

[Home](#) > [Business Transformation through Blockchain](#) > Chapter

Blockchain Economic Networks: Economic Network Theory—Systemic Risk and Blockchain Technology

| Chapter | First Online: 22 December 2018

| pp 3–45 | [Cite this chapter](#)



[Business Transformation through Blockchain](#)

[Melanie Swan](#) 

 5769 Accesses  26 Citations

Abstract

This chapter discusses how the widespread adoption of blockchain technology (distributed ledgers) might contribute to solving a larger class of economic problems related to systemic risk, specifically the degree of systemic risk in financial networks (ongoing credit relationships between parties). The chapter introduces economic network theory, drawing from König and Battiston (2009). Then, Part I develops payment network analysis (analyzing immediate cash transfers) in the classical payment network setting (Fedwire (Soramäki 2007)) synthesized with the cryptocurrency environment (Bitcoin (Maesa 2017), Monero (Miller 2017), and Ripple (Moreno-Sánchez et al. 2018)). The key finding is that

the replication of network statistical behavior in cryptographic networks indicates the robust (not merely anecdotal) adoption of blockchain systems. Part II addresses balance sheet network analysis (ongoing obligations over time), first from the classical sense of central bank balance sheet network analysis developed by Castrén (2009, 2013), Gai and Kapadia (2010), and Chan-Lau (2010), and then proposes how blockchain economic networks might help solve systemic risk problems. The chapter concludes with the potential economic and social benefits of blockchain economic networks, particularly as a new technological affordance is created, algorithmic trust, to support financial systems.



This is a preview of subscription content, [log in via an institution](#) to check access.

Access this chapter

[Log in via an institution](#)

Subscribe and save

Springer+

from €37.37 /Month

- Starting from 10 chapters or articles per month
- Access and download chapters and articles from more than 300k books and 2,500 journals
- Cancel anytime

[View plans](#)

Buy Now

Chapter

EUR 29.95

Price includes VAT (Poland)

- Available as PDF
- Read on any device
- Instant download
- Own it forever

eBook

EUR 117.69

Price includes VAT (Poland)

- Available as EPUB and PDF
- Read on any device
- Instant download
- Own it forever

↗ Hardcover Book

EUR 160.49

Price includes VAT (Poland)

- Durable hardcover edition
- Dispatched in 3 to 5 business days
- Free shipping worldwide - [see info](#)

[Buy Hardcover Book →](#)

Tax calculation will be finalised at checkout

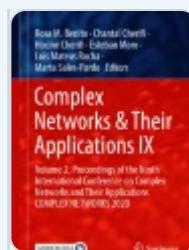
Purchases are for personal use only

[Institutional subscriptions →](#)

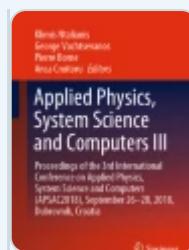
Similar content being viewed by others



[Decentralized Blockchain Networks and Economic Security: Balancing Scalability and Security Tradeoffs](#)



[Analysis of Tainted Transactions in the Bitcoin Blockchain Transaction Network](#)



[Design of Real-Time Transaction Monitoring System for Blockchain Abnormality Detection](#)

Chapter | © 2024

Chapter | © 2021

Chapter | © 2019

Explore related subjects

Discover the latest articles, books and news in related subjects, suggested using machine learning.

[Complex Networks](#)

[Computational Economics](#)

[Regulatory networks](#)

[Stochastic Networks](#)

References

Albert, R., & Barabási, A. (2002). Statistical mechanics of complex networks. *Reviews of Modern Physics*, 74(1), 47–97.

[Article](#) [Google Scholar](#)

Aldasoro, I., & Alves, I. (2016, September). *Multiplex interbank networks and systemic importance: An application to European data* (Working Paper No 1962). European Central Bank.

[Google Scholar](#)

Armknecht, F., Karame, G. O., Mandal, A., Youssef, F., & Zenner, E. (2015). *Ripple: Overview and outlook* (pp. 163–180). New York: Springer.

[Google Scholar](#)

Ballester, C., Calvó-Armengol, A., & Zenou, Y. (2006). Who's who in networks. Wanted: The key player. *Econometrica*, 74(5), 1403–1417.

[Article](#) [Google Scholar](#)

Barabási, A. L., & Albert, R. (1999). Emergence of scaling in random networks. *Science*, 286(5439), 509–512.

[Article](#) [Google Scholar](#)

Battiston, S., Caldarelli, G., May, R. M., Roukny, T., & Stiglitz, J. E. (2016). The price of complexity in financial networks. *Proceedings of the National Academy of Sciences*, 113(36), 10031–10036.

[Article](#) [Google Scholar](#)

Boss, M., Elsinger, H., Summer, M., & Thurner, S. (2003). *The network topology of the interbank market* (Working Paper 03-10-054:3). Santa Fe Institute.

[Google Scholar](#)

Brandes, U., Robins, G., McCranie, A., & Wasserman, S. (2013). What is network science? *Network Science.*, 1, 1-15.

[Article](#) [Google Scholar](#)

Brunswicker, S., Matei, S., Zentner, M., Zentner, L., & Klimeck, G. (2016). Creating impact in the digital space: Digital practice dependency in communities of digital scientific innovations. *Scientometrics*, 110(1), 417-442.

[Article](#) [Google Scholar](#)

Buck, J. (2017). Ethereum upgrade Byzantium is live, verifies first ZK-Snark proof. *Coin Telegraph*. <https://cointelegraph.com/news/ethereum-upgrade-byzantium-is-live-verifies-first-zk-snark-proof>

Castrén, O., & Kavonius, I. (2009, October 5). Balance sheet contagion and systemic risk in the Euro area financial system: A network approach. *ECB Workshop* “Recent Advances in Modelling Systemic Risk using Network Analysis.”

[Google Scholar](#)

Castrén, O., & Rancan, M. (2013, February). *Macro-networks: An application to the euro area financial accounts* (Working Paper No. 1510). European Central Bank.

[Google Scholar](#)

Chan-Lau, J. A. (2010, January). *Balance sheet network analysis of too-connected-to-fail risk in global and domestic banking systems* (IMF Working Paper

Chaturvedi, M. (2017). Contagion in financial (balance sheets) networks. *Viewpoints which matter* blog.

<https://chaturvedimayank.wordpress.com/2016/06/22/contagion-in-financial-balance-sheets-networks/>

Chinsky, M. (2017). Symbiont wins “Best Distributed-Ledger Technology Project” category at Waters Technology’s Buy-Side Technology Awards for second consecutive year. *Business Wire*.

<https://www.businesswire.com/news/home/20171103005598/en/Symbiont-Wins-%E2%80%9CBest-Distributed-Ledger-Technology-Project%E2%80%9D-Category>

Dale, B. (2017). Investors commit \$100 million to tZERO ICO. *Coindesk*.

<https://www.coindesk.com/investors-commit-100-million-first-day-funding-overstocks-tzero-ico/>

De, N. (2017). Russia’s government to test blockchain land registry system.

Coindesk. <https://www.coindesk.com/russias-government-test-blockchain-land-registry-system/>

De, N. (2018). Vermont City pilots land registry record with blockchain startup.

Coindesk. <https://www.coindesk.com/vermont-city-pilots-land-registry-record-with-blockchain-startup/>

Dell Amico, M., & Roudier, Y. (2009, September 24-25). A measurement of mixing time in social networks. In *STM 2009, 5th International Workshop on Security and Trust Management*, Saint Malo, France (Saint Malo, FRANCE, 09 2009).

Diebolt, C. (2012). Where are we now in cliometrics? *Historical Social Research.*, 37(4), 309-326.

[Google Scholar](#)

Embree, L., & Roberts, T. (2009). *Network analysis and Canada's large value transfer system* (Discussion Paper No. 2009-13). Bank of Canada.

[Google Scholar](#)

Erdos, P., & Rényi, A. (1959). On random graphs I. *Publicationes Mathematicae*, 6, 290-297.

[Article](#) [Google Scholar](#)

Friedman, S. (2017). IRS uses tech to track bitcoin transactions. *GCN*.

<https://gcn.com/articles/2017/08/31/irs-bitcoin.aspx>

Gai, P., & Kapadia, S. (2010). Contagion in financial networks. *Proceedings of the Royal Society A*, 466, 2401-2423.

[Article](#) [Google Scholar](#)

Gross, T., & Blasius, B. (2008). Adaptive coevolutionary networks: A review. *arXiv:0709.1858*.

[Google Scholar](#)

Haken, H. (2004). *Synergetics: Introduction and advanced topics*. New York: Springer.

[Book](#) [Google Scholar](#)

Hausman, D. M. (2003). *Inexact and separate science of economics*. Cambridge: Cambridge University Press.

Higgins, S. (2017). JPMorgan launches interbank payments platform on Quorum blockchain. *CoinDesk*. <https://www.coindesk.com/jpmorgan-launches-interbank-payments-platform-quorum-blockchain/>

Hurd, T. R. (2015). The construction and properties of assortative configuration graphs. *arXiv:1512.03084*.

Inaoka, H., Ninomiya, T., Taniguchi, K., Shimizu, T., & Takayasu, H. (2004). *Fractal network derived from banking transaction—An analysis of network structures formed by financial institutions* (Working Paper No. 04-E-04). Bank of Japan.

Jackson, M. O. (2008). *Social and economic networks*. Princeton: Princeton University Press.

Kambhu, J., Weidman, S., & Krishnan, N. (2007). *New directions for understanding systemic risk*. Washington, DC: National Academies Press. *Economic Policy Review*, 13(2).

Kauffman, S., & Levin, S. (1987). Towards a general theory of adaptive walks on rugged landscapes. *Journal of Theoretical Biology*, 128(1), 11-45.

Kirman, A. (1997). The economy as an evolving network. *Journal of Evolutionary Economics.*, 7(4), 339-353.

[Article](#) [Google Scholar](#)

König, M. D., & Battiston S. (2009). From graph theory to models of economic networks. A tutorial. In A. K.Naimzada, S. Stefani, & A. Torriero (Eds.), *Networks, topology and dynamics* (Lecture Notes in Economics and Mathematical Systems, vol. 613). New York: Springer.

[Google Scholar](#)

Lagerstrom, R., Baldwin, C., MacCormack A., & Dreyfus, D. (2013). *Visualizing and measuring enterprise architecture: An exploratory BioPharma case* (Working Paper No. 13-105). Harvard Business School.

[Google Scholar](#)

Maesa, D. D. F., Marino, A., & Ricci, L. (2017). Data-driven analysis of bitcoin properties: Exploiting the users graph. *International Journal of Data Science and Analytics*, 61(1), 63-80.

[Google Scholar](#)

Meyer, D. (2016). More banks are trying out blockchains for fund transfers. *Fortune*. <http://fortune.com/2016/06/23/ripple-blockchain-banks/>

Miller, A., Möser, M., Lee, K., & Narayanan, A. (2017). *An empirical analysis of linkability in the Monero blockchain*. <http://monerolink.com/monerolink.pdf>

Mohaisen, A., Yun, A., & Kim, Y. (2010). Measuring the mixing time of social graphs. In *Proceedings of the 10th ACM SIGCOMM Conference on Internet Measurement* (IMC '10, pp. 383-389), New York, ACM.

[Google Scholar](#)

Moreno-Sanchez, P., Zafar, M. B., & Kate, A. (2016). Listening to whispers of ripple: Linking wallets and deanonymizing transactions in the ripple network. *Proceedings on Privacy Enhancing Technologies*, 2016(4), 436–453.

[Article](#) [Google Scholar](#)

Moreno-Sanchez, P., Modi, N., Songhela, R., Kate, A., & Fahmy, S. (2018, April 23–27). Mind your credit: Assessing the health of the Ripple credit network. In *IW3C2 (International World Wide Web Conference Committee), WWW 2018*, Lyon, France.

[Google Scholar](#)

Murphy, A. C., Muldoon, S. F., Baker, D., Lastowka, A., Bennett, B., Yang, M., et al. (2018). Structure, function, and control of the human musculoskeletal network. *PLoS Biology*, 16(1), e2002811.

[Article](#) [Google Scholar](#)

Nakamoto, S. (2008). *Bitcoin: A Peer-to-peer electronic cash system*. [Bitcoin.org](#). <https://bitcoin.org/bitcoin.pdf>

Newman, M. E. J. (2003). The structure and function of complex networks. *Society for Industrial and Applied Mathematics Review*, 45(2), 167–256.

[Google Scholar](#)

Potts, J. (2001). *The new evolutionary microeconomics: Complexity, competence and adaptive behaviour*. Cheltenham: Edward Elgar Publishing.

[Google Scholar](#)

PWC (PricewaterhouseCoopers). (2015). *Bridging the gap 2015 annual global*

working capital survey. <https://www.pwc.com/gx/en/business-recovery-restructuring-services/working-capital-management/working-capital-survey/2015/assets/global-working-capital-survey-2015-report.pdf>

Ripple. (2017a). *Ripple insight*. <https://ripple.com/insights/federal-reserve-task-force-ripple-improves-speed-transparency-global-payments/>

Ripple. (2017b). *Company press release*. https://ripple.com/ripple_press/ripples-blockchain-network-now-100-strong/

Roos, S., Moreno-Sanchez, P., Kate, A., & Goldberg, I. (2017). *Settling payments fast and private: Efficient decentralized routing for path-based transactions*. *arXiv:1709.05748*. Preprint appearing at NDSS 2018.

[Google Scholar](#)

Rubinov, M., & Sporns, O. (2010). Complex network measures of brain connectivity: Uses and interpretations. *NeuroImage*, 52, 1059–1069.

[Article](#) [Google Scholar](#)

Schweitzer, F., et al. (2009). Economic networks: The new challenges. *Science*, 325(422), 422–425.

[Article](#) [Google Scholar](#)

Short, N. (2017). *R3 and four banks test Euro commercial paper issuance on Corda DLT platform*. [Corda.net](https://corda.net)

Soramäki, K., Bech, M. L., Arnold, J., Glass, R. J., & Beyeler, W. E. (2006, March). *Federal Reserve Bank of New York* (Staff Reports, no. 243).

[Google Scholar](#)

Soramäki, K., et al. (2007). The topology of interbank payment flows. *Physica A: Statistical Mechanics and its Applications*, 379, 317–333.

[Article](#) [Google Scholar](#)

Swan, M. (2017). Anticipating the economic benefits of blockchain. *Technology Innovation Management Review*, 7(10), 6–13.

[Article](#) [Google Scholar](#)

Swan, M. (2018a). Blockchain economics: Ripple for ERP. *European Business Review*. Feb-Mar:24–7.

[Google Scholar](#)

Swan, M. (2018b-In Review). U.S. foreign policy toward blockchain technology. *Georgetown Journal of International Affairs*.

[Google Scholar](#)

The Economist. (2017). Technology is revolutionising supply-chain finance.
<https://www.economist.com/news/finance-and-economics/21730150-squeezed-suppliers-and-big-corporate-buyers-stand-benefit-technology>

U.S. Fed. (2017). Board of Governors of the Federal Reserve System. Fedwire Funds Service: Annual.

https://www.federalreserve.gov/paymentsystems/fedfunds_ann.htm

Watts, D. J., & Strogatz, S. H. (1998). Collective dynamics of ‘small-world’ networks. *Nature*, 393, 440–442.

[Article](#) [Google Scholar](#)

Young, J. (2017). Sweden officially started using blockchain to register land and

properties. *Coin Telegraph*. <https://cointelegraph.com/news/sweden-officially-started-using-blockchain-to-register-land-and-properties>

Author information

Authors and Affiliations

Purdue University, West Lafayette, IN, USA

Melanie Swan

Corresponding author

Correspondence to [Melanie Swan](#).

Editor information

Editors and Affiliations

Department of International Management, MODUL University Vienna, Vienna, Austria

Horst Treiblmaier

Head of European Blockchain Center, IT University of Copenhagen, Copenhagen, Denmark

Roman Beck

Rights and permissions

[Reprints and permissions](#)

Copyright information

© 2019 The Author(s)

About this chapter

Cite this chapter

Swan, M. (2019). Blockchain Economic Networks: Economic Network Theory—Systemic Risk and Blockchain Technology. In: Treiblmaier, H., Beck, R. (eds) Business Transformation through Blockchain. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-98911-2_1

[.RIS ↓](#) [.ENW ↓](#) [.BIB ↓](#)

DOI	Published	Publisher Name
https://doi.org/10.1007/978-3-319-98911-2_1	22 December 2018	Palgrave Macmillan, Cham
Print ISBN	Online ISBN	eBook Packages
978-3-319-98910-5	978-3-319-98911-2	Business and Management
		Business and Management (R0)

Publish with us

[Policies and ethics](#) 

Search

Search by keyword or author

Navigation

Find a journal

[Publish with us](#)

Track your research

