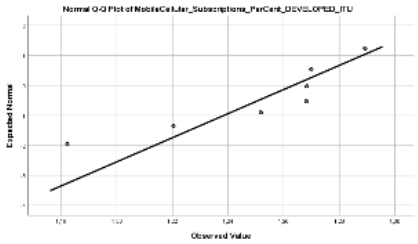


Fig. 72A

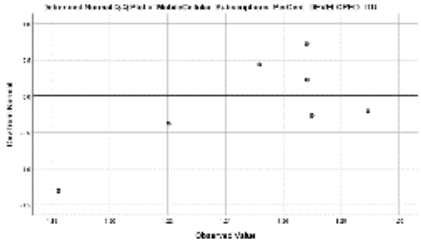


Fig. 72B

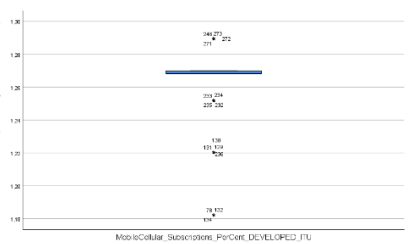


Fig. 72C

Figure 73 (73A, 73B and 73C) – Normality Plots with Tests: **Percentage (%) of Mobile-cellular Subscriptions in Developing Countries** (Source: Own elaboration, using SPSS).

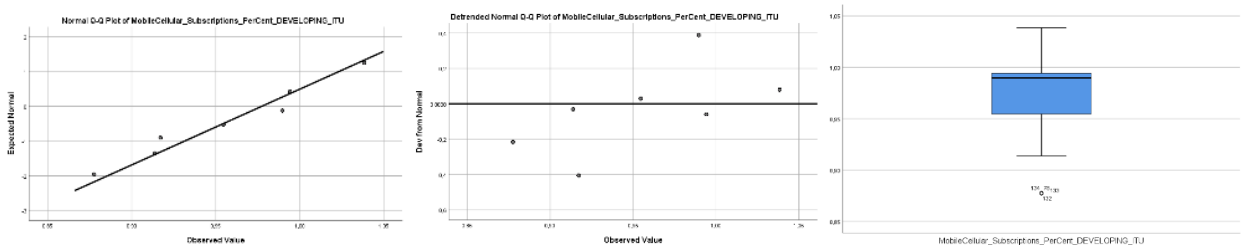


Fig. 73A Fig. 73B Fig. 73C

Figure 74 (74A, 74B and 74C) – Normality Plots with Tests: **Percentage (%) of Individuals Using the Internet in the World** (Source: Own elaboration, using SPSS).

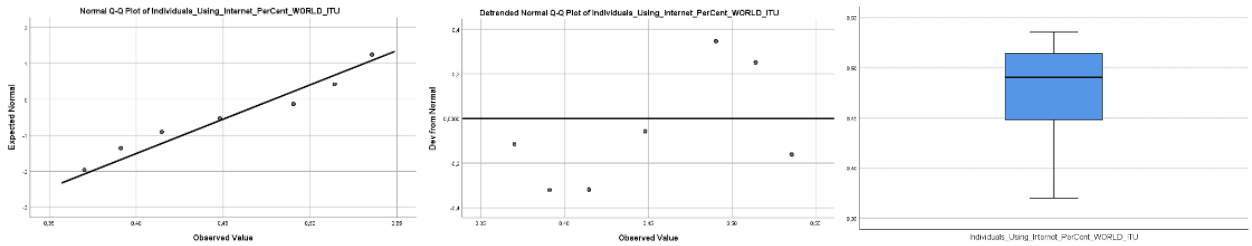


Fig. 74A Fig. 74B Fig. 74C

Figure 75 (75A, 75B and 75C) – Normality Plots with Tests: **Percentage (%) of Individuals Using the Internet in Developed Countries** (Source: Own elaboration, using SPSS).

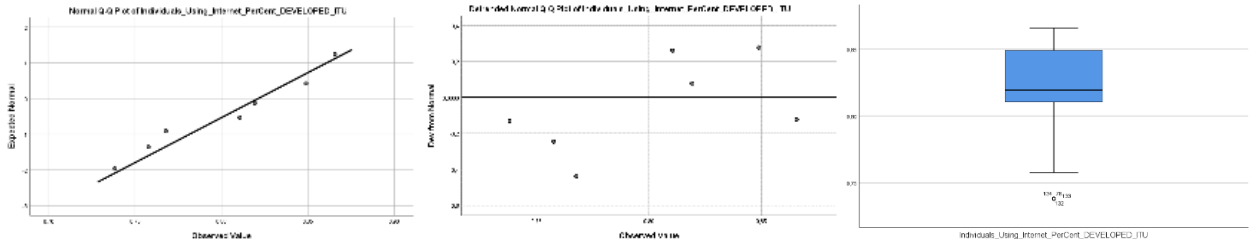


Fig. 75A Fig. 75B Fig. 75C

Figure 76 (76A, 76B and 76C) – Normality Plots with Tests: **Percentage (%) of Individuals Using the Internet in Developing Countries** (Source: Own elaboration, using SPSS).

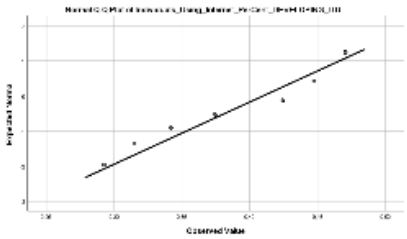


Fig. 76A

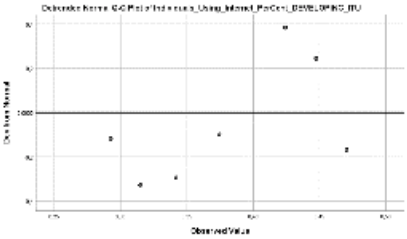


Fig. 76B

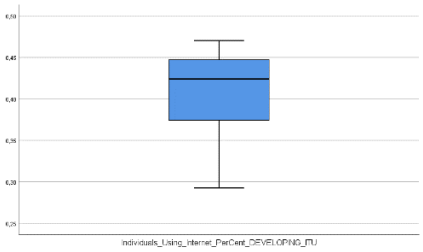


Fig. 76C