

“Distributed Ledgers:  
Innovation and Regulation in Financial Infrastructure and Payment Systems”

Robert M. Townsend\*  
Elizabeth & James Killian Professor of Economics  
Massachusetts Institute of Technology

Prepared for Presentation at  
Sveriges Riksbank, De Nederlandsche Bank, and Deutsche Bundesbank  
Annual Macprudential Conference  
Stockholm, Sweden  
June 16, 2018

Revised April 18, 2019

Abstract

Distributed ledgers have the potential to transform economic organization and financial structure. Yet the subject is embroiled in controversy, hype, and terminological inconsistencies. Rather than get waylaid by alternative possible definitions of distributed ledgers, or decentralized ledgers, we focus more broadly on an economic analysis of what distributed ledgers can do. We proceed by analyzing key individual components. We also compare and contrast the economics framework with the frameworks of computer science and data management disciplines, to clarify the technology.

The familiar but key component parts of distributed ledgers are: ledgers as financial accounts, e-messages and e-value transfers, cryptography, and contracts including multi-party mechanisms. Each component is discussed, evaluated, and illustrated through the context of historical and contemporary economies, with featured applications in both developed economies and emerging market countries. These use cases are a

---

\*Townsend gratefully acknowledges research support from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) (grant number R01 HD027638), the Centre for Economic Policy Research (CEPR) and the Department for International Development (DFID) under grant MRG002\_1255; and funding assistance for the continuation of the field surveys by the Thailand Research Fund, the Bank of Thailand and the University of Thai Chamber of Commerce. I also am grateful for the collaborations with the Federal Reserve Banks of New York, Boston, and Chicago; Velo for decentralized settlement banking network; and EvryNet for decentralized custodian banking network in Thailand. The views expressed are my own. Thank you to Ernst-Ludwig von Thadden, James McAndrews, discussants of this paper, and other participants at the Sveriges Riksbank Annual Macprudential Conference in June, 2017, participants at the “Kellogg Conference on Development Economics” conference at Northwestern University in September, 2018, participants at the “Cryptocurrencies and Blockchains” conference at the Becker Friedman Institute in November, 2018, participants at the First New York Fed Conference on FinTech, March 2019, participants at the Penn State Conference in Celebration of Neil Wallace’s Contribution to Economics, April, 2019, Daniel Aronoff, Neha Narula, Neil Wallace, Joshua Gans and Jesus Fernandez-Villaverde, for very helpful comments, and Jennifer Roche and Deborah Jamiol for wonderful editing. Thank you also for comments on preliminary drafts to: Marios Angeletos, Pablo Aznar, Zach Chao, Co-Pierre Georg, Michael Lee, Rhys Lindmark, Jacky Mallet, Antoine Martin and Nish Patel.

hallmark of the paper. A recurrent focus is the general equilibrium impact of innovations and welfare gains from innovations featuring key components. This does not require that all components be introduced at the same time.

Contract theory is used to derive optimal arrangements, constrained only by obstacles to trade, featuring how the various aspects of ledgers can deepen infrastructure. Mechanism design and monetary theory are used to study public versus partitioned ledgers and improvements in payment systems. Prudential regulation, rather than being a barrier to innovation, can be improved with the use of distributed ledger technologies.

The goal is to provide blueprints for the ex ante optimal design and regulation of financial systems, including not only choices at the end points of the spectrum, of centralized versus decentralized systems, as in the hype, but the choice of hybrid forms in between. Overall, the paper provides a vision for where we are heading, being clear about obstacles along the way.