

Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economics



Bachelor Thesis

The role of Bitcoin in the shadow economy

Elias ABI SAAB

© 2018 CULS Prague

BACHELOR THESIS ASSIGNMENT

Elias Abi Saab

Economics and Management

Thesis title

The role of Bitcoin in the shadow economy

Objectives of thesis

The main objective is to conclude whether cryptocurrency is widely used as an alternative to traditional currency on the shadow market of illegal or precarious activities. This is to be done by approximating the portion of bitcoin users and bitcoins involved in illicit transactions.

Methodology

The practical part will elaborate on theoretical and support or reject them once the processed information is derived from the survey of a sampled group of Bitcoin users. The survey methodology uses a stratified sampled group. Once the data is collected, it is to be analyzed and evaluated, the conclusions are to be derived using basic statistical methods, and the outcomes are to be interpreted and articulated.

The proposed extent of the thesis

40 pages

Keywords

bitcoin, cryptocurrency, black market, Silk Road, illegal trade.

Recommended information sources

Chohan, Usman W. "A History of Bitcoin." SSRN Electronic Journal, 2017, doi:10.2139/ssrn.3047875.

Christin, Nicolas. "Traveling the Silk Road: A Measurement of a Large Anonymous Online Marketplace." 2012, doi:10.21236/ada579383.

Lansky, Jan. "Possible State Approaches to Cryptocurrencies." Journal of Systems Integration, vol. 9, no. 1, 2018, pp. 19–31., doi:10.20470/jsi.v9i1.335.

Liebkind, Joe. "Bitcoin Government Regulations Around the World." Investopedia, 5 Dec. 2017, www.investopedia.com/news/bitcoin-government-regulations-around-world/.

Tasca, Paolo. "Digital Currencies: Principles, Trends, Opportunities, and Risks." SSRN Electronic Journal, 2015, doi:10.2139/ssrn.2657598.

Expected date of thesis defence

2017/18 SS – FEM

The Bachelor Thesis Supervisor

Ing. Petr Procházka, Ph.D., MSc

Supervising department

Department of Economics

Electronic approval: 8. 3. 2018

prof. Ing. Miroslav Svatoš, CSc.

Head of department

Electronic approval: 9. 3. 2018

Ing. Martin Pelikán, Ph.D.

Dean

Prague on 09. 03. 2018

Declaration

I declare that I have worked on my bachelor thesis titled “The role of Bitcoin in the shadow economy” by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on date of 12 March 2018

Acknowledgement

I would like to thank name of the supervisor and all other persons, for their advice and support during my work on this thesis.

Roli Bitcoin v rámci stínové ekonomiky

Souhrn

Následující práce miří za cíl porozumět roli kryptocurrency v rámci stínové ekonomiky a přiblížit část nelegální aktivity související s bitcoinem. Výzkum spojuje teoretické základy s existujícími studiemi o zapojení Bitcoin na černých a šedých trzích a závěry odvozené z empirické studie založené na průzkumu uživatelů bitcoinů. Zjištění dokazují, že významná část hodnoty bitcoinu jako platebního systému pochází z jeho zapojení do nelegalneho obchodu.

Klíčová slova: bitcoin, kryptocurrency, černý trh, Silk Road, nelegální obchod.

The role of Bitcoin in the shadow economy

Summary

The following thesis aims to understand the role of cryptocurrency within the shadow economy and to approximate the portion of illegal activity associated with bitcoin in particular. The research will bring together theoretical foundation from the existing studies about the involvement of bitcoin on black and grey markets and conclusions derived from empirical study based on a survey of bitcoin users. The findings prove that a significant portion of bitcoin's value as a payment system comes from its engagement in illicit trade.

Keywords: bitcoin, cryptocurrency, black market, Silk Road, illegal trade.

Table of content

1 Introduction	10
2 Objectives and Methodology	11
2.1 Objectives.....	11
2.2 Methodology	11
3 Theoretical overview	12
3.1 Cryptocurrency.....	12
3.1.1 The uprising and history of bitcoin	13
3.1.2 Functionality	15
3.2 The role of cryptocurrency within the informal economy	18
3.2.1 Bitcoin and the black market	20
3.3 The future of bitcoin.....	22
4 Practical Part	26
4.1 Survey results and analysis	28
4.2 Outline of findings	33
5 Conclusion	37
6 References	39

List of pictures

Figure 1: The principle of blockchain (Creider, 2017)

Figure 2: Survey age demographics

Figure 3: Participants in black market and grey market transactions

Figure 4: Estimated number of illegal and legal bitcoin users

List of tables

Table 1: Which cryptocurrency is most used on the shadow market?

Table 2: The forums used for survey purposes

Table 3: Darknet marketplaces accepting bitcoin

Table 4: Black market listings as of 2014

1 Introduction

The complexity of ancient history and the fact that the origin of monetary systems of exchange predates written history make it rather difficult to present an overview of how people throughout the times thought about currency (Mundell, 2002). In the traditional understanding, a currency is a form of money used as a medium of exchange in a particular country and during a particular time period. Its transactions and circulation is usually regulated by the state or a national bank (Investopedia, 2015). This understanding of the function of money and currency is quite orthodox and is accepted in the majority of the countries as of today.

Now, when something as uncustomary as cryptocurrency is introduced, one can anticipate a massive interest arising from the public. Cryptocurrency is a whole new phenomenon that goes against almost every notion of a traditional currency — it is decentralized, not regulated by the government and has the power to transcend geographic borders. The first decentralized cryptocurrency — Bitcoin — was introduced back in 2009 and has been in the spotlight ever since (Chohan, 2017). Both individuals and businesses instantly expressed interest in Bitcoin upon its debut on the market, because most of the Western countries today are becoming increasingly transparent and globalized. This boosts the demand for universal currency that would guarantee instant and secure transactions carried out via the Internet.

It is safe to assume that the emergence of cryptocurrency is an indicator of the ongoing transformations happening within our society. However, the majority of the existing research on cryptocurrency is only concerned with its prospects and influence on the economy per se, and not the society. The social premise of the usage of any virtual money is poorly explained and explored. Nevertheless, cryptocurrency, aside from the benefits of anonymity and subterritoriality also holds the potential for the criminal economy (e.g. the acts of drug and weapon trafficking, human organs trafficking, money laundering, etc.) to run smoothly.

This thesis will focus on understanding the nature of bitcoin and its role within the shadow economy with an objective to approximate the portion of illegal activity that runs within bitcoin transactions.

2 Objectives and Methodology

2.1 Objectives

The main objective is to conclude whether cryptocurrency is widely used as an alternative to traditional currency on the shadow market of illegal or precarious activities. This is to be done by approximating the portion of bitcoin users and bitcoins involved in illicit transactions.

2.2 Methodology

The theoretical part of my thesis will overview the studies and relevant literature in regards to cryptocurrency and Bitcoin in particular. I will focus on the role of cryptocurrency in today's economy, the premises behind the emergence of virtual currency, its legal integration into economies throughout the world and its potential impact on the black market economy. The practical part will elaborate on those assumptions and support or reject them once the processed information is derived from the survey that I will conduct with a sampled group of Bitcoin users. Finally, I will analyze the conclusions derived from both theoretical and practical parts of my thesis and will articulate the outcomes.

3 Theoretical overview

3.1 Cryptocurrency

Cryptocurrency holds its essence in its name. It is an asset that works just like a traditional tangible or electronic currency, but also uses cryptography for security reasons. The cryptography serves to ensure the smooth running of transactions, to govern the creation of new units, and to control the transfers (Paolo, 2015). Cryptocurrency depends on methods of cryptography, i.e. new monetary units emerge as an output of particular digital operations. The process of carrying out such operations that allows the so-called extraction of cryptocurrency is called mining. Also referred to as alternative or virtual currencies, cryptocurrencies are completely decentralized contrary to electronic money and are not under control of any monetary authority (e.g. Central Bank), they are not tied to a specific issuing centre and operate entirely in the user's network (Szabo, 2015). Bitcoin, just as any other cryptocurrency, is fundamentally different from any electronic payment system (PayPal, Webmoney, online banking)). Unlike those payment systems, which serve merely as electronic representatives of real, tangible money, Bitcoin is not associated with any financial institution and thus cannot be a debt obligation (Szabo, 2015).

As outlined by J. Lansky (Lansky, 2018), a cryptocurrency is a digital medium of monetary exchange that falls under all of the following criteria:

1. Its system runs without an institution of authority;
2. Its system keeps and monitors the records of units that are being mined and owned;
3. Its system determines whether the new units are to be created;
4. Its system determines the circumstances under which the new units emerge;
5. Its system only issues transaction statements once the requester proves their ownership;
6. Its system only performs one transaction of the same units if multiple transactions are ran simultaneously;

Above all things, I want to clarify that, from here and onwards, the term cryptocurrency will mostly imply a specific digital currency — Bitcoin, since it is, as opposed to its counterparts (e.g. litecoin, DASH, Monero, ethereum, etc) was the first decentralized currency and hence has gained the most popularity (Tasca, 2015). The functionality of

other digital currencies is similar to that of Bitcoin, but they all have significantly lower market capitalization.

3.1.1 The uprising and history of bitcoin

The idea behind cryptocurrency first appeared in David Chaum's work in 1983. Chaum, a Dutch mathematician, came up with the technology that integrated anonymity and security into the features of electronic payments (Chaum, 1983). He paved the ground for many other scientists and enthusiasts to theorize about the digital currency of the future. The very term "crypto-anarchy" was first mentioned in 1994 by the *Time* magazine and was introduced as a philosophy of the superiority of privacy, confidentiality, and the inviolability of personal freedoms. Crypto anarchists raised their concerns about the increasing spreading of the Internet access and the surveillance techniques that they believed could be used to spy on people against their will. For them, cryptocurrency seemed like a shield against the fast-growing technology (Levy, 2002).

In January, 2009, Satoshi Nakamoto—a pseudonym that, according to different theories, could be either a person, a group of people, or an entity—presented the first version of the bitcoin wallet and officially launched the system for public use (Bernard, 2017). Alongside, Satoshi posted an article that briefly explained the technology and the program code of the system. The identity of the mysterious founding father remains unknown as of March, 2018.

There was no breakthrough a year in bitcoin's introduction, but some niche enthusiasts expressed their interest right away, which led to the creation of the first bitcoin forum. Similarly to today's *Bitcointalk*, the users on the forum were the ones trying to understand and simultaneously improve the system. As the word of mouth was spreading, its value was increasing respectively. When the rate went from \$0.06 to \$0.5 for a unit, the users launched the first stock exchange Mt. Gox for buying and exchanging cryptocurrencies (Bernard, 2017). That was when the first incident occurred and made people question the security and invulnerability of bitcoin. One anonymous user managed to create 182 billion bitcoins, while the maximum amount was limited to twenty-one million (Bernard, 2017). The protocol error, however, was instantly eliminated, and there were no other incidents reported ever since.

Bitcoin exchange rate has been volatile all throughout its existence. The value has been mostly going up as a result of speculative purchases and active promotions coming from bitcoin users. On December 17, 2017, bitcoin reached its value peak — a unit was worth \$19,783.21 (Coindesk, 2017). Nevertheless, when the series of hacker attacks on users' wallets happened in 2012, plenty of loyal bitcoin holders cleared out their accounts lest they lost their money. A year later, one of the three largest cryptocurrency exchange market—Mt. Gox— declared bankruptcy. The most heated scandal unfolded soon after, after the popularization of the online marketplace Silk Road, where anyone could exchange bitcoins for all kinds of illegal goods, e.g. drugs and weapons (Bernard, 2017). This drastically undermined the overall concept of cryptocurrency, since what were considered positive features—decentralization and anonymity—backfired.

In a bit over than a decade, a number of countries have already officially recognized bitcoin as a currency. Germany gave bitcoin a special status of a currency, Singapore embraced the digital currency on all the institutional levels, countries like the U.S., Finland, the Netherlands, to name but a few, labeled bitcoin to be a valuable commodity which is now included in the tax reports. While the popularity increases, the outlook for cryptocurrencies' legal status is still unclear (Liebkind, 2017). In December 2014, the U.S. House of Representatives introduced a bill which goal was to establish a five-year moratorium on the regulation of digital monetary circulation within the country (U.S. Congress Bill, H.R. 5777, 2014). The similar idea is under consideration in Chinese government. Meanwhile, PayPal—the largest electronic payment system—made a major step towards recognizing bitcoin in fall of 2014, when it announced its intention to cooperate with BitPay, Coinbase and GoCoin—the three largest bit-processors within buyers and sellers of digital money (Coindesk, 2014). PayPal, being the epitome of the globalized market, thus made a statement of the importance of acceptance of cryptocurrency and implementing its transactions in the 21st century.

Being a non-regulated currency, Bitcoin is surrounded by a number of risks that might be insignificant on an individual level, but are highly serious from the point of view of the governments and authorities. Among some risks are the following:

1. Since the market has no regulator for the circulation of bitcoin, it essentially creates a perfect conditions for the illegal activities, such as money laundering and tax evasion, to run smoothly (Liebkind, 2017);

2. There is no guaranteed security of one's wallet. Trading of bitcoins is carried out on Coinbase, the so-called exchange market, which controls private access keys. However, back in 2014 there was a case when a bitcoin broker from Japan under a nickname Mt. Gox one day disappeared with millions of dollars worth of bitcoins. Meaning, that the buyer can not effectively control his or her own bitcoin keys. The only secure way is to keep it printed instead of in a digital form, which also carries a whole list of risks associated with it (Liebkind, 2017).
3. No insurance applies to bitcoins as of today (Liebkind, 2017).
4. Similarly to any other investment asset, the price of bitcoin fluctuates. The absence of a regulator opens the door to any sort of manipulation, and the price of bitcoin can theoretically drop by 80% within a day (Liebkind, 2017).
5. The liquidity of bitcoin is also a risky matter, since the equilibrium between its supply and demand is not regulated in any way (Liebkind, 2017).
6. Last, but not least, until bitcoin receives some kind of legal status of a currency, it is not taxable and any losses from its speculation are not deductible from taxable profits (Liebkind, 2017).

By accepting or rejecting the legitimacy of bitcoin, governments are, arguably, expressing their priorities and attitudes. For some countries and authorities, assigning the legal status to bitcoin would mean encouraging the development of e-commerce, while for others the very same action would make it easier to run illegal schemes. The fine line between promoting innovative technologies and encouraging illegal business is under an ongoing discussion of world leaders.

3.1.2 Functionality

The currency that is founded on the program code cannot exist as cash. Bitcoin has a relative value to other currencies but is not tied to either any currency or an asset. Its exchange rate is determined by the market equilibrium of supply and demand, which is established through the tradings on specialized exchange markets. As of today, the most common practices associated with the cryptocurrency are mining, currency conversions,

exchange, investments, and buying/selling of various goods and services, both legal and illegal (Taska, 2015).

Following up on Lansky's six cryptocurrency criteria mentioned in 1.1, Bitcoin differs from a conventional currency in the following ways (Tasca, 2015):

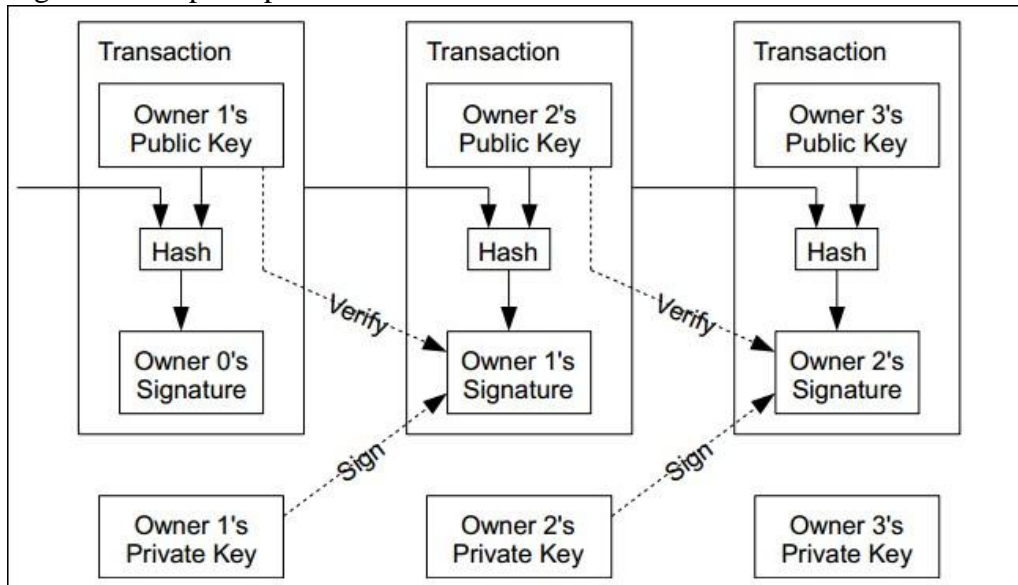
- It does not have a single control center; it operates because many users simultaneously have the same wallet program running;
- It cannot be banned or prohibited, since a failure of node in the network does not affect the rest of the network;
- It cannot be taken away, since only a person with an access to the wallet has an access to the money;
- It is not tied to a particular user;
- Its transaction cannot be denied, canceled, altered or affected in any way;
- It cannot cause inflation, since the system has a production schedule for new units which is embedded in its code.

The key foundation behind any cryptocurrency is the absence of any kind of a regulative main server for its database, meaning that the system is essentially decentralized. Encrypted copies of a database are accessible to all the participant within the system and is sustained by them. In case of Bitcoin, when we say system, we imply all the operations operations—extraction (mining), transferring, purchasing, sale—where Bitcoin is involved (Tasca, 2015). Any new entry in such a database is synchronized with all its copies of everyone who participates in this system (Creider, 2017). In layman's terms, if someone tries to steal something within a system, he or she would have to alter the data in databases of more than half of all the participants. Now that the network has more than a million participants, such fraudulent scheme is nearly impossible to execute because of the integrated algorithm of coordination (Creider, 2017).

The algorithm of coordination—blockchain—operates by integrating information (hash) from every block into the sequent one, and in such manner onwards. In a flowchart below, it is visible that the information from the first owner's transaction is engraved into the hash of the second owner, and both are integrated into the transaction of the third one (Figure 1). A transaction that falls out of the sequence is counterfeit. In order to forge a block—a payment—one would have to change the whole chain of blocks, each stored on

one of the millions of computers, meaning that he or she would need access to every single computer in the chain (Creider, 2017).

Figure 1: The principle of blockchain



Source: (Creider, 2017)

The process of bitcoin extraction is called mining. Mining is a complex calculation process which aim is to search for a number combination that would create a new hash. The process is carried out on computers or even whole systems of computers, the so-called mining farms. The production is limited by the system, its maximum is twenty-one million. Only one third has been extracted now, which is why there is a lot of speculation regarding what will happen when the limit is reached. More likely, the existing bitcoins will just circulate and occasionally change in value. As of now, the imposed limit protects the currency from inflation, since there is no way to print or devalue it. The principle is similar to that of gold, since, to obtain a bitcoin, it has to be either mined or bought (Creider, 2017).

The algorithm if bitcoin production is so complex that, regardless of the number of miners—people engaged in mining of bitcoin—a new unit would only appear once every ten minutes (Creider, 2017). The one who to mine a new unit last received a monetary reward. In this manner, all computers that participate in the production of bitcoin allow for transactions to happen and to convey the information regarding the transactions to all participants of the system.

The value of bitcoin has been fluctuating for a while now, experiencing rapid decrease and increase, but its unprecedented growth of 2017 made bitcoin to become a part of an investment mainstream agenda. Such growth is mostly due to the supply and demand imbalance. As of today, about 16.7 million bitcoins are in circulation; when the number of mined bitcoins reaches 21 million, that is, according to forecasts, will happen sometime in 2140, the mining will be stopped (Bernard, 2017). Thus, the growing interest in bitcoin due to the growth of its price leads to an increase in its demand, but the supply is steady and is not growing rapidly. Hence, prices are rising regardless of the attitudes of the markets.

When it comes to traditional currency, a long-term holding onto savings results into it gradually losing its value as the purchasing power of the savings decreases. Inflation of traditional money happens mainly due to the increase in the money supply within the country in excess in comparison to the requirements of commodity circulation. The money supply is to be easily increased if the government requires it (the reasons may be different: the growth of government spending, mass lending by unsecured currency, etc) as it is not essentially backed up by gold or any other resource. Cryptocurrencies, however, cannot meet the concept of inflation, since their number, similarly to the amount of gold on Earth, is limited by the algorithm. To create new bitcoins, one needs to spend his or her time and energy, which makes bitcoins to have the value similar to gold.

3.2 The role of cryptocurrency within the informal economy

From the very beginning of its existence, bitcoin has been a popular tool for monetary exchange within the shadow economy. In fact, this has played well for the currency itself, as it has boosted its demand and, respectively, increased bitcoin in value (Greenberg, 2017). Between the years of 2014 and 2015, a series of studies was conducted, which concluded that the average turnover of money in the shadow market is around half a million dollars a day, that is, almost \$180 million on an annual basis (Greenberg, 2017). Bitcoin serves for about half of the payments carried out on all the websites of a similar nature (Greenberg, 2017). Bitcoin is anonymous, meaning that every piece of information about each particular participant in the system is encrypted. This allows users to avoid punishment and prosecution from the special services. While for regular users, bitcoin is simply a highly volatile mean of payment, those who use it on the back market view bitcoin as a mean of payment that is easy to transfer but is nearly impossible to track back.

According to the research conducted by the *Recorded Future*—a real-time threat intelligence company—in 2018, among 150 scrutinized platforms with offers of illegal goods and/or services, Bitcoin remains the most preferred and circulated currency on the black market, followed by Litecoin (Recorded Future, 2018).

Nevertheless, the trend might change in the nearest future. As the rate and volume of Bitcoin coverage grow, its transactions slow down, which obstructs a smooth transaction and fosters concerns from users whose activity is time-oriented. The specifics of the black market is most certainly affected by the time pressure. The buyer and seller seek to maintain their anonymity and conduct a transaction as fast and as discreetly as possible. The larger the delay is between the payment and the shipment of goods, the more likely one is to become a victim of fraud. Therefore, users on the black market do not tolerate a long wait for the transaction.

According to the poll conducted by *Recorder Future*, those who encounter or run black market transactions with cryptocurrencies prefer the following ones:

Table 1: Which cryptocurrency is most used on the shadow market?

Cryptocurrency	Shadow market share (users)
Monero	21.28%
Dash	20.61%
Ethereum	19.39%
Litecoin	15.15%
Bitcoin	13.33%
Bitcoin Cash	9.70%

Source: interpreted according to the findings of *Recorded Future*, 2018

Black market operations in Europe are mostly supplied with Monero transactions, while American vendors prefer Dash and Eastern European users prefer Litecoin (Recorded Future, 2018). As indicated in the Table 1, as of 2018 bitcoin has lost its positions within the shadow economy, mostly due to its price and resulting outlays. Nevertheless, bitcoin still holds an imposing share of almost 14%, which, given its

accessibility and popularity, makes it one of the key cryptocurrencies within the shadow economy.

Before proceeding to the next two sections, I want to point at a difference between the gray market and the black market. Both refer to the illegal market segments, but there is a significant distinction between the two. Black market deals with all kinds of transactions with products that are banned by law (e.g. weapons, drugs, tobacco, pirated media and software, etc) (Economy Watch, 2010). Grey market deals with goods and services which are not necessarily illegal, but that were obtained or provided through the unauthorized channels or that exploited the loopholes in the legal system (e.g. crude oil sold by individuals, unregistered activity/tax evasion, undocumented workers, unauthorized distributors etc.) (Economy Watch, 2010). Bitcoin has not yet gained popularity within the gray market, since the transactions within it usually happen without any digital intervention and normally run with cash or regular web payments. However, given all the attributes of bitcoin, such as untraceability and anonymity, it has become widely used on black marketplaces since its very introduction.

3.2.1 Bitcoin and the black market

Back in 2012, Nicolas Christin, a researcher at the University of Carnegie Mellon, published a study in which he calculated how many bitcoins are involved in transactions that are somehow connected with illegal markets. Christin collected the data in the time range of 2011-2012 and determined that 4.5-9% (the range represents different evaluation methods used in calculation) of all bitcoins that are in the circulation as of now are or have once participated as mediums of exchange for illegal goods and services (Christin, 2012). The researcher also determined that as of 2012, the average listing of an illegal online market was about 13,000 products (Christin, 2012).

The most famous black market with bitcoins in circulation was the Silk Road, launched back in February of 2011. Its domain was located far in the deep web — a part of the worldwide network that is not indexed by conventional search engines. The websites of the deep web are not accessible by any hyperlinks and are extensively secured from the third parties.

It only took the Silk Road two and a half years to become an absolute leader in online drug selling, among which were marijuana, methamphetamines, heroin, cocaine,

LSD and many others. The volume of transactions from February 2011 to July 2013 was, according to the FBI estimates, approximately \$1.2 billion, and commission fees were nearly \$80 million (Trautman, 2014). According to the log in data of the users, 30% were US citizens, followed by those of the Great Britain, Australia, Germany, Canada, Sweden, France, Russia, Italy and the Netherlands (Trautman, 2014). The website also had offering of counterfeit cigarettes, works of art, clothing, jewelry and fake documents. The main turnover, however, was guaranteed by the drug selling—by March of 2013, drugs accounted for 70% of transactions happening on Silk Road (Trautman, 2014).

Silk Road could not exist without the anonymous software Tor and, of course, bitcoins. Bitcoin protected the users from being recognized by their names and places of ongoing or outgoing transactions. Theoretically, bitcoin transactions can be tracked, but used together with Tor, they leave almost no traces, at least not in the open segment of the Internet. To survive the extreme volatility of bitcoin, the prices on the Silk Road were in dollars (Trautman, 2014). When the FBI uncovered the person behind the Silk Road and shut the marketplace down, the value of bitcoin fell sharply in value (Trautman, 2014). It grew back soon though and many bitcoin enthusiasts believe that shutting down the Silk Road gives bitcoin a better name that is less associated with illegal activities.

Two years later Christin's research, the Digital Citizens Alliance (DCA) conducted a similar study, observing how the marketplaces reacted to the monopolist Silk Road ceasing to exist. New, smaller marketplaces entered the arena and the aggregate listing of illegal goods reached 41,207, almost 80% of which were drugs (DCA, 2014). All the marketplaces listed below used bitcoin as the main currency in all the transactions (DCA, 2014).

Law enforcement agencies from all around the world are becoming increasingly aware of darknet sites where cryptocurrency is used as a mean of payment. Among the examples of a special agency operation is the case of AlphaBay and Hansa darknet marketplaces that were shut down at the same time. Both were notorious for trading drugs, forged documents, weapons and other illegal goods. Trading on AlphaBay was only possible with three means of payment: bitcoin, Monero and Ethereum. According to Europol, since its launch in 2014 and until its closure in mid-2017, the users of AlphaBay have made transactions worth more than US\$1 billion (Gibbs, 2017).

Bits Media conducted its own experiment to understand how the payments for illegal drugs are being accepted by traders. They used the anonymous browser Tor to see how an ordinary internet user can buy drugs on the darknet. The first ten websites within the darknet offering banned substances were analyzed. The results were as follows: all ten platforms were accepting bitcoins (Bits Media, 2016).

3.3 The future of bitcoin

Bitcoin was originally intended as a system of data exchange independent from any state, political power, or territory). The beginning of its significant growth in popularity was back in 2013, when the rate increased from US\$20 to \$200 over the course of only four months (Trautman, 2014).. Bitcoin was noticed by some rather large investors, more people would express the interest and buy the cryptocurrency. By the end of 2013, the rapid rise in bitcoin's price could not be ignored any longer, and the number of users within the network began to grow at a much more rapid pace. This was when the governmental authorities from all around the world have started closely scrutinizing the currency and assessing its influence on national economies. For example, it was 2013 when the US Senate held a hearing discussing the risks, threats and prospects of virtual currencies. Back then, Ben Bernanke, the head of the US Federal Reserve, spoke in favor of bitcoin and indicated its efficiency as of a financial system because of being a cheaper alternative to the current system of international money transfers. Once the news spread out, the price of bitcoin instantly went up to US\$1000 (Trautman, 2014). The influence of bitcoin on state economies is as follows (Trautman, 2014):

- It is a threat to the national currency.

As bitcoin gains popularity, a state control over transactions is declining. First of all, bitcoin cannot contribute to a state treasury in any way, since the commission for its transactions does not go to any bank and there is no way of taxing the cryptocurrency capitals.

- Its circulation leads to reduced control over cash flows.

The anonymity of bitcoin allows citizens to avoid control over their monetary transactions. This encourages an unimpeded withdrawal of money from the country.

- It creates favourable conditions for trafficking of illegal goods.

To identify the buyer and the seller within a bitcoin transaction is almost impossible. This, as it was explained before, creates favourable conditions for trading banned goods within the country. By illicit goods one does not always mean just drugs and weapons, it can go as far as to any product considered illegal under current national policy.

The first reaction of most countries authorities in regards to bitcoin was extremely negative. Virtually all representatives of all states that have voiced their opinions on bitcoin were emphasizing the importance of informing the people about cryptocurrencies and the risks associated with them. One of the main concerns was that, since the system does not have a controlling body, neither the government nor the court would be able to refund the money to the users in case of fraudulent transactions. However, many believe that those warnings were not aimed to protect the public and their finances, but to form a negative image of the cryptocurrencies in the eyes of the people and to protect a state's ability to control its economy.

There are three main methods of regulation that have been discussed by the governments concerned with the recently increasing bitcoin popularity (Bloomberg, 2018):

- Taking control over crypto-exchange markets.

Since bitcoin is rarely used as a direct mean of payment and is mostly being exchanged for conventional currencies or hold onto, the governments can theoretically control the exchange, even though they would still not be able to control the transactions.

- Taxation

Giving a bitcoin the status of a commodity or an asset would make it possible to impose tax on all its transactions, particularly on exchange trades and profits from operations. This is what the Japanese government of Japan intends to do in the nearest future.

- Elimination of anonymity factor

National authorities may require crypto-exchange markets to register users on the territory of their countries and to verify their identity by providing copies of their Ids, passports and other documents. While it also does not make governments be in control over the

transaction, it reduces the anonymity feature and could potentially hard the bitcoin network of users who chose this payment system because of security reasons.

After its peak in December of 2017, Bitcoin has been steadily losing in value. The rate fall occurs as a result of strict regulations imposed on cryptocurrencies in many countries of the world. For example, in January of 2018, Chinese authorities voiced their intention to ban online platforms and mobile applications used for cryptocurrency tradings (Bloomberg, 2018). Earlier in fall of 2017, the authorities of the PRC banned the initial coin offering and closed all local crypto exchanges (Bloomberg, 2018). Interestingly, prior to the beginning of last year, China had the most active market for trading bitcoins on stock exchanges (Bloomberg, 2018).

In late 2017, South Korea announced that it intends to pass a law prohibiting the circulation of cryptocurrency on its exchanges. Korean Finance Minister Kim Dong-yeon confirmed this information and said that, while the future of bitcoin is still uncertain, the ministry is negotiating with the rest of the governmental authorities to prohibit transactions with cryptocurrencies within the country (Yonhap News, 2017).

The trend has also been picked up by the European authorities. The head of the Central Bank of Germany, Joachim Wuermeling, said that the regulation of cryptocurrencies, bitcoin in particular, should be carried out on a global scale, since national and regional laws would be difficult to implement within a limitless virtual community (Reuters, 2018).

In 2015, the European Court of Justice ruled that the exchange of bitcoins for fiat currencies is exempt from VAT. The court decision clarifies that the VAT law applies only to the supply of goods and services; the exchange of traditional currencies to the virtual cryptocurrency is thus an exempt from VAT. Transactions in bitcoins are attributed to payment transactions with currencies, coins and banknotes, and therefore are not subject to VAT. The Court recommended that all EU member states exclude crypto-currencies from the list of assets that are subjects to taxation (Reuter, 2018).

In 2017, the governmental authorities from all around the world have begun raising concerns regarding the use of cryptocurrency by different terrorist organizations (Express, 2017). This has yet again proved that one of the main markets that is greatly penetrated by bitcoin is that trading all sorts of illegal products and/or activities. Another problem

highlighted by the governments is the pattern of bitcoins being used for tax evasion. Cashing out bitcoins for a commission fee allows to avoid paying VAT and other taxes (Express, 2017). This can lead to massive tax evasion of entire spheres, for example, that of IT business.

Bitcoin is notorious for financing terrorist organizations and organizations that are not favorable to the government. For example, in 2014, the representatives of WikiLeaks stated that most of the donations that they receive come in the form of bitcoin payments (Express, 2017). A similar statement was then given by the representatives of Anonymous International (Express, 2017). Bitcoin cyber payments are obviously the most convenient way to go for organisations concerned with their security. Its anonymity features have already gained a massive popularity among cyber criminals, drug dealers, and computer virus traders.

4 Practical Part

As of today, there is little research done on the role of bitcoins within the shadow economy. While the presence of cryptocurrency on black and grey marketplaces boosts its value, rates, popularity, and coverage, being engaged into illegal activities also ties bitcoin to bad fame. This goes against the agenda of most bitcoin enthusiasts who view the crypto-assets as a libertarian solace rather than a tool for illicit purposes.

My research mainly consists of a survey of bitcoin users aimed to conclude whether or not illegal transactions are among the key motivations behind their interest in cryptocurrencies. The results are to be thoroughly scrutinized and explained by aligning them to the points of information learned in the theoretical part of the thesis. I will then analyze the existing data about dark marketplaces and the role of bitcoin on it and will derive conclusions based on my value-added research.

Even though bitcoin has been introduced almost a decade ago, it is still quite difficult to find a sample group of active bitcoin users using the snowball sampling. Given that, I have decided to reach out to the bitcoin forums and ask its users to fill out the questionnaire. Since the topic of illicit activities is quite difficult to tackle without implying incriminating oneself, I have tailored the questions to be unequivocal and highlighted the fact that it is being conducted for research purposes only. I have received the filled out questionnaires from 150 respondents which was a target number. Below is the list of forums where the survey was posted and the coverage of each as to the final results (the percentage of users from this forum in a sample). The sample shares also reflect the coverage and the size of the forum itself, meaning that the greater the share is, the greater is the average user activity on this forum (Table 2).

Table 2: The forums used for survey purposes

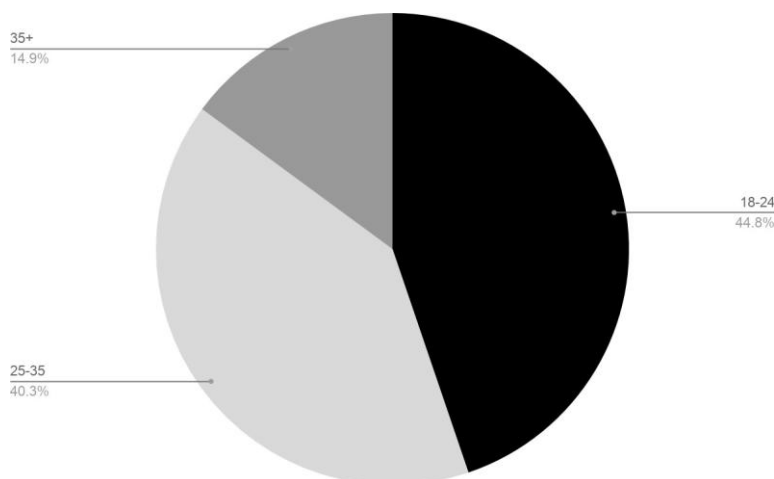
Name of a bitcoin forum	Sample % (out of 100%)	Sample portion (out of 150)
Cryptoheresy (cryptoheresy.com)	29.3%	88
Bitcoin Talk (bitcointalk.org)	33.3%	100

Masters of Crypto (mastersofcrypto.com)	14%	42
BTC Warriors (btcwarriors.com)	4.7%	14
Bitcoin Forum (bitco.in)	18.7%	56

To understand the demographics of the respondents, the survey included the questions about age, education level, and employment status of bitcoin users. The demographic questions about gender and ethnicity are left out because of being irrelevant to the research.

The age demographic of the research is visualized on the pie chart below (Figure 2). The majority of the respondents (46.6%) are between the age of 18 to 24, forty percent are between the ages of 25 and 35, and the rest is composed of people over 35 years old.

Figure 2: Survey age demographics



Source: Elias Abi Saab (Forum survey)

The age breakdown partially explains the two other demographic units. Out of the respondents, 33.3% have master’s degree, 26.7% have bachelor’s degree, 20% have some college credit without a degree, 12.3% have some kind of trade, technical, or vocational training. Only for 1% of the respondents high school is the highest educational level obtained, and another 1% has a Doctoral degree. Correspondingly, 40.5% are full-time employees, 19% of the respondents are full-time students, 16.4% are unemployed, 11% are part-time employed, 9.2% are freelancing, and 3.2% ticked the option “other.”

Such sample is proved to be representative since it largely consists of the most expected demographic groups as for this research, e.g. employed young adults with a university degree. The prevailing number of this demographic among Bitcoin users and investors is supported by the research conducted by the scholars of the University of Illinois Urbana-Champaign in 2014 (Bohr, 2014).

The questions asked were the following:

- Was engaging in illicit trade the main reason you opened a bitcoin wallet?
- Have you ever bought or sold any black market good or a service with a bitcoin?
- Have you ever bought or sold any gray market good/service with a bitcoin?
- Have you ever traded on Silk Road?
- Have you ever traded on any other dark marketplace?
- Do you personally know anyone who has ever used bitcoins for illegal transactions?
- Do you agree that bitcoin is a tool for law evasion?
- Do you think an individual's political and economic freedoms should be maximized?

The seven questions above were composed for the survey to answer the main research question: *What is the share of illegal activity on the Bitcoin network?*

4.1 Survey results and analysis

To interpret the survey results for each question and derive a conclusion that would partially answer the research question, I will further elaborate on all the findings, explain why they are valuable, and align them with already existing research and/or points of information from the theoretical part.

- Was engaging in illicit trade the main reason you opened a bitcoin wallet?

According to the survey results, 26.7% of the respondents initially launched their bitcoin wallets with an intent to participate in illegal trade. This number is impressively high as opposed to the 73.3% of bitcoin users who got their wallets for other reasons. Now, it is important to consider that the initial motivation does not always result in action. Initial motivation to engage into illegal trade using bitcoins can be fueled by curiosity and the

marketing. The follow-up questions are intended to estimate a share of bitcoin users who are more tightly associated with the illicit trade.

According to the study of the University of Technology Sydney (UTC), those involved in illegal activity tend to actively buy and spend bitcoins, while legal users usually hold the cryptocurrency to convert it to cash under a higher rate (Foley, 2018). To test this, I have added a follow-up question of whether or not a user actively participates in bitcoin transactions and aligned them with the initial question. The results were as follows: 71% of those who initially opened a bitcoin wallet for engaging in illicit activities are actively participating in bitcoin transactions. On contrary, only 25.7% of those who opened a wallet for legal activity actively participate in bitcoin transactions, as opposed to 74.3% who rather hold to the currency.

Interestingly, more than half (54.1%) of those who claim their initial motivation was that of illegal intent are respondents between the age of 25-35. This might be related to the drug industry which is especially well-popularized within this age demographic (Foley, 2018).

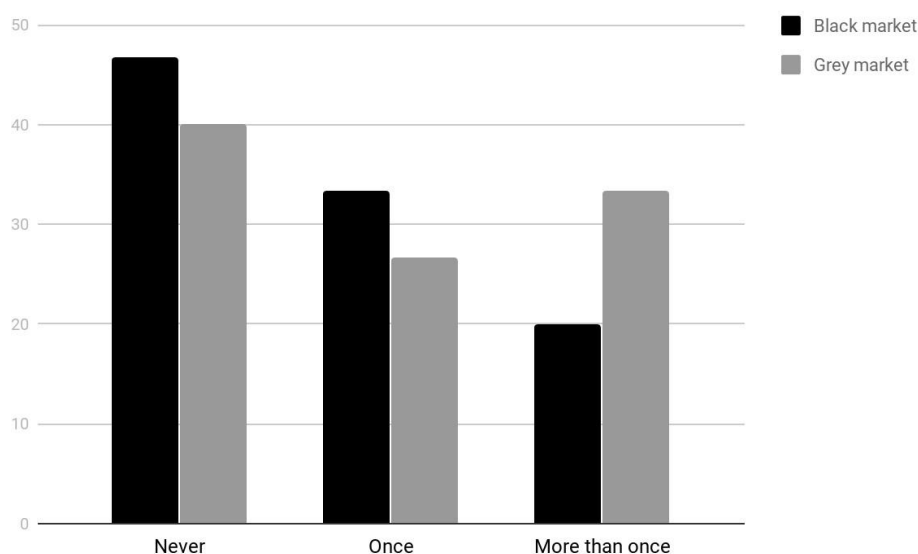
- Have you ever bought or sold any black market good or a service with a bitcoin? As delimited in the section 1.1.3 of this thesis, black market deals with all kinds of transactions with products that are banned by law (e.g. weapons, drugs, tobacco, pirated media and software, etc) (Economy Watch, 2010). This was specifically clarified for the respondents during the survey.

The findings were the following: 46.7% of the respondents answered that they have never participated in any black market transactions using bitcoins, 33.3% said that they were engaged in such transactions once, and 20% claimed participating in black market transactions more than once. This statistics better reflects the intent to action ration. While only 26.7% of the respondents initially launched their bitcoin wallets with an intent to participate in illegal trade, 53.3% of the respondents actually acted on this intent at least once. The follow-up question was optional because of its delicate nature and asked to choose among the illegal goods that a respondent ever bought on any black marketplace. 89.2% of the respondents chose drugs, which represents the demand and the respective supply of drugs on the dark web, as indicated in section 1.1.3.

- Have you ever bought or sold any gray market good/service with a bitcoin? Grey market, as it has been explained, deals with goods and services which are not necessarily illegal, but that were obtained or provided through the unauthorized channels or that exploited the loopholes in the legal system (e.g. crude oil sold by individuals, unregistered activity/tax evasion, undocumented workers, unauthorized distributors etc.) (Economy Watch, 2010). The difference between the two was explained to the respondents.

The statistics here is fairly similar to that of the previous question regarding the black market, that being 40% have never participated in a grey market transaction, 26.7% participated in such once, and 33.3% engaged in a gray market trade more than once. The difference between the findings in regards to the black and the grey markets is visualized below:

Figure 3: Participants in black market and grey market transactions



Source: Elias Abi Saab (data from the survey)

Given from the above chart, it is safe to conclude that the grey market activity is somewhat more prevalent, as it has a higher rate of users who have participated in it more than once. This can be partially due to the fact that 9.2% of the respondents are freelancers, who, as it tends to be, sometimes stay outside of the taxation system and do not pay income tax. Such activity is among the grey market scope, as it is rather ambiguous and hardly punishable, but still technically considered to be illegal.

- Have you ever traded on Silk Road?

Only 5% of the respondents ever conducted any transactions on the first modern darknet market Silk Road. However, 86.6% of those who did used bitcoins as the mean of exchange, while the other 13.4% named another cryptocurrency, and none of the respondents who traded on Silk Road used any conventional, non-encrypted form of web-payment.

- Have you ever traded on any other dark marketplace?

Thought only 5% of the respondents said that they have ever traded on Silk Road, 18.4% said that they have traded on other darknet marketplaces. Again, 89% of them used bitcoin for their transactions.

The seizure of the Silk Road has given more popularity and space for development to smaller, niche marketplaces. After being shut down in 2013, users have shifted their activity to a number of other darknet markets, many of which were closing as they open, not surviving a week. This is why, for the purpose of this research, I did not follow up to ask the specific illegal marketplaces on which bitcoin transactions were run by the respondents. However, below is the list of marketplaces accepting bitcoin that were and are in operation for more than a year and that (Table 3). The status “operation” indicates that the marketplace is still running as of March, 2018.

Table 3: Darknet marketplaces accepting bitcoin

Market	Launch date	End date
Dream	November 15, 2013	Operational
Outlaw	December 29, 2013	Operational
Silk Road 1	January 31, 2011	October 2, 2013
Black Market Reloaded	June 30, 2011	December 2, 2013
AlphaBay	December 22, 2014	Operational
Tochka	January 30, 2015	Operational
Crypto Market/Diabolus	February 14, 2015	Operational

Real Deal	April 9, 2015	Operational
Darknet Heroes	May 27, 2015	Operational
Agora	December 3, 2013	September 6, 2015
Nucleus	October 24, 2014	April 13, 2016
Middle Earth	June 22, 2014	November 4, 2015
BlackBank	February 5, 2014	May 18, 2015
Evolution	January 14, 2014	March 14, 2015
Anarchia	May 7, 2015	May 9, 2016
Silk Road 2	November 6, 2013	November 5, 2014

Source: interpreted in accordance with *Darknet market archives*, Gwen Branwen (2018)

- Do you personally know anyone who has ever used bitcoins for illegal transactions?

While applying the snowball method for sampling the respondents was practically inefficient, this question aims to achieve a better scope of coverage. Bitcoin users tend to have a network of other bitcoin users, which provides a glimpse into a bigger sample than the three hundred surveyed within this research. According to the responses, 87% of the sample personally knows someone who has ever used a bitcoin for illicit reasons.

- Do you agree that bitcoin is a tool for law evasion?

Since it is a rather open question, the respondents, aside from yes/no options, had an opportunity to fill out a short comment form to elaborate on their thoughts. To sum up, 73.3% said that bitcoin is, indeed, a tool for law evasion, against 20% who said that is not, and 6.7% who abstained from answering. As anticipated, the almost even breakage does not provide a specific answer, but the comments give a deeper insight.

Among the 34 people who left the explanation in the comment section, 30 were the ones who ticked the option “yes” and 4 chose the option “no.” Twelve of the thirty-four

pointed at the ambiguity of cryptocurrencies nature and said that it can be both a tool for fruitful legal and illegal activity. Three respondents expressed their concern with the legal oppression coming from the governmental authorities, and said that bitcoin is not a tool for law evasion, but a tool for establishment of a new legal system. The other fifteen were vocally agreeing with the fact that bitcoin is the simplest law evasion instrument to ever exist in a cybernated and highly surveilled world that we live in now.

- Do you think an individual's political and economic freedoms should be maximized?

According to the research of Bohr and Masooda, 37% of bitcoin users consider themselves Libertarian or anarcho-capitalist (Bohr, 2014). The question is my research is less limited to a particular political tendency and aims to understand a bitcoin user through his or her set of belief systems.

It is especially interesting to break down the percentage count by those who answered “yes” and “no” to the very first question — *was engaging in illicit trade the main reason you opened a bitcoin wallet?* 26.6% of respondents said that it was, indeed, the initial reason they opened a bitcoin wallet, against 73.3% of those who opened a bitcoin wallet for legal reasons. Now, 78.7%—67 respondents—of those who initially opened a bitcoin wallet for illicit trade answered “yes” to having more political and economic freedoms. On the other hand, only 11.8% —26 respondents—of those who opened a bitcoin wallet for legals other than illegal answered “yes” to the same question.

Overall, 31% of all the respondents agreed that an individual should have as much economic and political freedom as possible, which is close to the 37% as reported by Bohr and Masooda (Bohr, 2014).

4.2 Outline of findings

To sum up the findings and make conclusions, below is the main points of information derived from the survey of a 300 person sample:

1. 26.7% of the respondents initially opened their bitcoin wallets with an intent to participate in illegal trade. More than half of them (54.1%) are respondents between the age of 25 and 35.
2. 33% of the respondents have sold or bought a black market good or service once, 20% participated in such transactions more than once. 89.2% of those who said he

or she has had a black market transaction at least once said it was to buy or sell drugs.

3. 26.7% of respondents said that they have sold or bought a grey market good or service once, 33.3% did it more than once.
4. 5% of the respondents have had transactions on Silk Road. 86.6% of them used bitcoins as a mean of exchange.
5. 18.4% of the respondents have had transactions on other darknet marketplaces than Silk Road. 89% of them used bitcoins for their transactions.
6. 87% of the respondents know someone who has used bitcoins for illegal transactions.
7. 73.3% of the respondents believe that bitcoin is a tool for law evasion.
8. 31% of all the respondents agreed that an individual should have his or her economic and political freedoms maximized.

All of the above indicate an alarming presence of bitcoins on illegal marketplaces and, vice versa, an increasing illegal offers available to buy in bitcoins. As indicated in section 1.1.4, the report of the Digital Citizens Alliance points at the enormous number of darknet listings, and that is only a select marketplace list, which leaves out dozens of other platforms for selling and buying illegal goods and services.

Table 4: Black market listings as of 2014

Marketplace	Total listing	Drug listing	Weapons
Silk Road 2.0	17,192	13,648	No
Agora	9,158	7,400	Yes
Pandora Openmarket	5,812	5,249	No
Evolution	5,523	2,623	Yes
BlueSky Marketplace	1,833	1,740	No
Dark Bay	329	292	No
The Pirate Market	367	247	Yes

Outlaw Market	246	230	No
Tor Bazaar Alpha	252	205	Yes
Black Bank Market	239	201	No
White Rabbit Anonymous	256	194	Yes
Total listings	41,207	32,029	5-Yes/6-No

Source: *Busted, but Not Broken: The State of Silk Road and the Darknet Marketplaces*, Digital Citizens Alliance, 2014.

to the findings of my research, more than 50% of bitcoin users have participated in either black market or grey market transactions at least once, while only a quarter (26.7%) initially opened a bitcoin wallet for conducting illegal transactions. This indicates that, allegedly, almost half of the already mined bitcoins in circulation have been once involved in some kind of illicit activity.

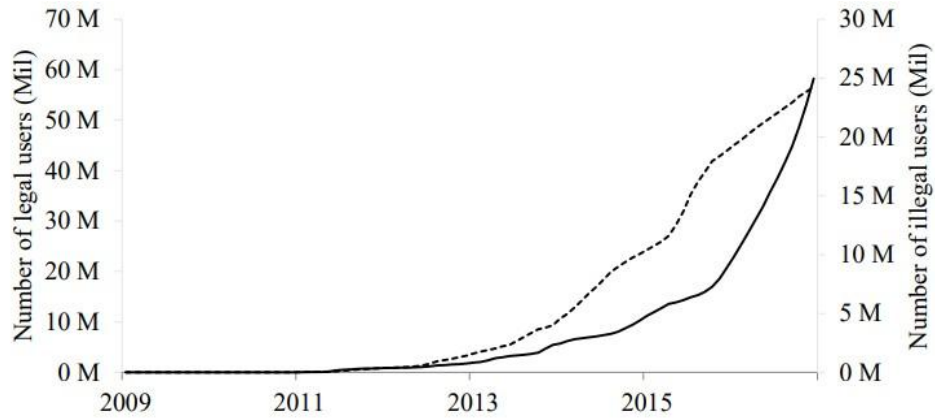
The findings of my research also reflect a more global insight into the role of bitcoin within the shadow economy proposed by the study from the Foundation for Defence of Democracies, Center on Sanctions and Illicit Finance, which suggests the following level of illicit activity in bitcoin network (Yaya, 2018):

- 24 million of bitcoin users are associated with illegal activities, accounting for 25% of all bitcoin users;
- 36 million illegal transactions are carried out on an annual basis, which accounts for 44% of all transactions;
- \$72 billion volume of illegal transactions per year, which is 20% of the dollar equivalent of all transactions;
- \$8 billion in the form of illegal bitcoin-holdings (as of January, 2018);
- 51% of all bitcoin-holdings have a history associated with illegal transactions.

Interestingly, Yaya and Robinson claim that the proportion of illegal bitcoin activities within a bitcoin network has been decreasing since 2015, when many new bitcoin users have entered the market out of sheer curiosity (Yaya, 2018). Nevertheless, the absolute amount of illicit activities including bitcoin transactions has been going steadily

up. The proportion has declined merely due to the increase of legal bitcoin transactions. The approximate comparison of legal and illegal bitcoin users is visualized on Figure 4 (Foley, 2018). According to Foley, illegal bitcoin users account for more than 44% of all bitcoin users (Foley, 2018). It is noteworthy that, as it was mentioned before, according to my research, 55% bitcoin users have ever conducted at least one black market transaction.

Figure 4: Estimated number of illegal and legal bitcoin users



Source: Sex, Drugs, and Bitcoin: How Much Illegal Activity is Finances Through Cryptocurrencies, Foley, 2018.

5 Conclusion

The potential of a bitcoin to serve for illegal purposes has been the most discussed cryptocurrency-related issue for years, and has only receded to the background amid the rapidly increasing price of bitcoin. Its recent volatility has made bitcoin rather unattractive for potential investors, which yet again opens new potential for more illegal transactions to penetrate the system.

In the future, the large use of bitcoins on the illegal arena can both benefit and harm the cryptocurrency. As it was indicated in the theoretical part, a shutdown of darknet marketplaces usually boosts the value of bitcoin due to it becoming more trustworthy in the eyes of those who intend to engage in legal activity. On the other hand, given a considerable share of bitcoins and bitcoin users involved in illegal trade—20-60% according to different researches mentioned above, including this one—its value is largely determined by illicit activity. Some new cryptocurrencies and encrypted payment systems, such as Monero and ZCash, could potentially weaken the position of bitcoin within the black markets, which is also to affect the value of bitcoin.

The close association of cryptocurrency, bitcoin in particular, with illegal activities is hardly a surprise. Both governmental authorities and bitcoin enthusiasts have been alarmed about cryptocurrency's potential to become a tool for law evasion since it has made its first entrance to the public. Yet, the statistics, both obtained through this research and analyzed from the already existing ones, puts bitcoin's role on the shadow economy in a prospective. It highlights the importance of the monitoring the market and keeping the system free from governmental control, yet not letting it step over one's personal freedoms. The fine line between the two is why the governments are struggling to agree on an ultimate status of bitcoin and other cryptocurrencies.

The theoretical studies and approximations reviewed earlier, along with more empirical, value-added research presented in the practical part, according to which 53% of bitcoin users have participated in black market transactions, and 60% of bitcoin users have been engaged in grey market transactions, prove that a significant portion of bitcoin's value as a payment system comes from its engagement in illicit trade. While it is still hard to say whether the use of bitcoin leads to an increase of illicit, black and grey market activity, or if it simply shifts that activity from an offline site to the Internet, it is safe to

claim that bitcoin is tightly associated with illegal activity on both macro—state—and micro—individual transactions—levels. This should be a sounding alarm for governments and independent alliances to rethink their understanding of crypto-exchanges and to look for ways to make it a safe space free from potentially dangerous activities.

6 References

- Allison, Ian. “Nick Szabo: If Banks Want Benefits of Blockchains They Must Go Permissionless.” *International Business Times UK*, 11 Sept. 2015, www.ibtimes.co.uk/nick-szabo-if-banks-want-benefits-blockchains-they-must-go-permissionless-1518874.
- Barnes, Joe. “Bitcoin WARNING: ISIS Using Cryptocurrency to Fund Reign of Terror as Bitcoin Price Soars.” *Express.co.uk*, Express.co.uk, 17 Dec. 2017, www.express.co.uk/finance/city/893151/Bitcoin-price-latest-news-ISIS-terror-cryptocurrency.
- Bernard, Zoë. “Everything You Need to Know about Bitcoin, Its Mysterious Origins, and the Many Alleged Identities of Its Creator.” *Business Insider*, Business Insider, 2 Dec. 2017, www.businessinsider.com/bitcoin-history-cryptocurrency-satoshi-nakamoto-2017-12.
- “Black Market, Black Economy, Grey Market, Gray Market.” *Black Market, Black Economy, Grey Market, Gray Market | Economy Watch*, www.economywatch.com/market/market-types/black-market.html.
- Bohr, Jeremiah, and Masooda Bashir. “Who Uses Bitcoin? An Exploration of the Bitcoin Community.” *2014 Twelfth Annual International Conference on Privacy, Security and Trust*, 2014, doi:10.1109/pst.2014.6890928.
- Canepa, Francesco. “Any Rule on Bitcoin Must Be Global, Germany's Central Bank Says.” *Reuters*, Thomson Reuters, 15 Jan. 2018, www.reuters.com/article/us-bitcoin-regulations-germany/any-rule-on-bitcoin-must-be-global-germanys-central-bank-says-idUSKBN1F420E.
- Chaum, David. “Blind Signatures for Untraceable Payments.” *Advances in Cryptology*, 1983, pp. 199–203., doi:10.1007/978-1-4757-0602-4_18.
- “China Escalates Crackdown on Cryptocurrency Trading.” *Bloomberg.com*, Bloomberg, 15 Jan. 2018, www.bloomberg.com/news/articles/2018-01-15/china-is-said-to-escalate-crackdown-on-cryptocurrency-trading.
- Chohan, Usman W. “A History of Bitcoin.” *SSRN Electronic Journal*, 2017, doi:10.2139/ssrn.3047875.
- Christin, Nicolas. “Traveling the Silk Road: A Measurement of a Large Anonymous Online Marketplace.” 2012, doi:10.21236/ada579383.

- Crider, Michael. "What Is Bitcoin, and How Does It Work?" *How-To Geek*, How-To Geek, 7 Dec. 2017, www.howtogeek.com/141374/htg-explains-what-is-bitcoin-and-how-does-it-work/.
- "Darknet Marketplace Watch." *Digital Citizens Alliance*, www.digitalcitizensalliance.org/get-informed/darknet-marketplace-watch/.
- "Financial Regulator Warns of Bitcoin Bubble." *Yonhap News Agency*, english.yonhapnews.co.kr/news/2017/12/28/0200000000AEN20171228003200320.html
- Foley, Sean Mname, et al. "Sex, Drugs, and Bitcoin: How Much Illegal Activity Is Financed Through Cryptocurrencies?" *SSRN Electronic Journal*, 2018, doi:10.2139/ssrn.3102645.
- Foundation for Defense of Democracies, *Bitcoin Laundering: An Analysis of Illicit Flows into Digital Currency Services | Foundation for Defense of Democracies*, www.defenddemocracy.org/media-hit/yaya-j-fanusie-bitcoin-laundering/.
- "From \$900 to \$20,000: Bitcoin's Historic 2017 Price Run Revisited." *CoinDesk*, 30 Dec. 2017, www.coindesk.com/900-20000-bitcoins-historic-2017-price-run-revisited/.
- Gibbs, Samuel, and Lois Beckett. "Dark Web Marketplaces AlphaBay and Hansa Shut Down." *The Guardian*, Guardian News and Media, 20 July 2017, www.theguardian.com/technology/2017/jul/20/dark-web-marketplaces-alphabay-hansa-shut-down.
- Greenberg, Andy. "Crackdowns Haven't Stopped the Dark Web's \$100M Yearly Drug Sales." *Wired*, Conde Nast, 20 July 2017, www.wired.com/2015/08/crackdowns-havent-stopped-dark-webs-100m-yearly-drug-sales/.
- Gwern. "Darknet Market Archives (2013-2015)." *Sitewide Global ATOMRSS*, 17 Feb. 2018, www.gwern.net/DNM-archives.
- "H.R. 5777 (113th): Cryptocurrency Protocol Protection and Moratorium Act." *GovTrack.us*, www.govtrack.us/congress/bills/113/hr5777/text.
- Lansky, Jan. "Possible State Approaches to Cryptocurrencies." *Journal of Systems Integration*, vol. 9, no. 1, 2018, pp. 19–31., doi:10.20470/jsi.v9i1.335.
- Levy, Steven. *Crypto: How the Code Rebels Beat the Government-- Saving Privacy in the Digital Age*. Penguin Books, 2002.
- Liebkind, Joe. "Bitcoin Government Regulations Around the World." *Investopedia*, 5 Dec. 2017, www.investopedia.com/news/bitcoin-government-regulations-around-world/.

“Litecoin Emerges as the Next Dominant Dark Web Currency.” *Recorded Future*, 9 Feb. 2018, www.recordedfuture.com/dark-web-currency/.

Mundell, Robert A. *The Birth of Coinage*. Columbia University, Department of Economics, 2002.

“PayPal: Bitcoin Partnerships Will Help Us Study Consumer Behavior.” *CoinDesk*, 26 Sept. 2014, www.coindesk.com/paypal-bitcoin-integration-will-help-study-buyer-behavior/.

Staff, Investopedia. “Currency.” *Investopedia*, 2 Nov. 2015, www.investopedia.com/terms/c/currency.asp.

Tasca, Paolo. “Digital Currencies: Principles, Trends, Opportunities, and Risks.” *SSRN Electronic Journal*, 2015, doi:10.2139/ssrn.2657598.

Trautman, Lawrence J. “Virtual Currencies: Bitcoin & What Now after Liberty Reserve and Silk Road?” *SSRN Electronic Journal*, 2014, doi:10.2139/ssrn.2393537.