Blockchains and the Boundaries of Self-Organized Economies: Predictions for the Future of Banking

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Abstract This chapter uses economic theory to explore the implications of blockchain technology on the future of banking. We apply an economic analysis of blockchains based on both new institutional economics and public choice economics. Our main focus is on the economics of why banks exist as organizations (rather than a world in which all financial transactions occurring in markets), and how banks are then impacted by technological change that affects transaction costs. Our core argument is that blockchains are more than just a new technology to be applied by banks, but rather compete with banks as organizations, enabling banking transactions to shift out of centralized hierarchical organizations and back into decentralized markets. Blockchains are a new institutional technology—because of how they affect transaction costs in financial markets—that will fundamentally re-order the governance of the production of banking services. We then explore this implication through broader political economy lens in which banking moves out of organizations and deeper into markets. We examine this as a form of institutional economic evolution in which the boundary of catallaxy—i.e., a self-organized economy—is enlarged, at the margin of the banking sector. Such institutional competition enables evolutionary discovery in the institutions of banking.

Keywords Blockchain · Bitcoin · Cryptocurrency · New Institutional Economics · Austrian Economics · Catallaxy

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1 Introduction

This chapter uses economic theory to explore the implications of the blockchain technology on the future of banking. We apply an economic analysis of blockchain based on both new institutional economics and public choice economics (Davidson et al. 2016). Our main focus is on the economics of why banks exist as organizations (rather than a world in which all financial transactions occurring in markets), and how banks are then impacted by technological change that affects transaction costs. Our core argument is that blockchains are more than just a new technology to be applied by banks in the same way that computers and the internet have driven significant improvements in banking technology. If we were to think about blockchains in this way—from the perspective as a new technology to be adopted and diffused—banks would more or less remain the same. Instead, we argue that blockchains compete with banks as organizations, enabling banking transactions to shift out of centralized hierarchical organizations and back into decentralized markets. Blockchains are a new institutional technology—because of how they affect transaction costs in financial markets—that will fundamentally re-order the governance of the production of banking services. The upshot is that while banking itself may not fundamentally change, banks might. Blockchains, we argue, will alter the boundaries of self-organization; the question is why, and how?

The second half of this chapter explores this implication through broader political economy lens in which banking moves out of organizations and deeper into markets. We examine this as a form of institutional economic evolution in which the boundary of catallaxy—i.e., a self-organized economy (Hayek 1960)—is enlarged, at the margin of the banking sector. As blockchain technologies work through banking—at the margins of measurement, monitoring, and new forms of automated governance (e.g. smart contracts and Distributed Autonomous Organizations)—they will enable a deeper process of institutional evolution to begin to unfold (MacDonald 2015b). The permisionless and non-territorial character of this unfolding 'secession' of banking transactions—from hierarchically organized banks to spontaneously organized blockchains—reduces institutional exit costs. Such institutional competition enables evolutionary discovery in the institutions of banking.

We proceed as follows. Section 1 outlines the basic economics of banks as organizations in the provision of banking services. We argue banks exist because of the transaction costs of using markets in coordinating the supply and demand for financial services. Section 2 introduces the new economics of blockchain, based on new institutional and public choice economics. This discussion is centered on transaction cost economics and the economics of governance more broadly. Section 3 ties these arguments together to derive a first principles economic analysis of the effect of blockchain technology on banking. Section 4 then explores broader political economy implications of the institutional orders of a market economy.

2 A Bank Is a Firm that Intermediates a Market

Banking, finance, and payments services are among the oldest of industries. These commercial services predate modern capitalism, even emerging before modern governments (Ferguson 2008; Hodgson 2015). Many of the functions that banks serve are necessarily familiar to us: the movement and production of capital (savings, finance), and the operation of the payments system (money). That banks, and the economic functions they perform, have existed for thousands of years, and in all parts of the world, at all stages of economic development, suggests a robust economic function. But what precisely is the robust economic function that banks provide; why do banks persistently exist?

Put simply, banks provide the specialized function of securely storing liquid capital. For effectively any storable fungible assets banks are able to utilize scale economies associated with providing this service. These scale economies would also suggest oligopoly or even monopoly provision in a particular geographical region; that is, centralization. Centralizing the excess supply of capital opens the possibility of creating a new market by lending this capital out to those with excess demand, such that banks becomes an internal capital markets.

The economic role of banks in a market economy, like firms more generally, is to internalize externalities; and in doing so they form subeconomies (Holmstrom 1999). Metaphorically, banks can be viewed as miniature economies: "islands" of command organization in a "sea" of spontaneous market exchanges (Coase 1937). Moreover, the island economies are complete with their own "rules of the game" (Buchanan 1990), over which individuals (as borrowers and savers) can choose to opt in or out. To complete the metaphor, the banking industry is not a centralized supercontinent but an archipelago, due to the value of exit rights as an incentive mechanism and tool to discipline the abuse of power.

It is clear, then, that beyond the physical storage of precious metals and other financial assets, a bank in this sense is a *centralized ledger* of transactions, whether of capital or payments, which records balances between many different parties. A bank, in the modern sense, is an internalized market: it is an organization that functions as a platform (a two-sided market, Rochet and Tirole 2003) to match those with excess supply of capital (savers) with those with excess demand for capital (borrowers). Banks intermediate two sides of a market. This intermediation is precisely what the recent wave of P2P finance endeavors to disrupt. By matching sellers of capital (those who would otherwise make deposits in a bank) with buyers of capital (those who would otherwise seek loans from banks) directly, the P2P finance directly threatens banks.

Let us return to the simple economic question with which we began: why do banks exist? That is, why are reallocations of financial capital, including payments, not entirely undertaken as decentralized market transactions in the form of a two-party system, rather than in the three-party system with banks as the third party intermediating agent? This is what P2P finance is trying to create, but it hasn't quite got there yet. From what we have established above, these questions are equivalent to enquiring into the value of a centralized ledger itself.

The basic scheme of answer to this, we propose, uses New Institutional Economics (NIE), also known as Transaction Cost Economics (TCE) . This area of economics follows Nobel Laureate Ronald Coase (1937) who first explained the existence of firms in consequence of the transaction costs of using a market. For someone with a surplus of capital, the transaction costs of participating in a financial market would usually be prohibitively expensive. To find a borrower, write a contract, monitor the exchange, and enforce that contract would quite simply require huge amounts of capital, time and expertise. The owner of the surplus capital would also be sacrificing liquidity. A symmetric problem similarly exists for the demander; how does a borrower find a potential supplier that meets their idiosyncratic terms? Without banks many of these mutually welfare-enhancing exchanges would simply never take place.

This is a two-sided matching problem (Roth and Sotomayor 1992) that is greatly facilitated by the existence of a specialized third-party acting as both a focal point and aggregator to transform otherwise highly heterogeneous agents into liquid capital markets. Banks achieve this through capital pooling, through aggregation and disaggregation, information pooling, economies in monitoring, creating submarkets with different risk-reward profiles, through various specializations in writing and enforcing contracts, and bundling financial services. Banks create and harness reputational incentive mechanisms that enable them to enforce contracts at lower cost than could distributed agents because of their ability to exclude defaulting borrowers from subsequent access to finance. A third party also enables coordination across geographic regions through networks through economies of scale, as well as bundling together different types of financial services through economies of scope.

In sum, banks exist as third-party intermediating organizations because there are substantial costs—physical costs, information costs, coordination costs—with using the market to match the supply of and demand for financial assets (Earl and Dow 1982). Financial intermediaries such as banks have been the method for solving this problem for many centuries. Banks have been comparatively economic efficient, so to speak. The entrance of blockchains as crypto-secured distributed ledgers, however, disrupts these basic transaction costs of the market for financial assets. This then affects the economic logic and efficiency margins of banks, whose entire logic of existence derives from their comparative economic efficiency compared to markets. What, then, are the specific transaction costs margins at which blockchains will impact upon banks? This will be the subject of Sects. 2 and 3.

3 New Economics of Blockchain

3.1 Blockchain as a New General Purpose Technology

A blockchain is a public decentralized ledger platform (Evans 2014; Swan 2015; Walport 2016). As a specific technology for digital currencies, the blockchain is a technical solution to the double-spending problem (what in computer science is called the ‘Byzantine General’s problem’) that hither-to had defeated all endeavors to create a non-centralized peer-to-peer electronic cash system (Dourado and Brito 2014). The blockchain solves this problem using a decentralized database (or ledger) with network-enforced processes that are based on a proof-of-work consensus mechanism for updating the database (Nakamoto 2008; Franco 2014).

The blockchain is best decoupled from its connection to Bitcoin because the economic value and disruptive potential of blockchain does not depend upon the value and prospect of Bitcoin (Buterin 2015). Blockchains are better understood as a new ‘general purpose technology’ (Bresnahan and Trajtenberg 1995; Lipsey et al. 2005) in the form of a highly transparent, resilient and efficient distributed public ledger (i.e., decentralized database). The general purpose technology is the blockchain and the many applications stemming from this invention are specific innovations (Pilkington 2016). The entrepreneurial problem of the blockchain is to discover such market applications (Allen 2016), which is a considerable challenge involving concurrent *institutional* innovations (i.e., in governance). This is because in principle such a distributed ledger can be applied to disrupt *any* centralized system that coordinates valuable information (Wright and De Filippi 2015; He et al. 2016; Walport 2016).

Ledgers are a very old technology. By the late twentieth century they have been digitized, but until invention of blockchain in 2008, they always remained centralized. The ledger is a technology of accounting, of keeping track of who owns what, and is instrumental to modern capitalism (Nussbaum 1933; Allen 2011; Hodgson 2015). But so too is trust in the ledger, which is most effective when it is centralized and strong, and so centralized ledgers for property titling, contracts, money, and so on, are also critical in connecting government to modern capitalism.

Centralized solutions are expensive and have many problems, particularly in relation to problems of trust and its abuse. Yet until very recently no effective decentralized solution has existed. In contrast, the blockchain technology is *trustless*, meaning that it does not require third party verification (i.e., trust), but instead uses a powerful consensus mechanism with cryptoeconomic incentives to verify authenticity of a transaction in the database. These properties also make blockchains safe. Security is maintained even in the presence of powerful or hostile third parties. In a recent lead article on blockchain—which they dubbed ‘The trust machine’—*The Economist* (2015) explained that:

> “Ledgers that no longer need to be maintained by a company—or a government—may in time spur new changes in how companies and governments work, in what is expected of them and in what can be done without them.”

There are many ways to think about the basic economics of blockchains. One method centers on why decentralized solutions to ledgers, now technically possible, are likely to become increasingly cost effective compared to centralized solutions. Along this line we could model the economics of blockchain as a new technology that is rapidly running down a learning curve, or equivalently as a technology cost curve rapidly falling, such that it becomes increasingly competitive against the mature technology of a centralized ledger, driving technological substitution. The innovation-adoption approach, for instance, underpins the study of cryptocurrencies from the perspective of modern monetary theory that recognizes the competitive efficiencies of private currencies (Böhme et al. 2015; Dwyer 2015; White 2015a; Luther 2015).

Another method views the economics of blockchain as an entrepreneur-driven technological competition, which is often met with political response (Olson 1965, 1982). Here we would expect that although centralized ledgers may not always be able to compete on cost, they can still compete through co-option of force, through enacting legislation or regulation to artificially drive up the cost of decentralized technologies (Hendrickson et al. 2015). As a new technology, the blockchain is in the early disruptive phase of the Schumpeterian process of 'creative destruction' (1942). Buterin (2015) argues that there is no 'killer app' for blockchain, just as there was not for open source, but rather a long tail of marginal use cases among particular groups, adding up to a lot. This diffusion trajectory will unfold as sequential applications are discovered and adopted along an entrepreneur-led market process of industrial dynamics in the adoption and diffusion of the new blockchain technology. But we propose a new view to the economics of blockchain: blockchain is an institutional governance technology of decentralization.

3.2 *Blockchain as a Technology of Decentralization, like a Market*

Blockchains are fundamentally a technology of decentralization. This suggests a different approach to the economics of blockchain, focusing on the economics of decentralized systems.

Open decentralized systems are centered on an evolutionary argument about *dynamic efficiency*. Evolving complex systems tend to develop from centralization to decentralization. Systems begin with centralization because this is the most efficient structure to create, establish and enforce rules, i.e., to create knowledge structures. This minimizes duplication and establishes clear hierarchy, and can adjudicate disputes. But those very features mean that centralization has costs that begin to accumulate as these powers become vulnerable to exploitation. In economic systems, this manifests as inflation, corruption, and rent seeking. Eventually, adaptation and differential selection drives such systems toward decentralization because the costs of centralization rise along the path of exploitation, while at the same time the costs of decentralization fall, often due to technological progress. Centralization brings order, but this order can be brittle, and adaptation toward decentralization begins to make the system more robust, flexible, secure and efficient.

The most general technological service blockchains perform is that they decentralize. They are a technology that pushes the governance of economic activity away from centralized organizations and toward decentralized markets. That is, blockchains can be conceptually be placed alongside markets, as an open platform technology (i.e., rule system) that performs this general service of decentralization (Potts 2001).

3.3 The Transaction Cost Approach to Blockchain

Blockchains are best understood as a new institutional technology that makes possible new types of contracts and organizations. Viewed through the lens of transaction cost economics, organizations and markets are alternative economic institutions for economic coordination—i.e., for organizing and governing transactions—and therefore the efficient mix of institutions in an economy will emerge as agents economize on transaction costs. Economizing on transaction costs leads to an efficient institutional structure of economic organization and governance.

In the economic theory of efficient governance (Williamson 1979, 1985), bounded rationality implies that contracts will be incomplete, while asset specific (idiosyncratic) investments bring the threat of opportunism. Quasi-rents due to investments in specific assets, where the value of those investments depends upon equally specific investments by others, creates *ex post* hazards of opportunism. That is, one party can exploit another through hold-up or bargaining after investments have already been made. These transactions costs can be economized through the use of efficient governance structures.

So why do some transactions occur in firms (hierarchies) rather than in markets? Put simply, different governance structures deal with different economic problems in different ways. Because of uncertainty, asset specificity and associated opportunism, and frequency of dealings, some transactions are more efficiently conducted in hierarchies rather than markets. For instance, markets are often efficient governance institutions for spot contracts (a pure exchange economy). In other scenarios, where economic activity requires coordinated investment through time (due to asset specificity), or an ongoing relation between parties (due to frequency), or involves uncontractable dealings (due to uncertainty), alternative governance institutions such as firms or relational contracting can be efficient ways to economize on transaction costs.

The boundary between the firm and the markets—i.e., which transaction occurs under what governance structures—is some function of the transaction costs and characteristics of different governance institutions. What, then, is this transaction cost economics logic applied to blockchains? The relevant question then is why do (or might) some transactions occur in blockchains, rather than in firms or markets?

3.4 A Blockchain Is a Catallaxy

Once we see blockchains as alternative governance institutions—alongside firms, markets and relational contracting—it is a short step from there to see that by adding a few more operational features—constitutions or foundational governing rules (Hayek 1960; Buchanan 1990), collective decision-making rules and procedures (Buchanan and Tullock 1962; Ostrom 1990), and private money (Hayek 1978)—blockchains appear as a technology for making economies. That is, a blockchain creates a self-organizing and constitutionally ordered catallaxy, or what MacDonald (2015c) has labeled a 'constellaxy'.

In this new view blockchains are not organizations; blockchains are spontaneous organizations which compete with organizations. But blockchains aren't markets, either. Blockchains have market-like properties, but their role is to facilitate transactions, not (just) exchange. Fundamentally blockchains coordinate a distributed group of people, making them actually closer to being an economy.

F. A. Hayek was a pioneer of the study of decentralized economies and distributed information processing. He defined an *economy* as an organization or an arrangement in which someone conspicuously uses means in the service of a uniform hierarchy of ends. Hayek's point was to distinguish the concept of an economy from the spontaneous order brought by the market—for which he preferred the term catallaxy. For Hayek,

> "a catallaxy is a special kind of spontaneous order produced by the market by people acting within the rules of the law of property, tort and contract" (1982: 269).

From the Hayekian perspective then, blockchains are actually catallaxies, not economies, for they serve not one particular end "but contribute to the realization of a number of individual objectives which no one knows in their totality". A catallaxy is characterized by a multitude of agents living within an 'extended order' (Hayek 1988). Blockchains are 'orders of economies' in the same way a market order is a catallaxy of mutually adjusting individual plans (economies). The first remarkable property of emergent economies built on blockchains is that they are non-territorially unbundled (MacDonald 2015d). Second, the price system in Hayek's conception operates at the level of a system of markets, as in a region or nation, but a further surprising property of blockchains is that they provide a mechanism to radically *reduce* the size and scale of effective catallaxies.

4 What the Economics of Blockchains Implies for Banking

We can now furnish some broad outlines based upon economic theory—or what are sometimes called 'pattern predictions' (Hayek 1964, 1989)—about the future of how blockchains might develop in banking. Above, we identified the relevant theory as the economics of technological dynamics, new institutional economics, and public choice economics. Our aim here should not in any way be taken to be equivalent or even comparable to specific identification of entrepreneurial opportunities from blockchains, nor do we seek to outline specific risks arising from their adoption (Tasca 2015). We do not wish to be seen to underestimate the immense entrepreneurial problem underpinning the discovery of applicable opportunities for blockchains (Allen 2016) or the potentially immense societal impacts from systemic diffusion of the technology (Atzori 2015; MacDonald 2015a). Rather, our framing is limited to: how could blockchain technology impact the economic organization of banking, and what are the relevant economic models to use in order to think about this problem?

The first clear point we sought to highlight was to challenge the otherwise seemingly compelling notion that blockchain is simply a new ICT-like technology that will be adopted into banks, thus improving the competitive efficiency of banks that adopt this technology, and harming the competitive position of banks that are slower to adopt (Chuen 2015). The model for understanding this would be, say, adoption of other general purpose banking technologies such as debit cards, ATMs or internet banking. This is a dominant thesis at the time of writing among banks who view this as a way to improve back-office efficiency in clearing transactions (for example consortiums such as Ripple). This, however, may be a mischaracterization of the nature of the blockchain technology.

What type of technology is a blockchain? As a new technology of decentralization, blockchains can then be understood to be a new competitor to the central objects that economics studies: markets. When coupled with token systems, blockchains seem to describe institutional orders that we might reasonably call an economy, or following Hayek (1960), a catallaxy. A blockchain is in this sense an unusual technology in that while manifestly an information and computation technology (an ICT)—viz. a blockchain is a new technology for public databases of digital information—blockchains are actually better understood as an institutional or social technology for coordinating people.

What, then, is the margin of competition for blockchains? As a new general purpose technology, there is a great deal of interest in the way in which existing firms and industries will adopt and use blockchains. This includes consortium and private blockchains, where restricted access protocols are used instead of trustless cryptoeconomic incentives. But the question we have sought to focus on here, through the lens of transaction cost economics, is not how firms and markets will adopt and use blockchains, but rather how blockchains will compete with firms and markets.

By adopting the Coase and Williamson perspective in which firms, markets, relational contracts, and now also blockchains, are alternative governance institutions—whose relative efficiency is determined by micro-institutional transaction cost considerations—we can understand how blockchains compete with banks, rather than being viewed as a technology adopted by banks. This is only visible when we view the basic analytic unit of blockchain economics as the transaction (i.e., the executable contract). This is the fullest expression of blockchains not as a new informational and communications technology, but as a new institutional technology.

Blockchains, as a new institutional technology, are a cryptoeconomic mechanism through which individuals can govern the difficulties inherent in transacting. There is one particular transaction difficulty that has long been dealt with through a hierarchical organization: opportunism. The presence of opportunism in many transactions makes hierarchies and relational contracting more transaction cost efficient mechanisms of governance. But blockchains look to have changed these comparative governance efficiencies—particularly through smart contracts and DAOs (Buterin 2014a, b)—by eliminating opportunism. Therefore blockchains, as institutional technologies, undermine the strong case for the economic efficiency of hierarchies (which exploits incomplete contracts) and relational contracting (which requires trust between parties) over markets. Where blockchains can eliminate opportunism they will, at least theoretically, outcompete traditional organizational hierarchies and relational contracts.

5 The New Political Economy of Blockchain

5.1 Cryptosecession to Blockchain Economies

Because blockchain is a new institutional governance technology, agents must decide whether to remain within the structures of markets and hierarchies, or secede to the new institutions of decentralization. As such, MacDonald (2015a), building on the foundational work of Buchanan and Faith (1987), explains how the interplay between blockchain technology and hierarchical institutions may lead to a political-economic rupture called 'cryptosecession'. The mechanism of cryptosecession—partial, non-territorial, and permissionless exit from incumbent institutions—enables us to build a new political economy of blockchains, which is the task of this section (cf. Kostakis and Giotitsas 2014).

Blockchains are fundamentally a mechanism of cryptosecession, where agents can escape the now less than optimal mechanisms of banking and money. Cryptosecession has so far been applied to the fiscal process, with similar domain claims possible about cryptolaw (De Filippi 2014; Wright and De Filippi 2015), cryptomoney (Hayek 1978; White 2015), and cryptofinance (Harvey 2015; Scott 2016).

The immediate implication of cryptosecession is that the *overtaxing proclivities* of governments must be severely curtailed, such that fiscal exploitation is reduced and eventually eliminated as the capability of citizens to cryptosecede increases and becomes absolute. That is, the balance of citizen opacity and government legibility —which is a function of the development of cryptographic and blockchain technologies—determines the balance of fiscal exploitation versus equivalence.

For cryptolaw the implication becomes that the *overregulating proclivities* of government must be curtailed (De Filippi 2014), such that the level of 'optimally exploitative' regulation (Stigler 1971; Peltzman 1976) must be reduced in respect of the capabilities of entrepreneurs and businesses operating on the cryptosecession frontier. This all depends on the viability of secession from the 'physical' jurisdiction of governments. Seceding from this physical jurisdiction, however, may be limited in certain entrepreneurial contexts. An example of successful cryptosecession from incumbent regulatory institutions, ironically, is the very development of cryptographic and blockchain technologies and applications. Notwithstanding, crypto and blockchain innovation is beginning to attract the attention of regulatory authorities (De Filippi 2014; Brito 2015; Peters et al. 2015). But the basic mechanism remains: to the extent that entrepreneurial activity can be excised from the regulatory reach of the state, via cryptographic blockchain technologies, regulatory capture will be diminished.

For cryptomoney the hierarchical institution is the central bank (and fiat money) and their interest rate manipulation, inflation, and currency debasement (White 1999; Hayek and White 2007; White 2015). Seen in this light, cryptocurrencies are actually a vehicle of monetary cryptosecession. Their primary purpose is not to emulate some definitive and optimally efficient monetary setting, but rather to permit citizens to escape the circumstances of 'optimal monetary exploitation' (in which certain individuals and businesses are advantaged by monetary policy settings at the expense of others) if even for only marginally improved institutions. Accordingly, as monetary cryptosecession becomes more potent an intensifying competitive dynamic between the incumbent institution (central banks) and potential competitors (bitcoin and other cryptocurrencies) should see the parameters of monetary policy shifted in the direction of 'sound money'. Again, much like fiscal cryptosecession, this is limited by the development of cryptocurrencies; i.e., their position on the spectrum of opacity-legibility (which is relatively high) but also by the extent of the market for cryptocurrencies (which is still trivially small) (White 2015; MacDonald 2015a).

The political economy of blockchains also applies in the banking and finance industries. That is to say the cryposecession dynamic threatens not only incumbent hierarchical institutions of government, but also legacy banking and financial organizations and markets. Blockchains seem apt to outcompete banks (as hierarchical organizations) and relational market contracting (as trust requiring transactions), which are both prone to opportunism. When banks and peer-to-peer finance (*sans* blockchains) succumb to this shortcoming there is essentially a redistribution of value from one party to another, which is analogous to the cases of fiscal, regulatory, and monetary predation outlined above. Thus in the political economy perspective the blockchain imperative derives not *only* from a drive to economy-wide efficiency as a recalibration of the institutions in which banking and finance take place. There is also a game-theoretic logic at play here, in which it is individually rational for those currently or potentially harmed by opportunism to secede to blockchains (if only to unwind predation and even in a zero-sum context). Again, this is limited by the extent of the market for cryptofinanceand the development of its technology.

5.2 *Blockchains and Institutional Exit Costs*

We can also examine the ability of individuals to exit their current institutional environment using blockchains. In this view, what blockchains really do, and what we argue in this section, is radically reduce institutional exit costs. There are two main ways blockchains reduce exit costs. The first is through reducing the *transition costs* because of their *permissionless nature* (Thierer 2014). That is, blockchains drastically reduce the cost of moving from one institution to another, especially in relation to state-imposed barriers. The second is through reducing the *opportunity costs* because of their *non-territorial nature*. That is, because blockchains operate through the non-territorial internet, they enable agents to *partially exit* their current institutions. Combining these two cost reductions we conclude that blockchains significantly ease individuals' institutional exit to the cryptoeconomy.

The transition from one institutional setup to another—say from banking organizations within financial markets to a blockchain-based financial system—does not occur in costless meta-institutions (Pagano and Vatiero 2015). Quite apart from the distribution of transaction costs within competing setups, we cannot theorise a frictionless transitional process between institutions. The process is better thought of as subject to a kind of meta-institutional *transition cost*. These are equivalent to mobility costs in the jurisdictional arbitrage setting.

States (governments) are the main arbiters of such institutional transition costs. If states intervene in decisions to switch between institutions—say by either inhibiting with regulation or outright prohibiting the use of blockchain and cryptographic technology—then exit costs will be higher. This might happen because states themselves wish to regulate or deter the exit to new institutions, for whatever reason, or at the behest of vested interests (e.g. banking industry).

By 'permissionless exit' we mean that there is no additional cost on top of the meta-institutional transition cost such (e.g. a manipulated component; Twight 2004) as would affect the transition to blockchains at the margin. The strong-form claim often made is that due to the cryptographic nature of blockchain technology it is resistant to state intervention and regulation, and is thus 'permissionless' per definition.

Aside from transition costs, we must also consider how complementary institutions affect their costs (Pagano and Vatiero 2015). When choosing between institutional setups one must consider *opportunity costs*. Only when we think about opportunity costs does the non-territorial nature of blockchain economies become important. In territorial systems the opportunity costs relate to the sacrifice of benefits of seceding from one geographical location to another.

Blockchain economies are coordinated via the internet, which is fundamentally a non-territorial space. Individuals need not sacrifice the benefits of conducting economic activities in particular locations. They can *partially* exit from, say, the banking system of their current locale without having to physically move to the location or jurisdiction of the banking system they prefer. The opportunity costs of institutional arbitrage are small, converging on zero. Institutions follow the individual, not the other way around. And they do so in a piecemeal or unbundled fashion. Essentially this is the hyper-realization of globalization achieved through ICT technology, and further accentuated by blockchain technology.

Cryptographic blockchain technology reduces institutional exit costs through the permissionless and non-territorial character of the institutional change it engenders.

This depends on two things: (1) blockchain technology is needed to create viable exit options; while (2) cryptographic technology is needed to keep those exit options open. First, the viability of exit is defined as the scope of and extent to which economic activity can be dissociated from legacy institutions and migrated to blockchain institutions. Clearly exit cannot proceed (permissionless or otherwise) for those activities for which there are no competing blockchain institutional options available. Similarly, because blockchain economies are coordinated via the internet (which is a non-territorial space) exit can be deterritorialized only to the extent that activity can be migrated to blockchain institutions. Second, the viability of exit depends on the extent to which cryptographic exit can create a genuine veil of opacity between transactions and states (e.g. a veil between polity and economy). If this is the case then exit will be permissionless in the sense that governments cannot intervene (e.g. neither in the creation of parallel institutions or choice to exit to them), and non-territorial because state borders will no longer demarcate transactions.

5.3 Blockchains and Institutional Evolution

The upshot of radically reduced institutional exit costs is greater competition; not between organizations, markets, and institutions *within* the banking industry, but between these incumbents and new blockchain based ones. Competition as an evolutionary, knowledge-generating process is a central idea in both Austrian and evolutionary economics (Hayek 1948; Vihanto 1992; Wohlgemuth 2008). Thus the emergence of blockchains has stimulated a kind of meta-intuitional evolution, and this elicits a knowledge-generating discovery process at the level of orders of economies. With the advent of blockchains we stand to discover which institution best governs financial transactions: markets, firms, or blockchains?

Evolutionary theory tells us that the strength of the variation and selection mechanisms—that is, the number of parallel experiments and the ease of citizen exit respectively—determine the rate of institutional evolution. Through this lens we can hypothesise that the mechanism of cryptosecession will intensify discovery processes by accelerating the rate of intuitional evolution. This is because both the selection mechanism (exit of people) and the source of variation (entrepreneurial conjectures) are permissionless and thus heightened. Low switching costs (permissionless exit) strengthen the selection mechanism, while low barriers to entry (permissionless innovation) means a more vibrant source of variation.

Parallel experimentation is a fundamental dynamic efficiency scheme to enhance and accelerate variation, innovation, and evolution (Ellerman 2014). Due to the non-territorial character of blockchains there can be multiple orders of economies tested at a time—i.e., both legacy banking and new cryptobanking at once—a laboratory of parallel experimentation *par excellence*. In much the same way that territorially decentralized intuitional experimentation is conceptualized as 'laboratory federalism', MacDonald (2015d) describes the theory of the discovery process through non-territorial institutional competition—as per emergent economies built on blockchains—as ‘laboratory panarchism.’ The final analysis of the political economy of blockchains can therefore by labeled ‘evotopian’ (Hodgson 1999): blockchains cultivate an evolutionary learning process that will coordinate the discovery of improved institutions for governing banking transactions.

6 Conclusion

There are two basic economic lenses through which to view the economics of blockchain. The first is to view the economics of the adoption and diffusion of the blockchain as powerful new *ICT technology*. Such a technology-based approach is currently the default perspective in the finance and banking sector, viewing blockchain as a new technology that will be adopted differentially by some banks, leading to a further round of technological competition in the banking sector. The conclusion to this view is to expect the same market process as we have seen with other technologies: some banks will adapt and prosper, others will lag and collapse. Their success will depend on their strategic choices and uses of this new technology to drive productivity and competitive efficiency.

But there is also a second economic perspective, focusing not on technology, but on governance. This view based on economic reasoning, begins by asking what type of technology is blockchain. The answer to that question, we have argued in this chapter, is that blockchain is fundamentally a technology of decentralization and is therefore better understood as a new *institutional technology* for coordinating people—i.e., for making economic transactions—which then competes with firms and markets. This path seeks to understand what economic transactions currently occurring in firms or markets will shift to blockchains.

The new institutional economics and public choice economics of blockchains emphasize disintermediation and decentralization. In a world of blockchains the functions and operations of banking may not change, but the economic organization of banking may shift significantly. In this view, it is banks that will experience fundamental shifts in their organizational boundaries, with many transactions currently governed through hierarchy, relational contracting or market transactions shifting to the blockchain as an outworking of economic efficiency over transaction costs.

Blockchain is a technology for internal exit from incumbent institutions. Simultaneously it is a technology for the creation of new institutions. The upshot of this is emergent economies built on blockchains. This is a political-economic rupture and bifurcation in which an incumbent institutional order precipitates a constellaxy—a constitutionally ordered catallaxy. The relevance of the development of blockchains for banking is that it has shifted the boundary between hierarchical banking organizations and non-territorial, spontaneously ordered, self-organizing economies. This transition suggests the future of banking will be conducted in more evolvable and dynamically efficient institutions of governance.

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