

# On the regulation of cryptocurrencies

## Abstract

Cryptocurrencies and the Distributed Ledger Technology (DLT) are redesigning transaction, payments systems and the transfer of information and value. They also raise new policy challenges for regulators and policymakers. The purpose of the paper is twofold. First, the paper takes stock of the arguments put forward by regulators to justify the regulation of cryptocurrencies. Second, the paper exposes the two most frequently mentioned regulatory options - obliged entities and the sandbox approach- and assess their applicability to cryptocurrencies. It will appear that they may engender significant detrimental side-effects. We then consider two alternative options - race to the bottom and self-regulation- as potential candidates to prompt significant positive effects. Decentralized exchange platforms (DEXs) and dark pools may play a pivotal role in the evolution of the regulation of cryptocurrencies.

Cryptocurrencies (also called virtual currencies) and the Distributed Ledger Technology (DLT, commonly referred to as the blockchain technology) are redesigning payment systems and the transfer of any form of information and value (Davidson *et al.*, 2018, IMF, 2018, Luther, 2016a, Tapscott & Tapscott, 2016, 2017). The blockchain technology is an innovative technology to store and transfer information via a distributed network of “honest” nodes that are remunerated to run the network (“mining”). Cryptocurrencies are not Fintech in that they do not aim at improving the overall efficiency of fiat-based transactions, but at replacing them altogether with alternative markets, assets, protocols and rules of governance. Cryptocurrencies are an application of the blockchain technology to the transfer of value and storage of transactions in a distributed ledger. The fields of application of the DLT are thus much larger than financial services and include several non-financial activities, such as health-care services, supply-chain management (quality tracking of luxury goods or coffee from farms to stores for example), gaming, robotics, sciences, art and digital design, intellectual property rights, property rights on real estate, land registration, etc. (Cointelegraph, 2019, Forbes, 2019, Urquhart, 2018, Yi *et al.*, 2018).

Even though the blockchain technology provides innovative procedures to store and secure information, firms are still reluctant to implement the technology in their information system. According to a study by PWC (2018) based on 600 CEOs worldwide, the top three deterring barriers to adoption of the blockchain technology by firms for business-related activities are regulatory uncertainty in which firms must navigate (27%), lack of trust among users (25%) and ability to bring network together (21%). Then come interoperability of private blockchains (11%), inability to scale (6%), intellectual property concerns (6%) and audit/compliance concerns (4%).

Cryptocurrencies (and especially their flagbearer, Bitcoin) gradually take root in society and attract a growing media and academic attention and regulation concerns (Böhme *et al.*, 2015, BIS, 2018a, Corbet *et al.*, 2018, Holub & Johnson, 2018, Luther, 2019a, Schilling & Uhlig, 2018). However, the rate of adoption still remains modest. For example, a report by the Bank of Canada (2018) shows that the level of awareness of Bitcoin in Canada increased from 64% in 2016 to 85% in 2017, while ownership only increased from 2,9% to 5% during the same period. Similar gaps between awareness and adoption are observed worldwide (Rauchs *et al.*, 2018). The gap suggests that the rate of adoption does not merely depends on access to information and is not a linear

function of their (perceived or observed) technological efficiency. However, more recent studies suggest that a growing part of the population intends to buy cryptocurrencies in the coming months (Coinbase.com, 2019).

This gap is explained by the fact that cryptocurrencies face specific hurdles to diffusion that engender uncertainty and volatility (Demir *et al.*, 2018), erode trust, disincentive users' adoption, postpone firms' investment (Marcus, 1981) and slows down the emergence of a consistent digital entrepreneurial crypto-ecosystem (Sussan & Acs, 2017). The most significant hurdles to adoption of cryptocurrencies are regulatory uncertainty, network effects and switching costs (Luther, 2015, Nair & Cachanosky, 2017), lack of technological command of beginners and would-be users, technological immaturity (with major issues such as scalability and interoperability between private blockchains), poor image and ethical concerns (Dierksmeier & Seele, 2018), narrow acceptance as a means of payment or erratic variations of value that complicates the tradeoff between risks and opportunities and deprives their role as a store of value.

The fact that regulatory uncertainty is the major deterring barrier to adoption for both the blockchain technology and cryptocurrencies deserves more scrutiny. More specifically, beyond understanding the deterring impacts of regulatory uncertainty on the incentive structure and adoption decision of users or would-be users (individual investors and firms alike), it is of interest to point out the arguments put forward by regulatory bodies and to know how they intend to design and implement a consistent regulation over a nascent technology that transcend national frontiers. Adopters of cryptocurrencies face a complex, unstable and unharmonized patchwork of national regulations (CRS, 2019, World Bank, 2018) where governments take different approaches to the regulation of cryptocurrencies, spanning from regulatory certainty, low tax, and active encouragement of the industry (such as in Switzerland<sup>1</sup>, Malta, Estonia or Singapore) (Forbes, 2019), to balanced regulation (such as in the US, UK and Eurozone countries), and outright or *de facto* banning (such as in China, Iran, Colombia or Vietnam). A first glance at the current state of the regulation worldwide makes clear that developing countries with poor and inefficient monetary authorities and strong political power are the most reluctant to develop a regulatory framework

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<sup>1</sup> Switzerland attracts major actors of the crypto-industry in the so-called “Crypto Valley” cluster located in the canton of Zug. Furthermore, Johann Schneider-Amman, the economics minister of Switzerland, recently stated that Switzerland should become the “crypto-nation” (CCN, 2019, Hackernoon, 2019, Financial Times, 2018).

favorable (or even tolerant) towards cryptocurrencies and related activities and are more likely to ban cryptocurrencies (Hendrickson & Luther, 2017).

The constant evolution of formal regulation and the copious quantity of official and unofficial reports surrounding cryptocurrencies and related crypto-assets make the regulatory landscape unstable, ambiguous and confusing for both actors of the industry, academics and regulators themselves (Luther 2019b). The profusion of sources complicates the synthesis of reliable data over the regulation of cryptocurrencies. Accordingly, for sake of practicability, we focused on the official reports of the major financial regulatory bodies of the Eurozone to identify the arguments for regulating cryptocurrencies, such as the Financial Stability Board (FSB), the European Securities and Market Authority (ESMA), the European Banking Authority (EBA), and the European Central Bank (ECB) (for a comprehensive appraisal of national policies of cryptocurrencies in European countries, see the online annex of Demertzis & Wolff (2018) and Hendrickson *et al.*, 2016, for a comprehensive appraisal of national policies of cryptocurrencies around the world, see The Law Library of Congress, 2018 and FSB, 2019). Since the arguments put forward by regulators worldwide are quite similar, our focus on European regulators don't bias our analysis.

The paper is structured as follows. In the first section, we expose how regulators define cryptocurrencies and what is to be regulated. In the second section, we classify the arguments put forward by regulators under four headings. In the third section, we consider the two most frequently mentioned regulatory options -obliged entities and the sandbox approach- and assess for their applicability to cryptocurrencies. Finally, we consider two alternative options -race to the bottom and self-regulation- as potential candidates to prompt significant positive effects. It will appear that decentralized exchange platforms (DEXs) and dark pools may play a pivotal role in the evolution of the regulation of cryptocurrencies.

To avoid technical concerns of computer science, the paper does not address issues related to the regulation of the blockchain technology but will only address the regulation of cryptocurrencies. Furthermore, other innovative financial crypto-assets and financial applications

of the blockchain technology, such as non-fungible tokens (NFT), smart contracts, Initial Coin Offerings (ICOs) and Initial Exchange Offerings (IEOs) won't be considered in the paper.

## 1. What is to be regulated?

The minimal requirement of a consistent regulatory scheme in multi-peaked jurisdictions is a consensus over the definition of the object to be taxed. Yet, as Demertzis & Wolff (2018: p. 5) remark, 'regulators, supervisors, and multilateral institutions have difficulties agreeing how to classify, treat, and regulate crypto assets. A large number of views have been expressed and a number of institutions have adopted contradictory or at least differing views on the nature of crypto assets'. Houben & Syners (2018: p. 23) further state that 'there is no generally accepted definition of the term *cryptocurrencies* available in the regulatory space. Even more, most policy makers have refrained from defining the term altogether'.

The current state of regulation of cryptocurrencies in the Eurozone illustrates this ambiguity. For now, no consensual definition emerged, and numerous regulatory bodies get a hold of the issue. European regulators themselves do not know what authority is competent to regulate cryptocurrencies. For instance, in an explainer document issued on February 13<sup>th</sup>, 2018, the ECB states that 'it is not the ECB's responsibility to ban or regulate bitcoin or other cryptocurrencies' (<https://www.ecb.europa.eu/explainers/tell-me/html/what-is-bitcoin.en.html>) without precising which institutions is responsible for it. This results in significant regulatory confusion and contradictions of the European regulatory landscape that favor regulatory uncertainty and arbitrage (EBA, 2016). As Mario Draghi (2018) pointed out, 'right now, digital currencies are not subject to a specific supervisory approach. Work is under way in the Single Supervisory Mechanism to identify potential prudential risks that these digital assets could pose to supervised institutions' (<https://www.ecb.europa.eu/press/key/date/2018/html/ecb.sp180205.en.html>). The following examples illustrate the present state of confusion over the definition of cryptocurrencies.

(a) The mission of the European Securities and Markets Authority (ESMA) is to enhance investor protection and promote stable and orderly financial markets<sup>2</sup>. It is thus no wonder that ESMA's definition of cryptocurrencies pay particular attention to the absence of legal protection to consumers and investors and the fact that they are not issued by central authorities. Thus, in

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<sup>2</sup> <https://www.esma.europa.eu/about-esma/who-we-are>

accordance with its missions, the ESMA defines virtual currencies as “a digital representation of value that is neither issued nor guaranteed by a central bank or public authority and does not have the legal status of currency or money. They are highly risky, generally not backed by any tangible assets and unregulated under UE law, and do not, therefore, offer any legal protection to consumers”<sup>3</sup>.

(b) The ECB (2012: p. 5) defines “virtual currency” as ‘a type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community’. Then, in line with the definition proposed in the European Banking Authority (EBA) Opinion on virtual currencies on July 4<sup>th</sup>, 2014, the ECB further specify that cryptocurrencies are ‘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’. Thus, contrary to the definition of cryptocurrencies endorsed by the ESMA, the definition favored by the ECB does not mention risk of capital loss for investors and protection to consumers but focus instead on decentralized issuance of cryptocurrencies and absence of intermediaries (see also ECB, 2015, Mersch, 2018a).

(c) The Financial Action task Force (FATF Report, 2014) defines cryptocurrencies by considering the three functions of currency: ‘Virtual currency is a digital representation of value that can be digitally traded and functions as (1) a medium of exchange; and/or (2) a unit of account; and/or (3) a store of value, but does not have legal tender status (*i.e.*, when tendered to a creditor, is a valid and legal offer of payment) in any jurisdiction. It is not issued nor guaranteed by any jurisdiction and fulfils the above functions only by agreement within the community of users of the virtual currency’. It is interesting to note that the FATF is the only institution to mention the fact that, contrary to fiat currencies, cryptocurrencies are voluntarily accepted by a community of users, with the implicit acknowledgement that network effects play a major role in their diffusion.

(d) Heterogeneity is even stronger at the national level. For instance, the German Federal Financial Supervisory Authority (“BaFin”) qualifies cryptocurrencies as units of account comparable to

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<sup>3</sup> <https://eiopa.europa.eu/.../Virtual%20Currencies%20Warning.pdf>

foreign exchange with the difference that they are not government-backed legal tenders, while Spain adopts a case-by-case approach to cryptocurrencies that opens avenue for arbitrary decisions and magnify uncertainty (Demertzis & Wolff: p. 6).

These examples of divergences over definition illustrate the current state of indecisiveness and ambiguity of the regulation of cryptocurrencies in the Eurozone and the need to clarify the legal status of cryptocurrencies. Similar ambiguities are observed worldwide.

## **2. Why regulating cryptocurrencies?**

Today, regulators face a similar situation than that in the early 1990s with the emergence of the Cyberspace, where individuals (whatever the age, culture, country, wealth, etc.) can freely exchange and communicate. At this time, national authorities had three options: no regulation, government regulation, or self-regulation (Gibbons, 1997). Today, regulators have basically three options over cryptocurrencies: isolate, regulate, or integrate (Carney, 2018). Banning would ensure isolation from traditional financial markets and curtail risks of contagion (Carney, 2018: p. 10). Regulation (*e.g.*, compliance of wallet providers to the AML, CFT and KYC requirements) would promote stability and resilience of the crypto-ecosystem by fighting against undesirable applications and criminal activities, preventing frauds, protecting consumers, and promoting overall financial stability (Auer & Claessens, 2018). There is a large consensus among regulators and academics that regulation is required (Spithoven, 2019). For its part, integration would consist in integrating crypto-assets into traditional asset management. Regulators widely agree that a finely tuned, technologically neutral, regulation is the best strategy to minimize risks at both the micro and macro levels without deterring innovation of the blockchain technology. However, they recognize that it is a difficult task since ‘current bank regulatory, supervisory and licensing frameworks generally predate the emergence of technology-enabled innovation’ (BIS, 2018b: p. 6).

Despite ambiguities and indecisiveness over the very definition of the object to be regulated, policy makers agree on potential reasons to regulate cryptocurrencies. Broadly speaking, regulation around cryptocurrencies falls into two broad categories: ‘those that protect people who use Bitcoins

(consumers, investors) and those that protect society from people who use, or might use, Bitcoins (drug dealers, terrorists, violent criminals)' (Tsukerman, 2015: p. 1152).

According to the FSB 2018 report (p. 1), 'in addition to the potential financial stability concerns relating to any significant increases in the use of crypto-assets, a variety of broader policy concerns exist, including: risks to consumer and investor protection and market integrity; money laundering, terrorist financing, sanctions evasion, fraud, and other illicit financing risks; tax evasion; and the circumvention of capital controls'. Along with these major concerns for regulation, the report further mentions other types of risks, such as technological immaturity, liquidity and volatility risks, hacking of wallets and exchange platforms and cyber security, concentrated ownership of cryptocurrencies (especially those with low market capitalization) that limits market depth and liquidity and favors price manipulation by "whales"<sup>4</sup>. Based on several reports and in line with the existing literature (BIS, 2017, Brito & Castillo, 2016, Luther, 2016b), we classify the regulatory concerns and policy challenges under four headings: (a) illegal activities, money laundering and tax evasion, (b) technological immaturity, (c) risk of capital loss and price manipulation and (d) macro-financial stability.

#### *(a) Illegal activities, money laundering and tax evasion*

The economic size of the criminal activities using cryptocurrencies as a means of payment is hard to assess (Foley *et al.*, 2018). Estimations range from around 380000 bitcoins (or \$2,5 billion) in 2018 (CipherTrace, 2018) to €7 billion worldwide (European Union, 2016). Regulators argue that unregulated cyberspaces and anonymity prompt fraud and illicit activities<sup>5</sup> and warns against the fraudulent uses of cryptocurrencies, such as money laundering, tax evasion, circumvention of capital control, financing of illegal activities and terrorism (with "Virgin Bitcoin"<sup>6</sup>), marketplaces for illegals products on the darknet (such as SilkRoad and Alphabay), ransoms, and other forms of cybercrimes (CipherTrace, 2018, Vandezande, 2017, WSJ, 2018).

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<sup>4</sup> Similarly, Demertzis & Wolff (2018: p.1) argue that crypto-assets (cryptocurrencies and other applications of the blockchain technology) raise six major public policy questions: 'How great is the potential of crypto-assets in advanced financial systems? What is the best way to combat illegal activity such as money laundering and terrorism finance? How can consumer and investor protection be ensured? What about financial stability? How might crypto-assets be taxed? And how can blockchain applications be embedded into the existing legal framework?'

<sup>5</sup> [https://www.esma.europa.eu/sites/default/files/library/esma50-157-829\\_ico\\_statement\\_investors.pdf](https://www.esma.europa.eu/sites/default/files/library/esma50-157-829_ico_statement_investors.pdf)

<sup>6</sup> <https://cointelegraph.com/news/virgin-bitcoin-most-in-demand-crypto-that-is-regulated-differently>

Regulators' warning is not groundless. For example, the price drop of Bitcoin by almost 20% in less than three hours after SilkRoad closure by the FBI on October 2, 2013 suggests a link between cryptocurrencies and illegal activities at this time. Furthermore, terrorist groups exploit the anonymity of cryptocurrencies and frequently beg their members and supporters to transfer funds and make donations, as the Palestinian Islamic group Hamas did on January 30<sup>th</sup>, 2019<sup>7</sup>.

To prevent the financing of illegal activities and frauds pervasive in the trading of cryptocurrencies, the European Union took steps to ensure that centralized exchange platforms will be submitted to the Anti-Money Laundering (AML), the Combating the Financing of Terrorism (CFT) and the Know-Your-Customer (KYC) requirements (FATF, 2018).

Users, issuers, wallet providers and trading platform are key players in the industry of cryptocurrencies. Yet, because cryptocurrencies prompt anonymity, there are numerous "blind spots" for regulators (Houben & Snyers, 2018). If the function of store of value of cryptocurrencies is considered as the prime characteristics of currency, the issue of regulation over capital gains follows. Yet, because cryptocurrencies are decentralized, the identity of the users and issuers of cryptocurrencies (initial designers and miners alike) cannot be ascertain. Thus, contrary to other forms of taxes over traditional financial assets or physical commodities, a tax on issuers of cryptocurrency is impossible to design and implement. Accordingly, because of the technological barriers of anonymity and cryptography, the tax scheme should exclusively rely on centralized trading platforms, wallet providers and users. This point is more elaborated below.

#### *(b) Technological immaturity and technology-specific risks*

The blockchain technology is just about a decade old<sup>8</sup>. The first exposition of the principle was presented in the white paper of Bitcoin, issued on November 1<sup>st</sup>, 2008, by an anonymous and still unidentified programmer (or team of programmers) under the pseudonym of Satoshi Nakamoto

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<sup>7</sup> <https://www.ccn.com/send-bitcoin-palestinian-group-hamas-begs-for-crypto-donations-amid-crippling-sanctions>. Considering that anonymity is the key challenge for money laundering, tax evasion and illegal activities, Houben & Snyers (2018) argue that some aspects of cryptocurrencies (such as Monero's protocol of anonymity) should be banned because they exhibit an unnecessary degree of anonymity.

<sup>8</sup> It is thus no wonder that major technological issues (such as scalability) remain unsolved. As a comparison, the world wide web information transfer protocol is now 50 years old, and major issues over privacy and data security breaches persist.

(<https://bitcoin.org/bitcoin.pdf>, <https://historyofbitcoin.org/>). The “genesis block” of the Bitcoin blockchain has been mined on January 3<sup>rd</sup>, 2009. As for any disruptive innovation, the true potential of the blockchain technology, cryptocurrencies and other forms of applications (such as smart contracts, Initial Coin Offerings (ICO), decentralized autonomous organizations (DAO) and decentralized applications (dApps)) will become apparent in many years. Since the pace of technological improvement depends on the current and expected level of adoption and investment, forecasting the areas and range of their application is impossible (Berentsen & Schär, 2018).

Crypto-enthusiasts and regulators agree that cryptocurrencies and the blockchain technology may dramatically improve the efficiency of both advanced financial and banking systems, such as significant decrease of international remittance fees for customers, speed of transaction for investors and generalized access to modern banking and finance services for firms and the unbanked populations in developing countries<sup>9</sup>. As Demertzis & Wolff (2018: p. 10) state, ‘permissioned blockchain solutions might eventually reduce the transaction costs of financial intermediation by broadening the access to finance for smaller companies and smaller projects [...] Public authorities should not stifle further innovation in this space’. In the ECB Opinion of October 12<sup>th</sup>, 2016<sup>10</sup>, the ECB also recognizes that ‘the technological advances relating to the DLT underlying alternative means of payment, such as virtual currencies, may have the potential to increase the efficiency, reach and choice of payment and transfer methods’.

However, it is also acknowledged that the present state of technology surrounding the industry of cryptocurrencies is still immature and face major issues, such as scalability (computational power dramatically increases as the network grows), computational power and energy required for validation procedure (such as the “proof-of-work” procedure, also called “mining”), and interoperability between private blockchains that limits or prevents communication of information between private blockchains. Considering these technological limits, regulators ask broader questions around the accountability in case of errors (immutability of transactions encrypted in the blockchain increases operational risk), the potentiality of systemic instability in the absence of middlemen and trusted middlemen in transactions, and the integration of these disruptive

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<sup>9</sup>[https://www.esma.europa.eu/sites/default/files/library/2016-773\\_dp\\_dlt\\_0.pdf](https://www.esma.europa.eu/sites/default/files/library/2016-773_dp_dlt_0.pdf); <https://www.esma.europa.eu/market-analysis/financial-innovation>

<sup>10</sup>[https://www.ecb.europa.eu/ecb/legal/.../en\\_con\\_2016\\_49\\_f\\_sign.pdf](https://www.ecb.europa.eu/ecb/legal/.../en_con_2016_49_f_sign.pdf)

technologies into existing information systems. These technological limits are substantial and the crypto-industry develops innovative organizations (such as consortia) and events (such as hackathons) to design more efficient and less energy intensive consensus models and verification procedures to validate blocks and run the system (for example, a “proof-of-stake” instead of a “proof-of-work” procedure to significantly reduce the amount of computation power and energy required and lower barriers to entry for users or the Lightning network)<sup>11</sup>. The search for improved governance procedures can also result in “forks” where a fraction of the nodes of a given network decide to implement alternative protocols with different characteristics. For example, on October 7, 2011, a fork of the Bitcoin core protocol was implemented to create the Litecoin (sometimes referred to as “the silver to Bitcoin’s gold”), a cryptocurrency with lighter mining computation power requirements that decreases block generation time and increases the maximum number of coins issuable (21 million coins for Bitcoin against 84 million for Litecoin)<sup>12</sup>.

While one may see hard forks as real-time instances of innovation in governance design and original solutions to trust-related issues, some regulators consider instead that they illustrate the limits, inefficiencies, and risks of decentralization. According to the FSB (2018: p.8), ‘Decentralization and lack of or inadequate governance makes it difficult to resolve technological limitations or errors and may lead to uncertainty and “hard forks” by a subset of miners’. Furthermore, (2018: 11), ‘it is costly to create trust, which is indispensable for credible payment and settlement instruments, in networks that do not rely on trusted intermediaries. The decentralized nature of many crypto assets can result in inadequate governance, giving rise to disputes among network participants and, in extreme cases, in “hard forks” on the blockchain or other distributed ledger, which may undermine the credibility of these assets’.

Even though the immaturity of the technology is hardly debatable, we can wonder whether technological limits are a sensible reason for regulating the DLT and related applications, such as cryptocurrencies. The application of a precautionary approach to regulation over an immature technology raises major questions and uncertainties over its definition and efficiency in both the short and long terms, such as discovery of opportunities and assessment of their profitability,

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<sup>11</sup> <https://medium.com/predict/proof-of-work-is-dead-long-live-proof-of-stake-bc6b8924f7ad>,  
<https://cointelegraph.com/lightning-network-101/what-is-lightning-network-and-how-it-works>

<sup>12</sup> <https://github.com/litecoin-project/litecoin>.

investment postponement, under-, over-, and malinvestment (Foster *et al.*, 2000, Marcus, 1981, Yang *et al.*, 2004). Considering these likely undesirable consequences, the argument in favor of regulation of cryptocurrencies based on the precautionary principle over technological immaturity may be counterproductive. Some regulators are conscious of the negative side-effects of technologically non-neutral regulation and consider that, in the present state of technological development, a direct regulation of cryptocurrencies is neither desirable, nor necessary because it would necessitate rigid definitions and classification of moving assets, with undesirable effects, such as regulatory arbitrage (Landau & Genais, 2018).

*(c) Volatility, risks of capital loss and price manipulation*

As an authority in charge of the protection of consumers, the ESMA warns against several risks of buying cryptocurrencies: (1) price volatility and risks of speculative bubble, (2) absence of protection because actors do not comply to EU regulation, (3) lack of exit options because of difficult trading between cryptocurrencies and fiat currencies, (4) lack of transparency over price formation, (5) disruption of trading platforms, (6) misleading and incomplete information and (7) the fact that cryptocurrencies are unsuitable for most consumers, especially those pursuing long-term goals, such as retirement savings<sup>13</sup>.

Even though broad access to finance is desirable for investors and firms alike, regulators point to the exposure to high market volatility mainly due to inelastic supply and speculation (Claeys *et al.*, 2018, Dwyer, 2015), scams and heists, and capital losses of unregulated crypto-assets for unexperienced and uninformed consumers and investors<sup>14</sup>. However, it is noticeable that positive and negative regulatory news regarding policy statements over cryptocurrencies have significant impact on price volatility of cryptocurrencies (Auer & Claessens, 2018).

Regulators also warn against the risks of price manipulation and concentrated ownership of cryptocurrencies by large “hodlers” (the so-called “whales”, composed of institutional investors, hedge funds, and early investors in cryptocurrencies). The risk of price manipulation is likely for

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<sup>13</sup> <https://www.esma.europa.eu/press-news/esma-news/esas-warn-consumers-risks-in-buying-virtual-currencies>

<sup>14</sup> [https://www.esma.europa.eu/press-news/esma-news/esas-warn-consumers-risks-in-buying-virtual-currencies; https://www.esma.europa.eu/sites/default/files/library/esma50-157-828\\_ico\\_statement\\_firms.pdf; https://www.esma.europa.eu/sites/default/files/library/esma50-157-829\\_ico\\_statement\\_investors.pdf](https://www.esma.europa.eu/press-news/esma-news/esas-warn-consumers-risks-in-buying-virtual-currencies; https://www.esma.europa.eu/sites/default/files/library/esma50-157-828_ico_statement_firms.pdf; https://www.esma.europa.eu/sites/default/files/library/esma50-157-829_ico_statement_investors.pdf)

cryptocurrencies with low market capitalization and liquidity. We can sometimes observe (but less frequently today than a few years ago) cryptocurrencies with small market capitalization obtaining daily gains of several digits. For instance, on February 27<sup>th</sup>, 2019, a cryptocurrency called “Agricultural Ecology Protocol” with a trading volume of only \$60000 obtained a 223322,8% price increase. In this case, price manipulation by large “hodlers” is very likely. Furthermore, several Telegram communities (such as Whales Crypto Guide) provide investment advices on cryptocurrencies with small market capitalizations that may be interpreted as price manipulation. Investment strategies such as “spoofing” and “pump and dump” also aim at influencing asset pricing.

Some studies suggest that price manipulation of cryptocurrencies is the rule rather than the exception, whatever their market capitalization. Based on data gathered on 2013 on the Mt. Gox trading platform (this trading platform closed on 2014), Gandal *et al.* (2018) suggest that Bitcoin remains vulnerable to manipulation and must be regulated. However, the methodology adopted to obtain this result is debatable. Indeed, on 2014 (date from which we obtain reliable data on Bitcoin), at its peak, the market capitalization of Bitcoin was around \$9 billion with a maximum daily trading volume of \$110 million, while it is now superior to \$160 billion with a daily trading volume usually superior to \$300 million. Even though the present size, depth and market liquidity of major cryptocurrencies does not preclude price manipulation, it is likely harder for whales to manipulate prices of cryptocurrencies with large market capitalization. On the other hand, price manipulation is likely for low market capitalization, especially on dark pool transactions (see below). Accordingly, the results and normative conclusions suggested by Gandal *et al.* (2018) are based on outdated data and must be mitigated by considering market capitalization, daily trading volume and market liquidity.

#### *(d) Macro-financial stability*

Macro-financial stability concerns are usually mentioned but considered as a minor threat for the moment, since the overall market capitalization of cryptocurrencies is still modest compared to classical financial markets. Furthermore, direct and indirect banks’ exposure to crypto-assets is still low, even though the scarcity of reliable data on banks’ holding of crypto-assets precludes precise quantification of exposure and associated risks (BIS, 2019). For now, significant macro-financial

wealth effects are thus unlikely: ‘global efforts are under way to monitor crypto-assets and assess the need for regulatory action. While crypto-assets currently do not pose a material financial stability risk within the existing environment, they raise a number of challenges in terms of protecting consumers and investors, preventing illicit activities and ensuring market integrity’ (ECB Financial Stability Review, 2018, pp. 123-4, FSB, 2018).

As a comparison, on August 28<sup>th</sup>, 2019, the total market capitalization of cryptocurrencies is estimated at \$265 billion (aggregation over 5555 currencies exchanged on 369 exchange platforms)<sup>15</sup>, while the total market capitalization of the S&P500 is superior to \$24 trillion. Furthermore, Corbet *et al.* (2018) found evidence that cryptocurrencies and traditional financial assets are relatively isolated and that their performances are uncorrelated. This is explained by the fact that, for now and in the short term, institutional investors are only marginally exposed to crypto-assets. As a consequence, potential transmission channels are limited and does not give rise to financial stability risks (FSB, 2018) and wealth effects associated with price volatility of cryptocurrencies over the average financial performance of institutional investors are mitigated. In line with these findings, Mario Draghi argued on February 5<sup>th</sup>, 2018 that ‘we are not observing a systematically relevant holding of digital currencies by supervised institutions – by banks, in other words. Actually, the credit institutions established in the European Union are showing a limited appetite for digital currencies like Bitcoin, notwithstanding the high level of public interest’ (<https://www.ecb.europa.eu/press/key/date/2018/html/ecb.sp180205.en.html>).

However, the statement that institutional investors are still away from cryptocurrencies must be qualified in two ways. First, the rapid evolution of the ecosystem of crypto-assets attracts a growing interest of institutional investors and traditional finance institutions. This is attested by the launch on February 11<sup>th</sup>, 2019 of two cryptocurrencies-related indexes on the NASDAQ (the BLX, Bitcoin Liquid Index, and ELX, Ethereum Liquid Index) and the introduction of Bitcoin Futures (XBT) on the CBOE that allow investors to expose to Bitcoin price moves without holding Bitcoin (<http://cfe.cboe.com/cfe-products/xbt-cboe-bitcoin-futures>). Second, OTC transactions and “dark pool” represent a growing share of total exchange volume of cryptocurrencies. Dark pools are hidden entry point of institutional investors to cryptocurrencies because they are not

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<sup>15</sup> Source: Coingecko.com

visible to the rest of traders and allow hodlers to anonymously place orders of large blocks of cryptocurrencies. It is usually assumed that institutional investors operate a significant part of these hidden transactions, even though it cannot be quantitatively ascertained. In other words, institutional investors are already present in the market for cryptocurrencies and their role will probably continue to grow in the coming months and years (PWC, 2019).

### **3. What can regulators do?**

Regulators need to address several key challenges to devise a consistent and efficient regulatory framework to mitigate the risks associated with cryptocurrencies. As the 2018 BIS Annual Economic Report suggests (2018c, p. 107), ‘Operationally, the main complicating factor is that permissionless cryptocurrencies do not fit easily into existing frameworks. In particular, they lack a legal entity or person that can be brought into the regulatory perimeter. Cryptocurrencies live in their own digital, nationless realm and can largely function in isolation from existing institutional environments or other infrastructure. Their legal domicile – to the extent they have one – might be offshore, or impossible to establish clearly. As a result, they can be regulated only indirectly’. We can classify the key challenges under five headings.

- (1) *Anonymity* of users and transactions, described by Houben & Snyers (2018: p. 55) as the “crux of the problem”.
- (2) *Decentralization* of governance and absence of interlocutor, engendering a lack of transparency surrounding the identity and geographical location of users, nodes, and issuers (FSB, 2018).
- (3) *Cross-border* nature of cryptocurrencies (and more generally IT) requires a globally coordinated policymaking at the risk of favoring regulatory arbitrage. As the EBA points out (2016: p. 7)<sup>16</sup>, ‘the virtual, internet-based nature of these entities [virtual currency exchange platforms and custodian wallet providers] give rise to unprecedented challenges for competent authorities’. As a consequence, ‘the new entities as well as the innovation itself (virtual currency schemes such as Bitcoin, Litecoin, etc.) are characterized by the international nature of service provided [...] This results in practical difficulties for a competent authority that imposes national registration or

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<sup>16</sup>

<https://eba.europa.eu/documents/10180/1547217/EBA+Opinion+on+the+Commission%20%80%99s+proposal+to+bring+virtual+currency+entities+into+the+scope+of+4AMLD>.

licensing requirements to prevent entities that are not licensed or registered in its jurisdiction from providing VC-related services in its jurisdiction' (2016: pp. 6-7). Furthermore, regulation favors regulatory arbitrage. As Auer & Claessens (2018: p. 63) argue, 'although markets are currently somewhat segmented, cross-border spillovers can occur in response to regulatory events. As the market continues to evolve, and if more banks and funds engage in cross-country arbitrage, regulation and enforcement in one jurisdiction may lead activity to migrate to others with more lax approaches'

(4) *Timing*: Some regulators doubt whether it is the right time to set rigid regulatory norms over an immature industry (Demertzis & Wolff, 2018, Landau & Genais, 2018). For instance, inappropriate timing would disincentive, postpone or even prevent innovations, such as second layer technologies to avoid network congestion or scalability issues that would increase the overall efficiency of the blockchain technology and internet altogether. Regulatory bodies must find the appropriate timing and right balance between encouraging the long-term benefits of innovation and the control over various risks for both investors and consumers (FSB, 2018).

(5) *Legitimacy*: Uninformed users and would-be adopters may confuse regulation with legitimacy and security. As Demertzis & Wolff (2018: p. 12) point out, taxation and regulation 'could prematurely provide legitimacy to the regulated entity. The fact that something is regulated and supervised is a stamp of quality that can be used vis-à-vis retail and professional customers'. A premature regulation may have reputational damage and undermine credibility and confidence in the regulator's competence in case of inefficient regulation (Blinder, 2000, Bursian & Faia, 2018, FSB, 2018).

Considering these key issues, the range of regulatory options is narrow. We present the two regulatory options that are the most often mentioned by regulators -indirect regulation via service providers and the sandbox approach- and assess for the detrimental side-effects they may engender.

*a. Indirect regulation: Service providers, gateways at the crypto-fiat interface*

Because of anonymity of crypto-users, nodes, and issuers, an immediate response is to target market participants at the fiat/crypto interface (exchange platforms and custodian wallet providers) to become "obliged entities" submitted to the same constraints as institutional investors, such as AML, KYC, and FCT requirements, licensing obligation for regulated entities, minimal capital

requirements, consumer protection rules, reporting, etc. (Houben & Snyers, 2018: p. 64). Furthermore, it is argued that requiring IDs and KYC increases market efficiency by reducing market inconsistencies of cryptocurrencies and deviation from representative market prices (Pieters & Vivanco, 2017).

The EBA (2016) favors this approach of licensing and registration to bring custodian wallet providers and exchange platforms as “obliged entities”. The EBA further argues that this may prompt service providers to develop self-regulatory internal procedures to detect and report money laundering activities and terrorist financing, but recognizes that a consistent regulatory regime for cryptocurrencies harmonized at the European level would require ‘several years to develop, consult, finalize and transpose’ (2016: p. 5).

Several European countries unilaterally implemented regulation over crypto-service providers, such as Finland on May 1<sup>st</sup>, 2019, where the FIN-FSA (Finn Financial Supervisory Authority) acts as the registration and supervisory authority for custodian wallet providers that must comply with the AML and CFT requirements and other legal requirements (such as distinction between client money and own funds) to obtain a license of operation (see coinlaw.io). Furthermore, in line with the EBA assumption that compliance to regulation would prompt a virtuous circle of self-regulatory practices, Localbitcoins, a Helsinki-based trading platforms, developed an improved identity verification process to conform to the new regulation (Bitcoin.com).

However, this solution has several detrimental side-effects if users do not want to comply with the regulation and refuse to document their trades and transfer requested information to protect their privacy and anonymity. We can conceive of at least three side-effects.

- (1) Regulation may incite some users (especially large hodlers) to redirect their investments to alternative trading options, such as decentralized exchange platforms (“DEX”) and dark pools. There are currently over 250 DEXs with several levels of decentralization and anonymity (Circle

Research, 2018). These alternative trading options usually exhibit lower market liquidity<sup>17</sup>, lower scalability, higher transaction costs and fees, less trading pairs, and higher volatility (and potential price manipulation) than centralized platforms. The impacts of dark pools on global market liquidity, risks, and price discovery (price spread) are ambiguous in traditional finance (Buti *et al.*, 2017, Comerton-Forde & Putnins, 2015) and are even harder to assess for cryptocurrencies (Cointelegraph, 2018<sup>18</sup>). Thus, imposing stringent legal requirements at the fiat/crypto interface may engender unpredictable effects on the global levels of risks, liquidity and volatility. Flight-to-risky and flight-to-illiquid markets to preserve anonymity are thus conceivable behaviors, behaviors at odds with the standard assumptions of risk aversion and preference for liquidity (Beber *et al.*, 2009).

(2) Decentralized trading platforms and dark pools are mostly crypto-crypto exchange platforms with no fiat currency involved. Accordingly, most DEXs and dark pools do not have to comply with AML or any other legal requirements. Furthermore, dark pools make transactions unobservable and untraceable. As a result, anonymity increases the difficulty to trace illegal activities. On the other hand, regulatory uncertainty for investors is increased since regulators consider submitting DEXs and dark pools to regulation even though it would be ‘more difficult for regulators to enforce exchange laws, because there is no central point of contact’ (Circle Research, 2018, p. 4). The report further argues (p. 19) that ‘the regulatory landscape remains unclear and uncertain at this point, and while regulators may not be able to shut down software, they have shown that they can and will charge founders and developers who built the software’.

(3) Regulating the crypto-fiat interface may lead to a segregation of trading platforms, between centralized trading platforms that comply to KYC, AML and CFT requirements to attract small hodlers and decentralized unregulated trading platforms that attract privacy-centric large hodlers. More generally, this may lead to a two-tier crypto-ecosystem, that may unintendedly hamper global stability and beneficial innovation. The cross-border nature of cryptocurrency magnifies the potentiality of segregation of the industry between centralized and decentralized trading platforms.

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<sup>17</sup> Recent DEX innovation, such as the Republic protocol, enables cross-chain swaps and interoperability to facilitate exchanges and movements of value between blockchains and create liquidity (<https://renproject.io/>).

<sup>18</sup> <https://cointelegraph.com/news/study-bitcoin-whales-are-not-responsible-for-volatility>

Even though regulation over trading platforms and wallet providers is straightforward to devise and relatively simple to implement, it may engender significant detrimental effects at the market level and lead to behaviors (such as flight-to-anonymity) at the opposite of the aimed goal.

*b. Sandboxes as facilitators of regulatory innovation*

Regulation of cryptocurrencies may draw inspiration from the regulatory initiatives over FinTech. Supervisors in some jurisdictions (UNSGSA, 2019: p. 44) have devised innovative initiatives to improve communication and interaction with innovative Fintech players to develop an appropriate oversight while not unduly or unintendedly hampering beneficial innovation (BIS, 2018b, p. 7). A variety of innovation facilitation mechanisms have been set up, such as innovation hubs, innovation offices, innovation areas, accelerators and regulatory sandboxes (BIS, 2018b, p. 38, UNSGSA, 2019). Through shared learning, the aim of these “evidence-based” initiatives to promote financial innovation is to help Fintech companies to navigate in the regulatory framework and help regulators to better understand the risks and benefits of innovative technologies (FSB, 2017). Constant learning would allow fine-tuning policies to ensure the good balance between promoting innovation and controlling risk (Menon, 2019).

Of these, regulatory sandboxes are widely adopted innovative regulatory initiative (UNSGSA, 2019, p. 26). Jenik & Lauer (2017: p. 1, *italics original*) define a regulatory sandbox as ‘a framework set up by a financial sector regulator to allow small scale, *life testing of innovations* by private firms in *controlled environment* (operating under a special exemption, allowance, or other limited, time-bound exception) under the regulator’s supervision. The concept, which was developed in a time of rapid technological innovation in financial markets, is an attempt to address the frictions between regulators’ desire to encourage and enable innovation and the emphasis on regulation following the financial crisis of 2007-2008’.

Contrary to other approaches to Fintech regulation, regulatory sandboxes do not merely promote dialogue between regulators and economic agents but delineate safe zone to test innovative financial services and business models in a controlled environment with tailored policy options (BIS, 2018b, p. 40). Several eligibility criteria must be met by firms when applying for a sandbox, such as being “genuinely innovative” and inform customers and stakeholders that the company is engaged in a sandbox process. On the other hand, supervisors must select the most

promising companies, respect the core principles for effective supervision (BIS, 2012) and determine transparent success criteria. Regulatory sandboxes also raise a lot of questions, such as ‘where to start and where to stop, who to involve (or not) and which activities to include’ (Mersch, 2018b).

The characteristics of cryptocurrencies and the crypto-industry make difficult the application of the sandbox approach for several reasons.

- (1) The sandbox approach is a dialogue between economic actors and regulators. Yet, the large majority of actors of the crypto-industry are either anonymous or explicitly reluctant to dialogue with institutions and supervisors. Indeed, most users of cryptocurrencies endorse the political philosophy of “cryptoanarchy” (Ludlow, 2001) that appeared in the late 1980s and early 1990s. This ideology rejects centralized control by public institutions and favor instead decentralization, self-organization and anonymity. Networks composed of anonymous nodes are the unique reliable trusted third party for transactions, while government, public institutions, and any form of sovereignty over currencies are distrusted. This is the *raison d'être* for the creation of Bitcoin as an alternative means of payment (<https://bitcoin.org/bitcoin.pdf>). The minimum methodological prerequisite of the sandbox approach is thus unlikely to be met.
- (2) The sandbox approach is well-suited for mature industries with enduring infrastructures and identifiable institutional investors, that is, industries with a certain level of centralization and no anonymity of tested entities. Even though there are well identifiable creators of cryptocurrencies (such as Charlie Lee for Litecoin or Vitalik Buterin for Ethereum), the nodes who run the system are anonymous and the rules of governance are collectively agreed upon and modified by anonymous users. To overcome anonymity, Houben & Snyers (2018, p. 14) propose to impose a “middleman” ‘where the use of blockchain or other distributed ledger technology has cut out such middleman, as this will allow the regulator to attach regulation to an identifiable person, thus contributing to enhanced compliance and effective enforcement’. We can doubt whether such a proposition may be applicable at all.

(3) The cross-border nature of cryptocurrencies raises the questions of the identity and legitimacy of the regulator in charge of the sandbox. This is especially important in multi-peaked jurisdictions, such as Europe, where multiple regulators coexist at both the national and European levels (UNSGSA, 2019).

#### **4. Regulatory competition, race to the bottom, and self-regulation**

Regulators and commentators almost unanimously claim that since cryptocurrencies (or other forms of evasive practices (Elert & Henrekson, 2016)) fall under a gray area of legality, then, they must be regulated. Yet, as the previous section makes clear, the point of entry to an efficient regulation of cryptocurrencies is not self-evident. In opposition to this position, we present race to the bottom and self-regulation as two alternative regulatory options.

##### *a. Regulatory competition and race to the bottom*

Inconsistency, regulatory ambiguities and lack of harmonization of cross-border regulation of cryptocurrencies create a *de facto* regulatory competition that prompt regulatory arbitrage across jurisdictions. This competition may give rise to a “race to the bottom” regulatory dynamics to attract active actors of the crypto-industry. As Lagarde (2018: p. 10) states, ‘if this uncoordinated response continues, activity will simply migrate toward more lightly regulated jurisdictions in a “race to the bottom.”’ Because crypto assets know no borders, a global approach is vital’. Yet, regulatory competition and race to the bottom are usually regarded as socially undesirable and harmful in the long run for all stakeholders since lighter regulation dilutes systemic risks and increases unfair competition (Cary, 1974, He, 2018). However, interstate competition and deregulation of cryptocurrencies may also prompt significant positive effects.

First, as Demertzis & Wolff (2018, p. 13) point out, ‘currently it might be useful to sustain different practices across EU countries for some time as a way to experiment and learn about the best approaches to this fast-developing technology’. Regulatory competition and “crypto-friendly” initiatives should thus be tolerated for some time since they increase the diversity of competing options (FSB, 2018) and provide information to fill institutional voids and design efficient market incentives. Regulators would then be engaged in a trial-and-error learning process with short term

regulatory arbitrage and inefficiencies to identify good practices and design a consistent and balanced regulatory framework in the longer term.

Second, several countries, such as the “Blockchain Island” Malta, Estonia, Switzerland, or Slovenia, recently adopted a crypto-friendly and “safe-haven” regulation by lowering taxes and building beneficial legal regulations for businesses related to the blockchain technology and applications, such as cryptocurrencies. This strategy gave rise to significant advances in encryption and computer security, highly qualified job creation, knowledge spillover, and the emergence of consistent crypto-ecosystems, such as the “Crypto Valley” in the Swiss Canton of Zug.

Third, building a crypto-friendly regulation of cryptocurrencies may be a long-term strategy for inclusion into world trade and finance, especially for developing countries, such as Uganda, where Binance, the world’s largest cryptocurrency exchange platform, successfully launched its African subsidiary on October 2018. Cryptocurrencies and the blockchain technology are particularly valuable in low-trust or zero-trust environment, with low degree of development and efficiency of traditional financial services, such as universal access to basic banking services. Cryptocurrencies and the blockchain technology provide numerous valuable opportunities of development for unbanked populations (in Uganda, 3 out of 4 people do not have bank accounts (Dupas *et al.*, 2018)), such as low fees on international remittances, cross-border payments and money transfer, access to reliable payment systems, access to micro-crypto-credit and peer-to-peer lending, and access to transparent and auditable contracts that define opposable property rights over lands and real estate.

#### *b. Industry self-regulation*

Self-regulation of the crypto-industry is seldom considered as a relevant regulatory option. Yet, self-regulation exhibits several characteristics that direct or indirect regulation by public authorities do not possess (Gupta & Lad, 1983): self-regulation is (1) dynamic and flexible in that it recognizes that technology is faster than the law, (2) open-ended and decentralized in that it allows actors to engage in a competitive process of discovery whereby innovative and efficient practices emerge, (3) bottom-up in that regulators may draw inspiration from the way actors navigate in an

uncontrolled environment, and (4) more legitimate in that the emerging rules and standards emanate from the actors themselves.

Even though the crypto-industry is still not compliant, some actors already engaged in a proactive self-regulation process whereby actors voluntarily make the first move to ban irregular or suspicious behaviors. The motivation behind this behavior is to “embrace the inevitable future” regulation (<https://medium.com/idex/pragmatic-decentralization-how-idex-will-approach-industry-regulations-8b109212128a>) or develop a “clean” image to attract new customers, institutional investors, and avoid reputation loss. Several recent examples illustrate this move.

- Firms like Coinfirm and IdentityMind provide companies of the blockchain-based financial ecosystem with several services, such as AML compliance frameworks, compliance advisory, data authentication, and fraud analytics to create a safer cryptoeconomy (<https://coinfirmprod.objects.frb.io/assets/AMLT-tiny-guide5.pdf>).
- The data aggregator Coingecko joined the AMLT network on August, 2019 to combat exchange fraud, scams and hacks so that users can report scams on ICOs and hacks (<https://cointelegraph.com/news/coingecko-joins-amlt-network-to-combat-exchange-fraud-scams-hacks>).
- Some DEXs, such as the largest IDEX, adopt a proactive approach to comply with KYC/AML requirements (Circle Research, 2018), such as blocking website access to users from several countries. For example, Binance DEX geoblocks 29 nations, such as USA, North Korea, the Crimea Region of Ukraine, Cuba, Ira, Iraq, Libya or Syria (<https://cointelegraph.com/news/binance-dex-navigating-country-specific-cryptocurrency-trading-restrictions>). IDEX turns this voluntary self-regulation as a major advantage for attracting large crypto funds that must comply with the KYC requirements that, in turn, create more liquid markets that benefit all customers.

## Conclusion

Cryptocurrencies raise a host of new challenges for regulators because they do not fit into existing regulatory frameworks. Even though regulators do not agree upon the definition of cryptocurrencies, they agree that regulation is needed because of (1) risks of money laundering, tax

evasion, and financing of illegal activities, (2) technological immaturity, (3) risks of capital loss and price manipulation, and (4) macro-financial stability concerns. Yet, considering the nature of cryptocurrencies and the current state of development of the crypto-industry, the number of direct and indirect regulatory options is limited and may engender significant detrimental side effects, such as a flight to unregulated dark pools and decentralized exchange platforms with ambiguous consequences on fraud, stability and liquidity. On the other hand, several recent examples show that alternative regulatory policies, such as inter-State competition and self-regulation, may prompt significant positive effects, in terms of innovation, financial inclusion for developing countries and emergence of good practices that may be mimicked by regulators.

Even though it is difficult to assess for their size, number, nature and feature, DEXs and dark pools seem to play a pivotal role in the regulation dynamics of cryptocurrencies. Yet, their position *vis-à-vis* regulation is ambiguous. On the one hand, they are a refuge for whales, institutional investors and informed traders who value privacy and do not want to comply with any regulatory requirement. On the other hand, they are major actors in the self-regulation of the crypto-industry. Furthermore, the net effect of dark pools on market liquidity and price discovery is unclear (for traditional financial markets (Comerton-Forde & Putnins, 2015, Zhu, 2013), and even more so for cryptocurrencies), since they allow exchange of large blocks of coins, but they favor centralization of ownership with potential price manipulation and volatility for small and medium market capitalization. Future research on the area of hidden crypto-liquidity is clearly needed.

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