

Central Banks and Regulation of Cryptocurrencies

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Abstract

This paper explores the interface between central banks and cryptocurrencies. Focusing on the European Central Bank (ECB), it identifies the potential threats that the rise of cryptocurrencies would pose to the basic and ancillary tasks of the ECB, in particular, its monetary policy operations and the exercise of its supervisory functions over credit institutions and payment systems. The paper finds that cryptocurrencies can potentially have both direct – through their potential impact on the price stability and monetary policy, and central banks’ monopoly over issuing base money – and indirect effects on central banks, mainly through the institutions and systems that fall under the ECB’s scope of competence.

To address the challenges posed by cryptocurrencies, the ECB may take both legal (including supervisory and oversight) measures and non-legal (or technical) measures. With respect to technical measures, the ECB - to the extent falling within the scope of its competence - may focus on improving the efficiency of existing payment systems and addressing the existing frictions in market infrastructures to indirectly affect the cryptocurrency markets. Alternatively, it can venture into issuing Central Bank Digital Currency (CBDC). Regarding legal measures, central banks could envisage regulating cryptocurrencies either directly or indirectly. However, as the most significant potential impact of cryptocurrencies on central banks is likely to be indirect through the impact of cryptocurrencies on the banking and payment systems, and given the limitations on the ECB’s mandate and its regulatory and supervisory tools, it is apposite for the ECB to consider using indirect strategies and tools to influence cryptocurrency markets. This indirect approach can be implemented through the ECB’s existing supervisory and oversight powers over the banking and payment systems. This paper specifies the direct and indirect measures and assesses their merits in addressing the concerns about cryptocurrencies.

Keywords: *Central bank, European Central Bank, Cryptocurrency, Bitcoin, Money, Regulation*

JEL classification: *E42, E51, E58, G01, G23, G28, K22, K23, K24*

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Introduction

Cryptocurrencies are financial technology (fintech) innovations, and similar to most financial innovations, they are driven by a desire to reduce transaction costs, facilitate risk management, complete incomplete markets by addressing agency costs arising from information asymmetry, and circumvent taxes and regulations or engage in regulatory arbitrage. Despite the much-touted economic, political, and ideological motivations behind the creation of cryptocurrencies,¹ they have emerged to address market frictions. One such friction was the lack of a global, uncensorable peer-to-peer (P2P) digital payment mechanism. One of the major challenges to the emergence of such a mechanism has been the double-spending problem. Prior to bitcoin, addressing this problem was delegated to trusted third parties in charge of centralized ledgers.² Bitcoin solved the double-spending problem in a highly secure,³ decentralized, consensus-based and censorship-resistant manner, replacing the traditional trusted third parties with cryptographic proof, and affording users the optionality of pseudonymity and anonymity.⁴

Despite their unique properties, cryptocurrencies, their underlying technology, and associated markets can pose risks to monetary and financial systems. Some of these risks include concerns about fraud,⁵ market manipulation,⁶ financial crime,⁷ consumer protection,⁸ liability issues in distributed ledgers,⁹ the development of large closed networks that can potentially create barriers to entry,¹⁰ concerns

¹ For background information, see: Nathaniel Popper, *Digital Gold: Bitcoin and the inside Story of the Misfits and Millionaires Trying to Reinvent Money* (New York: Harper, 2015); Michael D Bordo and Andrew T Levin, "Central Bank Digital Currency and the Future of Monetary Policy," (National Bureau of Economic Research, 2017).; Nick Bilton, *American Kingpin: The Epic Hunt for the Criminal Mastermind Behind the Silk Road* (New York: Portfolio/Penguin, 2017).

² For an overview of early attempts to solve this problem, see: Aaron van Wirdum, "The Genesis Files: If Bitcoin Had a First Draft, Wei Dai's B-Money Was It," *Bitcoin Magazine* (15 June 2018).; Aaron van Wirdum, "The Genesis Files: How David Chaum's Ecash Spawned a Cypherpunk Dream," *Bitcoin Magazine* (24 April 2018).; Aaron van Wirdum, "The Genesis Files: Hashcash or How Adam Back Designed Bitcoin's Motor Block," *Bitcoin Magazine* (4 June 2018).

³ Thus far, Bitcoin has proved to be one of the most secure financial networks. Other blockchain-based cryptocurrencies may prove less secure. For example, more recently, there have been a few successful 51% attacks to perform double-spend attacks on some cryptocurrencies such as Verge, Bitcoin Gold, MonaCoin and more recently on Ethereum Classic. See: Cali Haan, "Verge, Bitcoin Gold and Monacoin Hacked," *Crowdfund Insider* May 25, 2018.

⁴ Satoshi Nakamoto, "Bitcoin: A Peer-to-Peer Electronic Cash System," (2008).

⁵ Massimo Bartoletti et al., "Dissecting Ponzi Schemes on Ethereum: Identification, Analysis, and Impact," (2017).; Financial Stability Oversight Council, "Financial Stability Oversight Council (Fsoc) 2016 Annual Report," (Washington, D.C.: Financial Stability Oversight Council, 2016), 127. For a definition of Ponzi scheme: see Hyman P. Minsky, *Stabilizing an Unstable Economy* (New York: McGraw-Hill, 1986; repr., 2008), 377.

⁶ Anonymous (32E3690D50B3B477DF7841212D4BB938DC9CDB50307618328E7F8B53F37CC1E2), "Quantifying the Effect of Tether," (January 24, 2018).; John M Griffin and Amin Shams, "Is Bitcoin Really Un-Tethered?," *SSRN Working Paper Series* (2018).

⁷ Kim-Kwang Raymond Choo, "Cryptocurrency and Virtual Currency: Corruption and Money Laundering/Terrorism Financing Risks?," in *Handbook of Digital Currency: Bitcoin, Innovation, Financial Instruments, and Big Data*, ed. David Lee Kuo Chuen (San Diego, CA: Academic Press, 2015).; Robert Stokes, "Virtual Money Laundering: The Case of Bitcoin and the Linden Dollar," *Information & Communications Technology Law* 21, no. 3 (2012). See also: Office of the New York State Attorney General, "Virtual Markets Integrity Initiative Report," (September 18, 2018).

⁸ Dong He et al., "Virtual Currencies and Beyond: Initial Considerations," (Washington, D.C.: International Monetary Fund, 2016), 28-29.

⁹ Dirk A Zetsche, Ross P Buckley, and Douglas W Arner, "The Distributed Liability of Distributed Ledgers: Legal Risks of Blockchain," *University of Illinois Law Review (forthcoming)* (2017).

¹⁰ Dong He et al., "Fintech and Financial Services: Initial Considerations," *IMF Staff Discussion Note SDN/17/05* (2017).

about data protection, taxation policy for cryptocurrencies,¹¹ monetary policy,¹² and financial stability.¹³ Further future challenges may include lack of common standards and interoperability, governance issues,¹⁴ privacy concerns,¹⁵ scalability,¹⁶ and potential risks in the issuance of central bank digital currency (CBDC) or digital base money (DBM).¹⁷

Such multi-faceted challenges, coupled with cryptocurrencies' price volatility and their hybrid nature, which allows them to be used as a means of payment,¹⁸ investment,¹⁹ and access,²⁰ have led to a surge of interest in studying cryptocurrencies among regulators ranging from financial crime enforcement agencies to banking, securities and commodity markets regulators.²¹ However, these studies were mainly concerned with initial coin offerings (ICOs) enabled by the distributed ledger technologies (DLTs), blockchain and cryptocurrencies²² and potential risks and rewards of the blockchain technology. Several studies by the European Central Bank (ECB),²³ the European Banking Authority (EBA),²⁴ the International Monetary Fund (IMF),²⁵ the Bank for International Settlements (BIS),²⁶ the US Federal Reserve and its regional banks²⁷ on the risks and rewards of cryptocurrencies have been

¹¹ Aleksandra Bal, "How to Tax Bitcoin?," in *Handbook of Digital Currency: Bitcoin, Innovation, Financial Instruments, and Big Data*, ed. David Lee Kuo Chuen (San Diego, CA: Academic Press, 2015).

¹² Christine Lagarde, "Central Banking and Fintech—a Brave New World?," *Bank of England conference, London* (September 29, 2017).

¹³ Committee on Payments and Market Infrastructures, "Digital Currencies," (Basel: Bank for International Settlements, 2015), 15-16.

¹⁴ Aaron van Wirdum, "A Primer on Bitcoin Governance, or Why Developers Aren't in Charge of the Protocol," *Bitcoin Magazine* Sept. 7, 2016.

¹⁵ Primavera De Filippi, "The Interplay between Decentralization and Privacy: The Case of Blockchain Technologies," (2016).

¹⁶ Joseph Abadi and Markus Brunnermeier, "Blockchain economics," *National Bureau of Economic Research Working Paper 25407* (2018), <https://www.nber.org/papers/w25407>.; European Securities and Markets Authority, "The Distributed Ledger Technology Applied to Securities Markets," (Paris: European Securities and Markets Authority, 2017), 2. See also: Huw Van Steenis et al., "Global Insight: Blockchain in Banking: Disruptive Threat or Tool?," in *Morgan Stanley Research Report* (New York: Morgan Stanley, 2016).

¹⁷ See: Yves Mersch, "Digital Base Money: An Assessment from the Ecb's Perspective," in *Speech at the Farewell ceremony for Pentti Hakkarainen, Deputy Governor of Suomen Pankki – Finlands Bank, Helsinki* (16 January 2017).; Aleksander Berentsen and Fabian Schar, "The Case for Central Bank Electronic Money and the Non-Case for Central Bank Cryptocurrencies," *Federal Reserve Bank of St. Louis Review* (2018). See also: Morgan Ricks, "Money as Infrastructure," *Vanderbilt Law Research Paper No. 17-63* (2018).

¹⁸ Primarily known as 'cryptocurrencies'

¹⁹ Also known as 'security tokens'

²⁰ Also known as 'utility tokens'

²¹ European Securities and Markets Authority, "The Distributed Ledger Technology Applied to Securities Markets."

²² European Securities and Markets Authority, "Advice: Initial Coin Offerings and Crypto-Assets," (9 January 2019).

²³ European Central Bank, "Virtual Currency Schemes," (Frankfurt am Main: European Central Bank, October 2012).; European Central Bank, "Virtual Currency Schemes- a Further Analysis," (2015).; European Central Bank, "The Potential Impact of DLTs on Securities Post-Trading Harmonisation and on the Wider Eu Financial Market Integration," (Frankfurt am Main September 2017).; See also: Andrea Pinna and Wiebe Ruttenberg, "Distributed Ledger Technologies in Securities Post-Trading: Revolution or Evolution?," *ECB Occasional Paper Series No 172* (2016).

²⁴ European Banking Authority, "Eba Opinion on 'Virtual Currencies'," (London: European Banking Authority, 4 July 2014).;

²⁵ Dong He et al., "Virtual Currencies and Beyond: Initial Considerations."

²⁶ Morten Bech and Rodney Garratt, "Central Bank Cryptocurrencies," *BIS Quarterly Review* (2017).; Committee on Payments and Market Infrastructures, "Digital Currencies.;" Bank for International Settlements, "Cryptocurrencies: Looking Beyond the Hype," in *Annual Economic Report* (Basel 2018).

²⁷ Gina C. Pieters, "The Potential Impact of Decentralized Virtual Currency on Monetary Policy," *Federal Reserve Bank of Dallas Globalization and Monetary Policy Institute 2016 Annual Report* (2017).; Alexander Kroeger and Asani Sarkar to Federal Reserve Bank of New York Liberty Street Economics, June 27, 2017, 2017, <http://libertystreeteconomics.newyorkfed.org/2016/03/is-bitcoin-really-frictionless.html>.; Aleksander Berentsen and Fabian Schär, "A Short Introduction to the World of Cryptocurrencies," *Federal Reserve Bank of St. Louis Review* 100, no. 1 (First

conducted. In addition, there is a burgeoning literature on the economic, monetary and financial aspects of cryptocurrencies as they relate to central banking.²⁸ However, the legal aspects of cryptocurrencies from a central banking perspective are largely understudied. This paper is an attempt to narrow this gap.

To attain that objective, this paper seeks to study the relevance of cryptocurrencies to central banks, and specifically the ECB. It argues that since developments in the cryptocurrency ecosystem directly or indirectly involve the ECB's basic tasks and other functions, there is ground for ECB intervention based on its mandate enshrined in articles 127 and 128 of the Treaty on the Functioning of the European Union (TFEU) and article 3 of the Protocol (no 4) on the Statute of the European System of Central Banks and of the European Central Bank (hereinafter, ESCB/ECB Statute). The paper proceeds as follows. First, it sets the groundwork for analysis by classifying the effects of cryptocurrencies on central banking and linking them to the mandate and competences of the ECB. Second, it discusses the impact of cryptocurrencies on monetary policy and price stability by drawing parallels between different forms of fiat money and cryptocurrencies. As price stability is the primary objective of the ECB's monetary policy and any impact on price stability would justify the direct involvement of the ECB in cryptocurrency markets, in the third section, the paper discusses the policy options of the ECB. Having found that the direct involvement of the ECB in cryptocurrency markets would not be desirable, in the subsequent three sections, the paper explores the impact on payment systems, banking system and financial stability respectively and argues that the best strategy for regulating cryptocurrency markets is through the existing regulatory, supervisory and oversight powers of the ECB over banking and payment systems. The seventh section further explores the legal aspects of issuing central bank digital currency (CBDC), as an indirect technical intervention. Finally, after exploring the venues for policy coordination at the international level, the paper presents a few concluding remarks.

Quarter 2018).; Aleksander Berentsen and Fabian Schar, "The Case for Central Bank Electronic Money and the Non-Case for Central Bank Cryptocurrencies.;" David Mills et al., "Distributed Ledger Technology in Payments, Clearing, and Settlement," *Finance and Economics Discussion Series Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board* (2016).

²⁸ JP Koning, "Fedcoin," *Money* April 11, 2018 (October 19, 2014).; David Andolfatto, "Fedcoin: On the Desirability of a Government Cryptocurrency," *MacroMania* 2018 (February 03, 2015).; Sahil Gupta, Patrick Lauppe, and Shreyas Ravishankar, "Fedcoin: A Blockchain-Backed Central Bank Cryptocurrency," (2017).; Morten Bech and Rodney Garratt, "Central Bank Cryptocurrencies.;" Michael Kumhof and Clare Noone, "Central Bank Digital Currencies — Design Principles and Balance Sheet Implications," *Bank of England Staff Working Paper No. 725* (2018).; John Barrdear and Michael Kumhof, "The Macroeconomics of Central Bank Issued Digital Currencies," *Bank of England Staff Working Paper No. 605* (2016).; Michael D Bordo and Andrew T Levin, "Central Bank Digital Currency and the Future of Monetary Policy.;" Aleksander Berentsen and Fabian Schar, "The Case for Central Bank Electronic Money and the Non-Case for Central Bank Cryptocurrencies.;" Eswar Prasad, "Central Banking in a Digital Age: Stock-Taking and Preliminary Thoughts," *Hutchins Center on Fiscal & Monetary Policy at Brookings* (April 2018).; Larry White, "The World's First Central Bank Electronic Money Has Come – and Gone: Ecuador, 2014-2018," *Alt-M: Ideas for an Alternative Monetary Future* (March 29, 2018).; Jack Meaning et al., "Broadening Narrow Money: Monetary Policy with a Central Bank Digital Currency," *Bank of England Staff Working Paper No. 724* (2018).

1. Cryptocurrencies and the ECB: direct and indirect links

Despite a decade-long struggle to gain traction, the jury is still out on the success or failure of cryptocurrency experiments. If the popularity of cryptocurrencies passes a certain tipping point, they could pose threats to the financial system with a direct impact on central banks both in their monetary policy capacity, and supervisory and oversight capacity. Some of these challenges would pose threats to the activities, financial market infrastructures (FMIs) and entities that fall within the scope of ECB's basic tasks and other functions.

According to article 127(1) of the TFEU and article 2 of the ESCB/ECB Statute, maintaining price stability is the primary objective of the European System of Central Banks (ESCB).²⁹ The functions of the ESCB include basic tasks³⁰ and other functions (non-basic or ancillary tasks). The ESCB's basic tasks include defining and implementing monetary policy of the Union, conducting foreign-exchange operations, holding and managing the official foreign reserves of the Member States, and promoting the smooth operation of payment systems.³¹ The non-basic or ancillary tasks of the ESCB include issuance of banknotes,³² contribution to the prudential supervision of credit institutions and stability of the financial system,³³ advisory functions,³⁴ collection of statistical information³⁵ and international cooperation and external operations.³⁶ Within this framework and within the confines of this study, cryptocurrencies can directly or indirectly fall within the tasks and competence of the ESCB if they pose threats to one of its basic and ancillary tasks.

It seems that the potential effects of cryptocurrencies on central banks can be divided into two broad categories of direct and indirect effects. The direct effects include those that have an impact on the monetary policy, price stability and central banks' monopoly over issuing base money (e.g., banknotes) or the ECB's ability to control the money supply, which can be viewed as a *sine qua non* for the success of the price stability mandate and the conduct of monetary policy. In contrast, the indirect effects are those that largely stem from the interface between the banking and payment systems with cryptocurrencies, both of which fall within the scope of competence of the ECB. Needless to say, the interface between the banking and payment systems is where the potential systemic risk and financial stability concerns lie.

²⁹ This is why some commentators call the ECB a single mandate central bank. There have been calls to change the mandate of the ECB. See for instance: Joseph E Stiglitz, *The Euro: How a Common Currency Threatens the Future of Europe* (New York: W.W. Norton & Company, 2016).

³⁰ See: Article 127(2) TFEU and art. 3.1 ESCB Statute.

³¹ Art. 127(2) TFEU and article 3 ESCB/ECB Statute. For this classification, see also: Rosa María Lastra, "The Law of the European Central Bank," in *International Financial and Monetary Law*, ed. Rosa María Lastra (New York: Oxford University Press, 2015), 255.

³² According to article 128(1) of the TFEU and article 16 of the ESCB/ECB Statute, the ECB has the "exclusive right to authorise the issue of euro banknotes within the Union".

³³ Art. 127(5) of the TFEU

³⁴ Advisory functions are set out in article 127(4) of the TFEU, which states that the ECB should be consulted "on any proposed Union act in its fields of competence" and national authorities should consult the ECB with respect to "any draft legislative provision in its fields of competence".

³⁵ Article 5, ESCB/ECB Statute

³⁶ See: Rosa María Lastra, "The Law of the European Central Bank," 266.

However, addressing these direct and indirect effects should remain within the limitations imposed on the ECB's functions. In addition to the constraints imposed on its fields of competence, the EU primary and secondary legislation set limitations on the tools that the ECB can use to achieve its objectives. To carry out the tasks of the ESCB, the ECB is granted the powers to adopt legal acts with direct effects on third parties other than the National Central Banks (NCBs) and the Eurosystem by making *regulations* necessary to implement such tasks and taking *decisions*.³⁷ It can also impose *fines* (through its decisions) and periodic penalty payments on the undertakings that fail to comply with its regulations and decisions.³⁸

In addition to its regulatory powers, the ECB has advisory powers, with which it can adopt non-binding recommendations and opinions within its field of competence.³⁹ These recommendations can be used to initiate EU legislation or to provide the impetus for action to be taken.⁴⁰ With respect to initiating legislation, the ECB has shared competence with the European Commission to initiate the adoption of secondary legislation, to complement or amend the ESCB/ECB Statute (i.e., complementary legislation).⁴¹ Furthermore, the ECB should be consulted "on any proposed Union act in its fields of competence" and national authorities should consult the ECB with respect to "any draft legislative provision in its fields of competence".⁴² With the creation of the banking union and the Single Supervisory Mechanism (SSM), the ECB has been granted further rule-making powers in the area of financial services regulation.⁴³ These powers include adopting regulations, guidelines and recommendations, and taking decisions "without prejudice to the competence and the tasks of EBA, ESMA, EIOPA, and the ESRB."⁴⁴

Given these regulatory, supervisory and oversight tools at its disposal, it appears that the ECB may influence the cryptocurrency ecosystem either directly or indirectly. Direct regulation refers to regulatory measures focusing immediately on the regulation of the industry itself as a discrete activity⁴⁵ or on the activities immediately performed by business entities, targeting the industry's

³⁷ For example, the approval of the volume of coin issuance and sanctions are in the form of decisions.

³⁸ Art. 132(3) of the TFEU. See also: Council Regulation (EC) No 2532/98 of 23 November 1998 concerning the powers of the European Central Bank to impose sanctions (OJ L 318, 27.11.1998, p. 4); Council Regulation (EU) 2015/159 of 27 January 2015 amending Regulation (EC) No 2532/98 concerning the powers of the European Central Bank to impose sanctions, OJ L 27, 3.2.2015, p. 1–6; Article 18(1) of Council Regulation (EU) No 1024/2013 of 15 October 2013 conferring specific tasks on the European Central Bank concerning policies relating to the prudential supervision of credit institutions.

³⁹ Art. 132(1) of the TFEU

⁴⁰ Sheller K. Hanspeter, *The European Central Bank: History, Role and Functions*, Second ed. (Frankfurt am Main: European Central Bank, 2006). The ECB recommendation can be viewed as an instrument by which the ECB encourages action by EU institutions or Member States. See: *ibid.*, 71–72.

⁴¹ Article 129 TFEU and Article 41 ESCB/ECB Statute See: *ibid.*, 70–71.

⁴² Art. 127(4) of the TFEU

⁴³ See: Articles 4(3) and 6(5)(a) of the Council Regulation (EU) No 1024/2013 (SSM Regulation)

⁴⁴ See Art. 3(3) of the SSM Regulation, and Asen Lefterov, "The Single Rulebook: Legal Issues and Relevance in the Ssm Context," *ECB Legal Working Paper Series No 15/ October 2015* (2015): 17. The acronyms respectively stand for: the European Banking Authority, the European Securities and Markets Authority, the European Insurance and Occupational Pensions Authority and the European Systemic Risk Board.

⁴⁵ Phoebus Athanassiou, *Hedge Fund Regulation in the European Union: Current Trends and Future Prospects* (Alphen aan den Rijn (The Netherlands): Kluwer Law International, 2009), 227. For the application of the concept of direct and indirect

structure, strategies, and operations, whereas indirect regulation constitutes “market discipline-inspired regulatory measures targeting the creditors and counterparties” of those entities.⁴⁶ Direct regulation mainly relies on the threat of the law by using command-and-control regulatory instruments,⁴⁷ whereas indirect regulation mainly relies on economic instruments.⁴⁸ As its tools, direct regulation often employs registration, disclosure, capital requirements, and position limits as regulatory instruments. In contrast, indirect regulation utilizes an intermediary to transmit the imperatives or commands to the (primarily intended) regulated entity or activity that is the ultimate target.⁴⁹ Indirect regulation is often viewed as a more efficient strategy in financial regulation in the presence of suitable ‘surrogate regulators’.⁵⁰

Despite the potential direct impact of the cryptocurrencies on central banking, given the limited scope for direct intervention by the ECB, the paper will mainly be focused on the indirect intervention through the ECB’s supervisory powers over the banking entities⁵¹ as well as its regulatory and oversight powers over payment systems.⁵² However, even within the indirect approach, given the hybrid nature of cryptocurrencies and the constraints on the ECB’s scope of competence and regulatory powers, the ECB, as a regulator, supervisor or overseer, may not act alone in addressing the challenges of cryptocurrencies. In certain areas, the ECB can act as a catalyst for change, (e.g., within its advisory capacity) or act in tandem with other regulators (such as the European Commission and the European Parliament, the EBA, and the National Competent Authorities (NCAs) including NCBs), or act in accordance with its contributory competence in protecting financial stability in cooperation with the NCAs. Furthermore, at the international level, the ECB can contribute to the policy formulation within the international financial fora, in particular within the Financial Stability Board (FSB).

regulation in the regulation of the hedge fund industry, see: Hossein Nabilou and Alessio M. Paces, "The Hedge Fund Regulation Dilemma: Direct Vs. Indirect Regulation," *William & Mary Business Law Review* 6, no. 1 (2015).

⁴⁶ Phoebus Athanassiou, *Hedge Fund Regulation in the European Union: Current Trends and Future Prospects*, 227.

⁴⁷ Command-and-control instruments are the most traditional methods of effecting a behavioral change in the subjects of regulation. See John Austin, *The Province of Jurisprudence Determined* (New York: Cambridge University Press, 2001), 17-38.

⁴⁸ Phoebus Athanassiou, *Hedge Fund Regulation in the European Union: Current Trends and Future Prospects*.

The roots of the distinction between command-and-control and economic instruments can originally be found in the literature on legal origins. See, e.g., Richard A. Posner, *Economic Analysis of Law*, vol. 5 (New York: Aspen Law and Business, 1998), 21-35.; La Porta et al. show that countries with civil and common law traditions demonstrate different regulatory styles. See Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer, "The Economic Consequences of Legal Origins," *Journal of Economic Literature* 46, no. 2 (2008): 285-86, 93, 305, 26.

⁴⁹ Phoebus Athanassiou, *Hedge Fund Regulation in the European Union: Current Trends and Future Prospects*, 227-28 & 34.

⁵⁰ Hossein Nabilou and Alessio M. Paces, "The Hedge Fund Regulation Dilemma: Direct Vs. Indirect Regulation."

⁵¹ For example, as the ECB is bound to collateralize its credit operations under article 18.1, second indent of the ESCB/ECB Statute, the ECB can refuse any cryptocurrency collateral or any asset that is linked to cryptocurrencies as collateral under its collateral regime.

⁵² For example, such a regulatory approach would be conducted through setting out participation and access criteria for payment and banking institutions involved in cryptocurrency business for the access to the TARGET2.

2. Cryptocurrencies, monetary policy, and price stability

At least two catalysts can act as an impetus for the ECB's direct involvement in the cryptocurrency markets due to their direct impact on the *instruments* exclusively issued by the ECB (i.e., banknotes). The first catalyst would be the functional similarities between cryptocurrencies and the base money issued by central banks, and the second would be the potential for wider adoption of cryptocurrencies that would have a negative impact on the basic tasks of the ECB, i.e., by having an impact on the transmission of monetary policy, ultimately affecting price stability.

Lex Monetae is the body of laws and regulations that defines the monetary law of a state or a currency union. In the euro area, in addition to the TFEU and the ESCB/ECB Statute, the *Lex Monetae* of the Eurozone participating Member States is embedded in the Council Regulation 974/98⁵³ and the Council Regulation (EC) 1103/97.⁵⁴ The former regulation "defines monetary law provisions of the Member States which have adopted the euro".⁵⁵ Article 2 of this regulation sets the euro as the currency of the participating Member States. Within this framework, the ECB has "the exclusive right to authorise the issue of euro banknotes within the Union".⁵⁶ Although the Member States can issue *euro coins*, the volume of such issue is subject to the approval by the ECB.⁵⁷ The banknotes and coins issued by the ECB and National Central Banks (NCBs) have the *legal tender* status within the Union.⁵⁸

Granting full control over the base money enables the Eurosystem to formulate and implement monetary policy.⁵⁹ This is perhaps why when the Managing Director at Estonian e-Residency laid out its proposal for issuing crypto tokens - called 'estcoins' - to its e-residents through an ICO,⁶⁰ ECB's Mario Draghi adamantly opposed it stating that "... no member state can introduce its own currency... The currency of the euro zone is the euro."⁶¹ Developments of this kind, along with the keen interest of central banks in studying and, as regards some, exploring the possibility of issuing

⁵³ Council Regulation (EC) No 974/98 of 3 May 1998 on the introduction of the euro, OJ L 139, 11.5.1998, p. 1–5

⁵⁴ Council Regulation (EC) No 1103/97 of 17 June 1997 on certain provisions relating to the introduction of the euro, OJ L 162, 19.6.1997, p. 1–3

⁵⁵ Council Regulation 974/98, recital 1.

⁵⁶ Art. 128(1) TFEU and Article 16 ESCB/ECB Statute

⁵⁷ Art. 128(2) TFEU and Article 16 ESCB/ECB Statute

⁵⁸ Art. 128(1) of the TFEU and Article 16 ESCB/ECB Statute. See also Art. 11 of the Regulation 974/98. As the delegation of monetary sovereignty is 'complete, unconditional, and irrevocable', the only source of monetary law in the eurozone participating Member States is the EU law. See: Charles Proctor, *Mann on the Legal Aspect of Money*, 7 ed. (Oxford: Oxford University Press, 2012).; Helmut Siekmann, "Exit, Exclusion, and Parallel Currencies in the Euro Area," *Institute for Monetary and Financial Stability Working Paper Series No. 99 (2015)* (2015): 13.

⁵⁹ Sheller K. Hanspeter, *The European Central Bank: History, Role and Functions*, 48.

⁶⁰ Kaspar Korjus to E-Residency Blog, August 22, 2017, 2017, <https://medium.com/e-residency-blog/estonia-could-offer-estcoins-to-e-residents-a3a5a5d3c894>.; Lionel Laurent, "The Bitcoin Sovereign Wealth Fund; Estonia Wants in on the Crypto-Currency Bubble," *Bloomberg* August 25, 2017.

⁶¹ Reuters Staff, "Ecb's Draghi Rejects Estonia's Virtual Currency Idea," *Reuters* September 7, 2017. Although such a position by the president of the ECB could be criticized on the ground that non-euro denominated cryptocurrencies, which are not intended to serve as legal tender, despite being issued by state actors would not be in contravention to the EU primary or secondary laws. For details about the legal issues of Non-euro denominated CBDC, see: Phoebus L. Athanassiou, *Digital Innovation in Financial Services: Legal Challenges and Regulatory Policy Issues* (Alphen aan den Rijn: Kluwer Law International B.V., 2018), 204-06.

their own digital currencies,⁶² have shown the importance of the preservation of the unit of account as a coordination device across many products and services for the society at large.

In this sense, issuing any cryptocurrencies or parallel units of account – in particular by a *state actor* - offering functionalities similar to central bank money (CeBM) or base money could be in contradiction to article 128(1) of the TFEU, article 16 of the ESCB/ECB Statute, as well as article 11 of the regulation 974/98, and would be deemed illegal. In what follows, highlighting the functional similarities between cryptocurrencies and CeBM we argue that such similarities would eventually trigger the involvement of central banks in cryptocurrencies. Although issuing banknotes and coins is not specified as a basic task, given the ECB's exclusive right to issue base money,⁶³ and the close relationship between this right and price stability, we start with exploring the relationship and similarities between cryptocurrencies and CeBM, and the potential impact of cryptocurrencies on the monopoly of central banks over issuing base money, and then turn to the impact of cryptocurrencies on monetary policy and price stability.

2.1. Cryptocurrencies' similarities to base money

Despite the fact that issuing base money (note issue) has been considered as the *raison d'être* of central banking,⁶⁴ it is not included in the basic tasks of the ECB. In addition, the ECB's "exclusive right to authorise the issue of euro banknotes within the Union"⁶⁵ does not mean that issuing *money* is the sole prerogative of central banks. Indeed, commercial banks have been in the business of money creation long before the advent of modern central banking.⁶⁶ Despite the legal tender designation of

⁶² Morten Bech and Rodney Garratt, "Central Bank Cryptocurrencies.". Other central banks, such as Sweden's Riksbank, are considering issuing digital currencies (e-krona in the case of Riksbank), though at the time of writing, there is no final decision as to the issue or technical specification of e-krona. To follow this project, See: Sveriges Riksbank, "The Riksbank's E-Krona Project, Report 1," in *E-krona reports* (Stockholm: Sveriges Riksbank, September 2017).; Sveriges Riksbank, "The Riksbank's E-Krona Project Report 2," in *E-krona reports* (Stockholm: Sveriges Riksbank, October 2018). For the pros and cons of central bank digital currencies, see; Max Raskin and David Yermack, "Digital Currencies, Decentralized Ledgers, and the Future of Central Banking," (National Bureau of Economic Research, 2016).;

⁶³ Art. 128(1) TFEU and Article 16 ESCB/ECB Statute.

⁶⁴ Rosa María Lastra, "Central Banking Law," 31, 34. See also: Charles Goodhart, *The Evolution of Central Banks* (Cambridge, Massachusetts: The MIT Press, 1991).

⁶⁵ Art. 128(1) TFEU and Article 16 ESCB/ECB Statute.

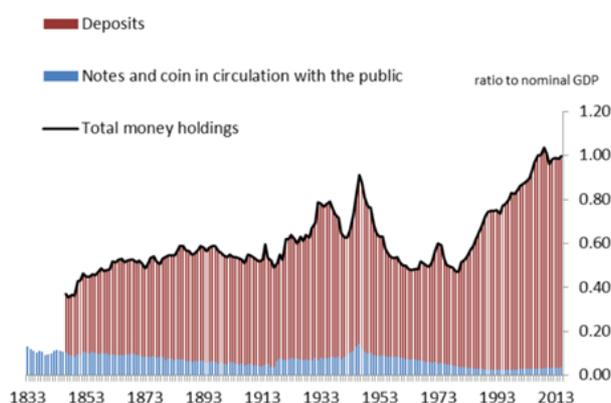
⁶⁶ Unlike many suggestions to the contrary, issuing money has not been the sole prerogative of governments. History has witnessed instances of successful and sustainable private money competing with the sovereign money and even threatening its dominance. See: George A Selgin, *Good Money: Birmingham Button Makers, the Royal Mint, and the Beginnings of Modern Coinage, 1775-1821* (University of Michigan Press, 2011), 12-13. (See especially chapter VI, explaining how private coinage become outlawed, in particular recounting Mr. Monck's gold coins).

See also: Charles A. E. Goodhart, "The Two Concepts of Money: Implications for the Analysis of Optimal Currency Areas," *European Journal of Political Economy* 14, no. 3 (1998): 418.

It seems that China was the first country that introduced fiat money and the concept of legal tender. See Eswar S Prasad, *Gaining Currency: The Rise of the Renminbi* (New York: Oxford University Press, 2017). Chapter 1. Prior to fiat money, the history of paper money goes back to more than 2,000 years ago in China, where the bills of exchange (used as money) were known as 'flying money'. See: Charles P. Kindleberger and Robert Z. Aliber, *Manias, Panics, and Crashes: A History of Financial Crises*, 5 ed. (Hoboken, New Jersey: John Wiley & Sons, Inc., 2005), 75-76. See also: David Wolman, *The End of Money: Counterfeiters, Preachers, Techies, Dreamers--and the Coming Cashless Society* (Boston, MA: Da Capo Press, 2012). There have also been periods during which private bank notes coexisted alongside the government-issued banknotes. See for example: Warren E. Weber, "Government and Private E-Money-Like Systems: Federal Reserve Notes and National Bank Notes," *Bank of Canada Working Paper 2015-18* (2015). See also: Lawrence H. White, "Competing Money Supplies," *The Library of Economics and Liberty* (2018).

CeBM, which consists of banknotes and coins,⁶⁷ evidence from the UK suggests that banks create and allocate approximately 97% of the money supply.⁶⁸ However, there are significant differences between commercial bank money (CoBM) and cryptocurrencies that would warrant a different approach by central banks towards cryptocurrencies.

Chart 1 Most money held in bank accounts, not as physical cash



Sources: Hills, Thomas and Dimsdale (2015)³ and Bank of England

Unlike bitcoin, both CoBM (or bank-issued IOUs representing a claim against a commercial bank in CeBM) and shadow banking quasi-money (securities or promises to pay CeBM or CoBM during a certain period of time in the future)⁶⁹ are claims against the issuer. This difference in nature entails that cryptocurrencies are also different in terms of the risks associated with them. Even if central banks pursue a price stability objective, CeBM is prone to an inflation risk.⁷⁰ However, bitcoin effectively carries no inflation risk as it has a capped and fixed supply schedule.⁷¹ Similar to CeBM,

Only in contemporary history has the state had the monopoly over issuing banknotes (legal tender). For example, the first Legal Tender Act in the U.S. was passed in February 1862 authorizing the issuance of notes (greenbacks) which were “lawful money and legal tender in payment of all debts, public and private within the United States”. This act was part of the government efforts to finance the civil war. It seems that until 1862, the issuance of banknotes was mainly a private enterprise in the US, a historical episode sometimes dubbed ‘free banking era’.

Alternatives to standard monopoly on the issuance of notes by the central bank is minimal competition (central bank issued notes with commercial bank issued notes backed by the central bank notes on a one to one basis, e.g., of Scotland and Northern Ireland, where bank-issued notes are allowed, but backed by the Bank of England notes, currency boards and real competition (free banking). See Rosa María Lastra, "Central Banking Law," 33-34.

⁶⁷ Thomas J. Jordan, "How Money Is Created by the Central Bank and the Banking System," (Zurich: Swiss National Bank, 16 January 2018). It should be noted that Demand deposits held by commercial banks at the central bank are also part of the CeBM. However, only banknotes and coins are legal tender, but not the demand deposits held by commercial banks at the central bank.

⁶⁸ Michael; McLeay, Amar Radia, and Ryland Thomas, "Money in the Modern Economy: An Introduction," *Bank of England Quarterly Bulletin 2014 Q1* (2014 Q1).; Michael; McLeay, Amar; Radia, and Ryland Thomas, "Money Creation in the Modern Economy," *ibid.*;

⁶⁹ Perry Mehrling, "The Inherent Hierarchy of Money," *Social Fairness and Economics: economic essays in the spirit of Duncan Foley* 169 (2012).

⁷⁰ Thomas J. Jordan, "How Money Is Created by the Central Bank and the Banking System."

⁷¹ This cap can also be changed in the protocol if there is sufficient consensus. It seems that such a consensus would be very hard to come by.

bitcoin carries no default risk as on-chain bitcoin transactions are conducted on a near real-time gross settlement basis on the Bitcoin blockchain.⁷² However, the elimination of inflation risk comes at the cost of price volatility, given that bitcoin’s fixed supply schedule is unable to effectively respond to demand shocks for bitcoin. Therefore, unlike CeBM or CoBM, bitcoin exposes users to the risks associated with price volatility.

CoBM is decentralized in its creation in the sense that it is demand-driven (i.e., demand for credit) and is created by commercial banks as they make loans (i.e., endogenous money).⁷³ In other words, the distinctive feature of CoBM is that it is a relatively decentralized credit creation and allocation mechanism, which is elastic and responsive to the demand shocks.⁷⁴ However, in addition to inflation risks, CoBM carries default risks. Although money creation in the commercial banking sector remains discretionary, the ability of a commercial bank in creating money is limited by the central bank’s monetary policy, and risk-return calculations of commercial banks (including considerations of current and future interest rates, the likelihood of defaults on loans or deposit withdrawals) and capital and liquidity requirements.⁷⁵

	<i>Inflation risk</i>	<i>Counterparty risk</i>	<i>Volatility risk</i>
<i>CeBM</i>	✓	✗	✗
<i>CoBM</i>	✓	✓	✗
<i>Bitcoin</i>	✗	✗	✓

Comparison of bitcoin with CeBM & CoBM in terms of risk profile

CoBM is issued by commercial banks, which in major jurisdictions are licensed or supervised by central banks, and – where available - enjoy the protection of deposit insurance fund. In addition, on a

⁷² Although there is no counterparty default risk in bitcoin transactions, using bitcoin exposes the users to operational or technical risks stemming from the settlement finality risks. As will be explained in section 4 of this paper, transactions in bitcoin often are batched by the miners and appended to the latest blockchain which on average takes ten minutes. During this time and the time that is required for the transaction to be deemed final (customarily six confirmations taking approximately sixty minutes), the users are exposed to the technical or operational risks. Therefore, bitcoin transactions are not real-time. Though they cannot be viewed as the equivalent of Deferred Net Settlement (DNS) Systems as they do not offer the advantages of that system in terms of economizing on liquidity and do not have counterparty default risks between the execution and settlement endemic to the DNS systems. For the lack of a better term, we use near real-time settlement.

⁷³ See: Claudio Borio, "The Financial Cycle and Macroeconomics: What Have We Learnt?," *Journal of Banking & Finance* 45 (2014).; Richard A. Werner, "How Do Banks Create Money, and Why Can Other Firms Not Do the Same? An Explanation for the Coexistence of Lending and Deposit-Taking," *International Review of Financial Analysis* 36 (2014).; Richard A. Werner, "Can Banks Individually Create Money out of Nothing? — the Theories and the Empirical Evidence," *International Review of Financial Analysis* 36 (2014).; Richard A. Werner, "A Lost Century in Economics: Three Theories of Banking and the Conclusive Evidence," *International Review of Financial Analysis* 46 (2016).; Giancarlo Bertocco, "Endogenous Money," in *The Encyclopedia of Central Banking*, ed. Louis-Philippe Rochon and Sergio Rossi (Northampton, MA, USA: Edward Elgar Publishing, 2015).;

⁷⁴ This would mean that it is unlikely that cryptocurrencies would eliminate the need for CoBM.

⁷⁵ Thomas J. Jordan, "How Money Is Created by the Central Bank and the Banking System."

daily basis, CeBM is used as the ultimate settlement asset in wholesale payment systems, which means that the value and convertibility of CoBM is being put to the test on a daily basis.⁷⁶ In other words, despite its designation as privately issued money, in effect, CoBM is an extension of CeBM. However, this daily final settlement in CeBM, which ensures the convertibility of CoBM to CeBM, does not in principle apply to cryptocurrencies as most of them do not aim to maintain a par value with fiat currencies. In other words, the value of CoBM is pegged to CeBM and it is a claim against the commercial bank to pay CeBM. It is exactly in this sense that cryptocurrencies are essentially different from CoBM, despite both being private money.

Since cryptocurrencies are used as the ultimate settlement asset within their own blockchains, they bear a resemblance to CeBM as the ultimate settlement asset both for retail and wholesale payments. As the ECB has monopoly on the issuance of the ultimate settlement asset,⁷⁷ potential wider adoption of cryptocurrencies by the general public and their use as the settlement asset within their own blockchains covering everyday transactions would be in direct contradiction with that role of CeBM. In other words, the daily convertibility of CoBM to CeBM entails that CoBM does not attempt to become a unit of account and a separate parallel currency, and directly compete with CeBM, but cryptocurrencies do.

To conclude, bitcoin and many other cryptocurrencies are not credit or shadow banking quasi-money; they share with CeBM the key feature that they do not represent a claim.⁷⁸ At least in theory, mass adoption of cryptocurrencies could challenge the monetary sovereignty of a nation-state (i.e., the monetary policy flexibility and independence and central banks' control over money supply) and governments' seigniorage revenues coming from creating money. Needless to say, the realization of such potential threats, however unlikely they may be, would justify the central banks' intervention.

2.2. Impact on price stability

Unit of account is the signature property of money.⁷⁹ Stability of the unit of account is crucial for a currency to become and remain a unit for the uniform measurement of value across several goods and

⁷⁶ European Central Bank, *The Payment System: Payments, Securities and Derivatives, and the Role of the Eurosystem* (Frankfurt am Main: European Central Bank, 2010), 45.

⁷⁷ Although CoBM can also be used as ultimate settlement asset (especially in some cross-border payments and settlements systems), most international standards as well as national regulations require the use of CeBM in the wholesale payments and settlement systems. See: Regulation of the European Central Bank (EU) No 795/2014 of 3 July 2014 on oversight requirements for systemically important payment systems (ECB/2014/28) OJ L 217, 23.7.2014, p. 16–30, Art. 10

⁷⁸ Max Raskin and David Yermack, "Digital Currencies, Decentralized Ledgers, and the Future of Central Banking." Similar to CeBM, bitcoin is not a claim or promise to pay and despite its accounting treatment, central banks do not view CeBM as a liability. See: European Central Bank, "What Is Money?," European Central Bank, https://www.ecb.europa.eu/explainers/tell-me-more/html/what_is_money.en.html.

However, it seems that even in its current form CeBM could be thought of as a 'liability' or promise. See: Nick Rowe, "From Gold Standard to Cpi Standard," in *Worthwhile Canadian Initiative: A mainly Canadian economics blog* (2012); Nick Rowe, "Is Money a Liability?," in *Worthwhile Canadian Initiative: A mainly Canadian economics blog* (2012).

⁷⁹ Charles Proctor, *Mann on the Legal Aspect of Money*.

services. Therefore, it is no surprise that ensuring price stability through inflation targeting has become one of the primary objectives of central banking.⁸⁰

Central banks often view competition in the provision of currencies somewhat healthy for the economy, in that multiple issuers of money can help enhance innovation and efficiency in the provision of payment and other financial services.⁸¹ For example, in ECB's view, neither mono-banking (central bank as the only issuer of money) nor free banking (commercial banks as the sole money suppliers) are sufficiently stable or efficient, and coexistence of CeBM and CoBM should be preserved.⁸² However, as mentioned earlier, there is a fundamental difference between privately issued bank liabilities like money, and cryptocurrencies. If, similar to cryptocurrencies, bank liabilities had different values independently of the CeBM and accordingly the prices would have been quoted in terms of those liabilities, every good or service would have had different quoted prices,⁸³ making it virtually impossible for the central bank to pursue its price stability objective. If a central bank cannot guarantee the uniform value of the unit of account, it would mean that multiple currencies would be used in a single currency area. This, in turn, would create obstacles to trade in a single market.⁸⁴ This scenario would be highly likely if various cryptocurrencies – especially issued by various state actors - were widely accepted.⁸⁵

In addition to being detrimental to the integrity of the unit of account, cryptocurrencies can have an impact on price stability by their potential impact on the demand for CeBM and on the control of money through the open market operations of central banks.⁸⁶ As for the former, based on the quantity theory of money (QTM),⁸⁷ the impact of cryptocurrencies on price stability highly depends on their impact on the quantity and the velocity of money. Firstly, if widely accepted, cryptocurrencies can affect price stability by increasing the quantity of *money* in circulation. Secondly, wider acceptance of cryptocurrencies would decrease the velocity of fiat money, because the increased use of cryptocurrencies would eat into the share of the fiat money in real-world and virtual transactions.⁸⁸ In addition, general acceptance of cryptocurrencies can cause distortions to the information content of monetary aggregates.⁸⁹ At its extreme, if public acceptance of cryptocurrencies would reach levels

⁸⁰ Although central banks either have a single mandate such as the ECB which is price stability, or they have dual mandate such as the US Federal Reserve which is price stability and employment, price stability has always been one of their basic tasks. Recently, there are suggestions to move from inflation targeting to (N)GDP targeting.

⁸¹ European Central Bank, *The Payment System: Payments, Securities and Derivatives, and the Role of the Eurosystem*, 45.

⁸² *Ibid.*

⁸³ *Ibid.*

⁸⁴ *Ibid.*

⁸⁵ It is noteworthy to mention that the wider adoption and circulation of cryptocurrencies as a means of payment may not be in contradiction to legal tender laws (e.g., Art. 10, 11 of the Regulation 974/98), despite its potential damage to the integrity of the unit of account.

⁸⁶ European Central Bank, "Virtual Currency Schemes."; European Central Bank, "Virtual Currency Schemes- a Further Analysis."

⁸⁷ According to the quantity theory of money (QTM), the following equation relates the aggregate prices (P) and total money supply (M): $P = MV/Y$, where V is velocity of money and Y is real output.

⁸⁸ Since the number of transactions would not be measurable in a centralized way, the velocity of money would also be unknown for the central bankers.

⁸⁹ ECB VC schemes, 2012. This concern has also been raised in the context of e-money.

that the CeBM would no longer define the unit of account, similar to the historical cases of dollarization, central bank monetary policy could become obsolete.⁹⁰

Thus far, there is no empirical evidence on the impact of cryptocurrencies on price stability. However, the price stability objective of central banks would be under threat by the proliferation and wider acceptance of cryptocurrencies through their impact on the demand for money and on the mechanism for the transmission of monetary policy. This would keep central banks on their toes, as it would pose both reputational risks to central banks and would jeopardize the mechanism at their disposal for carrying out their basic tasks.

2.3. Impact on monetary policy

In addition to the impact on the demand for CeBM, cryptocurrencies can affect monetary policy indirectly by removing certain policy options necessary for its implementation. In this respect, the potential impact of cryptocurrencies can be explained in light of the trilemma of international finance.⁹¹ Such an effect can be materialized by providing new venues for the users of the currency to circumvent capital controls.⁹² The trilemma of international finance suggests that for every country, it is only possible to have two of the following policy options at any point in time: unrestricted international capital markets, a managed exchange rate, and an independent monetary policy.⁹³ Wider or even global adoption of cryptocurrencies would render international capital markets unrestricted by default.⁹⁴ Therefore, there remain two options for policymakers and central banks from which only one should be chosen: managed exchange rates or independent monetary policy. In this scenario, if a country wants to manage its exchange rate, its monetary policy will automatically become reactive and cease to be independent.⁹⁵

As mentioned throughout the paper, the impact of cryptocurrencies on central banks are largely dependent on the widespread adoption of such currencies by the general public. However, despite bitcoin's unique attributes and the fact that the wider adoption of parallel cryptocurrencies would make it difficult for central banks to achieve their price stability objective, the prospect of the CeBM being replaced by bitcoin is virtually nil.⁹⁶ This is mainly due to certain limitations that are embedded

⁹⁰ Dong He, "Monetary Policy in the Digital Age," *Finance & Development* 55, no. 2 (June 2018).

⁹¹ Frederic S. Mishkin, *The Economics of Money, Banking, and Financial Markets*, 11 ed. (Boston: Pearson, 2016), 508-09.

⁹² Gina C. Pieters, "The Potential Impact of Decentralized Virtual Currency on Monetary Policy."

⁹³ *Ibid.*, 23-24.

⁹⁴ *Ibid.*, 20-25.

⁹⁵ Otherwise, if a country chooses unrestricted international capital markets, and independent monetary policy, it should invariably adopt a floating exchange rate because it will be bereft of tools to manage its exchange rate.

⁹⁶ A virtually hard cap and inflexible supply schedule on the number of bitcoins begets price volatility in response to the demand shocks, making it a hard sell as a unit of account. The hard cap on the number of bitcoins additionally means that the adoption of bitcoin by any country would put hard limits on the monetary policy and effectively remove monetary sovereignty, making bitcoin unattractive for any country to use it as a currency. Therefore, in its current form, price stability under bitcoin standard would be highly unlikely. In terms of monetary policy, bitcoin is dissimilar to CoBM, which is demand driven and very much responsive to the demands for credit. The same applies to the quasi-money created by the shadow banking system.

in the Bitcoin protocol by design. Due to the limitation on supply, unlike CeBM, bitcoin does not have inflation risk.⁹⁷ However, it has compromised three important functions of a stable monetary system. First, within a monetary system based on bitcoin, first, there would be no protection against the risk of structural deflation. Second, the inflexible supply schedule would deprive policymakers of significant policy levers and remove the possibility of any flexible response to temporary shocks to bitcoin demands and the possibility of smoothing the business cycle and minimizing macroeconomic dislocations, which is considered one of the main functions of monetary policy.⁹⁸ And third, such limitations would effectively remove the possibility of having a lender of last resort (LOLR).⁹⁹ As a consequence, in its current form, price stability under the bitcoin standard would be hard to achieve. This discourages bitcoin adoption at the nation-state or the currency-area level.¹⁰⁰ The above-mentioned limitations put specific constraints on bitcoin's promise of becoming a unit of account that aims to replace CeBM.¹⁰¹

This being said, it is not impossible to conceive a scenario where a widely accepted cryptocurrency would become a parallel or concurrent currency exerting competitive pressure on CeBM.¹⁰² In that case, the question would be whether it is acceptable for central banks - as part of their mandate to oversee the payment system and the wider FMIs - to welcome the existence of parallel currencies (and payment systems) outside the current formal banking and payment systems and with a settlement asset on which the central bank has no control. Although the coexistence of centralized and decentralized payment systems would ensure an additional layer of redundancy and would increase the resilience of the overall payment system,¹⁰³ it may forgo the benefits of economies of scale in using a single payment system and it would pose threats to the credibility of the unit of account if those alternative cryptocurrencies are widely accepted. The hypothesis where CeBM is sidelined by cryptocurrencies would also pose a reputational risk to central banks as it could be detrimental to the concept of the unit of account,¹⁰⁴ and may eventually result in the loss of central banks' control over money supply.

⁹⁷ Although each cryptocurrency (bitcoin) has a limit on its total number, there is no limit on the cryptocurrency brands that could be issued. Currently, there are more than 2,000 different cryptocurrencies and proliferation of such currencies are likely to lead to a suboptimal or unstable equilibria and affect price stability. See: Daniel R Sanches, "Bitcoin Vs. The Buck: Is Currency Competition a Good Thing?," *Federal Reserve Bank of Philadelphia Economic Insights Q2 2018* (2018): 13.

⁹⁸ Milton Friedman, "The Role of Monetary Policy," *American Economic Review* 58, no. 1 (1968).

⁹⁹ Dong He, "Monetary Policy in the Digital Age."

¹⁰⁰ George Selgin, "Synthetic Commodity Money," *Journal of Financial Stability* 17 (2015): 98.

¹⁰¹ It is also unlikely that bitcoin becomes a substitute for CoBM, as the latter has its unique advantages serving various needs of a given economy. This analysis is only applicable to bitcoin because of its specific properties in terms of capped supply schedule, but it may not be applicable to other cryptocurrencies. However, most other cryptocurrencies (including algorithmic stablecoin projects) face limitations that puts a question mark on economic fundamentals and their adoption prospects. See: Fabian Schär and Aleksander Berentsen, "Stablecoins: The Quest for a Low-Volatility Cryptocurrency," in *The Economics of Fintech and Digital Currencies*, ed. Antonio Fatás (London: CEPR Presss, 2019).

¹⁰² Max Raskin and David Yermack, "Digital Currencies, Decentralized Ledgers, and the Future of Central Banking." However, as the development of banking and shadow banking around bitcoin cannot be ruled out, bitcoin may in the future directly compete against commercial bank, as well as shadow banking money.

¹⁰³ Eswar Prasad, "Central Banking in a Digital Age: Stock-Taking and Preliminary Thoughts," 14.

¹⁰⁴ European Central Bank, "Virtual Currency Schemes."

Although many studies contemplate that the cryptocurrencies can affect monetary policy,¹⁰⁵ due to the relatively small size of the markets, thus far there has been no evidence of such an impact. However, there have been suggestions that a correlation exists between bitcoin price premia and global capital flows/flights.¹⁰⁶ Although a correlation should not be mistaken for causation, it can serve as an early warning sign on which further focus would be warranted. Concerns about the disruption in the implementation of the monetary policy due to the wider adoption of cryptocurrencies would warrant central banks' vigilance in closely watching the developments in this space.

Thus far, we have discussed the *direct* effects of cryptocurrencies on central banking that would warrant their *direct* involvement in the cryptocurrency ecosystem. There are further second-order or *indirect* effects that could trigger central banks' *indirect* involvement in cryptocurrency markets, but before discussing those challenges, it is important to discuss the policy options and tools at the ECB's disposal to determine if the ECB can directly intervene in cryptocurrency markets.

3. ECB's policy options

Although the intuitive knee-jerk reaction to the potential direct impact of cryptocurrencies on monetary policy and price stability would entail direct regulation of cryptocurrencies (e.g., banning such currencies), this paper argues that such a response would be neither feasible nor desirable. Instead, indirect regulation of cryptocurrencies through banking and payment systems would hold the promise of achieving the regulatory objectives without jeopardizing the potential benefits of fintech innovation. Based on the mandate and competences of the ECB, as well as the regulatory and supervisory tools at its disposal, it seems that many of the mechanisms for ECB intervention in the cryptocurrency ecosystem are among the mechanisms that only allow for the ECB's *indirect* intervention. Within this indirect regulation, central banks can have a prominent role to play, particularly by their regulatory and oversight powers on the credit institutions and payment systems and their role as a contributor to the financial stability-enhancing policies.

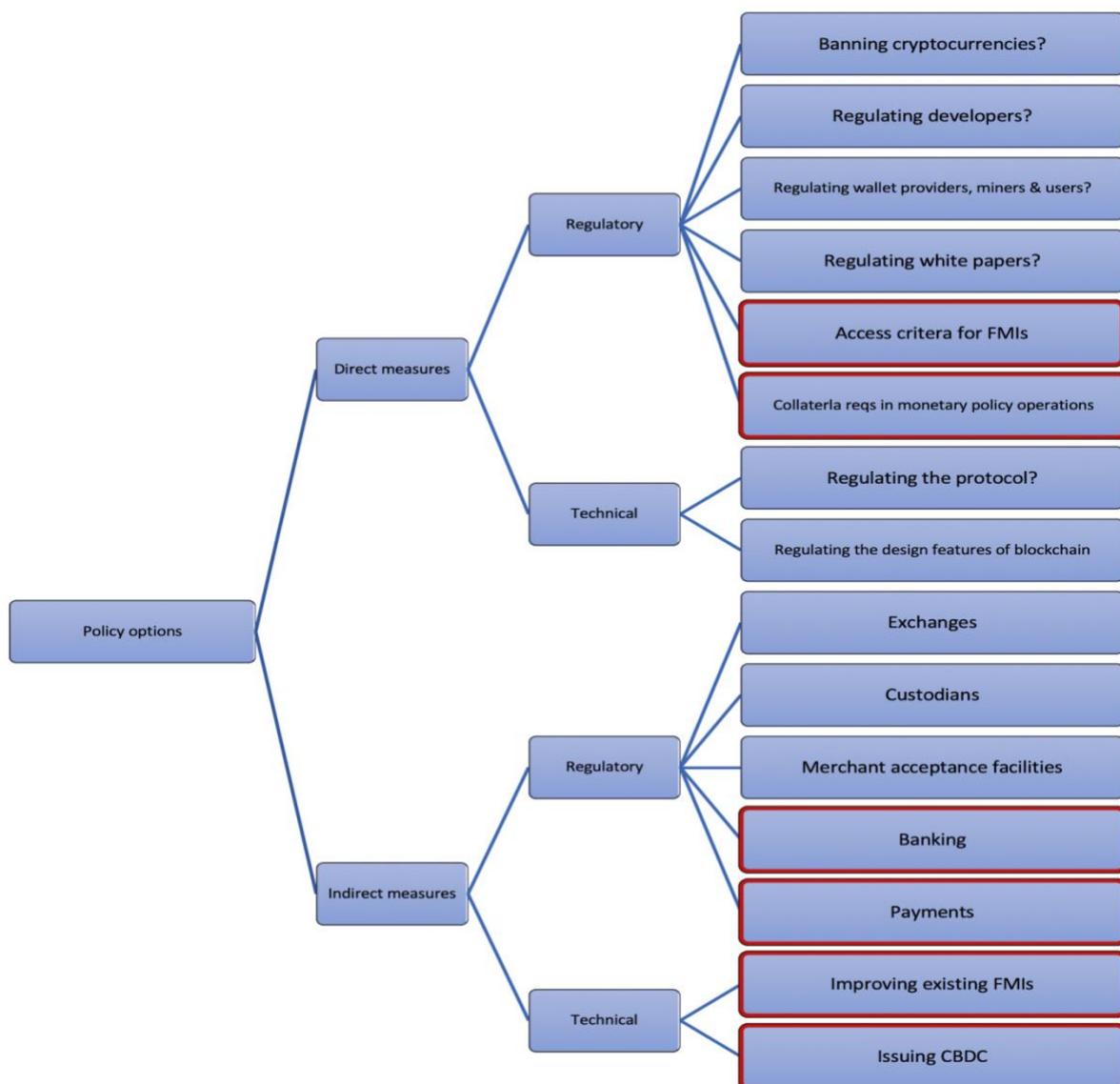
Direct and indirect regulatory measures can be either in the form of technical measures (i.e., non-regulatory measures) or regulatory measures. A manifestation of *direct regulatory measures* by the ECB would be rejecting cryptocurrencies and digital assets as collateral (i.e., eligible marketable assets) within its collateral eligibility framework in the ECB operations. Furthermore, as a *direct technical measure*, the regulator may consider regulating the code itself and imposing design-based

¹⁰⁵ Robleh Ali et al., "The Economics of Digital Currencies," *Bank of England Quarterly Bulletin 2014 Q3* (2014).; Committee on Payments and Market Infrastructures, "Digital Currencies," (2015).

¹⁰⁶ See: Bloomberg (2018), What Bitcoin Signals About Global Capital Flows, available at: <https://www.bloomberg.com/news/videos/2017-09-29/what-bitcoin-signals-about-global-capital-flows-video>.

Among the ESCB's basic tasks are conducting foreign-exchange operations, holding and managing the official foreign reserves of the Member States. Under this mandate, the ECB may be given the power to hold and intervene in cryptocurrencies. Such powers would be necessary for the successful implementation of monetary policy under the unlikely scenario of cryptocurrencies making international capital markets unrestricted.

requirements on the code or protocol. However, as far as the ECB is concerned, it would fall outside the scope of its mandate and competence. *Indirect regulatory measures* would be achieved largely by the regulatory and supervisory measures targeting banks and payment institutions, for example, imposing stricter criteria for access to the FMIs and technical platforms operated by the ECB on the banking and payment institutions providing payment services in cryptocurrencies. Finally, *indirect technical measures* would focus either on improving the efficiency and addressing the shortcomings of the existing payment and settlement systems, thereby indirectly influencing cryptocurrencies, or they would be aimed at venturing into the uncharted territory of issuing CBDCs, to which we will return in the final part of the paper.



3.1. Direct regulation of cryptocurrencies

Based on the concerns about the unit of account, price stability and the impact on the conduct of monetary policy, central banks might take an interest in regulating cryptocurrencies directly. Direct regulation of cryptocurrencies can take many forms. It could involve regulating the code or protocol (i.e., design-based regulation),¹⁰⁷ developers,¹⁰⁸ the design features of a given blockchain, node operators, wallet providers,¹⁰⁹ miners, and users, or imposing rules and standards for governing white papers. On the contrary, regulation of exchanges, where cryptocurrencies are exchanged for fiat money, custodians (including custodian wallet providers) and other service providers, such as merchant acceptance facilities would belong to the realm of indirect regulation.

An example of direct regulatory intervention may include imposing a blanket ban on cryptocurrencies and sanctioning the individuals, exchanges, financial institutions, and payment processors from handling or dealing in cryptocurrencies.¹¹⁰ On the other extreme of the spectrum, the ECB may be given the power to hold cryptocurrencies as part of its tasks under conducting foreign-exchange operations or holding and managing the official foreign reserves of the Member States. As the ECB and NCBs can “acquire and sell spot and forward all types of foreign exchange assets and precious metals”,¹¹¹ and as ‘foreign exchange assets’ include “securities and all other assets in the currency of any country or units of account and in whatever form held”,¹¹² it would be difficult to argue that the ECB would not have the power to acquire and hold cryptocurrencies if need be.¹¹³

As certain forms of direct regulation of cryptocurrencies would rely on design-based regulation, this approach cannot be independent of the specific features of the cryptocurrency in question and its underlying blockchain. For example, cryptocurrencies based on an open (unrestricted) blockchain are to be treated differently from those built on a closed (restricted) blockchain with identifiable and relatively centralized nodes. In the same vein, largely centralized cryptocurrency schemes, such as Ripple, should be treated differently from decentralized ones such as bitcoin. The dependence of direct regulatory approach on the design features of the specific cryptocurrency poses a serious

¹⁰⁷ For the concept of design-based regulation and examples thereof, see: Lawrence Lessig, *Code: And Other Laws of Cyberspace* (New York: Basic Books, 1999).; Lawrence Lessig, *Code: Version 2.0* (New York: Basic Books, 2006).; Primavera De Filippi and Aaron Wright, *Blockchain and the Law: The Rule of Code* (Cambridge, Massachusetts: Harvard University Press, 2018).; ; Lawrence Lessig, "The New Chicago School," *The Journal of Legal Studies* 27, no. S2 (1998).

¹⁰⁸ Angela Walch, "In Code(Rs) We Trust: Software Developers as Fiduciaries in Public Blockchains," in *Regulating Blockchain: Techno-Social and Legal Challenges*, ed. Philipp Hacker, et al. (Oxford: Oxford University Press, Forthcoming 2019). For a dissenting view, see: Aaron van Wirdum, "A Primer on Bitcoin Governance, or Why Developers Aren't in Charge of the Protocol," *BITCOINMAGAZINE* Sept. 7, 2016.; See also: Jerry Brito and Peter van Valkenburgh, "Writing and Publishing Code Alone Cannot Be a Crime," *CoinCenter.org* (October 29, 2018).

¹⁰⁹ Such wallet providers could be regulated as Money Service Businesses (MSBs) requiring money transmitter license, or money remittance service providers, both of which are equivalent to payment institutions in the EU.

¹¹⁰ Global Legal Research Directorate Staff of the Library of Congress, "Regulation of Cryptocurrency in Selected Jurisdictions," (Washington D.C.,: The Law Library of Congress, June 2018). See China entry by Laney Zhang.

¹¹¹ Art. 23 ESCB Statute

¹¹² Art. 23 ESCB Statute

¹¹³ If bitcoin becomes a major currency in the future, central banks may engage in buying and intervening in the bitcoin markets under the mandate of managing their foreign reserves. As this scenario appears to be unlikely at the moment, this paper will not discuss it.

challenge to direct regulation approach as recent proliferation of cryptoassets with various features would make direct regulation of cryptocurrencies an arduous task.

For tokens issued on permissioned distributed ledgers, direct regulation would be straightforward, as it can target the proprietors of the ledger or the nodes with access to the ledger and the authority to validate it. Therefore, for centralized cryptocurrencies, mandatory creation of a scheme governance authority (body), information technology (IT) security requirements, requirements on transaction verification process (e.g., the number of nodes and miners and confirmations needed for the finality of a transactions on the blockchain) can be imposed by the law to be built into the design of a given cryptocurrency. Operational and business continuity requirements, disclosure of the identity of node operators, requirements such as investor or user vetting process or customer due diligence before making the wallet or coin available to the user can be imposed directly on these identifiable scheme authorities. Although imposing most of the aforementioned requirements would go far beyond the existing scope of competence of the ECB, the ECB can have a role in its advisory capacity.

Despite the fact that many cryptocurrencies designed to be decentralized and censorship-resistant, those features do not necessarily mean that direct regulation of cryptocurrencies is destined to fail or be ineffective. Although governments can hardly do away with decentralized cryptocurrencies, they can disrupt their growth. As with all currencies, the success of any currency depends on its widespread adoption, which entails network effects. However, a government ban on cryptocurrencies can severely undermine their network effects.¹¹⁴ In addition, an aggressive tax policy, such as designating bitcoin as property for tax purposes and imposing property taxes each time a bitcoin or a fraction of it changes hands, as it is the case in some jurisdictions, would severely stifle its adoption as a medium of exchange.

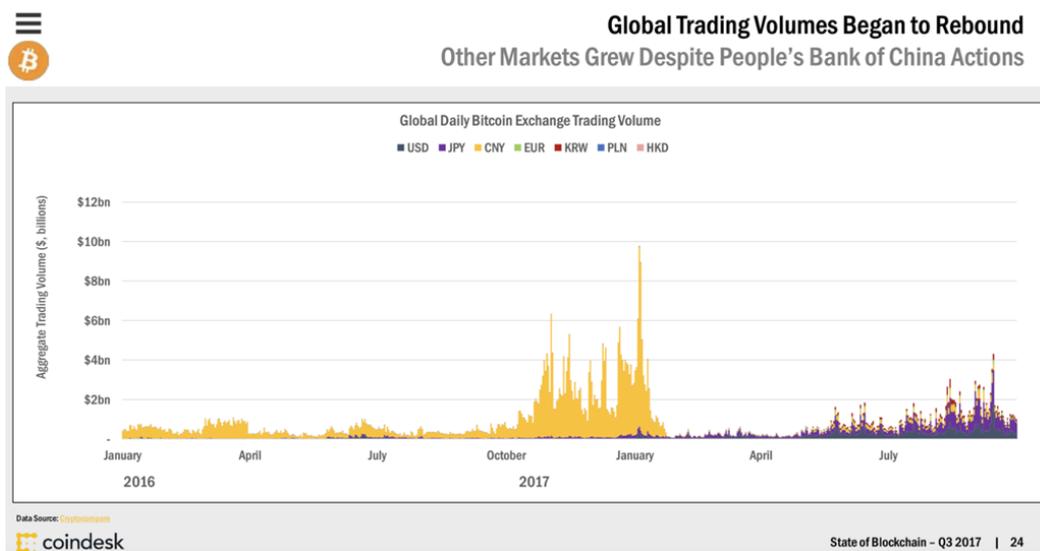
3.2. Challenges to direct regulation and opportunities for indirect regulation of cryptocurrencies

There are several reasons justifying that direct regulation of cryptocurrencies by central banks may not be desirable, or even possible, and may eventually fail to achieve the intended goals.

First, decentralized cryptocurrencies are borderless and direct regulation would encourage regulatory arbitrage. This is due to two main issues. First, no government can effectively ban a sufficiently decentralized cryptocurrency such as Bitcoin. Due to the P2P nature of Bitcoin, banning or aggressively regulating it will presumably only push it to the darker corners of the virtual world.

¹¹⁴ William J. Luther, "Cryptocurrencies, Network Effects, and Switching Costs," *Contemporary Economic Policy* 34, no. 3 (2016). (In Luther's view, governments are capable of undermining bitcoin due to their ability in stifling network effects. He also is of the opinion that in the absence of major breakthroughs, it is unlikely that bitcoin would gain widespread adoption.) On the other side of the spectrum, some believe that profit seeking incentives of entrepreneurs can contribute to the widespread adoption of bitcoin. See: Malavika Nair and Nicolás Cachanosky, "Bitcoin and Entrepreneurship: Breaking the Network Effect," *The Review of Austrian Economics* 30, no. 3 (2017).

Second, if only a few jurisdictions allow Bitcoin, such a ban would become ineffective because of regulatory arbitrage. The relatively decentralized nature of cryptocurrencies, their digital nature, their global reach, and the young and nimble industries that are being evolved within this ecosystem create border problems¹¹⁵ and a wide scope for regulatory arbitrage across borders.¹¹⁶ In the cryptocurrency sphere, if a cryptocurrency is legally allowed only in one jurisdiction, it is likely that it would spread across borders in the virtual world. This has already been the case in the regulator's cat and mouse game in the area of illegal download websites and decentralized protocols for P2P file sharing such as BitTorrent.¹¹⁷ In the context of cryptocurrencies, after the New York BitLicense, there have been reports of businesses, including exchanges, that changed their domicile with unprecedented pace.¹¹⁸ In 2017, a year in which the Bank of China took actions to regulate and ban ICOs, cryptocurrency markets witnessed a shift in the global trading volume from Chinese Yuan (CNY) to Japanese Yen (JPY) and US dollar (USD).



Second, the one-size-fits-all measures typical of direct regulation cannot adequately address the wide variety and heterogeneity of cryptocurrencies and the strategies of the businesses evolving around them.¹¹⁹ There is a plethora of actors playing distinct roles in the cryptocurrency sphere. They include developers, issuers, miners, processing service providers, users, wallet providers, exchanges, and

¹¹⁵ Charles A. E. Goodhart and Rosa M. Lastra, "Border Problems," *Journal of International Economic Law* 13, no. 3 (2010).; Charles Goodhart, "The Boundary Problem in Financial Regulation," *National Institute Economic Review* 206, no. 1 (2008).

¹¹⁶ For the concept of regulatory arbitrage, see: Hossein Nabilou, "Regulatory Arbitrage and Hedge Fund Regulation: The Need for a Transnational Response," *Fordham Journal of Corporate and Financial Law* 22, no. 4 (2017).

¹¹⁷ Primavera De Filippi and Samer Hassan, "Blockchain Technology as a Regulatory Technology: From Code Is Law to Law Is Code," *First Monday* 21, no. 12 (2016).

¹¹⁸ For example, the two exchanges that shifted their businesses offshore or to other states were Kraken and Shapeshift

¹¹⁹ See: Hossein Nabilou and Alessio M. Paccas, "The Hedge Fund Regulation Dilemma: Direct Vs. Indirect Regulation."

other trading platforms such as decentralized exchanges (DEX),¹²⁰ merchant acceptance facilities, and various other actors.¹²¹ To say the least, due to various design features of emerging cryptocurrencies, a one-size-fits-all regulatory solution could at best be counterproductive.

The main problem with direct regulation of cryptocurrencies is that decentralized permissionless blockchain-based cryptocurrencies - designed to be censorship resistant - are antithetical to the existing structure of financial regulation. These cryptocurrencies can exist and function independently of the existing institutions and market infrastructures and they may not fit into any existing legal framework. The issue becomes even more complicated as some issuing organizations have neither managers nor real or corporate entity and place of domicile.¹²² Therefore, the direct regulation of cryptocurrencies, to the extent possible, would run into the practical question of what or whom to regulate and in the absence of a centralized governance scheme, it is hard to propose a direct regulatory approach to regulating cryptocurrencies.¹²³

The closest that regulations can get in regulating such cryptocurrencies is regulating miners, and perhaps relatively centralized nodes on the Lightning Network¹²⁴ if that network proves its long-term viability. Indeed, as the second-layer solutions are being developed, it is reasonable to expect business communities to develop around them which could be directly identifiable and targeted by regulators. However, under the current legal framework, the ECB may lack the competence to regulate or influence node operators directly if such operators are not part of credit institutions or payment systems. The ECB may only do so through indirect channels, where regulation would focus on the applications, use-cases, and businesses that are being developed around the open-source cryptocurrency protocols.¹²⁵

Third, a more interesting feature of indirect regulation that makes it particularly suitable for the regulation of cryptocurrencies is its relatively decentralized nature.¹²⁶ In this respect, crafting appropriate indirect regulatory mechanisms for cryptocurrencies requires identifying the financial institutions that have the most consistent, continuous, and day-to-day relationships with

¹²⁰ For more details on DEX, see: Lindsay X. Lin, "Deconstructing Decentralized Exchanges," *Stanford Journal of Blockchain Law & Policy* (2019).

¹²¹ For a detailed description, see: European Central Bank, "Virtual Currency Schemes- a Further Analysis," 7-8.

¹²² Office of the New York State Attorney General, "Virtual Markets Integrity Initiative Report."

¹²³ Yves Mersch, "Virtual Currencies Ante Portas," *Speech at the 39th meeting of the Governor's Club Bodrum, Turkey, 14 May 2018* (14 May 2018).

¹²⁴ Joseph Poon and Thaddeus Dryja, "The Bitcoin Lightning Network: Scalable Off-Chain Instant Payments," (2016).; Aaron van Wirdum, "The History of Lightning: From Brainstorm to Beta," *Bitcoin Magazine* (4 April 2018).

¹²⁵ For similar ideas in a slightly different context, see: Michèle Finck, "Blockchains: Regulating the Unknown," *German Law Journal* 19, no. 4 (2018): 689.; Julie Maupin, "Mapping the Global Legal Landscape of Blockchain and Other Distributed Ledger Technologies," *Centre for International Governance Innovation Papers No. 149* (2017).

There are improvements on the Bitcoin protocol and also second layer solutions that promise to make bitcoin useful for all the above-mentioned purposes. For an overview of two such business improvements called "market exchange pricing", and "instantaneous exchange facilities", see: William Luther and Lawrence White, "Can Bitcoin Become a Major Currency?," *JMU Working Paper in Economics No. 14-17* (2014). See also: Jimmy Song, "Bits Denomination Bip," GitHub, <https://github.com/bitcoin/bips/blob/master/bip-0176.mediawiki>.

¹²⁶ For the concept of decentralized regulation, see: Julia Black, "Decentring Regulation: The Role of Regulation and Self Regulation in a "Post Regulatory" World," *Current Legal Problems* 54, no. 1 (2001).

cryptocurrencies. Identifying these institutions means identifying those equipped with sufficient knowledge and understanding of the industry and their activities in the financial markets.¹²⁷ These are the very institutions that can potentially be used as ‘surrogate regulators’ delegated with regulatory functions from the government agencies. In addition to increasing the efficiency of regulation by providing incentives to surrogate regulators to compete with each other, since indirect regulation of cryptocurrencies would be implemented by various multiple banks and payment institutions, it provides for the possibility of decentralized implementation and enforcement of rules that are initially applied to the banking and payment sectors. This can help mitigate the *knowledge problem* that exists in most centralized regulatory agencies and make regulation less vulnerable to regulatory capture.

In the following sections, we study the potential impact of cryptocurrencies on banking and payment systems and the venues for the implementation of indirect regulatory measures towards cryptocurrencies by the ECB by focusing on its regulatory, supervisory and oversight powers over credit institutions and payment systems. The final section will be dedicated to the indirect technical measures that can be taken to address certain risks posed by cryptocurrencies to central banking.

3.3. Indirect regulation through banking and payment systems

The predominant features of decentralized and permissionless cryptocurrencies, the limitations of direct regulation and the constraints on the ECB’s scope of competence mean that indirect regulation of cryptocurrencies would be the most feasible and effective regulatory approach.¹²⁸ Indirect regulation of cryptocurrencies would circumvent the difficulties of direct regulation and instead relegate them to a network of decentralized banks and payment institutions to address those problems.¹²⁹ For example, instead of regulation of tokens issued on permissionless blockchains, indirect regulation may focus on the regulation of wallet providers or exchanges, which could be a more practical solution.¹³⁰ In this case, regulation targets the interface between cyberspace and real

¹²⁷ In this sense, indirect regulation becomes very similar to regulation by standards, because it relies on decentralized knowledge. For more information about how standards involve utilizing such knowledge. See Hans-Bernd Schaefer, "Legal Rule and Standards," in *The Encyclopedia of Public Choice, Volume I*, ed. Charles K. Rowley and Friedrich Schneider (New York: Kluwer Academic Publishers, 2004). See also in general: F. A. Hayek, "The Use of Knowledge in Society," *The American Economic Review* 35, no. 4 (1945).

¹²⁸ Bank for International Settlements, "Cryptocurrencies: Looking Beyond the Hype," 107.

¹²⁹ Sanctions regimes, where the indirect regulation has proven its relative effectiveness, is a case in point. Within such regimes, where the activity in question is out of reach of the regulator, the regulator targets the industry upon which it has jurisdiction, and sanctions the transactions between the regulated entities and those outside its regulatory reach (also known as secondary boycotts or sanctions). This regulatory approach aims at minimizing the amount of the sanctioned activity. See: Kern Alexander, *Economic Sanctions: Law and Public Policy* (New York: Palgrave Macmillan, 2009), 15.

¹³⁰ Jason Albert, "What’s Next for Blockchain: Technology, Economics and Regulation," *Microsoft: EU Policy Blog* (June 20, 2016). The existing examples of this approach are the warnings issued by regulators (such as the EBA and the Commission de Surveillance du Secteur Financier (CSSF) of Luxembourg) discouraging banks that engage or plan to engage in cryptocurrency business from doing so.

world. This is in line with the old tradition in financial regulation where the regulation of financial markets and institutions has relied on gatekeepers.¹³¹

With respect to indirect regulation, although regulation may not be able to touch the Bitcoin Network itself, it applies at the use-case levels¹³² and regulates the entities and intermediaries that enable the interface and interaction between cryptocurrencies and fiat currencies on cryptocurrencies schemes with bidirectional flows.¹³³ In the future, there would be several scenarios in which banks might engage in payment services using bitcoin or other cryptocurrencies. For example, as second-layer payment solutions are being developed for bitcoin, banks might engage in the second-layer payment channels by running full nodes on the Lightning Network, essentially providing liquidity in bitcoin.¹³⁴ Whether running such nodes and engaging in transactions in the second-layer payment channels would mean that the bank engages in the provision of retail payment services and the application of payment laws should be triggered, and whether protocol layer payments qualify as (wholesale) payments system remain open questions. For the purposes of this paper, it seems that such developments would enable regulators to focus on the relatively centralized nodes on such networks.

The role of indirect regulation is particularly important in the context of emerging smart contracts on cryptocurrency schemes and their blockchains. The execution of such contracts is often dependent on the external validation of specific factual events (e.g., the actual transfer of the personal property), which are necessarily determined by trusted intermediaries (i.e., oracles).¹³⁵ In these cases, not only can reliance on oracles reduce the level of trustlessness of transactions on the blockchain, but they also become choke points, where law can target blockchain transactions. In addition to the oracles, which facilitate onchain transactions, indirect regulation, which targets intermediaries, can best be applied to off-chain transactions, where intermediaries are involved in the transaction and transaction is not broadcast to the blockchain. In contrast, in most on-chain transactions, where no intermediary is involved and no external validation is required, indirect regulation would be of limited use.

4. The ECB, payment systems and cryptocurrencies

Ensuring price stability requires the central bank to have mechanisms at its disposal to control inflation and exchange rate and to supervise the banking system as it plays a significant role in money creation and as a transmission belt for monetary policy. Accordingly, every legal system affords central banks with tools to operationalize such mechanisms and achieve the price stability objective.

¹³¹ Despite the merits of this regulatory approach in that it is directed to identifiable entities, the problem of regulatory arbitrage would still be an obstacle to the success of such a regulatory approach.

¹³² Phoebus L. Athanassiou, *Digital Innovation in Financial Services: Legal Challenges and Regulatory Policy Issues*, 38.

¹³³ *Ibid.*, 88.

¹³⁴ For the scaling solutions by using the Lightning Network see: Joseph Poon and Thaddeus Dryja, "The Bitcoin Lightning Network: Scalable Off-Chain Instant Payments."; For a critique of the Lightning Network on liquidity grounds, see: Frances Coppola, "Lightning Network May Not Solve Bitcoin's Scaling 'Trilemma'," *Coindesk* January 20, 2018.

¹³⁵ Primavera De Filippi and Samer Hassan, "Blockchain Technology as a Regulatory Technology: From Code Is Law to Law Is Code."

For example, controlling inflation requires monetary policy tools and since an efficient and well-functioning payment, clearing and settlement system plays a critical role in the operational efficiency of the monetary policy transmission,¹³⁶ and as such is crucial to the success of the ECB's monetary policy and price stability objectives, the provision, regulation and oversight of the payment system have also been included in the basic tasks of the ECB.¹³⁷

The ESCB's competence in the area of payments includes ensuring safe and efficient payment systems, which consists of making regulation, the *provision* of facilities, and the exercise of oversight powers.¹³⁸ Within this system, the Eurosystem has the authority both in a centralized and decentralized manner (by the ECB and NCBs respectively) to oversee retail and wholesale payment systems.¹³⁹ More rigorous oversight standards are applicable to the systemically important payment systems, including the systemically important retail payment systems (SIRPS).¹⁴⁰ In what follows, we highlight the increasing interconnectedness between conventional payment systems and cryptocurrencies that would affect conventional payment systems and eventually trigger action by central banks.

4.1. Emerging interconnections between conventional payment systems and cryptocurrencies

Risks in payment systems include credit risk, liquidity risk, operational risk, legal risk, and systemic risk.¹⁴¹ To address such risks, payment systems in Europe rest on an edifice of robust institutional and legal infrastructure.¹⁴² In addition to the laws and regulations regarding the retail payment systems, there is a well-established legal framework, including ECB guidelines and decisions, for the wholesale payment systems to address operational, liquidity and counterparty risks as well as

¹³⁶ Sheller K. Hanspeter, *The European Central Bank: History, Role and Functions*, 86.

¹³⁷ European Central Bank, *The Payment System: Payments, Securities and Derivatives, and the Role of the Eurosystem*, 153. Article 127(2) of the TFEU. In the euro area, the smooth operation of payment systems is one of the basic tasks of the Eurosystem, which is restated in the fourth indent of Article 3.1 of the ESCB Statute. In addition, according to the Article 22 of the ESCB Statute, the ECB and the NCBs "may provide facilities, and the ECB may make regulations, to ensure efficient and sound clearing and payment systems within the Union and with other countries".

¹³⁸ *Ibid.*, 309.

¹³⁹ European Central Bank, "Revised Oversight Framework for Retail Payment Systems," (Frankfurt am Main February 2016), 7.

¹⁴⁰ *Ibid.*, 3. See also: Recital 7 of the Regulation of the ECB on oversight requirements for systemically important payment systems (hereinafter "the SIPS Regulation"), Regulation of the European Central Bank (EU) No 795/2014 of 3 July 2014 on oversight requirements for systemically important payment systems (ECB/2014/28) OJ L 217, 23.7.2014, p. 16–30, Art. 1(2)

¹⁴¹ European Central Bank, *The Payment System: Payments, Securities and Derivatives, and the Role of the Eurosystem*, 115-30. For an overview of legal risks in the use of cryptocurrencies as payment media, see: Phoebus Athanassiou, "Impact of Digital Innovation on the Processing of Electronic Payments and Contracting: An Overview of Legal Risks," *ECB Legal Working Paper Series No 16* (October 2017): 16-18.

¹⁴² These regulations are collectively to address the problems arising from information asymmetry (consumer protection, e.g., prohibition on blending in interchange fees), enhancing competition among payment service providers (PSPs), and among PSPs, banks and Third Party Payment Service Providers (TPPs) (e.g., interchange fee regulation, promoting competition by transparency requirements especially for merchant, prohibition on product bundling, and protecting against the systemic risks in the wholesale payments). An additional set of directives and regulation attempts to address concerns about financial crime using payment system (e.g., AML, CFT, KYC regulations), access to payment accounts (payment accounts directive), user protection, by imposing asset segregation rules and limitations on fees, and ensuring finality of transactions and ultimately the trust in the payments system to achieve payment system stability objective.

settlement finality risks.¹⁴³ However, this legal framework does not apply to payments using cryptocurrencies.¹⁴⁴

Against the backdrop of a near-consensus about the inapplicability of the current prudential requirements to payments made by cryptocurrencies, current developments suggest that cryptocurrency service providers are increasingly becoming intertwined with conventional payment institutions. In addition to technological developments, this is partly due to semantics and definitional problems in payments law. The regulatory framework for payment institutions in Europe (e.g., Payment Services Directive 2; hereinafter, PSD2)¹⁴⁵ relegates the authorization of payment institutions to the competent authorities of the home Member State.¹⁴⁶ Some cryptocurrency exchanges, which also provide the possibility of cross-border transfers of cryptocurrencies across wallets and across exchanges, have been authorized as ‘payment institutions’ in certain Member States. For example, cryptocurrency exchanges such as Bitstamp Europe S.A. and bitFlyer Europe S.A. are licensed as payment institutions in Luxembourg, however, there is no clarity about the legal basis for granting such authorizations.¹⁴⁷

PSD2 defines a payment institution as “a legal person that has been granted authorisation to provide and execute *payment services* throughout the Union.”¹⁴⁸ [Emphasis added.] Therefore, the definition of a payment system largely relies on the definition of ‘payment services’ in the PSD2. The Annex I of the PSD2 defines payment services as services enabling *cash* placement or withdrawal on or from a payment account, “as well as all the operations required for operating a payment account.”

¹⁴³ In particular, this framework is of utmost importance in systemically important payment systems (SIPS) and in wholesale payment systems such as Target2 (Trans-European Automated Real-time Gross Settlement Express Transfer System), T2S (Target2-Securities), CLS (Continuous Linked Settlement), and provides legal certainty on collateral and finality of settlements.

¹⁴⁴ Except those rules applicable to financial fraud or financial crime. For a similar argument, see: Phoebus L. Athanassiou, *Digital Innovation in Financial Services: Legal Challenges and Regulatory Policy Issues*, 86-88. See also: Asress Adimi Gikay, "Regulating Decentralized Cryptocurrencies under Payment Services Law: Lessons from European Union Law," *Journal of Law, Technology & the Internet* 9 (2018): 20-21.; Noah Vardi, "Bit by Bit: Assessing the Legal Nature of Virtual Currencies," in *Bitcoin and Mobile Payments: Constructing a European Union Framework*, ed. Gabriella Gimigliano (London: Palgrave Macmillan UK, 2016).;

¹⁴⁵ Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market, amending Directives 2002/65/EC, 2009/110/EC and 2013/36/EU and Regulation (EU) No 1093/2010, and repealing Directive 2007/64/EC (Text with EEA relevance), *OJ L 337*, 23.12.2015, p. 35–127

¹⁴⁶ Article 5, PSD2

¹⁴⁷ At least indirectly, one may surmise that the decision to grant a payment institution license is backed by the reasoning that cryptocurrencies are money. In its communiqué on virtual currencies, dated 14 February 2014, the Luxembourg regulator, i.e., Commission de Surveillance du Secteur Financier (CSSF), states that ““virtual” currencies are considered as money, since they are accepted as a means of payment of goods and services by a sufficiently large group of people...” The CSSF continues to point out that virtual currencies are “scriptural money as opposed to cash in the form of banknotes and coins. The scriptural nature does not require a tangible writing, similarly to electronic documents or signatures that do not require paper. Virtual currencies may thus be electronic money, but not necessarily within the meaning of the European Directive 2009/110 which provides for a definition of electronic money limited to its own scope.”¹⁴⁷ See: Commission de Surveillance du Secteur Financier (CSSF), "Newsletter No. 157," news release, February 2014, http://www.cssf.lu/fileadmin/files/Publications/Newsletter/Newsletter_2014/newsletter157eng.pdf.

¹⁴⁸ Art. 4(4), PSD2.

In addition, execution of ‘payment transactions’, and *money* remittance also fall under the definition of payment services.¹⁴⁹

PSD2 defines ‘payment transaction’ as “an act, initiated by the payer or on his behalf or by the payee, of placing, transferring or withdrawing *funds*, irrespective of any underlying obligations between the payer and the payee”.¹⁵⁰ Therefore, it seems that the issue comes down to the definitions of the words ‘cash’, ‘fund’ and ‘money’. As cryptocurrencies cannot be classified as cash or money, the closest term that could be associated with cryptocurrencies is the term ‘fund’. PSD2 defines funds as “banknotes and coins, scriptural money or electronic money as defined in point (2) of Article 2 of Directive 2009/110/EC”.¹⁵¹ As bitcoin is neither a banknote nor a coin, nor is it scriptural money,¹⁵² the closest concept can be electronic money (e-money). The e-money directive¹⁵³ defines electronic money as “electronically, including magnetically, stored monetary value as represented by a claim on the issuer which is issued on receipt of funds for the purpose of making payment transactions ..., and which is accepted by a natural or legal person other than the electronic money issuer”.¹⁵⁴ As bitcoin does not represent any claim, classification of bitcoin as e-money would be a mistake.¹⁵⁵

As the above analysis suggests, under the current legal framework for payments in Europe, cryptocurrencies cannot fall under the definitional scope of funds,¹⁵⁶ putting a question mark on the applicability of European payment directives and regulations to cryptocurrency exchanges. Even assuming the full applicability of the payment services laws to the cryptocurrency exchanges, such exchanges would be subject to idiosyncratic risks that would not be covered under the current legal regime applicable to payment institutions and systems. The two such idiosyncratic risks are the risks associated with the reliance of cryptocurrency exchanges on illiquid and volatile settlement assets whose convertibility to CeBM is not guaranteed and the risks associated with the settlement finality within certain major cryptocurrency blockchains.

¹⁴⁹ See: Art. 4(3), PSD2 and Annex I, PSD2.

¹⁵⁰ Art. 4, PSD2.

¹⁵¹ Art 4(25), PSD2.

¹⁵² See: European Banking Authority, "Report with Advice for the European Commission on Crypto-Assets," (9 January 2019), 14.

In ECB's opinion of 26 April 2006 on a proposal for a directive on payment services in the internal market (ECB/2006/21) (2006/C 109/05), the ECB suggests that a definition of scriptural money should be provided. However, it specifies that only central banks and credit institutions (which include e- money institutions) may hold scriptural money. Available at: https://www.ecb.europa.eu/ecb/legal/pdf/c_10920060509en00100030.pdf

The PSD2 does not contain any definition of scriptural money. However, it seems that the term scriptural money can hardly be stretched to include cryptocurrencies.

¹⁵³ Directive 2009/110/EC of the European Parliament and of the Council of 16 September 2009 on the taking up, pursuit and prudential supervision of the business of electronic money institutions amending Directives 2005/60/EC and 2006/48/EC and repealing Directive 2000/46/EC, OJ L 267, 10.10.2009, p. 7–17. (Hereinafter, e-money directive)

¹⁵⁴ Art. 2, e-money directive

¹⁵⁵ Although some other cryptocurrencies, depending on their features may qualify as e-money. See: European Banking Authority, "Report with Advice for the European Commission on Crypto-Assets."

¹⁵⁶ *Ibid.*, 14.

4.1.1. The volatility of the settlement asset

In addition to the fixed supply schedule of certain cryptocurrencies, as the cryptocurrency exchanges offer bidirectional flows between fiat money and cryptocurrencies, market participants have an easy way out to fiat money, which could give rise to the extreme volatility of the settlement asset in cryptocurrency payment systems in times of illiquidity. The problem would arise if licensed cryptocurrency exchanges use relatively illiquid and highly volatile cryptocurrencies as their settlement asset over which neither the ECB nor the NCBs have any control. Where the cryptocurrency exchanges licensed as payment institutions, which are intertwined with the regulated payment institutions and use illiquid, highly volatile and unconvertible settlement assets without access to the LOLR, become large enough, they would effectively function as contagion channels for liquidity crises from the cryptocurrency ecosystems to conventional banking and payment systems.¹⁵⁷

Needless to say, the increasing number of payment institution licenses granted to cryptocurrency exchanges would increase the magnitude of the exposure of the conventional payment systems to cryptocurrency payments to the extent cryptocurrency and payment activities are not separate, which could ultimately draw central banks' interest in regulating cryptocurrencies. In this case, one policy option for central banks or other NCAs would be to require the separation of cryptocurrency payment systems from conventional regulated payment systems on prudential grounds.¹⁵⁸ In addition, the ECB may cut access to its infrastructure for the credit and payment institutions that have exposures to cryptocurrency exchanges or payment institutions.

In addition to risks associated with the settlement asset, cryptocurrency payments are mainly gross and (near) real time. Hence, they may be subject to substantial liquidity risks. Concerns about liquidity risks have been raised about bitcoin in the sense that it is impossible to have full decentralization, fixed money supply, and sufficient liquidity simultaneously.¹⁵⁹ Although cryptocurrencies would be prone to liquidity risks, as of yet, there have been no documented risks to the conventional payment systems posed by illiquidity in cryptocurrencies. However, the involvement of banks in cryptocurrency payment systems might result in risk spillovers from the latter to the former.

4.1.2. Finality of settlements

Another major risk about the payments made by cryptocurrencies, which may not be covered by the existing payments law, concerns the probabilistic finality of certain cryptocurrencies, such as bitcoin. The finality of payments and settlements on the Bitcoin blockchain is probabilistic due to the likelihood that the most recent transactions embedded in the blockchain may be undone, or bitcoins

¹⁵⁷ In addition, the failure of such cryptocurrency payment institutions/exchanges would also pose reputational risks to the EU license brand of payment institutions.

¹⁵⁸ European Banking Authority, "Eba Opinion on 'Virtual Currencies'."

¹⁵⁹ Frances Coppola, "Lightning Network May Not Solve Bitcoin's Scaling 'Trilemma'."

may be double-spent mainly due to formation of a fork.¹⁶⁰ This probability is a function of the block height, meaning that the probability of undoing transactions embedded in the blockchain depends on how deep the transaction is recorded in the blockchain. As more and more blocks are built on the Bitcoin blockchain, the lower the probability of undoing the embedded transactions, and as it gets deeper and deeper in the blockchain, the probability becomes infinitesimal as the PoW algorithm of the Bitcoin protocol ensures that the extrinsic investment in expended energy would act as a ‘thermodynamic guarantee of immutability’.¹⁶¹ Therefore, it is safe to assume that the transactions are *de facto* ‘final’ after six confirmations, as undoing six blocks requires a very high investment in energy.¹⁶² To reduce the uncertainty about the settlement finality especially within the first sixty minutes, the industry has developed its own commercial customs. Depending on the wallet used, as soon as a transaction is broadcast to the Bitcoin Blockchain, the receiving wallet receives a notification confirming the receipt of a payment, but the payment is considered final after six confirmations.

In the debate about the probabilistic finality, it is important, however, not to confuse two different aspects of transaction finality: actual, technical, or *de facto* finality, and legal or *de jure* finality. The technical settlements on the Bitcoin blockchain is probabilistic, and so is the actual settlement with cash and any other means of electronic payments, as there is always the possibility of taking the cash back by using brute force or reversing the transaction due to a technical failure in the payment system, including that of a central bank. However, the near impossibility of a *de facto* finality does not necessarily mean that the payment is not *legally* final, in the sense that legal challenges cannot invalidate the payment *ex-post*. In other words, *de facto* probabilistic finality does not necessarily mean *de jure* probabilistic finality and vice versa.¹⁶³ The difference between settlements with conventional payments vis-à-vis the settlements within the blockchain with probabilistic finality is that the settlement on the conventional payment systems enjoys legal protections, whereas there is no legal protection as to the finality of the settlements on the Bitcoin blockchain.

Although the case law may evolve and presume settlement finality after six confirmations for private-law purposes, given the potential for systemic risk arising from the ambiguity as to the finality of payments, such issues may be better dealt with *ex-ante* within a *regulatory* framework, as is the case

¹⁶⁰ Bank for International Settlements, "Cryptocurrencies: Looking Beyond the Hype," 101-04.

¹⁶¹ (Andreas Antonopoulos) – proof of work; Let’s talk bitcoin #368 the internet of money & <https://vevo.site/video/Bw3-Waz04X8/andreas-antonopoulos-talks-bitcoin-blockchain-and-beyond.html>. Aside from the expenditure on energy, the tamper-resistant feature of bitcoin is built on certain assumptions about rational and profit-maximizing miners. Therefore, the tamper-resistant feature of bitcoin is as much a technological concept as it is an economic concept, making bitcoin’s tamper-resistance a relative concept rather than an absolute one. Hence, the term ‘tamper-resistance’ would be a preferable to ‘immutable’ in describing what is known as immutability of the Bitcoin Blockchain.

¹⁶² This is not to say that it amounts to complete immutability. Theoretically complete immutability cannot be achieved.

¹⁶³ In fact, technically speaking, in most transactions, the real world may not provide a solid 100% certainty; therefore, there is a need for the law to intervene and presume that as soon as certain requirements are met, a transaction would be deemed final. As on the Bitcoin Blockchain, similar to any other payment system, the actual transfers are not 100% final and immutable, but the law may presume that at certain point in time a transaction becomes final. In other words, the fact that the finality on the Bitcoin Blockchain is not deterministic does not stop the law to presume the finality of a transaction on its blockchain.

with conventional payment and settlement systems. However, under the current payments law, the laws ensuring settlement finality (e.g., the Settlement Finality Directive),¹⁶⁴ which require payment and settlement systems to specifically define the moment of entry and irrevocability of the orders and transactions, do not seem to be applicable to payments made by cryptocurrencies.¹⁶⁵ The lack of legal protection in itself may entail systemic implications if the cryptocurrency markets become sufficiently large and more sophisticated products and services develop around them.¹⁶⁶

5. The ECB, banking stability and cryptocurrencies

Banks and cryptocurrencies have an uneasy relationship. On the one hand, there is a likelihood that the cryptocurrency-related businesses would grab part of the business of banking. For example, it seems that the first line of business of traditional banking, which is more likely to fall victim to cryptocurrencies, is the provision of payment services, especially correspondent-banking model of international fund transfers. On the other hand, to avoid such an outcome, banks might take a proactive approach and coopt cryptocurrency business, even in the provision of payment services.

There are many channels through which banks may involve in cryptocurrency activities. Examples would include direct ownership of cryptocurrencies, market making, lending against cryptocurrency collateral, engaging in clearing of trading cryptocurrency derivative instruments, lending to cryptocurrency businesses, underwriting ICOs, and providing custody wallet or trading platforms in cryptocurrencies.¹⁶⁷ An exhaustive treatment of the dynamics of the interaction between cryptocurrencies and banks goes well beyond the scope of this paper. Suffice it to mention that such business activities may pose new risks to the banking system. As banks play an important role in money creation and allocation of credit as well as in the transmission of monetary policy, a disruption in the banking system can have significant consequences for the supply of money and credit, price stability, and the implementation of monetary policy, which may warrant the ECB's attention to the risks involved in the interaction of cryptocurrencies and banks. Here, we discuss a few hypothetical scenarios about the interaction of the banking system with the cryptocurrency ecosystem in the future, the potential risks arising from such interactions, and the potential venues for ECB intervention.

The first venue for banks to engage in cryptocurrency business is through the recent developments in the scaling issues related to cryptocurrencies such as bitcoin by engaging in the business opportunities that are emerging around those new developments. From its earliest days of bitcoin, scaling issues

¹⁶⁴ Directive 98/26/EC of the European Parliament and of the Council of 19 May 1998 on settlement finality in payment and securities settlement systems, OJ L 166, 11.6.1998, p. 45–50. (Settlement Finality Directive)

¹⁶⁵ See: Arts. 1 & 2 of the Settlement Finality Directive.

¹⁶⁶ The lack of such legal protections may cast a shadow of doubt on the decisions to grant payment institution licence to cryptocurrency exchanges and payment service providers.

¹⁶⁷ European Banking Authority, "Report with Advice for the European Commission on Crypto-Assets," 22-23.

have been a constant concern that led to polarizing controversies in the bitcoin community.¹⁶⁸ Two main camps emerged on this dividing issue; one supporting vertical scaling solutions or second-layer solutions,¹⁶⁹ the other camp supporting horizontal scaling solutions or increasing the block size.¹⁷⁰ The ensuing *civil war* among the bitcoin community resulted in the failed SegWit2X, and a hard fork leading to the creation of bitcoin cash (BCH) and subsequent user activated soft fork (UASF) and the activation of SegWit on the legacy chain.¹⁷¹ Through time, it seems that within the bitcoin community vertical scaling solutions to address Bitcoin's scalability problem is gaining traction.¹⁷²

The second-layer solutions to Bitcoin's scalability problem are not new phenomena and have already been in the making from the early days of bitcoin. Fractional reserve banking on bitcoin can be considered as an early example of such a scaling solution to bitcoin. In the words of Hal Finney:

“... there is a very good reason for Bitcoin-backed banks to exist, issuing their own digital cash currency, redeemable for bitcoins. Bitcoin itself cannot scale to have every single financial transaction in the world be broadcast to everyone and included in the block chain. There needs to be a secondary level of payment systems which is lighter weight and more efficient. Likewise, the time needed for Bitcoin transactions to finalize will be impractical for medium to large value purchases. Bitcoin backed banks will solve these problems. They can work like banks did before nationalization of currency. Different banks can have different policies... Some would be fractional reserve while others may be 100% Bitcoin backed. Interest rates may vary... I believe this will be the ultimate fate of Bitcoin, to be the "high-powered money" that serves as a reserve currency for banks that issue their own digital cash. Most Bitcoin transactions will occur between banks, to settle net transfers....”¹⁷³

In addition to banks and exchanges, bitcoin custody-solution providers and bitcoin debit-card providers – which allow the transfers of a bitcoin from a wallet to another within or across companies without using the Bitcoin blockchain - can be considered as part of the second-layer scaling solutions for Bitcoin.

¹⁶⁸ Bitcoin itself can be viewed as an invention that emerged to overcome social scalability problem in the first place. Although the discussion of this paper is limited to technological scalability, the problem of social scalability stands at the core of the scalability issues in bitcoin. Indeed, the perceived inefficiencies in the PoW can be understood in the balance struck between social scalability and computational scalability. In the Bitcoin Blockchain the latter is sacrificed to improve the former. For more details, see: Nick Szabo, "Money, Blockchains, and Social Scalability," *Unenumerated* (February 09, 2017).

¹⁶⁹ See: Andreas M. Antonopoulos, *Mastering Bitcoin: Programming the Open Blockchain* (Sebastopol, CA: O'Reilly Media, Inc., 2017), 300-21.

¹⁷⁰ See: Joseph Poon and Thaddeus Dryja, "The Bitcoin Lightning Network: Scalable Off-Chain Instant Payments."; Aaron van Wirdum, "The History of Lightning: From Brainstorm to Beta."; Tom Elvis Jedusor, "Mimblewimble," (19 July 2016).; Aaron van Wirdum, "Mimblewimble: How a Stripped-Down Version of Bitcoin Could Improve Privacy, Fungibility and Scalability All at Once," *Bitcoin Magazine* (12 August 2016).

¹⁷¹ Laura Shin, "Will This Battle for the Soul of Bitcoin Destroy It?," *Forbes* Oct. 23, 2017.. Similar controversies happened on the Ethereum' blockchain due to the loss of funds associated with DAO project, resulting in a chain split and the creation of Ethereum and the Ethereum Classic.

¹⁷² See: Andreas M. Antonopoulos, *Mastering Bitcoin: Programming the Open Blockchain*, 300-21.

From these new solutions, the Lightning Network, Liquid Network, Sidechains, and other scaling solutions such as Mimblewimble stand out. See: Joseph Poon and Thaddeus Dryja, "The Bitcoin Lightning Network: Scalable Off-Chain Instant Payments."; Aaron van Wirdum, "The History of Lightning: From Brainstorm to Beta."; Tom Elvis Jedusor, "Mimblewimble."; Aaron van Wirdum, "Mimblewimble: How a Stripped-Down Version of Bitcoin Could Improve Privacy, Fungibility and Scalability All at Once."

¹⁷³ Hal Finney, "Re: Bitcoin Bank," (December 30, 2010).

Within the development of the second layer on Bitcoin, bank involvement in cryptocurrencies could take various forms. Banks would operate on the additional layer on the Bitcoin blockchain and the Bitcoin's base layer itself would function as the highly secure base or settlement layer for the net settlement of the financial obligations arising from the financial transactions conducted on Bitcoin's upper layers. Banks and payment service providers may also evolve into wallet providers, custodians, and node operators supporting payment channels within the Lightning Network.

However, the second layer payment channels within the Lightning Network may pose different challenges, such as liquidity risks, that would warrant special scrutiny if banking entities would run full nodes or otherwise engage in liquidity provision on the Network. In addition, the transactions on the Lightning Network may provide for higher levels of privacy compared to on-chain transactions. Although the concerns about the liquidity may warrant ECB's involvement in the regulation through discouraging the banking entities in engaging in such activities, the privacy of payments would require regulators' - other than central banks - intervention.

Second, banks may start accepting bitcoin or other cryptocurrencies as deposits¹⁷⁴ and as deposit-taking institutions, they may pay interest on the cryptocurrency deposits, or eventually, develop a fractional reserve banking model on bitcoin.¹⁷⁵ Although at the time of this writing, the banking sector does not engage in borrowing and lending cryptocurrencies,¹⁷⁶ this may be subject to change in the future, despite all the risks involved in such transactions. The engagement of banks in borrowing and lending in cryptocurrencies would pose two distinct prudential questions: first, the acceptability of cryptocurrencies as collateral and quantitative and qualitative standards to be used to determine haircuts in accepting their use and reuse as collateral both in the banking industry and in monetary policy operations of central banks.

The second problem would be associated with the absence of LOLR in cryptocurrencies. As fractional reserve banking on bitcoin would result in liquidity problems, the absence of a LOLR would become palatable. In the eurozone, the ECB and NCBs have offered LOLR services (equivalent to Fed's discount window) through the marginal lending facility.¹⁷⁷ The reason that the ECB or NCBs can offer such a service is that it has access to unlimited sources of liquidity. The predetermined supply schedule and fixed money supply model of cryptocurrencies such as bitcoin remove the possibility of

¹⁷⁴ Although under current legal framework, the word deposit and the legal protections afforded to such banking products are not applicable to cryptocurrencies.

¹⁷⁵ See for example: Hal Finney, "Re: Bitcoin Bank."; European Central Bank, "Virtual Currency Schemes," 39.; However, such activities would expose businesses to risks of maturity and liquidity transformation. As in the absence of a LOLR, establishing safeguards to alleviate the risks of maturity and liquidity transformation in decentralized cryptocurrencies would be virtually impossible, engaging in deposit-taking and lending would not be appealing to cryptocurrency businesses. Accordingly, it is less likely that the role of the banking sector in maturity and liquidity transformation would be disrupted by the developments in the cryptocurrency business.

¹⁷⁶ However, some lending platforms engage in cryptocurrency lending and some exchanges do margin lending at the moment.

¹⁷⁷ This is made redundant by the introduction of fixed rate full allotment policy (FRFA). See: Carlos Garcia-de-Andoain et al., "Lending-of-Last-Resort Is as Lending-of-Last-Resort Does: Central Bank Liquidity Provision and Interbank Market Functioning in the Euro Area," *ECB Working Paper Series No 1886* (2016): 10.

an ultimate liquidity provider. Although some projects for stablecoins, such as Basis,¹⁷⁸ are being structured on the algorithmic central banking model, which provides for price stability using flexibility in money supply, it is unlikely that stablecoin experiments would succeed in the presence of credible central banks with long-established reputation for price stability.

The third scenario, in which banks would involve in cryptocurrency businesses, is that banks themselves would engage in issuing such currencies either for retail payment services or for wholesale payments. Whether it is prudentially acceptable for banks or a consortium of banks to be allowed to issue their own retail-oriented cryptocurrencies or use settlement tokens in clearing and settling obligations remains an open question. Potential liquidity and legal challenges that this type of money creation and in particular its use in privately organized clearing and settlement systems can face would not rally in favor of such developments.

The fourth scenario would be for banks to offer cryptocurrency accounts or custodian wallets, establish proprietary trading desks in cryptocurrencies or eventually offer cryptocurrency funds, including Exchange Traded Fund (ETFs), or cryptocurrency derivative products.¹⁷⁹ However, given the liquidity risks in the cryptocurrency business and its derivatives, regulators, including the ECB, either in their supervisory role or as a catalyst for change may consider banning banks from trading in cryptocurrencies. Such a strategy may be implemented through the competent authorities of the Member States through the mechanism offered by article 104 of the Capital Requirements Directive IV (CRD IV), empowering competent authorities “to restrict or limit the business, operations or network of institutions or to request the divestment of activities that pose excessive risks to the soundness of the institution”, or “to require the reduction of the risk inherent in the activities” or to impose additional capital and liquidity requirements.¹⁸⁰ In addition, the ECB can make use of its supervisory powers within the framework of its comprehensive assessment (asset quality review (AQR) and stress testing) and establish a stricter framework for assessing credit institutions’ exposure to cryptocurrencies. Alternatively, regulators may consider imposing structural regulation,¹⁸¹ such as ring-fencing of proprietary trading in cryptocurrencies from other activities of banks, or imposing

¹⁷⁸ For more details see: <https://www.basis.io/>. For a critique of this project, see: Jemima Kelly, "The John Taylor-Backed “Stablecoin” That’s Backed by, Um, Stability," *Financial Times* June 25, 2018. This project was shut down in December 2018, perhaps due to its shaky economic foundations. See: Fabian Schär and Aleksander Berentsen, "Stablecoins: The Quest for a Low-Volatility Cryptocurrency."

¹⁷⁹ Nathaniel Popper, "Goldman Sachs to Open a Bitcoin Trading Operation," *The New York Times* May 2, 2018.

¹⁸⁰ See: Art. 104 Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms, amending Directive 2002/87/EC and repealing Directives 2006/48/EC and 2006/49/EC, *OJ L 176, 27.6.2013, p. 338–436* (CRD IV). See also: European Banking Authority, "Report with Advice for the European Commission on Crypto-Assets," 25.

¹⁸¹ For payment institutions, such structural regulation would be imposed using the powers granted under article 11(5) PSD2.

subsidiarization requirements for activities related to cryptocurrencies to avoid cross-subsidization of cryptocurrency proprietary trading by the governments' implicit and explicit subsidies to banks.¹⁸²

6. Cryptocurrencies and financial stability

At the time of this writing, there is a lack of reliable empirical evidence on the impact of cryptocurrencies on the banking system and financial stability. In addition to the lack of data, the existing data may be manipulated by market-manipulating activities such as wash trading, spoofing, and pump and dump strategies.¹⁸³ Despite all the above questions and hypothetical scenarios, the available data suggest that the market capitalization, leverage, and interconnectedness in the cryptoasset markets are unlikely to destabilize banking system and financial markets, or negatively affect the real economy. The correlation in the price of cryptoassets may suggest that there might be a risk of herd behavior in cryptocurrency markets. However, even in the presence of herd behavior, the small size of the industry would not imply that such price movements would cause systemic risk.

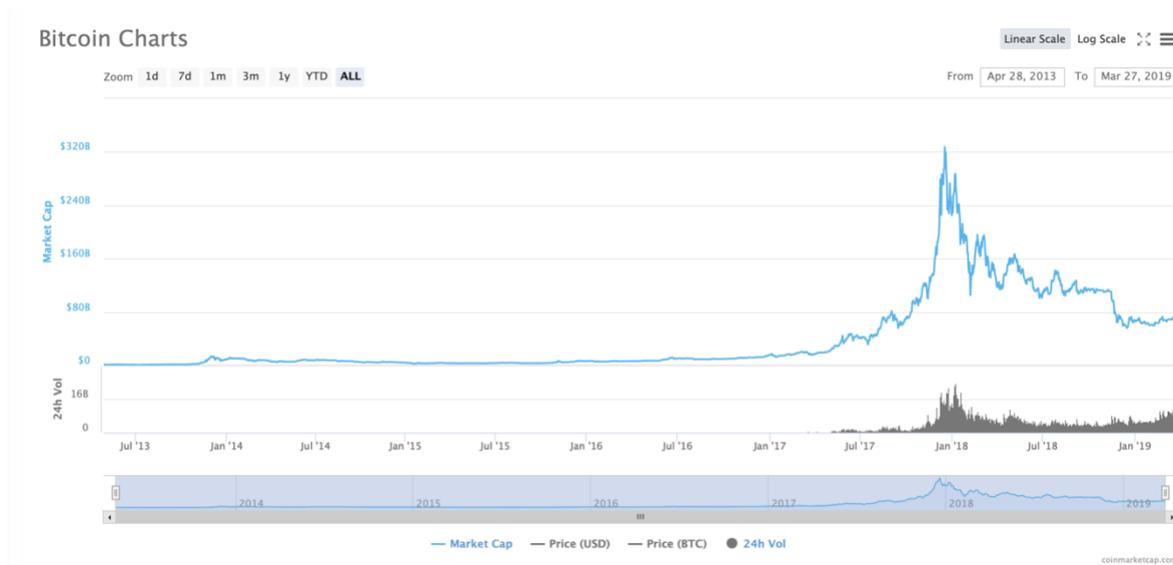
Indeed, the passive approach to regulating cryptocurrency markets heretofore can also be attributable to their insignificant size relative to conventional financial markets. At its peak, cryptocurrency market capitalization reached around \$800bn. This figure pales in comparison to the total assets of the Monetary Financial Institutions (MFIs) in the euro area which in March 2017 stood at around €34tr.¹⁸⁴ The total market capitalization of the overall cryptocurrencies at its peak was smaller than the market capitalization of the largest NASDAQ listed company (i.e., Apple Inc.) with a market capitalization of \$1.08tr as of September 11, 2018. At the same time, the market capitalization of bitcoin, the largest and the most popular cryptocurrency was around \$110bn and the total market capitalisation of all cryptocurrencies stood at around \$189bn.¹⁸⁵

¹⁸² See: Hossein Nabilou, "Bank Proprietary Trading and Investment in Private Funds: Is the Volcker Rule a Panacea or yet Another Maginot Line?," *Banking and Finance Law Review* 32, no. 2 (2017).; For a discussion on the implicit government subsidies to banks, see: Anat R. Admati and Martin Hellwig, *The Bankers' New Clothes: What's Wrong with Banking and What to Do About It* (Princeton, New Jersey: Princeton University Press, 2013).; Douglas J. Elliott, "Implicit Subsidies for Very Large Banks: A Primer," *Economic Studies at Brookings* (2014). The potential widespread use of cryptocurrencies in the financial system would raise additional questions about the margins (initial and variation margins) that could be set on cryptocurrency trading and their derivatives and whether there should be special regulatory capital, leverage, and liquidity requirements for the exposure to cryptocurrencies.

¹⁸³ Financial Stability Board, "Crypto-Assets: Report to the G20 on the Work of the Fsb and Standard-Setting Bodies," (Basel, Switzerland: Financial Stability Board, 16 July 2018), 3.

¹⁸⁴ European Central Bank, "Report on Financial Structures," (Frankfurt am Main 2017), 6.

¹⁸⁵ See: <https://coinmarketcap.com>



Therefore, even the collapse of the overall cryptocurrency market is unlikely to give rise to any financial stability concerns.¹⁸⁶ In addition to this insignificant size, the limitations on the ECB's powers would constrain its role in financial stability even in the presence of systemic risks of cryptocurrency markets.

Despite the fact that the possibility of a systemic impact in the future cannot be ruled out,¹⁸⁷ this paper will not consider systemic externality as a ground for regulatory intervention in the cryptoasset markets.¹⁸⁸ The reason is twofold. In addition to the lack of reliable data, which is explained above, the ECB has a limited role in maintaining financial stability. The ECB is a single-mandate central bank with price stability being central to its tasks. With respect to the contribution of the ECB to financial stability, the TFEU uses a rather nuanced wording. Article 127(5) of the TFEU explicitly mentions that "[t]he ESCB shall *contribute* to the smooth conduct of policies *pursued by the competent authorities* relating to the prudential supervision of credit institutions and the stability of the financial system."¹⁸⁹ [Emphasis added] Although "[p]rice stability and financial stability are tightly interconnected and mutually reinforcing",¹⁹⁰ financial stability is not among the objectives of the ECB according to the first paragraph of the Art. 127, neither is it among its four basic tasks. Accordingly, the ECB lacks appropriate regulatory, supervisory or operational tools in the area of

¹⁸⁶ See: Mark Carney, "Fsb Chair's Letter to G20 Finance Ministers and Central Bank Governors," (Financial Stability Board, 13 March 2018); Financial Stability Board, "Crypto-Assets: Report to the G20 on the Work of the Fsb and Standard-Setting Bodies." (Confirming that cryptoassets currently do not pose systemic risks.)

¹⁸⁷ Financial Stability Board, "Crypto-Asset Markets: Potential Channels for Future Financial Stability Implications," (Basel: Financial Stability Board, 10 October 2018).

¹⁸⁸ This also does not mean that small economies would be immune to the risks of cryptocurrencies.

¹⁸⁹ Art. 127(5) of the TFEU

¹⁹⁰ Peter Praet, "The Interaction between Monetary Policy and Macroprudential Policy," *Speech at the Money, Macro and Finance Research Group Conference on the Resilience of the Global Financial Architecture, London* (27 September 2018).; See also: Markus K. Brunnermeier and Yuliy Sannikov, "A Macroeconomic Model with a Financial Sector," *American Economic Review* 104, no. 2 (2014).

financial stability.¹⁹¹ This means that even if cryptocurrencies posed systemic risk to the financial system, the ECB would not have sufficient tools to address such risks.¹⁹² With respect to financial stability, the ECB has only a ‘contributory and supporting role’,¹⁹³ which is different from the shared competence and has the narrowest scope. Accordingly, in the euro area, the primary responsibility of maintaining financial stability remains with the national competent authorities.¹⁹⁴

However, it is likely that financial stability concerns may eventually materialize through the banking or payment systems, and in this regard, the prudential supervisory powers of the ECB on credit institutions can play an important role in mitigating such risks. The supervisory competence of the ECB is limited to the *prudential* supervision of credit institutions within the Single Supervisory Mechanism (SSM), the details of which are laid out in the SSM regulation,¹⁹⁵ SSM framework regulation,¹⁹⁶ EBA regulation¹⁹⁷ and the ECB’s Guide to Banking Supervision, the detailed treatment of which would go beyond this article.¹⁹⁸ As the scaling solutions for cryptocurrencies are being developed, it seems that the majority of the activities within the cryptocurrency ecosystem would migrate to second layers, and the protocol level would only be used for secure (deferred) net

¹⁹¹ Yves Mersch, "Financial Stability and the Ecb," *Speech by Yves Mersch, Member of the Executive Board of the ECB, ESCB Legal Conference, Frankfurt, 6 September 2018* (September 6, 2018).

¹⁹² Accordingly, financial stability is not the exclusive competence of a single institution. The task of preserving financial stability has been spread out among national, supranational and international actors such as finance ministries, supervisory expert bodies, (e.g., the European Systemic Risk Board (ESRB) and other national macroprudential regulators) central banks and the FSB. See: *ibid.* For example, ESMA “may temporarily prohibit or restrict certain financial activities that threaten the orderly functioning and integrity of financial markets or the stability of the whole or part of the financial system in the Union”. See: Art. 9(5) Regulation (EU) No 1095/2010 (ESMA Regulation), See also: Article 28 of Regulation (EU) No 236/2012 (Short-selling regulation), and Article 40 of Regulation (EU) No 600/2014 (MiFIR). See also Asen Lefterov, "The Single Rulebook: Legal Issues and Relevance in the Ssm Context," 27.

¹⁹³ For the limitations on the scope of supervision of credit institutions by the ECB, see. Yves Mersch, "Financial Stability and the Ecb." See also: Article 28 of Regulation (EU) No 236/2012 (short selling regulation) and Article 40 of Regulation (EU) No 600/2014 (MiFIR). This limitation is spelled out in Article 1, sixth subparagraph, and Article 4(3) of Regulation (EU) No 1024/2013. See Asen Lefterov, "The Single Rulebook: Legal Issues and Relevance in the Ssm Context," 27. There is also a very limited scope for the ECB in regulation. See: *ibid.*, 38.

¹⁹⁴ Yves Mersch, "Financial Stability and the Ecb."

¹⁹⁵ Council Regulation (EU) No 1024/2013 of 15 October 2013 conferring specific tasks on the European Central Bank concerning policies relating to the prudential supervision of credit institutions, *OJ L 287, 29.10.2013, p. 63–89*;

¹⁹⁶ Regulation (EU) No 468/2014 of the European Central Bank of 16 April 2014 establishing the framework for cooperation within the Single Supervisory Mechanism between the European Central Bank and national competent authorities and with national designated authorities (SSM Framework Regulation) (ECB/2014/17), *OJ L 141, 14.5.2014, p. 1–50*

¹⁹⁷ Regulation (EU) No 1022/2013 of the European Parliament and of the Council of 22 October 2013 amending Regulation (EU) No 1093/2010 establishing a European Supervisory Authority (European Banking Authority) as regards the conferral of specific tasks on the European Central Bank pursuant to Council Regulation (EU) No 1024/2013, *OJ L 287, 29.10.2013, p. 5–14*

¹⁹⁸ European Central Bank, *Guide to Banking Supervision* (Frankfurt am Main: European Central Bank, 2014). Under the SSM regulation and relevant framework regulation, the ECB assumes the direct supervision of the largest banks and those banks that received state support, amounting to approximately 85% Eurozone banking assets. The smaller banks fall under the direct supervision of the National Competent Authorities (NCAs) as part of the SSM and following the ECB instructions. This is in essence an indirect supervision of smaller banks by the ECB. The ECB can always step in and directly supervise such banks. With respect to prudential regulation, ECB has defined supervisory powers of micro and macroprudential nature. Microprudential measures that the ECB can take include authorization and withdrawal of license, authorizing acquisition or disposal of significant holdings, regular prudential tools, such as governance, remuneration standards and imposing limitations to businesses or even divestments, conducting stress tests, and supervising capital, leverage and liquidity requirements mainly embedded in the Capital Requirements Directive IV (CRD IV) and Capital Requirements Regulation (CRR). See Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms, amending Directive 2002/87/EC and repealing Directives 2006/48/EC and 2006/49/EC, *OJ L 176, 27.6.2013, p. 338–436.*;

Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012, *OJ L 176, 27.6.2013, p. 1–337.*

settlements. As participants in the second layers would likely to be banks, payment institutions, and other financial institutions, the powers of the ECB in the supervision of credit institutions and payments system will be of utmost importance. Thus, given the possibility of such developments and due to the limitations on the ECB's mandate, the ECB can best intervene indirectly in the cryptocurrency markets if systemic risk were to stem from cryptocurrency markets.

7. Indirect technical intervention

Frictions in payments across national boundaries and the lack of a global currency have played an important role in giving birth to some of the most prominent use-cases of cryptocurrencies, such as those in the remittance business. As mentioned above, one of the strategies that could be deployed by central banks is technical intervention in cryptocurrency markets. In this section, we explore the venues for indirect technical intervention in the cryptocurrency markets by the ECB, which could be achieved not by regulating the existing cryptocurrencies, but by issuing its own cryptocurrencies. This would be an indirect intervention because it only affects cryptocurrencies by providing an alternative virtual currency that exerts a competitive force on cryptocurrencies by leveraging on its price stability.

Before issuing CBDC, to pick up the lowest hanging fruit, central banks can start by improving the current payment infrastructures. For example, they can join forces with their foreign counterparts within the international financial fora or encourage payment and banking associations to enhance the efficiency of their existing infrastructure for international or cross-border fund transfers.¹⁹⁹ Current improvements to the payment systems catalyzed by the ECB as well as payment associations can be considered as methods to achieve such objectives. A case in point is the SEPA Instant Credit Transfer (SCT-Inst) – launched in November 2017 - enabling instant payments in euro across Europe around the clock, 365 days a year.²⁰⁰ TARGET Instant Payment Settlement (TIPS), offering a real-time settlement in CeBM, which went live on November 30, 2018, is another step forward in this direction. By making such infrastructure available to banking and other payment institutions, the ECB, in cooperation with its international peers and in its catalyst role, can encourage the banking system to lower fees for international payments and enhance their efficiency.

Furthermore, widening the choice of available online or digital payment instruments accommodating wider features in terms of efficiency, anonymity, and security would provide another alternative for cryptocurrencies and eventually may lead to mitigation of their potential impact. The existing

¹⁹⁹ For the public-private nature of payments law, see: Agnieszka Janczuk-Gorywoda, "Evolution of Eu Retail Payments Law," *European Law Review* 40, no. 6 (2015). Emphasizing the fact that the private initiative has often been insufficient in pushing for improvements of efficiency in the payment system and public or government intervention (in the case in question, SEPA regulation) is often needed.

²⁰⁰ This development can only be indirectly associated with the ECB. The Euro Retail Payments Board (ERPB) which is chaired by the ECB, requested an action plan from the European Payments Council (EPC) who eventually launched the SCT-Inst.

payment instruments, such as cash, debit and credit cards, electronic fund transfers or wire transfers (including credit transfers and direct debits), online payment platforms, and e-money offer a wide range of payment solutions. However, privacy and - to a lesser degree - security in online payments are still in short supply, despite the fact that the existence of prepaid payment cards (such as gift cards) would provide certain levels of privacy.

Since the demand for privacy in payments will not disappear by a potential cash elimination, offering means of digital payments that would provide certain levels of privacy is to continue. Otherwise, the privacy-conscious users of cash or even the mafia and gangsters would migrate to more privacy-enhancing cryptocurrencies or to developing their own IOUs, eventually giving rise to unforeseen and unintended consequences.²⁰¹ Further improvements would be achieved by reducing the amount of cross-subsidization that exists in the use of different payment instruments, the most important of which has been in existence in the indirect and hidden relationship between card users and cash users, where the latter cross-subsidize the former.²⁰² The adoption of the Multilateral Interchange Fee (MIF) Regulation partly alleviates this problem but falls short of eliminating it.

Nonetheless, it is important to bear in mind that the use of cryptocurrencies is not entirely driven by efficiency considerations. Censorship of payments has been a major driver of cryptocurrencies. Although censorship resistance would be frowned upon under democratic and accountable governments, such a property would still be useful for citizens living under less democratic and less accountable governments. Under those regimes, censorship resistance property of cryptocurrencies can empower citizens by providing a global uncensorable digital store of value and medium of exchange, which is independent of the whims of the unaccountable political actors.

The overuse and abuse of international payment infrastructures for political purposes and sanction regimes can also encourage the use of censorship-resistant decentralized cryptocurrencies. The recent calls for establishing international payment rails independent of the US have shown the frustration with the hegemony of a single dominant player having formal (i.e., through extraterritorial application of its laws) and informal dominance over international payment infrastructures.²⁰³ Detaching

²⁰¹ JP Koning, "The Odd Relationship between Gangster and Central Banker," *Moneynews* (March 2, 2018).; See also: JP Koning, "Anonymous Digital Cash," *American Institute for Economic Research* 2018, no. April 26 (2018).; Although it would be hard to expect a central bank to issue a complete privacy preserving digital asset, certain levels of privacy, especially towards third parties, can be built into the CBDC.

²⁰² As merchant costs might be higher for card payments, especially those offering a reward, to compensate those costs, merchants increase the general level of prices for all the customers, which eventually leads to cross-subsidization of credit card users by cash, check, or debit cards users.

²⁰³ See: Guy Chazan, "Germany Calls for Global Payments System Free of Us," *Financial Times*, August 21, 2018 August 21, 2018.; Yves Mersch, "Strengthening the European Financial Industry Amid Disruptive Global Challenges," *Speech by Yves Mersch, Member of the Executive Board of the ECB, at the European Institute of Financial Regulation (EIFR), Paris, 3 September 2018* (September 3, 2018).; JP Koning, "Monetary Exclusion," *American Institute for Economic Research* (July 26, 2018).

For the first practical steps taken at the EU level, see: European Union External Action - European External Action Service, "Implementation of the Joint Comprehensive Plan of Action: Joint Ministerial Statement," news release, September 24, 2018, September 24, 2018, <https://eeas.europa.eu/headquarters/headquarters-homepage/51036/implementation-joint->

wavering winds of politics from critical (payment) infrastructures and decreasing the use of payment systems for sanctions would mitigate the use of cryptocurrencies both within state actors and individuals. Even within the existing sanctions regimes, provisions can be made to make cross-border payments available for international micro-payments (i.e., de minimus exception). Such an exception can mitigate the impact of sanctions on ordinary citizens of sanctioned countries and could discourage them from switching to alternative payment methods with higher risk profiles.

7.1. Issuing CBDC

In addition to the above mentioned incremental changes that the ECB can effect or catalyze, the main innovative and radical non-regulatory action that it can take as a strategy to provide alternatives the growth of privately issued cryptocurrencies is the issuance of CBDC or DBM.²⁰⁴ This could offer a stable virtual currency to users and could function as a unit of account in cryptocurrency markets the lack of which currently poses one of the most challenging issues that cryptocurrency markets face. The mounting interest in creating stablecoins in the cryptocurrency industry in 2018 showed the importance of price stability for an effective digital medium of exchange. However, most of these attempts were limited to using collateralization techniques to create safety and stability giving birth to stablecoins that are either collateralized by fiat money or by cryptocurrencies. Prior financial crises, and in particular runs on repos during such crises, have demonstrated that such techniques can hardly bring long-term safety and stability. In the case of cryptocurrencies based on algorithmic central banking, it is hard to imagine their success in the absence of a long-established reputation of price stability. This might prove to be a window of opportunity for central banks to leverage their existing credibility to create stable CBDC. However, as it will be explained, issuing CBDC would potentially face practical, financial stability as well as legal challenges.

Although the power to issue banknotes and coins is the sole prerogative of governments, it may not necessarily include the power to issue CBDC, because issuing CBDC does not seem to be merely an inconsequential technological upgrade to the old-age technology of issuing money. As the CBDC would be programmable money, its nature would be different from that of the physical banknotes and coins. This property of CBDC means that it can accommodate features that can potentially amount to granting additional powers to central banks, such as having higher surveillance power over transactions and imposing negative interest rates, that would otherwise be absent or limited. Therefore, from a public law perspective, issuing CBDC by the ECB would face legal hurdles.

comprehensive-plan-action-joint-ministerial-statement_en., For more details, see also: Esfandiyar Batmanghelidj and Axel Hellman, "Europe, Iran, and Economic Sovereignty: A New Banking Architecture in Response to US Sanctions," (2018).

²⁰⁴ For a definition of CBDC and its unique features as compared to banknotes and CeBM, see: Phoebus L. Athanassiou, *Digital Innovation in Financial Services: Legal Challenges and Regulatory Policy Issues*, 185. CBDC would be different from e-money. One of the first central banks contemplating to issue CBDC is the Sveriges Riksbank. See: Sveriges Riksbank, "The Riksbank's E-Krona Project, Report 1."; Sveriges Riksbank, "The Riksbank's E-Krona Project Report 2."

Moreover, from technical and economic perspectives, issuing CBDC has proved to be controversial as it carries many risks alongside its potential benefits.²⁰⁵ Despite the perceived benefits of issuing CBDC in term of price stability, the smooth operation of payment systems and the conduct of monetary policy - e.g. removing the zero lower bound (ZLB) constraint on monetary policy operations - the decision to issue CBDC should be made taking a full account of a set of broader policy objectives, including technical (safety and efficiency considerations), economic and legal considerations such as technological neutrality and the users' freedom of choice of means of payments.²⁰⁶ Therefore, in addition to the objectives of price stability, the impact of issuing CBDC on the implementation of monetary policy and the smooth operation of the payment system, its impact on banking and financial stability (e.g., encouraging bank runs) and on the efficient and decentralized allocation of credit should be carefully studied.²⁰⁷

Here, we only study the CBDC from a legal perspective and analyze if the ECB has the power to issue such cryptocurrencies. For example, art. 127 TFEU states that “[t]he ESCB shall act in accordance with the principle of an open market economy with free competition, favouring an efficient allocation of resources, and in compliance with the principles set out in Article 119”.²⁰⁸ Issuing CBDC would be in contradiction with this provision if it were to lead to a centralized allocation of credit by central banks. Therefore, before engaging in issuing such digital currencies, it is prudent to examine if the TFEU or the ESCB/ECB Statute and other monetary laws of the EU grant such powers to the ECB and how issuing such currencies might come into conflict with the basic tenets and principles enshrined in the EU primary and secondary laws.²⁰⁹ In what follows, we briefly touch upon the various hypothetical design features of CBDC and then will have an overview of its impact on banking and financial stability, on the efficient allocation of credit as well as its implications for the future of central banking in terms of its accountability and independence.

7.2. Design features of CBDC

CBDC may take various forms and based on its specific design features, it could give rise to different legal challenges. For example, a CBDC could be account based or value based,²¹⁰ or it can be issued only for wholesale purposes or for retail purposes. Account-based CBDC would be booked in the

²⁰⁵ For an overview of the pros and cons, various design features, as well as macroeconomic impact of issuing CBDC, see: John Barrdear and Michael Kumhof, "The Macroeconomics of Central Bank Issued Digital Currencies," 9-16.; Phoebus L. Athanassiou, *Digital Innovation in Financial Services: Legal Challenges and Regulatory Policy Issues*, Chapter 7. pp. 181-213. See also: Michael D Bordo and Andrew T Levin, "Central Bank Digital Currency and the Future of Monetary Policy.;" Max Raskin and David Yermack, "Digital Currencies, Decentralized Ledgers, and the Future of Central Banking."

²⁰⁶ Yves Mersch, "Digital Base Money: An Assessment from the Ecb's Perspective."

²⁰⁷ It seems that at the moment most central banks are not convinced that the benefits of issuing CBDC would outweigh the costs. See: Christian Barontini and Henry Holden, "Proceeding with Caution - a Survey of Central Bank Digital Currency," *BIS Papers No 101* (January 2019).

²⁰⁸ Art. 127 TFEU & Art. 2 ESCB/ECB Statute

²⁰⁹ Eventually, this analysis will be a consequentialist one and will be heavily dependent on the cost-benefit analysis of issuing CBDC. In turn, the cost-benefit analysis of CBDC depends on its design features of CBDC.

²¹⁰ Yves Mersch, "Digital Base Money: An Assessment from the Ecb's Perspective."

accounts of the third parties holding accounts with the issuing central bank and the process of its transfer (including, in particular, the legal finality) would be conducted on the books of the issuing central bank.²¹¹ Account-based CBDC would be similar to reserve balances, with the only difference that besides commercial banks, account-holders would be also natural and legal persons. In contrast, value-based CBDC would be in the form of digitally stored tokens or units stored in the e-wallets of holders, but its transfer would be conducted and finalized in a decentralized or P2P fashion. Similar to cash, this form of CBDC would possibly provide users with anonymity with regard to the central bank.²¹² Additional variations in design would include whether the CBDC is intended to substitute or complement bank deposits and cash, whether the holders of CBDC would be natural or legal persons or both, whether such currencies should provide a level of anonymity, at-par convertibility, and interest accrual.²¹³

The use of blockchain or DLT would not be necessary for CBDC, as is the case with E-Krona project of the Riksbank.²¹⁴ In any event, it seems that the main difference between CBDC and other cryptocurrencies are that, in the former, as the name suggests, there remains a level of centralization; in account-based CBDC, both legs of creation and settlement are centralized, while in value-based CBDC, only the creation and destruction of money is centralized, and the transaction settlement would be decentralized. In this sense, CBDC is not in line with the initial vision of the invention of the cryptocurrencies. As neither the use of the blockchain technology nor its decentralization promise is likely to be implemented in the CBDC, it would bear no resemblance to cryptocurrencies such as bitcoin and its discussion under the rubric of cryptocurrencies would remain doubtful.

Additionally, as there is already DBM in the form of commercial banks' deposits with central banks for the purposes of wholesale settlements, the need for issuing CBDC for wholesale purposes remain questionable. It might be said that the main advantage of CBDC over other cryptocurrencies lies in its stability. However, in the absence of interoperability arrangements, such stability comes at the price of its geographic limit and its attachment to a single central bank. Unlike bitcoin, in the absence of a fiat-based global currency, such as the proposed Bancor envisioned by Keynes, CBDCs would only enjoy stability in relative terms as their value will continue to float against one another in the Forex markets.

²¹¹ Phoebus L. Athanassiou, *Digital Innovation in Financial Services: Legal Challenges and Regulatory Policy Issues*, 187.

²¹² *Ibid.*; See also: Yves Mersch, "Digital Base Money: An Assessment from the Ecb's Perspective."

²¹³ Phoebus L. Athanassiou, *Digital Innovation in Financial Services: Legal Challenges and Regulatory Policy Issues*, 195. Thus far, it seems that two competing models in the form of proposals on the design features of CBDC have emerged. They include CAD-coin model and Fedcoin model. CAD-coin is issued on a permissioned blockchain and is intended to be used for wholesale payment services. This coin would be fully backed by cash collateral and will function as a settlement coin to be used by designated entities on a distributed permissioned platform which is linked to a central bank Real Time Gross Settlement (RTGS) system. On the contrary, Fedcoin is a retail payment medium, issued on a permissionless ledger, while the central bank retains the sole authority to create and destroy coins. For more details, see: *ibid.*

²¹⁴ See: Sveriges Riksbank, "The Riksbank's E-Krona Project Report 2."

The multiplicity of design features of the CBDC and the limitations of space in this article would not allow further speculation on its effect on price stability, monetary policy, payment systems, and banking and financial stability. In the following section, we only provide some preliminary observations on the impact of CBDC on banking and financial stability, efficient allocation of financial resources, and on the monetary policy based on certain assumptions on the design features of the CBDC.

7.3. Impact on banking and financial stability

One important implication of issuing CBDC would be that the introduction of CBDC would move substantial parts of the balances in the transaction accounts of the commercial banks' customers onto the central banks' balance sheets. This is because with the introduction of CBDC if a commercial bank cannot compensate its customers for the extra counterparty risk inherent in CoBM, there would be no reason to hold balances with a commercial bank. Deprived of the customer deposits, commercial banks are likely to become highly dependent on the wholesale funding markets with higher interest rates²¹⁵ and less stable funding (short-term maturities), intensifying the maturity mismatch and liquidity problems in the banking sector. In addition, issuing CBDC may also result in the banking sector instability, especially in times of crises, where the depositors switch deposits from their commercial bank accounts to their CBDC account with central banks, facilitating a run from bank deposits to the safety of the CBDC.²¹⁶ This might not be a socially optimal outcome as it would amount to commercial banking disintermediation in normal times²¹⁷ and 'destabilizing flight to quality' in distressed times.²¹⁸

However, such an impact is ultimately dependent on the design features of CBDC. If the design of the CBDC would entail disintermediated public access to the central bank balance sheet,²¹⁹ in the absence of any other remedies, introducing CBDC would result in destabilizing consequences for the banking sector. Since the introduction of CBDC is likely to transform the banking business model, banks need

²¹⁵ John Barrdear and Michael Kumhof, "The Macroeconomics of Central Bank Issued Digital Currencies," 9.

²¹⁶ See: Committee on Payments and Market Infrastructures, "Central Bank Digital Currencies," (Basel, Switzerland: Bank for International Settlements, 2018), 16. It is also argued that this cannot be an obstacle for introducing CBDC. Stating that "runs on individual financial institutions, or system-wide runs from bank deposits into cash, are as feasible in a world without CBDC as in a world with CBDC, and given the advantages of CBDC in case it comes to a bank resolution, may be less likely with CBDC." See: Michael Kumhof and Clare Noone, "Central Bank Digital Currencies — Design Principles and Balance Sheet Implications," 35. See also: John Barrdear and Michael Kumhof, "The Macroeconomics of Central Bank Issued Digital Currencies," 14-15.

²¹⁷ Warren Coats, "Free Banking in the Digital Age," *Banking & Finance Law Review* (2018): 413.

²¹⁸ Ben Broadbent, "Central Banks and Digital Currencies," *Speech at the London School of Economics* (2 March 2016). See also: Yves Mersch, "Virtual or Virtueless? The Evolution of Money in the Digital Age," in *Lecture at the Official Monetary and Financial Institutions Forum, London* (8 February 2018).

²¹⁹ Barrdear and Kumhof define CBDC as "a central bank granting universal, electronic, 24x7, national-currency-denominated and interest-bearing access to its balance sheet." In this view, issuing CBDC would automatically mean direct public access to central bank balance sheet. See: John Barrdear and Michael Kumhof, "The Macroeconomics of Central Bank Issued Digital Currencies," 7. For more details on public access to the central bank balance sheet and its consequences, see: Morgan Ricks, John Crawford, and Lev Menand, "A Public Option for Bank Accounts (or Central Banking for All)," *Vanderbilt Law Research Paper 18-33* (2018).; Lev Menand, John Crawford, and Morgan Ricks, "Central Banking for All: Reply to Objections," *Oxford Business Law Blog* (27 August 2018).; Morgan Ricks, "Money as Infrastructure."

to evolve in response to such developments; otherwise, it would likely put the banking stability at risk.²²⁰ Such a consequence would be inimical to the ESCB's statutory mandate of contributing to "the smooth conduct of policies pursued by the competent authorities relating to the prudential supervision of credit institutions and the stability of the financial system."²²¹

7.4. Impact on the efficient allocation of resources

Despite the fact that credit institutions, public entities, and other market participants can have access to the ECB and NCBs' balance sheets,²²² currently, aside from holding cash, the general public has only an indirect or intermediated access to the ECB's balance sheets. The introduction of CBDC would imply a disintermediated public access to the central bank balance sheet, which means that the public could open an account at the central bank directly. Such direct access to central bank balance sheet is not unprecedented, as the Bank of England and the Sveriges Riksbank used to allow private accounts; this practice discontinued for practical reasons.²²³

As this disintermediated access might cause CoBM (bank deposits) to shrink, banks' ability to make loans – at least under the fractional reserve theory of banking – would be substantially restricted. As granting credit by banks amounts to the decentralized creation of money or credit in the financial system, removing such a function from the banking industry and granting direct access to central bank balance sheet may eventually lead to centralization of credit allocation under the control of central banks. This, in turn, would be detrimental to the efficient allocation of credit in the economy and would undermine "the principle of an open market economy with free competition" enshrined in the article 127 of the TFEU and article 2 of the ESCB/ECB Statute.²²⁴

7.5. A need for increased accountability of central banks

The recent intellectual assault on cash and the move towards cashless society adds another layer of complexity to the potential impact of issuing CBDC.²²⁵ Although a case against cash is far from being settled,²²⁶ the move towards digitization seems inevitable. Thus far, cash provides the only direct access to central bank balance sheets for the general public. If the introduction of CBDC is simultaneous with abolishing cash and banning other forms of private money (such as cryptocurrencies), it would effectively remove the Zero Lower Bound (ZLB) constraint in the conduct of monetary policy. On the upside, this would empower central banks with strong tools for the

²²⁰ Yves Mersch, "Digital Base Money: An Assessment from the Ecb's Perspective."

²²¹ Art. 127(5) of the TFEU

²²² Art. 17 ESCB/ECB Statute.

²²³ Michael D Bordo and Andrew T Levin, "Central Bank Digital Currency and the Future of Monetary Policy," 2.

²²⁴ See: Yves Mersch, "Virtual or Virtueless? The Evolution of Money in the Digital Age."

²²⁵ Kenneth S Rogoff, *The Curse of Cash* (Princeton: Princeton University Press, 2016).

²²⁶ Yves Mersch, "Why Europe Still Needs Cash," *Contribution by Yves Mersch, Member of the Executive Board of the ECB for Project Syndicate* (28 April 2017).; Henk Esselink and Lola Hernández, "The Use of Cash by Households in the Euro Area," *ECB Occasional Paper Series No 201* (November 2017).

implementation of monetary policy. However, on the downside, it would entail a de facto power of slashing bank deposits or cryptocurrency deposits with central banks. Although negative interest rates have proven to work even in the presence of cash, the existence of cash and other alternatives would create an effective lower bound and limit the depth of the negative territory a central bank can march in.

In addition, physical cash provides users with “irrevocable access to the payments system”.²²⁷ As payment systems are part of the FMIs, account-based CBDC would ease revoking legal and natural persons’ access to such FMIs, giving rise to potential financial inclusion concerns. Financial inclusion risks have been partly addressed in the traditional payment services by the Payment Accounts Directive (PAD).²²⁸ However, the PAD in its current form, may not be applicable to payments systems based on CBDC. In the event of introducing CBDC, it seems that this Directive needs to be amended to include access to CBDC. Otherwise, introducing CBDC would grant further censorship powers to the state vis-à-vis individuals, especially if the introduction of an account-based CBDC would coincide with the abolition of physical cash.²²⁹ Therefore, it seems that the risks associated with the introduction of CBDC as well as the new powers that it furnishes for central banks may require higher levels of central bank public accountability, appropriate safeguards, and standards of judicial scrutiny.

Physical cash is the main mechanism that facilitates the use of currencies, such as the USD and the euro, to be used as the backup to the global monetary system.²³⁰ As these currencies are used as a store of value and a fail-safe option outside their own country of issue or currency area, issuing CBDC to replace physical cash would jeopardize these currencies’ role in the global payments and monetary systems, a policy concern that should not be overlooked in the decision over issuing CBDC.

To summarize, depending on the design features of the CBDC, the ECB could face legal risks in issuing such a currency in addition to the technical issues, and potential transitional risks. Unless appropriate safeguards are in place to protect citizens from the potential abuse triggered by the absence of the ZBL constraint, to minimize the potentially destabilizing impact of CBDC on banking and financial stability, to allow the efficient allocation of credit in a decentralized manner, and to address the potential concerns about financial inclusion and privacy, a shadow of doubt could be cast on the attempts to introduce CBDC by the ECB.

²²⁷ JP Koning, "The Big Problems with Big Denomination Bills," *Cato Unbound* (August 7, 2018).

²²⁸ Directive 2014/92/EU of the European Parliament and of the Council of 23 July 2014 on the comparability of fees related to payment accounts, payment account switching and access to payment accounts with basic features Text with EEA relevance *OJ L 257, 28.8.2014, p. 214–246* (Payment accounts directive aka PAD)

²²⁹ It seems that the proliferation of various cryptocurrencies having privacy features would mitigate concerns about privacy. Therefore, if issuing CBDC were not to lead to the abolition of other cryptocurrencies or cash, it would only be complementary to other payment methods. See: Michael D Bordo and Andrew T Levin, "Central Bank Digital Currency and the Future of Monetary Policy," 1-2.

²³⁰ JP Koning, "The Big Problems with Big Denomination Bills."

8. International coordination through international financial fora

The regulation of cryptocurrencies faces both boundary and border problems.²³¹ Firstly, cryptocurrencies are global in nature and it would be difficult for any single jurisdiction to address their potential risks without international cooperation. This means that another venue through which the ECB can engage in the regulation of cryptocurrencies is through its engagement in the international financial fora. Secondly, the ECB's tasks both in the area of regulation, supervision and oversight, and monetary policy require certain degrees of international cooperation. Accordingly, the ECB has various types of memberships in the IMF, the Group of Twenty (G20), the BIS, the Organization for Economic Co-operation and Development (OECD), and the Financial Stability Board (FSB).²³²

From the above-mentioned international financial fora, the FSB stands out. As promoting international financial stability is the FSB's primary objective,²³³ it could function as a platform for monitoring and coordinating the developments in the area of cryptocurrencies.²³⁴ Regarding systemic risk concerns, and given the borderless nature of cryptocurrencies, the FSB, as an international agenda setter,²³⁵ is well placed to monitor the potential future systemic risks of cryptocurrencies.²³⁶ Central banks are expressly eligible for membership of the FSB.²³⁷ Therefore, the ECB and other central banks can play a significant role, though indirectly, in monitoring global developments in the ecosystem and coordinating the international financial regulatory developments.

The international coordination in the area of cryptoassets as related to the regulation and supervision of the banking system to enhance financial stability would largely remain with the Basel Committee on Banking Supervision (BCBS). In this respect, BCBS has ongoing initiatives on quantifying the materiality of direct and indirect exposures of the banking system to cryptoassets, prudential treatment

²³¹ Boundary problem, which is a manifestation of regulatory arbitrage, denotes a situation in which there is substitution flow of financial activities towards less regulated activities when the costs of 'effective regulations' make the regulated activities costlier and hence less profitable. See: Charles Goodhart, "The Boundary Problem in Financial Regulation." For the concept of boundary and border problems, see: Charles A. E. Goodhart and Rosa M. Lastra, "Border Problems."; Markus Brunnermeier et al., *The Fundamental Principles of Financial Regulation: Geneva Report on the World Economy* (London: ICMB International Center for Monetary and Banking Studies, 2009).; Rosa Maria Lastra and Jason Grant Allen, "Virtual Currencies in the Eurosystem: Challenges Ahead," (Brussels, Belgium: ECON Committee, European Parliament, 2018).

²³² European Central Bank, International relations and Analysis, available at: <https://www.ecb.europa.eu/ecb/tasks/international/institutions/html/index.en.html>

²³³ Article 2, the Articles of Association of the FSB

²³⁴ This is because the FSB is charged with the task of coordinating the work of national financial authorities and international standard setting bodies (SSBs) at the international level to promote the implementation of regulatory, supervisory and financial sector policies.

²³⁵ Chris Brummer, *Soft Law and the Global Financial System: Rule Making in the 21st Century*, Second ed. (New York: Cambridge University Press, 2015).; John Armour et al., *Principles of Financial Regulation* (New York: Oxford University Press, 2016), 619-22.

²³⁶ More specifically, the FSB is mandated to address the "vulnerabilities affecting financial systems in the interest of global financial stability" in collaboration with the international financial institutions. See: Art. 1, FSB Charter.

²³⁷ Article 3 (c), FSB Charter.

of such exposures and monitoring the development in this area and assessing their implications for banks.²³⁸

Despite its shortcomings, the soft-law nature of international financial regulation²³⁹ can serve the international financial fora in addressing the potential concerns about cryptocurrencies, as it can react to incredibly fast-moving and constantly evolving cryptocurrency ecosystem. Such swift regulatory responses would not be possible under the hard-law framework of a specific jurisdiction or international organizations. Relying on the advantages of soft law over the tardier nature of hard law, it is expected that such international cooperation and coordination to grow hand in hand with the developments of the cryptoasset and cryptocurrency markets.

Conclusion

This paper studied the potential risks of cryptocurrencies to the instruments, activities, and entities that fall within the basic and ancillary tasks of the ECB over which it has regulatory, supervisory or oversight powers. It found that cryptocurrencies can potentially have direct and indirect effects on central banking. Direct effects mainly concern the risks to the price stability and to the conduct of monetary policy. In addition, risks to the central bank monopoly over issuing banknotes and coins are considered as a direct effect because such a monopoly would be instrumental to the conduct of monetary policy and the objective of price stability. In contrast, the indirect effects are those that largely stem from the interface between the banking and payment systems with cryptocurrencies, both of which fall within the scope of competence of the ECB. Accordingly, this paper suggests that the ECB's regulatory measures to address such challenges can take two main forms: i.e., direct and indirect regulatory, supervisory and oversight measures. Direct measures may include direct *technical* measures and direct *regulatory* measures. Given the ECB's defined mandate and the legal constraints on the tools at its disposal, the ECB would face legal and technical constraints in effectively intervening in cryptocurrency markets directly. Rather, the main venue through which the ECB can take action is through indirect channels using its regulatory, supervisory and oversight powers over banking and payment systems, which may include setting participation and access criteria for payment and banking institutions with substantial cryptocurrency activities for access to ECB's payment and settlement infrastructures, or within the framework of its comprehensive assessment (asset quality review (AQR) and stress testing), establishing a new framework for assessing credit institutions' exposure to cryptocurrencies.

²³⁸ Financial Stability Board, "Crypto-Assets: Report to the G20 on the Work of the Fsb and Standard-Setting Bodies," 6-7.

²³⁹ Chris Brummer, "Why Soft Law Dominates International Finance—and Not Trade," *Journal of International Economic Law* 13, no. 3 (2010).; Chris Brummer, *Soft Law and the Global Financial System: Rule Making in the 21st Century.*; Rosa María Lastra, "International Financial Architecture."

At the time of this writing, since cryptocurrencies do not pose a significant risk to the scope of the mandate of the ECB, adjustments or amendments to the relevant primary and secondary legislation governing the ECB and its operations would not be needed, as the indirect tools at the disposal of the ECB are likely to address the potential risks stemming from cryptocurrencies. However, as future developments would render such changes necessary,²⁴⁰ the paper highlighted some of those potential areas of legal change that the potential wider use and adoption of private cryptocurrencies and potential issuance of CBDC may require.

Given that Bitcoin and other cryptocurrencies are programmable and capable of accommodating various innovative features (e.g., colored coins/smart contracts), an intrusive and direct approach to its regulation would stifle the potential future innovations that would be built upon the Bitcoin protocol layer, some of which may go beyond the field of central banking, money and finance and would be hard to fathom at the moment. Viewing Bitcoin as an evolving open-source, work-in-progress protocol warrants a nuanced indirect and light-touch regulatory approach, which is data dependent, and defers to the virtues of experimentation, spontaneous discovery process²⁴¹ and evolutionary dynamics in the financial system.²⁴²

²⁴⁰ For example, the introduction of CBDC, depending on its various design features, would eventually require amendments to the TFEU and other legal tender laws of the EU.

²⁴¹ Israel M. Kirzner, "The Perils of Regulation: A Market-Process Approach , 119–49.," in *Discovery and the Capitalist Process*, ed. Israel M. Kirzner (Chicago: University of Chicago Press, 1985).

²⁴² Simon A. Levin and Andrew W. Lo, "Opinion: A New Approach to Financial Regulation," *Proceedings of the National Academy of Sciences* 112, no. 41 (2015).; Andrew W. Lo, *Adaptive Markets: Financial Evolution at the Speed of Thought* (Princeton: Princeton University Press, 2017).

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