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

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## **Business Transformation through Blockchain**

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## 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-Sanchez 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.

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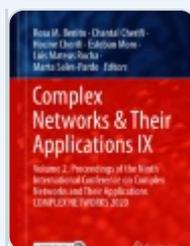
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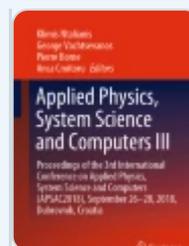
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## References

---

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

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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.

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 ppgrade 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 WP/10/107). International Monetary Fund. *SSRN Electronic Journal*, 10(107).

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

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.

[Google Scholar](#)

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*.

[Google Scholar](#)

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.

[Google Scholar](#)

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

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

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

[Google Scholar](#)

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

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

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).  
<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/](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).

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](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>

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