Building Out the Crypto-economy in Europe: An Proposal for Central Bank Digital Euros
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Abstract
The dApp economy is an innovative and exciting business space that is creating economic value. The recognition of its needs such as fund-raising is only emerging in the EU Digital Finance Package supporting the new action plan for the Capital Markets Union. This article proposes that policy-makers can play a further facilitative role in mobilising this economic space by considering the integration of the central bank digital euro with the dApp economy. This initiative addresses the weaknesses of the monetary order in the dApp economy and provides a departure point for the building out of the dApp economy by more enabling regulatory institutions and architecture, consistent with a vision of regulatory capitalism supporting financial and enterprise development.

Introduction

This article proposes a marriage or integration of two seemingly parallel economic and monetary spheres. These relate to: on the one hand, the crypto-economy (which has sometimes been described as a universe that lies beyond the rule of law[1] or a space for a novel type of capitalism unshackled from current institutions);[2] and the role of central banks, in particular the European System of Central Banks (ESCB). It argues that the crypto-economy can benefit from engaging with a programmable central bank digital euro, and the ESCB would also benefit from being able to test a limited rollout of the central bank digital euro in the crypto-economy.

The article first explains in Section A why the 'crypto-economy',[3] an unregulated but thriving space, would benefit from interface with a public sector institution such as the central bank digital currency (CBDC). The crypto-economy is increasingly populated with 'decentralised applications' (dApp) business developers innovating to promote peer-to-peer commerce supported by blockchain infrastructure.[4] Although structured to be a self-sustaining

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[1] Thibault Schrepel, 'Anarchy, State, and Blockchain Utopia: Rule of Law versus Lex Cryptographia' in *General Principles and Digitalisation* (Oxford: Hart Publishing, 2020), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3485436.
[2] John Flood and Lachlan Robb, 'Trust, Anarcho-Capitalism, Blockchain and Initial Coin Offerings' (2017), http://ssrn.com/abstract=3074263.
[3] Andrew Romans, *Masters of Blockchain and Initial Coin Offerings* (CreateSpace Independent Publishing 2018).
[4] This is a type of distributed ledger built by appending blocks of data to form one complete ledger shared amongst all nodes, see explanation in Michèle Finck, *Blockchain Regulation and Governance in Europe* (Cambridge: Cambridge University Press 2018), ch 1.II.

economic system uncorrelated with conventional economic institutions, the dApp economy suffers from weaknesses and market failures. The economic potential of the dApp economy can be mobilised with institutional support. A particular starting point for the role of public sector-led mobilisation of the dApp economy lies in the provision of a digital fiat currency issued by a central bank for investment in the dApp economy. This paves the way for an enabling[5] framework for regulation and institution-building. The EU Commission has recently introduced harmonising regulation for cryptoasset offers[6] issued by dApp business developers, pursuant to the Digital Finance Package[7] that mobilises digital access to meet the fund-raising needs of innovative enterprises, situated within the new action plan for the Capital Markets Union.[8] Our proposal supplies a crucial enabling linchpin for digital mobilisation at a social scale to meet dApp developers' fund-raising needs, and more broadly to build out the development aspects of the crypto-economy.

The article argues that CBDC could be targeted at the dApp economy as 'limited rollout'. The CBDC has been discussed predominantly in relation to mainstream economic and financial activities, but challenges are recognised in terms of its operationalisation. We propose that the ESCB could test a limited CBDC rollout targeted at the dApp economy, since the invention of private cryptocurrencies was the genesis for discussions of CBDC.[9]

The article then focuses on how such a limited rollout can be implemented in the euro-area. We discuss the legal basis for issuing a central bank digital euro, and the institutional structure for implementing such issuance. It provides a brief overview of the regulatory blueprint for the dApp economy that can follow from the integration of the central bank digital euro into the dApp economy. The integration of institutions of law and regulation provide legitimation and mobilising effects for the dApp economy, facilitating its scalability and recognition of the social utility it offers. A short conclusion is provided.

The DApp Economy

In the dApp economy, economic agents can act as prosumers,[10] selling virtual goods and services, as well as consuming these according to their needs. Economic relationships are no longer defined as business (or commercial, corporatized entities) vis a vis consumers, and take place over blockchain-based platforms, implemented by algorithmic processes that support precisely automated transactions (coded in digital 'tokens'). The blockchain facilitates transaction record-keeping in a decentralised manner.[11] Unlike in the sharing economy where online platforms are owned by corporations that extract rent and capitalise

[5] Regulation enabling economic activities to be carried out, organised and legitimised, Barak Orbach, 'What is Regulation?' 30 Yale Journal on Regulation Online 1 (2012).
[6] EU Commission, Proposal for a Regulation for Markets in Crypto-assets (Sep 2020), https://ec.europa.eu/finance/docs/law/200924-crypto-assets-proposal_en.pdf.
[7] https://ec.europa.eu/info/publications/200924-digital-finance-proposals_en.
[8] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Capital Markets Union for people and businesses-new action plan, COM/2020/590 final.
[9] Dirk Bullman, Jonas Klemm and Andrea Pinna, 'In Search for Stability in Crypto-assets: Are Stablecoins the Solution?' (ECB Occasional Paper 2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3444847.
[10] i.e. economic agents acting on both the supply and demand sides of the market.
[11] See n4.

on the network effects and data flowing through their platforms,[12] blockchain-based platforms are usually developed in an open source manner.[13] Berg et al recognise that the economic structuration offered by blockchains and the mode of exchange offered by tokenisation bring about a new form of institutional technology for economic activity.[14]

Introduction to the DApp Economy

The Ethereum blockchain, which went live in 2015[15] is the infrastructure that hosts 90% of the dApp economy.[16] The Ethereum blockchain provides a relatively developed permissionless ledger[17] and protocol tokens[18] that code in basic laws of functionalities. These tokens are used to build more specific 'smart contract'[19] code by dApp developers. The first protocol token, the ERC-20 token, which has since been improved by the Ethereum Foundation, is open source code that can be utilised by any dApp developer to build specific transactional code that stores, accesses and exchanges information, embeds entitlements, executes exchanges, and functions as the currency of the transaction, ie the unit of account of the transaction, known as ether.[20] DApp developers would build out and sell *application* tokens[21] to participants who wish to join the dApp network and benefit from its peer-to-peer marketplace. In such networks/marketplaces, participants are free to transact with each other, powered by dApp tokens.

Transactional validity and record-keeping are based on the consensus protocol for maintenance on the Ethereum blockchain, which is decentralised. The consensus protocol is currently programmed to incentivise competition[22] amongst participants to verify

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[12] Iris H-Y Chiu and Roger M Barker (eds), *The Law of Organisations and Governance: Responding to Disruptive Business Models and Digital Transformation* (Oxford: Routledge, 2020), ch7.

[13] Primavera De Filippi, 'Translating Commons-Based Peer Production Values into Metrics: Toward Commons-Based Cryptocurrencies' in David Lee (ed), *The Handbook of Digital Currencies* (Elseiver 2015), ch23.

[14] Chris Berg, Sinclair Davidson and Jason Potts, Understanding the Blockchain Economy (Cheltenham: Edward Elgar 2019) at 'The Universal Turing Institution', ch3; The Microfoundations of Ledgers', ch4 and 'Money, Dequity, and the Barter Economy of the Future', ch5.

[15] https://Ethereum.org/what-is-Ethereum/.

[16] Matthias Fromberger and Lars Haffke, 'ICO Market Report 2018/2019' (2020), https://ssrn.com/abstract=3512125.

[17] This means the network is open to participation by anyone. For a brief overview of permissionless and permissioned blockchains (whose participants are admitted according to eligibility rules and consent), Chiu and Barker (2020), ch9.

[18] These provide for the basic needs and functionalities for the blockchain infrastructure, and are differentiated from application tokens more specific to particular transactions, Jonathan Rohr and Aaron Wright, 'Blockchain-based Token Sales, Initial Coin Offerings, and the Democratization of Public Capital Markets' (2019) 70 Hastings LJ 463.

[19] These refer to automated protocols for action execution. 'Smart contracts' are not the same as binding contracts in the legal sense, Eliza Mik, 'Smart Contracts: Terminology, Technical Limitations and Real World Complexity' (2017) 9 Law, Innovation and Technology 269.

[20] Dragan Zelic and Nenad Baros, 'Cryptocurrency: General Challenges of Legal Regulation and the Swiss Model of Regulation' in Conference Proceedings of 33rd International Scientific Conference on Economic and Social Development – "Managerial Issues in Modern Business" (Heidelberg: Springer 2018), 168. Sandra Díaz-Santiago, Lil María Rodríguez-Henríquez, Debrup Chakraborty, 'A Cryptographic Study of Tokenization Systems' (2016) 15 International Journal of Information Security 413 argues that multifunctional tokens are efficient.

[21] These are usually sold as pre-development tokens, and the controversies are discussed in Section B.

[22] 'proof-of-work' which incentivises the fastest miners to perform algorithmic reconciliation to verify transactions in order to prevent double-spending. This involves use of expensive computer hardware with high processing power which also consumes significant energy resources, Jean Bacon and Johan David Michels and

transactions and approve of changes to the ledger, but is being refined to include distribution of opportunities to all participants in a more egalitarian manner.[23] Although the Ethereum blockchain continues to experiment with governance designs and protocols in a decentralised but programmable environment, Bullman et al estimate the global value of the dApp economy to be at USD$14bn.[24] Further, transaction confirmations on the Ethereum blockchain average between 15 seconds and 5 minutes,[25] and each block of the ledger is mined at an average of under 20 seconds.[26] Programmability has facilitated the efficient outworking of self-governance on the Ethereum blockchain although this economic space is still a work-in-progress.

The Ethereum blockchain hosts a variety of dApps, from 'DeFi' which facilitate peer-to-peer transactions in finance,[27] to commercial dApps providing innovative virtual goods such as the sale of cryptokitties.[28] Although the sale of virtual art or participation in online gaming are not new phenomena, the blockchain-based infrastructure promotes economic relationships in a peer-to-peer fashion that supports new forms of prosumerism. Economic relationships become more multifaceted as users can assume roles in both the supply and demand sides of the marketplace. For example, the marketplace for cryptokitties can accommodate many individual artists, but users can add further value by breeding their kitties on the peer-to-peer gaming platform and selling them.

This prosumerism is more pronounced in the novel business models discussed below. First, we turn to Iungo's blockchain-based global wireless facility. Iungo[29] is a blockchain platform that connects private users' wifi facilities to form a comprehensive network. Participants on Iungo's platform can rent out their wifi access facilities to ad hoc users on-the-go. Participation in this system is tokenised by the ING token, which allows access to the global wifi network and enables transfer of value. This system is built using the Ethereum smart contract template and is not directly built upon the Ethereum blockchain.[30] Iungo's peer-to-peer global wireless internet access platform potentially overcomes the jurisdictional oligopolies for mobile internet access that has sustained a market for expensive mobile data roaming charges. At scale, such a model can potentially become a peer-to-peer constructed global utility.

Golem[31] is a peer-to-peer service marketplace that brings together participants who have idle computing power and users who wish to borrow others' computing power to engage in

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Christopher Millard and Jatinder Singh, 'Blockchain Demystified: a Technical and Legal Introduction to Distributed and Centralized Ledgers' (2018) 25 Rich JL & Tech 1.

[23] 'proof of stake' which operates on a rotational selection basis for miners who have staked tokens to support their credibility for verifying transactions and adding to the ledger, Dimitris Karakostas, Aggelos Kiayias, Christos Nasikas and Dionysis Zindros, 'Cryptocurrency Egalitarianism: A Quantitative Approach' (2019), https://arxiv.org/abs/1907.02434.

[24] Bullman et al (2019).

[25] https://ethgasstation.info/blog/Ethereum-transaction-how-long/.

[26] https://etherscan.io/chart/blocktime data at January 2020.

[27] 'Decentralized Finance: Defying the Global Financial System' (16 Aug 2019), https://www.asiablockchainreview.com/decentralized-finance-defying-the-global-financial-system/.

[28] https://www.cryptokitties.co.

[29] https://iungo.network.

[30] discussion of ING tokens at https://iungo.network/ing-tokens/.

[31] https://golem.network.

computing tasks that require significant capacity. These users include graphics artists, small animation studios, needing significant computing power to render sophisticated graphics, and not having expensive hardware such as certain graphics processors. Golem provides a peer-to-peer worldwide network for the supply and demand sides. Participation in this economy is tokenised, as the GNT token provides access, and matching of tasks with suitable nodes' computing systems. Tasks are also subject to automated 'sharding', ie to divide the task amongst a number of nodes in order to maximise the capacity needed for the task and ensure no single point of failure. In this manner the task is efficiently and effectively achieved and value creation is distributed amongst a number of nodes, creating an egalitarian system.

It may be argued that Golem's business model is not new as there are already 'server farms' that rent out computational capacity to others.[32] These business-to-business arrangements may however lock users into continuing subscriptions and may become uncompetitive. Golem's novelty lies in the scaling up of such arrangements to a global marketplace without necessarily a relational fabric, allowing for *ad hoc* access by standardising and commoditising these arrangements via tokenisation.

Next, peer-to-peer cloud storage services may take off at the scale of a global marketplace. Key players in this field include Storj[33] and Filecoin.[34] Peer-to-peer cloud storage services allow individual users to rent out spare hard disk capacity in order to store other users' files. This meets the need of cloud storage for users who are looking for off-site storage, such as provided by cloud services offered by technological giants Apple, Google or Amazon. Peer-to-peer cloud storage services would not be using gigantic servers, but would be relying on the construction of a vast joint-up network provided by individual contributors. Peer-to-peer cloud storage systems enable protocols that 'shard' files in order to distribute data across nodes and to replicate copies of the data across nodes. In this manner, nodes do not have access to entire pieces of information that may compromise privacy. The downtime of any one node is unlikely to compromise the sending and retrieval of files.[35] Peers on the supply side are paid for their services, which opens up a 'sharing economy' for economic mobilisation of individuals.

The above examples show novel ideas that can potentially scale up to global marketplaces for services that may have been thought to be most efficiently provided by corporatized institutions with powerful servers. The dApp economy provides opportunities for new economic mobilisation[36] as individual users can now commoditise their wifi facilities, idle computing power or storage space. New value chains can be created and captured by new

[32] 'Down on the server farm' (The Economist, 22 May 2008), https://www.economist.com/business/2008/05/22/down-on-the-server-farm.
[33] https://storj.io.
[34] https://filecoin.io.
[35] 'Filecoin v. Sia, Storj & MaidSafe: The Crowded Push for Decentralized Storage' (3 Aug 2017), https://medium.com/tokenreport/filecoin-v-sia-storj-maidsafe-the-crowded-push-for-decentralized-storage-7157eb5060c9.
[36] Daivi Rodima-Taylor and William W. Grimes, 'Cryptocurrencies and Digital Payment Rails in Networked Global Governance: Perspectives on Inclusion and Innovation' in Malcolm Campbell-Verduyn (ed), *Bitcoin and Beyond: Cryptocurrencies, Blockchains, and Global Governance* (Oxford: Routledge 2018), ch6 that has extended insight beyond the cryptocurrency system.

economic actors.[37] Such global marketplaces are a further development from the 'sharing economy' phenomenon that has brought about new commoditisation and economic mobilisation since the 1990s.[38]

Weaknesses and Market Failures in the Self-Governing DApp Economy

The dApp economy is facilitated by private cryptocurrencies. The first private cryptocurrency, bitcoin, has continued to survive its notoreity,[39] volatility,[40] and express pronouncements by many that it does not function as good money,[41] in relation to being a unit of account, store of value and medium of exchange. Bitcoin has now become much more of a speculative asset[42] due to its potential to achieve high prices, but the most important private cryptocurrency in the dApp economy is ether. Ether has not been subject to the same levels of commoditised inflation as bitcoin but it also suffers from sub-optimal monetary qualities that may ultimately affect its currency role in the dApp economy. These are:

(a) the lack of governance of the commons of cryptocurrencies affects their key role as medium of exchange; and
(b) the commoditisation of cryptocurrencies adversely affects their roles as supplying a unit of account and store of value, and in turn adversely affects their role as medium of exchange.

Market-based solutions such as stablecoins are being developed, but functional and regulatory risks abound for stablecoins, as we shall discuss.

Weaknesses of Cryptocurrencies as Money

Private cryptocurrencies' weaknesses lie in their commoditisation as well as in how their payment functions are governed. As discussed above, cryptocurrency blockchains are supported by protocols for transaction validation and ledger construction. Although these protocols are regarded as essential 'governance' structures, many blockchain networks do not offer much more by way of governance institutions beyond those. For example if payment is effected in private cryptocurrency where transactions have on-chain and off-chain legs,[43] disputes that arise in the off-chain leg are not accommodated within internal

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[37] Alain Yee Loong Chong, Eric T. K. Lim, Xiuping Hua, Shuning Zheng, Chee-Wee Tan, 'Business on Chain: A Comparative Case Study of Five Blockchain-Inspired Business Models' (2019) 20 Journal of the Association for Information Systems 1308.
[38] Arun Sundarajan, 'The Economic Impact of Crowd-sourced Capitalism' in *The Sharing Economy* (Mass: MIT Press 2016), ch5.
[39] Henrik Karlstrøm, 'Do Libertarians Dream of Electric Coins? The Material Embeddedness of Bitcoin' 15 Distinktion: Scandinavian Journal of Social Theory 23-36 (2014); Damodaran Appukuttan Nair, 'The Bitcoin Innovation, Crypto Currencies and the Leviathan' 9 Innovation and Development 85-103 (2019).
[40] Marc Gronwald, 'Is Bitcoin a Commodity? On Price Jumps, Demand Shocks, and Certainty of Supply' 97 Journal of International Money and Finance 86 (2019).
[41] Emilios Avgouleas and William Blair, 'The Concept of Money in the 4th Industrial Revolution – a Legal and Economic Analysis' (2020), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3534701.
[42] Gronwald (2019).
[43] i.e. elements of the transaction cannot simply be performed and completed on-chain, such as where verification of external information is required, or where ex post delivery of goods or performance of services are required.

governance institutions in the blockchain-based network, and users face the problem of the irreversibility of payment.[44] It is uncertain to what extent private law systems meet users' redress needs in a blockchain-based cryptocurrency transaction.[45] Further blockchain networks foster clusters of power among code developers[46] and miners[47] that can undermine the democratic ethos of permissionless blockchains. If there is abusive or undesirable behaviour on a blockchain, for example in the face of a collusive '51% attack' on the blockchain to seize power, the default mode of governance is that selective clusters of users may pursue a hard fork, so as to deviate from the chain and create a separate chain/community. Forking can create uncertainties as to participants' transactions and assets and is not necessarily the go-to solution for governing anti-social behaviour. Blockchain networks are in need of developing more sophisticated governance mechanisms and protocols, and reliance on forking can be regarded as relatively 'primitive'. The under-development of governance affects rights, obligations and responsibilities surrounding the core payment function on blockchain networks.

Next, the commoditisation of cryptocurrencies began with bitcoin. It was not invented to serve a parallel crypto-economy, but was meant to compete with fiat currency payment systems. Thus, bitcoin became interchangeable with fiat currencies and private exchanges arose all over the world[48] to offer exchange between bitcoin and fiat currencies. The value for such exchange became determined by social and community sentiment[49] and speculation,[50] as rudimentary institutions such as capped supply and capped mining rewards do not provide a sufficient informational or institutional environment to regulate prices efficiently.[51] Bitcoin became highly commoditised and its price volatile, mimicking, in several researchers' findings, the prices of exhaustible commodities such as oil.[52] The commoditisation of bitcoin has invariably affected other cryptocurrencies even if they have been developed for different purposes.

The commoditisation of the monetary order of the dApp economy can adversely affect cryptocurrencies' roles as units of account and store of value, incentivising speculative trading in them and exchange activity. Volatile prices of cryptocurrencies means that the

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[44] Jared Arcari, 'Decoding Smart Contracts: Technology, Legitimacy, & Legislative Uniformity' 24 Fordham Journal of Corporate and Financial Law 363 (2019).

[45] Discussed extensively in Daniel Kraus, Thierry Obrist and Olivier Hari (eds), *Blockchains, Smart Contracts, Decentralised Autonomous Organisations and the Law* (Cheltenham: Edward Elgar, 2019); David Fox and Sarah Green (eds), *The Law of Cryptocurrencies* (Oxford: OUP 2019).

[46] Christian Catalini and Joshua S Gans, 'Initial Coin Offerings and the Value of Crypto Tokens' (2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3137213.

[47] Bronwyn E Howell, Petrus H Potgeiter and Bert M Sadowski, 'Open-Source or Open-Slather? Governing Blockchain Applications as Common-Pool Resources' (2019), https://ssrn.com/abstract=3427166.

[48] Such as Coinbase, Bitfinex, Binance etc.

[49] Nic Carter, 'Cryptoasset Valuation' in Chris Brummer (ed), *Cryptoassets: Legal, Regulatory, and Monetary Perspectives* (Oxford: OUP 2019), ch4; Udo Milkau and Jürgen Bott, 'Digital Currencies and the Concept of Money as a Social Agreement' (2018) 12 Journal of Payments Strategy & Systems 213 but the social underpinnings do not confer on such currencies stability. Volatility can still result in how the community perceives and uses the currency, eg for illicit purposes.

[50] Gronwald (2019).

[51] Hossein Nabilou and André Prüm, 'Central Banks and Regulation of Cryptocurrencies' (2019) at https://ssrn.com/abstract=3421417.

[52] Gronwald (2019).

'real' value of a virtual good or service in the dApp economy is fluctuating constantly, rendering the unit of account function meaningless. Both producers and consumers would constantly be trading in and out of their holdings in order to manage value, resulting in more financialised behaviour than is necessary for sustaining commerce. This environment can deter the scalability of the dApp economy as mainstream users may not be willing or able to undertake efforts in order to compensate for the poor monetary qualities of cryptocurrency, and choose not to participate in the commercial aspects of the dApp economy altogether. It may be counterargued that users can also be drawn to the state of the monetary order, as they can both experience commercial transactions in crypto goods and services while managing the investment aspect of the coins they hold. Going however by Hayek's assumption that economic agents ultimately want price stability,[53] and the fact that central banks around the world safeguard this as their main mandate, it can be argued that most users would unlikely enjoy the price volatility of their coins meant for transactional purposes,[54] even if a number of them would also desire price volatility for investment arbitrage.

The Uncertain Future of Stablecoins as Money for the Crypto-economy

Bottom-up solutions have been developed to satisfy this impossible coincidence of wants-both price stability for crypto commerce and price volatility for crypto investment. These are in the form of stablecoins. Stablecoins are designed to maintain their market values within certain certain parameters, therefore providing for their price stability.

There are two[55] types of stablecoins. One attempts to maintain a stable value pegged to collateral, such as certain fiat currencies or a basket of financial assets. The second type purports to maintain stable value by automated protocols that respond to excess demand or supply of coins, therefore performing central-bank like monetary functions.

It is uncertain that stable algorithmically-managed cryptocurrencies can be achieved.[56] For example, Ampleforth[57] is an algorithmically-managed stablecoin whose values are adjusted by demand-side information that is constantly updated. Although it purports to be self-adjusting and uncorrelated with bitcoin and ether's market volatility, its own price has fluctuated in the same pattern as these cryptocurrencies.

Stablecoins based on collateralisation are much more popular, but their relationships with fiat currencies and other financial assets means that they would not be left in a regulatory lacuna.[58] The European Commission has issued a proposal[59] to regulate 'asset-referenced' stablecoins, treating them as a suis generis type of financial product. It purports to capture stablecoins collateralised against fiat currencies, commodities and even crypto-assets.

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[53] F.A. Hayek, *Denationalisation of Money* (Institute of Economic Affairs, London, 1976).
[54] Avgouleas and Blair (2020).
[55] Hayek (1976).
[56] David Cerezo Sánchez, 'Truthful and Faithful Monetary Policy for a Stablecoin Conducted by a Decentralised, Encrypted Artificial Intelligence' (September 2019), https://arxiv.org/abs/1909.07445.
[57] https://www.ampleforth.org.
[58] Financial Stability Board, 'Addressing the Regulatory, Supervisory and Oversight Challenges Raised by "Global Stablecoin" Arrangements' (14 Apr 2020), https://www.fsb.org/wp-content/uploads/P140420-1.pdf.
[59] European Commission Proposal 2020.

Popular stablecoins such as Tether, dai and Libra would be affected. Their offers would be subject to authorisation and mandatory disclosure, and issuers are subject to prudential requirements and regulatory standards in terms of how reserves are managed, audited, disclosed, and how holders' rights are defined and protected.

The Commission's proposal is likely to subject collateralised stablecoins to a form of investment management regulation that emphasises their financial asset nature, potentially undermining their payment functions. Regulating asset-referenced stablecoins adversely affects their potential to become a means of payment, as e-money tokens are regulated differently and subject to either bank or electronic money issuer regulation in the EU.[60] This may not adversely affect Tether, the stablecoin with the greatest market capitalisation to date collateralised against fiat currencies such as the US dollar, euro and the Chinese yuan.[61] Tether Limited, its issuer would need to be authorised and be subject to approval based on a number of conditions, inter alia, regulatory vetting of enterprise governance, and good repute of management and controllers. It would face continuing regulatory requirements in relation to minimum capitalisation of at least 2m euros or 2% of its reserves, as well as continuing organisational, business continuity, audit and complaint handling regulations. Holders of tether treat it largely as an investment product to hedge against bitcoin, and they may likely welcome regulatory standards, although it is uncertain how 'investment management' cost may be passed on. Further, the libra project developed by the Libra Association[62] is likely to become a payment-focused initiative and be regulated as e-money, although the deployment of libra in the crypto-economy seems unlikely as it is focused on mainstream remittance, especially amongst unbanked peoples.

The Commission's proposal would adversely affect dai, a stablecoin issued by MakerDAO for payment purposes on the Ethereum blockchain. In order to make dai attractive to users, MakerDAO has developed dai as a collateralised stablecoin against ether and other Ethereum-based tokens, soft-pegged against the US dollar.[63] Further, MakerDAO encourages users of dai not to trade in and out of dai for speculation, but to hold dai, by saving in an app with a savings rate.[64] Finally, automated protocols stabilise dai against speculation by incentivising nodes to make markets in dai to moderate levels of demand.[65] As a whole, these aspects advance the purposes of dai becoming a trust-building and self-sustaining private cryptocurrency. Although its collateralisation and stabilisation protocols are now crucial to its credibility, it can be argued that dai's stability mechanisms premised upon collateralisation may be a transition phase. It is necessary now for dai to be transformed from ether, the productive cryptocurrency of the Ethereum blockchain. However, if sufficient dai enter into circulation so that the value of dai may be maintained by protocols regarding demand and circulation, then the value of collateralisation may become moot. This would be similar to the uncoupling of established fiat currencies from being backed by gold. In regulating dai narrowly as a financial asset focused on reserve and investment management, and subject to investors' rights of valuation and redemption,

[60] ibid.
[61] https://tether.to
[62] Libra White Paper, https://libra.org/en-US/about-currency-reserve/#the_reserve.
[63] https://makerdao.com/en/whitepaper#use-of-the-mkr-token-in-maker-governance.
[64] Ibid; https://oasis.app.
[65] Ibid.

regulators are likely to force compliance that may undermine the multifaceted features of the stablecoin, such as the payment and savings aspects. The EU's regulatory proposal seems likely to hamper the crypto-economy's bottom-up efforts in developing its monetary order. Further, MakerDAO would also face difficulties in securing authorisation under the Proposal as it may not be a legal organisational form recognised in any member state. Decentralised Autonomous Organisations (DAOs)[66] purport to be hierarchically flat, governed by automated protocols and do not subscribe to a corporate structure. In this manner, the imposition of 'management-like' duties upon 'responsible persons' in the DAO may also be ill-fitting.

The regulatory risk for stablecoins pose challenges for their development and adoption in the monetary order of the crypto-economy, although well-intentioned investor protection objectives underpin their regulation. The Commission locates this proposal under its Digital Finance Strategy[67] that intends to enable pan-European efficient utilisation of digital finance to support the Digital Single Market. However, it is arguable that the regulative aspects for stablecoins in fact undermine their payment and monetary functions.

In this light, this article argues that a different perspective can be adopted at the EU level- to consider how the dApp economy can be enabled and supported, so that the regulative aspects can then fall into place. The starting point we suggest is the integration into the dApp economy with a public sector institution, the CBDC.

CBDC and the DApp Economy- a Theoretical Framing

The dApp economy has grown in spite of its monetary order of unregulated crypto-currencies. However, its scalability and wide accessibility may be hampered by a continuation of the existing state. CBDC, if programmable into the blockchain protocols for the dApp economy, can pave the way for the galvanisation of commerce and investment. Blockchain-based businesses can appeal more directly to mainstream consumers used to fiat currencies, and possibly draw in greater participation. Both businesses and consumers may also prefer the greater familiarity and predictability of the digitalised fiat currency in relation to it being a store of value, unit of account and medium of exchange. Fund-raising by blockchain-based businesses conducted in CBDC can also be more generally appealing to mainstream retail and institutional investors.

The integration of the CBDC into the dApp economy needs to be based on a model of public sector facilitation and private sector provision. Central banks would benefit from engaging with the Ethereum Foundation as the major developer of dApp economy blockchain infrastructure, in developing CBDC's programmability. This is because much can be learnt from the lessons for programmability, robustness and problem-solving in the history of cryptocurrency innovation.[68] A model of public-private sector coordination can be based on the theoretical paradigm of regulatory capitalism.

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[66] 'The History of the DAO and Lessons Learnt' at https://blog.slock.it/the-history-of-the-dao-and-lessons-learned-d06740f8cfa5; Ori Oren, 'ICO's, DAO'S, and the SEC: A Partnership Solution' (2018) 2018 Colum Bus L Rev 617.

[67] 'Digital Finance Package', https://ec.europa.eu/info/publications/200924-digital-finance-proposals_en.

[68] Mauro Conti, Sandeep Kumar E, Chhagan Lal and Sushmita Ruj, 'A Survey on Security and Privacy Issues of Bitcoin' (2017), https://arxiv.org/pdf/1706.00916.pdf.

The broader theoretical framework of regulatory capitalism explains why apparently free-market or private sector-led activity is inextricably connected with and underpinned by the institutions of law and regulation. The scaling up, mobilisation and galvanisation of the dApp economy needs social acceptance and penetration into the mainstream. The institutions of law and regulation are able to provide facilitative support and regulative underpinnings that are essential for social trust.

In the history of Anglo-American capitalism, the promotion of free and liberal markets is seen to be necessary for individual freedoms and success, but free markets have been underpinned by regulatory capitalism. 'Regulatory capitalism' is defined as a symbiotic division of 'labour' between the state and the private sector where the role of the state in economic policy is that of 'steering' while the private sector is responsible for 'rowing'.[69] 'Rowing' depicts the work of actual service provision and technological innovation that is carried out by the private sector as commercial and business activity, while 'steering' refers to setting policy in order to influence, govern or incentivise behaviour or output in relation to 'rowing'. The objectives of regulation are to steer away from the problems that unbridled markets give rise to, such as market failures and to provide collective goods. Such intervention nevertheless supports markets so that they can work optimally. Regulatory capitalism arguably provides a theoretical underpinning for the building of the European Single Market, opined by some as a neo-liberal project but crucially embedding the unique ordoliberal ethos[70] that places the flourishing of innovative economic activity within social order and well-being.

In this manner, policy design for the dApp economy is targeted at integrating such economic developments within an institutional fabric. This does not mean that a 'coherentist' approach[71] is taken in reconciling, interpreting or extending existing bodies of law and regulation to the dApp economy however ill-fitting. The recognition that policy is needed for steering the rowing activities of the dApp economy means that we can consider its needs as the starting point for the establishment of appropriate legal institutional architecture. This can be legislative recognition of smart contracts or distributed ledgers,[72] or clarifying the legal interpretation or regulatory perimeters of existing bodies of law,[73] or establishing bodies of new law or regulation.[74] As Finck argues,[75] legal innovation is often necessary to accompany significant technological innovation and disruption.

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[69] Terms used in David Levi-Faur, 'The Global Diffusion of Regulatory Capitalism' (2005) 598 The Annals of the American Academy of Political and Social Science 12; John Braithwaite, *Regulatory Capitalism* (Cheltenham: Edward Elgar, 2008), ch1.

[70] Josef Hien and Christian Joerges, *Ordoliberalism, Law and the Rule of Economics* (Oxford: Hart Publishing 2017), chs 6, 9.

[71] Term used in Roger Brownsword, *Law, Technology and Society* (Oxford: Routledge 2019), pp191-196. It refers to a legal mindset that seeks to first fit new phenomena within the frameworks of existing legal ontologies.

[72] Discussed in relation to a few US states' initiatives in Stéphane Blemus, 'Law and Blockchain: A Legal Perspective On Current Regulatory Trends Worldwide' (2017) 4 RTDF 1.

[73] Such as undertaken by UK Jurisdiction Taskforce, 'Legal Statement On Cryptoassets And Smart Contracts' (Nov 2019), https://35z8e83m1ih83drye280o9d1-wpengine.netdna-ssl.com/wp-content/uploads/2019/11/6.6056_JO_Cryptocurrencies_Statement_FINAL_WEB_111119-1.pdf.

[74] such as the European Commission Proposal 2020.

[75] Michèle Finck, 'Blockchains: Regulating the Unknown' (2018) 19 German LJ 665.

As Goodhart and Lastra[76] argue, innovation often entails 'boundary' challenges for law and regulation as unregulated entities perform the equivalent of regulated activities or regulated entities undertake new and unregulated activities, raising questions for an appropriate institutional response. In the dApp economy, there is also potential 'smashing' of boundaries as unregulated entities undertake new and innovative unregulated activities which nevertheless attract concerns in relation to how the commons of such activities need to be governed.[77] An opportunity arises for new negotiation of the social contract regarding the integration of this space into the social and economic fabric. As the European Commission has expressed in relation to policy-making in the EU's Digital Single Market strategy,[78] this institutional process is essentially multi-stakeholder in nature,[79] and can give rise to new legal and regulatory institutions, discussed in Section C.

Some dApp developers may however hold the view that the dApp economy should *not* be integrated with the mainstream economy and should be 'sovereign resistant'.[80] However, this may not be a universal view held in all quarters. First, Howell et al[81] in their survey of token offerings made by dApp developers mention that developers could offer a choice of acceptance in fiat or cryptocurrency, showing that some developers would like to appeal more broadly to investors. Second, the popularity of collateralised stablecoins reflects the underlying need of dApp developers to mitigate cryptocurrency volatility and the adverse impact on them. The reliance on collateralisation against fiat currency reflects the inherent unsustainability in simple resistance against conventional institutions. We turn now to discuss the benefits of a targeted CBDC approach to the dApp economy, in light of central banks' interest in CBDC.

Targeting Central Bank Digital Currencies for the dApp Economy- a Limited and Experimental Rollout

Extant discussions on CBDC have moved from a 'research' phase to a phase looking into operationalisation.[82] The various benefits of CBDC have been canvassed, in relation to

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[76] Charles AE Goodhart and Rosa M Lastra, 'Border Problems' (2010) 13 Journal of International Economic Law 705.

[77] Sinclair Davidson, Primavera De Fillippi and Jason Potts, 'Blockchain and the Economic Institutions of Capitalism' (2018) 14 Journal of Institutional Economics 639; more generally Elinor Oström, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press 1990). A commons is relevant for blockchain-based networks as there may be collective goods apart from the protocols relating to transaction validation and ledger construction, such as dispute resolution.

[78] European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the Mid-Term Review on the implementation of the Digital Single Market Strategy: A Connected Digital Single Market for All (2017) at SWD(2017) 155 final.

[79] European Commission, 'Principles for Better Self and Co-Regulation' (2018), under the Digital Single Market Strategy, https://ec.europa.eu/digital-single-market/en/best-practice-principles-better-self-and-co-regulation.

[80] Quoted in 'Libra Scales Back Global Currency Ambitions in Concession to Regulators' (16 Apr 2020), https://www.coindesk.com/libra-scales-back-global-currency-ambitions-in-concession-to-regulators.

[81] Sabrina Howell, Marina Niesser and David Yermack, 'Initial Coin Offerings: Financing Growth With Cryptocurrency Token Sales' (2019), http://www.nber.org/papers/w24774.

[82] BIS, 'Central Bank Digital Currencies: Foundational Principles and Core Features' (9 Oct 2020), https://www.bis.org/publ/othp33.htm.

bringing about financial inclusion,[83] efficient payment systems integrated into e-commerce,[84] as well as facilitating innovations in fiscal[85] and monetary policy.[86] However, as research has indicated challenges for operationalisation, central banks have now developed a more precise interest in developing the CBDC for the retail economy.[87] The ECB has articulated interest in the CBDC's potential for an efficient and robust pan-European payment system, leveraging upon the ECB's public institution status to bolster pan-European payments infrastructure as a public good.[88] In light of the needs for economies battered by lock-down policies in the wake of the Covid-19 pandemic, CBDC has also been discussed as part of possible fiscal stimulation policies.[89] Nevertheless, without a CBDC, it has not prevented the government of Singapore from making helicopter drops directly into citizens' local bank accounts to provide 'solidarity' support during the Covid-19 pandemic.[90]

In view of the potential concerns of a universal rollout of CBDC, many central banks have carried out pilot projects but not major overhauls.[91] One pilot project already underway is the rollout of CBDC in China, which is limited to four provinces and utilises incumbent financial institutions such as large state-owned banks and major fintech institutions as wallet providers for CBDC.[92] The operationalising of CBDC in the mainstream economy involves architectural transformations even with existing private sector support. First, the 'back end' of CBDC in terms of issuance, plugging into commercial payment systems, as well as clearing and settlement, requires thinking in terms of new infrastructure that may be needed, especially if such infrastructure is to become decentralised to leverage upon blockchain technology.[93] Next, the 'front end' also requires thinking in terms of user interface, ease and convenience of use, robust custodianship of users' CBDC and resilience from data loss and cyberhacking, and the role of the central bank in such user relations.[94]

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[83] David Andolfatto, 'Assessing the Impact of Central Bank Digital Currency on Private Banks' (2018), https://doi.org/10.20955/wp.2018.026.

[84] Markus K. Brunnermeier, Harold James and Jean-Pierre Landau, 'The Digitalization of Money' (2019), http://www.nber.org/papers/w26300.

[85] John Barrdear and Michael Kumhof, 'The Macroeconomics of Central Bank Issued Digital Currencies' (Bank of England Staff Working Paper 2016), www.bankofengland.co.uk/research/Pages/workingpapers/default.aspx.

[86] ibid; U Bindseil, 'Central Bank Digital Currency - Financial System Implications and Control' (2019), https://ssrn.com/abstract=3385283. Central banks could make helicopter drops or experiment with negative interest rates in order to affect consumption behaviour, also Hossein Nabilou, 'Testing the Waters of the Rubicon: The European Central Bank and Central Bank Digital Currencies' (2019) Journal of Banking Regulation, https://doi.org/10.1057/s41261-019-00112-1.

[87] BIS (2020); ECB, *Report on a Digital Euro* (Oct 2020), https://www.ecb.europa.eu/euro/html/digitaleuro-report.en.html.

[88] ibid, Panel discussion, ECB Legal Research Conference on Central Bank Digital Currencies, 5 Oct 2020.

[89] 'US Lawmakers Talk Digital Dollar, FedAccounts in Thursday Hearing' (10 June 2020), https://www.coindesk.com/watch-us-lawmakers-will-talk-digital-dollar-fedaccounts-in-thursdayhearing?utm_source=newsletters&utm_medium=blockchainbites&utm_campaign=&clid=00Q1I00000LtSLoUAN.

[90] 'Solidarity Budget 2020 : Additional cash payments to help families get through Circuit Breaker phase' (6 Apr 2020), https://www.gov.sg/article/solidarity-budget-2020-additional-cash-payments-to-help-families-get-through-circuit-breaker-phase.

[91] Barontini and Holden (2019).

[92] 'China's central bank digital currency wallet is revealed' (16 April 2020), https://www.ledgerinsights.com/china-digital-currency-wallet-dcep-cbdc/.

[93] ECB (2020), BIS (2020).

[94] Ibid.

Finally, there is a need to consider how such a CBDC would affect existing providers of electronic money, deposit accounts and even credit.[95]

Rationale for Limited Rollout in the Crypto-economy

Although the CBDC initiative has tended to be connected with retail commerce and payment,[96] in light of the challenges surrounding a general rollout as discussed above, this article proposes that an optimal approach could be a limited rollout of CBDC in the crypto-economy, such rollout providing an experimental testing and observation ground. This neglected space in conventional CBDC discussions is arguably an optimal space for limited operationalisation, as a limited rollout may be more technologically compatible with the architecture of the crypto-economy and entails less of the operational challenges and dilemmas faced by central banks in a general rollout scheme.

The development of the dApp economy is of importance to the EU as many start-ups and innovative business ideas are arising in this space.[97] The need to incorporate disruptive technologies in the Digital Single Market initiative[98] has now been more explicitly articulated in the new action plan for the capital markets union.[99] The CBDC can be seen as part a facilitative mosaic for policy developments.

Such a limited rollout would occur in an economic space that is relatively 'bounded' as activities within this space is at the moment not too porous to mainstream commerce. The limited rollout initiative can be contained and experimental, not significantly affecting or disrupting the rest of the economy. Further the limited rollout is particularly beneficial for the crypto-economy and particularly efficient for central banks. The crypto-economy is still endeavouring to develop private cryptocurrencies of sufficient monetary qualities, with dai, possibly the strongest contender likely to be adversely affected by the impending regulation of asset-referenced stablecoins. The CBDC enjoys established monetary qualities. Central banks would also benefit from discourse with private sector developers in relation to the CBDC's programmability and robustness, lessons that can be relevant to further-reaching rollouts in the future. A limited rollout of the CBDC can take place in the dApp economy in order to observe uptake, demand and operational issues.

What Limited Rollout Means

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[95] Ibid. In this respect the BIS (2020)'s foundational principle for introducing CBDC is to do no harm while promoting co-existence with cash and innovation. This may extend to preserving financial stability in connection with private sector institutions and infrastructure, while not reducing the scope for innovation.

[96] European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on Completing a Trusted Digital Single Market for All (16 May 2018); Commission Decision of 26.4.2018 on setting up the group of experts for the Observatory on the Online Platform Economy; ECB, *Report on a Digital Euro* (Oct 2020), https://www.ecb.europa.eu/euro/html/digitaleuro-report.en.html.

[97] https://www.chaineurope.org/blockchain-startups/.

[98] advice in McKinsey & Co, 'Shaping the Digital Transformation in Europe' (European Commission Working Paper 2020).

[99] European Commission Communication on a new action plan for the capital markets union (2020), above.

The most significant economic activity in the dApp economy is fund-raising for blockchain-based development projects, known as 'initial coin offerings' (ICOs).[100] Developers of a blockchain-based business project typically offer tokens in return for cryptocurrency from supporters. These are the application tokens envisaged to be used on the blockchain-based business/marketplace when the project finally goes live. Token offerings are 'pre-incorporation' in nature, meaning that they are held ahead of any business development. The fund-raising is premised upon a business idea and developers' plans as to how the idea should be technologically executed. This is a novel point in time for business fund-raising as securities fund-raising is usually premised upon a degree of maturity of the company and even venture-capitalists that fund start-up stages are facing usually an already-incorporated company with perhaps some initial operations.[101]

Tokens confer a variety of consideration in return for supporters' funds. For example, utility tokens confer on subscribers a right (in the future) to use or enjoy certain services,[102] and resemble a pre-sale of yet-to-exist rights or services. However these come in different variety in terms of whether they may be user-based, or include other participation rights.[103] Investment tokens confer on subscribers a right to participate in a form of investment and risk being classified as falling foul of existing financial markets or securities regulation.[104]

The pre-sale of tokens comes close to resembling established practices for corporate fund-raising, which is regulated under many jurisdictions' securities regulation regimes. However, it can be argued that ICOs are a different beast altogether,[105] and such pre-sales are necessary in order to generate interest in and support for the project under development, which would ultimately become a distributed marketplace dependent on network effects.[106] Such pre-sales may also co-opt users into a space of co-developing the experimental software for the blockchain-based business in order to fix its bugs and refine it for ultimate launch.[107] Most developers insist that such sales are characterised as sales of future goods or services.[108] Needless to say, the investor protection concerns in this phenomenon have

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[100] Philipp Hacker and Chris Thomale, 'Crypto-Securities Regulation: ICOs, Token Sales and Cryptocurrencies under EU Financial Law' (2018) ECFR 645.

[101] Bob Zider, 'How Venture Capital Works' (Harvard Business Review, 1998), https://hbr.org/1998/11/how-venture-capital-works on the relative rarity of venture capital funds investing in start-up and very young stages of companies.

[102] Hacker and Thomale (2019).

[103] Carol Goforth, 'Securities Treatment of Tokenized Offerings under U.S. Law' 46 Pepperdine Law Review 405 (2019).

[104] SEC, *Report of Investigation Pursuant to Section 21(a) of the Securities Exchange Act of 1934: The DAO* (25 July 2017), https://www.sec.gov/litigation/investreport/34-81207.pdf, SEC Guidance (2018).

[105] Hacker and Thomale (2018); Lewis Rinaudo Cohen, 'Ain't Misbehavin': An Examination of Broadway Tickets and Blockchain Tokens' 65 Wayne L Rev 81 (2019).

[106] Wulf A Kaal, 'Crypto-Economics- The Top 100 Token Models Compared' (2018), https://ssrn.com/abstract=3249860.

[107] S Adhami et al, 'Why do Businesses Go Crypto? An Empirical Analysis of Initial Coin Offerings' 100 Journal of Economics and Business 64 (2018) documents these types of ICOs are most likely to succeed.

[108] SAFT or Simple Agreement for Future Tokens, which has been developed as a template for ICO offerings clarifying that sales are of tokens for future use. Also see Jiri Chod and Evgeny Lyandres, 'A Theory of ICOs: Diversification, Agency, and Information Asymmetry' (2018), https://ssrn.com/abstract=3159528.

drawn securities regulators' attention to the area.[109] The SEC in the US has in particular taken a stringent approach to classifying most token offers as securities offers.[110] The European Commission has also proposed to treat offers of crypto-assets as financial assets that should be subject to a regime of mandatory disclosure and civil liability for misleading or false information.[111] Although we argue below that regulatory policy can be refined, the development of regulation policy can benefit from deriving insights from the nature of market demand. Hence, we propose an enabling institution to engage with dApp developers' needs and to allow demand for such investments to be tested. This article proposes a starting and limited issuance of CBDC as tokens in exchange for investors' cash for the specific channeling of investment to dApp developers raising finance for project development.

This limited rollout proposal serves a few objectives. First, it is poised to map demand possibly at uneven levels across the euro area for CBDC in relation to the dApp economy. Second, it supports and refines policy thinking on developing regulatory endeavours for token offerings, but not in a siloed manner, as relevant regulators and the central bank could take advantage of such an intersection to engage in inter-agency dialogue and knowledge exchange with each other, ultimately supporting the evolution of new institutional responses or architecture.[112] Third, as dApp developments are aimed towards becoming a live business, the facilitative role of CBDC for investment into the crypto-economy brings about further intersections with a wider mosaic of business and commercial law and regulation, in order to serve wider economic facilitation purposes as well as regulative purposes. In other words, the starting point of CBDC as facilitating investment into a pre-development dApp economy galvanises and mobilises the policy mosaic for the dApp economy more broadly in the digital transformation of the single capital market.

CBDC can be issued in a manner that is account-based or token-based.[113] Token-based CBDC means that the central bank as issuing authority does not extend its services into custodial or transfer services for users, and users would need to be served by other commercial entities that provide those. A token-based CBDC would need to be supported by appropriate custodial services, and this could give rise to a new industry of custodial services for CBDC other than banks, such as the wallet industry supporting crypto-currencies. Consistent with the complimentary roles of the public and private sectors in regulatory capitalism, this article argues that CBDC should be issued as digital tokens against physical or digital cash tendered by individuals for the purposes of investing in the crypto-economy. In this manner, the public sector provides the facilitating institution of the CBDC while the private sector provides both the opportunities for dApp economy investment and the rise of private sector industries such as token custodial services that would implement the limited rollout policy. It is envisaged that such service providers would be subject to regulation, as discussed below.

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[109] Iris H-Y Chiu, 'Decrypting the Trends of International Regulatory Competition in Crypto-finance' (2020) 7 European Journal of Comparative Law and Governance 297 comparing securities regulators' responses to token offerings in a range of different jurisdictions.

[110] SEC Guidance (2018).

[111] European Commission Proposal 2020.

[112] Discussed under 'Implementing the Limited Rollout of CBDC in the Euro Area'.

[113] Barontini and Holden (2019).

We explain why CBDC should not be issued under an account-based design. In an account-based design, investors have accounts directly at the relevant central bank, and the account is credited with the requisite value exchanged. The central bank needs to have cryptographic expertise to generate a pair of public and private keys for the investor's account address in order for transactions to be facilitated in and out of the account. In an account-based design, it is envisaged that CBDC is transferred out of the account to fund a dApp developer, who issues tokens in return, which may be kept at the same account. Account-based designs require central banks to provide a fundamentally new service with cryptographic expertise and customer-facing interfaces. This allows central banks to monitor transactions in a comprehensive manner but would be demanding in terms of providing an essentially secure wallet service for investors. Further, central banks would themselves have to undertake anti-money laundering compliance, to address the fears that dApp economy investing has become a channel for laundering illicit proceeds.[114] The demands placed on the central bank in servicing account-based designs may place the central bank in new and uncomfortable territory as direct investment services providers. As the CBDC should be an enabling mechanism for dApp economy investment, it is best that such investment interfaces be provided by private sector services so that the investing public may not be confused as to the central bank's role and mistakenly treat the central bank as warranting the quality of such investments.

In a token-based design, an investor would have to show that the exchange for CBDC is for investment purposes, and custodial agents would hold issued CBDC on trust for their respective account-holders in order to commit the funds to regulated dApp issues. These custodial services can generate the public and private key pairs for each investor's account and receive CBDC credited by the central bank for investors' tendered cash. They then facilitate the investment transactions for investors. They would also be tasked with the functions of anti-money laundering due diligence, custodial safekeeping and transfer for investments to be made. In such a set-up, central banks would be relieved of direct service provision and some of the onerous implications, but would need to subject custodial services to regulation and supervision.

In this manner, custodial agents also act like brokers which makes such a role unique and different from conventional financial intermediaries. These service providers are envisaged to have custodial, payment and brokerage functions, and yet bundled in new ways. They would also have responsibilities engaging with central banks, investors and the relevant dApp issuers. Custodial providers in the private sector need to develop the requisite cryptographic expertise and customer service interfaces. Expertise can be developed from current wallet providers for cryptocurrencies. Existing payment services institutions authorised under the Payment Services Directive 2015 may also see the market opportunity

[114] Jongsub Lee, Tao Li and Donghwa Shin, 'The Wisdom of Crowds and Information Cascades in Fintech: Evidence from Initial Coin Offerings' (2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3226051 argue that token issuers carrying out voluntary anti-money laundering due diligence may be less popular. This may suggest the use of token investing as a money laundering channel.

to foray into providing these services and many of them are already overseen by national central banks in the euro area.[115]

It may be queried how the limited rollout proposal works alongside the European Commission's proposals to regulate cryptoasset offerings and service providers.[116] Cryptoasset offerings would be regulated via the mandatory disclosure of a prescribed white paper, subject to investor civil litigation for false or misleading disclosure. Cryptoasset service providers would be regulated under an umbrella category, subject to prudential requirements, mandatory insurance support, general rules of conduct of business such as fair treatment of customers and management of conflicts of interest, as well as organisational and governance requirements pertaining to business continuity and cybersecurity.[117]

The harmonisation of cryptoasset regulation allows passporting of compliant offers and enables single market access to such financial products. The Commission's proposal provides for the enabling aspect of supply-side access to the pan-European market but we argue that the demand-side can better respond to such opportunities if access to the crypto-economy were facilitated by the issuance of a CBDC for investment in the crypto-economy. The monetary order of the CBDC underpins greater social mobilisation than if reliance were placed on investors having to access private cryptocurrencies. In this manner, the limited rollout proposal supports and is not contradictory to the Commission's proposal. In playing a mobilising role for the dApp economy, the limited rollout of CBDC supports the building of the dApp economy within the Commission's new action plan for the Capital Markets Union.[118] In this new action plan, the Digital Finance Package is seen as a building block to help small and medium sized enterprises gain access to fund-raising outside of the traditional bank finance channels, while at the same time promoting digital transformation in the single market and being consistent with sustainability.

It may be queried why CBDC is needed as private e-money providers can issue programmable digital fiat currencies for investment or payment in the dApp economy. In the US, registered money service business Circle has launched a USD Coin, ie a digital version of the USD dollar to be fully programmable in Ethereum blockchain-based applications.[119] The European Commission's proposal also purports to regulate e-money token issuers under bank or electronic money issuer regulations.[120] However, CBDC would be programmed and 'signed' by the ESCB and is not a claim upon a private sector issuer (which is what privately issued electronic money amounts to) whose risk of insolvency the

[115] The EBA maintains a register of national central banks that also authorise and oversee payment services providers under the Payment Services Directive. The primary responsibility of national central banks in payments regulation and supervision is described as based on an intergovernmental framework for regulation in the EU, although Art 127 TFEU provides for the ECB to undertake the overall objective of ensuring smooth operation in payment systems, Dermot Hodson, 'De Novo Bodies and the New Intergovernmentalism :The Case of the European Central Bank' in Christopher J. Bickerton, Dermot Hodson, and Uwe Puetter (eds), *The New Intergovernmentalism: States and Supranational Actors in the Post-Maastricht Era* (Oxford: OUP 2015).
[116] Art 16(8) EU Markets in Financial Instruments Directive (MiFID 2014).
[117] Akin to Arts 23, 24, MiFID 2014.
[118] European Commission Communication on new action plan for Capital Markets Union (2020), above.
[119] https://www.circle.com/en/#.
[120] Electronic Money Directive, Directive (EU) 2015/2366.

recipient runs. It may nevertheless be argued that as e-money issuers are regulated prudentially, the risk faced by customers of issuer failure is small. However, despite prudential regulation, if we rely on e-money creation by the private sector for the limited rollout proposal, e-money providers can engage in leverage generation[121] for speculative instead of genuine investment purposes, and may fuel bubbles in token prices.

The next Section turns to the implementation of the limited rollout approach and its wider institutional implications for the euro area.

Implementing the Limited Rollout of CBDC in the Euro Area

In this Section, we argue that the legal framework for the CBDC in the euro area is able to support such issuance and offer proposals for the institutional structures for such issuance. We also explore how the enabling institution of the CBDC for investment in the crypto-economy paves the way for further institutional developments that enable the building out of the crypto-economy.

The Legal Framework for the Issue of CBDC for the Euro Area in the Single Market

The European Central Bank (ECB) has the exclusive right to issue euro banknotes as legal tender in the euro-area.[122] In practice, national central banks (NCBs) undertake such issue subject to the ECB's approval, as the ECB has limited institutional facilities for organising banknote production and distribution.[123] In relation to coins, NCBs are primarily responsible for issuing them.[124] This system ensures that although the ECB has centralised authority over the monetary functions in the euro area, decentralised implementation is carried out based on the existing institutional facilities as being most practical and efficient.

It may be queried whether the issuance of digital euros should be regarded as 'banknotes' or 'coins'. One also notes that tokens issued by dApp developers in fund-raising have also been called 'coins'. The difference between banknotes and coins in Article 128 of the TFEU relates to difference in denomination. This difference in denomination is meaningful as the physical representation of notes and coins differ. Physical representation is currently differentiated according to denomination ie banknote for 5 euros and above in terms of denomination and coin for 2 euros and below.[125] Where digital currency is concerned, the digitalisation of form cuts across the need for differentiating between denominations and consequent production.

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[121] Credit creation can be undertaken by electronic money institutions, art 6, Electronic Money Directive 2009/110/EC.

[122] Art 128, TFEU.

[123] Christos V Gortsos, *European Central Banking Law: The Role of the ECB and National Central Banks under European Law* (Basingstoke: Palgrave Macmillan 2020), ch7; Martin Seidel, 'The Constitutional Implications of the European Central Bank' (CESifo DICE Report 2012).

[124] Art 128(2), TFEU.

[125] Consolidated text: Decision of the European Central Bank of 19 April 2013 on the denominations, specifications, reproduction, exchange and withdrawal of euro banknotes (recast) (ECB/2013/10) (2013/211/EU).

Although the use of language reflects the assumption of physical representation, it is arguable, on a teleological basis,[126] that the digital versions of euros would still fall to be interpreted as digital euro banknotes or coins depending on denomination. Article 128 can be interpreted teleologically as including physical as well as digital representations of the same subject matter.[127] However, within the Treaty confines, it is arguably not possible to treat digital currency issued by the central bank as a species outside of 'banknote' or 'coin'.

The express competence for minting coins on the part of NCBs may constrain the interpretation of Article 128, meaning that there is only scope for the ECB to directly issue CBDC in denominations in 5 euros and above. However, as banknote denomination is a policy decided by the ECB,[128] the policy to denominate 5 euros and above in the form of banknote can be reconsidered. It is also possible for the ECB to issue separate decisions for denominations of physical banknotes and coins, alongside digital banknotes and coins,[129] with the digital banknote having a lower range of denominations than the physical range. It can be questioned whether digital banknotes can be denominated in low ranges, phasing out 'coins' altogether. This is permissible under the Treaty as coin issuance seems discretionary for NCBs. Further as Art 128 envisages that both the ECB and NCBs can issue banknotes under the ECB's authorisation, defining lower ranges of denominations for digital banknotes does not adversely affect competence between the ECB and NCBs. The potential issuance of low-denominated digital banknote euros would also meet the needs of the crypto-economy as many tokens trade in secondary markets in fractions of a US dollar.

Although digital banknotes can be defined in lower denomination ranges and can equally be issued by the ECB directly or by NCBs, this article supports a decentralised system where NCBs could be the primary issuers, subject to the overall oversight and approval of the ECB, in relation to the broader policy relating to issuing CBDC in the limited rollout proposal. This would also entail little change in practice from the present dominant role of NCBs issuing physical banknotes and coins.

It may be queried whether by analogy with electronic money, CBDC is therefore not 'legal tender'. Although the Electronic Money Directive provides for recognition and regulation of electronic money without specifying legal tender, Didenko and Buckley argue that the implicit assumption of the Directive is that it must deal with legally recognised currencies in the Union on the basis of the assumptions of stable value made in the Directive and the obligations issuers are imposed with in relation to the exchange or redemption of electronic money.[130] Whether CBDC is technically 'legal tender' would unlikely affect its favourable perception at a practical level. The advantage of legal tender is that creditors are obliged to accept legal tender in discharge of a debt. This advantage is not highly applicable in the context of the limited rollout proposal. In the investment context, investors make an offer

[126] Frank Elderson, 'Legal Interpretation within the ESCB: Is there Method in It?' in ECB, *Legal Aspects of the European System of Central Banks: Liber Amicorum for Paolo Zamboni Garavelli* (ECB, 2005), ch3.
[127] Nabilou (2019).
[128] N126.
[129] Advocate General Giovanni Pitruzzella's opinion in Advocate General's Opinion in Joined Cases C-422/19 Press and Information Johannes Dietrich and C-423/19 Norbert Häring v Hessischer Rundfunk arguably supports separate provision for the CBDC and its status as legal tender.
[130] Anton N Didenko and Ross P Buckley, 'The Evolution of Currency: Cash to Cryptos to Sovereign Digital Currencies' 42 Fordham Int'l LJ 1041 (2019).

to buy tokens which issuers accept, and issuers are free to set conditions of acceptance such as payment by CBDC or other cryptocurrency. CBDC issuance should be geared towards incentivising not forcing its adoption. However, if a policy choice to make CBDC indisputably legal tender is made, it becomes more imperative for the ECB to consider issuing a decision on the denominations of digital banknotes so that lower ranges can meet the definition of 'legal tender' under the Treaty.

Institutional Structure for Issuance of CBDC in the European System of Central Banks

Next, this article argues that it is structurally optimal for NCBs to take on the primary responsibility for issuing CBDC. At a decentralised level, NCBs may face different levels of demand for CBDC as there is an uneven level of interest and participation in the dApp economy across Europe. Although the DApp economy spans global borders, developers not uncommonly start as a socially close-knit group in particular geographically-precise locations,[131] such as Silicon Valley in the US. In Europe, Switzerland, Germany, Lithuania and the UK are highly popular jurisdictions where token offerings have been based,[132] and other euro area countries such as France and Spain are popular too. In this manner, due to different levels of demand across the euro area, NCBs can be well-placed to discover locally-generated needs. Further, the limited rollout proposal supports investment in the dApp economy and regulatory oversight of this is carried out by national agencies dealing with capital formation and investment regulation. There is no pan-European investment markets regulator as ESMA is a body overseeing and coordinating national regulators who remain at the forefront of regulatory tasks. NCBs can work with national securities regulators in mapping the developments in the dApp economy.

This does not mean that CBDC issuance should be carried out in a fragmented manner. A number of considerations need to be led by the ECB in securing coherence of policy for the ESCB.

First, the ECB must decide for what purpose the CBDC should be programmed. Should the CBDC be programmed for an alternative protocol infrastructure, so that the ESCB takes on the role of providing competing blockchain infrastructure in the crypto-economy? It should also be considered if such an innovation should be made open source and available for adoption or should result in proprietary rights subject to licensing for the ESCB. Making technological provision open source likely increases and encourages uptake although making it proprietary and subject to licensing may allow a regulatory channel to be constructed so as to select and supervise adopters and users. In the alternative, should the ESCB work with the private sector so that CBDC is programmed to be compatible with infrastructure protocol such as the Ethereum blockchain? This is arguably preferred as the Ethereum blockchain enjoys significant network effects for enterprise. These decisions need to be decided at the level of the ESCB overall orchestrated under the ECB, and it would be

[131] Dan Bousfield, 'Crypto-coin Hierarchies: Social Contestation in Blockchain Networks' 19 Global Networks 291 (2019).

[132] Wulf Kaal, 'Initial Coin Offerings: The Top 25 Jurisdictions and their Comparative Regulatory Responses (as of May 2018)' (2018) Stanford Journal of Blockchain Law and Policy, https://stanford-jblp.pubpub.org/pub/ico-comparative-reg.

beneficial for the ECB to take leadership in a unified form of engagement with the private sector.

Policy centralisation at the ECB level also arguably matches with the broader purpose of the CBDC, which, pursuant to Article 127 of the TFEU, relates to the ECB's support of general economic policies in the Union with a view to contributing to the achievement of its objectives.[133] This includes the Digital Single Market which is intended to promote cross-border e-commerce and the Digital Finance Package supporting the single capital market. The limited rollout proposal does not offend the needs for institutional independence and stature.[134] We turn to sketch out a blueprint for key aspects of wider policy and regulatory thinking for mobilising the dApp economy as a governed capitalist order, without excessive detail that would be beyond the scope of this paper.[135]

A Brief Blueprint for the Regulatory Design and Architecture Implications of an Enabling CBDC in Euro

Although this article focuses on the enabling role of the CBDC for the dApp economy, such an enabling role would give rise to implications for the scope and design of new policy and regulatory thinking to address the needs of the dApp economy, and how regulatory architecture at the national and EU levels may be adjusted in response. In other words, the facilitative role of the CBDC paves the way for development of a regulatory capitalist order that engages with the roles of the public sector, in terms of providing regulatory governance, and the private sector, in relation to innovation and growth. The role of the public sector can further involve issues surrounding the fitness of existing regulatory institutions, reform of substantive regulatory law and the mandates of existing regulatory agencies.

This Section discusses the contours of wider implications, in relation to the development of regulatory capitalism in the dApp economy in the EU, in four respects:

(a) The rise of new intermediaries for facilitating investment in the dApp economy and the need for extending regulatory governance over them;
(b) The need for a complimentary regime of token offer regulation which need not be the same as fully-fledged securities regulation;
(c) The need to consider more broadly business and commercial policy for the dApp economy as business projects become live, and economic activity in the dApp economy takes shape; and
(d) The need to consider how national central banks and relevant regulatory agencies may interact and coordinate to address the policy needs of the dApp economy, and how such interactions and coordinations are further advanced through the EU

[133] Article 127, TFEU read with Art 3.
[134] Harold James, 'Introduction' in *Making the European Monetary Union: The Making of a Non-national Currency* (Harvard University Press 2012); Werner Bonefield, 'Ordoliberalism and Political Theology: On the Government of Stateless Money' in Josef Hien and Christian Joerges, *Ordoliberalism, Law and the Rule of Economics* (Oxford: Hart Publishing 2017), ch17.
[135] Detailed proposals for regulating the dApp economy are developed in Iris H-Y Chiu, *Regulating the Crypto-economy* (Oxford: Hart 2022), forthcoming.

institutional levels involving the ECB and relevant European agencies such as the regulatory bodies in the European System for Financial Supervision.[136]

The Rise of New Intermediaries for Facilitating Investment in the DApp Economy

A key new market player discussed above is the custodial agent for token-based CBDC. These custodial agents on the one hand serve bank-like functions but they are not banks as they are not envisaged to have full intermediation and money-creation functions like banks.[137] They would have duties and responsibilities to national central banks with whom they exchange investors' cash for CBDC, to their customers, and also to token issuers. Such custodial agents perform both payment services and brokerage-like functions towards investors. The existing industry of wallet services for cryptocurrency may be appropriate for developing such services, and many wallet services are provided by cryptocurrency exchanges.[138] Regulatory obligations are already imposed under the fifth Anti-Money Laundering Directive,[139] but regulatory policy should be further tailored to specific risks of these services in relation to multi-way accountability to central banks, token issuer regulators and investors. There are nevertheless useful aspects from the Commission's proposal such as custodial duties akin to brokers,[140] and customer due diligence standards akin to under the Payment Services Directive.[141]

Further, it should be considered whether custodial agents may participate or diversify into investment services such as advisory services regarding the quality of token offers, and how those should be overseen. The Commission's proposed regulation for service-providers is highly broad-brush, grouping all manners of service providers together to be subject to similar prudential and conduct of business regulation. There is a need to consider how risks pertaining to different activities can be further understood for regulatory treatment.

In light of the rise of secondary trading markets for tokens,[142] the International Organisation of Securities Commissioners (IOSCO) has proposed that regulators consider regulating these marketplaces in view of investor protection issues such as standards of trading, market abuse and market transparency.[143] The EU Commission's proposal reflects these, but innovation in the crypto-economy and the arrival of decentralised exchanges[144] may pose challenges to narrowly-defined regulatory categories. Regulatory capitalism in this space

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[136] The System comprises of the European Banking Authority, the European Securities and Markets Authority, the European Insurance and Occupational Pensions Authority, and a joint committee of the three to look at cross-sectoral issues, see Regulation (EU) 1093/2010 establishing the European Banking Authority.
[137] Discussed in Peter Bofinger, 'Theoretical Fundaments of Monetary Policy' in *Monetary Policy: Goals, Strategies, Policies and Instruments* (Oxford: OUP 2001).
[138] Sarah Jane Hughes and Stephen T Middlebrook, 'Advancing a Framework for Regulating Cryptocurrency Payment Intermediaries' 32 Yale Journal on Regulation 295 (2015).
[139] Art 2, Anti-Money Laundering Directive 2018 amending the Anti-Money Laundering Directive 2015.
[140] Art 16(8) EU Markets in Financial Instruments Directive (MiFID 2014).
[141] Such as in relation in relation to strong customer authentication, Art 97, Payment Services Directive Directive (EU) 2015/2366.
[142] Such as Poloniex.com, Tokenmarket.net, Idex.com.
[143] IOSCO, 'Issues, Risks and Regulatory Considerations Relating to Crypto-Asset Trading Platforms' (May 2019), https://www.iosco.org/library/pubdocs/pdf/IOSCOPD627.pdf and *Issues, Risks and Regulatory Considerations Relating to Crypto-Asset Trading Platforms* (Feb 2020).
[144] Such as uniswap that facilitate liquidity pools, https://uniswap.org.

could be reflected by more intense engagement with private sector innovators and business developers, moving away from ontological assumptions with conventional financial service providers, so that regulatory policy can be dynamically informed. Further, new intermediaries facilitating investment into the dApp economy also include token rating services, which are unregulated at the moment.[145] The extent of investor reliance on them should be subject to observation in considering if regulatory standards are needed. The operation of pan-European service provision by intermediaries in this space also gives rise to implications for intersections between national agencies for regulation and supervision or elevation of such supervision to the European agency level.[146]

The Need for a Complimentary Regime of Token Offer Regulation

ICOs should be regulated differently from securities offerings as they are pre-development in nature,[147] and raise different information asymmetry and investor protection risks. Although Zetzsche et al[148] have empirically observed that the quality of voluntary disclosure in ICOs, in the form of white papers, is sub-optimal in most cases, mandatory disclosure regulation under securities regulation may not be the appropriate regime for ICOs. In this manner, we argue for a different approach from the European Commission's[149] which focuses excessively on *ex ante* mandatory disclosure and disclosure-based civil liability as market discipline.

ICOs usually take place with perhaps no relevant track record for investors to observe, and the informational environment for investors may be unprecedentedly thin. This is not necessarily an issue of information asymmetry ie that issuers have more information held to their chests than available to investors. This is an environment of information anaemia as both issuers and investors are wading into a speculative venture with much information to discover. Hence there may be a case for less reliance on extensive mandatory disclosure regulation, and to supplement with a regulatory regime that provides for more investor control to monitor the development of the project.

There may be a case for regulatory design that facilitates post-sale investor monitoring. Post-sale monitoring is important as ICOs result in a frontloading phenomenon whereby dApp issuers get all of the proceeds for development before anything is started.[150]

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[145] Such as ICObench.com, ICOratings.com. On usefulness and predictive power of ratings see Jongsub Lee, Tao Li and Donghwa Shin, 'The Wisdom of Crowds and Information Cascades in Fintech: Evidence from Initial Coin Offerings' (2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3226051; Thomas Bourveau, Emmanuel T De George, Atif Ellahie and Daniele Macchiochi, 'Information Intermediaries in the Crypto-Tokens Market' (2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3193392. However some commentators are of the view that the ratings services provide flawed ratings even for crypto-businesses that do not need to use a blockchain, Chen Feng, Nan Li, M.H. Franco Wong, and Mingyue Zhang, 'Initial Coin Offerings, Blockchain Technology, and White Paper Disclosures' (2019), https://ssrn.com/abstract=3256289.

[146] Part d of this Section.

[147] Alex Collomb, Primavera de Fillippi and Klara Sok, 'Blockchain Technology and Financial Regulation: A Risk-Based Approach to the Regulation of ICOs' (2019) 10 European Journal of Risk Regulation 263.

[148] (2017).

[149] European Commission Proposal 2020.

[150] Xin Deng, Yen-Teik Lee, Zhengting Zhong, 'Decrypting Coin Winners: Disclosure Quality, Governance Mechanism and Team Networks' (2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3247741 on the frontloading phenomenon.

Regulation can be aimed at mitigating developers' agency risk, especially behavioural sub-optimalities associated with investment frontloading that exacerbates such risk, as well as to allow investors to observe the outworking of business viability and investment value risks. Regulatory design can include staged financing and escrow arrangements, proposed by Rodrigues as similar to the kind of contractually agreed post-investment monitoring carried out in a venture capital investment in a start-up company.[151] Such a regulatory design would involve different obligations from under securities regulation, and possibly new intermediaries with new obligations in relation to staged financing monitoring and custodial safeguarding of funds. In general, securities or financial regulators need to be capabilised to grapple with new trends, regulatory ideologies and designs. There is scope for European agencies[152] to work with existing securities and financial regulators, as well as innovative regulators such as the new Maltese Digital Innovation Authority[153] in order to cascade insights and lessons for each other in a joined-up manner.

The Need to Consider More Broadly Business and Commercial Policy for the DApp Economy

As DApp developers plan to develop blockchain-based networks into live businesses, these new businesses and their structures, as well as their commercial operations may raise questions in relation to regulatory arbitrage and institutional fit. In the sharing economy space, well-canvassed examples of regulatory arbitrage include Uber which has resisted being categorised as a taxi service[154] and as an employer of drivers who may indeed work full-time hours for Uber.[155] Prosumers on blockchain-based networks may avoid being regulated like business entities providing similar services, but may also not benefit from consumer protection.[156] These regulatory lacunae need to be considered in relation to how standards and expectations may be safeguarded while allowing prosumers to engage in commercial freedoms and innovation. Such business and commercial regulatory policy is likely to span a number of sectors. In particular, financial regulators would need to consider how dApp businesses attempting to decentralise financial services such as in creating swaps, or providing lending or remittance should be treated in the 'DeFi' space.[157] This area is

[151] Usha R Rodrigues, 'Financial Contracting with the Crowd' 69 Emory Law Journal 397 (2019).
[152] Such as ESMA, part of the ESFS, sect d below.
[153] https://mdia.gov.mt. The Authority registers blockchain-based enterprises as a new organisational species under Malta's Innovative Technological Arrangements Act 2019, a new form of thinking that is yet absent at the EU level.
[154] Michèle Finck, 'Distinguishing Internet Platforms from Transport Services: Elite Taxi v. Uber Spain' 55 Common Market Law Review 1619 (2018).
[155] Brishen Rogers, 'Employment Rights in the Platform Economy: Getting Back to Basics' 10 Harvard Law and Policy Review 480 (2016).
[156] Uncertain if s49, 57 of the UK Consumer Rights Act 2015 may apply, also Florian Möslein, 'Conflicts of Laws and Codes: Defining the Boundaries of Digital Jurisdictions' in Ioannis Lianos, Philipp Hacker, Stefan Eich and Georgios Dimitropoulos (eds), *Regulating Blockchain* (Oxford: OUP 2019), ch15.
[157] Wulf A Kaal, 'Digital Asset Markets Evolution' (2020) Journal of Corporation Law, forthcoming, https://ssrn.com/abstract=3606663.

burgeoning with innovation and needs to be considered in relation to mitigating regulatory arbitrage[158] while not discouraging useful disruptive innovation.[159]

The Need to Consider Regulatory Intersections and Coordinations at National and EU Levels

The broader regulatory blueprint for the dApp economy would likely involve regulatory intersections and coordination at national levels and between national and EU levels.

The intersection between NCBs and financial regulators such as securities regulators may not be unfamiliar, as euro area member states with single regulators,[160] or single regulators under the central bank's auspices[161] could look at constructing coordinative channels or organising internally within the central bank such joined-up capacity. Member States with disparate regulators[162] with their own remits and turfs to maintain may face more challenges in terms of being path dependent. They may prefer to fit novel dApp economy issues into existing regulatory categories, such as how the United States with its disparate regulators have taken an approach of 'coherentism'[163] rather than regulatory reform towards the phenomena raised by the dApp economy.[164] European level agencies can have a role in mitigating divergences and coordinating regulatory policy, as long as a coherent policy, such as situating the dApp economy under the Digital Single Market umbrella, can provide a foundational basis for such coordinative steers. One achievement in the European Commission's proposal for regulating crypto-assets is the recognition for inter-agency coordination between the EBA and ESMA in governing crypto-assets. Further issuers of significant stablecoins and e-money tokens are envisaged to be overseen by colleges of national regulators coordinated under the auspices of the EBA and ESMA. We however see even more cross-agency linkages that are possible, such as between the ESCB and the European agencies that form the ESFS.

It may be queried whether the ECB and NCBs, which maintain a stature of independence for the ESCB's mandates, should be engaged in such new policy and regulatory intersections and coordinations. However, with the expansion of the ECB's remit in the Banking Union, Issing for example opines that 'serving the Union's wider economic policies' provides a basis for institutional dynamism for the ECB[165] as the ECB, though independently instituted for

[158] See Usha Rodrigues, 'Semi-Public Offerings? Pushing the Boundaries of Securities Law' (2018), https://ssrn.com/abstract=3242205.
[159] Joseph Bower and Clayton Christensen, 'Disruptive Technologies: Catching the Wave' Harvard Business Review 43-53 (1995).
[160] Such as Germany, Denmark, Finland, Austria, Sweden, Latvia, Poland,
[161] Such as Hungary, Czech Republic, Ireland, Lithuania, Slovakia.
[162] Such as sectoral regulators between banking, insurance and investment/securities regulation, eg Italy, France, Spain, Belgium, Cyprus, Greece, The Netherlands, Estonia, Luxembourg, Malta, Portugal, Romania, Bulgaria, Croatia, Slovenia.
[163] Brownsword (2019), pp191-196.
[164] Chiu, Decrypting the Trends of International Regulatory Competition in Crypto-finance (2020), also see M Todd Henderson and Max Raskin, 'A Regulatory Classification of Digital Assets: Towards an Operational Howey Test for Cryptocurrencies, ICOs, and Other Digital Assets' (2019), https://ssrn.com/abstract=3269295.
[165] Otmar Issing, 'The European Central Bank' in Rodney Edvinsson, Tor Jacobson and Daniel Waldenström (eds), *Sveriges Riksbank and the History of Central Banking* (Cambridge: Cambridge University Press 2018), ch14.

specific tasks, is not insular in nature from the wider institutional context for the Single Market.[166] Further, the Banking Union has brought coordinative channels between the Single Supervisory Mechanism and the EBA.[167] There should be scope for policy thinking regarding the intersection between the ESCB and the European System of Financial Supervision (ESFS), which comprises the EBA, ESMA, EIOPA, the Joint Committee of the agencies and the European Systemic Risk Board (ESRB) constituted under the ECB. The enabling institution of a limited rollout of CBDC for investment in regulated ICOs in the dApp economy would provide such a policy platform for inter-agency interfaces. Such a broader inter-agency coordinative network provides inter-agency linkages and opportunities for learning, dialogue and cooperation, and overcomes the apparently siloed appearance of each agency's mandate.[168] Greater inter-agency networking and coordination can facilitate regulatory agility and adaptability in the face of new technological and economic structurations offered in the crypto-economy.

Further, inter-agency coordinations at the EU level and through to national level bodies, are not institutionally unfamiliar. Perhaps new inter-agency liaison structures extended from the Joint Committee of the ESFS can serve as a model for regulatory intersections and coordinations involving EU-level agencies and between national and EU level agencies. The Joint Committee currently addresses common objectives such as anti-money laundering, consumer protection etc and these are relevant to the dApp economy. As a start, the ESCB and the ESFS can be coordinatively connected for policy deliberation on dApp economy mobilisation and regulation. This can also lead to new considerations such as whether new regulatory bodies may be needed, such as the new Maltese Digital Innovation Authority.

The kind of inter-agency and multistakeholder approach adopted in the Digital Single Market strategy[169] can also provide some inspiration or a basis for a way forward for organising regulatory intersections and coordinations, in order to develop policy thinking for the dApp economy. Hazards can be sounded in terms of the inefficiencies of 'too many cooks' and the lack of definite outcomes after protracted processes of listening to every voice.[170] Nevertheless, Finck's vision of 'co-regulation'[171] is arguably necessary due to the novelties and complexities posed by the new needs of the dApp economy. From national levels to European levels, regulatory linkages and capacity need to be considered, in terms

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[166] Werner Bonefield, 'Ordoliberalism and Political Theology: On the Government of Stateless Money' in Josef Hien and Christian Joerges, *Ordoliberalism, Law and the Rule of Economics* (Oxford: Hart Publishing 2017), ch17.

[167] Gianni Lo Schiavo (ed), *The European Banking Union and the Role of Law* (Cheltenham: Edward Elgar 2019); see critical discussions of the relationship between the SSM and EBA, Eilis Ferran and Valia Babis, 'The European Single Supervisory Mechanism' (2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2224538; Concetta Brescia Morra, 'From the Single Supervisory Mechanism to the Banking Union. The Role of the ECB and the EBA' (2014), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2448913; but see positive discussions, Guido Ferranini and Luigi Chiarella, 'Common Banking Supervision in the Eurozone: Strengths and Weaknesses' (ECGI Working Paper 2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2309897.

[168] Iris H-Y Chiu, 'Power and Accountability in the EU Financial Regulatory Architecture: Examining Inter-agency Relations, Agency Independence and Accountability' European Journal of Legal Studies 68 (2015).

[169] European Commission, 'Principles for Better Self and Co-Regulation' (2018), under the Digital Single Market Strategy, https://ec.europa.eu/digital-single-market/en/best-practice-principles-better-self-and-co-regulation.

[170] 'Incumbents rule; Europe's digital single market' (The Economist, 17 Sep 2016).

[171] Finck (2018), pp171-180.

of how harmonisation or indeed appropriate decentralisation can steer policy initiatives. Such linkages should be aimed at making regulatory architectures agile and adaptable, reflecting in enabling policy that is appropriate for new economic and dynamic needs.

Conclusion

The dApp economy is an innovative and exciting business space that is creating economic value although many aspects of it are currently unregulated. Regulatory policy is only emerging in the Digital Finance Package supporting the new action plan for the Capital Markets Union. This article proposes that policy-makers play a facilitative role in mobilising this economic space and for scaling up and interface with the conventional mainstream economy. The starting point of such a facilitative regulatory regime could lie in the issuance of a central bank digital currency that addresses the weaknesses of the monetary order in the dApp economy. Such issuance can support digital social mobilisation in connecting with fund-raising needs in the dApp economy, providing a testing ground for observing demand and operational implications. The issuance of a central bank digital euro is accommodated within the legal mandate for the European System of Central Banks in the Treaty. The article argues that the introduction of a central bank digital euro provides a departure point for the building out of the dApp economy by more enabling regulatory institutions, supporting financial development, enterprisal and commercial needs more broadly. Regulatory institutions, both of a facilitative and governing nature, support and mobilise new economic actorhood, service provision, and social trust and acceptance of developments in the dApp economy. Crucially, the starting point argued for in this paper would underpin substantive policy thinking and considerations regarding regulatory intersections and coordinations at the levels of national and EU regulatory architecture. This is consistent with a co-regulatory and multi-stakeholder approach to policy building pursued in the overall EU Digital Single Market Strategy.