How Crisis Affects Crypto: Coronavirus as a Test Case

HADAR Y. JABOTINSKY[†] & ROEE SAREL[†]

Everybody is talking about cryptocurrencies. These digital tokens, which started in a one-asset market, have swiftly ballooned into a massive and diverse "cryptomarket." The cryptomarket is still mostly unregulated, but this is about to change. With President Biden's adoption of the Executive Order on Ensuring Responsible Development of Digital Assets, regulatory initiatives are being adopted abroad, and global regulation looms ahead. In light of the expected regulatory changes, two important questions emerge: is there a clear rationale for legal intervention in the cryptomarket? And if so, what type of regulation is optimal?

This Article is the first to consider how to regulate the cryptomarket through an empirical analysis of how the COVID-19 crisis affected the cryptomarket. We take a two-step approach to answer these pivotal questions. First, we analyze empirical evidence from the early days of the COVID-19 pandemic to better understand the risks posed by the cryptomarket when a crisis emerges. Second, we apply a law-and-economics approach to identify which market failures are consistent with the data and derive novel regulatory lessons. Our empirical analysis reveals an interesting pattern: investors initially shifted funds to the cryptomarket when the pandemic erupted, but then made a U-turn and diverted funds out of cryptocurrencies, leading to a plunge in the market. We maintain that such investor behavior can have both rational and behavioral explanations, which in turn affects the optimal choice of regulation.

Accordingly, we map each rational and behavioral explanation onto potential market failures by surveying different possible interpretations of our findings, such as substitution effects between traditional markets and the cryptomarket, exploitation of investors in the form of pump-and-dump schemes, and other criminal activities. We then discuss how each type of failure can serve as justification for regulation and derive regulatory lessons on how to best intervene in the cryptomarket depending on the source of the market failure.

[†] Research Fellow, The Hadar Jabotinsky Center for Interdisciplinary Research of Financial Markets, Crises, and Technology.

[†] Junior Professor of Private Law and Law & Economics, Institute of Law & Economics, University of Hamburg.

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INTRODUCTION

> Advances in digital and distributed ledger technology for financial services have led to dramatic growth in markets for digital assets, with profound implications for the protection of consumers, investors, and businesses, including data privacy and security; financial stability and systemic risk; crime; national security; the ability to exercise human rights; financial inclusion and equity; and energy demand and climate change. . . .
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> While many activities involving digital assets are within the scope of existing domestic laws and regulations, an area where the United States has been a global leader, growing development and adoption of digital assets and related innovations, as well as inconsistent controls to defend against certain key risks, necessitate an evolution and alignment of the United States Government approach to digital assets.[1]

In late 2019, the world woke up to a new reality. What began as a local health situation in China swiftly turned into a hazardous pandemic with a mysterious viral disease, COVID-19, wreaking havoc all around the globe.[2] The damage caused by the virus was, and still is, overwhelming: international borders closed down,[3] education was halted or heavily disrupted,[4] public gatherings were prohibited or restricted,[5] airlines canceled flights (some up to the point of bankruptcy),[6] and financial markets crashed.[7] On March 11, 2020,

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1. Exec. Order No. 14067, 87 Fed. Reg. 14143, 14143 (Mar. 9, 2022).

2. For examples of the legal repercussions of the COVID-19 pandemic, see generally Amna A. Akbar, Sameer M. Ashar & Jocelyn Simonson, *Movement Law*, 73 STAN. L. REV. 821 (2021); Sebastian Guidi, Alessandro Romano & Chiara Sotis, *Depolarizing the COVID Vaccine Passport*, 131 YALE L.J.F. 1010 (2022); Etienne Toussaint, *Of American Fragility: Public Rituals, Human Rights, and the End of Invisible Man*, 52 COLUM. HUM. RTS. L. REV. 826 (2021); Suneal Bedi & William C. Marra, *The Shadows of Litigation Finance*, 74 VAND. L. REV. 563 (2021); Katherine Florey, *Toward Tribal Regulatory Sovereignty in the Wake of the COVID-19 Pandemic*, 63 ARIZ. L. REV. 399 (2021); Monika Batra Kashyap, *U.S. Settler Colonialism, White Supremacy, and the Racially Disparate Impacts of COVID-19*, 11 CALIF. L. REV. 517 (2020).

3. *See, e.g.*, Tarcísio Diniz Magalhaes & Allison Christians, *Rethinking Tax for the Digital Economy After COVID-19*, HARV. BUS. L. REV. ONLINE, 2021, at 1, 5, https://www.hblr.org/wp-content/uploads/sites/18/2021/08/TDM_AC_Proof_S21.pdf. *See generally* Doron Teichman & Kristen Underhill, *Infected by Bias: Behavioral Science and the Legal Response to COVID-19*, 47 AM. J.L. & MED. 205 (2021).

4. *See* Christian Sundquist, *The Future of Law Schools: COVID-19, Technology, and Social Justice*, CONN. L. REV. ONLINE, Dec. 2020, at 1, 5, https://connecticutlawreview.law.uconn.edu/wp-content/uploads/sites/2747/2021/03/The-Future-of-Law-Schools-Covid-19-Technology-and-Social-Justice.pdf; Matthias Klatt, *What COVID-19 Does to Our Universities*, 6 U. BOLOGNA L. REV. 1, 3 (2021); *see also* Bruce A. Easop, *Education Equity During COVID-19: Analyzing In-Person Priority Policies for Students with Disabilities*, 74 STAN. L. REV. 223, 231–41 (2022) (discussing the negative effects of education disruption on students with disabilities); Robert H. Klonoff, *COVID-19 Aggregate Litigation: The Search for the Upstream Wrongdoer*, 91 FORDHAM L. REV. 385, 397–99 (2022) (discussing tuition refund cases and the move to online teaching).

5. *See, e.g.*, Peter Czegledy, *Canadian Land-Based Gambling in the Time of COVID-19*, 24 GAMING L. REV. 555, 557 (2020); Alex N. Estroff & Boris W. Gautier, *First Amendment: Executive Order by the Governor Limiting Large Gatherings Statewide*, 37 GA. ST. U. L. REV. 197, 200 (2020).

6. *See, e.g.*, Craig Konnoth, *Narrowly Tailoring the COVID-19 Response*, 11 CALIF. L. REV. 193, 196 (2020).

7. *See, e.g.*, Joseph R. Quinn, *COVID-19, Constitutions, and a Connected World: Assessing the Constitutionality of Remote Voting in Legislatures*, 100 NEB. L. REV. 549, 553 (2021) ("By the time the WHO finally declared COVID-19 to be a pandemic in March, the Dow Jones Industrial Average had shed twenty percent of its previous record high, set just a month earlier."); Franklin Schrum, *No Shirt, No Shoes, No Mask,*

the World Health Organization (WHO) declared the virus a pandemic.[8] Two days later, a national state of emergency was declared in the United States.[9] Notwithstanding the medical breakthroughs in the form of COVID-19 vaccines,[10] and (more recently) medication,[11] the COVD-19 health crisis seems far from over.[12]

Therefore, it is essential to understand the consequences of this global disruption, which entails not only health implications but also financial ones.[13] The insights that arise can be used to advance policymaking and shape appropriate regulation, which can help stabilize financial markets and prevent them from collapsing during unstable times. In particular, the COVID-19 pandemic provides an interesting test case for observing investor behavior and assessing evidence on how the market responds in a time of crisis. This naturally can be accomplished by analyzing empirical data and searching for meaningful correlations.

A proper prediction of how financial markets will behave in the wake of the ongoing pandemic requires understanding the mechanisms at play: is COVID-19 equally bad for all financial instruments, or are there heterogeneous effects and tradeoffs? Does each new case of COVID-19 translate into the same kind of response by investors, or is there a tipping point where investors change their behavior? And do investors respond to the spread of the virus per se, or are they only intimidated when people die due to COVID-19?

No Entry, and (Hopefully) No Lawsuits Under the Georgia COVID-19 Business Safety Act!, 72 MERCER L. REV. 915, 935 (2021) ("In just a one-month time frame, around mid-March, the S&P 500 fell over a 30% to around 2,300, and the Dow Jones fell over 35% to around 18,000. This was the biggest crash in the stock market since the housing crisis back in 2008."). *See generally* Mohsin Ali, Nafis Alam & Syed Aun R. Rizvi, *Coronavirus (COVID-19)—an Epidemic or Pandemic for Financial Markets*, J. BEHAV. & EXPERIMENTAL FIN., Sept. 2020.

8. Nancy J. Knauer, *The Federal Response to COVID-19: Lessons from the Pandemic*, 73 HASTINGS L.J. 49, 85 (2022). For the contents of the announcement, see World Health Org., *WHO Director-General's Opening Remarks at the Media Briefing on COVID-19* (Mar. 11, 2020), https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020.

9. Knauer, *supra* note 8.

10. To date, full FDA approval has been given to the vaccines developed by Pfizer/BioNTech and Moderna, whereas emergency approvals have been given to a few other vaccines. For a continuously updated list, see *COVID-19 Vaccines*, FDA, https://www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/covid-19-vaccines (last visited Jan. 28, 2023).

11. *See, e.g.*, Roseann B. Termini, *The COVID-19 Modern Era Pandemic—the Impact of the 1905 United States Supreme Court Decision of* Jacobson*: Compulsory Vaccination Under State Police Power vs. the Individual Right to Refuse a Vaccination*, 27 WIDENER L. REV. 165, 168 & n.16 (2021). *See generally* Talha Khan Burki, *The Role of Antiviral Treatment in the COVID-19 Pandemic*, 10 LANCET RESPIRATORY MED. e18, e18 (2022).

12. The omicron variant has spread particularly rapidly. *See* Michael E. Keramidas, *Real Property, Real Problems: Expanding Alaska's Unfair Trade Practices and Consumer Protection Act*, 38 ALASKA L. REV. 275, 310 (2021).

13. *See, e.g.*, Daniel D. Bradlow & Stephen Kim Park, *A Global Leviathan Emerges: The Federal Reserve, COVID-19, and International Law*, 114 AM. J. INT'L L. 657, 657 (2020). *See generally* Dayong Zhang, Min Hu, & Qiang Ji, *Financial Markets Under the Global Pandemic of COVID-19*, 36 FIN. RSCH. LETTERS, Oct. 2020; Itay Goldstein, Ralph S.J. Koijen & Holger M. Mueller, *COVID-19 and Its Impact on Financial Markets and the Real Economy*, 34 REV. FIN. STUD. 5135 (2021).

While the negative turn in traditional financial markets caused by the COVID-19 pandemic was unsurprising, the effect on their "stepsibling," the market for cryptocurrencies ("cryptomarket"), was less clear from a theoretical perspective. On one hand, the cryptomarket was perceived as a "safe haven"[14]—that is, a substitute for traditional financial products—that was uncorrelated with market movements. Also, cryptocurrencies are not bound to any single jurisdiction due to their decentralization (i.e., lack of governance by a centralized authority),[15] and hence are less exposed to local liquidity shocks that may occur during a crisis.[16] Investors may therefore plausibly respond to a global crisis by fleeing from traditional markets to the cryptomarket. On the other hand, the cryptomarket might have a "tail risk,"[17] potentially causing it to become correlated and crash together with other markets when a massive crisis erupts. As the cryptomarket is still nascent and its connection to the real economy is not yet fully understood, it was initially unclear how investors would behave in response to COVID-19.

Resolving this ambiguity is important for at least two reasons. First, the cryptomarket is rapidly growing, starting from a one-asset market in 2008 with the introduction of bitcoin, and reaching the size of a small country's GDP by 2018.[18] Second, if the cryptomarket is in fact not a safe haven during a crisis, this holds serious implications for financial stability: an initial plunge in traditional markets might lead investors to mistakenly shift funds to the cryptomarket, falsely hoping for a safe haven, thereby exacerbating the cascade in traditional markets and increasing systemic risk.[19]

The latter is especially important because the cryptomarket is a mostly unregulated financial market.[20] While various regulatory approaches have

14. *See generally* Syed Jawad Hussain Shahzad, Ellie Bouri, David Roubaud, Ladislav Kristoufek & Brian Lucey, *Is Bitcoin a Better Safe-Haven Investment Than Gold and Commodities?*, 63 INT'L REV. FIN. ANALYSIS 322 (2019); L.A. Smales, *Bitcoin as a Safe Haven: Is It Even Worth Considering?*, 30 FIN. RSCH. LETTERS 385 (2019).

15. *See generally* Roee Sarel, *Property Rights in Cryptocurrencies: A Law and Economics Perspective*, 22 N.C. J.L. & TECH. 389 (2021); Brian D. Feinstein & Kevin Werbach, *The Impact of Cryptocurrency Regulation on Trading Markets*, 7 J. FIN. REGUL. 48 (2021).

16. *See, e.g.*, Shaen Corbet, Yang Hou, Yang Hu, Charles Larkin, Brian Lucey & Les Oxley, *Cryptocurrency Liquidity and Volatility Interrelationships During the COVID-19 Pandemic*, FIN. RSCH. LETTERS, Mar. 2022, at 1–2.

17. *See generally* Rui Ren, Michael Althof & Wolfgang K. Hardle, Tail Risk Network Effects in the Cryptocurrency Market During the COVID-19 Crisis (Apr. 9, 2021) (unpublished manuscript), https://ssrn.com/abstract=3753421.

18. *See generally* Antonín Korauš & Tomáš Koreň, Security Protection of People and Property in Connection to Bitcoins (Nov. 2018) (unpublished manuscript), https://www.researchgate.net/publication/329175380_SECURITY_PROTECTION_OF_PEOPLE_AND_PROPERTY_IN_CONNECTION_TO_BITCOINS. Sibghat Ullah, *21 Stats About the Global Bitcoin Market*, YAHOO! FIN. (Mar. 16, 2021), https://yhoo.it/3tPa3eY.

19. "Systemic risk" refers to the risk that the crash of one important institution or market would create a domino effect in other markets. *See generally, e.g.*, Steven L. Schwarz, *Systemic Risk*, 97 GEO. L.J. 193 (2008).

20. Some countries regulate some aspects of cryptocurrencies. *See infra* Part II.A. In the United States, there is a varying degree of involvement on the part of different government agencies, such as the Securities and Exchange Commission (SEC), Internal Revenue Service (IRS), Office of the Comptroller of the Currency

emerged around the globe,[21] the United States has not adopted comprehensive policies concerning cryptocurrencies.[22] However, massive regulation seems on its way: President Biden issued the Executive Order on Ensuring Responsible Development of Digital Assets ("the executive order") in March 2022 entailing a "crypto strategy,"[23] a separate bipartisan bill on crypto regulation was submitted to Congress in June 2022,[24] and developments on the international front point to increased global regulation.[25] There are also parallel state movements; the Governor of New Hampshire, for example, has issued an executive order establishing a state-level commission tasked with producing recommendations for potential regulation.[26] In order to judge whether the anticipated regulation plans are justified, one needs to ask two questions: Is there a clear rationale for intervening in the cryptomarket at all? And if so, what should such regulation be?

This Article takes a two-step approach to answer these pivotal questions. The first step consists of an empirical analysis, which provides regulators with some empirical evidence on how the cryptomarket reacted to its first major crisis—the COVID-19 pandemic. Any data-driven policy requires observing some type of evidence; looking at how the cryptomarket responds to a crisis provides evidence for evaluating the financial risks the cryptomarket poses. In particular, the outbreak of COVID-19 can serve as a sort of "natural experiment"[27] indicating how investors behave during a period of market instability.

The second step entails applying law-and-economics concepts to identify which market failures are consistent with the data. This identification is important because the data only reveals the facts—what happened in the

(OCC), and Financial Crimes Enforcement Network (FinCen). *See* Joe Dewey & Samir Patel, *Blockchain & Cryptocurrencies Laws and Regulations 2023 | USA*, GLOB. LEGAL INSIGHTS, https://www.globallegalinsights.com/practice-areas/blockchain-laws-and-regulations/usa (last visited Jan. 28, 2023).

21. *See infra* Part II.

22. *See, e.g.*, Matteo Formaggi, *Cybercrime and Ransomware*, 37 INT'L ENF'T L. REP. 401, 402 (2021) ("Right now, the cryptos are not operating within a regulatory framework to prevent fraud and ensure financial stability.").

23. Exec. Order 14067, *supra* note 1.

24. Lummis-Gillibrand Responsible Financial Innovation Act, S. 4356, 117th Cong. (2022). A few other bills were also announced thereafter. *See, e.g.*, Michael del Castillo, *Every U.S. Crypto Exchange (and Binance) Is Being Investigated by the SEC, Says Senator Lummis Staffer*, FORBES (Aug. 4, 2022, 7:08 PM), https://www.forbes.com/sites/michaeldelcastillo/2022/08/04/every-us-crypto-exchange-and-binance-is-being-investigated-by-the-sec-says-senator-lummis-staffer/?sh=ced9fb322c27 (mentioning a new planned bill by members of the Senate Committee on Agriculture, Nutrition, and Forestry).

25. *See generally* Roee Sarel, Hadar Y. Jabotinsky & Israel Klein, *Globalize Me: Regulating Distributed Ledger Technology*, 54 VAND. J. TRANSNAT'L L. (forthcoming 2023), https://ssrn.com/abstract=4167978.

26. N.H. Exec. Order No. 2022-1, https://www.governor.nh.gov/sites/g/files/ehbemt336/files/documents/2022-01.pdf (establishing the Governor's Commission on Cryptocurrencies and Digital Assets); *see also* Turner Wright, *New Hampshire Governor Issues Executive Order Establishing Commission To Study Crypto*, COINTELEGRAPH (Feb. 10, 2022), https://cointelegraph.com/news/new-hampshire-governor-issues-executive-order-establishing-commission-to-study-crypto.

27. *See generally* Jordan Schoenfeld, *The Invisible Risk: Pandemics and the Financial Markets* (Tuck Sch. Bus. Working Paper, Paper No. 3567249, 2020), https://ssrn.com/abstract=3567249.

cryptomarket when the COVID-19 pandemic erupted—which are then subject to interpretation. Because the same observed behavior may have different explanations, the appropriate regulatory lesson is conditional on interpretation. We hence derive a set of *conditional regulatory lessons*, tailoring the response to the different potential sources of the problem.

This Article is the first scholarly work to analyze the events in the cryptomarket during the early days of the pandemic from a law-and-economics perspective, and to offer regulatory lessons from such analysis.[28] We consider only the early days of the COVID-19 pandemic, up until the point when it was officially announced a pandemic, in order to focus on the outbreak of the crisis rather than the governmental responses that followed.

Our empirical estimations yield three main findings. First, we find a positive correlation, on average, between the number of new COVID-19 cases worldwide and the "market cap" (i.e., the worth of a cryptocurrency). Specifically, for each additional COVID-19 case, every cryptocurrency gained about $32,000 to $59,000, amounting to billions of dollars. Second, we identify an interesting pattern in the developments in the cryptomarket: at first, COVID-19 cases led to higher demand (and thus higher prices) for cryptocurrencies, but at some point the trend reversed and investors fled the market. Graphically, this captures an inverse-U relationship between COVID-19 cases and cryptocurrencies. Third, we find a more substantial effect on cryptocurrencies' market cap from COVID-19 deaths compared to COVID-19 cases, which is interesting because deaths may well be a random outcome (e.g., depending on the frequency of people with prior medical conditions) or simply misreported.[29]

From a regulatory perspective, these findings, particularly the inverse-U-shaped pattern, are interesting because they are consistent with at least three different potential market failures. First and foremost, the "crypto-rush" of the early days of the pandemic, alongside the fact that traditional markets were

28. For empirical work on the cryptomarket and the COVID-19 pandemic in the finance literature, see generally Thomas Conlon & Richard McGee, *Safe Haven or Risky Hazard? Bitcoin During the COVID-19 Bear Market*, FIN. RSCH. LETTERS, July 2020; Thomas Conlon, Shaen Corbet & Richard J. McGee, *Are Cryptocurrencies a Safe Haven for Equity Markets? An International Perspective from the COVID-19 Pandemic*, RSCH. INT'L BUS. & FIN., Dec. 2020; Shaen Corbet, Charles Larkin & Brian Lucey, *The Contagion Effects of the COVID-19 Pandemic: Evidence from Gold and Cryptocurrencies*, FIN. RSCH. LETTERS, July 2020; John W. Goodell & Stephane Goutte, *Co-Movement of COVID-19 and Bitcoin: Evidence from Wavelet Coherence Analysis*, FIN. RSCH. LETTERS, Jan. 2021; Conghui Chen, Lanlan Liu & Ningru Zhao, *Fear Sentiment, Uncertainty, and Bitcoin Price Dynamics: The Case of COVID-19*, 56 EMERGING MKTS. FIN. & TRADE 2298 (2020); Christy Dwita Mariana, Irwan Adi Ekaputra & Zaafri Ananto Husodo, *Are Bitcoin and Ethereum Safe-Havens for Stocks During the COVID-19 Pandemic?*, FIN. RSCH. LETTERS, Jan. 2021; Imtiaz Sifat, *On Cryptocurrencies as an Independent Asset Class: Long-Horizon and COVID-19 Pandemic Era Decoupling from Global Sentiments*, FIN. RSCH. LETTERS, Jan. 2021; David Vidal-Tomás, *Transitions in the Cryptocurrency Market During the COVID-19 Pandemic: A Network Analysis*, FIN. RSCH. LETTERS, Nov. 2021.

29. *See generally* Reka Szigeti, Domos Kellermayer, Giedrius Trakimas & Richard Kellermayer, *BCG Epidemiology Supports Its Protection Against COVID-19? A Word of Caution*, 15 PLOS ONE, Oct. 7, 2020.

crashing simultaneously,[30] suggests that markets were correlated[31] and that investors disregarded the effect of their behavior on market stability. In other words, the possibility of switching from traditional markets to the cryptomarket increased systemic risk.[32] This is a classic "externality"—neither buyers nor sellers care about the consequences to third parties (here, the general public) from enhanced systemic risk.[33] Second, the inverse-U relationship seems consistent with a price bubble, where people initially rushed to crypto but then started abandoning the market after the bubble burst. One may then suspect foul play in the form of "pump-and-dump"[34] schemes. That is, sophisticated investors artificially inflate demand only to dump their cryptocurrencies after the price increases at the expense of unsophisticated investors.[35] Third, the rise in demand may be at least partially attributable to other criminal activities, where criminals leveraged the chaos at the outset of the pandemic to increase their transactions in crypto.[36]

While each of these possible market failures may provide ample ground for legal intervention, the content of regulation intuitively should vary with the type of market failure. For instance, an externalities problem of enhanced systemic risk can perhaps be treated by restricting trade during unstable times, although

30. *See, e.g.*, Bradlow & Park, *supra* note 13, at 657.

31. During the COVID-19 pandemic, there was a general increase in interconnectedness in financial markets. *See generally* Mike K.P. So, Amanda M.Y. Chu & Thomas W.C. Chan, *Impacts of the COVID-19 Pandemic on Financial Market Connectedness*, FIN. RSCH. LETTERS, Jan. 2021; Muhammad Abubakr Naeem, Saba Sehrish & Mabel D. Costa, *COVID-19 Pandemic and Connectedness Across Financial Markets*, 33 PAC. ACCT. REV. 165 (2021).

32. For a general argument regarding systemic risk outside the context of cryptocurrencies, see generally Schwarz, *supra* note 19.

33. *See, e.g.*, Markus K. Brunnermeier & Martin Oehmke, *Bubbles, Financial Crises, and Systemic Risk*, *in* 2 HANDBOOK OF THE ECONOMICS OF FINANCE 1221, 1222 (George M. Constantinides et al. eds., 2013) ("[One type of negative externality] can arise when individual households or firms take potential drops in asset prices as given when making their investment decision, not internalizing that it is their joint investment decision that determines the size of the crash.").

34. A "pump-and-dump" scheme occurs when informed investors start increasing investments in the market in the hope of luring uninformed investors into the market and then dropping the price by cutting off demand. *See, e.g.*, Christopher P. Buttigieg & Christos Efthymiopoulos, *The Regulation of Crypto Assets in Malta: The Virtual Financial Assets Act and Beyond*, 13 LAW & FIN. MKTS. REV. 30, 34 (2019); *see also* Chelsea Button, *The Forking Phenomenon and The Future of Cryptocurrency in the Law*, 19 UIC REV. INTELL. PROP. L. 1, 21 (2019).

35. J.T. Hamrick, Farhang Rouhi, Arghya Mukherjee, Amir Feder, Neil Gandal, Tyler Moore & Marie Vasek, *An Examination of the Cryptocurrency Pump-and-Dump Ecosystem*, 58 INFO. PROCESSING & MGMT., July 2021, at 1.

> These schemes inflate the price of an asset temporarily so a select few can sell at the artificially higher price. In the case of cryptocurrencies, at the beginning of a pump, a signal indicating the currency to buy is transmitted to insiders via a group messaging platform. Ideally, from the standpoint of the pumpers, the coordinated buying increases the trading activity and begins to drive up the price. When outside buyers are attracted and begin making purchases, the price rises further; then the pumpers sell the positions they acquired previously at lower prices.

36. For a discussion of criminal activity using cryptocurrencies, see generally Hadar Y. Jabotinsky & Michal Lavi, *Speak Out: Verifying and Unmasking Cryptocurrency User Identity*, 32 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 518 (2022).

this is difficult to implement on the technological level because the cryptomarket is decentralized. Conversely, pump-and-dump schemes can be treated by reducing information asymmetries, making it harder to exploit unsophisticated investors, whereas criminal activity is perhaps best tackled through enforcement. On a more general level, however, our findings indicate that the cryptomarket serves as a shadow system[37] of traditional markets, and hence efforts to regulate traditional markets without also regulating the cryptomarket may prove useless, as the risk will simply travel from one market (the regulated one) to the other.[38]

The rest of the Article is organized as follows. In Part I, we provide a brief overview of what transpired during the early days of the COVID-19 pandemic. Part II briefly reviews what cryptocurrencies are, how trading cryptocurrencies works, and why cryptocurrencies may serve as a substitute for traditional financial instruments. In Part III we discuss the connection between the cryptomarket, systemic risk, and herding behavior. Our empirical analysis is described in detail in the Appendix, with the main findings summarized in Part IV. These findings ground our discussion in Part V, which delves into possible market failures and derives possible regulatory proposals.

I. THE EARLY DAYS OF THE COVID-19 PANDEMIC

In December 2019, a series of strange pneumonia cases were identified in Wuhan, China.[39] The cause was an unknown virus from the *Coronaviridae* family, a strand of viruses responsible for past plagues such as SARS and MERS.[40] Scientists coined the name "COVID-19" for the disease,[41] and the media began referring to it simply as "the Coronavirus."[42] COVID-19 swiftly gained momentum, spreading to a wide range of countries including the United States and the European Union. Countries started taking precautionary measures to slow the spread of the virus.[43] However, as incidental regulations in specific

37. *See, e.g.*, Ligita Gasparėnienė, Yuriy Bilan, Rita Remeikienė, Romualdas Ginevičius & Martin Čepel, *The Methodology of Digital Shadow Economy Estimation*, 4 ECON. & MGMT. 20, 26 (2017).

38. Such a switch reflects substitution effects, where regulation increases the cost of using one market and causes a switch to a riskier market. *See, e.g.*, Jan-Philip Elm & Roee Sarel, *No Policy Is an Island: Mitigating COVID-19 in View of Interaction Effects*, 48 AM. J.L. & MED. 7, 7 (2022). For the context of financial regulation specifically, see generally Jeffrey N. Gordon, *The Empty Call for Benefit-Cost Analysis in Financial Regulation*, 43 J. LEGAL STUD. S351 (2014).

39. *See Pneumonia of Unknown Cause—China*, WORLD HEALTH ORG. (Jan. 5, 2020), https://www.who.int/emergencies/disease-outbreak-news/item/2020-DON229.

40. Manas Pustake, Isha Tambolkar, Purushottam Giri & Charmi Ghandi, *SARS, MERS and CoVID-19: An Overview and Comparison of Clinical, Laboratory and Radiological Features*, 11 J. FAM. MED. PRIMARY CARE 10, 10 (2022).

41. *See, e.g.*, Ana Santos Rutschman, *The Intellectual Property of Vaccines: Takeaways from Recent Infectious Disease Outbreaks*, 118 MICH. L. REV. ONLINE 170, 170 (2020), https://repository.law.umich.edu/cgi/viewcontent.cgi?article=1031&context=mlr_online.

42. The virus is sometimes also referred to as SARS-CoV-2, an abbreviation of Severe Acute Respiratory Syndrome Coronavirus 2. The term COVID-19 stands for Coronavirus Disease 2019.

43. Dweepobotee Brahma, Sikim Chakraborty & Aradhika Menokee, *The Early Days of a Global Pandemic: A Timeline of COVID-19 Spread and Government Interventions*, BROOKINGS (Apr. 2, 2020),

countries (e.g., the mandatory quarantine of tourists who visited Wuhan) proved ineffective,[44] the situation rapidly escalated into a global state of emergency: international travel starkly declined,[45] public life was severely restricted, businesses shut down, and people around the world were ordered to isolate themselves from others and engage in "social distancing."[46]

Both real and financial markets were far from indifferent to the pandemic.[47] The loss of product due to COVID-19 has been estimated at (at least) $2.4 trillion.[48] Indices following major stock markets like the Dow Jones and S&P 500 nosedived into one of their lowest rates in history;[49] workers in large companies like Google, Uber, and Cisco Systems reported fears about their job security;[50] and millions of Americans faced a recession.[51] As businesses shut down, firms gradually became strained for cash, leading to massive cash-withdrawal requests.[52] On March 11, 2020, the WHO declared COVID-19 a pandemic.[53]

Since then, the world has gone through turmoil, with waves of COVID-19 variants striking one after another alongside significant progress on the medical front in vaccines and medication. On the policy side, governments around the world have taken various approaches to dealing with the COVID-19 pandemic, such as implementing mitigation measures like lockdowns, curfews, and social distancing.[54]

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https://www.brookings.edu/2020/04/02/the-early-days-of-a-global-pandemic-a-timeline-of-covid-19-spread-and-government-interventions/.

44. *See generally* Elm & Sarel, *supra* note 38 (discussing different studies on policies that were, or were not, effective).

45. Leslie Josephs, *Coronavirus Forces Airlines To Consider a Once Unthinkable Possibility—Halting US Flights*, CNBC (Mar. 16, 2020, 7:03 PM), https://www.cnbc.com/2020/03/16/coronavirus-makes-airlines-consider-chances-for-a-halt-to-us-flights.html.

46. *See, e.g.*, Lindsay F. Wiley, *Democratizing the Law of Social Distancing*, 19 YALE J. HEALTH POL'Y L. & ETHICS 50, 54 (2020); Aziza Ahmed & Jason Jackson, *Race, Risk, and Personal Responsibility in the Response to COVID-19*, 121 COLUM. L. REV. 47, 52 (2021).

47. *See generally* Goldstein et al., *supra* note 13.

48. Rosie Perper, *As the Coronavirus Spreads, One Study Predicts That Even the Best-Case Scenario Is 15 Million Dead and a $2.4 Trillion Hit to Global GDP*, BUS. INSIDER (Mar. 5, 2020, 2:15 AM), https://www.businessinsider.de/international/coronavirus-death-toll-global-gdp-loss-australian-national-university-study-2020-3/?r=US&IR=T.

49. Jessica Menton, *Stocks Crater as Investors Fear the Global Economy Is Headed for a Virus-Fueled Recession*, USA TODAY (Mar. 16, 2020, 4:43 PM), https://eu.usatoday.com/story/money/2020/03/16/dow-tumbles-halted-trading-fed-cuts-rates-coronavirus/5057108002/.

50. Kenneth Rapoza, *Coronavirus Impact: U.S. Tech Companies Fear Job Cuts, Income Loss*, FORBES (Mar. 13, 2020, 1:55 PM), https://www.forbes.com/sites/kenrapoza/2020/03/13/coronavirus-impact-us-tech-companies-fear-job-cuts-income-loss/#711c3b795d66.

51. Greg Iacurci, *Millions of Americans Could Lose Their Jobs in a Coronavirus Recession. Many Won't Get Severance Pay*, CNBC (Mar. 17, 2020, 12:49 PM), https://www.cnbc.com/2020/03/16/millions-of-americans-could-lose-their-jobs-in-a-coronavirus-recession.html.

52. Serena Ng, *Another Problem for the Fed: Banks Pressured as Clients Scramble for Cash*, WALL ST. J., https://www.wsj.com/articles/another-problem-for-the-fed-banks-pressured-as-clients-scramble-for-cash-11584356272 (Mar. 16, 2020, 7:55 PM).

53. WORLD HEALTH ORG., *supra* note 8.

54. Elm & Sarel, *supra* note 38, at 8.

We focus on the financial response to the initial outbreak, before the WHO's declaration of COVID-19 as a pandemic, in order to evaluate the impact of COVID-19 on the market without confounding effects.

II. THE CRYPTOMARKET

This Part provides an overview of how the cryptomarket functions. Subpart A includes a general overview of the market's development to date, and Subpart B discusses why the cryptomarket may serve as a substitute for traditional markets.

A. OVERVIEW OF THE CRYPTOMARKET

The cryptomarket was born when bitcoin, a virtual token offering an alternative for making online payments while bypassing intermediaries, was introduced by an unknown developer using the pseudonym "Satoshi Nakamoto."[55] The technology behind bitcoin, now known as "blockchain," records transactions using an automated and decentralized "distributed ledger."[56] Mimicking bitcoin, firms began developing their own cryptocurrencies. This trend was supported by innovative technological additions such as the Ethereum blockchain,[57] which provided an infrastructure for creating customizable tokens. Cryptocurrencies are deployed for a variety of purposes: some aim to serve as means of payment (similar to bitcoin), whereas others have a designated purpose, either as an investment tool or as a substitute for other products.[58] While trading tokens does not formally require a specific venue, most trading is conducted using "crypto exchanges"—designated platforms that provide bank account–like "wallets" for trading.[59] Prior to the pandemic, exchanges were mostly centralized and not only provided trading services, but also served as a sort of underwriter for token launches.[60]

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55. Satoshi Nakamoto, *Bitcoin: A Peer-to-Peer Electronic Cash System*, BITCOIN.ORG (2008), https://bitcoin.org/bitcoin.pdf.

56. *See, e.g.*, Sarel, *supra* note 15, at 390; Sarel et al., *supra* note 25.

57. *See* Sarel, *supra* note 15, at 399. For a formal description of the Ethereum blockchain, see *What Is Ethereum?*, ETHEREUM, https://ethereum.org/en/what-is-Ethereum (last visited Jan. 28, 2023).

58. *See, e.g.*, Rebecca Crootof & B.J. Ard, *Structuring Techlaw*, 34 HARV. J.L. & TECH. 347, 363 (2021) ("Cryptocurrencies blur the lines between several categories of more traditional assets, causing different federal and state regulators to classify it variously as a currency, a security, or a commodity."). For an overview of token taxonomy, see Sarel, *supra* note 15, at 397–415.

59. *See* Kendall Little, *Want To Buy Crypto? Here's What To Look for in a Crypto Exchange*, NEXTADVISOR (May 3, 2022), https://time.com/nextadvisor/investing/cryptocurrency/what-are-cryptocurrency-exchanges/.

60. Launches by exchanges are known as an "Initial Exchange Offerings" (IEOs). *See* María de la Concepción Chamorro Domínguez, *Financing of Start-Ups via Initial Coin Offerings and Gender Equality*, *in* THE FOURTH INDUSTRIAL REVOLUTION AND ITS IMPACT ON ETHICS (Katharina Miller & Karen Wendt eds., 2021). They became popular after many "Initial Coin Offering" (ICO) launches by firms suffered from scams and failures. *See generally* Seth Holoweiko, *What Is an ICO? Defining a Security on the Blockchain*, 87 GEO. WASH. L. REV. 1472 (2020).

Initially, governments adopted a laissez-faire approach, leaving the cryptomarket virtually unregulated.[61] However, some countries launched independent regulation attempts, which led to different and at times contradictory local rules.[62] Some countries, most notably China and South Korea, banned the use of cryptocurrencies altogether;[63] some like Switzerland went in the opposite direction and adopted blockchain-friendly regulations to attract investments;[64] and other countries, including the United States, applied their preexisting trade rules to cryptocurrencies.[65] Courts seemed equally confused, enforcing different rules arbitrarily, often without much discussion of why a particular rule was chosen.[66] The empirical pre-pandemic evidence on whether existing regulations had any effect on the cryptomarket are mixed: some studies find an effect, while others find null results.[67]

While these regulations concern various issues,[68] much of the regulatory focus, at least in the United States, has been the same as in traditional markets—on disclosure.[69] Namely, because many cryptocurrencies tend to behave as securities, the Securities and Exchange Commission (SEC) began enforcing the usual securities regulations concerning disclosure on some existing tokens.[70]

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61. Hossein Nabilou & André Prüm, *Ignorance, Debt, and Cryptocurrencies: The Old and the New in the Law and Economics of Concurrent Currencies*, 5 J. FIN. REGUL. 29, 29, 61 (2019). *See generally* Tom Barbereau, Reilly Smethurst, Orestis Papageorgiou, Johannes Sedlmeir & Gilbert Fridgen, Decentralised Finance's Unregulated Governance: Minority Rule in the Digital Wild West (Jan. 5, 2022) (unpublished manuscript), https://ssrn.com/abstract=4001891 (discussing the consequences of unregulated Decentralized Finance (DeFi), which is based on cryptocurrencies); *see also* Formaggi, *supra* note 22, at 402.

62. *See, e.g.*, Hadar Y. Jabotinsky, *The Regulation of Cryptocurrencies: Between a Currency and a Financial Product*, 31 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 118, 120–21 (2020). *See generally* Clark Sonksen, *Cryptocurrency Regulations in ASEAN, East Asia, & America: To Regulate or Not To Regulat*e, 20 WASH. U. GLOB. STUD. L. REV. 171 (2021) (providing an overview of the dilemma of countries whether to regulate cryptocurrencies); *see also* Sarel et al., *supra* note 25 (discussing uncoordinated initiatives to regulate cryptocurrencies).

63. Jabotinsky, *supra* note 62, at 120.

64. *Id.* at 121.

65. *Id.*

66. Sarel, *supra* note 15, at 393–94.

67. *See generally* Raphael Auer & Stijn Claessens, *Regulating Cryptocurrencies: Assessing Market Reactions*, 2018 BIS Q. REV. 51; Nicola Borri & Kirill Shakhnov, *Regulation Spillovers Across Cryptocurrency Markets*, FIN. RSCH. LETTERS, Oct. 2020; Feinstein & Werbach, *supra* note 15; Savva Shanaev, Satish Sharma, Binam Ghimire & Arina Shuraeva, *Taming the Blockchain Beast? Regulatory Implications for the Cryptocurrency Market*, 51 RSCH. INT'L BUS. & FIN., Jan. 2020; Mohammad Hashemi Joo, Yuka Nishikawa & Krishnan Dandapani, *Announcement Effects in the Cryptocurrency Market*, 52 APPLIED ECON. 4794 (2020); Raphael Auer & Stijn Claessens, *Cryptocurrency Market Reactions to Regulatory News*, *in* THE ROUTLEDGE HANDBOOK OF FINTECH. 455 (K. Thomas Liaw ed., 2021).

68. *See generally* Elcelina Carvalho Silva & Miguel Mira da Silva, *Research Contributions and Challenges in DLT-Based Cryptocurrency Regulation: A Systematic Mapping Study*, 6 J. BANKING & FIN. TECH. 63 (2022) (surveying existing literature on cryptocurrency regulation).

69. For a discussion of disclosure and cryptocurrencies, see generally Jabotinsky, *supra* note 62; Nishani Edirisinghe Vincent & Anne M. Wilkins, *Challenges when Auditing Cryptocurrencies*, 14 CURRENT ISSUES AUDITING A46 (2020); Matteo Solinas, *Investors' Rights in (Crypto) Custodial Holdings:* Ruscoe v Cryptopia Ltd (in Liquidation), 84 MOD. L. REV. 155 (2021).

70. *See generally* Jabotinsky, *supra* note 62; Michael J. O'Connor, *Overreaching Its Mandate? Considering the SEC's Authority To Regulate Cryptocurrency Exchanges*, 11 DREXEL L. REV. 539 (2019);

Some firms responded by launching their tokens as explicit securities, following the usual process required in an IPO (e.g., registration with the SEC).[71] Consequently, the cryptomarket is now compounded of earlier projects that do not follow existing regulations and others that conform to U.S. securities regulations.

B. CRYPTOCURRENCIES AS A POSSIBLE SUBSTITUTE FOR TRADITIONAL FINANCIAL MARKETS

It is difficult to deduce whether the COVID-19 pandemic should lead to an increased demand for crypto, and there are arguments in both directions. At first glance, cryptocurrencies seem like a natural substitute for financial markets in times of crisis, for several reasons. First, cryptocurrencies are explicitly accepted by some retailers and service providers as a means of payment without being directly exposed to inflation and country-specific liquidity concerns.[72] Investors seeking to hedge against such shocks, including those caused by central bank interventions, might opt for investing in cryptocurrencies.[73]

Second, tokens that explicitly provide revenue sharing would appear to be either a perfect substitute for shares in that same firm or even superior if the sharing is automated and hence protected from attempts of stressed firms to renege on their commitments. Investments in such revenue-sharing tokens may be, therefore, either more stable or at least perceived as such.[74]

Third and similarly, "utility tokens," which provide access to a product or service,[75] also entail technological insurance against the concern that sellers might renege on the promise to provide that product or service through so-called "smart contracts."[76] Smart contracts "allow users to instruct the computer program to transfer the currency from one to another given that certain conditions apply."[77] In other words, smart contracts are programs that "execute 'if this happens, then do that' commands."[78]

Othalia Doe-Bruce, *Blockchain and Alternative Sources of Financing*, *in* CRYPTOFINANCE AND MECHANISMS OF EXCHANGE 91 (Stéphane Goutte et al. eds., 2019).

71. *See generally* Doe-Bruce, *supra* note 70.

72. *See generally* Zlatko Bezhovski, Ljupco Davcev & Mila Mitreva, *Current Adoption State of Cryptocurrencies as an Electronic Payment Method*, 13 MGMT. RSCH. & PRAC. 44 (2021); Chen Liu & Haoquan Wang, *Crypto Tokens and Token Offerings: An Introduction*, *in* CRYPTOFINANCE AND MECHANISMS OF EXCHANGE 125 (Stéphane Goutte et al. eds., 2019).

73. Analyzing a similar time period, one recent study finds a positive correlation between the cryptomarket and inflation. *See* Thomas Conlon, Shaen Corbet & Richard J. McGee, *Inflation and Cryptocurrencies Revisited: A Time-Scale Analysis*, 206 ECON. LETTERS, Sept. 2021, at 1. But it is unclear a priori whether such a link exists.

74. *See generally* Lennart Ante & Ingo Fiedler, *Cheap Signals in Security Token Offerings (STOs)*, 4 QUANTITATIVE FIN. & ECON. 608 (2020).

75. Sarel, *supra* note 15, at 403–04.

76. *See* Dirk A. Zetzsche, Douglas Arner & Ross Buckley, *Decentralized Finance*, 6 J. FIN. REGUL. 172, 181 (2020); Saule T. Omarova, *Technology v Technocracy: Fintech as a Regulatory Challenge*, 6 J. FIN. REGUL. 75, 83–84 (2020).

77. Jabotinsky, *supra* note 62, at 138–39.

78. *Id.* at 139.

Finally, the prevailing view pre-pandemic was that cryptocurrencies are only weakly correlated with stock markets, such that if traditional markets crash, then the cryptomarket can serve as a safe haven.[79] Some pre-pandemic evidence suggests that investors indeed turned to cryptocurrencies during unstable times; for example, the price of bitcoin surged after the Cyprus bailout.[80] The pre-pandemic view thus explains why one might observe a higher demand for cryptocurrencies during a crisis.

However, there are also counterarguments suggesting that cryptocurrencies are not a viable substitute in times of crisis. First, the value of a revenue-sharing token is likely to depend on a firm's activity in the real and financial markets. Hence, it does not provide a full guarantee of payoff when a firm is stressed for cash, and its price may plummet alongside the share price. Second, if services cannot be provided due to the pandemic (e.g., large sporting events that get canceled), a utility token granting access to these services can at most ensure a reimbursement but not performance. Third, tokens serving as a currency may have other substitutes (e.g., "money under the mattress")[81] that seem more viable during a crisis. This concern applies particularly to so-called "stablecoins," which are designed specifically to mimic traditional fiat currencies such as the U.S. dollar or the euro.[82] Such tokens not only raise the same fears as fiat currencies, but also may not be as stable as promised.[83] This instability comes from their high correlation with bitcoin, the rather volatile market leader. Given these counterarguments, one might actually expect *lower demand* for cryptocurrencies when a crisis emerges.

In sum, with arguments in both directions, it is unclear whether the COVID-19 pandemic should lead to increases in demand for crypto.

III. SYSTEMIC RISK AND HERDING

Why should financial regulators care about the cryptomarket? In addition to the obvious reason—that protecting the cryptomarket can be socially beneficial as a way of facilitating exchanges between willing buyers and sellers—regulators might be concerned with spillovers between the

79. *See generally* Elie Bouri, Hussain Shahzad, Syed Jawad & David Roubaud, C*ryptocurrencies as Hedges and Safe-Havens for US Equity Sectors*, 75 Q. REV. ECO. & FIN. 294 (2020).

80. *See generally* William J. Luther & Alexander W. Salter, *Bitcoin and the Bailout*, 66 Q. REV. ECON. & FIN. 50 (2017).

81. *Cf.* Giulio Soana, *Regulating Cryptocurrencies Checkpoints: Fighting a Trench War with Cavalry?*, 51 ECON. NOTES 1, 3 (2022) (describing wallet services for cryptocurrencies as directed for those not wanting to keep money under the mattress).

82. *See generally* Corinne Zellweger-Gutknecht, Benjamin Geva & Seraina Neva Grünewald, *Digital Euro, Monetary Objects, and Price Stability: A Legal Analysis*, 7 J. FIN. REGUL. 284 (2021).

83. There is otherwise mixed evidence as to whether stablecoins are correlated with bitcoin, the market leader. *Compare* Lai T. Hoang & Dirk G. Baur, *How Stable Are Stablecoins?*, EUR. J. FIN., 2021, https://www.tandfonline.com/doi/full/10.1080/1351847X.2021.1949369, *with* Dirk G. Baur & Lai T. Hoang, *A Crypto Safe Haven Against Bitcoin*, 38 FIN. RSCH. LETTERS, Jan. 2021, at 1.

cryptomarket and traditional financial markets[84] that lead to general instability during a crisis. A major concern here is one of "herding behavior"—a term used to describe the behavior of a large group of people who appear to mimic or influence one another.[85] In the context of financial markets, this refers to the behavior of investors who, instead of making individually informed decisions, simply mimic each other's investment strategies.[86] Consequently, this leads to a domino effect, or a "cascade" in the market").[87] Such behavior seems especially relevant during a crisis: if some investors move away from traditional markets and start buying cryptocurrencies in response to a new event such as news of a virus, others might herd and follow suit, causing the price to increase rapidly. If this change is based on true demand—that is, people are in higher need of tokens—then herding is less worrisome. However, herding toward the cryptomarket may reflect an artificial price inflation that is unrelated to the token's underlying value.

There are generally two plausible explanations for unwarranted herding behavior. First, investors might herd due to irrational psychological impulses—that is, the decision results from bias.[88] Second, herding might be rational, which occurs if investors incorrectly interpret each other's behavior as a signal that the token is worth more than its current price.[89] An incorrect interpretation is especially likely if investors rely on incomplete or false data.

Herding is problematic because it can increase systemic risk: it makes price bubbles more likely to emerge and, at the same time, can cause bubbles to burst when people herd in the opposite direction.[90] A common example is a bank run, where depositors withdraw their deposits one after the other, depleting the bank's reserves.[91]

Some scholars attribute the general volatility in the cryptomarket to herding,[92] which is also supported by some pre-pandemic evidence.[93] Herding

84. Shiyun Li & Yiping Huang, *Do Cryptocurrencies Increase the Systemic Risk of the Global Financial Market?*, 2 CHINA & WORLD ECON. 122, 123 (2020).

85. Andrea Devenow & Ivo Welch, *Rational Herding in Financial Economics*, 40 EUR. ECON. REV. 603, 604 (1996).

86. *Id.*

87. *Id.* at 609–10.

88. *Id.* at 604.

89. *See, e.g.*, Dionisis Philippas, Nikolaos Philippas, Panagiotis Tziogkidis & Hatem Rjiba, *Signal-Herding in Cryptocurrencies*, 65 J. INT'L FIN. MKTS., INSTS. & MONEY, Mar. 2020, at 1 ("[I]nvestment behaviour in the cryptocurrency market is largely affected by signals . . . . Potentially, information signals initially have the form of spillovers that are later translated into irrational herd behaviour.").

90. For an overview of price bubbles and systemic risk, see generally Brunnermeier & Oehmke, *supra* note 33.

91. Rajkamal Iyer & Manju Puri, *Understanding Bank Runs: The Importance of Depositor-Bank Relationships and Networks*, 102 AM. ECON. REV. 1414, 1414 (2012).

92. *See generally* John Fry & Eng-Tuck Cheah, *Negative Bubbles and Shocks in Cryptocurrency Markets*, 47 INT'L REV. FIN. ANALYSIS 343 (2016).

93. *See generally* Elie Bouri, Rangan Gupta & David Roubaud, *Herding Behaviour in Cryptocurrencies*, 29 FIN. RSCH. LETTERS 216 (2019); David Vidal-Tomás, Ana M. Ibáñez & José E. Farinós, *Herding in the Cryptocurrency Market: CSSD and CSAD Approaches*, 30 FIN. RSCH. LETTERS 181 (2019); Antonis Ballis &

in the cryptomarket seems especially likely, given that much of the relevant information needed for correct pricing is dispersed[94] and that the market is still only lightly regulated because financial regulation striving to improve information flow is lacking.[95] The lack of information manifests, for instance, in a reluctance of some financial analysts to rate cryptocurrencies.[96] At the same time, some information is observable through designated Telegram channels[97] and websites on which one can observe the movements of "whales" in the market.[98] This is important because for herding to occur, investors must be able to collect information on what *others* are doing.

How important is the herding problem? If regulators' only goal is to prevent risk in the cryptomarket, there is currently little incentive to regulate the cryptomarket due to its still relatively small scale compared to other markets. However, this holds only if the risks in the cryptomarket remain contained during a crisis. Otherwise, if the cryptomarket turns out to be connected to other markets, then there are two opposing possibilities: the cryptomarket can either mitigate systemic risk by granting investors an alternative during a crisis or aggravate the problem through spillovers to other markets.

This connects to the discussion on how systemic risk relates to "shadow banking"—financial activity that does not directly fall under the usual activity of banks.[99] One of the main problems with shadow banking, which cryptocurrencies are part of, is that investors are potentially ignorant of the

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Konstantinos Drakos, *Testing for Herding in the Cryptocurrency Market*, 33 FIN. RSCH. LETTERS, 2020; Paulo Vitor Jordão da Gama Silva, Marcelo Cabus Klotzle, Antonio Carlos Figueiredo Pinto & Leonardo Lima Gomes, *Herding Behavior and Contagion in the Cryptocurrency Market*, 22 J. BEHAV. & EXPERIMENTAL FIN. 41 (2019); Lars Kaiser & Sebastian Stöckl, *Cryptocurrencies: Herding and the Transfer Currency*, 33 FIN. RSCH. LETTERS, 2020; Gerson de Souza Raimundo Júnior, Rafael Baptista Palazzi, Ricardo de Souza Tavares & Marcelo Cabus Klotzle, *Market Stress and Herding: A New Approach to the Cryptocurrency Market*, 23 J. BEHAV. FIN. 43 (2022). A recent study also found that herding in the early days of the pandemic did not differ from herding pre-pandemic. *See generally* Larisa Yarovaya, Roman Matkovskyy & Akanksha Jalan, *The Effects of a "Black Swan" Event (COVID-19) on Herding Behavior in Cryptocurrency Markets*, 75 J. INT'L FIN. MKTS. INSTS. & MONEY 1 (2021).

94. Ruben D'Hauwers, Jacobus van der Bank & Mehdi Montakhabi, *Trust, Transparency and Security in the Sharing Economy: What Is the Government's Role?*, 10 TECH. INNOV. MGMT. REV. 6, 8 (2020).

95. Jabotinsky, *supra* note 62, at 126–28.

96. *See generally* Raja Nabeel-Ud-Din Jalal, Massimo Sargiacomo, Najam Us Sahar & Um-E-Roman Fayyaz, *Herding Behavior and Cryptocurrency: Market Asymmetries, Inter-Dependency and Intra-Dependency*, 7 J. ASIAN FIN. ECON. & BUS. 27 (2020).

97. Telegram is a peer-to-peer communication software. One of its main features is the availability of "channels," which allow broadcasting public messages to a large audience, while maintaining anonymity. *See* Leonardo Nizzoli, Serena Tardelli, Marco Avvenuti, Stefano Cresci, Maurizio Tesconi & Emilio Ferrara, *Charting the Landscape of Online Cryptocurrency Manipulation*, 8 IEEE ACCESS 113230, 113231 (2020).

98. *Cryptocurrency Whale Watching*, CRYPTOSTACHE, https://www.cryptostache.com/2017/11/21/cryptocurrency-whale-watching/ (last visited Jan. 28, 2023); *see also* Bouri et al., *supra* note 93, at 217.

99. *See, e.g.*, Kathryn Judge, *Information Gaps and Shadow Banking*, 103 VA. L. REV. 411, 435–36 (2017). Shadow banking also entails actions of banks via indirect channels, such as commercial bills or wealth management programs. *See generally* Shen Wei, *Wealth Management Products in the Context of China's Shadow Banking: Systemic Risks, Consumer Protection and Regulatory Instruments*, 23 ASIA PAC. L. REV. 91 (2015).

actual risks, such as when there is information asymmetry as to whether loans are backed up by sufficient collateral.[100]

Whether the cryptomarket mitigates or exacerbates systemic risk is an important empirical question on which we provide some evidence by examining what happened to this market during the pandemic.

IV. SUMMARY OF THE EMPIRICAL FINDINGS

We conducted a statistical analysis of a dataset tracking the spread of COVID-19 (in terms of identified cases and deaths) alongside the movements in the cryptomarket (in terms of value and trading volume) from January 1, 2020, to March 11, 2020, which corresponds to the early outbreak of the virus before COVID-19 was officially announced as a pandemic. A detailed description of the analysis is provided in the Appendix. Here, we focus on summarizing the main findings, which ground our legal and economic discussion in Part V. Overall, our analysis yields three main findings, as well as some additional interesting results.

A. FINDING 1: INITIAL "CRYPTO-RUSH"

Our first finding is that, on average, the discovery of each new COVID-19 case corresponded with a substantial increase in both the value of cryptocurrencies (as measured by their market cap, the price of cryptocurrencies multiplied by the number of tokens circulating in the market) and their trading volume. More specifically, for each additional COVID-19 case, every cryptocurrency gained about $32,000 to $59,000, translating to billions of dollars.

B. FINDING 2: AN INVERSE-U RELATIONSHIP BETWEEN COVID-19 AND THE CRYPTOMARKET

Our second finding is that, notwithstanding the average increase in the cryptomarket (finding 1), a more refined look reveals that investors actually took a U-turn: in the very early days of the pandemic, investors rushed to the cryptomarket, but at some point the trend reversed and investors abandoned the cryptomarket. This inverse-U-shaped relationship—first increase, then decrease—seems particularly important from a policy perspective, as it is consistent with various market failures. We discuss these potential market failures in Part V.

C. FINDING 3: STRONGER IMPACT OF COVID-19 DEATHS THAN COVID-19 CASES

The third finding concerns the difference between COVID-19 cases (infections) and deaths. While we observe a correlation between cases and the

100. *See* Judge, *supra* note 99, at 418.

cryptomarket, the effect is much stronger when deaths are considered. In other words, every new death led to significant increases in both the trade and value of cryptocurrencies far above the effect of a new case. This is somewhat surprising: death is obviously worse than sickness, yet it is not clear what one should learn from an additional death from COVID-19. Specifically, while deaths could have indicated that the virus is more dangerous than originally anticipated, they could have also just as easily been a random consequence, depending on whether the infected person was old or had a previous medical condition. The fact that the reaction to deaths may not be fully rational strengthens our position that there may be grounds to intervene in the market to address behavioral investment decisions.[101]

D. ADDITIONAL FINDINGS

Our analysis also yields some additional, though somewhat less central, insights. First, we find that the total number of COVID-19 cases has an effect on the cryptomarket that is above and beyond the effect of the daily incoming stream of COVID-19 cases. This is interesting because it suggests that investors cared not only about the daily "shock" of new COVID-19 cases, but also about the existing state of the virus's spread at that point (i.e., total number of COVID-19 cases).[102]

Second, we find some anecdotal differences in the correlation between cryptocurrencies and the S&P 500. Namely, the values of the S&P 500 and the cryptomarket seemed to have moved in the same direction, but the trade volumes moved in opposite directions. That is, investors switched from traditional markets to the cryptomarket but did not actually find a "safe haven," because the payoffs from the markets moved in the same direction. This is important for the aforementioned discussion in Subpart B on safe havens and bears implications for systemic risk. We discuss this point further in Part V.

Third, we find few differences between the behaviors of different tokens; that is, most tokens seem to follow the same pattern. This is somewhat counterintuitive: if each token has different features because its value is determined by the content of the specific algorithm on which it relies, why should all tokens behave homogenously? We attempt to answer this question in Part V and further discuss a related finding that even stablecoins generally follow the same pattern as other cryptocurrencies.

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101. *See infra* Part V.

102. From an economic perspective, the COVID-19 cases identified in the early days (some of which already ended in recovery) might just reflect so-called "sunk costs"—events that already happened in the past and cannot be changed by future actions, and thus might be irrelevant for the valuation of tokens. Hence, caring about such cases might be part of a "sunk cost fallacy." *See, e.g.*, Christine Jolls, Cass R. Sunstein & Richard Thaler, *Theories and Tropes: A Reply to Posner and Kelman*, 50 STAN. L. REV. 1593, 1600 (1998).

V. DISCUSSION

In this Part, we discuss our empirical findings and the regulatory lessons that follow. Subpart A discusses why the main empirical results may point to a market failure in general. Subpart B connects the findings to specific market failures that may provide rationales for regulatory intervention. Subpart C then turns to the different regulatory lessons that our findings yield. Subpart D subsequently reviews key regulatory challenges.

A. IS THERE A MARKET FAILURE?

Our empirical findings point to an initial crypto-rush in the early days of the pandemic: on average, the outbreak of COVID-19 led to an increase in both the market cap and trading volume of cryptocurrencies. Given that traditional markets plunged during this time, a plausible explanation for our finding is that investors withdrew their money from traditional markets and diverted it into the cryptomarket. Yet it is difficult to disentangle the exact drivers of this behavior, as it is consistent with both rational and behavioral explanations. From the rational side, investors may have logically turned to the cryptomarket as a substitute based on the information that was available to them at the time. In particular, recall that the common perception before the pandemic was that the cryptomarket is a safe haven;[103] thus, investors may have rationally believed that buying cryptocurrencies was a safer option when traditional markets became unstable. However, on the behavioral side, investors may have simply herded. That is, some investors decided to buy cryptocurrencies, and everyone else followed suit without conducting a meaningful cost-benefit analysis of investment strategy.

However, this crypto-rush does not by itself necessarily point to any type of market failure. What suggests that a failure may have occurred is our second empirical insight: that, at some point, the trend reversed and the market crashed, yielding the aforementioned inverse-U-shaped relationship.

To better understand what happened, it is illustrative to visually compare the trend in the cryptomarket[104] with the spread of COVID-19 cases.[105] This comparison reveals that the tipping point in the cryptomarket occurred when there were approximately 50,000 cases in total, which is around the same time the number of incoming cases started to slow down. Thus, a plausible explanation is that investors observed decay in the spreading speed of COVID-19 and interpreted this as a positive signal for trading back in traditional markets, causing investors to move away from crypto back to traditional assets. However, as Figure 1 also shows, the number of cases began speeding up again toward

103. *See supra* Part II.B. *Compare* Bouri et al., *supra* note 79, *and* Conlon & McGee, *supra* note 28, *and* Conlon et al., *supra* note 28, *with* Shahzad et al., *supra* note 14, *and* Smales, *supra* note 14.

104. *See infra* Appendix, Figures 2 & 3.

105. *See infra* Appendix, Figure 1.

early March, although the trend in the cryptomarket did not reverse back and continued to crash.[106] This suggests that a market failure may be in play.

Another interesting aspect is the fact that the inverse-U-shaped relationship occurred across most, if not all, tokens. This seems inconsistent with rational behavior, which would typically require making a distinction between the values of different tokens and treating them differently. This further points to a possible market failure.

B. POSSIBLE MARKET FAILURES

The literature on law and economics typically divides market failures into four different categories: excessive market power,[107] information asymmetry,[108] externalities,[109] and behavioral market failures.[110] We consider, in turn, whether each of the categories applies.[111]

The problem with market power occurs when the quantity of products sold in equilibrium is too low and the price is too high[112] because sellers with market power have the ability to control the price.[113] Here, the problem does not seem to be that not enough cryptocurrencies were purchased. Yet one may wonder whether the changes in the market were driven by sellers who had a very large stake in cryptocurrencies ("whales"), such that their transactions affected the market price.[114] Insofar that the movements in the market are attributable to whales, market power seems to be one relevant factor.

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106. *See infra* Appendix, Figure1.

107. *See* ROBERT COOTER & THOMAS ULEN, LAW AND ECONOMICS 38–43 (6th ed. 2016).

108. *Id.*

109. *Id.*

110. The first three categories (market power, information asymmetry, and externalities) are traditional categories in law and economics. *Id.* Robert Cooter & Thomas Ulen distinguish between externalities and "public goods," but these are conceptually similar, as public goods simply raise the problem of "positive externalities"; that is, people are reluctant to donate money for the creation of a "public good" because they do not internalize the benefit to others. Behavioral market failures, on the other hand, are an additional category identified in the behavioral law-and-economics literature. *See, e.g.*, Michael David Thomas, *Reapplying Behavioral Symmetry: Public Choice and Choice Architecture*, 180 PUB. CHOICE 11, 12 (2019) ("[B]ehavioral market failure represents a revival of justifications for interventions by experts. The cognitive errors of market participants are understood as 'behavioral market failures,' which policymakers uniquely are able to correct."); *see also* Jim Hawkins, *Using Advertisements To Diagnose Behavioral Market Failure in the Payday Lending Market*, 51 WAKE FOREST L. REV. 57, 59 (2016).

111. For a general discussion of market failures and the cryptomarket, see generally Peder Østbye, The Adequacy of Competition Policy for Cryptocurrency Markets (Aug. 24, 2017) (unpublished manuscript), https://ssrn.com/abstract=3025732.

112. COOTER & ULEN, *supra* note 107, at 38 ("The price is too high, and the quantity supplied is too low from the viewpoint of efficiency.").

113. Formally, the problem with market power is that when a monopoly faces a standard demand curve—where consumers are willing to pay less and less for each extra product purchased because the first product is valuable but a second one of the same thing is less important—then the monopoly gets lower revenues when it sells larger quantities. This gives an incentive to instead lower the quantity sold, while still charging the high price that consumers are willing to pay. *See id.* at 28–32.

114. *See* Bouri et al., *supra* note 93, at 217.

However, the more important factor seems to be information asymmetries. Those occur when some players in the market have an information advantage over others.[115] The inverse-U relationship we identified might reflect a pump-and-dump scheme occurring when information asymmetries are present. The initial rise in demand would then represent the start of the scheme, where sophisticated investors inflated the price, and the tipping point would represent the moment where those same investors dumped their tokens. Because pump-and-dump schemes can occur more easily when a few central players have the power to suddenly dump large amounts of tokens and drive the price down,[116] the conjunction of uninformed investors and whales might be especially likely to cause a market failure.[117]

The problem is worsened by the lack of transparency in the cryptomarket, as uninformed investors know neither who held which token ex ante (given the aforementioned pseudo-anonymity) nor who dumped the tokens ex post.[118] The market failure then manifests in two ways. First, a pump-and-dump might lead to a market crash when investors sell off their tokens (ex post perspective). Second, if uniformed investors anticipate the possibility of being exploited, they might refuse to participate in the market (ex ante perspective).[119] Yet even without an explicit pump-and-dump scheme, information asymmetries provide a justification for regulation due to the fear of herding, which occurs when investors lack reliable information.[120]

The most fundamental problem that our findings point to, however, is one of externalities: when buyers and sellers trade in the cryptomarket, they most likely do not internalize the effect of their transactions on other markets because they only care about their own investment rather than the stability of the financial system.[121] In other words, the effect of cryptocurrency trading on

115. JILL M. HENDRICKSON, REGULATION AND INSTABILITY IN U.S COMMERCIAL BANKING, A HISTORY OF CRISES 4–5 (2011); *see also* Michael L. Wachter, *Takeover Defense When Financial Markets Are (Only) Relatively Efficient*, 151 U. PENN. L. REV. 787, 803 (2003) (discussing the relationship between information asymmetry and the efficiency of financial markets).

116. Bouri et al., *supra* note 93, at 217.

117. *Id.*

118. *See, e.g.*, Peter M. Krafft, Nicolás Della Penna & Alex Pentland, *An Experimental Study of Cryptocurrency Market Dynamics* 1 (Proc. of the 2018 CHI Conf. on Hum. Factors in Computing Sys., Working Paper No. 605, 2018).

119. The fear of market breakdown due to information asymmetries reflects the well-known problem of "adverse selection." *See* George A. Akerlof, *The Market for "Lemons": Quality Uncertainty and the Market Mechanism*, 84 Q.J. ECON. 488, 493 (1970); *see also* Cooter & Ulen, *supra* note 107, at 48. Namely, buyers who are unsure of the value of a good—here, the token—will only agree to pay an average price, at which the seller may not be willing to sell. What might then occur is that only "bad" tokens—that is, those with which whales participate only to exploit others—are traded, causing other tokens to drop out of the market.

120. Devenow & Welch, *supra* note 85, at 604; Bouri et al., *supra* note 93, at 216; Kaiser & Stöckl, *supra* note 93; Yarovaya et al., *supra* note 93; D'Hauwers et al., *supra* note 94, at 8.

121. There are many reasons why individuals would not care about the stability of the market. First, investors might be selfish and not care about what happens to other investors, either in the cryptomarket or other markets. Second, there might be incentive problems, because the stability of the market is a "nonexcludable" good, which benefits everyone at the same time. In this case, a free-rider problem can emerge: investors want

systemic risk is unlikely to be reflected in the price of tokens, as the parties are unlikely to care about the effect of their transaction on the economy's stability.[122]

Finally, a different kind of externality problem may be at play, because the market movements we observe might be related to criminal activity, where criminals exploit the chaos to enhance their illegal trading using cryptocurrencies.[123] Existing studies suggest that criminal activities constitute less than 10% of the cryptoeconomy in stable times,[124] but the liquidity pressures created by the pandemic could have increased the use of cryptocurrencies by criminals and terrorists.[125] If criminal activities are the main driver of our findings, the trend's reversal captures criminals' response, much like investors, to some general event, or to a crime-related event (e.g., concerns that the rapid spread of COVID-19 would reduce crime-commission opportunities due to delays in the supply chain).[126] While crime is arguably grounds for intervention in and of itself, it may also reflect a specific kind of externality: neither criminals nor those who trade with criminals internalize the negative effect of their actions on the general public.[127]

Having identified the different market failures that might justify legal intervention, we proceed to detail each type of intervention.

C. REGULATORY LESSONS

Market power problems are typically addressed using antitrust law; hence, some scholars have proposed using such laws to tackle the cryptomarket as well.[128] However, it is not obvious which antitrust-based rule can be used to

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stability but prefer to let others facilitate it, so that eventually everyone continues to trade in a way that enhances systemic risk. For a discussion on the free-rider problem in the context of cryptocurrencies, see generally Sarel et al., *supra* note 25. Third, investors may not have the information, or the skills to process the information, that allows them to assess the stability of the market.

122. Jabotinsky, *supra* note 62, at 128–29.

123. Jabotinsky & Lavi, *supra* note 36.

124. *See* Requirements for Certain Transactions Involving Convertible Virtual Currency or Digital Assets, 85 Fed. Reg. 83840, 83842 (proposed Dec. 23, 2020) (to be codified at 31 C.F.R. pts. 1010, 1020, 1022) (noting that about 1% to 11.9% of trade is related to illicit activities).

125. *See generally* Andréanne Bergeron, David Décary-Hétu & Luca Giommoni, *Preliminary Findings of the Impact of COVID-19 on Drugs Crypto Markets*, 83 INT'L J. DRUG POL'Y 102870 (2020); Alberto Bracci, Matthieu Nadini, Maxwell Aliapoulios, Damon McCoy, Ian Gray, Alexander Teytelboym, Angela Gallo & Andrea Baronchelli, *Dark Web Marketplaces and COVID-19: Before the Vaccine*, EPJ DATA SCI., Jan. 21, 2021; Katelyn Wan Fei Ma & Tammy McKinnon, *COVID-19 and Cyber Fraud: Emerging Threats During the Pandemic*, 29 J. FIN. CRIM. 433 (2022).

126. *See generally* Roee Sarel, *Crime and Punishment in Times of Pandemics*, 54 EUR. J.L. & ECON. 155 (2022) (discussing the incentives to commit crimes during COVID-19).

127. *See, e.g.*, Mollie Lee, *Environmental Economics: A Market Failure Approach to the Commerce Clause*, 116 YALE L.J. 456, 488 (2006).

128. *See generally* Florian Deuflhard & C. Philipp Heller, Antitrust Economics of Cryptocurrency Mining (Sept. 3, 2021) (unpublished manuscript), https://ssrn.com/abstract=3917012 (analyzing the problem of concentration in mining cryptocurrencies); Østbye, *supra* note 111; Dr. Thibault Schrepel, *Libra: A Concentrate of "Blockchain Antitrust,"* 118 MICH. L. REV. ONLINE 160 (2019), https://repository.law.umich.edu/mlr

address the specific problem of whales buying or selling cryptocurrencies. One possibility is to prohibit ex ante any *acquisition* of a dominant position; that is, to prevent whales from being formed in the first place. This seems like a somewhat extreme form of intervention, because antitrust laws typically prohibit the *abuse* of a dominant position rather than prohibiting the acquisition of such a position.[129] Nevertheless, the European Union's forthcoming legal framework for regulating cryptocurrencies, Regulation on Markets in Crypto Assets (MiCA),[130] proposes precisely this step, as it classifies *securing* a dominant position in cryptocurrencies as "market manipulation."[131]

A less extreme step would be to view abnormal transactions by whales in times of crisis as an abuse of a dominant position. Abuses of dominant positions are already prohibited in the European Union,[132] and the same idea is also mirrored in U.S. prohibitions on predatory practices.[133] Yet enforcing such prohibitions may be difficult due to the same information asymmetries faced by investors: regulators may not be able to easily find out who owns which token.[134] Hence, targeting information asymmetries and externality problems rather than market power seems more feasible.

Regulating markets with information asymmetry is typically achieved through either consumer protection measures in real markets,[135] or financial

_online/vol118/iss1/4; Giovanna Massarotto, *Antitrust in the Blockchain Era*, 1 NOTRE DAME J. EMERGING TECH. 252 (2020).

129. Firat Cengiz, *What the EU's New MiCA Regulation Could Mean for Cryptocurrencies*, EUROPP EUR. POL. & POL'Y (July 5, 2021), https://blogs.lse.ac.uk/europpblog/2021/07/05/what-the-eus-new-mica-regulation-could-mean-for-cryptocurrencies/; *see also* Josef Azizi, *The Limits of Judicial Review Concerning Abuses of a Dominant Position: Principles and Specific Application to the Communications Technology Sector*, 9 LOY. L. & TECH. ANN. 149, 158 (2010).

130. *Proposal for a Regulation of the European Parliament and of the Council on Markets in Crypto-Assets and Amending Directive (EU) 2019/1937*, COM (2020) 593 final (Sept. 24, 2020) [hereinafter *EU Crypto-Assets Proposal*]. The proposal was amended in November 2021. *Proposal for a Regulation of the European Parliament and of the Council on Markets in Crypto-Assets, and Amending Directive (EU) 2019/1937* (Nov. 19, 2021). MiCA is currently in its final stage of approval following a general agreement between member states made at the end of June 2022. *See* Council of the European Union Press Release 551/22, Digital Finance: Agreement Reached on European Crypto-Assets Regulation (MiCA) (June 30, 2022).

131. *EU Crypto-Assets Proposal*, *supra* note 130, art. 80.2(a) ("The following behaviour shall, inter alia, be considered as market manipulation: . . . securing a dominant position over the supply of or demand for a crypto-asset, which has, or is likely to have, the effect of fixing, directly or indirectly, purchase or sale prices or creates, or is likely to create, other unfair trading conditions . . . .").

132. Such abuse is prohibited in the European Union under article 102 of the Treaty on the Functioning of the European Union (TFEU). Consolidated Version of the Treaty on the Functioning of the European Union art. 102, June 7, 2016, 2016 O.J. (C202) 89.

133. LEXOLOGY, DOMINANCE 2020, at 238–39 (Patrick Bock & Kenneth Reinker eds., 2020). For general differences between the United States and the European Union in terms of how abuse of a dominant position is evaluated, see Pablo Ibáñez Colomo, *What Is an Abuse of a Dominant Position? Deconstructing the Prohibition and Categorizing Practices*, *in* RESEARCH HANDBOOK ON ABUSE OF DOMINANCE AND MONOPOLIZATION (Pinar Akman et al. eds., 2022).

134. Østbye, *supra* note 111, at 11.

135. *See generally* Howard Beales, Richard Craswell & Steven Salop, *Information Remedies for Consumer Protection*, 71 AM. ECON. REV. 410 (1981) (discussing information remedies); Uri Benoliel & Shmuel I. Becher, *The Duty To Read the Unreadable*, 60 B.C. L. REV. 2255 (2019) (discussing the effects of consumers' duty to read contracts).

regulation in financial markets.[136] Given the conceptual overlap between cryptocurrencies and securities, we focus primarily on financial regulation.

Recall that security tokens are already directly subject to U.S. securities regulation; thus, issuers of tokens that do comply with SEC rules are constrained by applicable sanctions. This may address some of the issues. For instance, the obligation to register any new launch of security tokens with the SEC might help bring to light information that investors can rely on.[137] Pump-and-dump schemes are then arguably somewhat more difficult to execute, as investors at least have some basic information on the tokens they invest in. Furthermore, the average increase in the demand for crypto may even speak in favor of existing regulation, suggesting that investors may have trusted the cryptomarket enough to divert funds in that direction.

Nonetheless, the inverse-U-shaped relationship between COVID-19 and the cryptomarket seems to suggest that the regulation did not function well, insofar as investors may still have fallen prey to a pump-and-dump scheme. There are two reasons why the regulatory measures in the United States were insufficient to prevent pump-and-dumps. First, measures taken by any single country (including the United States) are generally insufficient to address problems in the global cryptomarket.[138] Second, even if the SEC could prevent pump-and-dump schemes,[139] there are several problems that remain unaddressed by the existing SEC rules.

For one, securities regulations do not seem to be designed for a crisis, in that the disclosures mandated by the SEC may not be those that are most relevant in a global crisis.[140] Additionally, there has been some criticism of the SEC's attempts to enforce U.S. securities laws outside of the United States, which may interfere with the international consensus and business practices of foreign entities.[141] Such interference may be especially detrimental if foreign firms are already struggling due to COVID-19 constraints.

136. *See generally* Thomas Philippon & Vasiliki Skreta, *Optimal Interventions in Markets with Adverse Selection*, 102 AM. ECON. REV. 1 (2012).

137. SEC Div. of Corp. Fin., Div. of Inv. Mgmt. & Div. of Trading & Mkts., *Statement on Digital Asset Securities Issuance and Trading*, U.S. SEC. & EXCH. COMM'N (Nov. 16, 2018), https://www.sec.gov/news/public-statement/digital-asset-securites-issuuance-and-trading.

138. *See generally* Sarel et al., *supra* note 25. *But see* Tim Marple, *Updating Dollar Diplomacy: Leading on Digital Currency Standards*, 44 WASH. Q. 107, 115 (2021) (arguing that the United States is uniquely situated to "provide leadership and enforce norms around digital currencies").

139. *See* Sarel et al., *supra* note 25. *But see* Marple, *supra* note 138.

140. In this context, a recent study investigated the information that firms disclosed with respect to the influence of COVID-19 and found stark differences in which information was shared. *See generally* David F. Larcker, Bradford Levy, Brian Tayan & Daniel J. Taylor, *The Spread of COVID-19 Disclosure* (Rock Ctr. for Corp. Gov. at Stanford Univ. Closer Look Series: Topics, Issues & Controversies in Corp. Gov., Working Paper No. CGRP-84, 2020), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3636454.

141. *See generally* Carol R. Goforth, SEC v. Telegram*: A Global Message*, 52 U. MEM. L. REV. 199 (2021).

Finally, SEC regulation does not apply to all tokens, only to security tokens.[142] Hence, one should still consider the question of how to best regulate *non-security tokens* in light of our findings. If investors buy non-security tokens speculatively in the hope of selling them later for a higher price,[143] then the same rationales for financial regulation apply.[144] For all tokens, there is at least one rationale for intervening at the point in which they are launched: information asymmetries as to the quality of the services related to the token or of the token itself.[145] Specifically, the intervention can serve as an informative signal,[146] causing investors to update their beliefs about both the existing state of the market and the prospect of future regulation. For example, one might think about tasking some neutral entity with maintaining a publicly available rating of non-security cryptocurrencies. While such rankings already exist in the private market for token launches,[147] a regulatory-based registry tracking the reliability of tokens is perhaps more likely to avoid biased evaluations, as private market players may have an incentive to promote tokens in exchange for money. Then, cryptofirms that issue tokens and want to signal that their tokens are reliable could voluntarily self-select into such a regulatory-based registry as a form of a costly signal.[148]

However, regulating information asymmetries for both security and non-security tokens is not free of challenges. First, it is not obvious which features should be disclosed.[149] Unlike regular securities, which are standardized, cryptocurrencies can be customized to have multiple functions. Consequently, it

142. *See*, *e.g.*, SEC v. Shavers, No. 4:13-CV-416, 2013 U.S. Dist. LEXIS 110018, at *3–4 (E.D. Tex. Aug. 6, 2013); In re Voorhees, Securities Act Release No. 9592, 2014 SEC LEXIS 1922 (June 3, 2013) (discussing whether certain cryptocurrency-related investments were securities and finding that this was indeed the case); *see also* Report of Investigation Pursuant to Section 21(a) of the Securities Exchange Act of 1934: The DAO, Exchange Act Release No. 81,207, 2017 WL 7184670 (July 25, 2017) (the famous DAO Report).

143. This strategy is colloquially known as "HODL," which is an inside joke among crypto enthusiasts as an anagram for "hold" or an acronym for "hold on to dear life." *See, e.g.*, Rebecca M. Bratspies, *Cryptocurrency and the Myth of the Trustless Transaction*, 25 MICH. TECH. L. REV. 1, 2 (2018).

144. However, insofar as non-security tokens are used for their declared purpose (payment or access to services), the need to regulate them is not directly obvious, as one would need to look into potential market failures in the specific case where they are used. It should also be noted that it seems highly challenging to disentangle which tokens are bought speculatively and which ones are bought for other uses, because one might buy a token for both purposes at the same time.

145. Among other things, this asymmetry can lead to an adverse selection problem, where only cryptocurrencies associated with low-quality projects are launched. *See* Bouri et al., *supra* note 93.

146. Feinstein & Werbach, *supra* note 15, at 51.

147. *See, e.g.*, Emmanuel De George, Thomas Bourveau, Atif Ellahie & Daniele Macciocchi, *How Can We Trust Crypto-Markets?*, 29 LONDON BUS. SCH. REV. 34, 35 (2018) (mentioning a few websites).

148. *See* Giancarlo Giudici, Alistair Milne & Dmitri Vinogradov, *Cryptocurrencies: Market Analysis and Perspectives*, 47 J. INDUS. & BUS. ECON. 1, 12 (2020) (mentioning that in the cryptomarket, firms may want to voluntarily disclose information as a form of quality signaling).

149. There is also some debate regarding the usefulness of disclosure altogether for cryptocurrencies, based on the argument that investors in the crypto community "know where to get information and what they risk." Guido Ferrarini & Paolo Giudici, *Digital Offerings and Mandatory Disclosure: A Market-Based Critique of MiCA* 1 (Eur. Corp. Gov. Inst., Working Paper No. 605/2021, 2021), https://ssrn.com/abstract=3914768. Conversely, our analysis suggests that investors may well have been unaware of the risks. *Id.*

may be quite challenging to evaluate the risks involved in buying a cryptocurrency, even if all the key information is on the table. There have been claims that cryptocurrencies have "no intrinsic value at all,"[150] that different models are needed for valuing cryptocurrencies,[151] and that specific, complex models are needed for forecasting the behavior of cryptocurrencies.[152] Thus, a more promising regulatory path is perhaps one that also deals with the most burning issue arising from our results: the issue of externalities, especially with respect to systemic risk.

While the mitigation of systemic risk is a goal that few would argue with, the justification for any type of intervention depends on the degree to which movements in the cryptomarket transfer systemic risk to traditional markets. In other words, one needs to check whether the cryptomarket is responsible for a nonnegligible share of systemic risk.[153] Note that our analysis does not test this directly, as we focus on the relationship between COVID-19 and the cryptomarket rather than on intermarket volatility; nevertheless, our findings are still helpful for evaluating this issue.

A key determinant of the cryptomarket's contribution to systemic risk is its size. Is the cryptomarket "too big to fail?" And if it is not too big to fail, is it "too important to fail?" As of August 2021, the cryptomarket's total market value was estimated to be a boggling $2 trillion.[154] However, this valuation has

150. *See generally* Horst Treiblmaier, *Do Cryptocurrencies Really Have (No) Intrinsic Value?*, 32 ELEC. MKTS. 1749 (2021).

151. *See generally, e.g.*, Michael C. Burda, *Valuing Cryptocurrencies: Three Easy Pieces* (EconStor, Working Paper No. 2021-011, 2021), https://www.econstor.eu/handle/10419/235590.

152. *See generally* Leandro Maciel, *Cryptocurrencies Value-at-Risk and Expected Shortfall: Do Regime-Switching Volatility Models Improve Forecasting?* 26 INT'L J. FIN. & ECON. 4840 (2021) (finding that so-called "MS-GARCH" models are useful); Fahad Mostafa, Pritam Saha, Mohammad Rafiqul Islam & Nguyet Nguyen, *GJR-GARCH Volatility Modeling Under NIG and ANN for Predicting Top Cryptocurrencies*, 14 J. RISK & FIN. MGMT. 421 (2021) (finding that other models are better).

153. Jabotinsky, *supra* note 62, at 163.

> Market failures may become apparent as a result of cryptocurrencies that are not securities when these tokens become systemically important and affect financial institutions . . . systemic risk results from the interconnectedness of firms on the financial markets. Interconnectedness results from the fact that the value of one firm in the market is dependent on the payoffs it receives from its claims on other firms. The value of these claims depends, in turn, on the stability of other firms and so on. When firms are interconnected, the failure of one financial institution might have a cascading effect and bring down other large financial institutions in a chain reaction . . . .

154. Joanna Ossinger, *Crypto Market Retakes $2 Trillion Market Cap amid Bitcoin Gains*, BLOOMBERG (Aug. 15, 2021, 12:13 AM), https://www.bloomberg.com/news/articles/2021-08-15/crypto-market-retakes-2-trillion-market-cap-amid-bitcoin-gains. Some estimates go as high as $2.5 trillion. IMF, GLOBAL FINANCIAL STABILITY REPORT: COVID-19, CRYPTO AND CLIMATE: NAVIGATING CHALLENGING TRANSITION 42 (2021), https://www.imf.org/en/Publications/GFSR/Issues/2021/10/12/global-financial-stability-report-october-2021. Generally, however, the market size is subject to some debate, partly due to different metrics. *See* DoWallet, *What Is the Size of the Crypto Market?*, MEDIUM (July 18, 2019), https://medium.com/@dowallet/what-is-the-size-of-the-crypto-market-48dd88121182; Konstantinos Stylianou & Nic Carter, *The Size of the Crypto Economy: Calculating Market Shares of Cryptoassets, Exchanges and Mining Pools*, 16 J. COMP. L. & ECON. 511 (2020).

decreased dramatically due to crashes.[155] In June 2022, the market value was estimated to have dropped below $1 trillion,[156] proving once more that the market is highly volatile.[157] But the size of the cryptomarket is not the sole consideration for deciding how important it is. Rather, one must also consider what transactions in the market represent. For instance, change transactions (e.g., simply converting bitcoin to another token) would be captured in the trading volume but would not really represent a transfer of wealth.

Similarly, trade in security tokens may have very different consequences compared to trade in utility tokens, because, for example, trade in security tokens resembles trade in traditional financial markets, whereas trade in utility tokens may capture some specific consumer activity. Furthermore, as the cryptomarket is global in nature, it is difficult to disentangle which countries are strongly influenced by its movements and thus subject to greater systemic risk. A recent study found that 90% of transactions in cryptocurrencies are performed using the U.S. dollar, the South Korean won, and the Japanese yen.[158] However, this study also found that these transactions do not correlate with the size of the stock markets in those respective countries.[159] Thus, it remains somewhat unclear which countries are more exposed to systemic risk transferred from the cryptomarket.

The probability that the cryptomarket will become systemically important, if it is not already so, also depends on how much it is connected with traditional markets. Interconnectedness may stem from substitution effects—investors buying crypto as a substitute for traditional financial instruments—or from the fact that the value of firms operating in the cryptomarket depends on the payoffs they receive or claims against them in other markets. The value of these payoffs

155. *See* Elaine Yu, Joe Wallace & Paul Vigna, *Bitcoin Price Plunges as Crypto Lender Celsius Halts Withdrawals*, WALL ST. J. (June 13, 2022, 11:03 PM), https://www.wsj.com/articles/bitcoin-revisits-late-2020-levels-as-it-suffers-fresh-selloff-11655096332; Alex Hern & Dan Milmo, *Crypto Crisis: How Digital Currencies Went from Boom to Collapse*, THE GUARDIAN (June 29, 2022, 12:41 EDT), https://www.theguardian.com/technology/2022/jun/29/crypto-crisis-digital-currencies-boom-collapse-bitcoin-terra.

156. The market value of the cryptomarket continued to deteriorate during the second half of 2022, leading to a so called "cryptowinter." *See, e.g.*, Yesha Yadav, *Toward a Public-Private Oversight Model for Cryptocurrency Markets* 1 (Vanderbilt Law Rsch. Paper, Paper No. 22-26, 2022), https://ssrn.com/abstract=4241062. This trend was boosted by the high-profile collapse of the crypto exchange FTX. Lyllah Ledesma, *FTX Collapse Leaves Total Crypto Market Cap Under $800B, Close to 2022 Low*, COINDESK (Nov. 17, 2022, 2:05 PM), https://www.coindesk.com/markets/2022/11/17/ftx-collapse-leaves-total-crypto-market-cap-under-800b-close-to-2022-low/. For a general overview of the FTX collapse, see generally Thomas Conlon, Shaen Corbet & Yang Hu, The Collapse of FTX: The End of Cryptocurrency's Age of Innocence (Dec. 14, 2022) (unpublished manuscript), https://ssrn.com/abstract=4283333.

157. Yu et al., *supra* note 155*;* Elisabeth Howcroft, *The Cryptomarket Value Slumps Under $1 Trillion*, REUTERS (June 13, 2022, 9:56 AM) https://www.reuters.com/business/finance/cryptocurrency-market-value-slumps-under-1-trillion-2022-06-13/.

158. Gina C. Pieters, How Global Is the Cryptocurrency Market? 3 (2018) (unpublished manuscript), https://www.atlantafed.org/-/media/documents/news/conferences/2018/1018-financial-stability-implications-of-new-technology/papers/pieters_bitcoin_international.pdf.

159. *Id.*

and claims in turn depends on the stability of other institutions, firms, etc.[160] For instance, if firms invest in cryptocurrencies, their payoffs might influence the size and frequency of dividends to shareholders. A similar point can be made for firms issuing cryptocurrencies rather than buying them.

Once actions in one market affect the other market, this creates an interconnectedness that can lead to a "cascading failure"[161]—collapse in one market driving down the other market. As cryptocurrencies continue to gain traction, interconnectedness is expected to grow even further.[162] In a recent example, Blackrock, one of the world's largest asset managers, is reportedly planning to allow cryptocurrencies to be traded on its platform.[163] Fidelity, another major asset manager, has been mining bitcoin already for several years and has recently announced[164] the establishment of a new Canadian crypto-ETF.[165] The mix of traditional and crypto trading on such a massive platform may intuitively generate some correlation in investor behavior (e.g., investors buying different asset types in an attempt to diversify their portfolios), but it may also increase the exposure of asset managers to movements in the cryptomarket.

In addition to these examples of traditional asset managers joining the cryptomarket, there are also examples in the opposite direction, where cryptofirms are joining traditional markets. Most notably, Coinbase—a major crypto exchange—launched an IPO in 2021 and is tradeable on the NASDAQ exchange.[166] The initial valuation of Coinbase stock was a mindboggling $85

160. Larry Eisenberg & Thomas H. Noe, *Systemic Risk in Financial Systems*, 47 MGMT. SCI. 236, 236 (2001).

161. Raissa M. D'Souza, *Curtailing Cascading Failures*, 358 SCI. 860, 860–61 (2017).

162. *See, e.g.*, Christian P. Pinshi, *Central Bank Digital Currency: What Basis Should Be Taken for Crypto Assets?* 4 (MPRA, Working Paper No. 111674, 2022) ("[I]f authorities don't act preventively, cryptocurrencies could become more interconnected with the international financial system and become a threat to global financial stability."); Jabotinsky, *supra* note 62, at 163–64 (providing examples of insurance companies and major banks who become involved in cryptocurrencies); *see also generally* Nektarios Aslanidis, Aurelio F. Bariviera & Alejandro Perez-Laborda, *Are Cryptocurrencies Becoming More Interconnected?*, 199 ECON. LETTERS 2 (2020) (finding evidence of increases in interconnectedness); Filippo Ferroni, *How Interconnected Are Cryptocurrencies and What Does This Mean for Risk Measurement?*, 466 CHI. FED. LETTERS 1 (2022).

163. Ian Allison, *BlackRock Planning To Offer Crypto Trading, Sources Say*, COINDESK (Feb. 9, 2022, 10:34 AM), https://www.coindesk.com/business/2022/02/09/blackrock-planning-to-offer-crypto-trading-sources-say/.

164. Maria Abreu, Nina Bambysheva, Justin Birnbaum, Lauren Debter, Michael del Castillo, Steven Ehrlich, Chris Helman, Katie Jennings, Jeff Kauflin, Javier Paz, Jon Ponciano & Marie Schulte-Bockum, *Forbes Blockchain 50 2022*, FORBES (Feb. 8, 2022, 6:30 AM), https://www.forbes.com/sites/michaeldelcastillo/2022/02/08/forbes-blockchain-50-2022/?sh=5b799c3831c6.

165. An Exchange-Trading Fund (ETF) is a financial index that follows a specific market. Just as the S&P 500 follows the traditional financial market, a crypto-ETF tracks the leading cryptocurrencies. *What Is an ETF?*, CHARLES SCHWAB, https://www.schwab.com/etfs/understand-etfs (last visited Jan. 28, 2023). Thus, a person investing in a crypto-ETF implicitly divides investments between different cryptocurrencies, depending on, for example, their market cap.

166. *See, e.g.*, Ari Levy, *Coinbase Closes at $328.28 per Share in NASDAQ Debut, Valuing Crypto Exchange at $85.8 Billion*, CNBC (Aug. 10, 2021, 8:41 PM), https://www.cnbc.com/2021/04/14/coinbase-to-debut-on-nasdaq-in-direct-listing.html.

billion,[167] but it has since crashed.[168] The stock performance of Coinbase is, of course, correlated with its activity in the cryptomarket,[169] which enhances the interconnectedness of markets.[170]

Our findings also provide some initial indication that the cryptomarket may indeed have systemic importance—although this is clearly an important empirical question that should be answered with caution in future research. Namely, when we include the S&P 500 as a control variable in our regressions, one specification[171] shows a positive correlation between the market cap of cryptocurrencies and the stock market.[172] This suggests that the value of cryptocurrencies moves in the same direction as the value of stocks. However, when looking at trading volume, the correlation is negative. That is, investors seem to substitute trading in cryptocurrencies with trading in traditional markets, although the value of stocks and cryptocurrencies go in the same direction. This is an excellent example of a cascade: investors abandon traditional markets for the cryptomarket (a substitution effect) only to trade on something that is going in more or less the same direction anyway.

Whether or not the cryptomarket is already "too important to fail," one still needs to ask what can be done to mitigate systemic risk. Several options in the regulatory arsenal may be relevant. One possibility is to somehow restrict the trade in cryptocurrencies altogether at a time of crisis. Although this may appear drastic, there are parallels in the stock market, such as when trading is paused temporarily due to a shock.[173] The advantage of this approach is in its clarity: traders would refrain from shifting funds from traditional markets to the cryptomarket.

However, there are also obvious disadvantages to this approach. First, it is not clear that a switch to the cryptomarket is problematic: at least some of the money might end up in the hands of the firms who issued tokens, improving

167. *Id.*

168. Vildana Hajric & Edward Ludlow, *Coinbase Sees Biggest Drop on Record as Cryptocurrencies Crumble*, BLOOMBERG (Jan. 21, 2022, 9:46 AM), https://www.bloomberg.com/news/articles/2022-01-21/coinbase-sees-biggest-drop-on-record-as-cryptocurrencies-crumble; Trefis Team, *Coinbase Stock Falls 50% from Its Highs, Time To Buy?*, FORBES (Feb. 1, 2022, 9:00 AM), https://www.forbes.com/sites/greatspeculations/2022/02/01/coinbase-stock-falls-50-from-its-highs-time-to-buy/?sh=722d86fd6a9a.

169. *See* Trefis Team, *supra* note 168 (finding a positive correlation between Coinbase stock and the price of bitcoin).

170. The crash in Coinbase stock appears to have been directly linked to a decline in demand for bitcoin on the part of investors. Luc Olinga, *Crypto Crash Rocks Coinbase as Mainstream Investors Flee Bitcoin*, THE STREET (Jan. 23, 2022, 8:56 AM), https://www.thestreet.com/investing/crypto-crash-rocks-coinbase-as-mainstream-flees-bitcoin.

171. *See infra* Appendix, Table 2, col. 4.

172. *See infra* Appendix, Table 4, cols. 4 & 8. Column 8, however, shows an insignificant effect.

173. For a list of historical trade halts in the N.Y. Stock Exchange, see *NYSE Trading Halts*, NYSE, https://www.nyse.com/trade-halt-current (last visited Jan. 28, 2023). For empirical evidence, see generally Haiwei Chen, Honghui Chen & Nicholas Valerio, *The Effects of Trading Halts on Price Discovery for NYSE Stocks*, 35 APPLIED ECON. 91 (2003). For a normative discussion on the desirability of trade halts, see generally Avanidhar Subrahmanyam, *On Rules Versus Discretion in Procedures To Halt Trade*, 47 J. ECON. & BUS. 1 (1995).

their stream of income and preventing liquidity problems in the business sector.[174] Second, investors might still switch away from traditional markets, just into other, possibly worse alternatives, such as black markets. Third, as our findings show, interventions may be time sensitive. If regulators intervene too late, when the crisis grows and investors switch back to traditional markets, then restricting the cryptomarket can be pointless, or worse, backfire by reducing the value of cryptocurrencies with zero gains. If this translates back into other markets, regulatory intervention may actually increase systemic risk. Fourth, halting the cryptomarket may be impossible due to the technological difficulties of freezing a decentralized system and the inherent limits of enforcement. However, if the market continues its movement toward more centralization, this can provide a practical solution. For instance, the European Union's MiCA proposal includes provisions targeting crypto exchanges.[175] The proposal also includes prohibitions on market abuses in the form of insider trading and market manipulations in crypto exchanges. Such regulation targets practices such as "wash trading," the artificial inflation of trading volume, which may occur on crypto exchanges.[176]

Alternatively, regulators may consider a "code as regulation" approach, where the automated features of blockchain would be used to design a self-executing trade halt if certain conditions were fulfilled.[177] Of course, this can only be applied to some parts of the cryptomarket and would be infeasible for many existing tokens, including bitcoin.

A different approach might be to draw inspiration from the international Basel Accords, which were updated twice following the 2008 financial crisis, first as Basel III (2010–2011) and thereafter as Basel IV (2017). The Accords define the concept of a global systemically important financial institution (G-SIFI), which also includes banks (G-SIBs), with a financial advisory board updating the list of institutions.[178] These institutions are then subject to requirements such as additional loss absorption capacity[179] to avoid a risk of bankruptcy. Because the cryptomarket is global, some crypto exchanges could be treated analogously as G-SIFIs and be forced to adjust their risk exposure. Ideally, one would also do so for specific tokens, but the decentralized nature of

174. There is some recent empirical evidence suggesting that the cryptomarket can potentially mitigate systemic risk in some cases. *See* Li & Huang, *supra* note 84, at 137.

175. *EU Crypto-Assets Proposal*, *supra* note 130, at 13.

176. *See generally* Lin Cong, Lin William Cong, Xi Li, Ke Tang & Yang Yang, Crypto Wash Trading (Aug. 24, 2021) (unpublished manuscript), https://arxiv.org/abs/2108.10984; Guénolé Le Pennec, Ingo Fielder & Lennart Ante, *Wash Trading at Cryptocurrency Exchanges*, 43 FIN. RSCH. LETTERS, 2021; Jialan Chen, Dan Lin, & Jiajing Wu, *Do Cryptocurrency Exchanges Fake Trading Volumes? An Empirical Analysis of Wash Trading Based on Data Mining*, 586 PHYSICA A: STAT. MECHS. & ITS APPLICATIONS 126405 (2022).

177. For a discussion of "regulation by blockchain," see generally Karen Yeung, *Regulation by Blockchain: The Emerging Battle for Supremacy Between the Code of Law and Code as Law*, 82 MOD. L. REV. 207 (2019).

178. *See* FIN. STABILITY BD., POLICY MEASURES TO ADDRESS SYSTEMICALLY IMPORTANT FINANCIAL INSTITUTIONS 1 (2011), http://www.financialstabilityboard.org/publications/r_111104bb.pdf.

179. *Id.*

the cryptomarket makes this extremely challenging—it would require somehow offsetting the risk that a token poses with some other measure, but many cryptocurrencies are not held by one central authority. Of course, here one might target the whales; that is, anyone holding more than X number of tokens would be subject to regulation, analogous to rules applying to controlling shareholders. This might be easy for investors to get around, but imposing such a rule would also have an indirect effect of discouraging the acquisition of a dominant position. This in turn would lead to a lower concentration in ownership and less market power, which may be beneficial for the market. Furthermore, there have been speculations that Basel IV's stringency will cause traditional banks to switch over to the shadow economy,[180] and cryptocurrencies seem like one possible venue. In this sense, regulating parts of the cryptomarket in a way similar to the Basel IV approach would also close a loophole and avoid a travel of risk in the opposite direction, from the traditional market to the cryptomarket.

A different but related aspect of systemic risk concerns stablecoins.[181] Given that our empirical results yield similar effects for stablecoins, regulators may be able to avoid the difficulties of designing ad hoc policies for such tokens based on the incorrect assumption that these behave differently due to their closer connection to fiat currencies. Instead, a unified policy may be preferable.[182] However, a substantial portion of the European Union's MiCA framework is dedicated to stablecoins as a special asset class ("asset-referenced tokens").[183] Provisions regarding such tokens include mandatory approval from the competent authority in the European Union member state prior to offering the tokens to the public[184] and publication of a white paper containing various information[185] such as a detailed description of the nature of rights and enforceability of asset-referenced token holders.[186] These provisions mainly deal with disclosure, thereby affecting information asymmetry rather than systemic risk. However, there are also provisions clarifying that central banks can only consider "risks posed to monetary policy transmission, monetary sovereignty and the smooth operation of payment systems,"[187] which presumably can be used to reject tokens that enhance systemic risk.

180. Katarzyna Parchimowicz & Ross Spence, *Basel IV Postponed: A Chance To Regulate Shadow Banking?*, 13 ERASMUS L. REV. 12, 25 (2020).

181. Recall that stablecoins mimic fiat currencies. *See supra* Part II.B.

182. The differences which we do observe are most likely due to herding, so that a unified policy of disclosure would probably be effective even for stablecoins that currently move in opposite directions.

183. For a definition, see *EU Crypto-Assets Proposal*, *supra* note 130, tit. 1, art. 3.1(3).

184. *Id.* tit. 4, art. 15.1, 15.4, 16.1.

185. *Id.* tit. 4, art. 15.1, 15.4, 16.2(i), 17. Both credit institutions and noncredit institutions are obligated to draft a white paper, but noncredit institutions must submit them as part of an authorization process, whereas credit institutions do so separately.

186. *Id.* tit. 4, art. 17.1(d).

187. *Id.* tit. 4, art. 18.4(a).

A very different course of action that is being seriously considered by the Biden Administration[188] is addressing the cryptomarket problem through competition by launching a government-backed cryptocurrency. Such cryptocurrencies, known as central bank digital currencies (CBDCs),[189] reflect a mixture of centralization, as they are issued by the central bank, and decentralization, as they are traded like cryptocurrencies.[190] For instance, China has recently launched a government-backed token, the "digital Yuan," and has been pushing for its mass adoption.[191] As China currently bans[192] the use of other types of cryptocurrencies, this seems like a step intended to offer a substitute for the cryptomarket.[193] According to news reports, Russia, which has banned cryptocurrencies (but is reportedly about to change its policy),[194] is also planning to launch its "digital Ruble" later this year.[195] As the United States has no such ban,[196] it is unclear whether a centralized government-backed token will have any impact on the cryptomarket.

However, the ambiguity is more general than that: CBDCs could either increase or decrease systemic risk. On one hand, CBDCs enable the central bank

188. James Rubin, *Biden Administration To Release Executive Order on Crypto as Early as February: Report*, YAHOO! (Jan. 23, 2022), https://www.yahoo.com/now/biden-administration-release-executive-order-015755698.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAMjMsqoTHblR6xEw0QZPXt66U6T6EIozPxdq0d58wiLY6417ujdwpYRB2hOkJ8sy-m_JbKp30pTmm64Pu5LP7BftBojq9sdUXcak69gZ8VAcsaP0bY3NOEm4JxoI0sw6anO3ZrYNgj8u3D-nuUiTAm_luuQ_Om2mUQKWsjBMXFbA.

189. *See generally* Raphael Auer, Giulio Cornelli & Jon Frost, *Rise of the Central Bank Digital Currencies: Drivers, Approaches and Technologies* (CESifo, Working Paper No. 8655, 2020), https://ssrn.com/abstract=3724070.

190. *See, e.g.*, Ben S.C. Fung & Hanna Halaburda, Central Bank Digital Currencies: A Framework for Assessing Why and How 16–17 (June 29, 2017) (unpublished manuscript), https://ssrn.com/abstract=2994052 (noting that a cryptocurrency issued by a central bank can be beneficial to reducing systemic risk, if the problem is that cryptocurrencies are dominant in retails sales).

191. Arjun Kharpal, *China Is Pushing for Broader Use of Its Digital Currency*, CNBC (Jan. 11, 2022, 7:16 PM), https://www.cnbc.com/2022/01/11/china-digital-yuan-pboc-to-expand-e-cny-use-but-challenges-remain.html.

192. *See generally, e.g.*, Agata Ferreira & Philipp Sandner, *EU Search for Regulatory Answers to Crypto Assets and Their Place in the Financial Markets' Infrastructure*, 48 COMPUT. L. & SEC. REV., 2021.

193. Similar projects have emerged in other countries as well, including Sweden, Nigeria, and India. Eric Johansson, *Data Map Shows World's Nations Embracing Digital Currencies, as India Announces E-Rupee*, VERDICT (Feb. 8, 2022, 9:21 AM), https://www.verdict.co.uk/india-to-launch-cbdc-as-soon-as-next-year-digital-rupee-latest-of-worldwide-trend/.

194. Russia reportedly plans to regulate cryptocurrencies as a form of a regular currency. *See Russia Likely To Recognise, Regulate Cryptocurrency as Form of Currency in 2022: Report*, CNBC (Feb. 9, 2022, 3:05 PM), https://www.cnbctv18.com/cryptocurrency/russia-likely-to-recognise-regulate-cryptocurrency-as-form-of-currency-in-2022-report-12421582.htm. For an overview of the existing policy in Russia, see generally Ekaterina Dorokhova, Tatyana Belykh, Elena Dorokhova & Galina Koren'kova, *Economic and Legal Aspects of Cryptocurrency Usage in Russia*, 181 ADVANCES ECON., BUS. & MGMT. RES. 327 (2021).

195. Andrey Ostroukh, *Russia Expects To Launch Digital Rouble Prototype in Early 2022*, REUTERS (Nov. 9, 2021, 12:42 AM), https://www.reuters.com/business/russia-expects-launch-digital-rouble-prototype-early-2022-2021-11-09/.

196. *See* Alex McShane, *Federal Reserve Chair Jerome Powell: U.S. Has No Plans To Ban Bitcoin and Crypto*, NASDAQ (Sept. 30, 2021), https://www.nasdaq.com/articles/federal-reserve-chair-jerome-powell%3A-u.s.-has-no-plans-to-ban-bitcoin-and-crypto-2021-09.

to exert some control and be an active part of trade on blockchains, thereby increasing transparency of what is an otherwise private activity.[197] On the other hand, a full-fledged currency operating on blockchain can intuitively increase the interconnectedness of the markets, thereby increasing systemic risk. In this context, the Federal Reserve Board released a discussion paper[198] examining the pros and cons of CBDCs alongside a request for public feedback.[199] Among other things, this discussion paper mentions the possibility that individuals might respond to a crisis by withdrawing cash and converting it to a CBDC,[200] which is precisely the concern this Article raises with respect to systemic risk.[201]

Next, recall that our findings are also potentially consistent with an increase in criminal activity. Generally, regulation can reduce the flow of money used to fuel crimes and terrorism by imposing requirements on financial intermediaries.[202] Financial regulation has long been a tool for fighting money laundering in traditional markets but recently has been a tool for fighting money laundering in the cryptomarket.[203] Applying anti-money laundering regulations to the cryptomarket is one way to reduce crime, as it will impair criminals' ability to trade on the black market without reporting the transactions to authorities.

A relevant proposal in this regard was released by the U.S. Financial Crimes Enforcement Network (FinCen) in December 2020.[204] This proposal calls for regulation of cryptocurrencies to prevent illegal activity and focuses on "recordkeeping, verification, and reporting requirements" that apply to banks and "money service businesses," which include crypto exchanges.[205] Reporting requirements for "digital assets," including cryptocurrencies, were also adopted as part of the Infrastructure Investment and Jobs Act, which became law in

197. Michael D. Bordo & Andrew T. Levin, *Central Bank Digital Currency and the Future of Monetary Policy* 8 (NBER, Working Paper No. 23711, 2017) (stating that CBDC can reduce systemic risk if the problem is a private network of banks); Olga Cerqueira Gouveia Enestor Dos Santos, Santiago Fernández de Lis, Alejandro Neut & Javier Sebastián, *Central Bank Digital Currencies: Assessing Implementation Possibilities and Impacts* 12 (BBVA, Working Paper No. 17/04, 2017).

198. Bd. of Governors of the Fed. Rsrv. Bd., *Money and Payments: The U.S. Dollar in the Age of Digital Transformation* (Fed. Rsrv. Discussion Paper, 2022), https://www.federalreserve.gov/publications/money-and-payments-discussion-paper.htm.

199. Press Release, Fed. Rsrv. Bd., Federal Reserve Board Releases Discussion Paper That Examines Pros and Cons of a Potential U.S. Central Bank Digital Currency (CBDC) (Jan. 20, 2022), https://www.federalreserve.gov/newsevents/pressreleases/other20220120a.htm#:~:text=The%20Federal%20Reserve%20Board%20on,and%20effective%20domestic%20payments%20system.

200. Bd. of Governors of the Fed. Rsrv. Bd., *supra* note 198, at 17.

201. Systemic risk is discussed throughout this Article but is defined in detail *supra* Part III; *see also supra* note 19.

202. Jabotinsky & Lavi, *supra* note 36, at 530.

203. *See, e.g.*, The 5th Anti-Money Laundering Directive 2018/843, 2018 O.J. (L 156) 44 (including provisions regarding cryptocurrencies).

204. Requirements for Certain Transactions Involving Convertible Virtual Currency or Digital Assets, 85 Fed. Reg. 83840 (proposed Dec. 23, 2020) (to be codified at 31 C.F.R. pts. 1010, 1020, 1022).

205. *See id.*

November 2021.[206] The use of cryptocurrencies for criminal purposes might be even more directly discouraged by using criminal law and civil forfeiture. For instance, Craig Wright, who claimed to be the person behind the pseudonym Satoshi Nakamoto, the creator of Bitcoin, has recently argued that bitcoin is actually easily traceable due to the low number of "nodes" participating in the verification process of the transaction, and thus can be easily frozen or seized.[207] And indeed, there have been several cases where U.S. courts have ordered the seizure of cryptocurrencies under civil forfeiture.[208] As one example, the Justice Department recently succeeded in executing its largest financial seizure ever, taking control of cryptocurrencies valued at $3.6 billion that were stolen in a large computer hack in 2016.[209] In another recent case, the U.S. District Court for the District of Columbia ordered the seizure of various cryptocurrencies, clarifying that: "All cryptocurrency, not just BTC [Bitcoin], at the Target Premises are subject to seizure and forfeiture because it was the pseudo-anonymous nature of cryptocurrency—rather than the particular type used—that allowed for the commission and promotion of the crime."[210] Such steps not only deter criminals from attempting to steal cryptocurrencies, but also from buying them, knowing that they might later be seized. Hence, seizures can also be helpful in reducing crypto-rushes.[211]

A different direction suggested by some scholars,[212] as well as by the Federal Reserve,[213] is to tackle the issue of the pseudo-anonymity of cryptocurrencies. Removing the barriers to identifying who owns which account can be immensely helpful in increasing transparency when markets are volatile. However, this involves larger considerations that are outside the scope of this Article.[214]

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206. Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, 135 Stat. 429. For an overview of its effects on cryptocurrencies, see, for example, Michelle Freeman, *Tax Implications of the Infrastructure Investment and Jobs Act*, 2022 TENN. CPA J. 9, 10.

207. Craig S. Wright, Bitcoin: The Most Law-Abiding System Ever Created 3 (Oct. 13, 2021) (unpublished manuscript), https://ssrn.com/abstract=3942115.

208. *See* United States v. Twenty-Four Cryptocurrency, 473 F. Supp. 3d 1, 4 (D.D.C. 2020); United States v. Approximately 10.6396908 Bitcoin, No. 2:19-MC-00130-KJM-KJN (E.D. Cal. dismissed Oct. 26, 2021); *In re* Search of One Address in Wash. D.C., Under Rule 41, 512 F. Supp. 3d 23, 27 (D.D.C. 2021).

209. Dustin Volz & Ian Tally, *Justice Department Says It Seized $3.6 Billion Worth of Bitcoin Stolen in 2016 Hack*, WALL ST. J. (Feb. 8, 2022, 9:21 PM), https://www.wsj.com/articles/justice-department-says-it-seized-3-6-billion-in-stolen-cryptocurrency-exchange-hack-11644339381.

210. *In re Search of One Address*, 512 F. Supp. 3d at 30.

211. For a general discussion of seizures of cryptocurrencies, see generally Shirley U. Emehelu, *A Shot in the Dark: Using Asset Forfeiture Tools To Identify and Restrain Criminals' Cryptocurrency*, 66 U.S. ATT'Y BULL. 81 (2018).

212. *See generally* Jabotinsky & Lavi, *supra* note 36 (proposing a mandatory obligation to identify cryptocurrency users on the blockchain).

213. Bd. of Governors of the Fed. Rsrv. Bd., *supra* note 198, at 14 ("[A] CBDC intermediary would need to verify the identity of a person accessing CBDC, just as banks and other financial institutions currently verify the identities of their customers.").

214. Among other things, pseudo-anonymity might facilitate legitimate transactions that require privacy, but evaluating the scope of such transactions requires further data.

Finally, one may wonder if there is any practical way to mitigate a behavioral market failure like herding. One recent study suggests that simply issuing warning messages, such as the general warnings issued by the SEC, would be insufficient to counter herding.[215] Other studies highlight the general difficulty of fighting herding.[216] Additionally, herding may depend on a series of institutional factors like financial market development and culture[217] and is more likely to occur in times of "bad news," such as when markets are collapsing, disasters are erupting, and there is political instability.[218] Interestingly, some evidence on the adoption of international financial reporting standards (IFRS) suggests that the uniformity exacerbated investors' herding in EU equity markets,[219] whereas other evidence points to a mitigating effect of disclosure.[220] Hence, approaches like the one taken by the European Union's MiCA, which both unifies regulation and mandates disclosure, may entail countervailing effects.

D. CHALLENGES

Whether one measure or another is implemented, there are also institutional challenges. Particularly, financial authorities (at least in the United States) are highly dispersed, which might make it unclear whose job it is to regulate the cryptomarket.[221] A bill entitled the Crypto-Currency Act of 2020[222] was introduced in Congress amidst the pandemic to address this issue. The bill proposes categorizing cryptocurrencies as either securities, currencies, or commodities, and suggests dividing responsibility between three different regulatory bodies.[223] If such an approach is adopted, coordination of regulatory efforts must remain consistent, as the joint goal at a time of crisis must be the

215. *See* Boukje Compen, Francisco Pitthan, Wouter Schelfhout & Kristof De Witte, *How To Elicit and Cease Herding Behaviour? On the Effectiveness of a Warning Message as a Debiasing Decision Support System*, DECISION SUPPORT SYS., Jan. 2022, at 2 (conducting an experiment on insurance decisions).

216. *See generally* Mehdi Darban & Greta L. Polites, *Why Is It Hard To Fight Herding? The Roles of User and Technology Attributes*, 51 ACM SIGMIS DATABASE: DATABASE FOR ADVANCES INFO. SYS. 93 (2020) (discussing characteristics that may account for herding behaviors).

217. Natividad Blasco, Pilar Corredor & Sandra Ferreruela, *Can Agents Sensitive to Cultural, Organizational and Environmental Issues Avoid Herding?*, 22 FIN. RSCH. LETTERS 114, 114 (2017). For an overview of the literature, see generally Puput Tri Komalasari, Marwan Asri, Bernardinus M. Purwanto & Bowo Setiyono, *Herding Behavior in the Capital Market: What Do We Know and What Is Next?*, 72 MGMT. REV. Q. 745 (2022) (discussing factors affecting decision-making processes).

218. *See* Natividad Blasco, Pilar Correrdor & Elena Ferrer, *Analysts Herding: When Does Sentiment Matter?*, 50 APPLIED ECON. 5495, 5495 (2018).

219. *See generally* Mohammed Lawal Danrimi, Mazni Abdullah & Ervina Alfan, *Investors' Herding Practice: Do IFRS and National Economic Culture Matter?*, 44 MANAGERIAL FIN. 1117 (2018) (finding that mandatory IFRS adoption promotes investors' herding practice).

220. *See generally* Ike Arisanti & Tri Wahyu Oktavendi, *Herding Behaviour in Sharia Stock: The Moderation Effect of Good Governance Business Sharia Disclosure*, 21 J. ACCT. & INV. 45 (2020) (finding that GGBS disclosure was able to moderate herding behavior).

221. Hadar Y. Jabotinsky, *The Federal Structure of Financial Supervision: A Story of Information-Flow*, 22 STAN. J.L. BUS. & FIN. 52, 73 (2017).

222. Crypto-Currency Act of 2020, H.R. 6154, 116th Cong. § 1 (2020).

223. *Id.* § 3.

prevention of systemic failure. However, more recently, the Lummis-Gillibrand Responsible Financial Innovation Act ("the bipartisan bill") was introduced in Congress, which would grant the Commodity Futures Trading Commission (CFTC) almost exclusive jurisdiction over cryptomarket regulation.[224] Such an approach is also not without issues, as the SEC would still need to be involved in the security-law aspect, which may also yield coordination frictions.

In addition to the lack of clarity regarding which regulatory body is in charge of which area of cryptomarket regulation, there seems to be some competition between government entities for this role.[225] In addition to President Biden's executive order and the bipartisan bill,[226] the SEC,[227] IRS,[228] CFTC,[229] and state-level actors[230] are all initiating parallel attempts to regulate the cryptomarket.[231] This in turn raises concerns of overregulation, or overlapping regulation.[232] In a recent article, the Authors and Israel Klein show, from a law-

224. Lummis-Gillibrand Responsible Financial Innovation Act, S. 4356, 117th Cong. § 403(a)(1)(B) (2022). The new proposal by the members of the Senate Committee on Agriculture, Nutrition, and Forestry is taking a similar direction, granting exclusive jurisdiction to the CFTC. *See* Digital Commodities Consumer Protection Act of 2022, H.R. 8730, 117th Cong. § 3 (2022); del Castillo, *supra* note 24; Tory Newmyer, *A Senate Proposal Would Give CFTC Responsibility for Policing Bitcoin, Ethereum*, WASH. POST (Aug. 3, 2022, 6:00 AM), https://www.washingtonpost.com/business/2022/08/03/stabenow-boozman-bitcoin-cftc-bill/.

225. *See* David Gura, *A Big Fight Is Brewing over Cryptocurrencies. These Are Some Key Players To Watch*, NPR (Nov. 6, 2021, 5:00 AM), https://www.npr.org/2021/11/06/1050430801/cryptocurrencies-bitcoin-elizabeth-warren-gary-gensler?t=1644686911227.

226. *See supra* Part I.

227. *See generally* CORNERSTONE RSCH., SEC CRYPTOCURRENCY ENFORCEMENT: 2021 UPDATE (2022), https://www.cornerstone.com/wp-content/uploads/2022/01/SEC-Cryptocurrency-Enforcement-2021-Update.pdf. *See generally* O'Connor, *supra* note 70 (discussing the limits of the SEC's mandate to regulate cryptocurrencies).

228. *See generally* Mollie T. Adams & William A. Bailey, *Emerging Cryptocurrencies and IRS Summons Power: Striking the Proper Balance Between IRS Audit Authority and Taxpayer Privacy*, 19 ATA J. LEGAL TAX RSCH. 61 (2021) (discussing a case where the IRS tried to attain information on crypto investors' wealth by demanding customer information from the crypto exchange Coinbase).

229. For instance, the Chair of the CFTC has recently turned to Congress, asking for authority to regulate the cryptomarket in order to protect investors. Paul Kiernan, *CFTC Chair Asks Congress for Authority To Regulate Some Cryptocurrencies*, WALL ST. J., https://www.wsj.com/amp/articles/cftc-chair-to-testify-on-cryptocurrencies-as-congress-weighs-legislation-11644414710 (Feb. 9, 2022, 4:31 PM).

230. In addition to New Hampshire's executive order, prominent examples include a call by a North Carolina representative of the U.S. House Committee on Financial Services to consider state-level regulation of stablecoins, and New York's decision to supervise crypto exchanges by issuing "Bitlicenses." *See* sources cited *supra* note 26; Ross Keiser, *Blockchain and Its Potential Real-World Applications: Implications on Discovery Procedures*, 41 PACE L. REV. 228, 240 (2021). State-level resolutions regarding the cryptomarket can be found in at least seventeen states. *See* Heather Morton, *Cryptocurrency 2021 Legislation*, NAT'L. CONF. STATE LEGISLATORS (Dec. 16, 2021), https://www.ncsl.org/research/financial-services-and-commerce/cryptocurrency-2021-legislation.aspx.

231. Recent interviews suggest, however, that there is some cooperation between the agencies (at least between the SEC and CFTC). Kevin Helms, *SEC Working with CFTC on Crypto Regulation, Says Chairman Gensler*, BITCOIN (Feb. 11, 2022), https://news.bitcoin.com/sec-working-with-cftc-crypto-regulation-chairman-gensler/.

232. From a law-and-economics perspective, a multitude of authorities may generally lead to either under- or over-regulation, depending on the real-world situation in which the players are playing. *See generally* Hadar Yoana Jabotinsky, The Structure of Financial Supervision: A Game Theoretic Approach (Apr. 7, 2015) (unpublished manuscript), https://ssrn.com/abstract=2007856 (discussing models of financial supervision); Crootof & Ard, *supra* note 58 (discussing the cost of "over-inclusion" in the regulation of technology).

and-economics perspective, that the mechanism that generates this competition can be viewed as a form of the "tragedy of the commons,"[233] which refers to the concern of overconsumption of "common goods" such as natural resources.[234] This problem arises when a limited shared resource is consumed by various actors who rationally decide to consume the resource independently, ignoring the fact that this quickly leads to the depletion of the resource. Here, the shared resources are not cryptocurrencies. Rather, they are the regulatory benefits that regulators gain from regulating the cryptomarket. In the case of the cryptomarket, these benefits may include both public benefits, such as the better functioning of the market, and private benefits for regulators, such as regulatory reputation. Much of these benefits can be classified as a common good:[235] there is a limited amount of regulatory credit to go around, but it is difficult to exclude other agencies from intervening and thereby acquiring some of these benefits.[236] Consequently, agencies have an incentive to "consume" the benefits by launching independent regulation attempts, even if this yields a negative result overall.[237] The question of how to overcome this challenge is a matter best saved for future work, but it is essential to be aware of such institutional challenges when adopting a new regulatory framework for the cryptomarket.

A different challenge lies in the choice of regulatory structure. Currently, the scant regulation that does exist is mostly orchestrated by agencies focusing on the attributes of the token; for example, security tokens are governed by the SEC, utility tokens are targeted by the CFTC, and stablecoins have been marked by the Federal Reserve. Such an approach to financial regulation, which focuses on the content of the regulated item, is typically known as the "functional approach."[238] However, because "[c]ryptocurrencies blur the lines between several categories of more traditional assets,"[239] it is difficult to classify tokens and hence to decide how to divide regulatory responsibility.[240] Therefore, a

233. Sarel et al., *supra* note 25, at 7 (discussing how the tragedy of the commons may lead to over-regulation of the cryptomarket); *see also* COOTER & ULEN, *supra* note 107, at 140 (explaining the tragedy of the commons); Shi-Ling Hsu, *What* Is *a Tragedy of the Commons? Overfishing and the Campaign Spending Problem*, 69 ALB. L. REV. 75, 76–77 (2005) (discussing the impact of the tragedy of the commons on legal scholarship).

234. Common goods, also known as "common pool resource," fulfill two conditions. They are "rivalrous"— that is, the use by one person detracts from the ability of another person to use the resource—and they are "nonexcludable"— that is, one cannot easily exclude others from using the resource. *See, e.g.*, J. Samuel Barkin & Yuliya Rashchupkina, *Public Goods, Common Pool Resources, and International Law*, 111 AM. J. INT'L L. 376, 380 (2017).

235. In theory, one might also expect under-regulation if, for example, agencies need to invest enforcement resources and prefer to free-ride on the effort of other agencies. *See, e.g.*, Elm & Sarel, *supra* note 38, at 35. However, this does not seem to be the case here. For a general discussion of competition between different financial regulations, see generally Giovanni Dell'Ariccia & Robert Marquez, *Competition Among Regulators and Credit Market Integration*, 79 J. FIN. ECON. 401 (2006) (comparing a system of national regulations to one of international regulations); Jabotinsky, *supra* note 232 (discussing incentives for regulator cooperation).

236. Jabotinsky, *supra* note 232, at 17.

237. *Id.* at 3.

238. *Id.* at 9.

239. Crootof & Ard, *supra* note 58, at 363.

240. *See, e.g.*, Sarel, *supra* note 15, at 397–414; Crootof & Ard, *supra* note 58, at 363.

different approach that unifies responsibility under one regulatory scheme irrespective of the content of the token may be preferable. It may well be the case that this reasoning backs President Biden's executive order,[241] which seeks to handle cryptocurrency regulation at a higher, unified level.[242] Opting for one regulator may also improve specialization, which seems especially important given the need to narrow the existing knowledge gap between public officials and industry players.[243]

Yet the move toward federal regulation may face some political resistance, not only due to the said competition between agencies, states, and the federal government, but also due to the current political divide. Cryptocurrencies have been a topic of political debate for quite some time,[244] such that gathering a political consensus for regulation seems complicated. In the absence of legislative consensus, the Administration can only turn to tools like executive orders, which allow implementing new policy unilaterally[245] but can conflict with principles of administrative law.[246]

Another challenge is one of measurement. Recall that the existing evidence on how the announcement of regulation affects the cryptomarket is mixed,[247] which either indicates that there is no effect or that the tools used to measure effects do not produce a clear and consistent conclusion. Moreover, existing studies can only shed light on *country-specific* regulations. As trading can take

241. *See supra* pp. 435–41.

242. One can think of an even more extreme version of this approach in the form of a global regulation. A comprehensive discussion of this possibility is outside the scope of this Article. For preliminary calls for such regulation, see generally Matthias Lehmann, *Global Rules for a Global Market Place? - Regulation and Supervision of Fintech Providers*, 38 B.U. INT'L L.J. 118 (2020) (proposing options for global harmonization of minimum regulation); Omri Marian, *Blockchain Havens and the Need for Their Internationally-Coordinated Regulation*, 20 N.C. J.L. & TECH. 529 (2019) (discussing potential international frameworks for blockchain regulation). For an overview of positive and negative network effects when opting for a unified regulatory approach, see generally Hadar Yoana Jabotinsky & Barak Yarkoni, *The Network Effects of International Financial Regulation* (Hebrew Univ. of Jerusalem L. Stud. Rsch. Paper, Paper No. 19-04, 2018), https://ssrn.com/abstract=3309118 (suggesting the use of network effects to create harmonized international regulation).

243. Bronwyn E. Howell & Petrus H. Potgieter, Regulating Cryptocurrencies: Mapping Economic Objectives and Technological Feasibilities (Sept. 21, 2021) (unpublished manuscript), https://ssrn.com/abstract=3927658 ("Traditional regulatory agencies are ill-equipped to govern these [blockchain-driven] institutions, as they lack the knowledge of 'insiders' regarding the novelty, the technologies and the potential ways of using and abusing them.").

244. John Keary, Rebuffing Russian Ransomware: How the United States Should Use the Colonial Pipeline and JBS USA Hackings as a Defense Guide for Ransomware 31–32 (2022) (unpublished manuscript), https://scholarship.shu.edu/cgi/viewcontent.cgi?article=2278&context=student_scholarship (discussing the differences between the Trump and Biden Administrations); Scott D. Hughes, *Cryptocurrency Regulations and Enforcement in the U.S.*, 45 W. STATE L. REV. 1, 10 (2017) (discussing how Democrats and Republicans voted differently on proposals related to cryptocurrencies); Maria Gagarina, Timofey Nestik & Tatiana Drobysheva, *Social and Psychological Predictors of Youths' Attitudes to Cryptocurrency*, 9 BEHAV. SCIS. 118, 127 (2019) (finding that attitudes toward cryptocurrencies depend on differences in moral foundations).

245. Terry M. Moe & William G. Howell, *The Presidential Power of Unilateral Action*, 15 J.L. ECON. & ORG. 132, 133 (1999); Kenneth R. Mayer, *Executive Orders and Presidential Power*, 61 J. POL. 445, 445 (1999).

246. Phillip J. Cooper, *By Order of the President: Administration by Executive Order and Proclamation*, 18 ADMIN. & SOC'Y 233, 246 (1986).

247. *See generally* Feinstein & Werbach, *supra* note 15.

place from anywhere in the world, it is quite tricky to match a transaction to a physical location, making it unclear which local rules govern a transaction.

It is also important to keep in mind that a cost-benefit analysis should accompany the decision on which regulation to adopt. Even if the benefits of intervention are clear—mitigating systemic risk, preventing investor fraud, reducing crime, and so on—one still needs to account for potential costs. Some costs are intuitive. For instance, any type of financial regulation, especially in technological markets, bears the concern that interventions will undermine innovation.[248] This is particularly true for the cryptomarket, which is used by many firms to fundraise.[249] Thus, any restrictions on trade to protect the market from crashes should be weighed against the cost of disrupting innovation. Moreover, the regulation can also entail direct costs, such as expenditures on technical experts or software developers to design technology that monitors policy compliance.

Other costs require a closer look to identify. For instance, once the cryptomarket is subjected to stricter regulation in the United States, this may spur substitution effects, including the emergence of yet another market to which investors might switch.[250] Still, given the significant rationales supporting intervention—most notably, reducing systemic risk—the main question does not seem to be whether one should intervene, but how.

This realization is also reflected in the different regulatory initiatives in the United States. President Biden's executive order, which was released several months after an earlier version of this Article was posted online, seems to have embraced the rationales we identify, referring explicitly to systemic risk,[251] crime,[252] and the protection of investors,[253] but does not impose new obligations other than requiring different agencies to submit reports.[254] These same goals

248. Østbye, *supra* note 111, at 31. *See generally* Nissim Cohen & Hadar Y. Jabotinsky, Nudges and Sludges: Regulating Innovation (Feb. 1, 2022) (unpublished manuscript), https://ssrn.com/abstract=3523910 (arguing that regulators must be careful not to suppress innovation).

249. Raising funds has been one of the main purposes of issuing tokens in an ICO. For instance, in 2019, $14.8 billion was raised in ICOs, not only for firms directly dealing with cryptocurrencies, but also those in other industries (for example, banking, media, and entertainment). *Amount of Funds Raised for Cryptocurrency Initial Coin Offering (ICO) Projects Worldwide as of November 2019, by Leading Industry*, STATISTA (Mar. 15, 2022), https://www.statista.com/statistics/802925/worldwide-amount-crytocurrency-ico-projects-by-industry/.

250. *See generally* Loïc Sauce, *The Unintended Consequences of the Regulation of Cryptocurrencies*, 46 CAMBRIDGE J. ECON. 57 (2021) (arguing that regulation may drive certain investors outside the scope of regulation).

251. Exec. Order No. 14,067, 87 Fed. Reg. 14,143, 14,143–45, 14,148–49 (Mar. 14, 2022).

252. *See, e.g.*, *id.* at 14,143, 14,146–47.

253. *Id.* at 14,143, 14,147.

254. *Id.* at 14,146–47.

are also echoed in a recent factsheet published by the U.S. Department of the Treasury in congruence with the executive order[255] and bipartisan bill.[256]

When the direction in which the United States is headed in terms of regulating the cryptomarket becomes clear, a cost-benefit analysis can take a more concrete form, weighing the importance of potential market failures against the specific costs entailed in the planned reform.

CONCLUSION

Our empirical analysis of the cryptomarket's response to COVID-19 reveals interesting patterns consistent with various types of market failures, including information asymmetry, in conjunction with market power, and externality problems, most notably those related to systemic risk. In particular, we observe a crypto-rush at the very beginning of the crisis, implying a positive correlation between COVID-19 cases and the cryptomarket, but also a trend reversal at some point, yielding an inverse-U-shaped relationship between the general progress of the virus and the cryptomarket.

Pointing to alternative explanations for our findings, we have highlighted how intervention in the market can correct each type of market failure, including disclosure rules, trade halts, or other types of intervention. At the same time, we have emphasized the difficulties of such interventions on both the institutional and practical level, given technological challenges.

Focusing on the early days of the pandemic allows us to observe how the initial shock, rather than subsequent governmental responses, affected investor behavior. While we leave the exploration of later days of the pandemic to future research, some recent anecdotal evidence further supports our finding that COVID-19 cases and the cryptomarket are tightly related. Namely, the emergence of the omicron variant seems to be partially responsible for a plunge in the cryptomarket, according to news reports.[257] Whether this holds under the

255. *Fact Sheet: Framework for International Engagement on Digital Assets*, U.S. DEP'T OF THE TREASURY (July 7, 2022), https://home.treasury.gov/news/press-releases/jy0854.

> The framework is guided by the principal policy objectives of the United States as laid out in the Executive Order on *Ensuring Responsible Development of Digital Assets* (March 9, 2022) and tailored to reflect the international aspects of our work: [p]rotect consumers, investors, and businesses in the United States and globally by promoting technology and regulatory standards that reflect U.S. values; [p]rotect U.S. and global financial stability and mitigate systemic risk; [m]itigate illicit finance . . . .

256. The Lummis-Gillibrand Responsible Financial Innovation Act also mentions "reduction of systemic risk" as a matter that needs further study. Lummis-Gillibrand Responsible Financial Innovation Act, S. 4356, 117th Cong. § 809(c)(1)(H) (2022). The bill also proposes more concrete measures that seem in line with the rationales identified in this Article, such as preventing manipulation. *Id.* § 5i(c)(1), (d)(3)(A), (d)(5)(c)(ii), § 805(2)(D).

257. Frank Holland, *Cryptocurrency Prices Fall in December, and Investors Blame Omicron, Climate Change*, CNBC, https://www.cnbc.com/2021/12/29/cryptocurrency-prices-fall-in-december-and-investors-blame-omicron-climate-change.html (Dec. 29, 2021, 6:54 PM); Tom Wilson, *Cryptocurrencies Tumble as Coronavirus Variant Shakes Markets*, REUTERS, https://www.reuters.com/markets/currencies/bitcoin-tumbles-coronavirus-variant-sees-riskier-assets-dumped-2021-11-26/ (Nov. 26, 2021, 5:28 AM). *But see* Javier Paz, *Did*

scrutiny of careful empirical investigation remains an open question, and current effects reflect the passing of time and various government policies adopted later in the pandemic. It is precisely for this reason that our focus on the early days of the pandemic provides a cleaner result that can help shed insight into the ways cyryptomarkets function during a crisis.

Although we consider a specific event—how the cryptomarket responded to the outbreak of COVID-19—our arguments can easily be generalized to other crises. People switching away from traditional markets to the cryptomarket is possible during any type of financial instability, and not only during a pandemic.

Our Article is the first to consider how to regulate the cryptomarket through an analysis of how the COVID-19 crisis affected the cryptomarket. It is also the first to include token fixed effects in the empirical analysis, thereby providing more convincing estimations. Our approach provides new insights and enables us to delineate how the different potential interpretations of the market response could be addressed using regulatory tools. Hence, this Article can assist regulators in navigating both the justifications and content of future cryptocurrency regulation, especially in preparation for any future crisis.

APPENDIX: EMPIRICAL ANALYSIS

This Appendix presents our empirical analysis. Subpart A describes the sources we used to collect the data and the variables used in the analysis. Subpart B presents our findings from the analysis.

A. DATA SOURCES AND VARIABLES

Data on the volume and market cap of cryptocurrencies was collected from the website CoinMarketCap.[258] We use the top 100 cryptocurrencies in terms of market size as of March 11, 2020, and focus on the time window of January 1, 2020, to March 11, 2020. March 11, 2020, was the day when the WHO classified the COVID-19 situation as a pandemic and is therefore an appropriate termination date for the initial stage of the crisis. This yields a pre-COVID-19 range (January 1 to January 21) and a post-COVID-19 range (January 22 to March 11). Data on COVID-19 cases and deaths was hand-collected using graphs featured on the website Worldometer.[259] Data on exchange rates and the S&P 500 was gathered using Google Finance.[260] The resulting dataset has the

Omicron or a Bitcoin Futures Short Last Week Trigger a Weekend Selloff?, FORBES, https://www.forbes.com/sites/javierpaz/2021/12/07/did-omicron-or-a-bitcoin-futures-short-last-week-trigger-a-weekend-selloff/?sh=658399075f3f (Dec. 7, 2021, 12:17 PM).

258. COINMARKETCAP, http://www.coinmarketcap.com (last visited Jan. 28, 2023). The website is a usual source for crypto-related issues.

259. WORLDOMETER, https://www.worldometers.info/coronavirus/ (last visited Jan. 28, 2023).

260. Google Finance allows users to download data directly into Google Sheets. We used this feature to attain the data.

structure of so-called "panel data," or "longitudinal data,"[261] which tracks a set of units over time. In this particular case, the dataset tracks a group of cryptocurrencies (bitcoin, ether, etc.) over time, where each observation represents one cryptocurrency in one day. This feature of the data has some advantages, as explained further below.

We then focus on two outcomes: (1) market cap and (2) trade volume. The former is simply the product of multiplying the price of the cryptocurrency (in U.S. dollars) by the number of tokens circulating in the market. The latter captures the level of activity: how many tokens are sold and bought on a given day. We check separately how market cap and trade volume each change due to movements in COVID-19 cases.[262] To avoid dealing with large numbers, we have coded the variables such that they are measured in units of $1 million.

Our main predictors of the two outcomes are then (1) the total existing number of COVID-19 cases identified globally on a given day, and (2) the number of additional new cases identified on that given day. Here, the first variable ("ExistingCoronaCases") captures how far the virus spread starting from January 22, 2020.[263] The second variable ("NewCoronaCases") measures the daily inflow of new cases. These two variables are, of course, related but capture different aspects of COVID-19 effects: people may respond to the severity of the crisis, which corresponds with the existing number of cases, but may also respond when there is a "shock" of new cases. We therefore account for both. We also look at existing and new deaths ("ExistingCoronaDeaths" and "NewCoronaDeaths") to see whether investors care about such incidents.

Although these variables (the outcome and the predictors) can reveal the statistical association between COVID-19 and the cryptomarket, we go a step further and attempt to account for some confounding effects. We do so using so-called "control variables": variables that can also predict the outcome alongside our main predictors. Accounting for control variables helps ensure that the correlation we observe truly comes from the COVID-19 cases rather than an unrelated factor that co-moves with COVID-19 cases.

Specifically, we have included several groups of control variables. First and foremost, our data structure allows us to include token fixed effects, or a set of control variables each capturing one token. When these are included, anything that is time-invariant ("fixed") is absorbed, and the remaining variation we see can more convincingly be attributed to COVID-19 rather than to random

261. *See, e.g.*, Michael O. Finkelstein, *Regression Models in Administrative Proceedings*, 86 HARV. L. REV. 1442, 1448 (1973); Colin S. Diver, *Policymaking Paradigms in Administrative Law*, 95 HARV. L. REV. 393, 397 (1981).

262. Note that the market cap captures the value of the tokens and should increase if there is more demand. Conversely, the volume of trade involves selling, not only buying, such that it is not necessarily straightforward to assume that people will actually trade more. For example, some sellers might refuse to sell, which would lead to a price increase but not to more trade.

263. Worldometer documents cases from January 22, 2020, onwards. *See* WORLDOMETER, *supra* note 259. We coded all previous dates as zero cases, assuming that the virus did not spread much before then.

differences between tokens. Moreover, it ensures that each token is comparable to the other tokens in the analysis. For example, if the difference between bitcoin and ethereum is always present and does not change over time, we account for that difference.

To achieve a similar goal, we also control for which day of the week it is (days of the week "dummy" variables).[264] This is important because both trading activity and the number of identified cases may be different on some days, for example, if there is less testing on the weekend but also less (or more) trade on the weekend.

We also control for three indicators that capture the activity in the regular financial market: the S&P 500 ("SpClose"), the U.S.-dollar-to-euro exchange rate ("USDEUR"), and the U.S.-dollar-to-Chinese-yuan exchange rate ("USDCNY").[265] Controlling for the S&P 500 allows us to check whether the effect of COVID-19 on cryptocurrencies can be seen even after considering that the U.S. stock market changed at the same time. Controlling for the exchange rates ensures that the changes we observe in the market cap are not related to how much the U.S. dollar was worth at a given moment.

Finally, we control for spot prices of gold ("GoldClose").[266] This helps us capture possible capital movements from financial markets to the commodity market, as gold is a typical safe haven in times of crisis[267] and is often described as a substitute for cryptocurrencies.[268]

B. ANALYSIS AND FINDINGS

We begin our data description by plotting the number of COVID-19 cases and deaths over time, as depicted in Figure 1. The figure shows how the virus progressed in terms of cases (part (a) on the left) and deaths (part (b) on the right), in and outside of China in the timeline of our sample, the early stage of the pandemic. Inspecting the total number of cases shows a stark upward trend of the virus, with two interesting kinks. The first kink occurs around February 11, where the trend is still upwards, but the pace slows down. The dash-dotted line just below reveals that this kink is due to the slowdown of the spread in China. The second kink occurs around February 28, where the spread of the virus

264. A dummy variable is a binary variable, assigning either the value 1 or 0. For instance, a dummy variable for Sunday would get the value 1 if it is indeed Sunday and 0 otherwise.

265. The exchange rate and the S&P 500 were extracted using Google Finance and Google Spreadsheets.

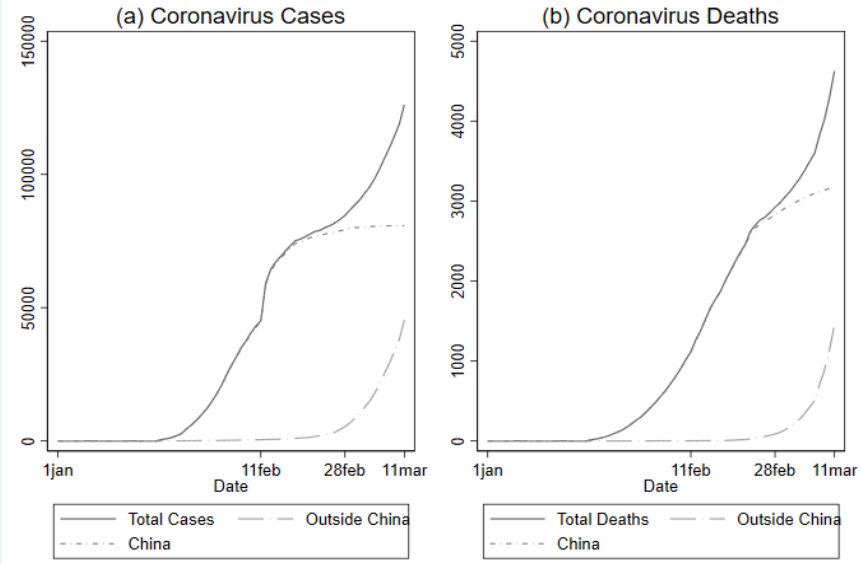
266. Prices are measured in USD per ounce using the daily closing rate taken from the website Markets Insider. MARKETS INSIDER, https://markets.businessinsider.com/commodities/gold-price (last visited Jan. 28, 2023).

267. Jędrzej Białkowski, Martin T. Bohl, Patrick M. Stephan & Tomasz P. Wisniewski, *The Gold Price in Times of Crisis*, 41 INT'L REV. FIN. ANALYSIS 329, 329 (2015).

268. Dirk G. Baur, Thomas Dimpfl & Konstantin Kuck, *Bitcoin, Gold and the US Dollar—a Replication and Extension*, 25 FIN. RSCH. LETTERS 103, 104 (2018); Ryan Clements, *Assessing the Evolution of Cryptocurrency: Demand Factors, Latent Value, and Regulatory Developments*, 8 MICH. BUS. & ENTREPR. L. REV. 73, 77 (2018).

outside of China lead to an exponential growth in both cases and deaths. During the second kink, about 50,000 cases of COVID-19 were identified.

FIGURE 1: COVID-19 CASES AND DEATHS OVER TIME



Next, inspecting the number of deaths shows only one kink—the second kink—which seems to suggest that while the number of identified cases slowed down, the death rate did not. One possible reason for this may be that the number of identified cases was actually lagging,[269] as countries could not diagnose those who did not manifest symptoms, whereas deaths are, of course, immediately identifiable.

We continue our analysis by relating the progress of COVID-19 to the cryptomarket. As a first rough check, we divide the data into pre-outbreak and post-outbreak. We then check to see whether there were differences in the market movements before and after the virus.[270] However, as different cryptocurrencies have very different market cap ranges (because, for example, the popular tokens fluctuate around high numbers and vice versa), we consider

269. A lagging of identification has been claimed to occur based on empirical analyses and estimations. *See* Tomas Pueyo, *Coronavirus: Why You Must Act Now*, MEDIUM, https://medium.com/@tomaspueyo/coronavirus-act-today-or-people-will-die-f4d3d9cd99ca (Mar. 10, 2020) (a highly influential blogpost that received many views and provides graphs and numbers on COVID-19).

270. Note, however, that the *grand mean* of our centered variables presented in Table 1 is, of course, not zero. The reason is that we subtracted the individual *token's* average from each observation, and as the market cap of, for example, bitcoin is larger, this naturally led to large negative values that drove down the grand mean.

two versions of the market cap: the original number and a "centered" version. The centered version simply means that we subtract the average market cap of each cryptocurrency from the observations belonging to that cryptocurrency. This achieves a more comparable scale because now, within each cryptocurrency, all the observations have an average of zero.

As seen in Table 1, our findings show that the market cap and trade volume were higher in the post-outbreak period, and that the difference is statistically significant.[271] This difference between the pre- and post-outbreak market caps and trade volumes provides the first interesting finding in support of what we tried to test: both the trade volume and market cap were higher at the time of the virus.

Table 1 also shows that our sample includes a similar number from each day of the week, as there is no significant difference with respect to days of the week dummies. This is important because it shows that our results are not driven by random daily effects that happen to coincide with our sample's division such as market activity, which is usually higher on some days and lower on others.

271. Statistical significance means that it is very unlikely that the relationship between two variables occurred simply by chance. The degree of significance is expressed by a "p-value," which measures the probability of drawing the sample we observe in cases where the virus would actually have no effect. As this probability is small (less than 1% to 10%, depending on the specification), we can conclude that the virus *does* have an effect. Note that the difference is significant for our "centered" version, which is the more accurate one.

TABLE 1: DESCRIPTIVE STATISTICS[272]

Factor	Pre-Virus (Jan. 1–Jan. 21)	Post-Virus (Jan. 22–Mar. 11)	P-Value
Number of Observations	2100	5000	
Dependent Variables (Centered)			
MarketCap (centered), mean (SD)	-103.1 (1213.0)	324.5 (2231.1)	<0.001
Volume (centered), mean (SD)	-199.7 (1574.5)	210.6 (1688.1)	<0.001
Dependent Variables (Non-Centered)			
MarketCap, mean (SD)	2229.1 (15102.2)	2604.2 (17035.8)	0.39
Volume, mean (SD)	941.5 (4636.7)	1351.7 (6457.5)	0.008
Independent Variables			
ExistingCoronaCases, mean (SD)	0.0 (0.0)	55353.7 (36738.9)	<0.001
NewCoronaCases, mean (SD)	0.0 (0.0)	2524.1 (2163.2)	<0.001
ExistingCoronaDeaths, mean (SD)	0.0 (0.0)	1681.5 (1312.9)	<0.001
NewCoronaDeaths, mean (SD)	0.0 (0.0)	92.5 (62.7)	<0.001
Control Variables			
USDEUR, mean (SD)	1.1 (0.0)	1.1 (0.0)	<0.001
USDCNY, mean (SD)	0.1 (0.0)	0.1 (0.0)	<0.001
S&PClose, mean (SD)	3277.0 (35.4)	3212.2 (170.7)	<0.001
GoldClose, mean (SD)	1557.0 (13.2)	1602.1 (39.2)	<0.001
Day of the Week:			0.77
Sunday	300 (14.3%)	700 (14.0%)	
Monday	300 (14.3%)	700 (14.0%)	
Tuesday	300 (14.3%)	700 (14.0%)	
Wednesday	300 (14.3%)	800 (16.0%)	
Thursday	300 (14.3%)	700 (14.0%)	
Friday	300 (14.3%)	700 (14.0%)	
Saturday	300 (14.3%)	700 (14.0%)	

272. This table compares descriptive statistics for the variables used in the analysis between the time period before the virus outbreak and the time period after. For independent variables, we include both a centered (demeaned) version and a non-centered version. For each comparison, the last column includes a p-value. The comparison of all variables except for day of the week dummy variables is implemented using a two-sample t-test. For the day of the week dummies, which are categorical variables, we use a Pearson chi-squared test.

We proceed by using linear regressions.[273] These regressions shed light on two main points. First, they allow us to add control variables: additional variables that may affect the market cap or trade volume but might be correlated with the progress of the virus as well. If we add these control variables and observe that the effect of COVID-19 is still statistically significant, it indicates that the effect we identified is not an accidental correlation. To illustrate, suppose that the virus causes people to stop purchasing U.S. dollars because they want to buy goods elsewhere in the world. If the U.S. dollar's value decreases, the market cap must decrease by definition, because it happens to be counted in U.S. dollars. Adding the aforementioned exchange rate rules out this confounding explanation.

Second, in the rough check introduced above, we pooled together the days after the outbreak and the days before. However, we are also interested in how an increment in the number of cases, or deaths, affects cryptocurrencies, which can be tested via a regression. The regression also helps us check whether the effect always goes in the same direction (a linear effect), or whether there is some tipping point where the effect changes direction.[274]

Our main findings are summarized in the body of the Article above, but are also organized below in further detail.

1. Effects on Market Cap

One of our interests is how a marginal increase in the number of COVID-19 cases and deaths affects the cryptomarket. Our results are presented in Tables

273. A linear regression, also known as Ordinary Least Squares (OLS), is a statistical method for evaluating the effect of one variable (a "predictor" or "independent variable") on another variable (an "outcome" or "dependent variable"). The regression estimates a linear equation of the form $y = \beta_\sigma + \beta_1 x + \varepsilon$, where x is the predictor, y is the outcome, and β_1 is the "coefficient" of x: the coefficient measures the change in the outcome y when x increases by one unit. For example, if the outcome is the trade volume, the predictor is the number of COVID-19 cases, and the coefficient is 2; this means that each additional COVID-19 case is associated with an increase of two units in the trade volume. The other items in the equation represent the following: β_σ is the "intercept" of the line (that is, the prediction for the outcome when $x = 0$), and u is an "error term," capturing anything that is unobservable but nonetheless contributes to the outcome. For an application to corporate finance, see generally Ofer Eldar, *A Lawyer's Guide to Empirical Corporate Governance*, 27 STAN. J.L. BUS. & FIN. 1 (2022).

274. We can achieve this by including a so-called "quadratic term" (a squared independent variable). If the coefficient of this term is also statistically significant, it means that the relationship between the independent variable (COVID-19 cases and deaths) and the dependent variable (market cap and trade volume) is in the shape of a U-inverse; that is, that more COVID-19 cases positively affect the outcome up to a certain point and then start to negatively affect the outcome.

2[275] and 3.[276] The results show that for each new COVID-19 case, the market cap of each of the tokens we examined increased by about $26,170 to $59,330.[277] Furthermore, when the number of existing cases (that is, the total minus new cases) increased, this contributed an additional amount of $5,310 to $5,840, on average, to the market cap of each token.[278] Our results also show that for each new death, the market cap of each token increased by about $1.68 to $2.66 million.[279] The increase in the number of existing deaths contributed an additional $118,780 to $138,010.[280] Hence, the market cap responds more strongly to deaths than new cases.

275. Table 2 presents the average (marginal) effect of an increase in the number of new and existing COVID-19 cases and deaths on the market cap of each cryptocurrency. Columns (1) through (4) refer to cases, whereas columns (5) through (8) refer to deaths. In columns (1) and (5), we only include the number of new cases. As can be seen, the marginal effects shown in the table (0.05 and 1.67, respectively) are both positive and statistically significant at the 5% level. These effects remain positive and significant (at the 5% or 10% level) in the other columns, even after we control for token fixed effects and our other control variables. The effect of existing cases and deaths is also positive and significant (at the 5% or 10% level).

276. Table 3 shows the original coefficients used to calculate the marginal effects shown in Table 2. It demonstrates that the coefficient of the quadratic term—existing case and deaths squared—is negatively significant in all columns except for column (4), which is also close to significance. This is the source of the U-inverse relationship we identify. The table further shows that the market cap is negatively correlated with the USDEUR exchange rate, but positively correlated with the USDCNY exchange rate and the S&P 500 (where *S&PClose* refers to the closing rate of the S&P 500).

277. *See infra* Table 2, cols. (1)–(3).

278. *See infra* Table 2, cols. (3)–(4).

279. *See infra* Table 2, cols. (5)–(8); Table 3, cols. (5)–(8).

280. *See infra* Table 2, cols. (7)–(8).

TABLE 2: AVERAGE MARGINAL EFFECT OF COVID-19 ON MARKET CAP[281]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
New Corona Cases	0.052 18** (0.02 527)	0.059 33** (0.02 976)	0.026 17* (0.01 448)	0.035 00* (0.01 915)				
Existing Corona Cases			0.005 84* (0.00 297)	0.005 31** (0.00 248)				
New Corona Deaths					1.677 08** (0.78 134)	1.944 74** (0.93 238)	2.326 18* (1.23 226)	2.65977* (1.45279)
Existing Corona Deaths							0.138 10* (0.07 110)	0.11878** (0.05456)
Fixed Effects	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Quadratic Term	No	No	Yes	Yes	No	No	Yes	Yes
Controls	No	No	No	Yes	No	No	No	Yes
Observations	6976	6976	6976	6976	6976	6976	6976	6976

281. This table presents (average) marginal effects of the COVID-19 cases or deaths on the market cap of cryptocurrencies. Five tokens for which information on the market cap was unavailable for some days are omitted, yielding a total of 6,976 valid observations. The OLS results used to calculate the marginal effects are available as Table 3. The dependent variable is *MarketCap* in all regressions. Standard errors are clustered by token. Controls (when included) are USDEUR, USDCNY, SPClose, GoldClose and days of the week dummies. * p<0.1 ** p<0.05 *** p<0.01.

TABLE 3: OLS RESULTS – EFFECT OF COVID-19 ON MARKET CAP[282]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
New Corona Cases	0.052**	0.059**	0.026*	0.035*				
	(0.025)	(0.030)	(0.014)	(0.019)				
Existing Corona Cases			0.022*	0.018*				
			(0.012)	(0.010)				
Existing Corona Cases # Existing Corona Cases			-0.000*	-0.000				
			(0.000)	(0.000)				
New Corona Deaths					1.677**	1.945**	2.326*	2.660*
					(0.781)	(0.932)	(1.232)	(1.453)
Existing Corona Deaths							0.544*	0.604*
							(0.289)	(0.320)
Existing Corona Deaths # Existing Corona Deaths							-0.000*	-0.000*
							(0.000)	(0.000)
USDEUR				-8050.235*				-7332.229
				(4740.120)				(4509.406)
USDCNY				138319.661*				155538.881*
				(82659.456)				(90994.469)
S&PClose				0.286**				-0.555
				(0.118)				(0.405)
GoldClose				1.989				1.754
				(1.429)				(1.309)
Adjusted R-Squared	<0.01	0.990	0.991	0.991	<0.01	0.990	0.991	0.991
Days of the Week Dummies	No	No	No	Yes	No	No	No	Yes
Fixed Effects	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Observations	6976	6976	6976	6976	6976	6976	6976	6976

2. Effects on Trade Volume

Proceeding along similar lines, we test how a marginal increase in the number of COVID-19 cases and deaths affected the trading volume. Our results

282. This table presents the results of the OLS regressions of the market cap on COVID-19 cases and deaths. The dependent variable is *MarketCap*. Five tokens for which information on the market cap was unavailable for some days are omitted, yielding a total of 6,976 valid observations. Standard errors are clustered by token. The coefficients of the constant, fixed effects, and days of the week dummies are not reported. * p<0.1 ** p<0.05 *** p<0.01.

are presented in Tables 4[283] and 5.[284] The results show that for each new case of COVID-19 or death from the disease, the trading volume of the cryptocurrencies we examined increased. Again, deaths seem to have a stronger impact, as each new death is associated with an increase of between $0.9 to $2.87 million, whereas each new case is associated with an increase of only about $3,000 to $64,040.[285]

TABLE 4: AVERAGE MARGINAL EFFECT OF COVID-19 ON TRADE VOLUME[286]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
New Corona Cases	0.06404**	0.06404**	0.00681**	0.003				
	(0.02945)	(0.02966)	(0.00325)	(0.004)				
ExistingCoronaCases			0.00789**	0.020**				
			(0.00367)	(0.008)				
NewCoronaDeaths					2.87296**	2.87296**	0.90902*	1.44**
					(1.38482)	(1.39458)	(0.48215)	(0.69)
ExistingCoronaDeaths							0.24495**	0.727**
							(0.11374)	(0.309)
Adjusted R-Squared	<0.01	.93	.93	.93	<0.01	.93	.93	.93
Fixed Effects	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Quadratic Term	No	No	Yes	Yes	No	No	Yes	Yes
Controls	No	No	No	Yes	No	No	No	Yes
Observations	7100	7100	7100	7100	7100	7100	7100	7100

283. Table 4 presents the average (marginal) effect of an increase in the number of new and existing COVID-19 cases and deaths on the trade volume of each cryptocurrency. Again, columns (1) through (4) refer to cases and columns (5) through (8) to deaths. In columns (1) and (5), we only include the number of new cases. As can be seen, the marginal effects (0.064 and 2.87) are both positive and statistically significant at the 5% level. These effects remain positive and significant (at the 5% or 10% level) in the other columns, except for column (4). The effect of existing cases or deaths is also positive and significant.

284. Table 5 shows the original coefficients used to calculate the marginal effects in Table 4. As with the market cap, it demonstrates that the coefficient of the quadratic term is negatively significant when considering the trade volume instead. This again supports the U-inverse relationship we identify. The table further shows that the volume is negatively correlated with the USDEUR exchange rate, but positively correlated with the USDCNY exchange rate. The correlation with the S&P 500 is, interestingly, negative, but significant only in column (8).

285. *See infra* Table 4, cols. (2)–(8); Table 5, cols. (2)–(8).

286. This table presents average marginal effects of COVID-19 cases or deaths on cryptocurrencies' market cap. The OLS results used to calculate the marginal effects are available as Table 5. The dependent variable is *Volume* in all regressions. Standard errors are clustered by token. Controls (when included) are USDEUR, USDCNY, SPClose, GoldClose and days of the week dummies. * p<0.1 ** p<0.05 *** p<0.01.

TABLE 5: OLS RESULTS – EFFECT OF COVID-19 ON TRADE VOLUME[287]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
New Corona Cases	0.064**	0.064**	0.007**	0.003				
	(0.029)	(0.030)	(0.003)	(0.004)				
Existing Corona Cases			0.017**	0.020**				
			(0.007)	(0.008)				
Existing Corona Cases # Existing Corona Cases			-0.000**	-0.000**				
			(0.000)	(0.000)				
New Corona Deaths					2.873**	2.873**	0.909*	1.441**
					(1.385)	(1.395)	(0.482)	(0.690)
Existing Corona Deaths							0.527**	0.727**
							(0.233)	(0.309)
Existing Corona Deaths # Existing Corona Deaths							-0.000**	-0.000**
							(0.000)	(0.000)
USDEUR				-7685.382*				-6343.142*
				(4095.021)				(3556.174)
USDCNY				170616.808**				181216.655**
				(71401.962)				(76914.333)
S&PClose				-0.299*				-0.793*
				(0.179)				(0.410)
GoldClose				0.319				0.283
				(0.319)				(0.429)
R-Squared	0.000	0.925	0.927	0.927	0.001	0.926	0.927	0.927
Days of the Week Dummies	No	No	No	Yes	No	No	No	Yes
Fixed Effects	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Observations	7100	7100	7100	7100	7100	7100	7100	7100

3. An Inverse-U Relationship

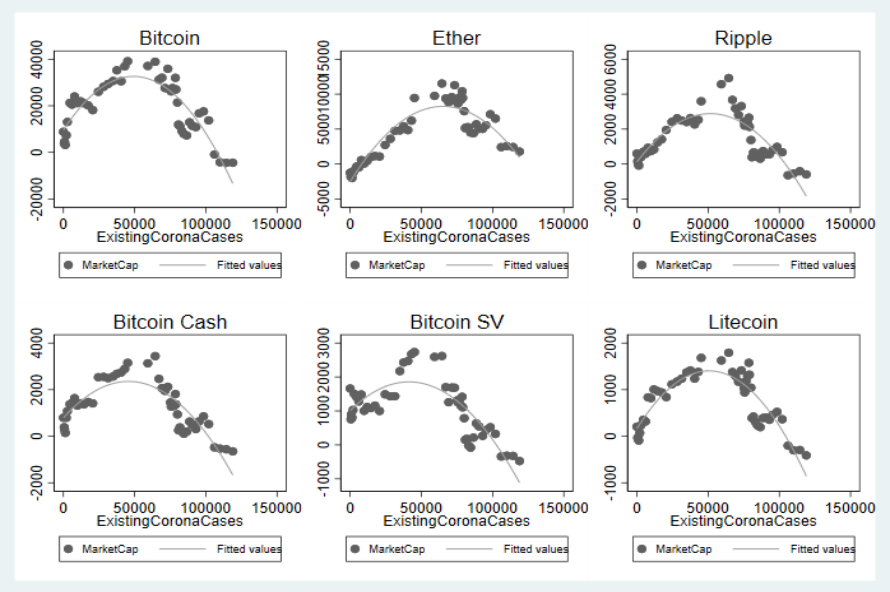
While an increase in COVID-19 cases and deaths is associated with higher trade volume and market cap, the numbers above correspond to the *average* effect over the timeline in our sample. As the effect is positive on average, it is interesting to see how it was achieved: do more COVID-19 cases always cause

287. This table presents the results of the OLS regressions of COVID-19 cases and deaths on the trade volume (*Volume*). Standard errors are clustered by token. The coefficients of the constant, fixed effects, and days of the week dummies are not reported. * p<0.1 ** p<0.05 *** p<0.01.

an increase? Or is it the case that for some observations in our sample, the effect is negative where the average is still positive?

Inspecting the relationship graphically can assist in clarifying what effects are in play. As the effects of deaths and cases are graphically similar, we restrict attention to cases only. In Figures 2 and 3, we provide a scatter plot that depicts the relationship between the existing number of COVID-19 cases (x-axis) and the centered market cap (y-axis) of selected cryptocurrencies.[288] In addition, the figure includes a "fitted values" line, which depicts the prediction of our statistical model. In Figure 2, we include six leading cryptocurrencies ("Bitcoin," "Ether," "Ripple," "Bitcoin Cash," "Bitcoin SV," "Litecoin"), which are some of the most well-known and salient tokens in the market. As shown in Figure 2 below, the relationship has a U-inverse form: first an increase, but then a decrease. The fitted values (lines) do a reasonably good job of predicting the actual observations (dots). The graph illustrates that although on average more COVID-19 cases are associated with a higher market cap, the effect starts to reverse for high values.

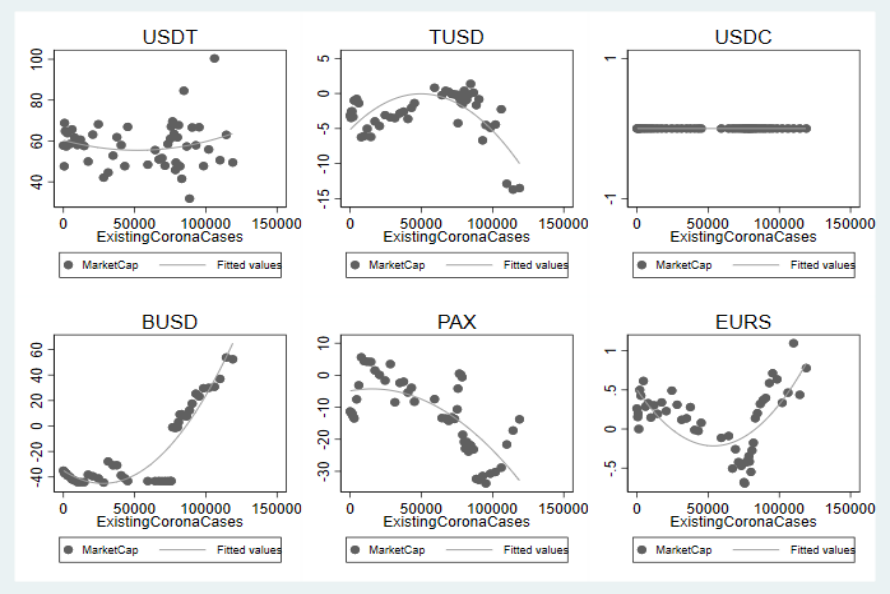
FIGURE 2: MARKET CAP & LEADING CRYPTOCURRENCIES



288. Figures 2 through 4 do not directly represent the results of the regressions, as we focus only on the number of existing cases. The fitted values are thus generated from individual regressions by token that only include ExistingCoronaCases and ExistingCoronaCases—squared as independent variables.

Another interesting comparison in this respect is to test whether the same relationship holds for stablecoins. Thus, Figure 3 includes six stablecoins that are available in our sample: Tether ("USDT"), Paxos Standard ("PAX"), Binance USD ("BUSD"), USDcoin ("USDC"), TrueUSD ("TUSD"), and Stasis Euro ("EURS"). As shown in Figure 3, the relationship again has an inverse-U shape for some stablecoins, a regular U shape for others, and a more linear shape for the rest. As stablecoins are more of a proxy for traditional currencies, the differences can perhaps be explained in how investors perceive the value of stablecoins: if their value stems from the underlying value of traditional currencies, and those currencies drop in value due to the COVID-19 crisis, then the token is worth less. In which case, we would expect a mirror image (a regular U shape) of how other tokens behave. Respectively, if tokens are perceived as stronger than their underlying currency (possibly due to pure herding and a misunderstanding of the tokens' actual value), we would expect a U-inverse shape. Note, however, that the fitted values (recall that these are the values predicted by a linear regression)[289] remain close to the actual observations. Accordingly, our model seems to do a good job at predicting what is going on.

FIGURE 3: MARKET CAP & STABLECOINS



Figures 4 and 5 proceed along the same lines and display the relationship between the existing number of COVID-19 cases and trade volume.

Comparing Figures 2 and 4 reveals that the effects on the market cap and trade volume among the leading cryptocurrencies is similar. Next, comparing

289. *See supra* note 288.

Figures 3 and 5 shows that for stablecoins, some relationships are similar, whereas others are different. However, it is important to keep in mind that these stablecoins are already taken into account in our linear regressions, so that these differences can be treated as a negligible outlier and do not matter much for the purpose of predicting how the market as a whole will behave.

FIGURE 4: TRADE VOLUME & LEADING CRYPTOCURRENCIES

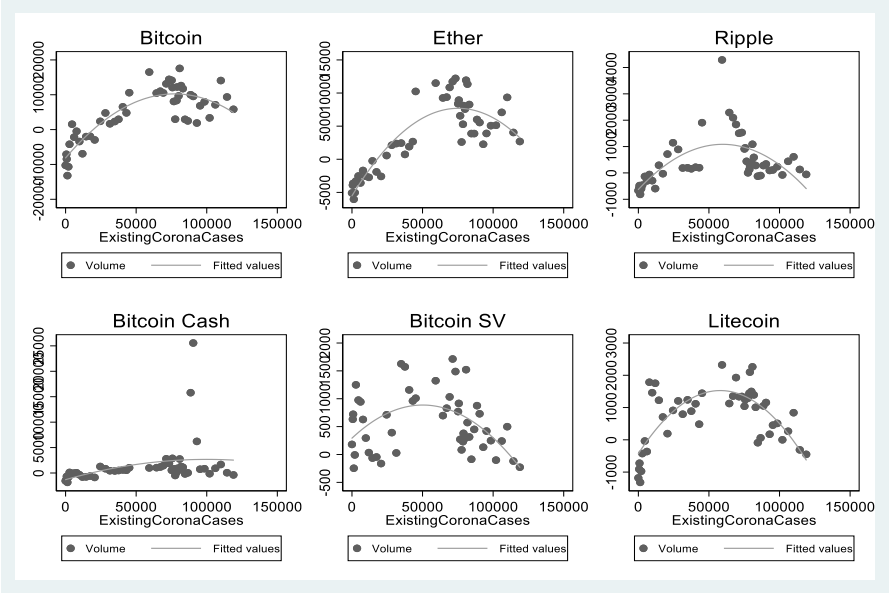


FIGURE 5: TRADE VOLUME & STABLECOINS