STUDIA UBB NEGOTIA, LXVI, 2, 2021, pp. 99-134
(RECOMMENDED CITATION)
DOI:10.24193/subbnegotia.2021.2.06

CRYPTOCURRENCIES' PUZZLE

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ABSTRACT. The present paper tries to bring a certain degree of clarity to the cryptocurrencies puzzle by discussing the existing definitions and some classifications identified by academic studies. Further, it investigate, based on various academic studies, the uses of cryptocurrencies and their potential role as alternative money. The regulations regarding the cryptocurrencies are also considered since the spreading of the cryptocurrency phenomenon and the risks associated with the use of cryptocurrencies in various capacities raise problems related to (small) investor protection and anti-money laundering.

Key words: cryptocurrencies, medium of exchange, assets, regulations

JEL Classification: E49; E59

Recommended citation: Pop, C., Colonescu, I-E., ***Cryptocurrencies' puzzle***, Studia UBB Negotia, vol. 66, issue 2 (June) 2021, pp. 99-134, doi: 10.24193/subbnegotia.2021.2.06

Introduction and a brief literature review

The introduction of bitcoin on October 31st 2008 through the white paper released by the pseudonymous programmer/group of programmers, Sastoshi Nakamoto (Ammous 2018, Dimitrova et al. 2019) was a first small step toward what became, a decade latter, the global phenomenon of cryptocurrencies.

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Bitcoin started operating in January 2009 (Hileman & Rauchs 2017, Ammous 2018), was first listed on an exchange/trading platform starting with October 2009 and May 2010 recorded the first transaction where bitcoin served as medium of exchange (Ammous 2018). The second cryptocurrency, Namecoin, emerged in April 2011 (Hileman & Rauchs 2017). Since then, the amount of what are generically called cryptocurrencies grew dramatically (Table 1) in number and market capitalization, though bitcoin maintaining its dominance and popularity generated by its first mover position. Nonetheless, one should mention that, as of December 2020, 1,683 of the 4,048 (41.58%) cryptocurrencies registered by CoinMarketCap provided no information regarding the amount of units/tokens in circulation and therefore no market capitalization was calculated for them (https://coinmarketcap.com/historical/).

Table 1. Evolution of cryptocurrencies' number and capitalization

Data	No. of cryptocurrencies	Capitalization (UDS million)	Bitcoin capitalization as percentage of total	Bicoin price in USD
April 28th 2013	7	1,580.54	94.18%	134.21
Dec 29th 2013	67	10,364.14	87.63%	745.05
Dec 28th 2014	517	5,555.95	78.00%	317.24
Dec 27th 2015	557	6,946.92	91.38%	422.82
Dec 25th 2016	663	16,385.56	87.86%	896.18
Dec 31st 2017	1,353	614,240.51	38.66%	14,156.44
Dec 30th 2018	2,073	130,538.79	51.69%	3,865.95
Dec 29th 2019	2,388	201,565.95	66.76%	7,422.65
Dec 27th 2020	4,048	728,469.25	67.02%	26,272.29

Source: authors' compilation based on data available at https://coinmarketcap.com/historical/

Not only the number of cryptocurrencies and their associated market capitalization registered growth, but also the alternative products using the cryptocurrencies as underlying assets entered the market have grown. Foley et al. (2019) mention more than 170 crypto(hedge)funds and the fact that since December 2017 bitcoin futures contracts were introduced at Chicago Board Options Exchange (CBOE) and at Chicago Mercantile Exchange (CME). These developments show the growing interest of the investors and intermediaries on what was once a marginal asset (Foley et al. 2019).

The white paper of Nakamoto laid out the ground for a token/ virtual currency which exists within a specific system and is based at least on the following features (BIS 2018, De Filippi 2014, Cobert et al. 2019, Hileman & Rauchs 2017):

a) there is an open-source software/protocol which allow the private issuance of the respective token/virtual currency;

b) the existence of a fully decentralized and less costly peer-to-peer (P2P) network which allows the transfer of the respective token/virtual currency without the presence and/or intervention of a central counterpart or an intermediary;

c) the existence of a digital ledger sharing the history of the transactions and available to all the network participants.

The most attractive idea behind the launch of bitcoin (and the cryptocurrencies that followed since) was represented by the absence of a central authority (central bank, government or other classic financial institution) involvement in the issuance of the respective cryptocurrency, in its transfer among the network participants, and in the adjustment of the available number of units or circulating quantity (BIS 2018, Vaz & Brown 2020, Hileman & Rauchs 2017).

Cryptocurrencies seemed to promise to attain and maintain the trust (of their users) and the stability of their value based on cryptoghraphic algorithms and consensus-based blockchain platforms, by avoiding the presence of the traditional financial institutions and the governments' interventions, supervision and support and their potentially misguided incentives (BIS 2018, Vaz & Brown 2020, Cobert et al. 2019, Sobiecki 2015).

The introduction of bitcoin at the end of 2008/the beginning of 2009, with the alluring promises presented above, came at an opportune time: the global financial crisis reached its climax in September 2008 creating what was considered the most serious economic downturn since the Great Depression of 1929-1933 (Merediz-Sola & Bariviera 2019, Almunia et al. 2009). Therefore, the general public trust in the classic financial sector institutions and governments was at a very low level and this erosion of trust triggered a quest for alternative solutions, one being proposed by bitcoin (BIS 2018, Vaz & Brown 2020).

While the erosion of trust in the classic financial system might be consider one main trigger of the interest arose by the introduction of bitcoin, the wide spread of personal computers, the increased performance

of mobile phones and the cheaper and faster access to Internet played their role in the rapid spreading of bitcoin (and later on of the other cryptocurrencies) among a large number of individual users[3]. Furthermore, while no academic study investigated the problem yet (to the best of authors' knowledge) the spread of information technology was also combined with the generation Y (the millennials) reaching the maturity and having a lot of influence with their propensity toward any novelty introduced via information technology.

Since 2011, when most of the early studies related to cryptocurrencies were identified by Guo & Donev (2020) and Holub & Johnson (2018), the literature on this topic grew similar to the expansion in the number of cryptocurrencies. Table 2 below shows the main topics discussed by academic works in relation to cryptocurrencies.

Table 2. Main topics in academic works related to cryptocurrencies

Liu (2016)	Holub & Johnson (2018)	Merediz-Sola & Bariviera (2019)	Guo & Donev (2020)
Based on 253 studies from Scopus database	Based on 917 studies selected from 20 databases	Based on 1,162 studies from Web of Science	Based on 833 studies from Web of Science and Scopus
Main topics: *Technology* *Economics & finance* *Legal and regulatory*	Main topics: *Technology* *Economics* *Finance* *Accounting* *Tax* *Regulation*	Main topics: *Computer Science* *Business Economics* *Engineering* *Telecommunications* *Science Technology*	Main topics: *does not structure the investigated studies by main topics*

Source: based on Liu (2016), Holub & Johnson (2018), Merediz-Sola & Bariviera (2019), Guo & Donev (2020)

Furthermore, while the early focus of academic studies was mainly on blockchain technology, the focus gradually shifted toward the features of cryptocurrencies that can allow them to (eventually) become a substitute

[3] One should not forget that privately issued virtual currencies predate cryptocurrencies by at least a decade - e.g. the use of private tokens in massive multiplayer online games (BIS 2018, De Filippi 2014). Others (Fletcher et al. 2020) also consider various types of loyalty points and/or air miles as virtual currencies which exists within a centralized structure of particular entity.

of fiat money. More recently the interest shifts again toward the features of cryptocurrencies that make them attractive alternative investments and/or safe-have assets due to their low correlation with the traditional financial markets (Merediz-Sola & Bariviera 2019, Guo & Donev (2020), Lee & Teo 2020).

The present paper tries to bring a certain degree of clarity to the cryptocurrencies puzzle by discussing the existing definitions and some classifications identified by academic studies. Further it investigate, based on various academic studies, the uses of cryptocurrencies and their potential role as alternative money. The regulations regarding the cryptocurrencies are also considered since the spreading of the cryptocurrency phenomenon and the risks associated with the use of cryptocurrencies in various capacities raise problems related to (small) investor protection and anti-money laundering.

A brief discussion regarding the definition of cryptocurrencies and their typology

Since bitcoin was launched in 2008/2009 and with the subsequent development of similar cryptocurrencies, various regulatory authorities and academic studies have tried to find a suitable definition for cryptocurrencies. However, until the end of 2020, there is no general consensus neither regarding the nature of cryptocurrencies nor regarding, in fact, the name. The nature of cryptocurrencies is difficult to establish since they can represent different things depending on their owners' and/or users' interests. In this capacity, a cryptocurrency can be, as suggested by Sobiecki (2015) and Feinstein & Werbach (2021), an investment asset or a speculative asset, respectively a new class of financial assets, a commodity, a medium of exchange or a payment mechanism, a novel fund-raising tool for businesses, just to name a few. On the other hand, the name 'cryptocurrencies' has arisen long before the formulation of a definition and became a generally accepted expression, though the name is attached to representations that have not been recognized as money, nor have been accepted as legal tender and, therefore, inappropriately called currencies.

Nonetheless, since the expression 'cryptocurrency/cryptocurrencies' entered more than a decade the vocabulary of specialists, academia and common people, it will be generically used within this paper also.

Most of the definitions regarding cryptocurrencies consider them digital or virtual currencies that rely on cryptographic algorithms for the security of its creation, counterfeiting, and against fraudulent transactions among interested parties (De Filippi 2014, BIS 2018, Boshkov 2019, Lahajnar & Rozanec 2020; Dumchikov et al. 2020).

More recently, some of the European regulatory authorities – ECB (European Central Bank), EBA (European Banking Authority), ESMA (European Securities and Markets Authority), and FATF (Financial Action Task Force) – have aligned their vision on cryptocurrencies based on the definition proposed by the EU Directive 2018/843 (Houben & Snyers 2018). The definition considers cryptocurrencies as being virtual currencies which describe a digital representation of value that has the following characteristics: a) the respective representation of value is neither issued nor guaranteed by a central bank or a public authority; b) it is not necessarily (but might be) attached to a legally established currency; c) it does not possess the legal status of currency or money; d) however, it is accepted by natural or legal persons as a medium of exchange/payment; and e) it can be transferred (mostly peer-to-peer), stored and traded electronically.

Similar to the European definition, the IMF (International Monetary Fund) and the World Bank consider cryptocurrencies as a subset of virtual/digital currencies which stand for a digital representation of value, denominated in their own unit of account (Houben & Snyers 2018).

While the most important features of cryptocurrencies are captured by the EU Directive definition, several other features should be added in order to understand why, up to this moment, the cryptocurrencies have not managed to become important competitors to the fiat currencies as they seemed to promise about a decade ago. Among the other features that should be considered by anyone interested in cryptocurrencies the following must be included:

a) the fixed maximum quantity for the most launched cryptocurrencies, which is established and controlled by the respective protocols (De Filippi 2014).

b) the transfer of the respective cryptocurrencies is done peer-to-peer, based on the cryptographic techniques to achieve consensus[4] and the transfer of cryptocurrencies does not need the presence of a third (trusted) part intermediary (Houben & Snyers 2018).

c) though created privately, most cryptocurrencies are no one's liability, therefore they cannot be redeemed in case of accidental loss of access keys and/or cyber-attacks (BIS 2018, Vaz & Brown 2020, Lastra & Allen 2018).

d) the transactions with cryptocurrencies cannot be reversed in case of simple mistakes or, again, cyber-attacks (Vaz & Brown 2020, De Filippi 2014).

One must note that, given the above-mentioned features, most cryptocurrencies have no intrinsic value. Therefore a number of studies suggested that the value given to them derives from the way users perceive them (as asset, commodity, medium of exchange), from the expectation that the respective cryptocurrencies will continue to be accepted by other users, and from the confidence and trust users have in the algorithms that operate the respective networks and allow the identification of all transactions via ledgers (Cobert et al. 2019, Fletcher et al. 2020, BIS 2018, Athey et al. 2016). Feinstein & Werbach (2021) added the dimension of user sentiments and/or attitudes to the quest of the perceived value of cryptocurrencies, highlighting that these sentiments/attitudes can play a greater role in the case of cryptocurrency pricing compared to traditional financial assets.

Given the large number of cryptocurrencies in existence, any attempt to classify them will remain incomplete. However, at least two classifications can be taken into account.

One can be considered an early classification and is related to the introduction of bitcoin and its dominance on the market. This classification proposes the following arrangement:

a) bitcoin, standing alone, in a class of its own, given the status of being the first launched cryptocurrency;

b) altcoins, being any other cryptocurrency alternative to/other than bitcoin (Hileman & Rauchs 2017; Houben & Snyers 2018). Further, Houben & Snyers (2018) proposes the following sub-classes for altcoins:

[4] For more details see footnote 65 in Houben & Snyers 2018).

b1) altcoins that are similar with bitcoin, having however some different features; Hileman & Rauchs (2017) showed that, at the time of their work, most of the existing cryptocurrencies were similar to bitcoin;

b2) altcoins that use their own, different, blockchain protocol on which their distributed ledger is based.

The second classification is mostly used by various reports and academic studies due to the fact that it offers a better structure for studying cryptocurrencies mainly considering their potential capacity as medium of exchange, unit of account, and store of value (Houben & Snyers 2018, Auer & Claessens 2020, Fletcheret al. 2020). This classification proposes the following sub-classes based on the type of blockchains used by the respective cryptocurrencies' networks. Therefore, the following grouping can be found:

a) *cryptocurrencies based on open/public or permissionless blockchains*; these cryptocurrencies are accessible via an open-source software and promise a fully decentralized setting (Fletcher et al. 2020, BIS 2018, Auer & Claessens 2020); there is no central entity that can be considered the owner and/or the administrator of the respective cryptocurrency network and software (Houben & Snyers 2018); any person can join or leave the network of the chosen cryptocurrency anytime and there is no need of a pre-approval issued by any central entity (Houben & Snyers 2018); the transactions are recorded by a ledger and identical copies of the ledger are available to the network participants, though the ledger can be changed only by a consensus among the participants (Houben & Snyers 2018, BIS 2018); the transactions are peer-to-peer and are validated and executed without the intermediation of a trusted third party (Houben & Snyers 2018).

This category of cryptocurrencies is the dominant one and most of the time the cryptocurrencies are intended **to be used as means of payment or of exchange**; they are also used for **investment** purposes (EBA 2019, Lastra & Allen 2018).

Over the past few years the subcategory of ***stablecoins*** was introduced as means of payment/exchange. The ***stablecoins*** are either backed by a fiat currency or by another type of physical asset or even a crypto-asset, or can be based on an algorithm that can try to ensure the stability of the value of the respective stablecoin (EBA 2019, Klein et al. 2020). Nonetheless, according to Klein et al. (2020), most stablecoins are

used rather as vehicle currencies for the exchange of various crypto-assets and the situation seems to be due to the regulatory uncertainty related to cryptocurrencies in general.

b) *cryptocurrencies based on permissioned blockchains*; the networks of these cryptocurrencies give selected participants various types of access rights and the networks' administrators set the rules for pre-selecting the transactions' validators (considered trusted participants) and the rules for their respective ledgers (Auer & Claessens 2020 Houben & Snyers 2018, BIS 2018); in these cases, the participants to the network have to trust the central entity which coordinates/administrates the network mainly for selecting the reliable trusted participants or nodes (Houben & Snyers 2018, BIS 2018).

Houben & Snyers (2018) proposes the further division of *the cryptocurrencies based on permissioned blockchains* in two subcategories:

b1) *cryptocurrencies based on open or public permissioned blockchains*; these networks can be accessed and viewed by any interested person; however, the transactions can be generated and/or the ledger can be updated only by the authorized network participants; similar with the cryptocurrencies based on permissionless blockchains, the transactions within these networks can be validated and executed without involving a third (trusted) party; these cryptocurrencies, depending on the rules set by the respective networks' administrators, can be **convertible** in fiat currencies and/or can function as **investment tokens**, as discussed by EBA (2019) and Lastra & Allen (2018); they also can be **means of payment or of exchange** (EBA 2019, Lastra & Allen 2018);

b2) *cryptocurrencies based on closed or 'enterprise' blockchains*; in the case of these networks, the access is restricted to those participants accepted by the administrators; furthermore, only the network administrator can generate transactions and update the state of the ledger; these cryptocurrencies are often associated with **utility tokens** (EBA 2019, Lastra & Allen 2018) and most of the time are considered to be **non-convertible** in fiat currencies (FATF 2014); they are confined to the centralized structure of a particular entity and the respective entity can be identified as a legal one (Auer & Claessens 2020, Fletcher et al. 2020).

One cannot close this brief classification without stressing that the boundaries between various categories of cryptocurrencies remain blurry since the cryptocurrencies' versatility depending on their users' perceptions

can move them easily from one category to another, as stressed by EBA (2019) and Lastra & Allen (2018) and showed by the alternative classification (based on their various uses) proposed by Lee & Teo (2020).

The use of cryptocurrencies and their potential role as alternative money

The relatively rapid acceptance and the growth in the use of cryptocurrencies can be connected mainly to their promises of low-cost technologies, low transaction costs, the peer-to-peer system, the absence of a central/governmental authority and (pseudo)anonymity for the users (Cobert et al. 2019, Van Alstyne 2014, BIS 2018). Based on these features, the advocates of cryptocurrencies enhanced the idea that the cryptocurrencies will be easily available to those who have a difficult access to traditional finance alternatives due to their size (e.g. small merchants as stressed by Scott (2016)) or to those banned from the classic financial alternatives due to bankruptcy or for other reasons (Granot 2019).

Nonetheless, one must note that, strictly speaking, no cryptocurrency transaction is completely anonymous since any protocol has the possibility to trace the transactions to and from the (pseudo)anonymous addresses used and which, in the end, can be linked to an identity (De Filippi 2014, Brito & Castillo 2013). However, as FATF (2014) shows, one can use various anonymising tools for further concealment of their identity, like 'tumbling' and 'mixing' (Morton 2020). Based on these anonymising tools a subset of cryptocurrencies with enhanced privacy features emerged (called privacy coins/cryptocurrencies); the most well-known within this new subset are Dash, Zcash, Zcoin and Monero (Lee & Teo 2020).

There is no doubt that it is difficult or very difficult to discover the real identity of cryptocurrency users (De Filippi 2014, BIS 2018) and therefore warnings regarding the use of cryptocurrencies for money laundering, other fraudulent transactions to avoid capital control and/or taxation were discussed by the early studies of Stokes (2012) and Gruber (2013). Also, the recent study of Fletcher et al. (2020) points toward the features of cryptocurrencies (their (pseudo)anonymity, their peer-to-peer transactions with their irreversible and transnational nature) as enablers for the use

of cryptocurrencies in various criminal activities, including terrorist financing and money laundering. This situation is further enhanced by the studies of Foley et al. (2019), Vaz & Brown (2020), and Feinstein & Werbach (2021).

The study of Tasca et al. (2018), for the period 2009-2015, identified 3 sub-periods in the use of bitcoin/cryptocurrencies, as follow:

a) the first sub-period between 2009 and 2011, dominated by mining and by small test transactions;

b) the second sub-period between 2011 and 2013, that of 'sin users', when bitcoin was rapidly adopted by 'sin enterprises' (those involved in gambling, drug use, pornography, and other illicit activities); this rapid adoption was incited by the bitcoin features – (pseudo)anonymity and the absence of a governmental control; nonetheless, during this sub-period also exchange activities were taking place;

c) the third sub-period since 2013 onward, considered to be exchange dominated due to the proliferation of exchange activities and the increased presence of legitimate merchants as users of bitcoin; this growing presence of legitimate merchants is also mentioned by De Filippi (2014).

A series of studies confirm the above-mentioned sub-periods, adding more information.

De Filippi (2014), Vaz & Brown (2020), and Lee & Teo (2020) highlighted that the mining process for cryptocurrencies (namely bitcoin) is not a very simple one for any average computer uses and also proved to be costly from energy consumption viewpoint. This high energy consumption, mainly for bitcoin mining, is also presented by Stoll et al. (2019), a situation which led to a concentration of the mining market within a small number of mining companies (like Bitmain, Ebang, Canaan) which accumulate about 65% of this market, while small scale miners barely reach 8% (Lee & Teo 2020).

As consequence, a series of intermediaries emerged, providing a simpler and easier way for common people to acquire, trade and exchange cryptocurrencies versus fiat money at low or very low transaction fees (De Filippi 2014, Vaz & Brown 2020). The market system for cryptocurrencies grew in complexity including the cryptocurrency creators/inventors, cryptocurrency offerors, the miners (in the case of proof-of-work protocols) and forgers (in the case of proof-of-stake protocols), cryptocurrency exchanges and trading platforms, (crypto)wallet providers

and, of course, the users (Houben & Snyers 2018, FATF 2014). The cryptocurrencies exchange market is highly fragmented, with about 250 crypto exchanges functioning around the world, according to Lee & Teo (2020), while Feinstein & Werbach (2021) mentions 325 crypto exchanges as of June 2020.

A Europol report of 2015 considers that cryptocurrencies were used in more than 40% of the illicit transactions in the European Union (Morton 2020). Fanusie & Robinson (2018) report on bitcoin laundering, between 2013 and 2016, after investigating 102 illicit entities, shows that most of the unlawful activities originated mainly on dark-net marketplaces with Silk Road (shut down in 2013), Alpha Bay (shut down in 2017) and Agora leading the way with their involvement in selling illegal drugs and a multitude of other illicit items and services (Fanusie & Robinson 2018). The findings of Fanusie & Robinson (2018) are confirmed by the strong market price reaction of bitcoin to the shut down of Silk Road, suggesting a substantial connection – at least of bitcoin – with illicit activities (BIS 2018). The report of Fanusie & Robinson (2018) is further supported by the study of Foley et al. (2019) which shows that about 25% of bitcoin users are involved in illegal activities and about 46% of bitcoin transactions are illegal activities. The findings of these studies are reinforced by Feinstein & Werbach (2021). All these results extend the second sub-period of Tasca et al. (2018) beyond 2013, at least until the beginning of 2017/2018.

On the other hand, other relatively early study of Glaser et al. (2014) showed that the common (mostly uninformed) users who approached cryptocurrencies were interested mainly in the potential cryptocurrencies' role as alternative investment vehicle and were less predisposed to regard them as an alternative mean of payment. This idea was later confirmed by Fabris (2019) who also showed that cryptocurrencies – mainly bitcoin – are mostly traded for investing or speculative purposes, suggesting that – in some cases – cryptocurrencies are referred as 'tulips', making a parallel with the tulip-mania of the 17th century and stressing the highly speculative profile of cryptocurrencies.

Further, the study of Foley et al. (2019) indicates that the illegal share of bitcoin transactions is decreasing as the mainstream interest for bitcoin increases, mentioning that the emergence of other, more opaque, cryptocurrencies (the above-mentioned privacy cryptocurrencies/coins)

attract the interest of the 'sin users'. The study of Foley et al. (2019) is further confirmed by Lee & Teo (2020) and Feinstein & Werbach (2021) which also consider that cryptocurrencies are rather used as (speculative) investment vehicles. All these studies confirm the third sub-period proposed by Tasca et al. (2018) and highlight the relative marginal role of cryptocurrencies as the initial intended medium of exchange/payment mechanism.

Foley et al. (2019) distinguished two main categories of bitcoin users, categories that can be extended to the other cryptocurrencies:

a) the illegal users who tend to use bitcoin/cryptocurrencies as a medium of exchange, to transfer this medium of exchange repeatedly to a given counterpart and the transfers are of (relative) small size; these users also often employ transaction techniques that obscure their activities; they also tend to hold less bitcoin or other cryptocurrencies;

b) the legal users of bitcoin/cryptocurrencies that treat them mainly as investments or speculative assets.

The study of Bouri et al. (2020) shows that the use cryptocurrencies is also influenced by geopolitical risks. In the region where political instability is high, the investors might move toward cryptocurrencies (mainly bitcoin) as shelter, while the mistrust in the respective local traditional currencies induce the use of cryptocurrencies as medium of exchange. However, even when these extreme situations are taken into consideration, the use of cryptocurrencies as medium of exchange remains low.

The evidence of the studies mentioned above suggests that the main use of cryptocurrencies (mostly bitcoin and other top 20 cryptocurrencies) is as alternative investments or speculative assets, in general since 2013-2015. It is only natural for one to ask why the cryptocurrencies din not really succeeded in their intended purpose to become (at least) a wide-spread medium of exchange?

In order to answer the question above, a brief review of the three roles that classic/fiat money perform is necessary. These three fundamental roles are: a) medium of exchange; b) unit of account; and c) store of value (BIS 2018, Vaz & Brown 2020). To fulfill this triad the fiat money need to maintain a relatively stable value (purchasing power) over time, to prove that a transaction can be completed and can intermediate the transfer of

value (BIS 2018, Vaz & Brown 2020, Ammous 2018). To avoid the purchasing power volatility, the supply of fiat money must be elastic in order to address the fluctuating demand (BIS 2018, Vaz & Brown 2020, Ammous 2018). In order to ensure this and generate trust in fiat money, the current institutional arrangements were created (BIS 2018, Vaz & Brown 2020). The central banks are the core of these arrangements and through their monetary policies they prevent their respective currency's purchasing power volatility (Ammous 2018). Furthermore, the central banks create and manage the public trust by controlling excessive risk-taking behaviors and by reducing the concerns related to the risk of using the fiat money in any of the three roles (Vaz & Brown 2020,). These are the overall features of what is generally called 'good money' (BIS 2018, Ammous 2018).

When cryptocurrencies were launched with the intention to represent an alternative form of money, their advocates claimed there will be a new model of decentralized trust (Auer & Claessens 2020). Furthermore, this trust seemed to derive from the cryptocurrencies 'one stop shop' features since, as shown by Vaz & Brown (2020), the cryptocurrencies are a combination between digital currencies, a payment system and a settlement mechanisms. These features are completed by the capacity of cryptocurrencies to provide automatically initiated conditional transactions associated with bank-like account functions (Vaz & Brown 2020).

Based on the declared model of decentralized trust and on their multifaceted features, is is only naturally to ask which of the fundamental roles of fiat money the cryptocurrencies were able to fulfill in their existence of about a decade.

The role of medium of exchange is best suited for those cryptocurrencies that are based on permissionless blockchains and, probably up to a point, to those cryptocurrencies based on open permissioned blockchains, providing that they are not tokens intended to be used for a specific purpose (Ammous 2018).

In their role as medium of exchange, the cryptocurrencies are supposed to intermediate transactions peer-to-peer, via their respective networks/protocols.

However, recent studies have pointed out that mainly the proof-of-work consensus mechanism, though most secure and sophisticated (Klein et al. 2020, BIS 2018), prove also to be energy intensive (Chiu &

Koeppl 2019, Cobert et al. 2019, Klein et al. 2020, Fabris 2019, Bouveret & Haksar 2018) since it requires expensive redundant processing due to the need to operate a consensus based distributed ledger (Vaz & Brown 2020, BIS 2018, Auer 2019). It seems that there is a low transaction turnover; Klein et al. (2020) mentions about 7 bitcoin transactions per second, while Vaz & Brown (2020) mention that the processing time of a (bitcoin) transaction might vary between few seconds and an hour, an affirmation confirmed by BIS (2018) which shows that cryptocurrency transactions have a tendency to become congested (payments becoming more slow and difficult) when the number of those who use them for payment increases.

Furthermore, academic studies have also shown that (mainly for the most used 10 to 20 cryptocurrencies) their scalability to the transaction demand is another important problem, cryptocurrencies proving to be from difficult to use to almost useless in day-to-day, small transactions (Auer 2019, Vaz & Brown 2020, BIS 2018, Klein et al. 2020). Vaz & Brown (2020) further suggest that small transactions within the respective cryptocurrencies networks might be marginalized and discriminated based on costs in favor of large transactions. This situation proves that the promise of low-cost transactions via cryptocurrencies was not realized (Auer 2019, Vaz & Brown 2020). Also unrealized remained the pledge of an increased accessibility for low-income and other groups ignored by the traditional financial system due to various reasons (Vaz & Brown 2020). This low accessibility of cryptocurrencies networks by the mentioned groups comes not only from high access costs (energy related to protocol complexity) but also from the lack of knowledge regarding cryptographic algorithms and their ability and/or available time to deal with an important amount of information contained by the distributed ledgers (Auer 2019, Vaz & Brown 2020).

To this important problem another one was revealed and added: the fact that the finality of payments via permissionless protocols cannot be guaranteed nor the transactions could be reversed if an error (regarding the destination) occurs (De Filippi 2014, BIS 2018, Vaz & Brown 2020, Fletcher et al. 2020).

In an attempt to solve some of the problems mentioned above, various solutions appeared. New protocols, like proof-of-stake, tried to address the scalability of cryptocurrencies, though some of the security

features of the proof-of-work mechanism were lost (Klein et al. 2020). Another solution was the forking: the replication of a blockchain under a new name of a new version of an existing cryptocurrency (Vaz & Brown 2020). Both solutions and the problems mentioned above had a negative impact on the cryptocurrency users, mainly on their trust in cryptocurrencies as an alternative form of money (Vaz & Brown 2020). This situation is further enhanced by the study of Foley et al. (2019) showing the dominance of illegal users of cryptocurrencies as mean of payment.

Another important problem with most cryptocurrencies, which were inspired by the success of bitcoin and therefore are based on permissionless blockchains (Hileman & Rauchs 2017, Ammous 2018), is represented by their predetermined supply which implies strict limits on the quantity that can be issued and controlled by protocols (BIS 2018, Ammous 2018, Vaz & Brown 2020). Therefore the cryptocurrencies supply is rigid/inflexible and, without the intervention of a third party, cannot be adjusted to a widely fluctuating demand, and - in the end - to the economy's needs (BIS 2018, Ammous 2018, Vaz & Brown 2020). Hence, this unsteady demand has already created bubble type situations (Vaz & Brown 2020) whit the natural consequence of high volatility of cryptocurrencies' value (BIS 2018, Ammous 2018, Lee & Teo 2020). Obviously, this situation had at least the following negative consequences:

a) on cryptocurrencies scalability – limiting their capacity to adapt to small scale transactions and, as a result, impairing their potential role as a common and liquid medium of exchange (Ammous 2018, Vaz & Brown 2020);

b) on cryptocurrencies capacity to be used as unit of account since their value is highly unstable (BIS 2018, Ammous 2018, Vaz & Brown 2020, Fabris 2019);

c) on cryptocurrencies capacity to be used as store of value, for the similar reason of high volatile value (Fabris 2019).

An additional problem related to cryptocurrencies was highlighted by BIS (2018): any cryptocurrency can simply stop functioning for various reasons and since the respective cryptocurrency is no one's liability, the result for any user will be a complete loss of value.

All the problems mentioned above show that any interested user (if he/she is not a blind enthusiast of cryptocurrencies) has to ask some

questions when the trust in cryptocurrencies as an alternative form of money comes into discussion. For sure some important doubts exists and these are proven by documented facts. Until the end of 2020 cryptocurrencies could not establish themselves as alternative money since their role of medium of exchange is still limited and they do not represent a real replacements of the existing large retail payment networks (Chiu & Koeppl 2019) and do not – at least for now – can provide a solid base for a cashless world (Fabris 2019, Auer & Claessens 2020,Vaz & Brown 2020). Furthermore, cryptocurrencies can not fulfill the other two roles of money: unit of account and store of value due to their highly volatile value. Also, as Vaz & Brown (2020) showed, due to their (pseudo)anonymity, cryptocurrencies are difficult to use in lending/credit relations. Though some platform like CoinMarketCap start offering on their websites services for lending cryptocurrencies, it is not clear yet how extensive and frequent these services are used. Furthermore, the lending of cryptocurrencies raises questions related to interest rate levels and also how and who will deal with the creation of new quantities of the respective (lent) cryptocurrencies via interest rate in a medium where the available volume of cryptocurrencies is limited. As Ammous (2018) highlights, the cryptocurrencies role as medium of exchange should be supported by their utility in the other main roles as alternative money.

Therefore, the suggestion of Vaz & Brown (2020) and of BIS (2018) that cryptocurrencies (as an alternative form of money) need a form of financial architecture – like the existence of a counterpart willing to stabilize their value, either under legal obligation or through incentives – in order to enable the built of trust and further the support of this trust is based on the main characteristics of 'good money'.

As mentioned above, most users of cryptocurrencies prefer them an alternative investments or speculative assets, therefore relying heavily on the intermediaries that emerged to provide intermediation services for the cryptocurrency markets (cryptocurrencies' exchanges, (crypto)wallets' providers, (crypto)trading platforms). Most of these intermediaries were and still are unregulated and also most of them are located offshore (BIS 2018, Vaz & Brown 2020). These 'features' only increase the risk of total value loss for average, usually small, cryptocurrency users (Vaz & Brown

2020). A number of these intermediaries fell victim of hacking attacks[5], in the lead being the Japanese MtGox exchange in 2014 which lost an estimated value of $400 million in bitcoin and the Japanese Coincheck exchange in 2018 which lost an estimated value of $500 million in digital token (BIS 2018, Cobert et al. 2019).

Furthermore, as stressed by Vaz & Brown (2020), due to the cryptocurrencies design, if the password or the digital key for a (crypto)wallet is stolen/hacked or lost, there is no possibility for the user to recuperate the lost value unless there is a backup offered by the holder/provider of the respective service or the situation is mitigated via a third party (Vaz & Brown 2020).

These problems further tested the trust in cryptocurrencies and in their market intermediates. Vaz & Brown (2020) show that some (crypto)exchanges consider to provide custody services and the possibility to recover the (crypto)wallet key. This suggests also the need for a regulated intermediate structure for the cryptocurrencies markets (Vaz & Brown 2020) and it is further supported by Van Wegberg et al. (2018) who reveals that, ironically, mainstream cryptocurrency exchanges are lobbying to become regulated.

Cryptocurrencies and regulations

As indicated in the previous section, for cryptocurrencies (mainly those based on open blockchains) to become an accepted and good form of alternative money, the need to trust them in this capacity is critical. Furthermore, the market structure that appeared to allow the intermediation of cryptocurrencies needs also to be trusted. In both cases, the trust follows regulatory frameworks and institutional infrastructures that prevent, as much as possible, various risks – from protecting average, small users from the risk of value loss and allowing the reversibility of their transactions if necessary, to the obstruction of more serious criminal activities.

[5] One can find the names of other, smaller, (crypto)exchanges or crypto-trading platforms that were victim of hacking in the studies of DeFilippi (2014), Cobert et al. (2019), Miciula (2019), and Feinstein & Werbach (2021).

The cryptocurrencies (mainly the permissionless ones) put a lot of challenges to the effort to include them into the existing regulatory framework since most of them lack a legal entity or person to be related to and even if such an entity/person exists, to establish its domicile is either impossible or very difficult (BIS 2018). Due to their decentralized nature, cryptocurrencies are borderless and nationless, being able to function outside the existing regulatory framework for the (traditional) financial institutions (Auer & Claessens 2020, BIS 2018, Cobert et al. 2019). What makes regulating cryptocurrencies even harder is the speed with which they evolve and appear, determining regulators to lag behind (Cobert et al. 2019). Therefore the debate is on about how effective the regulation at national level can be (Auer & Claessens 2020, Feinstein & Werbach 2021), highlighting how uneven the views regarding the nature and status of cryptocurrencies are (Cobert et al. 2019, Fletcher et al. 2020). Other studies suggest the need to create a regulatory system for cryptocurrencies that should be integrated, comprehensive and effective (Dumchikov et al. 2020, Morton 2020).

Currently, cryptocurrencies are, from a legal perspective, in a twilight zone (Van Wegberg et al. 2018) since they are neither banned nor regulated in many countries which chose to adopt the 'wait and see' attitude and, in most cases, only issuing warnings regarding the risks associated with the use for transactions and the possession of cryptocurrencies (Miciula & Kazojc 2019). However, some countries introduced regulations related to cryptocurrencies, while others choose to ban the use of cryptocurrencies either as medium of exchange and/or investment alternative and/or the mining activities. A selection of these countries is presented in Appendix 1.

Based on the cryptocurrencies' features, one can suppose that they are either out of the reach of national regulations or the influence of these country regulations is negligible. Nonetheless, some interesting findings come to light relating the price/capitalization and the transaction volume of cryptocurrencies with the regulatory actions in various countries as several studies showed. Cobert et al. (2019) mention mainly the important decrease in bitcoin price (about 50% in the early 2018) widely attributed to the concerted regulatory intentions of South Korea, Japan, and China. Borri & Shakhnov (2020) also show that the

restrictions imposed by China in 2017 (when initial coin offerings were banned) generate a decrease in trading volume in China and an increase of trading volume outside this country, mainly exchanging bitcoin versus the Korean won, Japanese yen and US dollar.

The study of Auer & Claessens (2020) indicates that the impact of regulations on the cryptocurrencies' prices and trading volume is influenced by the specific category to which it relates. Further, the findings of Auer & Claessens (2020) show that:

a) strong adverse effects on cryptocurrencies markets are related to news regarding regulations related to the general interdiction of cryptocurrencies to be used for (financial) transactions; these news are followed by those regarding the regulation of cryptocurrencies' treatment as securities; also important adverse effects are induced by the clear statements that cryptocurrencies will not be treated as fiat currencies;

b) adverse effects are linked to news about combating money laundering and prohibiting financing terrorism; this type of effects are also caused by regulations limiting the interoperability of cryptocurrencies with the regulated financial system;

c) no effects were detected when authorities issues general warnings (regarding the risks of using and/or possessing cryptocurrencies); also there are no effects when news appears regarding the possible issuance of a central bank digital currency (CBDC);

d) strong positive effects seem to be related to news that point toward possible novel regulatory framework favorable to the use of cryptocurrencies.

The study of Auer & Claessens (2020) is further confirmed by Shanaev et al. (2020) findings that anti-money laundering regulation announcements and the regulations on (initial) coin issues have significant effects on cryptocurrencies' prices, while the study also reports no significant effects when the general warnings regarding the risks associated with cryptocurrencies are issued. Similar findings are reported by Feinstein & Werbach (2021) when the prices are taken into consideration.

Nonetheless, when Feinstein & Werbach (2021) focus on cryptocurrencies (bitcoin and ethereum) trading volume - in fact on the authors consider the turnover – they find little evidence that the

announcements regarding regulatory actions induce abnormal trading volumes on crypto exchanges. Nonetheless, these results should be considered with caution since the same authors mention a high level of bitcoin concentration within a small number of accounts[6] and therefore this concentration might have an important influence on turnover.

As studies of Brito et al. (2014) Auer & Claessens (2020) and Feinstein & Werbach (2021) show, the main areas on which the existing national regulations have the tendency to be concentrate are a) the anti-money laundering and the prevention of other criminal uses of cryptocurrencies and b) the protection of cryptocurrencies users. A third area of regulation is related to the taxation of the gains resulted from investing in or speculating the cryptocurrencies[7]. In all cases, the regulators are exploiting the need of cryptocurrencies to leave their parallel virtual world and to be exchanged versus fiat currencies for various purposes (Vaz & Brown 2020, Auer & Claessens 2020, BIS 2018). Therefore a series of regulations target the specialized intermediaries that allow the functioning of cryptocurrencies markets. As shown above, recently some of these intermediaries start lobbying to be regulated, as Van Wegberg et al. (2018) mentions, in order to increase the trust of their users. Furthermore, Auer & Claessens (2020) highlight the need to regulate the interoperability of cryptocurrencies with regulated financial institutions (commercial banks, credit card companies, various types of exchanges), since these entities are allowing most users to convert the cryptocurrencies in fiat/sovereign currencies and the rules how to deal with cryptocurrencies and related products (like derivatives and ETFs) are important. There is no doubt that cryptocurrencies markets rely to a certain extent on the regulated financial institutions to operate (Auer & Claessens 2020, Vaz & Brown 2020).

[6] Kharif (2020) estimates that, for bitcoin, about 2% of the (crypto)exchange accounts are controlling about 95% of all bitcoin.

[7] Morton (2020) mentions the creation the creation of the Joint Chiefs of Global Tax Enforcement (J5) which includes US, Australia, Canada, UK, and the Netherlands. This initiative tries to oppose the tax crimes related to cryptocurrencies.

Though, any relevant ground for regulating cryptocurrencies should first establish what these representations are[8]. More to the point, given their versatile and multi-faced nature, any definition of cryptocurrencies should consider them in all the already identified capacities: mean of payment and exchange, security, commodity, property, payment system, settlement mechanism. By including all these aspects the complexity of regulation will increase though it will also be inclusive. The need for a comprehensive legal definition and classification of cryptocurrencies is also stressed by Morton (2020).

As shown above, most of the present regulations are at national level, though most studies related to regulations on cryptocurrencies express concern regarding how effective these sovereign regulations are or will be. In most studies proposal are made regarding the need for a global regulation of cryptocurrencies mainly from financial viewpoint. This is a difficult goal to achieve since the characteristics of cryptocurrencies allow them to be highly elusive even if an agreement would be reach regarding the authority which should regulate and supervise the domain. Other voices consider that the regulation of cryptocurrencies should come from within their system, namely the private sector technology companies or an agreed upon organization ought regulate the domain (De Filippi 2014, Fletcher et al. 2020).

As the debate continues, a number of countries continue to regulate or have regulation in progress for cryptocurrencies and their markets at national level, while other continue to forbid the use of cryptocurrencies. Meanwhile the number of cryptocurrencies entering the market is growing at a rapid pace.

[8] The difficulty to agree upon the status of cryptocurrencies is illustrated by the different views on bitcoin (which can be extended to cryptocurrencies in general) expressed by four regulatory bodies in US. Their views are the following, according to Fletcher et al. (2020) and Cobert et al. (2019): FinCEN (Financial Crime Enforcement Network) considers bitcoin to be a currency; CFTC (Commodity Futures Trading Commission) regards bitcoin as a commodity; SEC (Securities and Exchange Commission) sees bitcoin as a type of security; IRS (Internal Revenue Service) views bitcoin as a property for federal tax purposes.

Conclusions

The introduction of cryptocurrencies more than a decade ago brought into the main scene the blockchain technology and its potential benefits for the global financial system. This phenomenon also highlighted how powerful the integration between the IT and the financial sector can be(come).

When launched, the cryptocurrencies were intended as an alternative payment mechanism, without a central counterpart, which promised to be available at low-cost to any (informed) user. However, this intention was only partly confirmed by the subsequent evolution, cryptocurrencies becoming the payment of choice in a high number of illicit transactions during the second decade of the 21st century.

Furthermore, the relative high energy costs related to cryptocurrency mining of forging (depending on protocol) combined with the level of knowledge regarding cryptography generated a concentration of the mining sector in the hands of few. This situation also pushed the common/uninformed users to employ various intermediation services to reach the cryptocurrencies and therefore transmuting the initial intended use (payment mechanism) toward investment and/or speculative assets. This behavior generated market bubbles for several cryptocurrencies (mainly the dominant bitcoin) and therefore a high volatility in their respective prices. These circumstances also hindered the potential use of cryptocurrencies as medium of exchange, having an important impact mainly on the scalability of cryptocurrencies for small (day-to-day) transactions, but also on their potential role as unit of account and store of value.

The use of cryptocurrencies as 'good money' is additionally obstructed by the limited quantity of tokens/units available, most of the time imposed by the respective blockchain. The cryptocurrencies have a rigid offer which does not allow (in the absence of a central authority) a flexible adjustment to demand, creating further volatility. Forking was used as a solution, though the result in most cases weakened the much needed trust in means of payment. Other problems related to the limited quantity might be solved via the smallest denominations for the respective cryptocurrencies (e.g. bitcoin is denominated in 100,000,000

or 108 satoshi[9], while ethereum is divided in 1,000,000,000,000,000,000 or 1018 wei[10]) though the restricted quantity can not be overlooked. Due to their limited quantity, cryptocurrencies were often compared with gold and one should not forget the negative influence played by the gold (bullion) standard which generated the same inflexible offer of money which could not adapt to the growing level of world trade flows and, consequently, becoming one of the causes for the Great Depression of 1929-1933.

Another problem, though seldom mentioned, is the very high number of reported cryptocurrencies (over 4,000 by the end of 2020). This number continues to grow and no one can say how many of the cryptocurrencies had only a meteoric existence. While the creators of cryptocurrencies follow their quest for success, this high number of cryptocurrencies can only generate further confusion among the existing and the potential users and might erode their trust since the quest for the next speculative asset 'winner' requires a substantial effort mainly related to information gathering. This situation can be assimilated with the medieval Europe and the high number of existing mints and the problems created by the intrinsic value of the minted coins (Redish & Weber 2011, Volckart 2018, Naismith 2018). One should not overlook the past experiences when the liberal issuance of private money almost always ended badly (BIS 2018, Fabris 2019).

An additional aspect that should be looked upon when the potential role as alternative money of cryptocurrencies is considered: the trust. Until the end of 2020, without the institutional support of fiat/traditional money, the existing trust (not measured yet to the best of authors' knowledge) in cryptocurrencies seems to arise mainly from their blockchain technologies, the alluring (pseudo)anonymity, and even more seductive idea of no government control. However, these tempting features do not cancel the fact that cryptocurrencies are no one's liabilities and can represent a complete loss for a number of reasons (from lost key/password to cyber-attacks). The risks for small, rather uniformed, users to place their money in cryptocurrencies no matter for what reasons, remain high and, in the end, have an impact on trust.

[9] https://www.investopedia.com/terms/s/satoshi.asp
[10] https://www.investopedia.com/terms/w/wei.asp

To reduce some of these risks, like the loss of investment assets, some crypto intermediaries started to act as counterparts and recognized the need for regulations. Though, this is not the norm yet within the cryptocurrencies environment.

Given the global dimension of cryptocurrencies phenomenon, the regulation process proves to be difficult. The attitude of governments around the world differ from prohibiting the use of cryptocurrencies within their borders and imposing a certain level of control on the Internet transactions, to the open attitude of some countries which introduced a regulating framework allowing the use of cryptocurrencies and their intermediaries, though not accepting - for now - the cryptocurrencies as legal tender. However, most of the countries around the world adopted the 'wait and see' attitude, not prohibiting the use of cryptocurrencies and allowing the banking institutions to offer various services related to cryptocurrencies, and issuing warnings related to the risks involved with the use of cryptocurrencies. Nonetheless, despite this 'wait and see' attitude most of these countries have anti-money laundering regulations and taxation regulations which include the use of cryptocurrencies mainly as investment assets.

Most studies and reports consider that the regulation of cryptocurrencies at national level might prove to be rather ineffective since the virtual currencies do not have a legal domicile and can 'travel' around the world in their parallel virtual universe. Nonetheless, the protection of numerous small and medium investors attracted by cryptocurrencies should not be discarded since, in the end, it will impact on their trust in these new virtual instruments.

Probably the best approach will be a dual one. The creators of cryptocurrencies should establish at least a set of good practices from within the IT community and create an association to deal with various specific problems. However, this situation might have impact on the liabilities and responsibilities these creators must assume; on the other hand, it might have a huge impact on users' trust.

From outside, the legal environment should create an inclusive legal definition of cryptocurrencies (which also might completely change their names) which should capture the multi-faced nature of these virtual currencies and their versatility. The legal definition would be the base for

further regulation since, in the end, cryptocurrencies should come into the traditional world to be exchanged either against fiat money and/or be transformed in material assets like real estate or various commodities. Therefore, the regulation of initial coin offerings (ICOs) and of various crypto intermediaries will be the normal step further, having in mind the potential small users/investors. Furthermore, the traditional financial institutions role as intermediaries for cryptocurrencies needs to be regulated since they are a 'crossing' between the cryptocurrencies environment and the traditional money settings. All these might use the already existing regulatory framework for traditional asset investments and can be done more easily at country level, though not impossible at international level if the supervisory institution can be agreed upon and subsequently established.

Nonetheless, how difficult a global regulation can be is shown currently by FOREX, the OTC market that exists for almost half a century and which is not regulated globally, despite BIS (Bank for International Settlements) efforts in this direction. Though, FOREX bases its architecture on well regulated national currency markets around the world.

Probably some of the existing cryptocurrencies are here to stay either as investment assets and/or medium of exchange. On the other hand, the blockchain technologies and their benefits can not be ignored and for sure will be used in the future. The governments and central banks are not ignoring these aspects and some countries announced their intention to test their respective central bank digital currency (CBDC). It is not clear now if and when a CBDC will be launched or it will be a completely different virtual representation. Nonetheless, the decades to come will see an increased interference between information technologies and financial products. It remains to be seen if they also can generate the needed trust to be used at global level or will remain a footnote to the history.

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Appendix 1

While the list is far from being a comprehensive one, the selected countries included in this Appendix were confirmed from at least two sources regarding the regulatory status of cryptocurrencies.

1A: Countries where cryptocurrencies are banned

Country	Comments
Algeria	
Bangladesh	
Bolivia	
China	In China are banned: the exchange of crypto in fiat currencies; the ICO; the crypto exchanges and most recently the mining of cryptocurrencies which previously was not specifically forbidden.
Egypt	
Ecuador	Ecuador though permits cryptocurrency transactions via internet.
Iraq	
Kyrgyzstan	
Macedonia	
Morocco	
Namibia	
Nigeria	Introduced the ban relative recently 2019/2020.
Nepal	
Qatar	
Turkey	The banning of cryptocurrencies was introduced in April 2021

Note 1: There are also three countries which impose partial bans: Albania - bans the crypto to fiat currency exchange; Armenia - bans the crypto mining; Ghana – bans crypto to crypto exchanges.
Note 2: According to Zhang (2018), China was, before the introduction of various bans, the most active market for bitcoin; the exchange of bitcoin versus Chinese yuan accounted for an approximated 90% of global bitcoin trading.

Sources: Feinstein & Werbach (2021);
https://www.loc.gov/law/help/cryptocurrency/cryptocurrency-world-survey.pdf;
https://www.finder.com/my/global-cryptocurrency-regulations;
https://www.mondaq.com/india/fin-tech/1044546/global-cryptocurrency-regulatory-landscape; https://www.coindesk.com/bolivia-crypto-ban;

https://kyc-chain.com/cryptocurrency-regulations-around-the-world/;
https://www.cnbc.com/2018/03/27/a-complete-guide-to-cyprocurrency-regulations-around-the-world.html;
https://www.egypttoday.com/Article/3/100224/Egypt-s-central-bank-prohibits-issuing-cryptocurrencies-or-carrying-out; https://freemanlaw.com/ecuador-and-cryptocurrency/;
https://freemanlaw.com/iraq-and-cryptocurrency/;
https://freemanlaw.com/macedonia-and-cryptocurrency/;
https://www.coininsider.com/namibia-central-bank-bitcoin-illegal/;
https://www.dw.com/en/nigerias-cryptocurrency-crackdown-causes-confusion/a-56547374; https://www.securities.io/qatar-bans-all-cryptocurrency-in-qfc/;
https://www.euronews.com/2021/04/16/turkey-has-just-banned-the-use-of-cryptocurrencies-and-bitcoin-is-already-feeling-the-stra

1B: Countries with no regulations or confusing regulations which perceive cryptocurrencies as having a (very) high risk

Country	Comments
Columbia	
Iceland	
India	It is expected that new regulations will be imposed and the banning of cryptocurrencies is viewed as almost certain.
Iran	The mining of cryptocurrencies is accepted, while the trading is banned.
Pakistan	Initially, Pakistan banned cryptocurrencies. However, recently the attitude change and the strict banning was relaxed.
Saudi Arabia	
Vietnam	

Sources: Feinstein & Werbach (2021);
https://www.colombiafintech.co/novedades/colombia-is-slowly-moving-toward-bitcoin-friendly-regulations; https://freemanlaw.com/iceland-and-cryptocurrency/;
https://kyc-chain.com/cryptocurrency-regulations-around-the-world/;
https://www.coindesk.com/iran-central-bank-ban-trading-crypto-mined-abroad;
https://www.mondaq.com/india/fin-tech/1044546/global-cryptocurrency-regulatory-landscape;
https://www.coindesk.com/tag/saudi-arabia;
https://www.aseanbriefing.com/news/vietnam-to-start-regulating-cryptocurrencies/#:~:text=As%20of%20today%2C%20Vietnamese%20law,and%20banned%20for%20trade%20relationships.

1C: Countries which regulated the cryptocurrencies

Country	Comments
Japan	Considered the most advanced country on what the cryptocurrency regulations are concerned.
Canada	Some sources mention Canada as the first country that established taxation regulations applying to cryptocurrencies
United States	Various regulatory bodies (see footnote 8, above) have different views regarding the cryptocurrencies. Though US attempts to adapt the existing regulations to cryptocurrency investments, mainly concerning initial coin offerings. However, some academic studies consider that without clear regulatory guidelines, blockchain start-ups rather prefer to avoid US given the potential implications of taxation regulations.
European Union (EU)	Work in progress. EU has issued the 5th AML (anti-money laundering) Directive at the end of 2017. This regulation is considered one of the most significant concerning cryptocurrencies. The 5th AML Directive is implemented gradually by the member states. The most advanced countries in complying with EU framework of 5th AML Directive and regulating cryptocurrencies are: Estonia, Malta, Lithuania
Australia	Attempts to adapt the existing regulations to cryptocurrency phenomenon
Switzerland	Some studies consider that the country developed bespoke regulations in order to attract cryptocurrency related businesses
Singapore	Some studies consider that the country developed bespoke regulations in order to attract cryptocurrency related businesses
South Korea	Regulated mainly the crypto exchanges and accept cryptocurrencies related transactions only the identity of the trader/investor is revealed. Though initial coin offerings are banned, and also the privacy coins (e.g. Zcash, Monero)

Country	Comments
South Africa	Work in progress. This country is considered to have a 'sandbox' or flexible approach in regulating cryptocurrencies by trying not to restrict innovation in this field.
Bermuda	Issued bespoke regulation regarding cryptocurrencies since 2018.

Note 1: The countries in the list above mainly accept these virtual currencies to be used for various purchases; also there exist regulations concerning the crypto exchanges and, at certain level. the initial coin offerings might be regulated. In addition, these countries have regulations regarding the taxation of the gains resulted from cryptocurrency investments and/or transactions.
Note 2: Other countries with work in progress regarding cryptocurrencies might include: Bahrain, Belarus, Isle of Man, Mexico, Russia.

Sources: Feinstein & Werbach (2021); Morton 2020;
https://www.internationallawoffice.com/Newsletters/Banking-Financial-Services/Bermuda/Carey-Olsen-Bermuda/Blockchain-and-cryptocurrency-regulation-2020;
https://www.loc.gov/law/help/cryptocurrency/cryptocurrency-world-survey.pdf;
https://www.finder.com/my/global-cryptocurrency-regulations;
https://www.loc.gov/law/foreign-news/article/russian-federation-new-bill-defines-cryptocurrency-proposes-tax-regulations/;
https://www.tamimi.com/law-update-articles/central-bank-of-bahrain-issues-regulations-governing-crypto-asset-services/;
https://kyc-chain.com/cryptocurrency-regulations-around-the-world/

The case of Venezuela

The situation of Venezuela and its proposed cryptocurrency Petro must be mentioned.

Petro was proposed by Venezuela's government and launched in 2018 in an attempt to raise financial resources based on Venezuela's natural resources, given the country years long financial and economic crisis (with the national currency, bolivar, weakened by high inflation) and deepened by US sanctions.

Petro was received with mixed feelings and, in the end, failed to attract the needed financial resources.

Venezuela's president tried to enforce the use of Petro by Venezuelan corporations at the beginning of 2020 (see https://www.coindesk.com/tag/petro) but failed to obtain a result and Petro ledger was closed down for maintenance sometime during 2020 (Frankenfield, 2021).

Furthermore, there is still a debate if the virtual currency launched by Venezuela's government is really a cryptocurrency since its ledgers and nodes are under government control. The cryptocurrency community for sure do not see Petro as a 'classic' cryptocurrency.

The failure of Petro seems to be tacitly accepted by the Venezuela's government through the issuance of a regulation allowing bitcoin mining to become legal since September 2021 (Official Gazette No. 41,969), though the regulation regarding cryptocurrencies continues to have numerous gaps (Aguilar, 2020).