Computer Law & Security Review 53 (2024) 105970

Contents lists available at ScienceDirect

Computer Law & Security Review: The International Journal of Technology Law and Practice

journal homepage: www.elsevier.com/locate/clsr

The financialisation of Crypto: Designing an international regulatory consensus

Douglas W Arner [a,*], Dirk A Zetzsche [b], Ross P Buckley [c], Jamieson M Kirkwood [d]

[a] Kerry Holdings Professor in Law, RGC Senior Fellow in Digital Finance and Sustainable Development, Senior Fellow – Asia Global Institute, and Associate Director – HKU-Standard Chartered Foundation FinTech Academy, University of Hong Kong, Senior Fellow, Melbourne Law School, University of Melbourne, Australia
[b] Professor in Financial Law, ADA Chair in Financial Law (Inclusive Finance), Coordinator, House of Sustainable Governance & Markets, Faculty of Law, Economics and Finance, University of Luxembourg, and Co-Lead, National Centre for Excellence in Research in Financial Technologies (FT NCER), Luxembourg
[c] Australian Research Council Laureate Fellow and Scientia Professor, Faculty of Law & Justice, UNSW Sydney, Australia
[d] Barrister (Middle Temple, England and Wales) and Research Fellow, Centre for Banking and Finance Law, National University of Singapore, Singapore

ARTICLE INFO

Keywords:
Financialisation
Financial regulation
FTX
Cryptocurrencies
Financial stability
Decentralised finance
DeFi
Bitcoin
financial crises
Crypto-assets
Crypto Winter

ABSTRACT

Bitcoin was presented in 2008 as a technology-driven alternative to the weaknesses of the traditional monetary, payment and financial systems dramatically highlighted by the Global Financial Crisis of 2008. The underlying technology – blockchain and distributed ledger technology – was posed as a technological solution to the problems of trust, confidence, transparency and behaviour traditionally addressed in finance through a framework of law, regulation and institutions (including markets and the state). Cryptocurrencies, blockchain, distributed ledger technology and decentralised finance were designed to address the weaknesses and risks in traditional finance. Yet fifteen years of evolution culminating in the Crypto Winter of 2022–23 have demonstrated that crypto is neither special nor immune and has come to feature all the classic problems of traditional finance. As the crypto ecosystem has evolved, the market failures and externalities of traditional finance have emerged – a process we term the 'financialisation' of crypto. These include conflicts of interests, information asymmetries, centralisation and interconnections, over-enthusiastic market participants, plus agency, operational and financial risks. We argue that (a) in order to develop successfully going forward, the crypto ecosystem needs to assimilate the centuries of experience of underpinning traditional finance with law and regulation, and (b) in the aftermath of the Crypto Winter, an international consensus is crystalising in respect of the regulation of the crypto ecosystem. We argue regulatory systems are now being instituted to ensure the proper functioning of crypto and its interconnections with traditional finance. The lessons of the financialisation of crypto also apply more broadly: appropriately designed regulatory systems are central to financial market functioning and development.

1. Introduction

The year 2022 was an *annus horribilis* for the crypto ecosystem, even before the collapse of the FTX group.[1] In one year, crypto lost about USD 2 trillion in market value.[2] Following the failure of FTX, one of the biggest corporate or financial failures since the 2008 Global Financial Crisis ('GFC'), the rationale and need for a global and coordinated approach to crypto regulation has become clear.[3]

The irony inherent in what has come to be called the 'Crypto Winter' of 2022–23 is the fundamental premise of this article. Bitcoin, cryptocurrencies, digital assets and decentralised finance (which for these purposes we refer to collectively by the shorthand 'crypto') were

* Corresponding author.
E-mail address: douglas.arner@hku.hk (D.W. Arner).

[1] See, eg, Peter Fitzgerald & Amalia Neenan, Annus Horribilis 2022: Regulation May Be the Only Way out of Crypto's 'Horrible Year', City Am (5 Dec. 2022),https://www.cityam.com/annus-horribilis-2022-regulation-may-be-the-only-way-out-of-cryptos-horrible-year.

[2] See Damian Fantato, Crypto and Digital Assets Summit, Financial Times Events (28 Nov. 2022), https://www.ftadviser.com/events-awards/2022/11/28/crypto-digital-assets-summit.

[3] See, eg, Tom Burroughes, FTX Collapse May Prompt Big Regulatory Crackdown – Lawyer, Wealth Briefing Asia (18 Nov. 2022), https://www.wealthbriefingasia.com/article.php?id=196248.

https://doi.org/10.1016/j.clsr.2024.105970

Available online 2 May 2024
0267-3649/© 2024 Published by Elsevier Ltd.

presented as alternatives to the failures of traditional finance, as demonstrated in centuries of financial crises and culminating in the 2008 financial crisis. Through a transparent technological framework, crypto was precisely designed to avoid the market failures and negative externalities of traditional finance: conflicts of interest from powerful intermediaries, information asymmetries, centralisation of crucial functions and markets, concentrated control by a few large and often interconnected intermediaries, an abundance of poorly informed over-enthusiastic market participants ('irrational behaviour'), as well as agency, operational and financial risks, and of course fraud, manipulation and misconduct. Financial regulation and supervision have evolved over centuries, seeking to address a series of core objectives: to support monetary stability; enhance financial stability; ensure adequate investor, depositor and consumer protection; further market fairness, efficiency and integrity; and steer the financial system towards economic growth, financial inclusion and sustainable development.

We argue that crypto – despite its intention and technological design to be fully decentralised finance[4] ('DeFi') – has over the first fifteen years of its development evolved to display all of the classic market failures and externalities that characterise traditional finance. Since its genesis in 2009, crypto has experienced a series of cycles. At each stage, there has been a range of regulatory discussions and initiatives, usually focusing on the problems which emerged in each specific instance: Silk Road, Mt. Gox, initial coin offerings ('ICOs'), Libra and FTX all provide clear examples. Together with the duplication of traditional financial products and services in the crypto ecosystem, we call this evolutionary process the 'financialisation' of crypto. Where the market failures and externalities as well as economic motivations and objectives of participants mirror traditional finance, so must the necessary solution: the crypto ecosystem, to function properly, requires legal, regulatory and supervisory systems designed to address its inefficiencies, market failures and externalities. To survive and thrive, appropriately designed regulation is essential.

In a recent article, Aquilina, Frost and Schrimpf frame this as the necessity of 'functional' regulation.[5] We frame these functions, drawing upon experience in both TradFi and crypto, in five main areas: monetary stability, financial stability, efficiency and transparency, market integrity, consumer /investor /depositor protection, and a range of developmental objectives including growth, innovation, inclusion, competition, and sustainable development.

As a result of the experiences of the past fifteen years, we argue a new international regulatory consensus is emerging across a range of major economies. In the 2023 New Delhi Leaders' Declaration,[6] the Group of 20 ('G20') endorsed a crypto regulation framework developed by major international standard-setting organisations in response to the Crypto Winter. After the Financial Stability Board ('FSB'),[7] International Monetary Fund ('IMF')[8] and Bank for International Settlements ('BIS')[9] issued position papers, in July 2023 the FSB released three major reports. The first was an 'umbrella' note that summarised the FSB Global Regulatory Approach for Crypto-Asset Activities,[10] and the various agreements and reports from across the international financial regulatory sector regulatory organisations, particularly the International Organisation of Securities Commission ('IOSCO'),[11] Financial Action Task Force ('FATF')[12] and the Basel Committee on Banking Supervision.[13] This was accompanied by two major component pieces: 'High-level Recommendations' for crypto regulation and supervision,[14] and a revised set of high-level recommendations for stablecoins,[15] both of which were officially endorsed by the G20 in New Delhi in September 2023. In addition, the IMF-FSB released a synthesis paper outlining how

[4] DeFi strictu sensu is characterised by peer-to-peer transactions and an absence of a centralised intermediary. With DeFi, smart contracts should execute transactions between supply and demand automatically, and all servers that support the operation of the protocols ('nodes'), or token holders, as the case may be, have equal access to data and equal governance rights (or the technological equivalent of governance rights); cf. Dirk A. Zetzsche, Douglas W. Arner & Ross P. Buckley, (2020) Decentralised Finance 6:2 J. Fin Reg. 172. However, throughout the crypto industry, centralised intermediaries often deliver important functions to the DeFi ecosystem. For instance, Binance, Coinbase, FTX and others are operated by centralised entities (hence dubbed Centralised Exchanges – CEXs). From the perspective of the DeFi sector, these constitute a type of Centralised Finance ('CeFi'). Nevertheless, these CEXs allow for (a) the initial investment of fiat currency into tokens, and (b) cross-chain bridge operations, that is the swap of one crypto asset with another, ie. trading of tokens. In turn, CEXs provide most trading volume for tokens issued under alleged DeFi protocols and influence the valuation of crypto-assets which may then be relied upon by DeFi protocols. We here use the term crypto for both CeFi and DeFi services that deal with crypto-assets.

[5] Matteo Aquilina, Jon Frost & Andreas Schrimpf, (2024) Decentralised Finance (DeFi): A Functional Approach, (2024) J. Fin Reg.

[6] G20, One Earth, One Family, One Future, New Delhi Leaders' Declaration (Sep. 2023), https://www.g20.org/content/dam/gtwenty/gtwenty_new/document/G20-New-Delhi-Leaders-Declaration.pdf.

[7] See Financial Stability Board, Regulation, Supervision and Oversight of Crypto-Asset Activities and Markets: Consultative Document (11 Oct. 2022), https://www.fsb.org/wp-content/uploads/P111022-3.pdf.

[8] See International Monetary Fund, IMF Policy Paper Elements of Effective Policies For Crypto Assets (No 2023/004, Feb. 2023), https://www.imf.org/en/Publications/Policy-Papers/Issues/2023/02/23/Elements-of-Effective-Policies-for-Crypto-Assets-530092 ('Effective Policies For Crypto Assets'). See also Parma Bains et al., Regulating the Crypto Ecosystem: The Case of Unbacked Crypto Assets, IMF (26 Sep. 2022), https://www.imf.org/en/Publications/fintech-notes/Issues/2022/09/26/Regulating-the-Crypto-Ecosystem-The-Case-of-Unbacked-Crypto-Assets-523715. The IMF also proposed regulations for stablecoins on the same day – see Parma Bains et al., Regulating the Crypto Ecosystem: The Case of Stablecoins and Arrangements, IMF (26 Sep. 2022), https://www.imf.org/en/Publications/fintech-notes/Issues/2022/09/26/Regulating-the-Crypto-Ecosystem-The-Case-of-Stablecoins-and-Arrangements-523724. In a related paper the IMF reported on capital flow management measures in crypto – see Dong He et al., Capital Flow Management Measures in the Digital Age: Challenges of Crypto Assets, IMF (10 May 2022), https://www.imf.org/en/Publications/fintech-notes/Issues/2022/05/09/Capital-Flow-Management-Measures-in-the-Digital-Age-516671. See also Cristina Cuervo, Anastasiia Morosova & Nobuyasu Sugimoto, Regulation of Crypto Assets, IMF (Jan. 2020) https://www.imf.org/en/Publications/fintech-notes/Issues/2020/01/09/Regulation-of-Crypto-Assets-48810.

[9] See Matteo Aquilina, Jon Frost & Andreas Schrimpf, Addressing the Risks in Crypto: Laying out the Options, Bank for International Settlements (12 Jan. 2023) https://www.bis.org/publ/bisbull66.htm; Raphael Auer & Stijn Claessens, Regulating Cryptocurrencies: Assessing Market Reactions, Bank for International Settlements (23 Sep. 2018) https://www.bis.org/publ/qtrpdf/r_qt1809f.htm.

[10] FSB, FSB Global Regulatory Framework for Crypto-Asset Activities: Umbrella public note to accompany final framework (Jul. 2023), https://www.fsb.org/wp-content/uploads/P170723-1.pdf.

[11] IOSCO, Policy Recommendations for Crypto and Digital Asset Markets: Consultation Report (May 2023), https://www.iosco.org/library/pubdocs/pdf/IOSCOPD734.pdf.

[12] FATF, Virtual Assets and Virtual Asset Service Providers: Updated Guidance for a Risk-Based Approach (Oct. 2021), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Updated-Guidance-VA-VASP.pdf.coredownload.inline.pdf.

[13] Basel Committee on Banking Supervision, Prudential treatment of cryptoasset exposures (Dec. 2022), https://www.bis.org/bcbs/publ/d545.pdf.

[14] Financial Stability Board, High-level Recommendations for the Regulation, Supervision and Oversight of Crypto-asset Activities and Markets (Final Report, Jul. 2023) https://www.fsb.org/wp-content/uploads/P170723-2.pdf ('Recommendations for Crypto-asset Activities and Markets').

[15] FSB, High-level Recommendations for the Regulation, Supervision and Oversight of Global Stablecoin Arrangements Final report (Jul. 2023), https://www.fsb.org/wp-content/uploads/P170723-3.pdf.

the policy and regulatory frameworks for crypto-assets that the IMF and the FSB have developed (as part of the broader G20 crypto and stablecoin standard-setting process) fit together and interact with each other.[16]

Intertwining with these international processes, a range of major jurisdictions are implementing comprehensive frameworks: in the European Union, the Market in Crypto-assets Regulation (MiCA) was adopted on 19 April 2023 and came into force in June 2023.[17] MiCA introduces a licensing scheme for crypto intermediaries, prospectus rules, anti-market abuse and insider trading rules as well as bespoke legislation for stablecoins. The UK Parliament affirmed legislative changes in June 2023 as the basis of a framework of crypto regulation,[18] with ongoing consultation on further aspects.[19] Singapore, which has had a licensing regime for crypto since enacting the *Payment Services Act* in January 2020, is also implementing stablecoin regulations.[20] Hong Kong is finalising a framework for stablecoins and has implemented a licensing system for crypto intermediaries, which must apply to Hong Kong's Securities and Futures Commission for a license.[21] The United Arab Emirates ('UAE') has also developed a comprehensive licensing framework for crypto intermediaries, eg, in the form of Dubai's Virtual Asset Regulatory Authority ('VARA').[22]

We analyse these national initiatives into four main groupings. The largest group, which includes the EU, UK, Hong Kong, Singapore, Japan, Switzerland, UAE and Australia, is rapidly implementing broadly similar regulatory approaches to crypto. For the members of this group, crypto is or will soon be a regulated industry, reflecting a fundamental shift in policy approaches after a decade and a half of experience. The second group (characterised by China) has put in place strong prohibitions and controls on crypto, with limited prospects for change. The third group (characterised by a range of emerging economies including India, Brazil and Indonesia) has to date historically taken conservative and restrictive approaches to crypto but is now moving towards similar approaches to those of the first group.

The final group comprises the US, where domestic issues prevent structured approaches and where 'regulation by enforcement' has become the dominant approach. In the US, legislation has proven problematic, despite US government plans to do so by an executive order on 9 March 2022,[23] and by releasing an actual regulatory framework proposal on 17 September 2022.[24] In the US crypto has typically been *regulated* via different regulatory bodies – chiefly the Securities and Exchange Commission ('SEC') and Commodities Futures Trading Commission ('CFTC'), which have so far largely employed a 'regulation by enforcement' approach.[25] The level of enforcement however has been increasing dramatically. For example, the SEC launched investigations into various aspects of crypto, including recent crypto 'exchange' selling of unregistered securities (eg, the SEC's investigations into Genesis and BlockFi, which have now extended to Binance, Coinbase and others).[26]

This article considers financialisation, regulatory implications, and the emerging crypto regulatory consensus. It proceeds as follows. In Part 2 we consider the evolution of crypto cycles and crises, including Mt. Gox in 2014 and the ICO Bubble of 2017–2019 but focusing particularly on the Crypto Winter of 2022–23.[27]

In Part 3 we argue that these crises are characterised by what we term the financialisation of crypto. We argue that crypto is *not immune* from conflicts of interests, information asymmetries, interconnections of principal actors, irrational behaviour, criminal conduct, and a wider range of agency, operational and financial risks. This process of financialisation has included the rise of what we call 'systemically important crypto intermediaries' ('SICIs') that, directly contrary to the philosophy of crypto and DeFi, dominate the ecosystem. The emergence of dominant intermediaries has proven historically problematic in traditional finance; the same has been proven true in the crypto ecosystem. Due to lack of regulation and transparency, we classify these as forms of 'shadow finance', which, in the formal banking sector, was a central precipitant of the 2008 GFC.[28]

Part 4 distinguishes between the risks where crypto exhibits features of traditional finance, and those where idiosyncrasies justify bespoke regulation. We then propose regulatory solutions to address the financialisation of crypto.

Part 5 argues that while technology and innovation are central to the evolution of finance, so long as humans are central participants, the core

[16] See IMF and FSB, Synthesis Paper: Policies For Crypto Assets (Sep. 2023), https://www.fsb.org/wp-content/uploads/R070923-1.pdf.

[17] Regulation (EU) 2023/1114 of the European Parliament and of the Council of 31 May 2023 on markets in crypto-assets ('MiCA'). For a good overview see Press Release, European Council & the Council of the European Union, Digital finance: agreement reached on European crypto-assets regulation (MiCA) (30 Jun. 2022), https://www.consilium.europa.eu/en/press/press-releases/2022/06/30/digital-finance-agreement-reached-on-european-crypto-assets-regulation-mica; David Carlisle, Crypto 2023 Predictions: MiCA Will be the Blueprint For Regulation Globally, Elliptic Connect (14 Dec. 2022), https://hub.elliptic.co/analysis/crypto-2023-predictions-mica-will-be-the-blueprint-for-regulation-globally. For a critical discussion of MiCA see DA Zetzsche, et al., Remaining Regulatory Challenges in Digital Finance and Crypto-assets after MiCA (2023) ('Remaining Regulatory Challenges').

[18] The Financial Services and Markets Act 2000 (Financial Promotion) (Amendment) Order 2023 (Jul. 2023), https://www.legislation.gov.uk/uksi/2023/612/contents/made

[19] HM Treasury, Future financial services regulatory regime for cryptoassets: Consultation and call for evidence (Report PU 3273, Feb. 2023), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1133404/TR_Privacy_edits_Future_financial_services_regulatory_regime_for_cryptoassets_vP.pdf.

[20] See, eg, Singapore Launches Licensing for Cryptocurrency Firms, ejinsight (30 Jan. 2020) https://www.ejinsight.com/eji/article/id/2364700/20200130-singapore-launches-licensing-for-cryptocurrency-firms; Lena Ng, Singapore to Tighten Rules on Cryptocurrency Trading, Clifford Chance Talking Tech (30 Nov. 2022) https://www.cliffordchance.com/insights/resources/blogs/talking-tech/en/articles/2022/11/singapore-to-tighten-rules-on-cryptocurrency-trading.html.

[21] See, eg, Hong Kong Licensing Regime for Virtual Asset Exchanges to Take Effect on 1 March 2023, Charltons Law (Jul. 2022), https://www.charltonslaw.com/hong-kong-licensing-regime-for-virtual-asset-exchanges-to-take-effect-on-1-march-2023.

[22] See, eg, Virtual Asset Regulatory Authority (Aug. 2023), https://www.vara.ae/en/.

[23] Ryan Browne, Biden Just Put Out an Executive Order on Cryptocurrencies – Here's Everything That's in it, CNBC, 9 Mar. 2022, https://www.cnbc.com/2022/03/09/heres-whats-in-bidens-executive-order-on-crypto.html.

[24] MacKensie Sigalos, Biden White House just put out a framework on regulating crypto — here's what's in it, CNBC, 18 Sep. 2022, https://www.cnbc.com/2022/09/16/heres-whats-in-biden-framework-to-regulate-crypto.html.

[25] Chris Brummer has coined the term 'regulation by enforcement': "In the absence of clear guidelines, regulation by enforcement is becoming increasingly likely as a clarity-inducing tool". C. Brummer, Disclosure, Dapps and DeFi, (2022) 5:2 Stan. J. Blockchain L. & Pol'y 137 at 146.

[26] For a comprehensive overview, see Program on International Financial Systems, A Review on Cryptoasset Market Structure and Regulation in the U.S. PIFS International (Feb. 2023), https://www.pifsinternational.org/cryptoasset-market-structure-and-regulation-in-the-u-s. See also SEC, SEC Files 13 Charges Against Binance Entities and Founder Changpeng Shao (Press Release, Jun. 2023) https://www.sec.gov/news/press-release/2023-101; SEC, SEC Charges Coinbase for Operating as an Unregistered Securities Exchange, Broker, and Clearing Agency (Press Release, Jun. 2023) https://www.sec.gov/news/press-release/2023-102#:~:text=The%20SEC%20alleges%20that%2C%20since,certain%20blockchains%20and%20Coinbase%27s%20efforts.

[27] See, eg, Russell Wong, Why Stablecoins Fail: An Economist's Post-Mortem on Terra, (2022) 22:24 Fed. Res. Bank Rich. Econ. Brief. See also Hilary J. Allen, The Superficial Allure of Crypto, (2022) 59:3 Fin & Dev. 27.

[28] We use 'shadow finance' rather than 'shadow banking' because these activities were largely beyond the regulatory perimeter (and hence in the shadows) but not conducted by traditional lending businesses.

risks of finance throughout its history will be present, the objectives central to financial regulation will continue to apply, and markets will continue to develop and function best when both regulators and market participants work together to provide appropriate frameworks. In Part 6, drawing on crypto as an archetypal innovation, we consider whether the emerging regulatory approaches are appropriate to balance both risks and opportunities. We conclude that the principle of 'same function, same risk, same rules' is an important formulation with potentially general applicability.

2. Crypto, DeFi and digital assets: The first fifteen years

Since its inception and despite the intentions of its underlying technological design, crypto has experienced a series of crises and cycles of euphoria, collapse and failure, with particular examples during 2011–14 (culminating in the collapse of Silk Road and Mt Gox), 2016–18 (the ICO Bubble), 2019 (Facebook's Libra proposal) and 2020–23 (ending with the Crypto Winter). Each of these, culminating in the 2022–23 Crypto Winter, provide clear examples of market failures and externalities in the crypto ecosystem very similar to those which characterise traditional finance.[29] We term this the 'financialisation' of crypto: as crypto has become functionally more like traditional finance, it has also come to display the market failures and externalities that were at the heart of the 2008 GFC and the other major financial crises, including regulatory arbitrage, concentration, interconnection and a range of governance failures and criminal behaviour. This in turn provides the central argument for the application of regulation.[30]Given that a central *raison d'etre* of crypto was to make such problems impossible, this is exquisitely ironic.

As we have considered earlier crypto cycles in our previous work, [31] we focus here on the Crypto Winter of 2022–23.

2.1. The Crypto Winter of 2022–23: the Lehman and Enron moments for crypto

FTX, the most prominent crypto failure of 2022, was valued at USD 32 billion in its January 2021 funding round.[32] In early 2022, FTX was one of the world's largest cryptocurrency intermediaries, labelling itself as an 'exchange' but actually functioning as a complex conglomerate. FTX's revenue grew exponentially from USD 90 million in 2020 to over USD 1 billion in 2021[33] – an astonishing growth of over 1000 per cent in one year. Although these figures were significantly smaller than, say, Coinbase, which posted revenue of over USD 7 billion in 2021,[34] and the market leader Binance, with revenues of over USD 20 billion in 2021,[35] FTX was one of the major crypto firms by both visibility and transaction volumes.[36]

The FTX failure was a classic liquidity crisis that turned into a solvency crisis, like that of Lehman Brothers in 2008. When a financial intermediary is unable to access sufficient liquidity to continue its business, this liquidity crisis will often evolve into a solvency crisis which can trigger wider losses of confidence in the entire sector, and potentially a financial crisis, as we observed in the second half of 2022 in crypto. Despite FTX's efforts to secure a solution in the form of emergency liquidity and maintain the trust and confidence of market participants (including by reaching out to Binance – as a sort of crypto 'white knight' for emergency assistance),[37] ultimately it was forced to file for insolvency in the context of a traditional court based resolution. The result today is a range of insolvency actions in major jurisdictions and regulatory, investor and customer actions spread around the world.[38]

The role of Binance as FTX's largest competitor merits closer consideration, as FTX's difficulties first became known to the world through Binance's publicly aired concerns of the (apparently) excessive exposures of FTX's investment vehicle Alameda to FTT, an FTX-issued crypto token.[39] That announcement was made *after* crypto-assets worth USD 500 million previously held in FTT were transferred to Binance accounts, thereby frontrunning the FTT liquidity crisis and preserving its balance sheet from the announcement imposed on other crypto investors only able to sell *after* the announcement undermined trust in FTX.[40] Binance's role was unlike that of regulated intermediaries in similar situations that have acted primarily in coordinated efforts to maintain the overall trust in financial markets, for instance in the context of the LTCM crisis of 1998. After posing as a potential 'white knight' (thereby delaying bankruptcy for roughly a week and allowing time to execute many – possibly dubious – transactions), Binance opted out with another public statement that effectively thwarted other third-party restructuring efforts.

[29] Although financialisation is a process that has been going on for thousands of years, it has accelerated since the 1990s – see Mario Seccareccia, Understanding Financialisation: History, Theory, and Institutional Analysis: Editor's Introduction, (2013) 42:4 Int'l J. Pol. Econ. 3. See also Malcolm Sawyer, What Is Financialisation?, (2013) 42:4 Int'l J. Pol. Econ. 5. Iris H-Y Chiu, Regulating the Crypto Economy: Business Transformations and Financialisation (1st ed, 2021).

[30] There is also talk of the cryptoisation of finance – see Bo Li & Nobuyasu Sugimoto, Crypto Contagion Underscores Why Global Regulators Must Act Fast to Stem Risk, IMF (18 Jan. 2023), https://www.imf.org/en/Blogs/Articles/2023/01/18/crypto-contagion-underscores-why-global-regulators-must-act-fast-to-stem-risk. The cryptoisation of finance refers to when crypto "assets are substituted for domestic currency and assets, and circumvent exchange and capital control restrictions". We do not analyse this here. See also Aquilina, Frost and Schrimpf (n 5).

[31] DA Zetzsche, RP Buckley, DW Arner & L Fohr, "The ICO Gold Rush: It's a Scam, It's a Bubble, It's a Super Challenge for Regulators", (2019) 60 (2) Harvard International Law Journal 267; DA Zetzsche, RP Buckley & DW Arner, "The Distributed Liability of Distributed Ledgers: Legal Risks of Blockchain", (2018) 4 University of Illinois Law Review, 1361; DA Zetzsche, DW Arner & RP Buckley, "Decentralized Finance", (2020) 6 (2) Journal of Financial Regulation, 172; and DA Zetzsche, RP Buckley & DW Arner, "Regulating Libra", (2021) 41 Oxford Journal of Legal Studies, 80.

[32] 'Rise and Fall of Crypto Exchange FTX', Reuters (online, 17 Nov. 2022) https://www.reuters.com/markets/currencies/rise-fall-crypto-exchange-ftx-2022-11-10/.

[33] See Kate Rooney, FTX grew revenue 1,000% during the crypto craze, leaked financials show, CNBC (22 Aug. 2022), https://www.cnbc.com/2022/08/20/ftx-grew-revenue-1000percent-during-the-crypto-crase-leaked-financials.html.

[34] See Shareholder Letter, Fourth Quarter and Full-Year 2021, Coinbase (24 Feb. 2022) https://s27.q4cdn.com/397450999/files/doc_financials/2021/q4/Coinbase-Q421-Shareholder-Letter.pdf.

[35] See Tom Maloney, Yueqi Yang & Ben Bartenstein, World's Biggest Crypto Fortune Began With a Friendly Poker Game, Bloomberg Crypto (11 Jan. 2022), https://www.bloomberg.com/news/features/2022-01-09/binance-ceo-cs-s-net-worth-billionaire-holds-world-s-biggest-crypto-fortune.

[36] Lehman Brothers was reputed to be in the "Too Big To Fail" category with 2007 revenues of USD$59 Billion – with the list of the biggest companies in the US in 2008, see Fortune 500, CNN Money (5 May 2008) https://money.cnn.com/magasines/fortune/fortune500/2008/snapshots/10312.html. Ultimately however, Lehman Brothers was allowed to fail in 2008 – see, eg, Oonagh McDonald, Bank Failure: Lessons from Lehman Brothers (Dennis Faber & Niels Erwin Vermunt eds., 2017).

[37] See Ortenca Aliaj et al., Binance Ditches Deal to Rescue Rival Crypto Exchange FTX, Financial Times (10 Nov. 2022), https://www.ft.com/content/ad440b22-00e2-44e9-b95d-449bb89fd504

[38] In 2018 we showed that decentralised does not mean you are not subject to suit anywhere, but rather that you are subject to suit everywhere. See Dirk A. Zetzsche, Ross P. Buckley & Douglas W. Arner, The Distributed Liability of Distributed Ledgers, (2018) 4 U. Ill. L. Rev. 1361.

[39] See Fitzgerald & Neenan (n 1).

[40] For a full account of events, see DA Zetzsche, et al., Regulatory Chalenges after MiCA and the Revision of the Transfer of Funds Regulation (2023), at 39-41.

2.2. Regulation vs technology: the foundation of trust

FTX's inability to source liquidity was the same as in traditional finance: insolvency resulting from an inability to meet customer/creditor/investor calls when they became due.

In traditional finance, when liquidity crises occur, the remedy is sourcing liquidity from an external source, such as other market participants. Recently, liquidity has more often been sourced from central banks or governments, for instance during the 2008 GFC, at the start of the COVID-19 pandemic in 2020, and in the 2023 Credit Suisse case, with the classic framework dating to Bagehot at the end of the 19th century.[41]

With regard to crypto this road was blocked: crypto market trust and confidence were meant to flow from the underlying technology, rather than regulation, supervision and central bank involvement, particularly from the standpoint of emergency provision of liquidity to support market function and monitoring potential financial stability risks. Cryptocurrencies are based on decentralised peer-to-peer money exchange, designed to avoid liquidity and solvency crises. But intermediaries like FTX and others typically serve as the entry point to these decentralised systems, which introduces a high degree of centralisation not originally contemplated by the original designers of the peer-to-peer transaction recording systems. Workable reform agendas for the crypto industry need to recognise this profound change in the nature of these 'decentralised' systems and provide the regulation required by such centralised markets.

At the height of the 2022–23 Crypto Winter, crypto lacked both the *preventative* measures (such as regulation and supervision both to maintain market trust and confidence, and in particular risk management and market abuse rules) *and* the *liquidity, restructuring and resolution* measures characteristic of traditional finance implemented in the wake of the 2008 crisis, facilitating crisis support or intervention today. Both prevention and resolution in traditional finance rest on what crypto enthusiasts deem superfluous due to technological design: regulation.

2.3. Liquidity vs solvency

However, there is the wider question about exactly why FTX had financial problems and whether FTX was not only a liquidity crisis but instead a solvency crisis. The answer to this question, given the accusations of fraud, potentially makes this an *Enron moment* for the crypto industry, rather than a *Lehman moment* or a *Minsky moment*.[42]

The FTX group comprised four main elements: first, the exchange, an entity licensed in the United States which focused on US customers, and was the second-largest US crypto exchange before the group's collapse; second, the global 'exchange', which acted as an intermediary or trading venue, and was a market maker and broker-dealer for cryptocurrency trading; third, a trading fund called Alameda; and finally, a variety of venture capital investments.[43] The global exchange moved its headquarters from Hong Kong to the Bahamas in September 2021, registering with the Securities Commission of the Bahamas under the Bahamas Digital Assets and Registered Exchanges Act 2020.[44]

While FTX portrayed itself as an exchange, it was functioning as a broker-dealer and proprietary trader in assets whose issuance it controlled. All in all it functioned as a financial conglomerate (more like Lehman or Enron) rather than an exchange bringing together buyers and sellers. It appears problems arose in Alameda, FTX group's trading arm. Ultimately, when in financial difficulty, reports suggest FTX customer funds were transferred from the cryptocurrency trading venue to other parts of its corporate group to cover Alameda's trading and investment losses[45] – behaviour utterly different from that required of a *bona fide* exchange, or any regulated entity in traditional finance.

Determining what precisely happened is severely hampered by the complete lack of internal controls, proper accounting systems, and even systems for keeping track of customer accounts. As John Ray III, the restructuring expert appointed to lead FTX, stated, he has never in his entire career seen 'such a complete failure of corporate controls'.[46] So, what truly happened is at the time of writing still being deciphered and is likely to take years to finally make its way through the insolvency courts.

2.4. Contagion and interconnection

A single snowflake does not a winter make, and many collapses beyond FTX together comprise the Crypto Winter of 2022–23. Fig. 1 shows the crypto failures of 2022–23 by gross liabilities.

As for trading platforms, Vauld and Sipmex filed for creditor protection on 22 July 2023, Hodlnaut followed in August 2022,[48] and FTX and BlockFi in November 2022.[49] Babel Finance, Celsius Network, BlockFi and Genesis were more crypto lending firms; although we note the business models are not clear cut, as both Hodlnaut and FTX also ran crypto lending programmes. Further, Core Scientific and Compute North are Bitcoin mining firms, the Terra algorithmic crash concerned a stablecoin system, while Three Arrows Capital (3AC) acted as a crypto hedge fund (ie, a proprietary trader on its own and its investor's

[41] See e.g., Walter Bagehot's work, "Lombard Street: A Description of the Money Market" first published in 1873.

[42] See, eg, Steve Mollman, 'A Lot of People Have Compared This to Lehman. I Would Compare It to Enron': Larry Summers Has Some Choice Words for Sam Bankman-Fried and FTX, Fortune (12 Nov. 2022), https://fortune.com/2022/11/11/larry-summers-ftx-crypto-collapse-more-like-enron-than-lehman. A Minsky moment, named after the Economist Hyman Minsky, is the moment in a liquidity crisis when the entity becomes insolvent – see, eg, Jan A. Kregel, Is this the Minsky Moment for Reform of Financial Regulation?, (Levy Economics Institute Working Paper No. 586, Feb. 2010).

[43] See, eg, Alex Hern & Dan Milmo, What do we know so far about collapse of crypto exchange FTX?, The Guardian (18 Nov. 2022), https://www.theguardian.com/technology/2022/nov/18/how-did-crypto-firm-ftx-collapse.

[44] As regards the Bahamas Digital Assets and Registered Exchanges Act 2020, see Aliya Allen & Sean McWeeney Jr., 15 FAQ's on the Digital Assets and Registered Exchanges (DARE) Act, 2020, Graham Thompson Insights (2021), https://grahamthompson.com/wp-content/uploads/2021/01/GT-News-Insights-Vol-3-Issue-1-DARE.pdf.

[45] See Angus Berwick & Tom Wilson, Exclusive: Behind FTX's fall, Battling Billionaires and a Failed Bid to Save Crypto, Reuters (11 Nov. 2022), https://www.reuters.com/technology/exclusive-behind-ftxs-fall-battling-billionaires-failed-bid-save-crypto-2022-11-10; Vicky Ge Huang, Alexander Osipovich & Patricia Kowsmann, FTX Tapped Into Customer Accounts to Fund Risky Bets, Setting Up Its Downfall, Wall Street Journal (11 Nov. 2022), https://www.wsj.com/articles/ftx-tapped-into-customer-accounts-to-fund-risky-bets-setting-up-its-downfall-11668093732.

[46] See also Kadim Shubba, Joshua Oliver & Sujeet Indap, New FTX Chief Says Crypto Group's Lack of Control Worse than Enron, Financial Times (18 Nov. 2022), https://www.ft.com/content/7e81ed85-8849-4070-a4e4-450195df08d7.

[47] Source: Research by ADA Chair in Financial Law (inclusive finance), University of Luxembourg. Note that the Signature numbers refer to Signature's crypto business only and leave out traditional banking business.

[48] Rebecca Oi, Top 10 Biggest Crypto Failures of 2022, Fintech News Singapore (20 Dec. 2022), https://fintechnews.sg/67859/crypto/top-10-biggest-crypto-failures-of-2022/.

[49] Press Release, United States Securities Exchange Commission, BlockFi Agrees to Pay $100 Million in Penalties and Pursue Registration of its Crypto Lending Product (14 Feb. 2022), https://www.sec.gov/news/press-release/2022-26; Greg Iacurci, As BlockFi Files for Bankruptcy, What to Know about Crypto Investor Protections, CNBC (28 Nov. 2022), https://www.cnbc.com/2022/11/28/what-to-know-about-crypto-investor-protections-as-blockfi-files-for-bankruptcy.html.

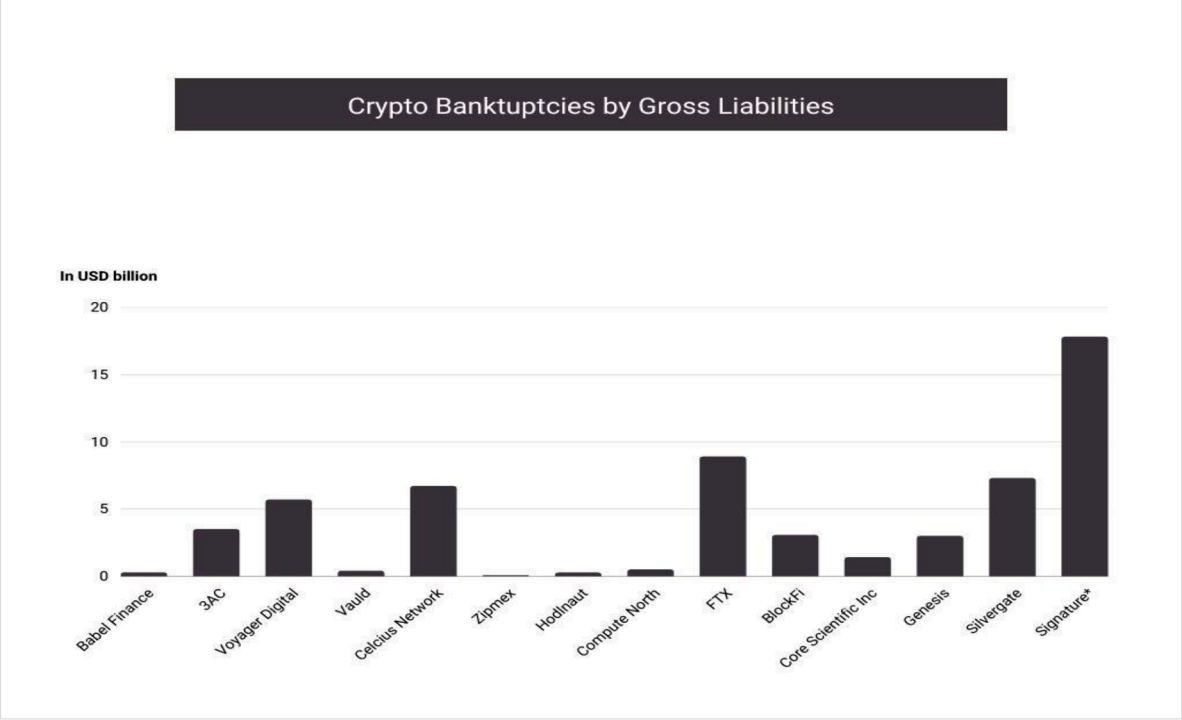

Fig. 1. Crypto Failures (by Gross Liabilities).[47]

account). These issues echoed into eventual deposit withdrawals and losses at Silvergate Bank in the US, leading to its failure. Concerns about other tech-exposed banks led to the failure of Signature and Silicon Valley Bank all early in 2023.

While crypto exchanges are cloaked in a narrative of decentralisation, the widespread institutional instability throughout the crypto industry highlights the reality of high concentrations of risk in highly centralised entities that are utterly different to what would be the case in a truly decentralised financial system. Close examination of each collapse confirms that the risks were concentrated in the crypto intermediaries, with a high degree of interconnectedness and centralisation which became unstable due to some combination of mismanagement, malfeasance, theft and a general lack of transparency.[50]

The intermediaries exist and prosper for one of the core reasons financial intermediaries always have – they either make the market easier to participate in or more efficient. In this case if participants were willing to manage their private keys and keep them safe themselves, the market could operate without intermediaries, but this is very difficult. If the key is lost, so is the crypto asset, utterly and irretrievably. So very understandably, intermediaries have grown in the form of the crypto exchanges and crypto custodians to manage this function for participants, and in doing so have centralised the risk to a degree beyond that regularly seen in traditional financial markets.[51]

Yet, crypto had by then developed far beyond 'exchanges'. As additional examples, we discuss stablecoins, investment funds and crypto lenders in turn.

2.4.1. *Stablecoin projects*

Before failing in May 2022, Terra's UST stablecoin was the fourth-largest stablecoin with USD 18 billion in market capitalisation, behind only Tether ('USDT'), USD Coin ('USDC') and Binance USD ('BUSD').[52] The Terra project collapsed because its algorithmic design relied on a two-coin system. Terra's UST coin was pegged to the underlying fiat currency via Terra's LUNA token, designed to stabilise the supply and demand of UST through arbitrage (ie, contracting or expanding the UST pool by using the LUNA pool as a counterweight). Additionally, arbitrage opportunities were expected to quickly correct any slight movements away from the peg, since Terra allowed arbitrageurs to trade USD 1 worth of LUNA for 1 UST, and vice versa, at any time.[53]

This algorithmic mechanism could not handle Terra's growth and ultimately failed. Terra's algorithmic stabilisation mechanism probably became overwhelmed because its Anchor protocol offered a hefty, and probably overly-ambitious, 20 per cent return for staking UST, since UST holders often sold en masse if they feared LUNA would fail.[54] Additionally, it is speculated that a coordinated attack on Terra broke the link, thereby profiting those on the other side, similar to the 2021 IronFinance algorithmic stablecoin project.[55] Terra's failure sent shockwaves through the entire crypto industry, perfectly illustrating

[50] See, eg, Dietrich Knauth, Factbox: Crypto Companies Crash into Bankruptcy, Reuters (2 Dec. 2022), https://www.reuters.com/technology/crypto-companies-crash-into-bankruptcy-2022-12-01; Julian Mark, The Companies That Helped Create 2022's 'Crypto Winter', Washington Post (5 Dec. 2022), https://www.washingtonpost.com/business/2022/12/05/crypto-ftx-collapse-bankruptcy-companies.

[51] See Crypto Council for Innovation, Key Elements of an Effective DeFi Framework (Aug. 2023).

[52] See TerraClassicUSD Historical Data, CoinMarketCap (6 Dec. 2022), https://coinmarketcap.com/currencies/terrausd/historical-data.

[53] Antonio Briola et al., Anatomy of a Stablecoin's Failure: The Terra-Luna case, (2023) 51 Fin Res. Letters.

[54] See, eg, Elisabeth Lopatto, How the Anchor Protocol Helped Sink Terra, The Verge (22 May 2022), https://www.theverge.com/2022/5/20/23131647/terra-luna-do-kwon-stablecoin-anchor.

[55] See, eg, Taylor Locke, Did a 'Concerted Attack' Cause Terra's UST to Crash below $1? An Exec behind the Largest Stablecoin and Experts Agree It's Suspicious, Fortune (14 May 2022), https://fortune.com/2022/05/13/terra-ust-stablecoin-crash-suspicious-potential-attack-george-soros. See also Austin Adams & Markus Ibert, Runs on Algorithmic Stablecoins: Evidence from Iron, Titan, and Steel, Federal Reserve, FEDS Notes (2 Jun. 2022), https://www.federalreserve.gov/econres/notes/feds-notes/runs-on-algorithmic-stablecoins-evidence-from-iron-titan-and-steel-20220602.html.

how DeFi cannot unilaterally prevent linkages from centralised platforms and revealing the systemic risks that affect downstream intermediaries (described below).

2.4.2. Crypto investment funds

The once respected Singaporean crypto hedge fund 3AC filed for bankruptcy protection on 1 July 2022, a few days before Voyager and Celsius (see below).[56] 3AC went from over USD 10 billion in assets to collapse in a few months. After its failure, the Monetary Authority of Singapore accused 3AC of exceeding its assets threshold and providing false information.[57] 3AC, which has been called 'the crypto version of Long-Term Capital Management' (LTCM[which]), used high levels of leverage to make a series of large directional trades in Grayscale Bitcoin Trust (GBTC), Luna Classic (LUNC) and Staked Ether (stETH).[58] The consequences of losses on its positions spread throughout the ecosystem because it was trading funds primarily borrowed from over 20 other institutions. The concentration of risk in one point of failure and the resultant impact on a range of other significant market participants echoes LTCM's situation in the aftermath of Russia's August 1998 default. 3AC's founders Su Shu and Kyle Davies quickly disappeared after filing for bankruptcy, prompting liquidators to serve subpoenas via Twitter.[59] The founders have since resurfaced as founders of Open Exchange, a new crypto investment vehicle, focusing on claims against failed crypto firms.[60]

The 3AC failure appears to reinforce the view that 'crypto is a game of creating virtual fortunes out of thin air and convincing other humans with traditional forms of money that those virtual fortunes deserve to be real-world ones'.[61]

2.4.3. Crypto lenders

Celsius was meant to operate as a safe and secure mechanism to generate attractive returns for crypto holders. It filed for bankruptcy protection on 13 July 2022, losing some USD 5 billion in customer funds.[62] It has been alleged (in a civil lawsuit) that Celsius was running a 'Ponzi scheme' by offering depositors rates for staking of up to 17 per cent, while also loaning these funds out. The lawsuit claims that Celsius 'artificially inflated the price of its digital coin, failed to hedge risk and engaged in activities that amounted to fraud'.[63]

Voyager was a crypto lender like Celsius and suffered the same fate. Voyager filed for bankruptcy protection on 5 July 2022, as it was unable to repay or even account for customer deposits.[64] Voyager did not keep customer deposits in designated wallets, but mixed deposited crypto and then lent deposits to third parties (like 3AC and FTX/Alameda) to pay interest to customers. Allegations that Voyager was involved in illegal conduct have also been made in, inter alia, an investigation by the US Federal Deposit Insurance Company.[65]

Crypto lender Genesis similarly filed for bankruptcy protection in January 2023, shortly after the US SEC charged it with selling unregistered securities.[66] Genesis operated within the Digital Currency Group, in which other companies operated various trading businesses (which continue) and had been borrowing from Genesis.[67]

It is probable that many other crypto firms, including FTX, were destabilised by these other failures earlier in 2022 (especially as FTX was involved in attempted restructuring activity).[68] This should not happen if crypto is truly decentralised as DeFi was designed to avoid the interlinkages of traditional finance.

2.5. Operational instability: Not an exception, but rather the norm

While the 2022–23 Crypto Winter largely demonstrates crypto management's incapacity to steer financial firms well, 2022–23 was further characterised by the capacity of outsiders to exploit a system's weaknesses and divert assets.

Fig. 2 lists some high-volume asset diversions in the DeFi sector. Strikingly, several large-scale asset diversions occurred in 2022–23,

[56] See Arjun Khapal, Crypto Hedge Fund Three Arrows Files for Chapter 15 Bankruptcy, CNBC (2 Jul. 2022), https://www.cnbc.com/2022/07/02/crypto-hedge-fund-three-arrows-files-for-chapter-15-bankruptcy.html; MacKensie Sigalos, From $10 Billion to Zero: How a Crypto Hedge Fund Collapsed and Dragged Many Investors down with It, CNBC (12 Jul. 2022), https://www.cnbc.com/2022/07/11/how-the-fall-of-three-arrows-or-3ac-dragged-down-crypto-investors.html. See also Alex Hern & Dan Milmo, Three Arrows Capital to Become Latest Casualty of Crypto Crash, The Guardian (29 Jun. 2022), https://www.theguardian.com/technology/2022/jun/29/three-arrows-capital-to-become-latest-casualty-of-crypto-crash.

[57] See Tom Westbrook & Jason Neely, Singapore Regulator Rebukes Crypto Fund Three Arrows Capital, Reuters (30 Jun. 2022), https://www.reuters.com/business/finance/singapore-regulator-rebukes-crypto-fund-three-arrows-capital-2022-06-30.

[58] Jacob Wollinsky, How Hedge Fund Three Arrows Capital Was Crypto's Long-Term Capital Management, Forbes (24 Aug. 2022), https://www.forbes.com/sites/jacobwolinsky/2022/08/24/how-hedge-fund-three-arrows-capital-was-cryptos-long-term-capital-management.

[59] Muyao Shen & Jeremy Hill, Three Arrows Capital Liquidators Demand Documents Via Twitter, Bloomberg Crypto (6 Jan. 2023), https://www.bloomberg.com/news/articles/2023-01-05/3ac-liquidators-demand-documents-from-founders-via-twitter.

[60] Aaryamann Shrivastava, Bankrupt 3AC Founders Kyle Davies and Shu Su Launch New Exchange for Crypto Claims Trading, FXStreet (10 Feb. 2023), https://www.fxstreet.com/cryptocurrencies/news/bankrupt-3ac-founders-kyle-davies-and-shu-su-launch-new-exchange-for-crypto-claims-trading-202302100000.

[61] Jen Wiecsner, The Money Game: The Crypto Geniuses Who Vaporised a Trillion Dollars, NY Mag (15 Aug. 2022), https://nymag.com/intelligencer/article/three-arrows-capital-kyle-davies-su-shu-crash.html.

[62] See Wayne Duggan & Farran Powell, Celsius Crypto Meltdown: A Crypto Lender In Crisis, Forbes (Oct. 4, 2022), https://www.forbes.com/advisor/investing/cryptocurrency/what-is-celsius.

[63] See Arjun Kharpal, Embattled Crypto Lender Celsius Is a 'Fraud' and 'Ponsi Scheme,' Lawsuit Alleges, CNBC (8 Jul. 2022), https://www.cnbc.com/2022/07/08/crypto-lender-celsius-is-a-fraud-and-ponsi-scheme-lawsuit-claims.html.

[64] See Jeremy Hill, Voyager Account Holders Likely Won't Get all Their Crypto Back, Bloomberg Crypto (6 Jul. 2022), https://www.bloomberg.com/news/articles/2022-07-06/voyager-account-holders-likely-won-t-get-all-their-crypto-back.

[65] See, eg, Allyson Versprille, FDIC Probing How Bankrupt Crypto Lender Voyager Marketed Itself, Bloomberg Crypto (8 Jul. 2022), https://www.bloomberg.com/news/articles/2022-07-07/fdic-probing-how-bankrupt-crypto-broker-voyager-marketed-itself.

[66] See Rohan Goswami & MacKensie Sigalos, Crypto Lender Genesis Files for Bankruptcy in Latest Blow to Barry Silbert's DCG Empire, CNBC (20 Jan. 2023), https://www.cnbc.com/2023/01/20/crypto-lender-genesis-trading-files-for-bankruptcy-barry-silbert-digital-currency-group.html; Rohan Goswami, Crypto Firms Genesis and Gemini Charged by SEC with Selling Unregistered Securities, CNBC (12 Jan. 2023), https://www.cnbc.com/2023/01/12/sec-charges-genesis-and-gemini-with-selling-unregistered-securities.html.

[67] Sonali Basak et al., Genesis Balance Sheet Reveals Web of Loans Across Silbert Empire, Bloomberg Technology (23 Nov. 2022), https://www.bloomberg.com/news/articles/2022-11-22/genesis-balance-sheet-reveals-web-of-loans-across-silbert-empire-dcg.

[68] See, eg, Olga Kharif, Crypto Billionaire Bankman-Fried Eyeing Bid for Celsius Assets, Bloomberg (28 Sep. 2022), https://www.bloomberg.com/news/articles/2022-09-27/crypto-billionaire-bankman-fried-eyeing-bid-for-celsius-assets. See also Steven Church, FTX's $1.4 Billion Deal for Bankrupt Lender Voyager Is Cancelled, Bloomberg Crypto (16 Nov. 2022), https://www.bloomberg.com/news/articles/2022-11-15/ftx-s-1-4-billion-deal-for-bankrupt-crypto-lender-voyager-void.

[69] Research by ADA Chair in Financial Law (inclusive finance), University of Luxembourg.

thereby undermining much of the trust remaining in the general institutional stability of DeFi business models.

In some instances, private keys were stolen through hacks of crypto custodians' wallets and exchanges ('hot wallet hacks');[70] in others, attackers hacked the governance mechanism, acquiring control over the platform's protocols ('Governance Hacks'), which allowed them to divert assets.[71] Several platforms experienced in 2022 attacks which were similar, casting doubt on the industry's ability to learn and improve cyber security.

In hindsight, each failure during the Crypto Winter involved similar elements including concentration, institutional instability, operational failures, and fraud and misconduct. For instance, before Mt. Gox's failure in early 2014, it dealt with some 70 percent of Bitcoin transactions worldwide. Mt. Gox was a systemically important intermediary for the Bitcoin ecosystem. As in the 2022–23 Crypto Winter, a mix of incompetence, lack of risk management and unrealistic promises met a mass of overenthusiastic crypto clients searching for high returns. Once the capacity and resources of the system were overstretched, vulnerabilities emerged due to operational incompetence, theft and fraud: in the case of Mt. Gox this eventuated in the infamous 2011 hot wallet hack. That this hack was undetected for three years demonstrates severe internal deficiencies in accounting and auditing – these critical functions were not compliant with the standards prescribed for regulated financial intermediaries or even reasonable business behaviour, particularly when dealing with other people's money (the classic agency risk in finance).

A lack of appropriate risk-management and analysis combined with fraud and misconduct also characterised the 2016–18 ICO Bubble:[72] the common denominator of many crypto projects was (1) the emergence of one dominant crypto token, paired with (2) utterly inadequate disclosure of information, supported by (3) over-enthusiastic promises and announcements, and (4) the avoidance of financial regulation through generous self-classification of crypto-assets, skirting existing financial regulation and facilitating institutional instability. The issue with the ICO Bubble lay not in the failure of innovative projects – failures are part of innovative ventures and losses are inherent in venture investing. The issue was that institutional failures and weaknesses prompted many failed crypto projects, resulting in operational malfeasance that facilitated fraud and theft, all while information technology ('IT') infrastructure locked in investors' and customers' funds, without appropriate systems of transparency and investor protection. As these examples demonstrate, the purported decentralisation of transactions in fact does little to remove risk, and rather repositions it either in individual users or, at times, the governance mechanism itself.

3. Concentration and interconnection in the crypto ecosystem: the rise of 'systemically important crypto intermediaries'

The 2022–23 Crypto Winter's central element (as well as that of the earlier Mt. Gox crisis and a key risk perceived in the Libra project) was centralisation in what we identify as SICIs that were both too-big-to-fail and too-connected-to-fail in their ecosystems, though not necessarily with the wider financial system. While issues in the crypto ecosystem have historically had limited impact on traditional financial stability, the crypto ecosystem has produced its version of crypto concentration risk, similar to traditional finance's systemically important financial institutions and infrastructure. This concentration arises partly because a single crypto intermediary – often the entity controlling the issuance of a fashionable token – assumes a powerful role within its ecosystem and a *de facto* monopoly in supply and demand. Concentration further develops as market participants tend to move away from purely decentralised tokens which are typically marked by price instability.[73] Central governance is also required to address 'algorithmic incompleteness' as code cannot cover all potential situations and outcomes. Finally, blockchain is reliant on the transmission of data by oracles which process and source that information, which inevitably introduces centralisation.[74]

We have argued in the context of traditional finance that economies of scope and scale combined with technology's network effects facilitate the rapid emergence of new systemically important financial institutions; a trend we have characterised as FinTech 4.0.[75] SICIs illustrate this process in crypto; they tend to arise out of a dependence between transactions of a crypto asset and an intermediary's continued existence. Within *their ecosystem*, many crypto intermediaries are classic examples of systemically significant non-bank financial institutions, known as 'shadow banks' or 'non-bank financial intermediaries', that have been key in many financial crises and are a major ongoing focus of major regulators and policymakers globally.[76]

While the emergence of SICIs stands at odds with the DeFi raison d'etre, it is also the case that many so-called DeFi business models have centralised elements of structure and governance.[77] For instance, 80 per cent of the governance tokens of decentralised exchange Uniswap are held by Uniswap team members, early investors and token holders with large balances who collectively exercise great voting power.[78] In the same vein, 'decentralised exchanges' ('DEXs') pool liquidity between individuals to enable crypto trading. Despite their portrayal as decentralised, these protocols tend to reallocate risk amongst liquidity providers rather than remove it.[79] The BIS authors refer to this as the 'decentralisation illusion' of DeFi.[80] And despite claims to the contrary,[81] the market has accepted

[70] On Mt. Gox see, eg, Robert McMillan, The Inside Story of Mt. Gox, Bitcoin's $460 Million Disaster, Wired (3 Mar. 2014), https://www.wired.com/2014/03/bitcoin-exchange.

[71] On Beanstalk see, eg, Corin Faife, Beanstalk Cryptocurrency Project Robbed after Hacker Votes to Send Themself $182 Million, The Verge (19 Apr. 2022), https://www.theverge.com/2022/4/18/23030754/beanstalk-cryptocurrency-hack-182-million-dao-voting.

[72] See Zetzsche, Buckley, Arner & Fohr (n 37).

[73] Kun Duan & Andrew Urquhart, The Instability of Stablecoins, (2023) 52 Finance Research Letters 1. The authors find Binance USD (BUSD) to be the "most stable [coin] with the highest correction speed" and DAI (a decentralised stablecoin) the least stable.

[74] Bank for International Settlements, The Crypto Ecosystem: Key Elements and Risks, 9–11 (2023) https://www.bis.org/publ/othp72.pdf; Chanelle Duley et al., The Oracle Problem and the Future of DeFi (BIS Bulletin No 76, 7 Sep. 2023) https://www.bis.org/publ/bisbull76.pdf.

[75] D.W. Arner et al., BigTech and Platform Finance: Governing FinTech 4.0 for Sustainable Development, (2022) 27:1 Fordham J. Corp. & Fin L. 1.

[76] The term "shadow bank" was coined by economist Paul McCulley in a speech at the 2007 annual financial symposium hosted by the Kansas City Federal Reserve Bank in Jackson Hole, Wyoming. McCulley focused on the US and referred primarily to nonbank financial institutions that engaged in maturity transformation – see Laura Kodres, Shadow Banks: Out of the Eyes of Regulators, IMF (27 Feb. 2023), https://www.imf.org/en/Publications/fandd/issues/Series/Back-to-Basics/Shadow-Banks.

[77] See Linn Anker-Sørensen & Dirk A. Zetzsche, From CEFI to DEFI: The Issue of Fake DeFI (U. of Luxembourg Working Paper 12, 2021).

[78] Tom Barberau et al., DeFi, Not So Decentralised: The Measured Distribution of Voting Rights in Proceedings of the 55th Hawaii International Conference on System Sciences 6043 (2022). See also Alexandra Born et al., Decentralised Finance (30 Jul. 2023), https://www.ecb.europa.eu/pub/financial-stability/macroprudential-bulletin/focus/2022/html/ecb.mpbu202207_focus1.en.html.

[79] Lioba Heimbach, Eric Schertenleib & Roger Wattenhoefer, Risks and Returns of Uniswap V3 Liquidity Providers in AFT '22: Proceedings of the 4th ACM Conference on Advances in Financial Technologies 89 (2019).

[80] Sirio Aramonte, Wenqian Huang & Andreas Schrimpf, DeFi risks and the decentralisation illusion BIS Quarterly Rev. (2021). See also Lioba Heimbach, Eric Schertenleib and Roger Wattenhofer, Exploring Price Accuracy on Uniswap V3 in Times of Distress in DeFi'22: Proceedings of the 2022 ACM CCS Workshop on Decentralised Finance and Security 47, 51-53 (2022).

[81] Leeor Shimron, DEXs Gain Market Share As Faith In Centralised Crypto Players Erodes (29 Jul. 2023), https://www.forbes.com/sites/leeorshimron/2022/11/23/dexs-gain-market-share-as-faith-in-centralised-crypto-players-erodes.

Major Asset Diversions

DATE	PLATFORM	TYPE	D/C	ASSETS DIVERTED	METHOD
Jul '15	Mt. Gox	CEX	C	$ 473,000,000	Inside job / mismanagement
Jan '18	Coincheck	CEX	C	$ 534,000,000	Inadequate security
Feb '21	CreamFinance	Lender	D	$ 38,000,000	Flash loan attack
Mar '21	PAID Network	Payment services	D	$ 7,000,000	Infinite mint attack
Aug '21	CreamFinance	Lender	D	$ 25,000,000	Flash loan attack
Aug '21	Poly Network	Bridge	D	$ 611,000,000	Software bug
Oct '21	CreamFinance	Lender	D	$ 130,000,000	Flash loan attack
Oct '21	Compound	Lender	D	$ 150,000,000	Software bug
Nov '21	bZx Protocol	Lender	D	$ 55,000,000	Stolen private keys
Dec '21	Bitmart	CEX	C	$ 196,000,000	Stolen private keys
Dec '21	VulcanForged	GameFi	D	$ 140,000,000	Stolen private keys
Dec '21	BadgerDAO	Bridge	D	$ 120,000,000	Governance attack
Feb '22	Wormhole	Bridge	D	$ 325,000,000	Bridge exploit
Feb '22	Qubit Finance (X-Bridge)	Bridge	D	$ 40,000,000	Bridge exploit
Mar '22	Ronin Network	GameFi	D	$ 625,000,000	Stolen private keys
Apr '22	Beanstalk	Stablecoin	D	$ 182,000,000	Flash loan attack
Aug '22	Nomad Bridge	Bridge	D	$ 190,000,000	Software bug
Sep '22	Wintermute	Market Maker	pD	$ 162,000,000	Software bug
Oct '22	Binance	CEX	C	$ 570,000,000	Bridge exploit
Nov '22	FTX	CEX	C	$ 477,000,000	Inside job / mismanagement

Fig. 2. Major DeFi Asset Diversions.[69]

concentration in practice, as is demonstrated by the huge disparities in daily spot trading volumes of leading DEXs, such as Uniswap, at USD $183.30 million[82] and leading centralised exchanges, such as Binance, at USD$551.53 million[83] as of September 2023.

The increasing centralisation of crypto markets *and* crypto applications brings with it the governance and agency risks of traditional finance.[84] The operations envisaged in the original Bitcoin white paper were indeed very different from how FTX was run.[85] For instance, Bitcoin was formulated to operate with peer-to-peer transactions and without intermediaries. By contrast, FTX processed transactions centrally and acted as an intermediary. While FTX was not a cryptocurrency and so Bitcoin is not a direct comparison, the comparison does highlight FTX's departure from DeFi in its business models and operating procedures. FTX demonstrates the evolution of centralised crypto services, and the attendant market failures and negative externalities which regulation generally seeks to address in traditional finance.

Crypto was designed to maximise the potential for positive externalities, such as democratisation, inclusion, transparency, permanence and innovation via technological trust infrastructure. Ironically, what crypto was designed to prevent has come to characterise its ecosystem: the economies of scope and scale of finance combined with the network effects of technology have resulted in large complex crypto conglomerates of systemic importance for their users. This is a pattern which arose early with Mt Gox and which has then continued through a series of others, whether FTX, Tether or Binance.

3.1. *Bundled intermediary functions*

The opacity and complexity of crypto conglomerates also carry connotations of shadow banking, shadow finance and regulatory arbitrage. We are interested in the cause of this opacity and complexity, identifying two drivers: a combination of a range of economic functions paired with the lack of transparency regarding actual operations and risks, as well as the regulation requiring appropriate management of these various economic functions. Both elements become obvious when compared to the five main models of intermediaries in traditional finance. In this section, we consider four types of these intermediaries, but not the fifth (insurance companies). Each of these attract licensing requirements as well as ongoing supervision. In each case, while functionally similar, crypto intermediaries sought to avoid such requirements, on the basis of technologically superior arrangements, but this has not proven to be the actual experience.

First are **exchanges**, or marketplaces at large. The main examples are stock exchanges, which after centuries of crises and scandals,[86] are now subject to strict securities regulation requiring transparency requirements and segregation of accounts for all customers. This ensures that in the event of exchange insolvency, customer assets are segregated and able to be returned. Segregation and custody requirements, and a range of operational controls promoting safety and soundness, along with transparency requirements, are all central to exchange regulation. Cryptocurrency intermediaries often describe themselves as exchanges, but beyond a few regulated instances, very rarely behave like exchanges by segregating accounts and assets.[87] Notably, there are three or four times more firms claiming to be exchanges in the crypto industry than in traditional finance for a far lower number and volume of transactions and number of users, suggesting these firms are also engaging in other functions (and for much higher fees!).[88] Therefore, further consolidation is expected, bringing increased concentration risks and the continued evolution of systemically important financial infrastructures in crypto.

Second are **investment firms**, including broker-dealers and market

[82] Uniswap Overview, Uniswap (27 Jul. 2023), https://archive.md/SHnNC.

[83] Binance, CoinMarketCap (27 Jul. 2023), https://archive.md/GhOrY.

[84] See Consultative Group of Directors of Financial Stability, Financial Stability Risks from Cryptoassets in Emerging Market Economies, Bank for International Settlements (BIS Paper No 138, Aug. 2023) 10–11 https://www.bis.org/publ/bppdf/bispap138.pdf; Anker-Sørensen and Zetzsche (n 84); Olivier Fliche et al, 'Decentralised' or 'Disintermediated' Finance: What Regulatory Response? (Discussion Paper, Apr. 2023) https://acpr.banque-france.fr/sites/default/files/medias/documents/20230403_decentralised_disintermediated_finance_en.pdf.

[85] Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System, bitcoin.org (31 Oct. 2008), https://bitcoin.org/bitcoin.pdf.

[86] The Financial Crisis Inquiry Commission, The Financial Crisis Inquiry Report: Final Report of the National Commission On the Causes of the Financial And Economic Crisis in the United States (Jan. 2011), http://fcic-static.law.stanford.edu/cdn_media/fcic-reports/fcic_final_report_full.pdf.

[87] Dennis Chu, Broker-Dealers for Virtual Currency: Regulating Cryptocurrency Wallets and Exchanges, (2018) 118:8 Colum. L. Rev. 2323.

[88] Forbes puts the number of crypto exchanges at around 500 – see Farran Powell, 10 Best Crypto Apps & Exchanges of 2023, Forbes (1 Feb. 2023), https://www.forbes.com/advisor/investing/cryptocurrency/best-crypto-exchanges, and there are estimates of up to 1000 additional decentralised exchanges. Conversely Deloitte states there are only around 130 traditional securities exchanges – see David Myers, The future of global securities exchanges, Deloitte (Jan. 2023), https://www.deloitte.com/global/en/Industries/financial-services/perspectives/gx-future-of-global-securities-exchanges.html.

makers. Investment firms take client assets, engage in trading, and offer finance and a range of repo and other collateralised services. Investment firms, and their clients, are typically exposed to counter-party risk, yet segregated client accounts provide considerable bankruptcy protection. Broker-dealer regulation involves custody, settlement and other forms of risk management measures to benefit clients.

Third are **collective investment vehicles**, such as investment funds, mutual funds and pension funds. These are pools of assets that are invested, under the investment policy, to the benefit of the collective investors. Assets of the pooled investment vehicles are held in custody and segregated from other assets held by involved intermediaries. For any investment decision, the collective investors' interest as defined in the constituent documents should be the sole guiding consideration, identified in the investment policy, and strictly distinct from the interests of any intermediary involved. Any investment in a crypto asset should be made only if that asset seems to be a good investment from the perspective of the fund's investor. Asset managers making investment decisions on behalf of the fund (eg, for the sake of argument only, Alameda) must not take into account the benefits that the acquisition or disposal of certain crypto-assets (eg, FTT) creates for a related entity (eg, FTX exchange). Moreover, conflicts of interest rules resulting in information barriers should actively prevent these considerations from being operative, blinding asset managers to the needs and wishes of other parts of the conglomerate and avoiding anticipatory obedience.

Fourth are **banks**. A bank takes in funds as deposits, loaning or investing most of the funds to other parties. Banks are subject to a range of prudential regulatory requirements to enhance their safety and soundness and maintain market trust and confidence, both to support their core roles in payments and finance (a positive externality) and reduce contagion risks (a negative externality). For crypto, investors may use 'crypto derivatives' (ie, forwards and options on crypto-assets) as cash substitutes. The crypto industry may also have furthered the misunderstanding of an investment as cash, even through the term 'cryptocurrency' itself. Many crypto entities thus appear to function more like banks than exchanges, and to some extent as broker-dealers, as stated above.[89]

These crypto intermediaries operating (functionally) as banks were not subject to traditional bank regulation and did not have access to protections such as deposit insurance, restructuring frameworks and eventually the central bank for liquidity support. Such measures aim at avoiding liquidity and confidence crises but none, including mandated capital levels and liquidity, applied to crypto prior to the 2022–23 Crypto Winter.

In short, we experienced something similar to bank runs in the case of several SICIs, exacerbated by an absence of measures designed to prevent and resolve these runs. The abrupt exit of customers fuelled the liquidity crisis inherent in each crypto insolvency.

3.2. *Implications: the financialisation of crypto*

We term this concentration of crypto intermediaries and the rise of oligopoly or monopoly powers in markets, following the mantra of decentralisation, the financialisation of crypto. Where financialisation happens, neither decentralisation nor free market forces counter the control of the SICI as a central intermediary. In fact, market forces are far more likely to preference the convenience and liquidity of centralised exchanges over the potential security of trading on a genuinely decentralised DEX.[90]

Given financialisation and the rise of SICIs, the crypto failures of 2022 are highly unlikely to be the last; others will surely follow. The 2022–23 Crypto Winter confirms that crypto intermediaries and conglomerates are exposed to the classic financial and operational risks of market failures and negative externalities.[91]

Traditional finance addresses these issues through regulation, which raises the question we now address:: if crypto exhibits similar risks, market failures and externalities, how should we best regulate crypto?

4. Principles of crypto regulation

While crypto was presented as a new technological framework for finance that avoided traditional financial risks, the ecosystem's operational, behavioural, and other risks nonetheless have evolved over the past fifteen years to evidence the full range of traditional financial risks. Centuries of financial evolution illustrate that market trust requires transparency, comparable information, and protection from fraud and abuse. Trust in financial institutions follows risk mitigation, and is indispensable for efficient markets and market development. Therefore, we argue that where problems have similar causes, they require similar remedies: the financialisation of crypto requires crypto regulation. While others argue the best approach is to isolate crypto from finance, leaving it largely unregulated as a non-connected ecosystem,[92] we highlight how crypto has financialised, both in terms of what is being offered and in market failures and other weaknesses.[93] Indeed, such financialisation introduces environmental externalities, financial stability risks and consumer protection issues that are further reasons for in-kind policy responses.[94]

Financial regulation largely targets improved market functioning, reduction of negative externalities, support for positive externalities, and efficiency. Crypto's biggest risk is that financialisation erodes trust and confidence such that the market collapses, or legislators feel pressed to shutter crypto markets permanently. We argue that an approach recognising and addressing market failures, behavioural concerns and externalities (both positive and negative) through regulation, enforcement and supervision, as well as international cooperation and coordination, is necessary for crypto to survive and thrive. We outline the need for regulation in the context of traditional risks of finance in Section 4.1.

The idiosyncrasies of crypto require certain bespoke approaches. We highlight the most important of these aspects and considerations in Section 4.2. Section 5 then combines these insights and sets out detailed policy proposals, framing these in the context of an emerging international regulatory consensus around these elements.

[89] Chu (n 94); William D. O'Connell, Crypto platforms Say They're Exchanges, but They're More Like Banks, The Conversation (12 Aug. 2022), https://theconversation.com/crypto-platforms-say-theyre-exchanges-but-theyre-more-like-banks-188339; George Selgin, Bank and Crypto Runs: F(ac)TX vs Fiction, Cato Institute (21 Nov. 2022), https://www.cato.org/blog/bank-crypto-runs-factx-vs-fiction.

[90] See Angelo Aspris et al., Decentralised Exchanges: The "Wild West" of Cryptocurrency Trading (2021) 77 Int. Rev. Fin. Analysis 1.

[91] See, eg, Cornelius Christian, FTX Collapse Could Mean 'Cascade' of Failures in Crypto Sector - Ran Neuner, KitCo News (11 Nov. 2022), https://www.kitco.com/news/2022-11-11/FTX-collapse-could-mean-cascade-of-failures-in-crypto-sector-Ran-Neuner.html; Jack Denton, Exchanges Seek to Calm Users as Trust in Crypto World Wavers, Barron's (14 Nov. 2022), https://www.barrons.com/articles/ftx-crypto-exchange-reserves-51668457984.

[92] CryptoSprint Outputs, Financial Conduct Authority (11 May 2022), https://www.fca.org.uk/firms/cryptoassets/cryptosprint. See also Todd H. Baker, Let's Stop Treating Crypto Trading as If It Were Finance, The CLS Blue Sky Blog (29 Nov. 2022), https://clsbluesky.law.columbia.edu/2022/11/29/lets-stop-treating-crypto-as-if-it-were-finance/. See also Kim Schoenholtz and Stephen Cechetti, "Let Crypto Burn" (*Opinion*, NYU Stern) (17 November 2022).

[93] Katharina Pistor, The Code of Capital: How the Law Creates Wealth and Inequality (2018).

[94] See Hilary J. Allen, DeFi: Shadow Banking 2.0? (2023) 64 Wm. & Mary L. Rev. 919, 949.

4.1. Financialisation, shadow finance and regulatory arbitrage: 'Same risks, same rules'

Financial regulation seeks to enhance market transparency and efficiency, ensure financial stability, market fairness and integrity, and provide adequate customer, depositor and investor protection. Financial regulation has also recently sought to support monetary stability, market development, economic growth, and further financial inclusion and sustainable development.[95] We will show that each of these regulatory objectives are also relevant to the future development of the crypto ecosystem.

4.1.1. Financial stability

Financial regulation is about seeking to prevent or reduce the most significant externality which arises in the context of finance: financial crises and particularly systemic financial crises. Financial stability regulation – both macroprudential and microprudential – is designed to achieve this objective.[96]

While crypto has not yet reached the financial dimension that warrants intervention to ensure systemic financial stability, financial technology usually grows very quickly, due to the scale and scope economies inherent in information technologies and network effects.[97] Crypto models often quickly bypass the stage of 'too small to care' and quickly enter the stage of 'too large to ignore' or even 'too big to fail' in the context of the crypto ecosystem.

In particular we are concerned with the crypto industry's spillover effects into traditional finance. One regulatory response is to ringfence crypto-assets and insulate crypto from traditional finance, and vice versa. For preventative measures, regulators will require information on counterparties, exposures and interconnectivity both across the crypto industry and with traditional finance. Overall, however, we do not consider that such an approach will successfully address the full range of issues identified in this article. Regulators need to be aware that a spillover between the crypto and non-crypto sectors is practically certain, and similarly that – even if isolated – are unlikely to function well without regulatory intervention to address the core financial regulatory objectives.

These aspects of concentration, centralisation and interconnection can be clearly seen in the context of Mt. Gox, the Libra proposal, and the 2022–23 Crypto Winter.

4.1.2. Market efficiency and transparency

Beyond stability, financial regulation focuses on promoting market functioning, transparency and efficiency.[98] Market efficiency seeks a semi-strong form of informationally efficient markets, ie, markets in which prices reflect all publicly available information.[99]

Market efficiency is a concern for crypto for three reasons. First, information is available in a non-structured, unorganised manner, made available through various private and unregulated channels. Professional and retail investors are thus unable to properly evaluate investment opportunities and related risks. Second, a combination of erratic disclosure and unregulated, non-standardised, information streams, as well as opaque and complex intermediary structures, cause unclear information and transaction costs while liquidity in most crypto-assets is limited. With some notable exceptions for some large volume crypto-assets like ETH, arbitrage is thus unable to push asset prices towards the 'right price' using publicly available information.

Third, crypto is characterised by non-financial information about the IT architecture, systems design and stability, which are often central to project evaluation. While white papers and project descriptions usually show some features of the IT design, few crypto customers fully understand *both* the technical side of crypto *and* their financial implications, to understand and manage the risks. Developers, and in the case of SICIs, the crypto conglomerate developing and operating the system, have significant informational advantages.

As the principal traditional tool to further market efficiency,[100] disclosure should be adopted and supported by the standardisation of crypto protocols and transparency on crypto asset supply and demand. Crypto disclosure could focus on the standardisation of information disclosure requirements and information quality assurance mechanisms. These include accounting and auditing standards, technical details of projects, supply and demand in markets and assets, as well as valuation methods and algorithms. Further, microprudential regulation enhancing crypto intermediaries' operational safety and soundness would reduce fraud and theft, and promote trust while reducing the need for costly self-protective measures.

While the ICO Bubble most clearly reflected these issues, they have also been very clear in the context of the 2022–23 Crypto Winter.

4.1.3. Customer, depositor and investor protection

The third central objective of financial regulation focuses on customer, investor, depositor and client protection.[101] This focuses on less informed but sometimes overly enthusiastic market participants that lack the means to protect themselves. It also seeks to maximise rational behaviour while recognising that rationality is often not the dominant characteristic of human behaviour. Consumer protection also forms a part of the client and investor protection rationale. Despite the expectations of crypto consumers, the secret or hidden centralisation and monopolisation of market segments run contrary to DeFi principles.

Investor protection includes disclosure to enable informed decisions (as discussed vis-a-vis market functioning and efficiency), enforcement to address misconduct, and prudential mechanisms to reduce losses from intermediary or infrastructure failures while allowing exit to support market discipline (thus reinforcing financial stability regulation).

Like traditional finance, conflicts of interest stemming from the bundled intermediary functions need to be addressed. The unbundling and separation of functions and information barriers are of particular importance.

Such conflicts and behavioural challenges have been a consistent feature of crypto's evolution.

4.1.4. Fairness and market integrity

Fairness and market integrity focus on preventing both criminal use of the financial system (eg, anti-money laundering) and fraud and misconduct. Market integrity mainly focuses on issues relating to various forms of sanctions, money laundering and terrorist financing. Market fairness mainly focuses on criminal behaviour and financial misconduct, including insider trading and market manipulation, thus relating also to customer protection.

Silk Road, Mt. Gox, the ICO Bubble, the Libra proposal and the 2022–23 Crypto Winter each highlight dimensions of both market fairness

[95] Douglas W. Arner et al., Sustainability, FinTech and Financial Inclusion (2020) 21 Eur. Bus. Org. L. Rev. 7.

[96] Franklin Allen & Xian Gu, The Interplay between Regulations and Financial Stability (2018) 53:2 J. Fin Ser. Res. 233.

[97] Michael L. Kats & Carl Shapiro, Network Externalities, Competition, and Compatibility (1985) 75:3 Am. Econ. Rev. 424.

[98] Australian Government Department of the Treasury, Approaches to Financial Regulation (1 Nov. 1996), <https://treasury.gov.au/sites/default/files/2019-03/p1996-fsi-dp-07-chapt04.pdf>.

[99] Eugene F. Fama, Efficient Capital Markets: A Review of Theory and Empirical Work (1970) 25:2 J. Fin 383.

[100] Charles R. Korsmo, The Audience for Corporate Disclosure (2017) 102:4 Iowa L. Rev. 1581.

[101] Charles Goodhart et al., The rationale for regulation in Financial Regulation: Why, How and Where Now? 1 (1998).

and integrity.

With regard to market fairness, some report that FTX's fund Alameda traded primarily in FTX's main crypto asset, equivalent to trading in a regulated entity's own security. Similarly, Binance publicly cast doubt on the financial reliability of FTX, their most serious competitor. Such a statement would enliven market abuse and market manipulation legislation in the regulated finance industry.

Additionally, some crypto intermediaries are seemingly not following anti-money laundering and counter-terrorism financing ('AML/CTF') requirements, accepting funds without know your customer checks. There are two possible explanations for this. First, some intermediaries operate from jurisdictions where they are beyond the scope, or there is no enforcement, of AML/CTF legislation. Second, where there are enforced crypto AML/CTF rules, some intermediaries characterise their services to circumvent existing rules. For instance, they may characterise crypto-assets as utility assets where only investment and payment crypto-assets are subject to regulation.[102]

4.1.5. Growth, inclusion, innovation and sustainable development

While economic growth features strongly in financial regulation and regulatory policy, recently many other aspects have been added including innovation, inclusion and sustainable development.[103] Innovation, development and inclusion objectives have provided the strongest support for taking a permissive approach to crypto regulation.[104] While current views are increasingly sceptical about the technology potential, we think it important to highlight its great success in supporting fundraising efforts.[105] Further, an increasing range of successful applications are emerging in the context of traditional finance.[106] However, this reinforces our financialisation argument and its implications necessitating appropriate regulation to support market development.

Additionally, some systems' designs raise energy issues.[107] Some crypto models waste energy and are exclusive, while others are highly energy efficient and inclusive, providing access to customers with low degrees of financial and technical literacy. For instance, the Ethereum Merge, which moved Ethereum from a proof-of-work to a proof-of-stake mechanism, claims to have reduced the Ethereum blockchain's energy usage by 99.95 percent. Moreover, a forthcoming upgrade dubbed 'the Surge' intends to reduce costs, and enhance speed and system stability even further.[108]

While these upgrades show the potential of technological innovation, the absence of similar upgrades to the Bitcoin blockchain is regrettable, as it is estimated to use as much energy as the Netherlands, a country with some 17 million people.[109] One reason for this is Bitcoin's lack of a centralised governance mechanism to design and implement upgrades (a necessary feature if one is to follow the principles of DeFi and its aversion to centralised external regulation).

4.2. Decentralisation: 'New risks, new rules'

While crypto is exposed to traditional financial risks, it is somewhat different to traditional finance, especially in its partial decentralisation of financial functions.[110] This partial decentralisation results in technical and financial complexity and often a cross-border situation, which renders regulation and enforcement a challenge.[111] While many functions are centralised, crypto, as part of DeFi, is often characterised by only *partial* decentralisation of functions. Depending on the technology and set-up, there may be cases where many entities must function together to ensure the stack's proper functioning, and also to generally ensure compliance, cybersecurity, asset recovery, and investor protection. Similarly, the cooperation and coordination of several regulators may be required to enforce existing rules.

Partial decentralisation has consequences for the design of regulation, as we highlight in this section, in the context of crypto custody, bundling of governance rights ('crypto staking'), crypto lending and derivatives ('crypto stacking'), and finally, insolvency and resolution.[112]

4.2.1. Custody in the context of blockchain

The technical structure of segregation and custody is of particular concern to customer and investor protection. This takes the form of 'hot' custody, leveraging omnibus accounts that are permanently online and linked to the distributed ledger from which the ownership in the token derives. Crypto intermediaries also often store their clients' private keys, the data confirming ownership of the clients' assets. Depending on the technology used, *some* crypto intermediaries represent a single point of failure contrary to the DeFi philosophy; cyberattacks, fraud or malfunctions could result in the public exposure of the private keys, or prompt fraudulent transactions from the omnibus account to another one controlled by the attacker or fraudster.[113]

Several other concerns have been reported with custody. For instance, some crypto intermediaries reused client assets held in custody without consent and proper governance.[114] As a result, significant concerns have been noted by the IMF-FSB over client asset protection in

[102] Zetzsche, Buckley, Arner & Fohr (n 37).

[103] Douglas Arner et al., Digital Finance, Financial Inclusion, and Sustainable Development: Building Better Financial Systems in Fintech and COVID-19 Impacts Challenges and Policy Priorities for Asia 176 (John Beirne, James Villafuerte, and Bryan Shang eds., 2022).

[104] Christine Moy and Jill Carlson, Cryptocurrencies can enable financial inclusion. Will you participate?, Weforum (9 Jun. 2021), https://www.weforum.org/agenda/2021/06/cryptocurrencies-financial-inclusion-help-shape-it.

[105] Nareg Essaghoolian, Initial Coin Offerings: Emerging Technology's Fundraising Innovation (2019) 66:1 UCLA L. Rev. 294.

[106] Bain & Company, Web3 and Blockchain, Bain (31 Jan. 2023), https://www.bain.com/insights/management-tools-web3-and-blockchain.

[107] Johannes Sedlmeir et al., The Energy Consumption of Blockchain Technology: Beyond Myth (2020) 62:6 Bus & Infor. Sys. Engineering J. 599.

[108] Reuters, Crypto Winter End in Sight as Ethereum Looks to Shake the Chills-Analysts, Reuters (13 Dec. 2022), https://www.reuters.com/markets/currencies/crypto-winter-end-sight-ethereum-looks-shake-chills-analysts-2022-12-12.

[109] University of Cambridge, Cambridge Bitcoin Electricity Consumption Index: Comparisons, The Cambridge Centre for Alternative Finance (2023), https://ccaf.io/cbeci/index/comparisons.

[110] Fabian Schär, Decentralised Finance: On Blockchain- and Smart Contract-Based Financial Markets (2021) 103:2 Fed. Res. Bank St. Louis Rev. 153.

[111] Francesca Carapella et al., Decentralised Finance (DeFi): Transformative Potential & Associated Risks, Federal Reserve Board (2022), https://www.federalreserve.gov/econres/feds/decentralised-finance-defi-transformative-potential-and-associated-risks.htm.

[112] IOSCO, Policy Recommendations for Decentralized Finance (DeFi): Consultation Report (Sep. 2023), https://www.iosco.org/library/pubdocs/pdf/IOSCOPD744.pdf.

[113] Efpraxia Samani, Ying He & Matthew Phillips, On the Security Risks of the Blockchain (2020) 60:6 J. Computer Info. Sys. 495; Dirk A. Zetzsche, et al., Remaining Regulatory Challenges in Digital Finance and Crypto-Assets after MiCA (2023).

[114] See Consultative Group of Directors of Financial Stability (n 84), 12–13.

custody and the lack of fair access, suitability, and distribution to retail customers.[115] This is facilitated by a lack of transparency in the crypto ecosystem as to who acts as the contractual party, the liquidity provider, margin agent, and so on.[116] Note that these functions can be provided also by a group of nodes on the stack, rather than the SICI running the ecosystem.

Further, the use of omnibus accounts results in the blending of an intermediary's own and third-party claims in crypto-assets. In response, the IMF[117] and FSB[118] have clearly focused on the need for the safekeeping and segregation of individuals' crypto accounts. The industry seems to make little or no use of the tracing feature implicit in blockchain and distributed ledgers' endless chain of transactions. This happens at a time when the private law on competing claims stemming from reuse of assets is unsettled, to say the least,[119] rendering any true assessment of who holds an asset in bankruptcy and fraud cases very difficult.

4.2.2. Crypto staking

Crypto staking is the 'locking up' of one's crypto-assets to support the network's operation in return for a reward ;[120] such as the bundling of governance rights to influence the outcome of the voting mechanism. For instance, users may 'lend' their tokens or the governance rights attached to them, to other users, for a fee or altruistic motives.[121] Governance rights therefore remain decentralised in form, but not in function. A person, or group of persons, becomes a dominant stakeholder, contrary to the disclosed functioning of the ecosystem.

The situation is not unlike what was debated at length in the context of 'vote buying' and 'empty voting' in corporate law, yet without the mitigating effects of disclosure rules, corporate law-based collective redress, and in some countries the fiduciary duties of large shareholders and 'group law' (*Konsernrecht*). We have argued that staking poses regulatory challenges, including the use of staking practices to bundle voting rights and initiate governance attacks, and its enabling a few people to control the platform in practice.[122]

Such staking practices have often been the focus of high returns, drawing customers who perceived the risks to be low and a reliable way to earn returns. However, a lack of segregation and custody has instead often meant that – rather than a safe high-return investment (always a warning signal), investors were taking on high levels of risk via the intermediary providing the crypto.[123] In the absence of legislative intervention and case law, investors' rights in the event that the intermediary becomes insolvent are uncertain.[124] The United States' SEC prosecuted trading platform Kraken for failing to register their staking program and disclose to investors how their investments would be used.[125]

4.2.3. Crypto stacking

Some DeFi ecosystems are connected to other ecosystems, both technically and financially. For instance, crypto derivatives drawing on a basket of derivatives could connect multiple ecosystems financially, or one token type can integrate another token type in its algorithm, thus embedding the other token technically.[126]

Besides financial stability concerns, this practice creates a type of leverage through contracts whose settlement is deferred (as in derivatives), and crypto lending arrangements, with crypto-assets as underlying or margin. We do not see why crypto derivatives are less risky for consumers than financial derivatives; indeed, given the often-missing regulation and absence of disclosure obligations around interconnections and exposures, crypto derivatives may be riskier. Consumers can also mistakenly believe that consumer protections apply to high-risk crypto derivatives when issuers offer them alongside regulated financial products.[127] While this is a dimension of traditional financial risk, the new dimension is the technical interlinkage which may trigger, and has triggered, operational malfunctions and system shutdowns.[128]

4.2.4. Insolvency and resolution

Partial decentralisation poses difficulties in arranging business continuity in insolvency, as financial incentives to maintain the system vanish when several entities must act together to maintain a system's operation. For instance, where code maintenance requires the upload of an update on many nodes, an update is impossible when nodes stop operating in anticipation of insolvency. Similarly, users will provide less liquidity, and developers will invest less in cyber defence when it becomes likely that their investments (in terms of time and intellectual capacity) will be lost. Incentivising and integrating these many actors in insolvency, resolution and restructuring proceedings will require new

[115] FSB and IMF (n 16), 15.

[116] IOSCO, Policy Recommendations for Crypto and Digital Asset Markets: Consultation Report (CR01/2023, May 2023) 31-34.

[117] Effective Policies For Crypto Assets (n 8), 24; FSB, FSB Global Regulatory Framework for Crypto Asset Activities: Umbrella public note to accompany final framework (17 Jul. 2023), 5-6.

[118] FSB, High Level Recommendations for the Regulation, Supervision and Oversight of Crypto-Asset Activities and Markets: Final Report (17 Jul. 2023) 8, 11-12 ('High Level Recommendations').

[119] See Jannik Woxholth, Dirk Zetzsche, Ross Buckley & Douglas Arner, Competing Claims to Cryptoassets, (2024) 2 Uniform Law Review (forthcoming).

[120] Financial Stability Board, Regulation, Supervision and Oversight of Crypto-Asset Activities and Markets (Consultative Document, 11 Oct. 2022) 44 https://www.fsb.org/wp-content/uploads/P111022-3.pdf.

[121] See, eg, Mildred Chidinma Okoye & Jeremy Clark, Toward Cryptocurrency Lending in Aviv Sohar et al (Eds), Financial Cryptography and Data Security 367–380 (2019). See also Hakwan Lau & Stephen Tse, Decentralised Basic Income: Creating Wealth with On-Chain Staking and Fixed-Rate Protocols, Cornell University (13 Aug. 2021), https://arxiv.org/pdf/2107.14312.pdf.

[122] D. Zetzsche et al., Remaining Regulatory Challenges in Digital Finance and Crypto-Assets after MiCA (Study, May 2023) https://www.europarl.europa.eu/RegData/etudes/STUD/2023/740083/IPOL_STU(2023)740083_EN.pdf.

[123] See, eg, Adam J. Levitin, Not Your Keys, Not Your Coins: Unpriced Credit Risk in Cryptocurrency (2022) 101 Tex. L. Rev., https://ssrn.com/abstract=4107019, https://doi.org/10.2139/ssrn.4107019.

[124] Matthias Lehmann et al., 'Staking Your Crypto: What Are the Stakes?' (Feb. 2023)

[125] US SEC, 'Kraken to Discontinue Unregistered Offer and Sale of Crypto Asset Staking-As-A-Service Program and Pay $30 Million to Settle SEC Charges' (Press Release, 9 Feb. 2023) https://www.sec.gov/news/press-release/2023-25; Louise Gullifer et al., Client-Intermediary Relations in the Crypto-Asset World, Paper No. 18/2021 (Mar. 2021).

[126] See generally Blockchain Economics and Financial Market Innovation: Financial Innovations in the Digital Age (Umit Hacioglu ed., 2019).

[127] Australian Securities and Investments Commission, Design and Distribution Obligations: Retail OTC Derivatives (Report No 770, Sep. 2023) 20.

[128] For a more complete explanation see Ryan Surujnath, Off The Chain! A Guide to Blockchain Derivatives Markets and the Implications on Systemic Risk (2017) 22:2 Fordham J. Corp. & Fin L. 256–304.

regulatory approaches. The EU's MiCA addresses this by requiring that crypto asset service providers prepare a living will.[129] Furthermore, the FSB has published high level recommendations on redemption regulation in respect of redemption rights, stabilisation and prudential requirements.[130] Yet, solutions need to extend beyond financial regulation and include the development of private law, to ensure smooth cross-border insolvency proceedings in a world where all major DeFi systems are characterised by an international distribution of token holders. Swift progress on the private law that governs crypto is of utmost importance given the development of this private law in even the most advanced jurisdictions remains in its infancy.[131] While we expect large cross-border proceedings like FTX to prompt rapid development of crypto practices, implementing internationally harmonised and endorsed standards in domestic legislation such as the Unidroit's *Principles on Digital Asset and Private Law*[132] is likely to be a far slower process. Nonetheless the work of Unidroit on these issues is critically important to promote legal certainty and lower transaction costs.

5. Designing crypto regulation

Both when crypto is akin to traditional finance, and when it poses new risks stemming from decentralisation, our earlier dictum applies: 'rather than eliminating the need for regulation, in fact DeFi requires regulation in order to achieve its core objective of decentralisation'.[133] Further, the current absence of proper regulation presents a real opportunity to reconceptualise regulation in the future. Our benchmark should not be what has worked well for traditional finance. The goal is suitable (and *in some respects* entirely novel) regulation for an evolving industry that is technologically unlike what has gone before but which in many cases nonetheless exhibits similar market failures and externalities.

In the remainder of this section, we set out some relatively straightforward (in terms of implementation) regulatory approaches to the financialisation of crypto, derived from an application of the main market failures and externalities characteristic of traditional finance that we set out in the previous parts. These approaches seek to appropriately address the range of issues caused by the financialisation of crypto.

5.1. Licensing, conduct of business, prudential regulation and supervision

A core requirement in our view for the future successful evolution of the crypto ecosystem is licensing: crypto services should be prohibited unless they are properly licensed. Several legal requirements attach to licensing: the definition and delineation of the services provided, proper organisation and adequate and sufficient human and IT resources, fit and proper management, adequate conduct of business, and prudential regulatory rules (ie, the maintenance of adequate capital and liquidity).[134]

With such licensing comes clear regulatory treatment and differentiation of services provided. For instance, the use of the term 'exchange' should be reserved to entities that bring together third parties' supply and demand in crypto-assets in an appropriately designed and managed environment, while broker-dealers, market makers, banks and asset managers should all be subject to tailored requirements.

When drafting licensing rules, regulators will have to define crypto-related services and activities. In the absence of a very clear or comprehensive regulatory approach, legal uncertainty will prevail and some crypto intermediaries may either remain, or seek to stay, outside of the scope of regulation.[135] Uncertainty as to whether certain crypto conduct is within the regulatory perimeter will result in under-enforcement, as all enforcement bodies are resource-constrained. Legal certainty is paramount to ensure proper enforcement.[136]

In fact, many jurisdictions identified in Part 1 have introduced or are introducing a licensing regime for crypto intermediaries (including the EU, UK, Singapore, Japan, Hong Kong and the UAE). However, whilst a *perfect* licensing regime might be best practice, regulating crypto is clearly not a panacea. Not only might many jurisdictions find implementing a licensing regime for crypto intermediaries challenging, but crypto itself is still evolving and the risk of some crypto projects remaining unregulated is too high.

For these reasons, implementing a default rule would be the straightforward solution. For instance, defining all crypto services as being within the scope of securities regulation (so that securities regulation always applies)[137] *unless* exempted by financial supervisory authorities following an application from the respective crypto intermediary for a related license, eg, as a *true* decentralised exchange or in the case where the intermediary establishes the case for regulatory treatment as a payments token or a utility token etc.[138] A default rule shifts the burden of activity and information gathering from the authorities (where it currently rests) to the crypto intermediaries. It also entitles financial supervisory authorities to order crypto firms to provide information to them. The outcome of such a default rule may, however, be proportional: while the crypto intermediaries must register and ensure proper disclosure to regulators of the categorisation of their offering as a precondition for selling or dealing in crypto products, regulation may be designed to ensure that the issue itself is not automatically subject to licensing. Further, given that existing AML/CTF rules apply to

[129] Cf. MiCA (n 17), art 74 (requires CASPs have "a plan that is appropriate to support an orderly wind-down of their activities under applicable national law, including the continuity or recovery of any critical activities performed by those service providers.").

[130] See Recommendations for Crypto-asset Activities and Markets (n 14), recommendation 9.

[131] Jonathan Sears & Julian Ng, Bit by Bit - the Future Direction of English Insolvency Law and Cryptocurrency (2022) 15:2 Corp. Rescue & Insolvency 53–55; Janis Sarra & Louise Gullifer, Crypto-claimants and Bitcoin Bankruptcy: Challenges for Recognition and Realisation (2019) 28:2 Int'l Insolvency Rev. 233–272.

[132] See UNIDROIT, Principles for Digital Assets and Private Law (Governing Council draft of May 2023). For a detailed discussion of the principles' impact as well as the interplay with financial regulation see Woxholth, Zetzsche, Buckley & Arner (n 128).

[133] Zetzsche, Arner and Buckley, "Decentralized Finance" (n 37), 172.

[134] See Saule T. Omarova, Dealing with Disruption: Emerging Approaches to Fintech Regulation (2020) 61 Wash. J.L. & Pol'y 25. For a contrary view, see Hossein Nabilou, The Dark Side of Licensing Cryptocurrency Exchanges as Payment Institutions (2020) 14:1 L. & Fin Mkts Rev. 39-47.

[135] See Ripple Ruling Deals a Blow to SEC's Effort to Regulate Crypto, The Wall Street Journal (13 Jul. 2023), https://investor.coinbase.com/home/default.aspx.

[136] See generally Joseph Lee & Florian L'heureux, A Regulatory Framework for Cryptocurrency (2020) 31:3 Eur. Bus. L. Rev. 423. See also Tina van der Linden & Tina Shirasi, Markets in Crypto-Assets Regulation: Does It Provide Legal Certainty and Increase Adoption of Crypto-Assets (2023) 9:1 Fin Innovation 9.

[137] With securities we include securities under US securities regulation. For Europe, the term, "transferable securities" leads to the same result.

[138] See, eg, Carol Goforth, U.S. Law: Crypto Is Money, Property, A Commodity, And A Security, All At The Same Time (2019) 49 J. Fin Transformation 102-109.

all transactions involving securities, the default rule proposed herein ensures full compliance with such rules.

We acknowledge that this solution is rather simplistic. Deeming a crypto asset a 'security' will not magically transport the crypto asset into a regime 'ready built to provide proper or even efficient oversight or clarity', but instead may create 'both a lack of clarity and inefficiency in compliance', since securities regulation generally fails to account for critical aspects of the crypto asset ecosystem and may impose obligations with little to no relevance for crypto-assets.[139] Nevertheless we suggest that this situation is preferable to the current converse situation where some crypto conglomerate businesses remain unregulated. Furthermore, exemptive powers granted to securities regulators in their dealings with crypto can rectify these inefficiencies.

The need for our default rule is echoed in the recent IMF-FSB synthesis paper: 'Comprehensive regulatory and supervisory oversight of crypto-assets should be a baseline to address macroeconomic and financial stability risks'.[140]

5.2. Disclosure and transparency

Central to financial market functioning is information. This is the core of the efficient markets hypothesis and of much financial regulation. With crypto, mandatory disclosure or the necessary standards of disclosure have so far received insufficient attention from both market participants and regulators.[141]

First, we see a need to provide financial information analogous to that which securities regulation entails. We would require from issuers initial documentation (such as a prospectus), and ongoing information through semi-annual and annual reports and material adverse change releases. The FSB has identified that authorities should monitor indicators of the sector's size, evolution, financial vulnerabilities, potential for spillovers, and connections between crypto and traditional finance.[142] Blockchain may be a much better system to do this and may – with appropriate design – provide to regulators real-time information.[143] This requires appropriate and consistent information and disclosure which is not yet required by regulation nor built into existing systems in blockchain environments by way of embedded regulation and supervision.

Second, certain intermediaries would need to provide information. Licensed crypto exchanges will have to provide pre- and post- trade information as well as comply with best execution duties. Furthermore, crypto intermediaries will need to provide information about group structure and activities so that counterparties can evaluate and understand risks. Coinbase, as a listed company, provides a most useful counterpoint in this regard to FTX.[144]

Beyond these disclosure rules that are part of the standard repertoire of regulators, we suggest issuers and crypto intermediaries should have to disclose the operational structure of the service and IT environment in which the crypto asset is issued and traded. This would include explaining which functions are centralised and which decentralised. Some regulators have introduced obligations to submit a 'Programme of Operations' that explains the system's architecture and ensures systems resilience.[145] Such an approach should be adequate given the unique features and architecture of many crypto-assets. It would also outline how decentralised functions would be maintained in times of insolvency.

In fact, the EU's MiCA requires the set-up of a programme of operations for some, but not all, issuances of crypto-assets.[146] As to increasing clarity in this area, the IMF supports regulation to promote transparency in the activities carried out by crypto asset entities.[147] Additionally, the FSB has recommended that regulators press for transparency in the disclosure of crypto asset issuer operational and transactional activities as well as any risks arising from their products.[148] On this issue, IOSCO has made progress, proposing a suite of recommendations that target the breakdown of information asymmetries in crypto markets.[149] Difficult challenges in the application of these frameworks remain since no bright line is discernible between the crypto ecosystem and financial system more broadly.[150]

We suggest in the context of DeFi the usefulness of embedding regulatory principles – including sustainability – into system design. Disclosures on sustainability impacts, as the EU's MiCA requires from token *issuers* and crypto asset services providers,[151] are a starting point, but do not extend to sustainability risks of equal importance for crypto clients

[139] Written Testimony, Chris Brummer, Written testimony before the US House of Representatives, Agricultural Committee, Subcommittee on Commodity Exchanges, Energy, and Credit, The Future of Digital Asset Regulation at 2 (23 Jun. 2022), https://agriculture.house.gov/uploadedfiles/brummer_congressional_testimonythe_future_of_digital_asset_regulation.pdf.

[140] FSB and IMF (n 16), 1.

[141] See, eg, Jun Heng Chou, Prerana Agrawal & Jacqueline Birt, Accounting for crypto-assets: stakeholders' perceptions (2022) 39:3 Stud. Econ. & Fin 471-489; Consultative Group of Directors of Financial Stability (n 84), 33, 35.

[142] Bank for International Settlements (n 74), 17–18.

[143] D.W. Arner, J. Barberis & R.P. Buckley, FinTech, RegTech, and the Reconceptualisation of Financial Regulation (2017) 37 Nw. J. Int'l L. & Bus. 371.

[144] Coinbase has a reasonably sophisticated 'Investor Relations' website - see Investor Relations, Coinbase, https://investor.coinbase.com/home/default.aspx. Additionally much other information is available from the NASDAQ stock exchange - see Coinbase Global, Nasdaq, https://www.nasdaq.com/market-activity/stocks/coin>, and from stockbrokers etc.

[145] See Dirk A. Zetzsche, Linn Anker-Sørensen, Maria Lucia Passador & Andreas Wehrli, DLT-based enhancement of cross-border payment efficiency – a legal and regulatory perspective (2021) 15:1-2 L. & Fin Mkts Rev. 70 at 103-108, DOI: 10.1080/17521440.2022.2065809; Dirk A. Zetzsche & Jannik Woxholth, The DLT sandbox under the Pilot-Regulation (2022) 17:2 Cap. Mkts L.J. 212–236, https://doi.org/10.1093/cmlj/kmac003 (citing the EU DLT Pilot Regulation).

[146] See MiCA (n 17) (1) lit. b, 18 (2) lit. d for issuers of asset-referenced tokens, Arts 44 (1) and (2) and 57 (1) and (2), 60 (7) lit. a for issuers of significant asset-referenced tokens and e-money tokens, and Arts 60 (2) lit. d and 62 (2) lit. d MiCA for crypto-asset service providers. MiCA does not foresee a Programme of Operations for issuers of other crypto-assets than ART and EMT, and does not extend to decentralised DeFi protocols.

[147] Effective Policies For Crypto Assets (n 8), 24.

[148] High Level Recommendations, (n 120, 9-10.

[149] IOSCO (n 118).

[150] Raphael Auer et al., Banking in the shadow of Bitcoin? The institutional adoption of cryptocurrencies (BIS Working Papers No 1013, May 2022) 4.

[151] Cf. MiCA (n 17), arts 6(1) lit. j., 12, 19(1)(h), 11, 51(1) lit. g, (15), 66(5), recital 110.

and protocols, do not require sustainability risk *management*, and fail to resolve the other issues for decentralised systems that lack a centralised issuer.[152]

5.3. Segregation and custody

To ensure safekeeping of assets, the separation of custody from other intermediary activities (such as exchange, brokerage, market making and proprietary trading, ie, trading on one's account) is essential, along with requirements for segregation of individual accounts, and subjecting crypto custody to licensing. As part of such a licensing scheme, clarity around the fiduciary duties of crypto custodians is significant.[153] This may involve, on the one hand, a definition of what custody entails in this context, for instance the retention and administration of a private key. On the other hand, such regulation may ensure that assets, without the owner's consent, may neither be lent, traded nor used as security in transactions on the intermediary's account. Any crypto asset lending for the benefit of investors should be properly documented, earmarked, traced across the blockchain, and monitored by the crypto custodian, while counterparty risks during the transactions should be properly managed by way of required margins and the like. To a large extent, the EU's MiCA meets these requirements, drawing on a concept where control of the private key is analogised to custody.[154] Yet many details will need to be provided in the forthcoming implementing legislation and MiCA's scope is limited to custody services provided by centralised service providers.

Again, a default rule bringing crypto within the scope of securities regulation may well simplify matters, as custody of securities and segregation of accounts are a central feature of securities regulation.

In addition, specifically with crypto, regulators should consider the additional technical complexity and exposure in multiple DeFi stacks in which crypto-assets are referenced or otherwise tied to other crypto-assets. This justifies additional requirements around technical and cyber resilience. We would propose additional description of custody practices in the business plan and rules that reduce, as far as possible, 'hot wallet' transactions and that mandate storage of disaggregated amounts of assets (the equivalent to omnibus accounts) in cold wallets.

The crypto industry has already taken the initiative in the last few years to initiate 'Proof of Reserves' ('PoR') protocols.[155] In this regard, the general idea is that a crypto exchange, or other crypto project or intermediary, subject its reserves to audit at regular intervals. We suggest licensed crypto exchanges and projects make their PoR public (and in real time). Then the regulators (and the public) can access and potentially audit the PoR statement as needed. Notwithstanding that it will be very difficult for most of the general public to perform the blockchain analytics required to audit the PoR, nevertheless, the fact that some users, and especially regulators, can do this should go a significant way to ensuring that the client funds held by a crypto exchange or project are stored safely and segregated properly.[156]

5.4. Fraud, market abuse and insider dealing

To ensure market fairness and investor protection, regulators must implement and enforce effective rules against market abuses and insider trading.[157] Title VI of the EU's MiCA may provide an example, developing bespoke crypto market abuse and insider dealing legislation for centralised protocols.[158] If possible, these rules will need to be coordinated globally through cooperation mechanisms such as the IOSCO Multilateral Memorandum of Understanding, which could be extended explicitly to cover crypto.[159]

Core to market abuse regulations will be the definition of what constitutes market abuse. Again, securities regulation will provide important lessons and illuminative examples. Thus, our proposal – that securities regulation apply to crypto as a default rule – will avoid the need for bespoke regulation and often simply mimic existing securities regulation. Furthermore, to the extent of any divergence between securities regulation and crypto regulation, bespoke regulation of crypto will encourage regulatory arbitrage because virtually all securities can be tokenised to bring them within a bespoke crypto regulatory regime if any advantages flow from doing so.[160]

5.5. Restructuring and resolution legislation

At the height of the crypto collapses, private market participants often shunned measures to preserve assets. While there may be many reasons as to why Binance did not provide liquidity to FTX when it was needed, any resolution would have faced quite profound and likely disabling legal uncertainty, considering the uncertain qualification of crypto-assets in insolvency. This uncertainty relates to very basic questions, for instance whether proprietary rights are assigned to crypto asset holders in insolvency and if so which ones and under which circumstances.[161] The EU's MiCA has recognised the importance of

[152] See DA Zetzsche, RP Buckley, DW Arner and MC van Ek, Regulatory Challenges after MiCA and the Revision of the Transfer of Funds Regulation (Study, ECON Committee, European Parliament, May 2023) at 3.5 (providing proposals about how to include decentralised systems in EU sustainable finance regulation).

[153] See, eg, Geoffrey Cone, Nicholas S. Bjorklund & Gregory C. Dyekman, Digital Assets and Property Rights in Insolvency (2021) 27:5 Tr. & Trustees 406. See also Matteo Solinas, 'Trustless' Distributed Ledgers and Custodial Services in Routledge Handbook of Financial Technology and Law (Iris Chiu & Gudula Deipenbrock eds., 2021); Matthias Haentjens, Tycho De Graaf & Ilya Kokorin, The Failed Hopes of Disintermediation: Crypto-Custodian Insolvency, Legal Risks and How to Avoid Them (2020) 2 Singapore J. Legal Stud. 526; Gullifer et al. (n 128).

[154] See MiCA (n 17), arts 3(17), 70, 75; for an in-depth discussion see Zetzsche et al, Remaining Regulatory Challenges (n 17), 5.1.4.

[155] See Mark Maurer, More Crypto Exchanges Verify Reserves, But Questions About Assets Remain, Wall Street Journal (5 Dec. 2022), https://www.wsj.com/articles/more-crypto-exchanges-verify-reserves-but-questions-about-assets-remain-11670153687.

[156] See also the letter from Adrienne A. Harris, Superintendent of Financial Services to Entities Licensed Under 23 NYCRR Part 200 or Chartered as Limited Purpose Trust Companies Under the New York Banking Law That Custody Virtual Currency Assets, RE: Guidance on Custodial Structures for Customer Protection in the Event of Insolvency (23 Jan. 2023), https://www.dfs.ny.gov/industry_guidance/industry_letters/il20230123_guidance_custodial_structures.

[157] See generally Edward J. Swan & John Virgo, Market Abuse Regulation (2019). See also Ester Herlin-Karnell & Nicholas Ryder, Market Manipulation and Insider Trading: Regulatory Challenges in the United States of America, the European Union and the United Kingdom (2019).

[158] For details see Zetzsche et al, Remaining Regulatory Challenges (n 17), 5.1.5.

[159] Memorandum, International Organisation of Securities Commissions (IOSCO), Multilateral Memorandum of Understanding Concerning Consultation and Cooperation and the Exchange of Information (MMoU), IOSCO (2020).

[160] See eg, Julien Chaisse & Jamieson M. Kirkwood, Tokenised funding and initial litigation offerings: the newkids putting third-party funding on the block (2022) Law and Financial Markets Review, <https://doi.org/10.1080/17521440.2022.2153609>.

[161] See Woxholth, Zetzsche, Buckley & Arner (n 128).

regulator-furthered restructuring and resolution at least in some cases. For asset-referenced tokens and e-money tokens, MiCA requires issuers to set up a recovery plan, to ensure that token holders' redemption rights against issuers may be exercised effectively, although regulators may halt exemptions where the platform as such is at risk.[162] Further, crypto asset service providers must set up recovery plans to address ICT operational risk.[163] Yet, these instances only touch upon the tip of the iceberg.

While financial regulation alone cannot solve every legal issue surrounding crypto-assets, resolution legislation (including recovery and resolution plans, 'living wills') would facilitate a clear line between an insolvent intermediary's assets subject to bankruptcy, and those that remain out of scope.[164] Such a clear perimeter for assets subject to bankruptcy proceedings will be particularly crucial to a crypto insolvency or resolution, where IT systems in the DeFi stack are often proprietary and non-standardised, and depend on the interaction of many different actors. If the dissolution of the crypto system seems likely, these actors will become distinctly uninterested in the maintenance and defence against cyberattacks of the DeFi stack, which in turn will quickly erode any ability to restructure the crypto environment in times of stress. Resolution legislation is crucial to provide system continuity and incentivise the many (decentralised) support functions that characterise crypto ecosystems. This may include, where ultimately necessary and warranted for the financial system or one of its segments, central banks' liquidity support.

5.6. Cross-border harmonisation and coordinated enforcement

We have shown elsewhere that the decentralisation of functions across borders further disincentivises compliance.[165] To address this, regulators need to engage in close cross-border cooperation and coordination.[166] This requires, first and foremost, the inclusion of crypto-assets in existing cross-border regulatory, supervisory and information sharing arrangements, in particular the range of existing inter-regulator memoranda of understanding (MoUs), particularly IOSCO Multilateral MOU (MMOU), providing for such arrangements across the IOSCO membership of practically all of the world's securities regulators. Again, the easiest solution would be to widen the scope of existing MoUs amongst securities regulators worldwide, with the IOSCO MMoU providing the most important mechanism. Second, we recommend expanding existing MoUs including the IOSCO MMoU to address the partial decentralisation of functions that we have laid out as characteristic of crypto. Asset segregation, safekeeping, crypto staking and stacking, and in particular cross-border restructuring and administration in bankruptcy with related asset recoveries, may all require the joint action of several regulators across jurisdictions.

Industry associations may facilitate information flows in certain instances,[167] but where externalities are concerned, regulators are best equipped to pursue the public interest and act to provide requirements relating to public goods and externalities.

Crypto provides a suitable case for a global oversight coordination body. Yet, the organisational complexity of a global regulator starting with the question of where the body will be located, financed and equipped, how it will be able to enforce decisions, and to what extent it can override local decisions, will combine to make the establishment of any global oversight body a very significant challenge. In the meantime, as we have shown throughout this paper, crypto regulation will benefit greatly from insights drawn from the regulation of traditional finance.

6. The emerging international crypto regulatory consensus

Crypto claimed many advantages which, with hindsight, have proven inaccurate. Many of the challenges revealed during the 2022–23 Crypto Winter and previous episodes such as Silk Road, Mt. Gox, the ICO Bubble and Libra are well-known in traditional finance. These include agency risks, conflicts of interests, lack of transparency, counterparty risks, operational risks, and the way individual crypto intermediaries often dominated trading and market making in certain crypto-assets. For all these issues, we have good reason to apply the principle 'same function, same risks, same rules'.

In some respects, however, crypto's special features require bespoke regulation.[168] The most important idiosyncrasy of crypto is its *partial* decentralisation that requires many entities, rather than just one, to work together to deliver compliance, cybersecurity, asset recovery, and investor protection. Partial decentralisation poses difficulties in ensuring business continuity in the event of insolvency, as with insolvency the financial incentives to maintain the system vanish. To address this consequence of partial decentralisation we have recommended a combination of licensing and mandatory disclosure of details of the IT architecture and business continuity arrangements in a business plan approach. We also welcome the initiative from the crypto industry regarding 'Proof of Reserves', although we feel this approach should go further and the information be available publicly and in real-time.

Due to its partially decentralised functions, crypto is, from a technical and financial perspective, complex. It requires additional expertise from intermediaries and gatekeepers including lawyers, auditors and regulators. We have argued that the fit and proper test of most licensing regimes and the transparency ensured by a business plan approach, in addition to standardised disclosure requirements, are proper measures to enable market participants and regulators to address this additional complexity.

Finally, partial decentralisation often results in a cross-border situation that renders enforcement difficult and costly. Addressing this requires clear rules with crypto at the centre of their scope (eg, a default rule that treats all crypto-assets as falling under securities regulation) and coordinated cross-border regulatory action facilitated by G20, BIS, IOSCO, FSB, IMF and FATF cooperation frameworks. A well-coordinated cross-border approach to regulation can also assist enforcement.

6.1. Framing the international regulatory consensus

The core elements of a framework for the regulation of the crypto asset ecosystem must include licensing and supervision of the various forms of crypto intermediaries based on their functions and risks, money laundering and terrorist financing requirements built on licensing and customer identification, monetary and financial stability oversight with specific attention to stablecoins and global stablecoins, active domestic and cross-border misconduct enforcement, and emerging disclosure and insolvency arrangements.

The emerging international regulatory consensus which is emerging along these lines is most clearly evidenced in the September 2023 G20 New Delhi Leaders' Declaration and is designed to address the major market failures, externalities and financial regulatory objectives which we have highlighted throughout this article: monetary and financial

[162] See MiCA (n 17), Recital 64 and Arts 39 (2) lit. b, 46, 55.

[163] See MiCA (n 17), Arts 68 (7).

[164] High Level Recommendations (n 127), 9-10; FSB and IMF (n 16), 3.2.3.

[165] Zetzsche, Arner and Buckley (n 4).

[166] FSB and IMF (n 16), 2.3.1.

[167] Such as the Crypto Market Integrity Coalition, see CMIC, <https://www.cmic.global>.

[168] Fliche et al. (n 91), 27.

stability; consumer, investor and depositor protection; market efficiency and fairness; financial integrity; and innovation, growth, inclusion and sustainable development. This is clearly reflected and implemented through a range of reports and standards from the FSB (stablecoins), IOSCO (investor protection, market efficiency and fairness), the FATF (AML financial integrity),[169] the IMF and FSB (financial stability and monetary stability, sustainable development, inclusion), as summarised in the July 2023 FSB umbrella framework and in the September 2023 IMF-FSB synthesis paper.

The recent IMF-FSB paper synthesises the risks and policy findings from the IMF's work on macroeconomic and monetary issues and the FSB's work on financial stability risks. It provides collective recommendations and guidance to authorities to address the macroeconomic and financial stability risks posed by crypto-assets and makes clear that comprehensive regulatory and supervisory oversight of crypto-assets should be a baseline from which to address macroeconomic and financial stability risks. It sets out a roadmap to achieve a more effective, flexible and coordinated implementation of the policy responses for crypto-assets.[170] The IMF-FSB paper concludes, as we do, that the crypto asset ecosystem exhibits vulnerabilities similar to those found in the traditional financial system.[171]

Such a framework, well designed and applied, is essential for the future of crypto. Crypto can only have a flourishing future as a regulated and supervised financial industry, and supervision of this industry will not be easy or simple – the continual rapid innovation in the markets, and the difficulties of regulating decentralised algorithmic-based trading, lending and investment based somewhere in the cloud, both ensure that the effective regulation of the crypto asset ecosystem will remain a massive challenge.

6.2. *Evolving approaches*

Looking around the world, we have identified four major groups of jurisdictions in the context of evolving regulatory approaches. One group – including the EU, UK, Hong Kong, Singapore, Japan, UAE, Switzerland, Australia and Canada – have or are in the process of implementing crypto regulatory frameworks reflecting the international consensus highlighted above. In these jurisdictions, crypto is or soon will be a regulated industry, ending the fifteen -year debate on this point. The second group – with China as the major example – is implementing comprehensive prohibitions across the breadth of the crypto ecosystem. China however – with its strong controls on finance and information flows – is perhaps unique in its ability to do this successfully. The third group – including a range of major emerging markets including India, Brazil and Indonesia – was initially highly sceptical about crypto but is now moving slowly in the direction of the first group. The final group – the US – is somewhat sui generis, reflecting an inability to legislate due to domestic circumstances combined with an active process of 'regulation by enforcement'.

6.3. *Looking forward*

In looking forward, we believe the best opportunities for the development of digital assets will come in the regulated context, particularly as regulated stablecoin projects develop and Decentralized Ledger Technology and blockchain become more widely applied in the context of capital markets, especially debt capital markets, and early stage and sustainable finance.

More broadly, while technology and innovation are central to the evolution of finance, so long as humans are central participants, the core risks of finance throughout its history will be present, the objectives central to financial regulation will continue to apply, and markets will continue to develop and function best when both regulators and market participants work together to provide appropriate frameworks. This time – in the words of the seminal text – is not different.[172]

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No self-generated data was used for the research described in the article.

Acknowledgement

The authors gratefully acknowledge the financial support of the Hong Kong Research Grants Council Senior Research Fellowship programme, the Australian Research Council Laureate Fellowship (FL200100007) and the ADA Chair in Financial Law (Inclusive Finance). We are also grateful for the excellent research assistance of Anna Ho, Nazim Rahman, Georgia Fink-Brigg and Jarrod Li as well as for comments from Jon Frost, three anonymous reviewers and a wide range of conference and policy discussion participants over the past 12 months. The views herein are solely the authors and not necessarily the views of these funding bodies.

[169] FATF, Virtual Assets: Targeted Update on Implementation of the FATF Standards on Virtual Assets and Virtual Asset Service Providers (Jun. 2023), https://www.fatf-gafi.org/en/publications/Fatfrecommendations/targeted-update-virtual-assets-vasps-2023.html

[170] IMF and FSB (n 16).

[171] Ibid.

[172] Carmen M Reinhart and Kenneth S Rogoff, This Time Is Different: Eight Centuries of Financial Folly (2009).