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Cryptocurrencies and Regulation, a Master Thesis on the best practices for regulating cryptocurrencies within the EU

By

Arthur R. Bos
S1306464

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Declaration of Authorship

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This work was done wholly or mainly while in candidature for a research degree at this University.

Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.

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Signed: Arthur Bos

Date: 06-07-2018

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1. Introduction

'Banking is essential, banks are not' is the controversial statement released by Bill Gates in 1994 arguing that banking would be needed in the future but banks themselves would become obsolete (Filkorn). This statement has not been realized yet and is currently far from being realized. However, steps are being taken in order to provide an alternative financial system that is not reliant on banks. Within the wake of the 2008 financial crisis, distrust amongst governmental authorities and private banking institutions were soaring. The crisis resulted in a near complete collapse of the banking system and led to bailouts of insolvent banks, ultimately reaching a pinnacle in low interest rates and zero inflation and a general lack of economic stimuli (Guadamuz and Marsden 2). It was therefore a logical consequence that cryptocurrencies and their proposed Peer-To-Peer financial system gained immense popularity during an era of distrust and uncertainty. Bitcoin was born during this tumultuous time and provided stakeholders such as consumers or businesses to execute transactions without the reliance on one party (Banks), allowing them to operate outside of the regular existing financial institutions (Panchèvre 5).

All cryptocurrencies follow the same principle following the ideas of the cryptologist Satoshi Nakamoto, the father of Bitcoin. Nakamoto released his white paper in 2008, effectively laying the foundation for cryptocurrencies. The main features laid out within the whitepaper of Bitcoin, is largely the same for other cryptocurrencies which are defined as alt-coins (Alternative coins). These features range from, having a decentralized network, utilizing a Peer-to-Peer connection, requiring internet access and have some form of cryptology incorporated in their technology and accounts (Wallets) (Spenkelink 8).

The rise of these cryptocurrencies has led to increased popularity and interest for cryptocurrencies. For instance, there are currently over 1634 different cryptocurrencies (Considered as Alt-coins) and the estimated number of active users of cryptocurrency wallets has risen from a figure of 3,177,707 in 2015 to 23.952.849 in 2018 (Statista). The crux of cryptocurrencies however, is that law and policymakers often lag behind technological developments and don't know how to regulate novel phenomena in their early stages. This is reflected within cryptocurrencies insofar that different approaches for regulating cryptocurrencies are taken around the globe. The lack of consensus on regulation is reflected in for instance, the classification of cryptocurrencies where one nation state might regard cryptocurrencies as assets or commodities and others might classify them as transfers of payment or virtual goods and services. The exact rules and regulations therefore differ across the globe. Additionally, the disparity is reflected within the different legality classifications around the globe as some nation states classify cryptocurrencies as legal whereas others classify them as illegal or restrict the usage.

To tackle the problem of the lack of consensus on regulation, a G20 summit had been summoned in Argentina on the 19th and 20th of March, 2018. The summit focused on the future of cryptocurrency highlighting the necessity for a holistic and global approach in terms of regulating cryptocurrencies (Achal; Pollock). The conclusion of the summit had been that additional data and information need to be gathered before recommendations can be put forth within the deadline of July 2018. The additional data is however missing as there are very few precedents to provide the data. Additionally, the different approaches towards regulating cryptocurrency that have been taken make it increasingly hard to judge what the best approach is towards regulating cryptocurrencies. For instance, the first pathway to regulating

cryptocurrencies, is the option of banning or restriction on the use of cryptocurrency. Secondly, a 'Wait and see' approach is chosen by the majority, effectively waiting for others to dive into a favorable strategy that could set the standards. Lastly, there is the option of implementing regulation (Pollock; McConnell 37; Sotiropoulou and Guégan 472-477).

The EU is then regarded as having the possibility of obtaining a leading role for regulation as the Vice President of the European Commission (Andrus Ansip) urged the member states of the EU to accept and contribute financially and politically to technologies such as Artificial Intelligence and the Blockchain as the EU is currently falling behind in terms of these technological developments. Additionally, Ansip stated that technological developments require the right conditions and infrastructure hence the deadline for recommendations for regulations is pushed for July 2018 for the G20 members (Georacopoulos; Partz). The EU has however, been keeping a watchful eye on the developments regarding the blockchain and is developing an interest in blockchain technology as for example Ansip recognized that the Distributed Ledger Technology (Blockchain) could serve an infinite amount of possibilities (Ansip).The EU has therefore invested in several projects to promote blockchain technology develop through for example, the EU Blockchain Observatory & Forum and EU blockchain funds (European Commission, "Blockchain technologies"; European Commission, "Study on… infrastructure").

As far the European Central Bank (ECB) is concerned, virtual currencies are considered as: 'A digital representation of value that is neither issued by a central bank or a public authority, nor necessarily attached to a fiat currency, but is accepted by natural or legal persons as a means of payment and can be transferred, stored or traded electronically' (ECB, CON/2016/49). The Electronic Money Directive specifies three conditions which electronic money is required to meet to be classified as such. These three conditions are: (I) Electronically stored, (II) issued on

receipt of funds of an amount not less in value than the monetary value issued (III) accepted as means of payment by undertaking other than the issuer (ECB 43; EU Directive 2009/110/EC). The current situation within the EU with any form of virtual currencies is that there is a lack of a regulatory framework. The rules and regulations that are currently implemented are limited to money laundering and to prevent fraud/illicit transactions. Additionally, individual member states within the EU are taking their own approaches towards regulation leading to disparity and a climate of uncertainty within the EU.

The ECB and the EU recognize that the risks they face with cryptocurrency for them are risks such as price volatility, operational risks, the use of cryptocurrencies for illegal activities such as money laundering and reputational risks when the central bank is not regulating or managing virtual currencies (ECB 6, 45). Other risks include the impact these newly developed virtual currencies have on the economy as the ECB faces difficulties in managing price stability and impact of monetary policy as the money supply and the velocity of Money is altered due to the substitution effect (ECB 34, 35). A paradox then arises as the EU and the ECB have the possibility to alleviate certain risks that are associated with cryptocurrency through regulation as it will allow for an extended toolkit to deal with the risks and uncertainties. It is however the case that the EU largely engages in a 'Wait and see' approach and up until this point is hesitant about implementing any forms of additional regulation. It is however stated by Valdis Dombovskis, the EU's financial chief that should a global response be omitted, the EU will step up its game and consider EU wide regulation as he states: "We do not exclude the possibility to move ahead (by regulating cryptocurrencies) at the EU level if we see, for example, risks emerging but no clear international response emerging." (Gibbs). The EU's goals for regulation are to build on a framework that lets innovation flourish as they recognize the benefits of the technology that

cryptocurrency brings but managing the risks that are tied to cryptocurrencies as Mariya Gabriel, EC commissioner for Digital Economy and Society mentioned: *"We need to build an enabling framework to let innovation flourish, while managing risks and protecting consumers."* (Suberg). In the current climate of regulation within the EU however, the lack of regulatory clarity and consensus leaves the users of cryptocurrencies at risk. This risk needs to be mitigated without stifling further innovation in Europe. Amidst the paradox of regulation whereby lawmakers are hesitant to regulate cryptocurrencies by can mitigate the risks of cryptocurrencies, this Thesis will explicate what the best approach for the EU is towards regulating cryptocurrencies. This will be done on the basis of answering two research questions:

1. Why should cryptocurrencies be regulated?
2. What are the best approaches to be taken in terms of regulating cryptocurrencies in congruence with the goals of regulation laid out by the EU?

The three dimensions of regulation that will be discussed are: Consumer risks, taxation and classification. This thesis will explicate what types of risks plague cryptocurrencies and how they impact the aforementioned dimensions. Recommendations and proposals will be put forth in order to mitigate the risks that cryptocurrencies currently pose to the fullest extent that is possible. These recommendations and proposals will be in line with the possibilities, current infrastructure and the goals by laid out by the EU.

Methodology

The research question requires a multi-faceted approach. The thesis is therefore split into five chapters to answer the different aspects and characteristics that come into play when discussing regulation on cryptocurrency. The approach of this thesis is focused on literature analysis, examining which areas there is agreement and disagreement. Theory and theoretical frameworks will help explain the benefits and disadvantages of cryptocurrencies and the different approaches towards regulating cryptocurrency. Thereafter, a quantitative analysis will be undertaken on the EU and its individual member states, the different approaches of regulation and within the scope of two research dimensions; classification and taxation (Little to no data is available for consumer risks). For determining the best practices in the EU, a theoretical framework will be put forth and discussed in relation to the different dimensions of regulation discussed in this Thesis.

First and foremost, chapter (2) will clarify the exact nature of cryptocurrencies by providing background information. The exact workings of cryptocurrencies will be put under a magnifying glass in order to come to a complete understanding of this novel technology. Thereafter, the rationale behind regulating cryptocurrencies will be brought to light, explaining why regulation is necessary in the first place and the goals of regulation. Additionally, this chapter focuses on risk assessment (Cost-Benefit analysis), risk mitigation and assessing the prospects of cryptocurrencies. To determine whether or not cryptocurrencies have a future, models proposed within academia will be interpreted to determine the rate of adoption of cryptocurrencies. Having established whether or not regulation is desirable, the different approaches towards regulation should be analyzed. This chapter (4) will firstly identify the different approaches and their characteristics. Secondly, the different aspects of the approaches

will be conceptualized and whether they are desirable. Finally, examples will be given where the different approaches are practiced. As a case study and since the focus of this thesis is on the EU, the individual approaches of the member states of the EU will be discussed in accordance with the three dimensions of regulation chosen for this Thesis. Moreover, this chapter will also elucidate on the classification of cryptocurrencies within the EU. Additionally, the developments of the EU regarding cryptocurrencies and their plans will be examined. The final chapter will answer the question which actor is best suited to be targeted for regulation and which pathway is most suitable for the EU. This will be done by assessing internet architecture and using an analogy with cryptocurrency within the aforementioned architecture. Ultimately, having incorporated the different facets of cryptocurrencies and discussed the merits and demerits of the different approaches and cryptocurrencies themselves and what actor to target, recommendations can be established on the basis of the three dimensions of regulation.

2. Cryptocurrencies explained and why regulation is necessary

2.1 Background on Cryptocurrency

The economist Milton Friedman stated during a 1999 interview on the topic of the internet that: “The one thing that’s missing, but that will soon be developed, is a reliable e-cash, a method whereby on the Internet you can transfer funds from A to B, without A knowing B or B knowing A” (Walton 6). Additionally, he mentioned that this form of money would serve a function of anonymity and would therefore be a viable option for crime (Walton 6). This idea became a realization during 2008 with the release of the whitepaper on Bitcoin, the first cryptocurrency that had emerged. Cryptocurrencies represent a novel and avant-garde digital currency with the intent of harnessing a financial system that is aimed at a worldwide adoption scheme and supplanting or substituting national sovereign fiat currencies and dominating the modern financial systems with one single digital fungible asset that is traded globally and is based on a global exchange-backed valuation (Turpin; Walton 11). The cryptocurrencies that exist today largely follow several characteristics. These characteristics include:

- A Peer-to-Peer connection and data transfer scheme and is therefore decentralized by nature (Although there are some exceptions such as nationally developed cryptocurrencies).
- Contain a finite and fixed total amount or supply of coins that can be generated or given (Also influences price, availability).
- Incorporates a public ledger (Mostly known as a Blockchain) or database that stores records of transactions and transfers of coins which prevents double spending.
- Feature a computational algorithm or “Proof of work” which verifies the integrity of the blockchain and consecutive blocks that contain the transaction data. In most cases, the

computational power is provided by “Miners” to the network. Due to the finite amount of coins in circulation in most cryptocurrencies, the algorithm scales in difficulty and computational power required in accordance to the amount of coins mined.

- Utilize some form of cryptography (Usually public and private key cryptography) for safe storage (Kapoor 16; Spenkelink 8-11; Baur et al. 67, 68; Sotiropoulou and Guégan 468).

These are the guiding principles that most cryptocurrencies follow. However, since there are, as of May 2018, 1634 cryptocurrencies in total there are some differences between all of these cryptocurrencies (Coinmarketcap). However, for the scope of this research it is not relevant to discuss the differences in technical implementations and mechanisms. To demonstrate how cryptocurrencies operate and how they are utilized, I will make use of the prime example of Bitcoin which is currently still considered as the “Golden standard” of cryptocurrencies and alt-coins share most similarities with Bitcoin.

Bitcoin is an open-source Peer-to-Peer, global and decentralized network that facilitates the transfer of funds in the respected currency. It does so in a global scale and on the basis of a key pair (Public and private) whereby the public address is much like an IBANC number or e-mail address that can be shared to a given person or enterprise for commerce purposes (Kapoor 16). An essential element in the Bitcoin network is the decentralized nature as the money only exists virtually and there is no third-party intrusion allowed to alter the network in any way shape or form. All transactions that are undertaken on the network require a verification process through the use of digital signatures whereby all transactions are publicly announced and stored within a public ledger which has been dubbed as the “Blockchain” (Spenkelink 10). This process eliminates the double spending problem as the system keeps track of who is the owner of the virtual currency and all transactions are checked and verified. Subsequently, these transactions

are enacted through the mining process whereby users offer their computational power to solve a computational problem (A "Proof of work") in order to verify that a transaction is legitimate and to encrypt transactions within the block chain (Spenkelink 10). Those that aid in contributing to the Bitcoin network through mining are awarded with Bitcoins should they be the first that mine a new block. The proof of work is however, becoming exponentially more difficult as the total amount of Bitcoins to be circulated is capped at 21 million with the intent of becoming deflationary as soon as the cap is nearing (Kapoor 15, 16). In sum, cryptocurrencies can therefore be defined as follows: "A cryptocurrency is a digital medium of exchange that relies on a decentralized network, that facilitates a peer-to-peer exchange of transactions secured by public-key cryptography" (Spenkelink 8).

Bitcoin is one of the prime examples of cryptocurrency but newer coins are entering the market through Initial Coin offerings every day. These coin offerings can be seen as kickstarter projects for newly developed coins whereby coins might utilize a different scheme of circulation, algorithm or proof of work. The basic principles as sketched above however, apply to most cryptocurrencies. From a societal perspective and from the ideas of Satoshi Nakamoto within his whitepaper '*Bitcoin: A Peer-to-Peer Electronic Cash System'*, the main incentive has been to implement a system that would allow for the possibility to decentralize authorities (Banks), enact transactions on a peer-to-peer basis whereby everything is recorded in public databases and is immune to risks such as counterfeiting and fraud (Nakamoto; Rijers and Coeckelbergh 106, 107). However, since the ideology behind cryptocurrencies is to evade any third-party intrusion, the question of regulation becomes increasingly blurry as that would go against the very foundation of many cryptocurrencies and their virtual communities that are avid on privacy and decentralization.

2.2 Do we need Regulation for cryptocurrencies at all?

Regulation on cryptocurrencies need not happen when cryptocurrencies remain a niche in the market. After all, why would it be worth regulating something that has no perceived benefits or constitutes only a small fraction of usage in terms of use as a method of payment or funds. For cryptocurrency to receive any form of future regulation, they should have either; a competitive or beneficial aspect, superior qualities and a positive future outlook. At the core however, regulation is necessary due to the risks such as the facilitation of illicit transactions and this is independent of whether or not cryptocurrencies will surpass or substitute traditional currencies. This chapter will therefore elucidate to what extent cryptocurrencies accomplish the aforementioned aspects. The first aspect that will be discussed are the risks that cryptocurrencies face and why it is necessary to regulate cryptocurrencies to counteract these risks. Subsequently a cost and benefits analysis will be done in order to determine whether or not cryptocurrencies have some type of advantage or edge over traditional currencies. Thereafter, the prospects, adoption rates and usage statistics will follow to sketch the future of cryptocurrencies.

2.3 The Risks and demerits of cryptocurrencies

The decentralized nature of cryptocurrencies can be seen from as either an advantage or a disadvantage. The disadvantage however, is that cryptocurrencies do not have a central authority that is in charge other than those that develop software (Wallets, transaction software) for cryptocurrencies. These software engineers are however not liable nor responsible for anything that happens. This makes cryptocurrencies a disruptive force as there is no codified law in the technology that would protect its users in the case of fraud or hacks (Kapoor 23). Aside from the technological blueprint, there is also no (Authority) on cryptocurrencies. A second major

drawback of the current cryptocurrencies is that they are currently massively utilized as a speculative tool for investing and achieving quick capital returns on investments. Price volatility is argued to be one of the most negative influence on further adoption of cryptocurrencies as it makes speculative attacks possible and cryptocurrencies cannot be used for purposes such as borrowing and lending due to their fluctuating price (Baur et al. 70, 71; Spenkelink 24-28; ESMA 11, 12). The ECB regards the risks to price stability, financial stability and payment system to be the most crucial. Price stability is argued to be crucial as cryptocurrencies influence the velocity of money, money supply and impact monetary policy through unreliable information due to the lack of monitoring and gathering of payment data of cryptocurrencies (ECB 33-35). Secondly, financial stability might be at risk as virtual currency schemes work outside of the banking system and present some risks in the form of speculation, cannot provide trust in their current state and the highly fluctuating price (See figure 3, 4). Price volatility limits users and businesses to utilize cryptocurrencies as a medium of exchange as the price greatly differs per exchange and time period (See figure 5) (McConnell 28, 29). This is exactly the reason why vendors and businesses such as Steam (Valve) have revoked the possibility of payments in cryptocurrencies as the funds that they receive might be worth either more or less the very next day and transactions fees were skyrocketing. This happened during December 2017 when transaction costs for Bitcoin per transaction was close to 20$ (Dinkins). Additionally, the number of cryptocurrencies is still growing and the amount invested as well as part of these novel projects being launched despite warnings issued by central authorities.

Another major hurdle for cryptocurrencies, are the security risks that are attached to cryptocurrencies. For instance, should a person gain access to your virtual (Software) or hardware (E.g. Ledger Nano) wallet, and your funds are stolen or subjected to fraud, there is no

possibility of getting your funds back (Spenkelink 45). Similarly, whenever a user would enact a transaction and sends funds to the wrong recipient, there is no way to remit the funds (As there is no central authority – Banks) other than trusting on the goodwill of the person or business that received the funds. Building upon security risks, as cryptocurrencies involve software and code, the storage in digital wallets, personal devices, online storage lockers or in exchanges are subjected to vulnerabilities as any other pieces of software and therefore pose a security risk. There are numerous examples of cryptocurrency exchanges that have been hacked in the past whereby the business and their clients lost their funds without any legal backup or recourse. The prime example being the Mt. Gox (Magic the Gathering Online Exchange) which was the biggest Bitcoin exchange in the world. This exchange been hacked back in 2013 and 2014 where $473 Million Dollars' worth of Bitcoin (740,000 Bitcoins) were stolen (Schwarz). Even more ambiguous, is the Bitfinex exchange that is currently ranked as the 5th biggest exchange in the world for cryptocurrencies. This exchange had been compromised in a hacking heist in August 2016 whereby 120,000 Bitcoin at a value of 66 million Dollars was stolen. All bitcoins were lost from the exchange and as is the case with almost all of the hacks, users never received compensation or any form of security at all (Schwarz). The crux here however, is that Bitfinex is currently still very much alive and kicking and still an extremely popular exchange as for example a volume of 39,507.19 has been traded during May 2018 (Bitfinex). These cryptocurrency exchanges are however not subjected to intense and strict regulation as regular banks hence why security in the past has been lacking as it was most likely not one of the top priorities (Cryptocurrency exchanges in their current form are not considered as critical infrastructure).

Another major reason why lawmakers and authorities alike are in the current state of affairs, hesitant to regulate cryptocurrency is that implementing forms of regulation without careful consideration or being one of the pioneers, could potentially backfire as it presents uncertainty. Stepping into the unknown presents risks for lawmakers themselves as they could potentially implement ineffective regulation or implement a regulatory scheme that would promote risks rather than mitigating them. One of these risks is for example, the way in which cryptocurrencies has in the past and continues to facilitate illicit transactions as it comprises a form of partial anonymity or as Jacob Boersma, senior manager of the blockchain team at Deloitte states: "Use by criminals is a disadvantage. The partial anonymity facilitates this." (Spenkelink 46). Perhaps the most infamous of examples is the Silk Road drug market that was part of the deep web or The Onion Router (TOR) network. Silk Road was a hidden service that was almost entirely anonymous whereby the design philosophy was to create a free market that could exist without the scope of government control. Transactions through this network would solely be done with cryptocurrencies which offered a level of anonymity that is far greater than any other form of currency or method of payment (Norry). Silk Road has ever since its existence experienced several revivals and Silk Road is not the only market (E.g. Wall street market, Dream Market, Cannazon etc.) for illegal goods and services within the deep web. Everything on those platforms and beyond however, are funded through cryptocurrency due to the relative anonymity that they provide (Norry). The aforementioned risks are some of the most critical that are facing cryptocurrencies. To get a more nuanced view however, the benefits and adoption rate must be discussed.

2.4 Benefits and Cost-benefit overview

There are certain benefits within cryptocurrencies which have resulted in the adoption rates that have been exhibited recently and cryptocurrencies diffused into public knowledge. By the current design, cryptocurrencies such as Bitcoin, Litecoin and Ripple have certain benefits over traditional fiat currencies. The consumers that seek to minimize their reliance on a single payment service provider such as their local bank, are through the technology and ideology behind cryptocurrencies, able to freely choose between the range of cryptocurrencies for all their financial service needs (If accepted by other parties). The first benefit is therefore the decentralized nature which is able to make global transactions, instant (Fast) and cheap through a Peer-to-Peer network and the mining process that only charges very little transactional fees (Although in the case of Bitcoin, this has increased severely due to the rise in price). It is estimated by the Venture Capital Company that efficient blockchain technology is able to reduce the need for costly banking infrastructure by which 20 billion Dollars could be saved (This figure is most likely much higher for worldwide adoption) (Kapoor 19). Efficient blockchain technology refers to the implementation of proof-of-work schemes that are less energy intensive, data compression algorithms for efficient storage allocation to minimize the costs compared to the costly traditional banking infrastructure. Quite similarly, due to the blockchain technology, all transactions are visible and this is something that gives potential for actors such as the EU to keep an audit trail or for taxation purposes (Spenkelink 40, 41). If implemented in a correct manner, blockchain technology is also capable of identifying those that engage in illicit transactions, aiding in the process of identifying individuals or groups which engage in fraud or utilize cryptocurrencies for illicit purposes.

The most influential benefit which cryptocurrencies bring is the technology that is the backbone of these cryptocurrencies: The Distributed Ledger Technology (DLT) (Different terminology for Blockchain technology). The European Securities and Markets Authority (ESMA) identifies that there are benefits to this technology. These benefits range from an efficient trade process (Security, safekeeping, record-keeping), enhanced reporting and oversight, resilience and availability (Potential to fend off cyber attacks or system breakdowns (DDoS), reduced risks and reduced costs (ESMA 5-7). At the same time, they report the risks: Limited deployment in their current state, immutable transaction (Cannot cancel or revoke transactions), privacy issues, risk of fraudulent activities, volatility, liquidity risk (ESMA 7-12). Weighing in every pro and con on cryptocurrencies will not be fruitful. However, recognizing the most important costs and benefits in terms of risks and possibilities that they provide is important for the purpose of seeing where opportunities and risks lie and adapting regulation accordingly. The core feats of cryptocurrencies and their risks and opportunities are listed below:

Table 1. The core feats of cryptocurrencies with their Possibilities and Risks

Feat	Possibilities	Risks
Transparency	Easy to monitor, tracking, visible to any party	Even though you can track transactions, there is still pseudo-anonymity and not much else can be done
Ease of Use	Low cost, fast and global transactions, payment options	Knowledge required to enact transactions or make use of the software,

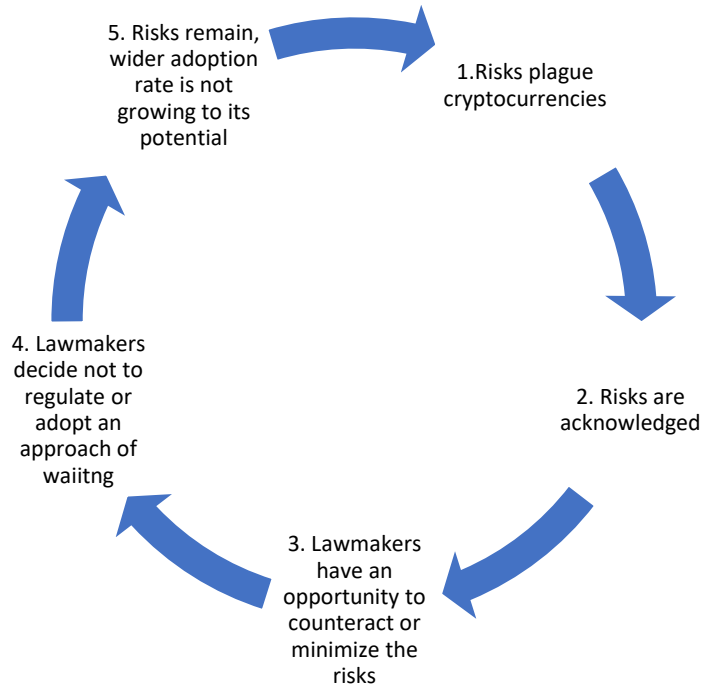
	are vastly increasing (Apps, software etc.)	
Economic growth	Investment opportunities, technological development (Blockchain technology and the likes)	Difficulty in taxation/tax evasion, profit shifting,
Decentralized	Shifts from the traditional banking structure relying on a Peer-to-Peer network and exchanges	No government backing, volatility of the crypto's
Security	Cryptographic proof and securitization of your account and funds (Private and Public key cryptography), resilience towards DoS attacks	Possibilities of security breaches such as hacks (E.g. 51% attacks)

(Folkinshteyn and Lennon 223-244; Baur et al. 66-77; Spenkelink 24-54; McConell 24-36; Kapoor 16-29; Douma 15-27). For a full overview on the costs and benefits on cryptocurrencies, see Table 3 in the appendix.

2.5 The bottom line why regulation is necessary

The question then becomes, why would actors such as the EU, banks, intermediaries even consider regulating something that is plagued with disadvantages and certain risks. The answer to this question is multi-faceted. First and foremost, the paradox needs to be broken as some of the issues that face cryptocurrencies can be mediated by applying regulation. The paradox that

occurs is that regulators are hesitant to implement regulation as they are unsure how their implementation will turn out. The paradox leading to a vicious cycle:



Making a conscious decision by governments not to regulate cryptocurrencies can pose dangers for their users. As the ECB points out: “Owing to the small size of virtual currency schemes, these risks do not affect anyone other than the users of the schemes” (ECB 47). The main incentive for regulation would therefore be to counteract the risks that actually prevents actors from regulating or even from happening in the first place. Examples of risks that occur due to the lack of regulation could be; a speculative attack, loss of money (Although these also apply for traditional currencies), no obligation for intermediaries (Exchanges) to protect data (See Mt.Gox attack) and consumer risks when making a purchase or investing in cryptocurrencies, illicit transactions and tax evasion. Currently, actors such as the ESMA and the U.S Securities and Exchange Commission only warn for the risks of Initial Coin Offerings (ICOs). These are considered to be highly risky and speculative investments (ESMA, “ESMA Highlights ICO

Risks for Investors and Firms; Clayton). At this point in time, there is no way of protecting users that engage in funding these ICOs. In addition, the volatility of cryptocurrencies reflects that the majority of transactions that are processed are utilized more for speculative gain rather than actual methods of payment for goods and services. All in all, the aforementioned risks and paradox lead to uncertainty and a lower adoption rate.

The adoption process is however exhibiting growth rates as for example, the estimated number of active users of cryptocurrency wallets has increased from 3,177,707 users in 2015 to 23.952.849 in 2018 (Statista) (See figure 6). Total market capitalization has also increased massively from approximate 17-25 billion in January 2017 to a peak of 284,822 million in January 2018 (See figure 7) (Coindance). Other indicators that adoption is increasing are the amount of times the terms 'Blockchain' or 'Bitcoin' have been searched for on the internet (See figure 8, 9). Cryptocurrency will continue to garner the interest of the public however, this can decrease if regulation remains an illusion. Applying regulation potentially results in wider adoption and this is necessary to accomplish the full benefits of cryptocurrencies as it is the case with anything, wider adoption and wider interest leads to more competition and increased development (McConnell 41, 42).

I would like to point out that actors across the globe consider regulating cryptocurrencies should they become a worthy substitute for traditional currencies. The signals are there that cryptocurrencies are improving and gaining a wider interested audience. Additionally, actors such as the EU/ECB are highly interested in the blockchain technology hence it would be beneficial to start thinking about how to regulate this type of technology in order to gain an advantage. This does not necessarily mean that the EU or ECB should engage in full scale regulation but rather, in order to potentially reap the benefits in the future should wider scale

adoption of both cryptocurrencies and blockchain technology occur. Lastly, in terms of the technological shortcomings of cryptocurrencies, lines of code and software in general is malleable. Any (Technological) shortcoming such as security costs, ease of use, electricity costs etc that have emerged can effectively be dealt with by either altering the code according to new specifications or choosing to opt for a different coin. This partly explains why there are numerous cryptocurrencies that exist today. For instance, a total of 26,000 blockchain projects were launched in 2016 of which 92% died out due to competition whereby the best projects have a place in this world (Froelings). It is therefore no surprise that we will eventually end up with technology that can eradicate some of the risks that are tied to the technological blueprint. Until that time comes however, risks continue to manifest themselves and alterations to the software won't eradicate all risks.

3. The different approaches of regulation

This chapter will seek to expand on the different approaches taken towards regulation with a specific focus on regulation within the EU. The three approaches will be compared and see what the strengths/benefits are of each approach. Before the following chapters, a baseline should be established where the three approaches are discussed and assessed. There are three routes to which an actor can decide to tackle the issue of dealing with cryptocurrencies. The three approaches are listed below:

1. Banning Cryptocurrencies
2. The 'Wait and see approach'
3. Regulating cryptocurrencies

3.1 Banning cryptocurrency

The approach of banning cryptocurrency implies the restriction on the use of cryptocurrencies and possibly on contributing towards the network of cryptocurrency (E.g. mining, servers for nodes). A ban on cryptocurrency can be enacted in two ways. The first involves the banning of the acceptance of cryptocurrencies as a currency on a national scale. In the case of Russia, the Ruble is considered as the only legal tender and official currency of Russia and the exchange of other virtual currencies is forbidden (Ramasastry). Alternatively, a government is able to prohibit banks and other third parties from either accepting or engaging in exchange practices with virtual currencies. Any transactions that involves virtual currencies would therefore be prohibited. The best example of this approach can be seen within China which has opted for an approach that follows the aforementioned route as ICOs and cryptocurrency exchanges are fully banned within the cyberspace and borders of China (Hsu).

The amount of countries that have banned cryptocurrency and where it is considered as outright illegal is a total of eleven nation states (Coindance). For a full comparison of where the cryptocurrency Bitcoin is considered either illegal, alegal, legal or restricted or unknown, please see figure 10.

The approach of banning cryptocurrency is however, questionable whenever it is enforced. By downright outlawing cryptocurrencies, a nation state will not be able to reap the benefits from cryptocurrencies nor engage in the global market of cryptocurrencies. More importantly however, the risks outlined in the previous chapter will be even higher for those that still manage to gain access and utilize cryptocurrencies. As cryptocurrencies are inherently global and in cyberspace, access with the right tools or an anonymous cryptocurrency coin (McConnell 35-38). Whether or not the decision of banning cryptocurrency on a national level is favorable is questionable due to a lack of quantifiable data. It is however, a possibility as the research by Hendrickson and Luther points out in their article: '*Banning Bitcoin'*. They conclude that a government is able to manifest a ban on cryptocurrencies if there is a sufficiently large government that enacts the ban or if a government is willing to dish out sufficiently severe punishments (Hendrickson and Luther). Their research is based upon a monetary model, transaction policies and punishments on the bases of interviews with interviewees which are monitored for their preference (Either in favor of acceptance or banned with punishments). Further consideration of this approach is however irrelevant for our recommendations for the EU as the banning of cryptocurrencies does not remove the risks for users of cryptocurrencies and removes the possibility of reaping the benefits of blockchain/cryptocurrency technology and possible tax revenue.

3.2 The 'Wait and see approach'

This approach is chosen when a government or nation state does not see the growth potential of cryptocurrencies and therefore doesn't see a rationale to regulate it as the market for cryptocurrencies is a fraction of traditional currencies (Guadamuz and Marsden 26). Awaiting further developments and willfully choosing not too act until others have set the precedent is adopting the 'Wait and see approach'. This approach follows three characteristics. Firstly, the approach includes the issuing of warnings to consumers and investors that virtual currencies carry certain risks. This has for example been the case within the Netherlands whereby the Autoriteit Financiële Markten (AFM) has warned for the financial risks and investment bubble nature of cryptocurrencies (RTLnieuws). Secondly, the approach allows users that desire to engage in exchanging or utilizing cryptocurrency despite the warnings, the freedom to do as they please. Thirdly, the approach follows the notion that cryptocurrencies are self-regulating in the sense that the cryptography and the technology behind cryptocurrencies can keep a user safe (McConnell 37, 38; Guadamuz and Marsden). Examples of nation states whom engage in this approach are for instance: Japan, Canada, Israel, Hong Kong and Australia (McConell 39). These actors are however, announcing or implementing regulation in some shape or form in this year (Suberg, Austrac; Faife). It would therefore seem that some of the nation states that refrained from taking a 'wait and see' stance towards a more proactive stance towards regulation.

3.3 The regulation approach – Different pathways

Regulatory approaches taken around the globe can be considered as minimal efforts targeted at counteracting the risks that cryptocurrencies posed mentioned in the previous chapter. These approaches target specific areas but mostly Anti-money laundering and counteracting

terrorist funding. For instance, in the case of the U.S, cryptocurrencies are classified as commodities and are thus regulated through the Commodity Futures Trading Commission and does not encompass legal tender status (Clinch; CNBC). However, most nation states adopt a 'Wait and See' approach they are not minimizing the extent of the risks to the fullest extent that is possible. An approach towards regulation that is unitary and is enacted with international cooperation is proposed by the G20 to be the most optimal way of regulating (Helms, "South Korea to Follow G20 Unified Cryptocurrency Regulations"; Ficcaglia; Reyes; Tu and Meredith). There have been several proposals put forth within academia of enacting a global response to cryptocurrency regulation. For instance, Plassaras suggests giving digital currencies a quasi-membership status within the IMF that would recognize cryptocurrencies and regulate them (Plassaras). A different option has been put forth by Keidar and Blemus as they propose a national solution with self-regulatory bodies that implement (Global) codes of conduct on tackling several issues of cryptocurrencies. These bodies then respond and are exported within the international level in for example, existing institutions such as the Internet Corporation for Assigned Names and Numbers (ICANN) (Keidar and Blemus).

Although these are valid proposals, the most recent G20 meeting stranded and concluded with a lack of consensus and agreement (Tassev, "G20 Watchdog Says Cryptos Not a Risk, Resists Calls for New Rules"; Kelso). The proposed deadline of July 2018 to provide recommendations is ambitious as for instance, Frederico Sturzenegger, Argentina's Central Bank Chairman stated: *"In July we have to offer very concrete, very specific recommendations on, not 'what do we regulate?' but 'what is the data we need?"* (De). The G20 meeting also does not recognize the individual approaches taken by member state. Although it is argued that national regulatory power is limited and global cooperation is more suitable to tackle the issues of

cryptocurrencies as for example, Joachim Wuermeling acknowledges that: “Effective regulation of virtual currencies would therefore only be achievable through the greatest possible international cooperation, because the regulatory power of nation states is obviously limited” (Zhao; De; Sundararajan; Wilmoth). Ultimately, regulation depends on the goals that are set and the aim of the regulation which is in the case of the EU, to mitigate risks as will be seen in the following paragraphs.

3.4 Classification of cryptocurrency in the EU

First and foremost, the EU regards fiat money as legal tender whereby the value of the currencies (Such as the Euro) are largely based off of trust and in relation to other currencies rather than being based on a commodity such as gold or silver (European Parliament 4). Central banks such as the ECB do not however, consider virtual currencies as legal tender. Additionally, the ECB argues that virtual currencies do not fulfill the criterion of being theorized as money as the degree of acceptance is extremely low and they would not act as a medium of exchange, store of value or a unit of account (European Parliament 4). A distinction should be made here as the EU mostly refers to virtual currencies whereby the ECB identifies three types of currency schemes:

1. Closed virtual currency schemes: Little to no link with the formal economy and is often referred to as an “In-game only” scheme. This scheme offers currencies that can only be spent on virtual goods and services within a specified virtual community (E.g. World of Warcraft gold).
2. Virtual currency schemes with unidirectional flow: A virtual currency scheme that allows for a virtual currency to be purchased using fiat money at a certain exchange rate. The

virtual currency however, cannot be exchanged back for the original fiat currency. An example of this scheme are Facebook Credits or Nintendo points.

3. Virtual currency schemes with bidirectional flow: This scheme allows users to buy and sell virtual money according to the exchange rates with traditional currencies allowing for the purchase of both virtual and real goods and services and is interchangeable with traditional currencies. (ECB 13, 14) (For a schematic on these virtual currency scheme flow, see figure 1).

These schemes represent the flow of virtual currencies. However, the ECB and the EU make a distinction when it comes to virtual currency and electronic money. The Electronic Money Directive (2009/110/EC) states that "Electronic money" holds monetary value as represented by a claim on an issuer and is stored electronically, issued on receipt and is accepted as a means of payment at other parties other than the user of the "Electronic money" (ECB 16). The fundamental disparity with electronic money and virtual currency is that electronic money has a legal foundation and are stored within traditional units of account (E.g. Euro's, Dollars etc.). In contrast, virtual currency schemes hold a unit of account on their own and that is solely virtual (E.g. Bitcoins, Ethereum, Ripple) (For a full account on the differences between the two, see Figure 2) (ECB 16).

The limitation within the EU is that cryptocurrencies (Virtual currencies) do not fall strictly under the Electronic Money Directive (2009/110/EC) as this directive includes three conditions: 1. A virtual currency should be stored electronically 2. Issued on receipt of funds of an amount not less in value than the monetary value issued and 3. Accepted as a means of payment by undertakings other than the issuer (ECB 43). Cryptocurrencies would not fall under this directive as cryptocurrency cannot meet the requirement of the second criteria as the process

of "Mining" interferes with the receipt of funds. Mining however, applies to most cryptocurrencies (With a few exceptions). Additionally, Article 11 of the Directive states: "Member States shall ensure that, upon request by the electronic money holder, electronic money issuers redeem, at any moment and at par value, the monetary value of the electronic money held" (Directive 2009/110/EC)). This is however impossible for cryptocurrencies. The Payment Services Directive (2007/64/EC, now obsolete) and the more recently updated Directive (EU) 2015/2366 lays down the ground rules on the execution of transactions with electronic money. However, it does not regulate nor does it allow for payment institutions to be allowed to issue electronic money other than service providers that follow national law and directions of the 2009/110/EC directive (Directive (EU) 2015/2366). The downfall here is that the current regulatory framework of the EU does not give a lot of leeway for cryptocurrencies and financial institutions for further regulation as the criteria are strict and are required to be met.

Nonetheless, the EU recognizes the risks of not regulating cryptocurrencies as the ECB expresses concern: "The legal uncertainty surrounding these schemes might constitute a challenge for public authorities, as these schemes can be used by criminals, fraudsters and money launderers to perform their illegal activities." (ECB 45). The majority of the regulation that is currently in place on a supranational level within the EU is the 5th EU money Laundering Directive that have been issued by the Financial Action Taskforce (FATF). The most recently adopted 5th Anti-Money Laundry Directive (5AMLD) is said to, according to EC Vice-President Dombrovskis to implicate: "Less anonymity and more traceability, through better customer identification, and strong due diligence." (Miseviciute). The directive is mostly aimed at preventing the EU's financial system for the purposes of money laundering and terrorist financing (Directive (EU) 2015/849). It does so by incorporating virtual currencies within the

Anti Money Laundering and Counter Terrorism directives. One significant change that has been incorporated within the 5AMLD is the decision to bring wallet providers and virtual currency exchange platforms under the auspice of the 5AMLD. For instance, these providers are now required to implement policies and procedures to detect, prevent and report money laundering and terrorist financing at the risk of financial sanctions (10% of annual turnover or 5 million Euro's) (Grant Thornton; Miseviciute; Directive (EU) 2015/849). Exchanges within the directive are defined as "Providers engaged in exchange services between virtual currencies and fiat currencies". Additionally, wallet providers are defined as "An entity that provides services to safeguard private cryptographic keys on behalf of their customers, to hold, store and transfer virtual currencies" (Directive (EU) 2015/849). These are the only regulations which apply to all member states of the EU and are very minimalistic and are limited to protection in terms of money laundering and terrorist activity funding.

3.5 Developments within the EU

The EU has however, not been sitting idly by as is exemplified by the statement of the Vice-President (Ansip) on the question of Distributed Ledger Technology during which he states that Distributed Ledger Technology's serve almost limitless potential use cases (Ansip). The EU is therefore at a dichotomy between the risks and potential use cases for the blockchain technology. The EU is however, currently exploring various use cases for blockchain technology to implement within the public and private sector. One of the examples is a study undertaken by the EU regarding the feasibility of an EU blockchain infrastructure for which €250.000 has been made available (European Commission, "Study on… infrastructure"). This is however a relatively small amount as so far, a total of 83 million Euros have been allocated to EU blockchain projects and 340 million Euro's is projected to be contributed to blockchain research

from 2018 to 2020 (European Commission, "Blockchain technologies"). Moreover, the EC has launched the EU Blockchain Observatory & Forum on Feburary 1st, 2018. This observatory and forum aims to; map existing initiatives in Europe and beyond, monitor development trends, become a knowledge hub on everything related to the blockchain, promote European engagement with important blockchain stakeholders and inspire European interest (European Commission, "Blockchain technologies")- Even though the ECB and the EU recognize the risks of not regulating cryptocurrencies, they are above all, facing the risks of reputational damage in terms of public image and credibility as the ECB and EU recognize that anything that is related to money and payments should "Clearly fall under the responsibility of central banks" (ECB 45). This reputational damage is apparent considering the divergent individual approaches undertaken by the member states of the EU despite the warnings and recommendations put forth by the ECB.

3.6 Individual Approaches of Member States of the EU

Germany was one of the first European Countries to recognize cryptocurrencies as early as August 2011, the German Federal Financial Supervisory Authority (BaFin) declared Bitcoins to be a "Rechnungseinheiten" (A unit of account in German) (Tasca et al. 53). These currency units are however not legal tender and neither qualify as foreign currency. Within the German Payment Services Supervision Act, they are not considered as e-money as there is no central authority that issues the currency. Cryptocurrency is rather regarded as a kind of "Private money" and regards a complementary currency for private use (Tasca et al. 53). Subsequently, Germany taxes cryptocurrencies according to the units of account rules. These rules imply a 25% capital gains tax if cryptocurrencies are held for a period longer than a year (Tasca et al. 53). It should be noted that Value Added Tax (VAT) cannot be applied to cryptocurrencies within all

member states of the EU in terms of exchanging cryptocurrencies or mining according to the Case C-264/14 of the Court of Justice of the EU on the 22nd of October 2015 as it regards exchanges as a transaction (22.10.2015, Rs C-264/14, Hedqvist; UStR 2000 Rz 759). The following table illustrates the different approaches by member states of the European Union and their approach towards regulating cryptocurrencies:

Table 2. Overview on the different classification and taxation approaches across EU member states.

Member State:	Classification:	Taxation:	Other noteworthy developments:
Germany	Unit of Account	Yes – 25% Capital gains (If coins held are over a period longer than one year)	Mining of cryptocurrencies does not require special authorization unless used for commercial purposes
France	Previously seen as a Unit of Account. Ever since April 27th 2018, considered as 'Moveable property'	Capital gains tax (Changed in Apr 2018 to 19% rather than 45%)	Payment transactions are acknowledged by not protected
Italy	Not considered as legal tender. Not	No taxations, not considered as capital	Any business with commercial usage of

	illegal however, dissuasion of digital currencies until a legal framework will be established	gain but rather, considered as a transaction	cryptocurrencies must report any suspicious activity according to the Italian and European AML
Estonia	Not regulated or controlled by the government. Traders must Identify themselves if they trade over 1,000 euros per month (E-residency programme)	Not taxed unless for commercial purposes, then normal business taxes apply	Favors ICOs and blockchain startups by lowering the cost for these blockchain startups
Netherlands	Do not fall under the scope of the Act on Financial Supervision, is not seen as 'Electronic money' nor legal tender	Taxed as capital, must be declared at the beginning of the fiscal year (January)	

Belgium	No specific regulations or laws; no government intervention is deemed necessary at this time	Exempted from taxes if cryptocurrencies are private assets. If they are commercial or speculative, it will be taxed as miscellaneous income with a rate of 33%	
Luxembourg			
Finland	Considered as a private contract (Increase in price or value is taxable)	Capital gains tax, treated similarly as dividends, rent at the rate of 30% (For an amount under 30,000 and 34% for everything above	
Greece	No specific regulation is implemented at this time	Tax exempted	
Bulgaria	Cryptocurrencies are not considered as	Standard capital gains tax, all	

	legal tender, not illegal nor legal	cryptocurrency related income will be taxes as a sake	
Croatia	Considered legal	Considered as additionally income and is taxable as capital gains at a rate of 12% should the profits exceed 500,000$	
Cyprus	Use of cryptocurrencies is not regulated.	No tax is applied to cryptocurrencies	Statement by the central bank of Cyprus considers it dangerous but is not under a regulatory system at this time
Czech Republic	Considered as legal, and classified as an intangible asset	Aims to implement a Value Added Tax to virtual currencies in one way or another (Even though disallowed by the EU)	Exchanges require to verify their customers who spend over €1,000

Denmark	Denmark's Financial Supervisory Authority does not regulate cryptocurrencies as it is not legal tender or a currency	Tax exempted	
Latvia	Not considered as legal tender or money but rather a contractual agreement of payment between two parties	Proposed capital gains tax at a rate of 20% (Apr 13 2018)	
Lithuania	Not considered as legal tender	Income received from individual purchases and sales of virtual currencies will be taxed with a 15% standard and fixed income tax trate	Lithuanian State Tax Inspectorate (STI) aims to implement regulation in the foreseeable future, if a cryptocurrency is sold for profit, the income tax will apply

Hungary	NO DATA – Presumably legal as they are launching their own cryptocurrency	Taxed as "Other income" with a rate of 15% Personal Income Tax	Launching their own Cryptocurrency "Korona"
Malta	Does not have any regulations in place on cryptocurrencies	Exempt from taxation, considered as a tax haven	Has plans to promote bitcoin and blockchain technology, aims to use blockchain technology within a decentralized ecosystem
Portugal	Considers cryptocurrency according to the ECB definition (Virtual currency scheme type 3)	Exempted for taxes in its current state. Only capital gains taxes will be applied when operated under professional or commercial interests	
Romania	Cryptocurrencies follow Article 4 (1) f of Romanian Law	Tax exempted as the purchase of cryptocurrencies is	National Fiscal Administration Agency (ANAF) has

	and are considered as movable goods	considered as a barter and taxes can only be applied on legal tender (Cryptocurrencies are not legal tender in Romania)	declared lack of legislative framework hence no taxes or regulation
Poland	Not regulated at this point in time	Taxes were deemed as irrational in Poland and has been temporary suspended as of April 30th 2018	
Slovakia	According to the National Bank of Slovakia (NBS), cryptocurrencies do not possess attributes of a currency and therefore does not fall under national legislation	Slovakian Ministry of Finance has announced as of April 3rd that Slovakia will be taxing "Revenue derived from the sale of a virtual currency"	
Slovenia	Cryptocurrencies are considered virtual	Capital gains tax does not apply due to not	

	currencies - neither financial instruments nor monetary assets under national law	being defined as financial instruments hence tax exemption status is applied. Capital gains for corporate businesses is subjected at 19%	
Spain	Not considered as legal tender. Considered as a method of payment	Savings tax rate is applied between 19 and 23% Up to €6,000 = 19% €6,000 – €50,000 = 21% €50,000 upwards = 23%	
Sweden	Considered as assets, subjected to mandatory reporting requirement	Capital gains tax of 30% applies	Attempted to include cryptocurrencies under VAT but has been repealed by the Swedish Tax Authority

United Kingdom (Obsolete once Brexit is finalized)	Considered to be a 'Foreign Currency' and is unregulated	Value added tax of 10-20% for the exchange of goods or services Profits and losses are subjected to capital gains tax (18%)	Compliance with National AML laws rather than EU laws

(Terzo; Dotta; Helms; Santos; Tassev; Copay; Ecovis; Debitum; Arjun B; Stojaspal; Nomoretax; Galea; Levring and Pohjanpalo; Library of Congress; Wikipedia; Schwarz; Srdoč; Reese; Thomson Reuters; Redman; Tassev; Arjun B; Zuckerman; Tasca et al. 51-57)

The aforementioned table is a comprehensive summary of the different approaches taken by the member states of the EU. The essential component that this table provides is that it illustrates that there is no cohesion nor agreement within the EU on how to deal with cryptocurrencies which manifests itself within a pool of confusion and uncertainty. If consumers travel or spend their currency in a member state of the EU that handles different laws and regulations for cryptocurrencies, confusion and errors could occur. Although such errors have not yet occurred, if member states continue the path of implementing their own rules and regulation, this could become a possibility. Additionally, having divergent approaches towards regulation is ineffective in the long run as it will become a battlefield and fight for which nation state imposes the strictest or implements the loosest regulation such as creating a "Tax haven" on cryptocurrencies (Leading to capital flight). These measures would lead to competition within the EU, trying to outcompete each other in terms of attracting consumers or savings, investments etc. This not only goes against the ideals of the EU (Free movement of people, goods, services

and capital) but also raises questions for immigration, emigration and employment abroad as the taxation rate then varies if one moves from member state to member state. Lastly, as mentioned earlier, a unitary and more global response is stronger than individual approaches hence there is a lot to be gained to converge these divergent approaches taken by individual member states of the EU.

4. Determining the best approach

4.1 The requirements and goals of regulation

Considering that there are currently only two regulatory measures implemented on an EU wide level (The 5AMLD and the prohibition on VAT for cryptocurrencies), consumers within the EU are still at risk. Despite warnings by all the European Supervisory Authorities (ESAs) such as the ESMA, the European Banking Authority (EBA) and the European insurance and Pensions Authority, there is currently no way of protecting the users of cryptocurrencies. The warnings range from increased number of consumers that purchase these virtual currencies and these are, as the ECB has pointed out, highly volatile in their price mechanism and subjected to price bubbles (ECB 6; ESMA, "ESAS warn consumers of risks in buying virtual currencies"; European Commission, "Remarks by Vice-President Dombrovskis at the Roundtable on Cryptocurrencies"). Additionally, the risks for users within the EU stretch further as protection for consumers is practically non-existent. This chapter will therefore bring forth several recommendations and proposals in terms of taxation, classification and consumer protection. These recommendations and proposals will follow the ideals and goals laid out by the EU. These goals largely follow the principle of a "Proportionate regulatory approach at the EU level so as not to stifle innovation or add superfluous costs to it, while taking seriously the regulatory challenges that the widespread use of VCs and DLT (Distributed Ledger Technology) might pose" (European Parliament, "Motion for a European Parliament Resolution"). Academia also points out that regulation needs to occur in accordance without stifling innovation in any way possible and seems to be one of the cornerstones future regulation needs to take into account Hughes and Middlebrook 546, 547; McConnell 43, 44). Lastly, risks are desired to be mitigated to the fullest extent possible.

4.2 The framework for regulation – What or whom should be targeted?

As the recommendation by the EU and academia is determined to foster innovation whilst minimizing risks for users and consumers, the question whom or what to target becomes tricky. Regulating cryptocurrencies in accordance with newly established or existing authorities such as central banks could go against the values of cryptocurrency (Decentralized, anonymity, self-reliance). Secondly, as most cryptocurrencies that exist today are in their current state, inherently decentralized, putting it under a central authority would be impossible (Yee 3). Additionally, putting cryptocurrencies under the control of such authorities will make cryptocurrencies extremely similar to traditional fiat currencies. This is however, not applicable to the current situation as actors are currently hesitant to even recognize cryptocurrencies as legal or implement further regulation. For the foreseeable future alternative routes must be assessed. The route which I suggest, must respect the two-way stream of principles by both consumers and policymakers in order to bridge the gap and solve the regulators paradox.

Similar to the Internet, cryptocurrencies are novel innovations that feature a certain architecture or layers. Bitcoin for example, is an open-source and decentralized platform and is a well suited for innovation and creativity due to the community developing software for different applications. The structure of Bitcoin follows the layered model of the internet proposed by Solum and Chung in their article: "*The Layers Principle: Internet Achitecture and the Law*". The internet is regarded as being a neutral platform whereby any individual is able to build upon the platform. This platform consists of six architectural layers which provides interoperability and are interconnected. These six layers are:

1. The Physical layer
2. Link layer
3. Transport Layer
4. Application Layer
5. Application/Services Layer
6. Content Layer

Alternatively, there is the Open Systems Interconnection Model developed by International Organization for Standardization and is a model that explains how network communication is transmitted from the base (Physical layer) to the end user (Mitchell). For a visual presentation of these models see Figure 12, 13). Both models aim to explain how (From bottom to top, physical infrastructure at the bottom), how the flow of data is carried out in accordance with the different protocols internet traffic passes through different stages (Yee 3,4). The top layers are dependent upon the bottom layers and determine the cyber-experience for the end users. This is exemplified in the way that anyone is able to develop network applications upon the TCP/IP protocol (Which makes internet possible) (E.g. Applications layer builds upon network Layer). The upper layer is considered to be free for any one to develop applications, allows innovation to foster, is decentralized as development is in the hands of the developers themselves (Yee 3). Much like the internet, cryptocurrencies follow the ideals of the internet as both follow a non-discriminatory and permission less innovation milieu (Although this is subject to change with the current discussions of Net Neutrality in the U.S). In contrast, cryptocurrencies are well suited for acting as the internet of money and should not solely be seen as a substitute for money as the potential within cryptocurrencies is huge. Financial innovation will happen on cryptocurrency platforms and it will happen in waves (Yee 3). Regulation is however, tricky to accomplish without

hampering this innovation and growth. It is however possible by targeting and intruding within the correct layer.

For the analogy of cryptocurrencies and the layers of the Internet, I am borrowing an analogy from Yee's article: "*Internet architecture and the layers principle: a conceptual framework for regulating Bitcoin*". Yee targets three different layers of internet architecture From Choucri and Clark's "*Integrating Cyberspace and International Relations: The CoEvolution")* and reflects how these layers can be applied to cryptocurrencies. These three layers are: The logical layer, the information layer, the user layer. In the case of the logical layer, it follows Bitcoin's Peer-to-Peer and decentralized protocol of Bitcoin in congruence with the blockchain technology whereby it lays the groundwork for anyone to build upon this protocol and develop applications (E.g. miners, developers, businesses). Secondly, the information layer is the service layer whereby intermediaries make cryptocurrencies available to the public through user-friendly applications (This differs greatly). For instance, this could regard exchanges whereby the bridge between the users and the real economy is made or payment service providers bridging the gap between consumers, businesses and exchanges. Lastly, there is the user layer. This layer consists of all individuals whom utilize cryptocurrencies for a wide array of uses. These uses range from trading, speculators (Current majority of users), consumers making real payments, merchants and businesses and on the flip side, those using it for illegal activities such as money laundering, drug dealing etc. (Yee 4). This analogy, although very simplistic, does offer great insight in the operability of innovatory technological developments. It lays down the precedent for considering what layer is the best to target i.e. on the lower part of the scale, the middle or towards the end?

4.3 Assessing the different layers

Regulating the logical layer would imply altering and reprogramming cryptocurrencies according to specific standards in order for regulation to take place. Implementing regulation on this layer would be illogical as this would interfere with the neutrality (Much like the internet and open-source nature of many cryptocurrencies) and could potentially stifle innovation as it alters the very foundation on which cryptocurrencies currently rely (McConell 44, 45). If for example, a certain cryptocurrency coin is altered in such a way that pseudo anonymity is no longer possible, users will stray away and no longer use the coin thereby killing off any chance of further innovation in the process. This regulatory approach would diminish the use of cryptocurrencies for illicit goals but as a consequence, it would kill innovation along with the user base and is therefore a self-defeating approach. This approach has already been proposed by several governments of certain nation states by developing a national cryptocurrency that is fully controlled by the government and which allows insight in every transaction. These nationally developed cryptocurrencies are however, unsuccessful and only used for speculation (See for example, Venezuela's Petro and the projected Cryptoruble for Russia and Estonia's scrapped Estcoin). The respective market capitalization of PetroDollar is at a mere $715,541 (96BTC) compared to the market cap of Bitcoin; $127,285,638,362 (17,076,450 BTC) as of May 2018 (Coinmarketcap). This same trend will most likely apply to the Cryptoruble and Estcoin has since June 3rd 2018 been scrapped from becoming a national cryptocurrency (Buntinx). The reason for the decision to scrap Estcoin was the statement by Mario Draghi whereby he stated that the Euro is the only suitable currency for Estonia and the EU (Buntinx). The future is therefore gloom for cryptocurrencies that are nationally developed and maintained.

Alternatively, regulation on the user layer would be a very challenging task. The problem will therefore be transported from governments towards end users that would have to look out for their own protection. For instance, taxation is an element which is currently happening on a user layer level as taxation on cryptocurrencies is based on the voluntary submission of consumers to report their holdings (Excluding exchanges, these are obligated to report). For instance, in the Netherlands there are currently no control mechanisms on the process of cashing in taxes from cryptocurrency as citizens are obliged and responsible for their own tax submissions (Marlisa). Additionally, it is impossible to target the end users as it is impossible to track who owns which coin and in which quantities (McConnell 44). Leaving regulation up to the users will be ineffective, especially with the different approaches taken in for example taxation whereby there is no clarity or a unitary approach, leaving consumers blinded. In terms of risks as illicit activities, it would most certainly seem an illusionary situation that individuals or groups whom enact illicit transactions for illegal purposes would self-report any of their activities.

Having discussed the logical and user layer, there is only one layer left for possible regulation. The information layer is vastly superior for regulation as it is able to act as a bridge between the logical and user layer. In essence, this layer links the virtual world with the real economy making it the perfect layer for intervention as it does not interfere with the operability of the other layers. Cryptocurrencies at the heart of their technical design are intended to cut out third party intrusion (E.g. banks). Targeting regulation at this layer would however, not result in direct intrusion within the cryptocurrency ecosystem as exchanges in the current ecosystem, are already acting as a bridge. Considering the cryptocurrency ecosystem, four stakeholders can be identified: miners, individuals holding cryptocurrencies (Consumers), merchants and businesses,

banks, governments and Payment Service Providers (PSP) or exchanges (Spenkelink 12; McConnell 17, 18). All of these stakeholders are required to operate within the cryptocurrency ecosystem whereby exchanges are the link with the "Real" economy of traditional currencies (For a visual representation of the bitcoin ecosystem see Figure 14). Exchanges can thus be regarded as being the gatekeepers which are necessary for close cooperation as for example, intermediaries (Not only for cryptocurrencies) have in the past often cooperated with law enforcement to prevent, detect and investigate illegal transactions (Yee 5). In combination with the blockchain technology, transactions are easier to trace as, at some point in time, cryptocurrencies will be exchanged for either a different coin or a traditional currency. In the case of the EU, the proposed 5AMLD aims to curtail the anonymity within cryptocurrencies by implementing due diligence controls such as identity verification within exchanges (Tassev; See 5AMLD).

Targeting intermediaries has as the benefit that when identifying information is required to register and exchange through an intermediary that it removes the anonymity aspect of cryptocurrencies. Implementing due diligence requirements such as name, address, date of birth, passport number, terrorist checks, government identification allows for tighter controls and prevents illicit users from obtaining and exchanging in cryptocurrencies. Therefore, due to these due diligence controls (If properly implemented) and all transactions that are visible to the exchanges due to the blockchain, it will actively deter criminals and terrorists from using cryptocurrencies (McConnell 46-48). One option is for example, as mentioned in the last paragraph, a tighter implementation of the 5th AMLD and requiring identity verification for any individual wishing to enact a transaction through an exchange. An example of such a system is Estonia's digital identity or virtual residency programme. Estonia issues digital identity cards

that are encrypted (2048-bit public key) whereby it helps to detect and manage illegal activity. This digital identity extends towards an e-residency which implements the blockchain technology in a distributed ledger aiming to give citizens control over their own personal data such as medical records and taxes (Korjus). The digital ID or e-Residency programme could be further extended towards cryptocurrency exchanges, monitoring transactions in the process. It should be noted however, that only a limited number of individuals have opted for the e-Residence programme as there are currently 20,000 e-residents around the world (Korjus). In the essence however, targeting the information layer is most suitable due to the ability to apply light forms of regulation, without intruding too much and more importantly, respect the core benefits of cryptocurrencies and allow for innovation to develop further.

4.4 Who should oversee regulation or implement them?

Considering that the majority of the recommendations in the following paragraphs largely follow a path of standard setting, oversight, monitoring and stricter enforcement of due diligence controls, there should be a superordinate and coordinating organ that oversees intermediaries. I would therefore propose that the Financial Action Task Force (FATF) ought to fulfill this function. The FATF is an inter-governmental body that develops and promotes policies to protect the global financial system against money laundering and terrorist financing (FATF). The FATF's jurisdiction spreads over thirty-seven nation states. In the current state of affairs, the FATF is seeking to revise standards regarding cryptocurrencies and advise the G20 in their quest to regulate cryptocurrencies (Helms, 35 Countries, EU and FATF Agree to Revise Global Cryptocurrency Standards"). Ever since July 2017, the FATF has been recognized and given more agency in order to further evolve into a legal binding entity.

Judging by how a global response is sought after and is arguably more effective than national regulation, it would therefore be a wise decision to bring the setting of standards on a more global level. Some recommendations provided within the 2015 report titled: "*Guidance for a Risk-Based Approach*" already provided recommendations and suggestions in order to counteract some of the risks that are tied to cryptocurrencies. The main premise is to aid national authorities in order to make their regulatory responses compatible with the existing AML and TF regulations that are in place and will be developed (FATF 3,4). Recommendations put forth by the FATF vary: stricter due diligence controls (Identification, cooperation of authorities, recordkeeping and suspicious activity reporting) or standard setting, limit of transactional volume and frequency, network security and tax compliance (FATF, articles 1-50). In the case of the EU, the core objective is making national regulation compliant with the standards provided by either the FATF or developing standards by and for the EU itself or in cooperation with the FATF. These rules and regulations should therefore be applied nationally on intermediaries located in EU member states that are compliant with the overarching rules (AMLD, FATF or newly developed standards).

5. Recommendations for the EU

5.1 Classification of Cryptocurrencies

First and foremost, recommendations and a proposal will follow for the classification of cryptocurrencies in the EU. The disparity on the classification in EU member states is reflected in the situation that cryptocurrencies are being classified as either a property, private money, a foreign currency, a commodity or a method of payment. The extremes range from completely unregulated (E.g. Belgium, waiting for EU guidance), Poland recognizing cryptocurrencies but waiting for regulation from the EU and Germany wherein Bitcoin was recognized, classified and taxed at an early stage (See chapter 4.4, Figure 10, 11). Cryptocurrencies are however, allowed in the EU, trade and exchange is not subjected to any restrictions. The only requirement however, is that European cryptocurrency exchanges are obligated to certain due diligence procedures amongst which identity verification is required to allow users to the exchange platform (Tassev, "Europe Introduces Customer Verification on Cryptocurrency Exchanges").

The divergent approaches by the member states of the EU does not contribute to the abolishment of risks of cryptocurrencies but rather adds to confusion and more risks due to the uncertainties and misinformation for consumers. More importantly however, gathering consensus on classification paves the way for further regulation in other areas. The rationale behind this statement is that, regulatory measures are subject to change when classified differently. More simply put, classification determines how cryptocurrency is taxed, handled and determines what type of protectionary measures apply.

The first real move that can be made by the EU and would be illustrative of a unitary approach and which will solve a lot of current hurdles is to implement a common classification

on cryptocurrency that is applicable for all member states to abide by. This does not necessarily imply that cryptocurrencies should be regarded as legitimate currencies but rather, to solve inconsistencies and to limit the risks arising from different approaches undertaken by individual member states. The main incentive is to address regulation in a unitary and concise manner or as McConnell finds: “To address the difficulties Bitcoin presents to regulators, it has been established that regulators should seek international cooperation. Regulations should be consistent across borders, neutral and flexible, taking into account the diverse uses of Bitcoin.” (McConell 45). Classification should then range from either 1. Commodity/Asset 2. Security 3. Method of payment 4. Unit of account. This classification cannot be done by intergovernmental organizations such as the FATF but should come forth from an alteration of the existing directives or a newly developed directive on Virtual currencies/Cryptocurrencies.

5.2 Taxation of Cryptocurrencies

To prevent tax fraud, complications or wrongful taxation it would be advantageous to transfer taxation to the responsibility of the government with the aid of intermediaries. Targeting intermediaries is the only real way of monitoring and approximating an individual’s holdings. For instance, if a consumer decides to buy an amount of 10 Bitcoins at a price of $9000 each, the consumer would be taxed for those 10 Bitcoins if they are not exchanged by the end of the fiscal year (Disregarding the exemption rates and price fluctuations in this example). In terms of taxation, fraud can easily be made as there is no real way of knowing an individual’s exact holdings if they remain private and unexchanged or exchanged through intermediaries that do not require I.D verification. An Identification process implemented at the intermediaries will make it easy to track exchanges and accurately assess an individual’s current holdings. This is already happening to a small extent for EU based exchanges and aids in preventing illicit

transaction. However, in terms of taxation, it is still on a voluntary basis which could be altered to be automatically calculated based off of a consumer or businesses' exchanges and transactions.

More importantly however, the EU can provide guidelines and recommendations for a unitary tax rate. As mentioned previously, it is dependent upon the type of classification hence no recommendation can be made on the exact rate as it is dependent upon the classification. It would however, be a sensible decision to converge on a common tax rate range for cryptocurrencies in order to prevent tax havens from appearing and better yet, member states seeking to outcompete each other in terms of attracting blockchain startups, blockchain services or investments. The key is however, consistency in terms of taxation and also erasing ambiguity of constant fluctuating or changing tax rates. For instance, France opted for a 19% tax rate in favor of the exuberant 45% it held previously in April this year. This decision had been ratified as cryptocurrency profits are now regarded as "Moveable property" within France adding to the confusion in the ever-changing landscape (Terzo). Therefore, providing clarity and consistency should benefit the consumer. It is however, dependent upon the classifier and willingness to converge on the part of EU member states (For tax rates). More concretely, guidelines can be established on a tax rate which should be compatible with the type of classification as for example, a common capital gains tax should be beneficial. To limit the possibilities of tax havens or flight capital, the EU should implement a range (That is not too broad) that member states are obligated to follow.

5.3 Consumer Risks

In the current state of affairs, warnings are issued to consumers for the risks for purchasing or investing in cryptocurrencies as they would be unfit as investment, savings or retirement planning options according to the ESMA (Browne). Aside from these warnings and the Anti money laundering regulations, there are very little safeguards to protect consumers from the preceding risks. Targeting the information layer for consumer risks is tricky as one of the risks, the aspect of cyber security/hacking/fraud is able to manifest itself within intermediaries. For instance, as mentioned earlier, exchanges that are hacked or compromised in any way do not offer any protection for their users. For example, should an intermediary be compromised or go bankrupt, users are left with a loss of their funds and unable to recover their funds through either insurance or the backing of a central authority (See Mt.Gox hack) (McConnell 50, 51). Consumers are merely warned for trusting and exchanging through these intermediaries. These intermediaries in turn, are also subjected to the AMLD but there are no regulations implemented to ensure safety of consumers. Regulation of financial products and services are largely absent. The reason is that there is no central authority to back transactions or purchases made with cryptocurrencies.

This is an area in which the EU can contribute towards the safety of its consumers. Further tightening and control of the AMLD for intermediaries or further checks and balances could aid in prevented users becoming subjected to the risks of cryptocurrencies. However, within the current Electronic Money Directive (2009/110/EC), there is no protection as cryptocurrencies hold their own unit of account and fall out of the scope of the directive (2009/110/EC; ECB 16). In the current situation therefore, intermediaries are tied to the AMLD but users of cryptocurrencies remain unregulated. For instance, tightening controls on

intermediaries to heighten their standards will mitigate some risks. Setting standards in terms of cyber security, reliability, the collection and retention of customer information and anti-fraud measures should ensure higher safety for consumers at this point in time. Similar to how banks are regulated to meet certain standards, intermediaries should also follow a certain threshold of standards to protect their users. More concretely, the FATF or the EU can prescribe these standards on intermediaries. These standards would range from, data collection, identification, cyber security protocols, implementing transitionary limits and trade volumes. Additionally, intermediaries must have certain standards that would protect their users from the loss of funds, fraud or being charged exuberant transaction fees. In the current state, intermediaries should uphold rules wherein high-volume traders recognize the risks, possibly through signing an agreement when a threshold on trading is met. An example is Coinbase, a cryptocurrency exchange that is already putting restrictions on consumers who do not verify their personal details. Further identification diminishes further restrictions allowing for larger transactions or trade volumes (Coinbase). Similar control systems should be implemented for all EU or FATF affiliated Exchanges.

5.4 Summary of concrete recommendations

Overall:

- Provide bodies such as the FATF more agency and responsibility, having an oversight and monitoring function over the relevant authorities (Intermediaries).
- Set minimum standards and requirements for exchanges (Intermediaries) located in the EU or those bound to the FATF. These should range from cyber security, reliability, collection and retention of customer data (Compatible with the GDPR), anti-fraud measures and compliance with existing AMLD, TF and cooperation with the authorities. Additionally, due diligence controls ought to be strengthened and enforced strictly.

- FATF aids in making national legislation compatible with the EU wide regulation scheme and FATF/EU standards.

Classification:

- Converge on a common classification scheme within the EU on cryptocurrencies.
- Cryptocurrencies can either be classified as 1) Commodity/Asset 2) Security 3) Method of Payment 4) Unit of account
- Classification should either be taken up into an existing directive (AMLD, Payment Directive, Electronic Money) or the establishment of a new directive that is more specified and tailored towards Virtual currencies.
- Classification should be done from within the EU – Adoption and ratification by the European Commission in cooperation with all relevant stakeholders such as the FATF, ECB, national governments, blockchain Forum etc.

Taxation:

- EU should set guidelines for a taxation range that is determined in coalition with EU member states (Member states are still free to choose their rate) and where the rate is dependent upon the classification scheme chosen.
- Obligate exchanges to report an individual's holdings for taxation purposes (I.D verification required).
- Obligate national governments and intermediaries for the correct monitorization and record keeping of virtual currency holdings for tax purposes. This prevents uncertainty, tax fraud and confusion for consumers.

Consumer Risks:

- Implement safeguards in the form of due diligence controls – monitoring, checks and balances in order to prevent high-volume and risky trading for average consumers
- Similar to the overall recommendation, more agency and control systems and standards to be implemented on intermediaries which aids in preventing consumers from falling to the risks of cryptocurrencies.

Conclusion

All things considered surrounding the process of regulating a novel technological development, is a strenuous and difficult process. The reason being that law and policymakers oftentimes lag behind newly developed innovations of which the impact is not entirely certain (And the impact of regulation would be uncertain) hence why most would engage in a 'Wait and See' approach. In the case of the EU, there is no single legally binding party to accept cryptocurrencies, mining interferes with the process of issuing of coins and cryptocurrencies have a low degree of acceptance, do not act as a medium of exchange or hold a steady store of value or unit of account (Cryptocurrencies hold a unit of account on their own) (European Parliament 4; ECB 16). However, this does not necessarily matter if there is no reason to regulate cryptocurrencies.

Therefore, answering the question whether or not regulation is necessary in the first place was essential and dependent upon the benefits and disadvantages of cryptocurrencies. This research has provided a complete view on how cryptocurrencies operate and their technological blueprint through analyzing the iconic Bitcoin. Additionally, on the basis of the workings of cryptocurrencies and seeking consensus within the literature, this thesis has identified the merits and demerits of cryptocurrencies and put them alongside each other for comparison. The risks tied to cryptocurrencies manifest themselves within the paradox of regulation whereby policy and lawmakers are hesitant to regulate cryptocurrencies due to the perceived risks. Despite these risks, this thesis has identified several merits which makes cryptocurrencies superior to fiat currencies in these particular categories: fast and worldwide transactions with low costs, utilizing the blockchain technology which provides opacity and record keeping of all transactions that are

enacted (Prevents double spending) and having cryptographic security. On the contrary, the biggest risks that plague cryptocurrencies have identified to be: Price and liquidity volatility, security risks (E.g. hacks and fraud), the use of cryptocurrencies for their anonymity and illicit transactions and that there is no central/any authority that safeguards the usage and holding of cryptocurrencies. These risks are able to manifest themselves in EU member states that have adopted a wide array on different approaches towards regulating cryptocurrencies in terms of classification and taxation (See table 2). These risks are not only apparent in member states themselves but also pose risks to the EU as an entity as consumers and businesses alike are suffering from a regulatory climate that is inconsistent, unclear and uncertain in terms of future developments (Alterations are constantly implemented, see the example of France with their taxation rate). This uncertain and divergent regulatory climate has not manifested into serious calamities but could in the future most certainly raise issues with for example, migration, taxation and employment abroad.

In contrast, since there is a positive adoption rate, growing interest and there is a positive future outlook, cryptocurrencies will continue to innovate and be developed hence why regulators are increasingly interested in the technology behind cryptocurrencies. For instance, the EU has already announced it is willing and able to step up its game in implementing EU wide regulations if a global response would remain omitted (Gibbs). In combination with the plans of the EU of expanding and building upon the blockchain technology by establishing the EU blockchain Observatory & Forum and allocating funds towards an EU blockchain fund. These developments, the possibility to allow innovation of cryptocurrencies and blockchain technology to flourish in the EU and the ability to mitigate the risks for consumers, make it increasingly logical for the EU to engage in regulation.

Recommendations put forth within this Thesis were therefore subjected to two main premises. Namely: 1. Not to hamper with innovation or development of cryptocurrencies and Blockchain Technology and 2. To eliminate the risks to the fullest extent possible (European Parliament, “Motion for a European Parliament Resolution”; McConnell 44, 45). Firstly, cryptocurrencies need not receive extensive regulation at this point in time but rather, a well-considered early approach to set the precedent for future regulation and to mitigate the biggest risks. Secondly, cryptocurrencies are currently inherently decentralized and therefore putting it under a central authority would be impossible. For the analysis on which actor to target an analogy by Yee was utilized on the basis of the layers principle of the internet architecture. The three most important layers: Logical, user layer and information layer were compared and assessed. The information layer has been deemed as superior as intermediaries serve the purpose of bridging the logical and user layer, does not interfere with the operability of the other layers and respects the workings of cryptocurrencies whilst not putting any restrictions on development or innovation. Additionally, in combination with the blockchain technology, close cooperation with law enforcement, due diligence control systems and a thorough monitoring system, the risks such as illicit transactions can be prevented. Measures included within due diligence control systems such as identity verification actively deters those aiming to utilize cryptocurrencies for ill purposes and in combination with adequate standards, risks can be actively mitigated.

Looking at the bigger picture, in the case of general recommendations the first major change that needs to happen is providing organizations such as the FATF more agency and an oversight/monitoring function on FATF and EU based affiliated exchanges. Secondly, standards ought to be improved in several areas to ensure the safety of consumers and investors. Laying down minimum requirements to which exchanges must comply in multiple fields such as cyber

security, reliability, data collection, quota's and limitations, I.D verification will minimize some of the risks. In terms of classification and regulation, the EU has a unique opportunity to end the controversy and uncertainty amongst its member states. Similar to the abolishment of the VAT on cryptocurrencies, it is recommended that the EU ought to bring cryptocurrencies under one common denominator. This does not necessarily imply to consider cryptocurrencies as currencies but rather, a common classification that serves the purpose to further regulations in other fields (E.g. Taxation and Consumer law), as further regulation is dependent upon how cryptocurrencies are classified. Taxation is another field wherein member states take upon individual approaches. Recommendations put forth by the EU and ECB in terms of a taxation range that is applicable and designed by all member states would be beneficial. Additionally, obligating governments and intermediaries for the role of taxing consumers is advantageous as this obligation prevents tax fraud, complications or wrongful taxation. The rationale behind this, is that intermediaries are the gateway between the real economy and the virtual economy of cryptocurrencies, intermediaries could gather an accurate estimate of taxable income generated from cryptocurrencies (Other than the voluntary tax report system that is currently in place across EU member states). As far as consumer risks go, bolting down and setting standards for EU cryptocurrency exchanges with due diligence controls, cyber security obligations and checks and balances will ensure that consumers are more protected than they are now. In the current state of affairs, the EU and banks solely warn for investing or using cryptocurrencies whereas if something happened such as fraud or hacks, consumers are on their own. Intervening by stricter enforcement of the AMLD and placing checks and balances within exchanges will minimize risks.

Ultimately, this research has shown a pathway towards regulation that is a halfway measure (Before full scale or additional regulation is required and taken up into newly developed directives) that is compatible and accomplishes the goals of the EU (Mitigate risks, develop innovation). In the current state of affairs, it is uncertain what the future for cryptocurrencies hold, although it is estimated that they will grow in popularity and the underlying technology will continue to be developed. However, up until this point, only minimalistic measures have been taken which are deemed ineffective as the risks continue to persist. This Thesis has therefore proposed a theoretical regulatory framework with recommendations and proposals to counteract the risks. Whether or not these recommendations are effective in practice is uncertain as with every newly developed law or regulation. Future research should therefore continue to monitor the regulatory updates and new data on the efficacy of the implemented regulation. Alterations and amendments can always be made to regulation hence why it would not be unbeneficial to implement these recommendations in the foreseeable future and gradually make alterations or extend the regulations as cryptocurrencies and the technology behind it progresses.

Appendix

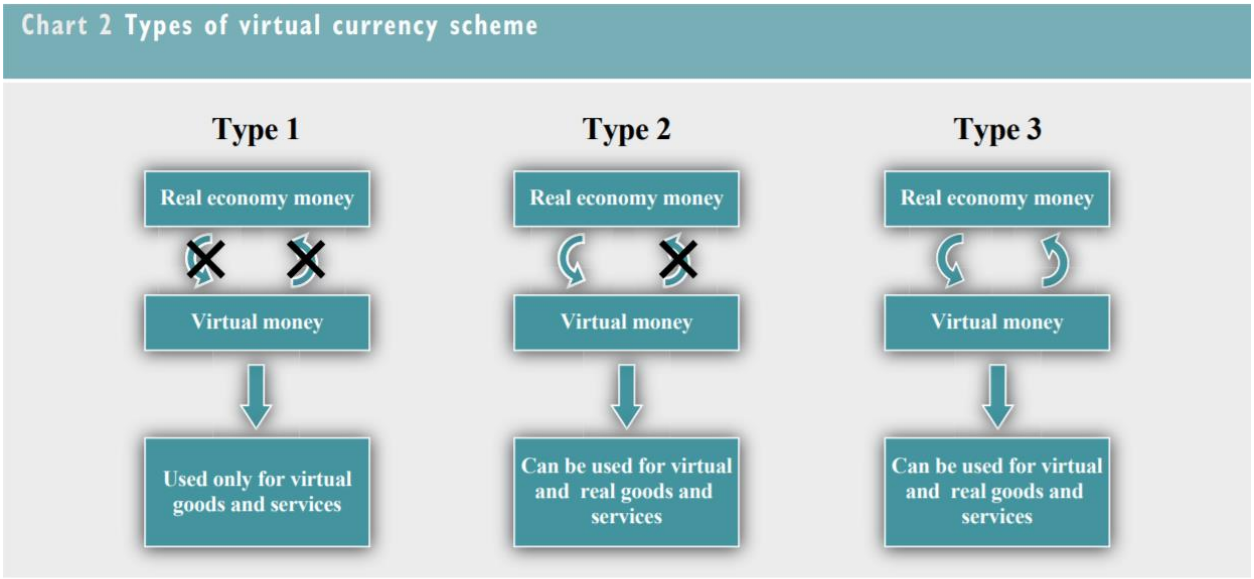


Figure 1. Types of Virtual currency schemes (ECB 14, 15).

Table 2 Differences between electronic money schemes and virtual currency schemes

	Electronic money schemes	Virtual currency schemes
Money format	Digital	Digital
Unit of account	Traditional currency (euro, US dollars, pounds, etc.) with legal tender status	Invented currency (Linden Dollars, Bitcoins, etc.) without legal tender status
Acceptance	By undertakings other than the issuer	Usually within a specific virtual community
Legal status	Regulated	Unregulated
Issuer	Legally established electronic money institution	Non-financial private company
Supply of money	Fixed	Not fixed (depends on issuer's decisions)
Possibility of redeeming funds	Guaranteed (and at par value)	Not guaranteed
Supervision	Yes	No
Type(s) of risk	Mainly operational	Legal, credit, liquidity and operational

Source: ECB.

Figure 2. Differences between electronic money schemes and virtual currency schemes (ECB 16).

Figure 3. Snapshot on Bitcoin Price Volatility (1 Year) (Coinmarketcap).

Figure 4. Snapshot on Ehtereum Price Volatility (1 Year) (Coinmarketcap).

Each Currency Market comprises multiple exchanges with orderbooks in that specific currency. These, along with their pricing data and weighting can be found below.

MARKET CURRENCIES	SHARE %	VOLUME (B)	LAST PRICE	PREMIUM
Kraken	55.78	3811.82	6468.10	0.00 %
Bitstamp	13.85	946.18	6475.55	0.12 %
GDAX	12.14	829.73	6490.27	0.34 %
Bitfinex	10.05	686.49	6459.98	-0.13 %
Exmoney	4.89	334.12	6556.91	1.37 %
itBit	1.05	71.76	6339.00	-2.00 %
BitBay	0.62	42.40	6471.68	0.06 %
CoinMate	0.59	40.24	6479.00	0.17 %
LocalBitcoins	0.48	32.94	6963.48	7.66 %
Quoine	0.28	19.26	6464.55	-0.05 %
Rock Trading	0.26	17.98	6452.70	-0.24 %
Bitsquare	< 0.01%	0.26	6486.65	0.29 %
Cryptonit	< 0.01%	0.00	6408.45	-0.92 %
Coinfloor	< 0.01%	0.00	6994.00	8.13 %

Figure 5. Price fluctuations within different exchanges and different currencies (Bitcoinaverage).

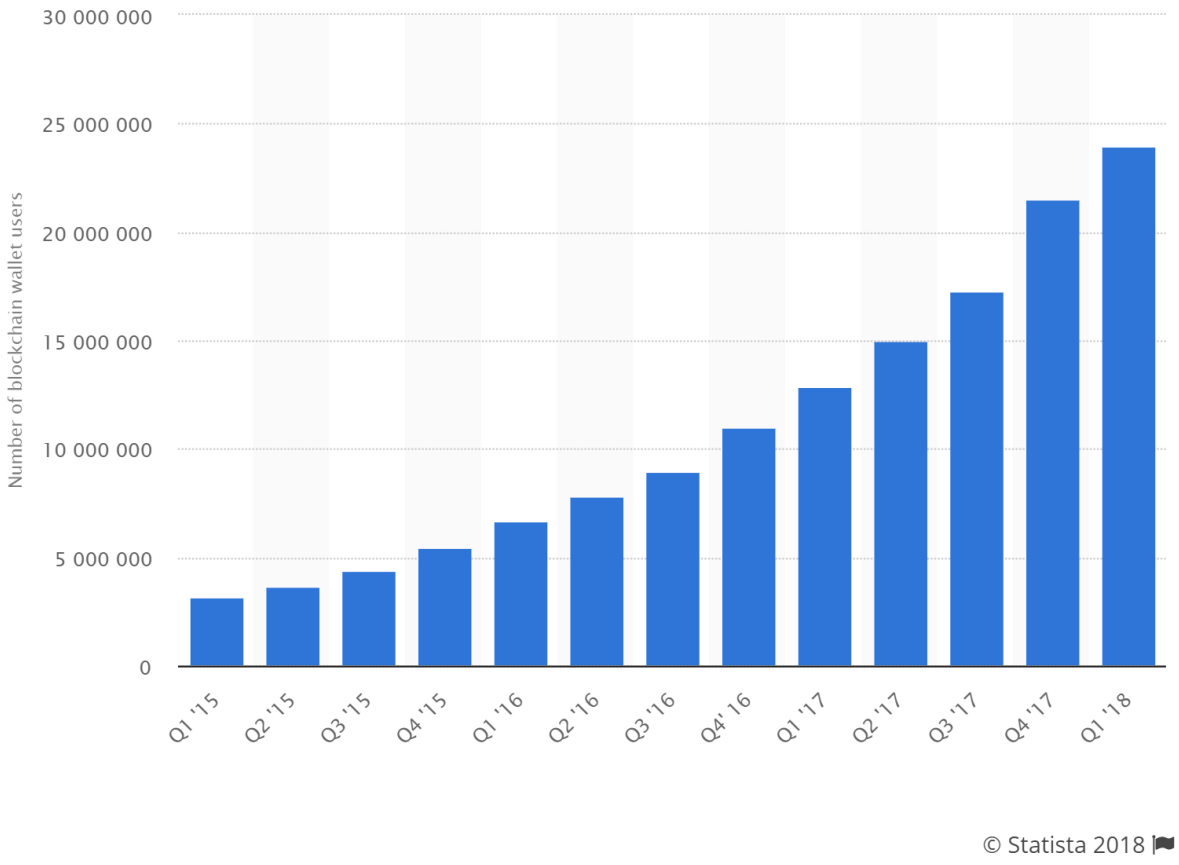


Figure 6. Number of cryptocurrency wallet users Q1 ’15 to Q1 ‘18 (Statista).

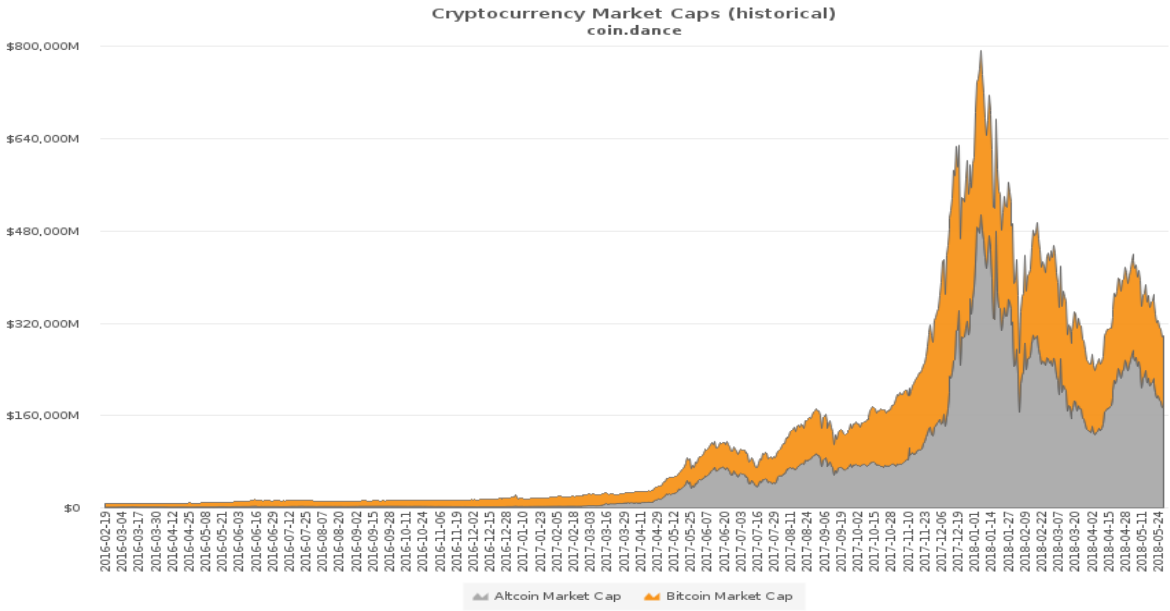


Figure 7. Market Cap of cryptocurrencies (Coindance).

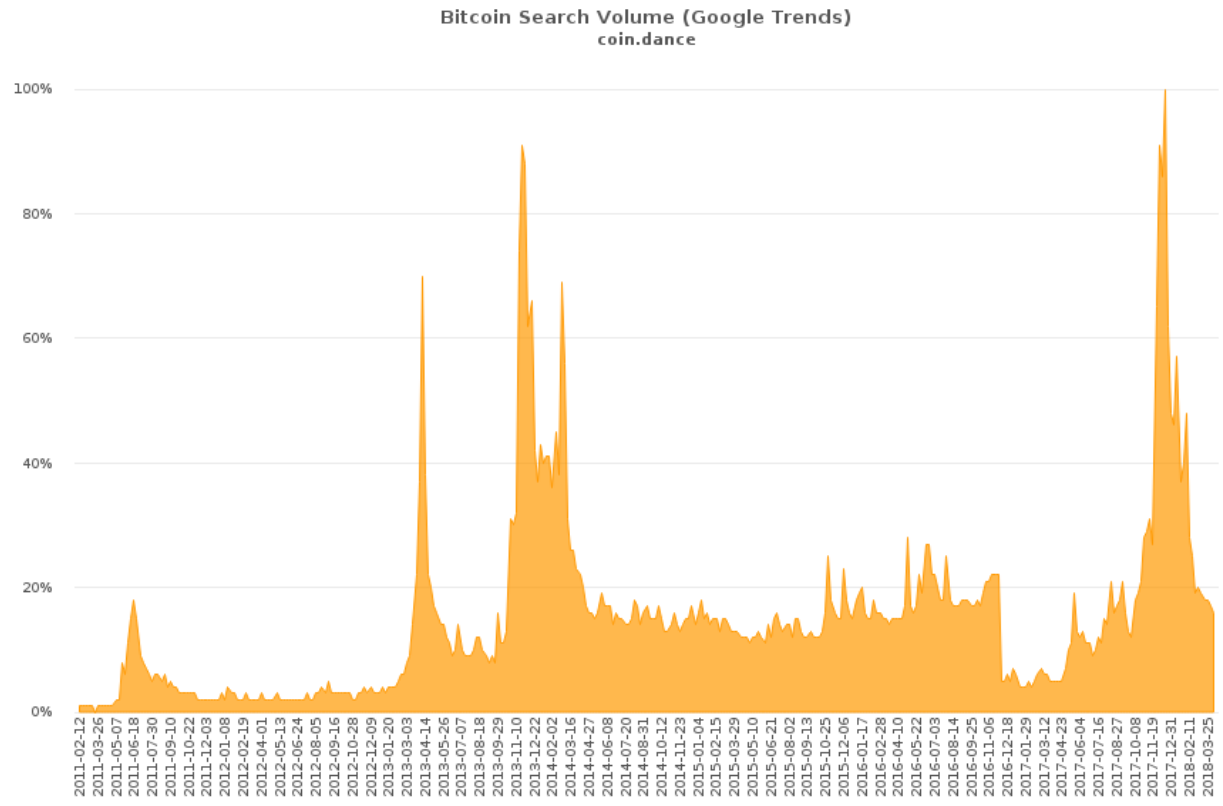


Figure 8. Google search trends for the term 'Bitcoin' (Coindance).

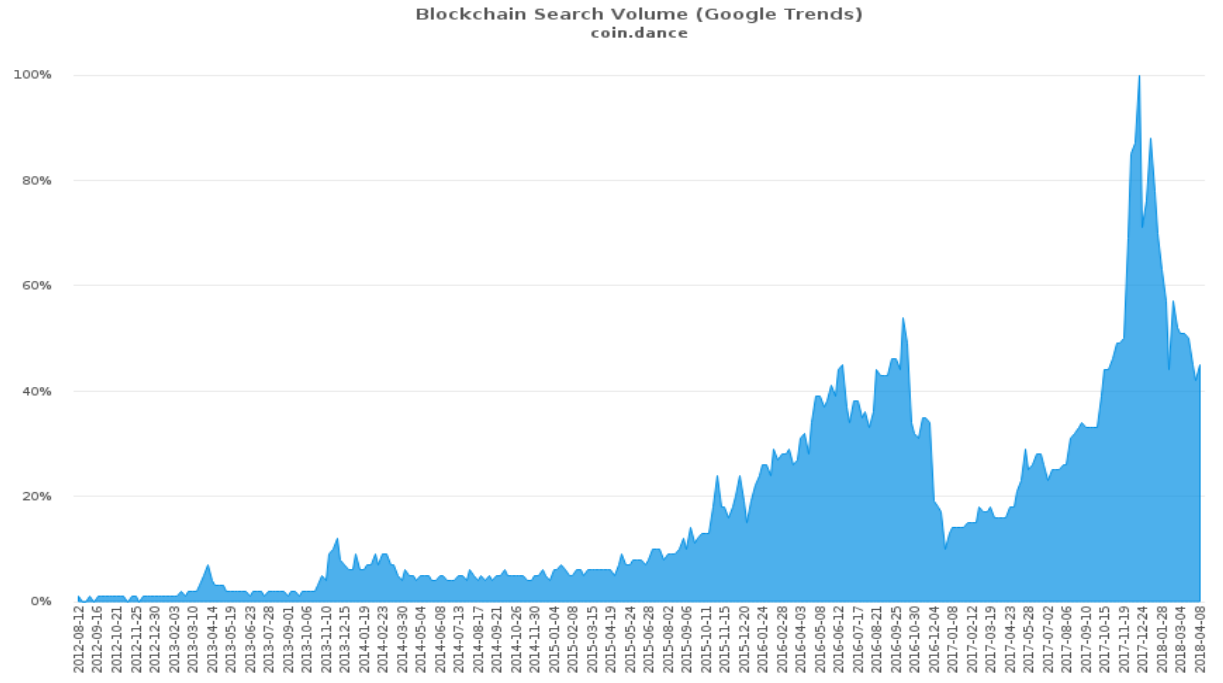


Figure 9. Google search trends for the term 'Blockchain' (Coindance).

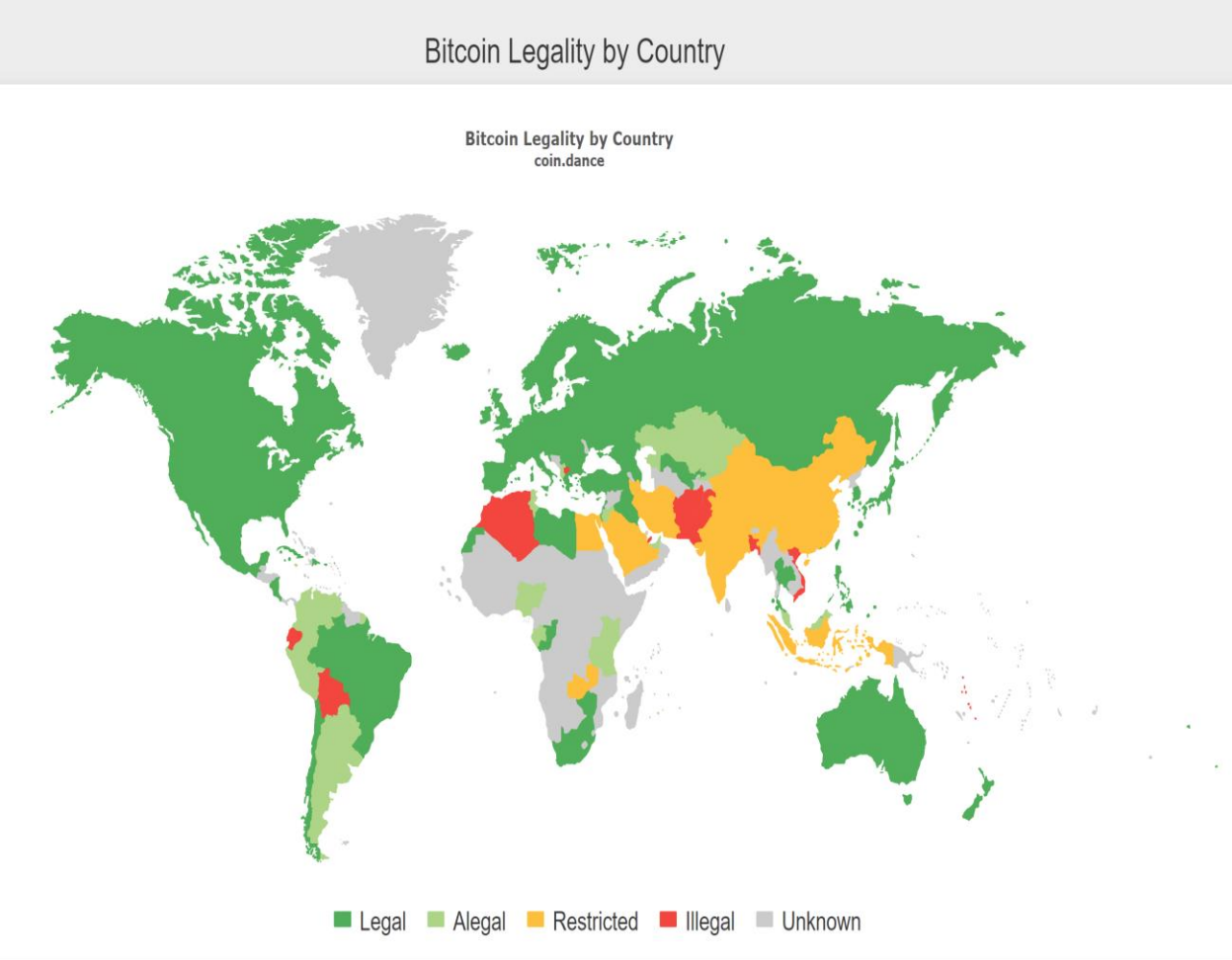


Figure 10. Legality of Bitcoin on a per country basis (Coindance).

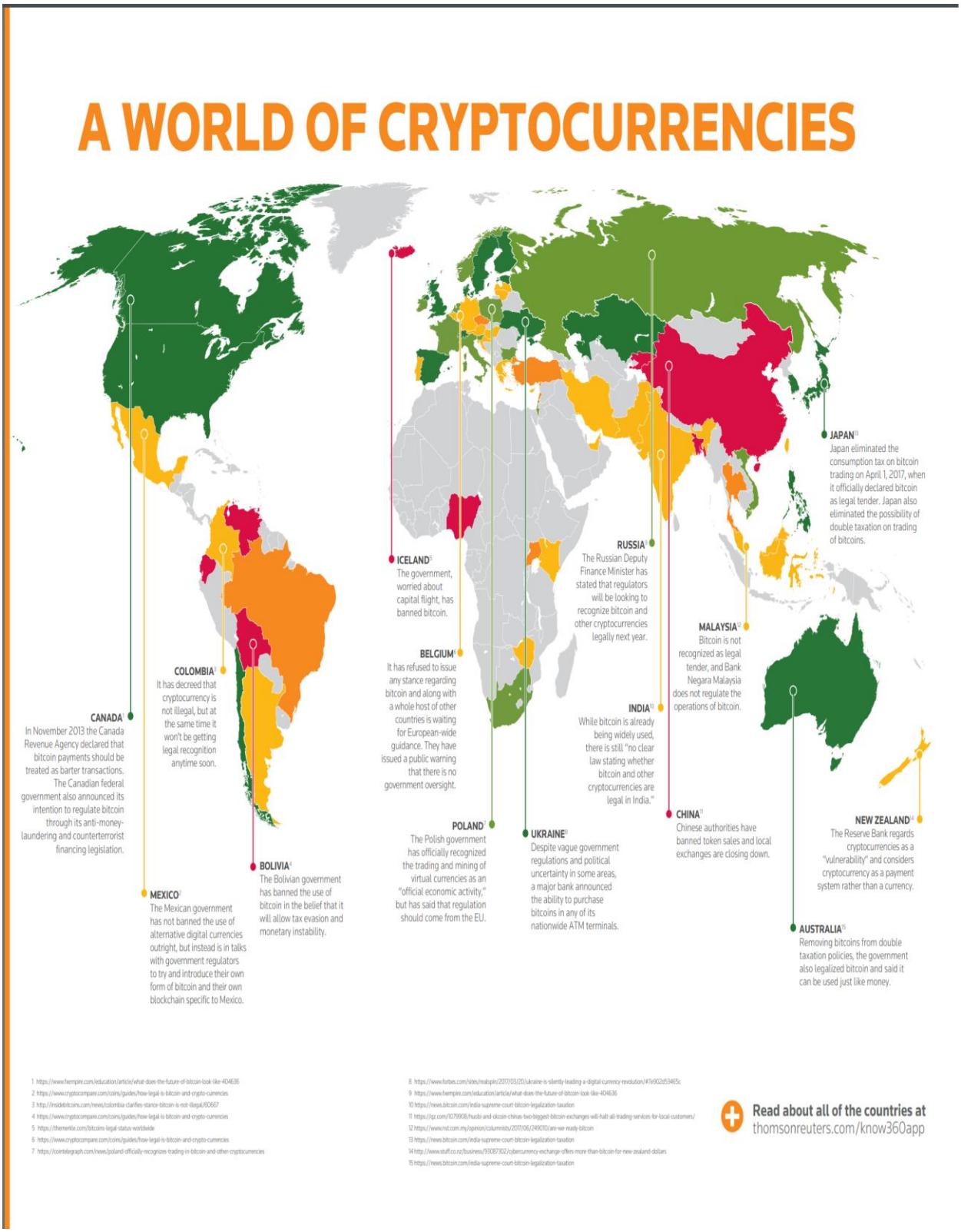


Figure 11. A world of Cryptocurrencies and their regulation (Reuters).

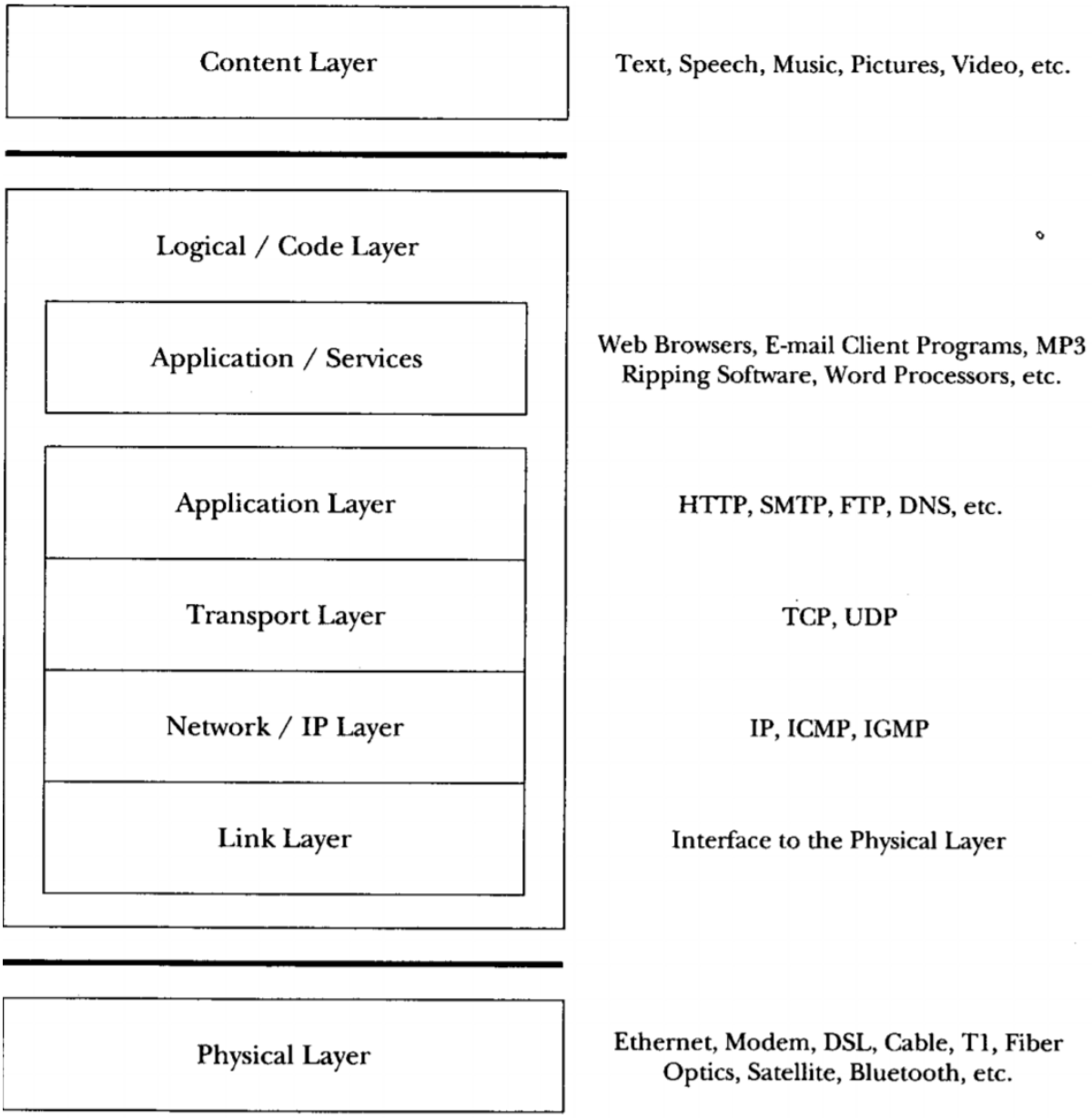


Figure 12. Communications System Layers (Chung 848).

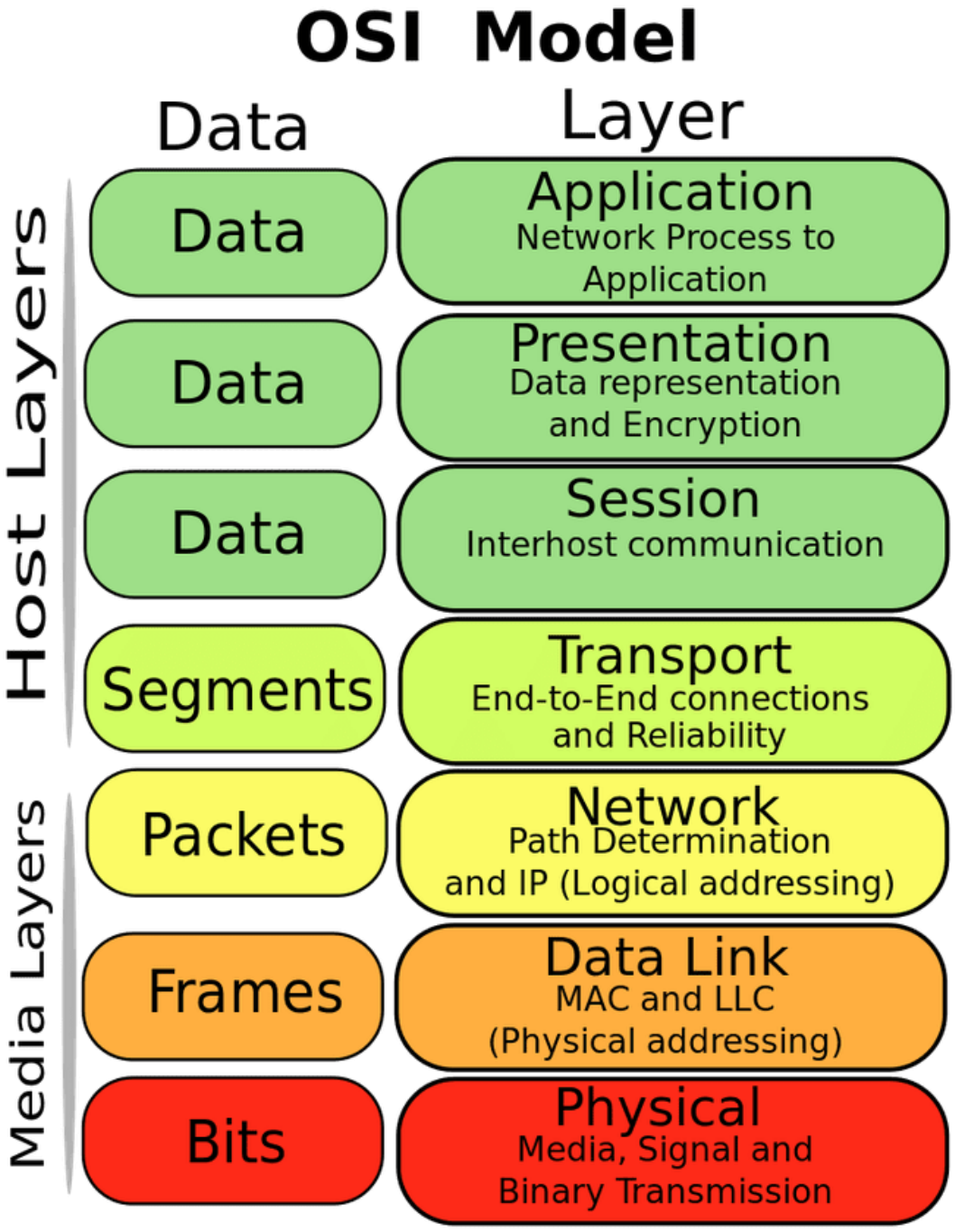


Figure 13. OSI Model (Mitchell).

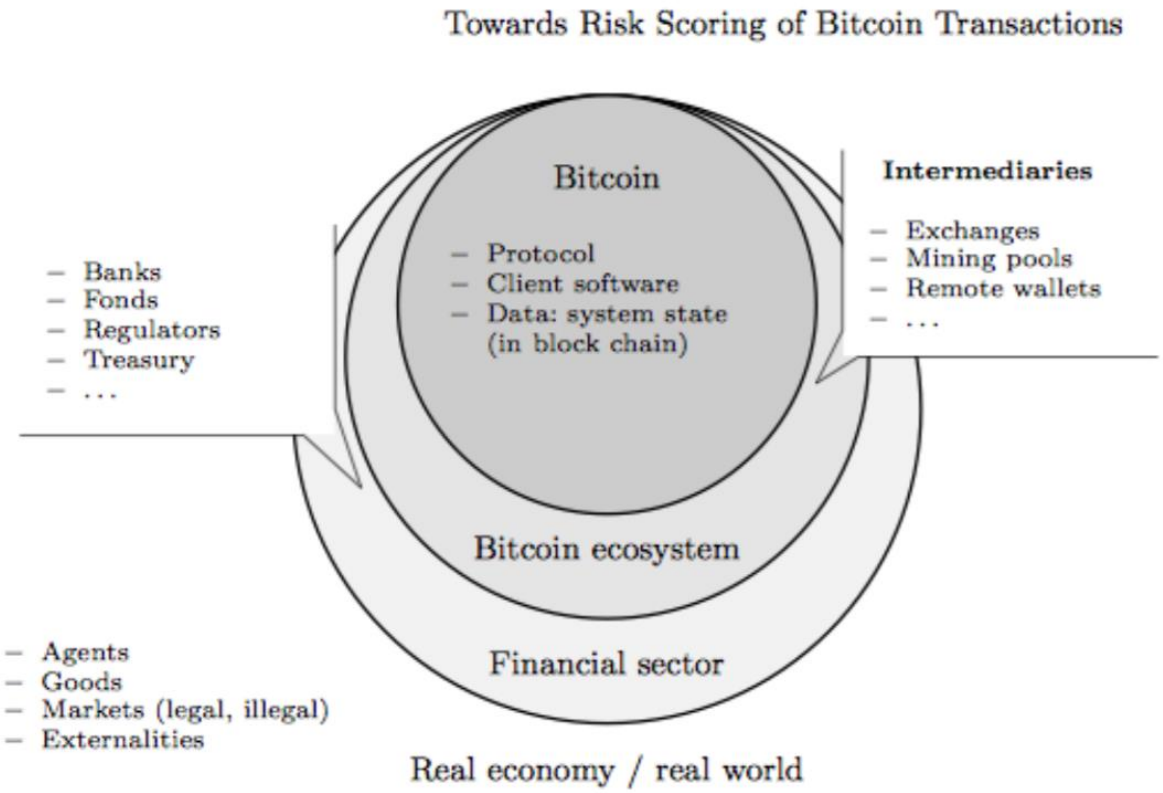


Figure 14. Bitcoin Ecosystem (McConnell 18).

Table 3. Cost and Benefits of cryptocurrencies.

Advantage:	Uncertain or both	Disadvantage
Decentralized	**Anonymity (Useful for some, mostly negative for governments)**	**No government backing**
Fast transactions	**Irreversible payments**	**Ease of use (E.g. Software, apps, online tools)**
Low costs	**No Inflation (Deflationary)**	**Price, liquidity volatility**
Transparency (Blockchain), record keeping and record integegrity	**Low barrier for banking, knowledge for usage is required**	**Use for illicit transactions**
Worldwide reach	**Still not widely accepted as a method of payment, progression in this area is moving slow**	**Security risks (E.g. hacks, fraud)**
Scalability		**Used as a Speculatory tool in its current state**
Cryptography security		**Electricity costs and equipment**
No point of technological failure (Always running)		
Most cryptocurrencies are open source		

(Folkinshteyn and Lennon 223-244; Baur et al. 66-77; Spenkelink 24-54; McConell 24-36; Kapoor 16-29; Douma 15-27).

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