Chapter 1

Blockchain Economic Theory: Digital Asset Contracting Reduces Debt and Risk

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Abstract

Disparate aspects of the emerging Blockchain Economics paradigm have been discussed, particularly cryptotokens and Initial Coin Offerings (ICOs), however, a comprehensive picture of the greater economic transformation unfolding with blockchain technology has not yet been articulated. This chapter proposes a Blockchain Economic Theory of Digital Asset Contracting as an explanatory model. The central argument is that blockchain-registered digital assets can be transacted instantaneously and pledged in new ways. This advance is leading to new modes of contracting (smart contracts) and new forms of money (cryptotokens), which in turn facilitate new structures of financial interaction. Distributed ledgers and blockchain-based structures might be applied to structural economic problems such as debt, systemic risk, technological job outsourcing, entitlements overhang, healthcare cost-outcome disconnects, and financial inclusion. A key innovation is Payment Channels, which enable the use of capital on a net rather than a gross basis, which might eventually lead to a restructuring of debt burdens.

1.1 Introduction

While not a panacea, one litmus test for blockchain technology could be the extent to which it might be used to address structural economic problems. Existing challenges include debt, systemic risk, an orderly transition to the automation economy (technological job outsourcing [Swan, 2017a]), entitlements overhang, a disconnect between healthcare costs and outcomes, and financial inclusion. Table 1 enumerates outstanding economic challenges and potential solutions using blockchain technology. This chapter discusses the challenges and solutions in the form of a causal model.

Table 1. Economic Challenges and Potential Blockchain-based Solutions.

	Economic Challenge	**Blockchain-based Solution**
1	Debt	Net Settlement • Payment Channels • Securities as a Service
2	Systemic Risk	Programmable Risk • Real-time Balance Sheets • Black Swan Smart Contracts
3	Automation Economy	Future of Work • Maslow Self-development Smart Contracts • Shared ownership in automated means of production
4	Entitlements Overhang	Smart Contract Futures (Inflation-protected) • Contractual link of current earnings to future payout • Securities as a Service
5	Healthcare Outcomes	Blockchain Health Economics • Global Healthcare Equivalency Units (quantified outcome tracking) • Digital ID, smart contract consent, interoperable data
6	Financial Inclusion	eWallet Banking Serivces • Officially-recognized Digital ID Credentials • Open Source Credit Bureaus

1.2 Blockchain Economic Theory: Digital Asset Contracting

A Blockchain Economic Theory of Digital Asset Contracting is proposed. The theory presents the distinguishing features of the emerging Blockchain Economics paradigm in the form of a causal model to explain the relationships between the elements (Figure 1). The premise is that blockchain-registered digital assets lead to new modes of contracting and new forms of money, which facilitate new structures of financial interaction. Framed more formally, the hypothesis is that the dependent variable (structures of financial interaction), is influenced by the independent variable (blockchain-registered digital assets), and further affected by the moderating variables (modes of contracting and forms of money).

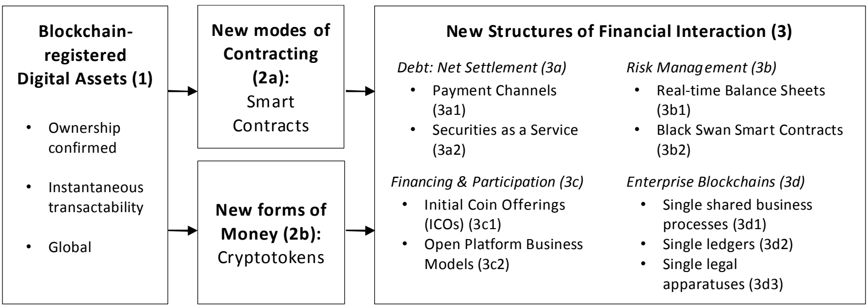

Figure 1. Blockchain economic theory of digital asset contracting.

Outlining the model in detail, blockchain-registered digital assets (1) have the novel functionality that asset ownership is already confirmed, which means that they can be transacted instantaneously, on a global basis. Digitally-registered assets can therefore be pledged in new ways which leads to new modes of contractual relationships between parties (smart contracts) (2a) and new forms of money (cryptotokens) (2b). New modes of contracting and new forms of money facilitate new structures of financial interaction (3). Regarding debt (3a), there is the possibility that capital might be engaged on a net rather than a gross basis with vehicles such as Payment Channels (3a1) and Securities as a Service (3a2). Risk management (3b) could be enhanced with Real-time Balance Sheets (3b1) and programmable risk Black Swan Smart Contracts (3b2). Cryptotokens lead to new modes of financing and participation (3c) such as Initial Coin Offerings (ICOs) (3c1) and participative Open Platform Business Models (3c2). Enterprise Blockchains (3d) configure the possibility of single shared business processes, ledgers, and legal apparatuses (3d1-3). Decentralized methods of contracting and economic orchestration are an extension of digital models more generally. Already with the widespread implementation of the Internet, regulators realized the evolutionary implications of digital network technologies for central banking, including global settlement, and a much smaller institutional footprint and control apparatus for monetary transfer [King, 1999; Ize *et al.*, 1999].

1.3 Blockchain-Registered Digital Assets (1)

Distributed ledgers mean that assets (both physical and digital) can be registered to blockchains for confirmation, control, and transfer. Enforcement mechanisms for connecting physical assets to electronic transfer are non-trivial [Dupont, 2017; Nelson, 2017], but not discussed here. For economic theory, the point is that blockchain-registered digital assets have a heightened mode of exchange. Assets exist in a state of readiness for transfer with the ownership of the asset and the identity of the owner pre-confirmed. Blockchain-based assets should be understood as having the property of being instantaneously transferable, including per digital contractual arrangements. A variety of digitally-enabled and automated transfer mechanisms are made possible. The network-confirmed ownership is the salient mechanism for how parties who do not know each other can nevertheless become contractually obligated. A bank or lawyer is not needed as an intermediary; the network software instantiates the contractual relationship for the peer-to-peer transaction. The principles of the instantaneous digital transferability of assets and the real-time confirmability of identity credentials enable new modes of contracting between parties (2a) and new forms of money (2b).

1.4 New Modes of Contracting: Smart Contracts (2a)

To be legally binding, a contract typically has four elements: two or more parties to the contract, financial consideration, and terms. A *smart contract* is a contract registered to a blockchain, including for some portion of its execution to be automated [Swan, 2015]. For example, the interest rate on a floating-rate mortgage is reset on a monthly basis. Resets are orchestrated digitally at present, and could be further automated with greater transparency with blockchain-based lookup processes using *oracles* (independent data providers). The interest rate reset might be a standard smart contract process calculating the rate as Libor + 150 basis points (1.5%). Blockchain technology might start to be used to coordinate both the initial asset registration and transfer process, as well as the ongoing execution of financial contracts. The implication is that the economy could become increasingly digitally operated. Electronic signatures and digital contracts are legally binding in many geographical domains, enforced in the U.S. through the E-Sign Act (2000) [Stern, 2001] and globally with the UN's Model Law on Electronic Commerce [1996]. The future incarnation of digital contracts could be blockchain-based smart contracts.

1.5 New Forms of Money: Cryptotokens (2b)

Cryptotokens constitute a new kind of money. Conceptually, cryptotokens are "money +" in that they confer the usual functions of money plus additional community participation features. The three tradition functions of money are serving as a medium of exchange, a store of value, and a unit of account. Cryptotokens are a new form of digital money, which have these standard aspects together with additional functions. Definitionally, *cryptotokens* represent a particular fungible and tradable asset that is found on a blockchain ledger [Investopedia, 2018a]. *Digital tokenization* is the process of creating cryptotokens by turning an asset, right, or good (digital or physical) into a tradable unit, and instantiating the asset on a blockchain for its exchange. Cryptotokens are a more complicated and feature-rich form of money that is also a tool for enabling participants to undertake more actions within an economic community, in particular, to earn money, access resources, and vote on decisions.

Cryptotokens could inaugurate a new phase for how individuals expect to interact with Internet-based communities. In blockchain communities, the expectation may be to have both economic and governance participation. The Ethereum project District0x is an example of such a community. A key incentive for users to join a crypto community could be that there is economic participation in terms of an accounting system that tracks and rewards contributions, and a voice in community governance through voting, decision-making, and the ability to propose and discuss initiatives. Rewards for contributions could include earning royalties whenever user-created content is used (e.g. software code, music, art). Community members could likewise pay to access community resources (e.g. content, file storage).

Table 2. User Participation Expectations in Internet-based Communities.

Information Internet 1990-2005	**Social Internet (Web 2.0)** 2005-Present	**Token Internet** 2017-Present
Static information	Engage with dynamic content: like, share, comment, mash-up	Meaningful participation in the economic community: earn money, access resources, vote on decisions

Table 2 considers the evolution of user expectations when engaging with web communities. Initially, websites presented static information, and there was no possibility of interaction. Then, with the social web, users started expecting to be able to "like," comment, share, and interact with dynamic content and other community members [O'Reilly, 2005]. Now in a third phase, what it means to be a token project is to engender the notion of a participative economic community. Tokens are a means of providing remuneration to those who participate in the community and add value. A greater vesting of responsibility and intensity of community participation is enabled, literally allowing members to "put their money where their mouth is" (i.e. contribute economic resources to areas of concern). This is precisely the greater economic and political self-definition that Kant calls for in *What is Enlightenment?* [1794]. Blockchains enable us to rethink who we are as subjects, configuring the sensibility of the *cryptocitizen* as one who thinks freely from the dictates of authority [Swan, 2018b].

1.6 New Structures of Financial Interaction (3)

1.6.1 *Debt: Net Engagement of Capital (3a)*

Traditionally, capital has been engaged at the gross, not the net level. *Net settlement* is a settlement system between parties in which transactions are accumulated and offset against each other, with only the net difference transferred. Most national and international banking and payments systems, however, operate on a real-time gross settlement (RTGS) basis. Significant financial operations also engage capital at the gross level, for example fundraising. A municipality building a bridge borrows the whole amount needed in an Industrial Development Bond (IDB) (Figure 2). However, with digitally-registered blockchain assets, new kinds of arrangements might be possible to engage capital on a net basis [Swan, 2017b]. The economic question is to what extent public sector activity might be instantiated in distributed ledgers. The public sector currently comprises 15% of OECD economies federally [Baddock *et al.*, 2015], plus 14.2% at the state level in the U.S. [Frohlich and Kent, 2015]. Overly large public sectors have been shown to hamper growth [Olson, 1999].

Smart contracts might be employed to address the time lag between current and future cash flows such that capital could be pledged and transferred in smaller more regular payments. In the bridge example, smart contracts could match expected tax receipts with cost outlays for the bridge construction. In principle, a bond offering might not be necessary with directed tax receipts. Smart contracts could transfer weekly tax receipts from constituents to contractor construction expenses. In a more efficient system, real-time finance could be a possibility. Blockchain-based contractual structures might enable capital to be utilized more effectively. One benefit could be offering an alternative to the monolithic structure of debt, a problem affecting sovereign states [Zumbrun, 2017; Frewen, 2010], institutions [Choudhry *et al*., 2014], and individuals [Sweet *et al*., 2013] alike.

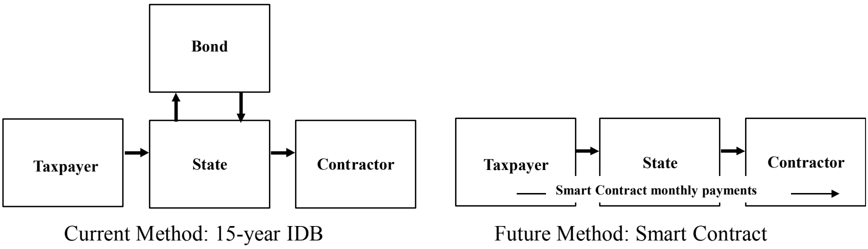

Figure 2. Structure of municipal finance: bonds could become smart contract pledges.

Net settlement is not a new concept. Before central banking, there was an historical precedent for net settlement amongst parties and free banking systems (meaning a plurality of banks each issuing their own notes). Societies with more equitable distributions of power were more likely to have net-settled systems. Notable examples include Canada (1800-1935), Sweden (1831-1902), and the Fukien province in China (1644-1911) [Selgin, 1988, pp. 7-15]. White describes English and Scottish free banking (1716-1845), particularly in the linen industry, where trust and a diversity of IOU instruments played a role in financing remote trade in the Scottish Highlands [1996]. Smith argues that net-cleared financial systems are less risky because self-preservation is more prominent [1990, pp. 178-184].[a] Banks having reciprocal claims on each other may instill greater financial responsibility than centralized methods. Selgin proposes a theory of free banking, suggesting that money supplies are more stable and resilient when there is competitive note issuance [1988]. Despite the historical precedent of net clearing, many countries were forced to adopt a central banking system in wartimes. The central banking model is prevalent today, however distributed ledgers might enable a return to net settlement, including net clearing models facilitated by central authorities [DTCC, 2017]. A preference for the benefits of net clearing can be seen in

[a] A specific balance sheet example of net-cleared note issuance is provided [Smith, 1990, pp. 197-200].

securities industry implementations of blockchain technology [Guo and Liang, 2016; Mainelli and Milne, 2016; FINRA, 2017].

The market benefits of net settlement and the possibility of digitized value transfer on blockchain networks suggest that a greater portion of the economy might be net-settled rather than gross-settled. The economic gains could be more effective capital utilization by restructuring debt into smaller borrowed amounts and obviating the need for fallow pools of capital. For example, PricewaterhouseCoopers [2015] estimates that $3.9 trillion of otherwise unused working capital is committed in global supply chains. Similarly, Ripple claims that $5 trillion in capital is stored unproductively in local bank accounts around the world to fund the conduct of international business [2017]. These fallow capital pools might be remedied by blockchain-based real-time net settlement.

1.6.1.1 *Payment Channels (3a1)*

One important new form of financial relationship that has emerged in the blockchain economy is the payment channel. A *payment channel* is a three-step financial contract between parties. First, one party deposits an escrow balance with another party, together with a request for a refund for the full amount, which the other party signs as an acknowledgement. The deposit does not become live (is not broadcast to the blockchain network) until the receiving party signs the refund. Thus, both parties (who may not know each other) are protected. Either party can end the payment channel at any time, and the then-current balance is refunded. Second, during the specified period (e.g. an hour, day, or month), the first party consumes a resource against the escrow balance (e.g. watches video minutes or drinks a daily coffee), or the second party performs work for the first party against the escrow balance (e.g. programmer hours worked against a contract). At each activity update, a new refund transaction is signed by both parties acknowledging the elapsed activity against the escrow deposit (e.g. each hour of work, or each coffee consumed). Third, at the end of the period, the payment channel is closed, with the latest refund transaction between the parties broadcast to the network.

Payment channels engage capital on a net basis in that only the opening deposit transaction and ending net transaction are broadcast to the network, not each intermediary transaction. This could facilitate blockchain scalability since only the net activity is posted to the long-term record. Both parties are protected since they are contractually obligated the whole time, and any party can close the contract at any time, triggering the latest signed refund to be broadcast to the network. The net settlement aspect becomes more prominent in two-way payment channels, such as roommates sharing expenses, local neighborhood economies, and small business networks [Swan, 2018c]. Payment channels could be used at any level of economic activity for individuals, businesses, and municipalities for the net engagement of capital [Swan, 2018e].

1.6.1.2 *Securities as a Service (3a2)*

The contractual pledging of assets in distributed ledgers could enable new modes of ownership such that it is no longer necessary to own the whole asset or amount. Fractional ownership can be executed easily with blockchain-based models. The sharing economy has demonstrated that the consumable benefits of an asset can be rented on demand. Streaming music and video services have supplanted CD and DVD ownership, and Uber and Airbnb have obviated the need to own cars and homes. Theoretically, there is no reason why this could not also be the case with securities. *Securities as Service* is a model that grants access to the consumable benefits of the asset (cash flows and price appreciation) without having to own the underlying asset [Swan, 2016]. At present, it is still necessary to own the underlying assets, securities, to provide for one's retirement. Instead, there could be smart contracts (implemented slowly over time to engender sufficient trust and proven results) that deliver the consumable benefit of owning securities without having to own the underlying securities. These kinds of choices are available to sophisticated investors (e.g. invest in the capital appreciation tranche in a securitized offering), but the principles could be more widely applied to provide these kinds of benefits to a broader audience. The potential impact is freeing capital for more productive uses and reducing uncertainty about future cash flows. Entitlement overhangs (governments unable to meet future obligations to retired workers) might be addressed by instantiating pension systems with Securities as a Service smart contracts to guarantee future cash flows.

1.6.2 *Risk Management (3b)*

1.6.2.1 *Real-time Balance Sheets (3b1)*

Blockchain-registered digital assets enable the possibility of new mechanisms of financial control and risk management such as real-time balance sheets for organizations [Swan, 2018a]. Private views of real-time balance sheets could be shared with regulators to better manage bank capital requirements and systemic risk (the risk of large-scale failure in financial systems [Rimkus, 2016]). The consolidated effect of off-balance sheet liabilities could become more transparent. More importantly, the need for off-balance sheet liabilities could disappear as there is more trust and less risk in financial systems with real-time asset valuation, immediate transactability, and greater visibility into counterparty obligations [Swan, 2018d]. There could be greater predictive management of systemic risk. Regulators could have better access to data to model the intensity and effects of financial institution interdependence to protect against contagion (the impact of one institution's failing on the overall market). Since blockchain-based data may be more readily available, data science methods such as deep learning algorithms might be applied to the understanding of risk. For example, the risk posed by programmatic or high-frequency trading (HFT) is unclear. HFT has doubled since the 2008 financial crash, and comprises 55% of the volume in U.S. equity markets [Miller and Shorter, 2016]. HFT is implicated in flash crashes, a recent phenomenon in financial markets in which there are extremely rapid price declines caused by automated trading [Kirilenko *et al*., 2014].

1.6.2.2 *Black Swan Smart Contracts (3b2)*

Distributed ledgers could be implemented to facilitate both *monetary economics*, monetary transfer in the present moment, and *financial economics*, the more complicated financial instruments related to transfer in future periods such as mortgages. In finance, options are a standard instrument used to manage risk in future time periods. Options give the holder the right to buy (call) or sell (put) an asset at a certain price at a future date. Smart contracts have the same functionality of financial options: the possible right to buy or sell an asset at a certain price at a certain date. However, smart contracts might be used to control a wider variety of assets, not only financial assets. The degree of risk could be a user-selected parameter of any smart contract. The most basic choices could be low-medium-high risk. Just as users do not need to have a legal background to pick a Creative Commons license for a YouTube Video from standard drop-down choices (e.g. Attribution, ShareAlike, NonCommercial), likewise users would not need to have financial expertise in order to select the desired level of risk for a smart contract. Thus, *programmable risk* could become a standard smart contract feature.

In Black Swan financial theory, risk is mapped in the form of an s-curve [Taleb, 2007]. The risk curve is s-shaped: convex (a bowl facing upward) at the start, then linear, then concave (a bowl facing downward). Engaging with a phenomenon at the convex portion of the risk curve may be preferable because there is protection against downside risk. Big data analytics indicates that the s-curves which characterize financial risk may have a wider application, particularly in the healthcare domain. Risk curves are used in disease treatment to find the optimal amount of drug dosage for patients that is not too little to have an effect and is not so great as to produce harm [Davis and Svendsgaard, 1990].

S-curve risk quantification can be combined with insurance methods to generate Black Swan Smart Contracts. It is straightforward to measure the cost of risk for large-scale known phenomena. For example, in the insurance market, the percent of car crashes and the cost of repair for any postal code is known. These kinds of metrics could be used to price the cost of insurance in a smart contract. Insurance for any known and quantified situation might be automatically included as an option in any smart contract, similar to the way flight insurance is offered as an option with online airline ticket purchases. Black Swan Smart Contracts allow the user to programmatically select the amount of risk in the smart contract.

1.6.3 *Financing and Participation (3c)*

1.6.3.1 *Initial Coin Offerings (ICOs) (3c1)*

Initial Coin Offerings (ICOs) have emerged as a novel and official form of financing in Blockchain Economics. Whereas Initial Public Offerings (IPOs) sell investors access to a company's equity, ICOs sell access to a cryptotoken money supply connected to a specific project. Definitionally, an ICO is a means by which funds are raised for a new cryptocurrency venture by selling a percentage of the cryptocurrency to early backers of the project [Investopedia, 2018b]. In the U.S., after crowdfunding (a donation-type investment for product pre-purchase) became legal in 2016 [Puutio, 2016], there was a boom of ICOs under the auspices of crowdfunding until, due to their securities-like properties, the SEC started regulating ICOs as such in July 2017 [SEC, 2017]. China has banned ICOs, but the precedent is that many other countries treat ICOs as securities that must comply with local regulatory laws [Reese, 2017].

Already in June 2017, it was reported that blockchain entrepreneurs had raised more through ICOs than traditional VC funding ($327 million as compared with $295 million) [Sunnarborg, 2017]. As of February 2018, it was cited that cumulatively, ICOs had raised $8.84 billion [Coindesk, 2018], as VCs and other investors now invest in cryptotoken projects through ICOs. On one hand, *regulated* ICOs are the official financing vehicle of the blockchain economy. On the other hand, ICOs have a tainted reputation. Commentators and former regulators alike note that perhaps 99% of *unregulated* ICOs may end up worthless, if not completely fraudulent [Suberg, 2017; Poppernov, 2017]. It should be noted that even regulated ICOs are still quite risky due to the uncertain future prospects of projects, and because best practices have not yet arisen as to standard expectations regarding how funds are to be used and recirculated to token holders. (In the future all of this might be stipulated by smart contract with standardized Creative Commons-type selections, for example Automatic Profit Sharing to Token Holders.)

ICOs are an advance in that they offer an even more direct interest in a project than was possible previously. In a sense, ICOs are a capital budgeting mechanism because they offer project-level investment. The progression is that in IPOs, access to equity ownership in a firm is pre-sold to investors before being available to the general market. In crowdfunding (e.g. via Kickstarter and Indiegogo), access to a company's product is pre-sold. In ICOs, access to the platform and local economy is pre-sold with the participation token. The next phase could be using blockchain models to surface and pre-commit customer demand for a project. Blockchain-based pre-contracts could attest to customer demand for a potential product or service. Financing might be obtained on the basis of securitized customer demand.

ICOs are emblematic of the blockchain economic principle of tighter linkage between the sources and uses of capital, and the contributions and rewards of economic community participants. A closer connection between supply and demand (the supply of capital and the demand for products and services) can be seen in the owner-user model of ICOs because owners are users. ICOs are an example of *platform cooperativism* [Scholz, 2016] in that token offerings facilitate the ownership of assets by their users (although investor-only owners also participate). The incentive to invest in a token offering is that a token holder can use the platform, and also realize any capital appreciation benefits that accrue if the platform's user community grows.

1.6.3.2 *Open Platform Business Models (3c2)*

A cryptotoken-based system for monetary transfer enables open platform business models for large-scale global participation. Not only is the underlying blockchain software often available as APIs and open source code that can be modified, but the business models too are open, in the sense of operating on open platforms (open to any user to develop an application on the platform). The traditional Internet-based business model is closed proprietary platforms such as Netflix, Facebook, and Instagram. The idea is to establish a proprietary database and network, with the goal of maximizing users, content generation, and revenue [Manigart and Wright, 2013]. Users can contribute content but not applications on closed platforms. Instead, the blockchain model is open platforms, in which the goal is maximizing user participation, value creation, and rewards to participants, so that the overall economy grows and all participants can benefit. An intermediary point between closed proprietary platforms (Netflix) and open platforms (Ethereum) is App Stores (e.g. Apple, Android, and Windows), in which user-contributed applications can be merchandized to consumers and revenue is shared between the platform and the developer.

In digital economies (whether open or closed platform), *network effects* occur in that network platforms have increasing returns to scale as more users are added [Eisenmann *et al*., 2006]. Network effects are described mathematically by Metcalfe's Law, as the value of a network being proportional to the square of the number of connected users [Shapiro and Varian, 1999]. Economists argue that networks lead to natural monopolies due to the network effect that the overall value delivered to users increases if everyone uses the same network instead of having competing networks. Therefore, inefficiencies arise due to the market power of Internet giants such as Google, Amazon, and Facebook, because they can impose rent-seeking (exploitative) behavior [Catalini and Gans, 2018]. Market power inefficiencies allow one-way network effects to accrue to proprietary platform owners, particularly as enforced through the system of private property ownership. Instead, blockchain models allow two-way network effects to accrue to all community participants, because the platforms are not singularly owned [Barrera, 2018].

Given the shared ownership model in blockchain projects, rent-seeking tokens (those merely earning a pass-through fee) have been criticized as compared with value-creation tokens (those which reward contribution). Two-way network effects (which benefit all parties, not just the platform owner) are characteristic of the sharing economy generally, and the blockchain economy specifically [Brynjolfsson and McAfee, 2017]. One indication of how two-way network effects operate in the blockchain economy is through bootstrapping. This is the value created by the compressed time-to-market of entrepreneurs being able to deploy new token projects on an already-existing network without having to bootstrap (create) their own network. Since Ethereum is an open platform for decentralized applications (DApps), a new token project can ostensibly reach the entire installed base of Ethereum wallets [Anacrypt, 2017]. Unlike the App Store example, the platform hosting the application (Ethereum) does not take a fee, but does charge for computation resources in the form of *gas*. Further, Ethereum is an ecosystem model such that any holder of the platform's native token, Ether, experiences appreciation in value as more users and applications start using the platform.

There is social empowerment through the economic decision-making and ownership dimensions of token projects. *Platform cooperativism* is the idea of digital platforms being owned as co-operatives [Scholz, 2016]. Digital platform co-operatives are a proactive alternative to resisting economic monopolies and other mechanisms of hierarchical control and exploitation. Further, user-owned means of production not only resist hierarchical control, but also decrease income inequality [Piketty, 2013], improve social equity [Wilkinson and Pickett, 2011], and could foster an orderly transition to the automation economy (jobs outsourced to technology) [Swan, 2017a].

1.6.4 *Enterprise Blockchains (3d)*

Business blockchains could enable substantial improvements in efficiency. Ultimately, there could be just one instance of the shared business processes, accounting ledger, and legal apparatus, wherein each party in the value chain engages with separate read-write views [Swan, 2018a]. Implementing single shared business processes could take time as sufficient trust and accustomation to blockchain processes would be necessary. However, efficiency savings could propel adoption as separate record-keeping no longer makes sense in an era of digital services and blockchain-based asset pledging and transfer. It is expensive for firms to reconcile transactions across private ledgers [Iansiti and Lakhani, 2017], when the cost of basic operations such as invoice processing might be decreased by as much as 80% in blockchain networks [IBM, 2017].

Not only might single shared business processes, ledgers, and legal apparatuses be enabled among firms in a value chain, but firms might also run payment channel-type accounts with one other instead of having traditional vendor credit relationships. In the Blockchain Economy, digitized assets imply that value transfer can be immediate. Every asset is always available online for transfer at any time. Since assets are stored digitally, they can be escrowed and collateralized, which means that parties can more easily run an on-demand credit account with one another.

The 30-60-90 day vendor terms that must be approved piecemeal for trading partners now could become obsolete as parties start to run payment channel accounts with one another protected by digital collateral, smart contracts, and automatic payment transfer.

1.7 Risks, Limitations, and Future Outlook

This analysis is limited by many factors, in particular a necessarily speculative outlook given the early phase of development of the blockchain sector. Some of the most prominent risks facing the industry include technology scalability, political regulation, and consumer adoption. Blockchain technology is challenging to understand both conceptually and technically, and the steep learning curve could produce costly failures as it is implemented. It may be too early to propose a model linking elements that could continue to evolve considerably from their current form.

1.8 Conclusion

This chapter provides a comprehensive overview of the distinct and emergent Blockchain Economics paradigm and proposes a causal model of the relationships between elements. The central argument is that blockchain-registered digital assets can be transacted instantaneously and pledged in new ways. This advance is leading to new modes of contracting (smart contracts) and new forms of money (cryptotokens), which in turn facilitate new structures of financial interaction.

The practical impact of this work is that tools and structures are proposed which might be implemented to overcome contemporary economic challenges. Distributed ledgers and blockchain-based structures might be applied to structural economic problems such as debt, systemic risk, technological job outsourcing, entitlements overhang, healthcare cost-outcome disconnects, and financial inclusion. A key innovation is Payment Channels, which enable the use of capital on a net rather than a gross basis, and thus might lead to a restructuring of debt burdens. Other structures such as Real-time Balance Sheets and Black Swan Smart

Contracts might provide firms and regulators with greater financial control and risk management capacity.

The theoretical impact of this work is two-fold. First, foundational economic theorizing is proposed which includes a shift to engaging capital on a net rather than a gross basis, the ability to quantize and select risk parameters, and the possibility of increasing efficiency through single-shared business processes and real-time valuation mechanisms. Second, a novel explanatory model is articulated, a Blockchain Economic Theory of Digital Asset Contracting. The gap bridged is that although specific aspects of the emerging Blockchain Economics paradigm have been discussed, a comprehensive picture of the causal interaction of elements has not yet been proposed. This model could serve as a structure for understanding developments as the Blockchain Economy continues to unfold, and lead to improved decision-making in the context of policy-making, corporate investment, consumer adoption, and entrepreneurial innovation.

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