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BLOCKCHAIN TECHNOLOGY AND STARTUP FINANCING: A TRANSACTION COST ECONOMICS PERSPECTIVE

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Abstract:

Cryptocurrencies (e.g., Bitcoin, EOS, Etherum, Litecoin, and others) are disrupting the traditional banking and financial systems. The cryptocurrencies are based on a set of technologies commonly referred to as blockchain technology. The potential effect of blockchain technology on institutional economics is profound. Already, blockchain technology-based applications in supply chain management, marketing, and finance are decentralizing and streamlining vital institutional functions. In this paper, we examine the economics of blockchain technologies as it pertains to transaction costs in startups. We draw upon the theory of transaction cost economics and the transactional nature of blockchain technology to propose a model to demonstrate how and why blockchain technology based applications are effective in some areas but not in others. We then apply the model to demonstrate how blockchain technology can be used to overcome many problems inherent in startup financing. For example, information asymmetry and transaction costs involved with matching an entrepreneur with an investor and the terms of the financing deal are some of the fundamental issues in entrepreneurial financing. We explain how a financing system based on blockchain technology can ameliorate the problems and lead to a more effective and decentralized entrepreneurial financing process.

Keywords: Blockchain Technology, Institutional Economics, Transactional Costs, Startup Financing, Entrepreneurship, Venture Capital

1. Introduction

Technologies based on the blockchain platform have the potential to disrupt various industries (de Soto, 2017; Potts et al., 2017). We are already witnessing the disruptive effects of cryptocurrencies, such as Bitcoin and Ethereum, on the ongoing revolution in banking, online currency markets, and online buying-selling of goods and services (Tapscott and Tapscott, 2016). The decentralized nature of blockchain technology in conjunction with the trust generation through sophisticated algorithms, absence of any middlemen, and negligible counterparty risk has far-reaching implications for institutional economics (Evans, 2014, Narayanan et al., 2016). However, while there has been research on various aspects of cryptocurrencies and specific applications of blockchain technology, studies exploring the economic and entrepreneurial side of blockchain technologies are limited[1] (Catalini and Gans, 2016). According to the limited extent research, blockchain technologies represent several entrepreneurship opportunities in areas of unbanked practices(Larios-Hernández, 2017), new business models (Morkunas et al., 2019), and startup financing (Ante et al., 2018; Akbarpour, 2019; Tumasjan et al., 2019). Given the relevance of blockchain technologies in entrepreneurship and the anecdotal evidence about the advantages and disadvantages of implementing cryptocurrencies for startups financing, the ongoing academic debate highlights the need for exploring both themes using robust conceptual and methodological

[1] During the last five years, the research on blockchain has been growing. According to the Web of Science, 1351 papers associated with blockchain technologies have been published from 2015 to 2019. Concretely, linked with business (51), economics (29), management (44), and finance (76). However, on the theme that we focus in this manuscript (startup finance) only 9 papers have been published and mostly in 2019.

approaches. Inspired by these academic debates, this paper examines the blockchain technologies and startup finance through the lens of the institutional economics approach (i.e, transaction costs).

Transaction cost economics has played a dominant role in shaping the scholarly debate on economics of institutions for decades. Ronald Coase was the first researcher to analyze how transactions costs influence organization of firm and markets in his seminal paper on "The Nature of The Firm". Kenneth Arrow further extended the argument in highly influential 1969 paper on the organization of economic activity by explaining the role of transaction costs in market failures and intermediate product contracting. Williamson (1971, 1981, and 2002) contributed to the argument by applying transaction cost economics to explain various aspects of market and organization economics such as vertical integration, governance, and market coordination and failures. In the digital era, we examine the economic decisions that a startup understakes regarding their search for cryptocurrency as an alternative funding mechanism. Concretely, the theory and predictions of transaction cost economics model help to inform how blockchain technologies can influence a firm's organizational decisions because of their ability to decentralize (democratize) and reduce transactions costs (economically and socially) thereby creating trust in the counterparties (Chen et al., 2018). We assume, technologies based on the blockchain architecture has a potential to revolutionize transaction costs, both in terms of cost and convenience. We utilize the framework to develop a better understanding of various industries and institutional functions in the economy. In this regard, this paper focuses on the area of entrepreneurial finance where the information asymmetries (between an entrepreneur and an investor) and transaction costs associated with startup financing are high and often unsurmountable. More concretely, we explain how blockchain technologies inherent transaction-based decentralized system can alleviate these problems in the area of startup financing.

Our paper makes significant contribution to the entrepreneurship, finance and technology literature. To the best of our knowledge, this is the first paper to explain the transactional costs of implementing blockchains technologies for startup financing. Specifically, this is the first study

to explore the ability of blockchains to reduce and provide alternative to activities that involve transaction costs. Treiblmaier (2018) utilized transaction cost economics model to analyze the potential impact of blockchain technology on supply chain management. However, in the present study we complement Treiblmaier (2018) by focusing on the startup financing and how the blockchain technology applications in the field of startup financing can be better understood using transaction cost economics. Further, in utilizing a transaction cost economics model to explain the utility of blockchain technologies, the study explains how blockchain's ability to reduce and manage transactions is the driving force behind its applicability in the broader institutional framework. Moreover, the proposed theoretical framework highlights applications of blockchain technology to address inherent inefficiencies and problems in the traditional entrepreneurial financing model. As a result, the paper provides practical examples of the efficacy of this novel framework by applying it to analyze how blockchain technology can be applied to raise startup financing. We explain how the blockchain technology's ability to generate trust, its decentralized nature, and the capacity for tokenization help startups seeking financing.

Our paper is structured as follows. In the next section, we provide a brief description of transaction cost economics to familiarize readers about the main theoretical framework. In the third section, we offer a brief description of the literature on blockchain technologies and startup financing. In the proposed theoretical model, we provide arguments and logical reasoning regarding the transactional costs and blockchain technology applied to startup financing. In the discussion section, we explain how our model compares to findings and arguments advanced in the extant literature. We conclude our paper after providing future research directions .

2. Transaction Cost Economics Theory

Transaction cost economics has been a dominant theoretical paradigm in the study of management and organization (Chiles and McMackin, 1996; David and Han, 2004; Williamson, 2008) since the publication of Williamson's seminal book, Market and Hierarchies (Williamson, 1975). The theory attempts to explain the nature of the firm and predicts why certain activities are performed inside the firm versus the neoclassical economics view of the activities undertaken by a free market system or a hybrid market arrangement, where parties to the transaction are interdependent in a nontrivial way (David and Han, 2004). The core of the transaction cost economics theory is 'transactions' and 'costs'. The transaction refers to the transfer of a unit of goods or service, while costs refer to the sum of associated monetary and non-monetary values involved in facilitating the transfer. The latter is also referred to as the transaction costs. The transaction costs arise from environmental uncertainty, bounded rationality, opportunism, and specificity of assets. Environmental uncertainty and bounded rationality lead to incomplete contracts and subpar decision making. These two factors make it impossible to have informationally complete contracts as proposed by neoclassical economics. In the absence of complete contracts, there is a probability that either party to the transaction can indulge in opportunism and extract economic rents (Williamson, 2008). Thus, trust in transactions becomes a vital part of the relation between the parties. Blockchain technology has potential to overcome the trust problem by using mathematical algorithms and decentralized networks.

Another factor contributing to the transaction costs is asset specificity. If an asset cannot be easily redeployed for alternative uses, it is said to have a high asset specificity, while an asset that can be utilized for alternative purposes has low asset specificity. For example, if a supplier commits to undertake substantial investments in assets that are used to manufacture a good for a

specific buyer. The supplier has caused their assets to be specific to the buyer. In this case, if the supplier fails to meet the buyer's demands, the supplier allows the buyer to pay less to not lose the substantial value of specific assets. Figure 1 shows the traditional model of transaction cost economics:

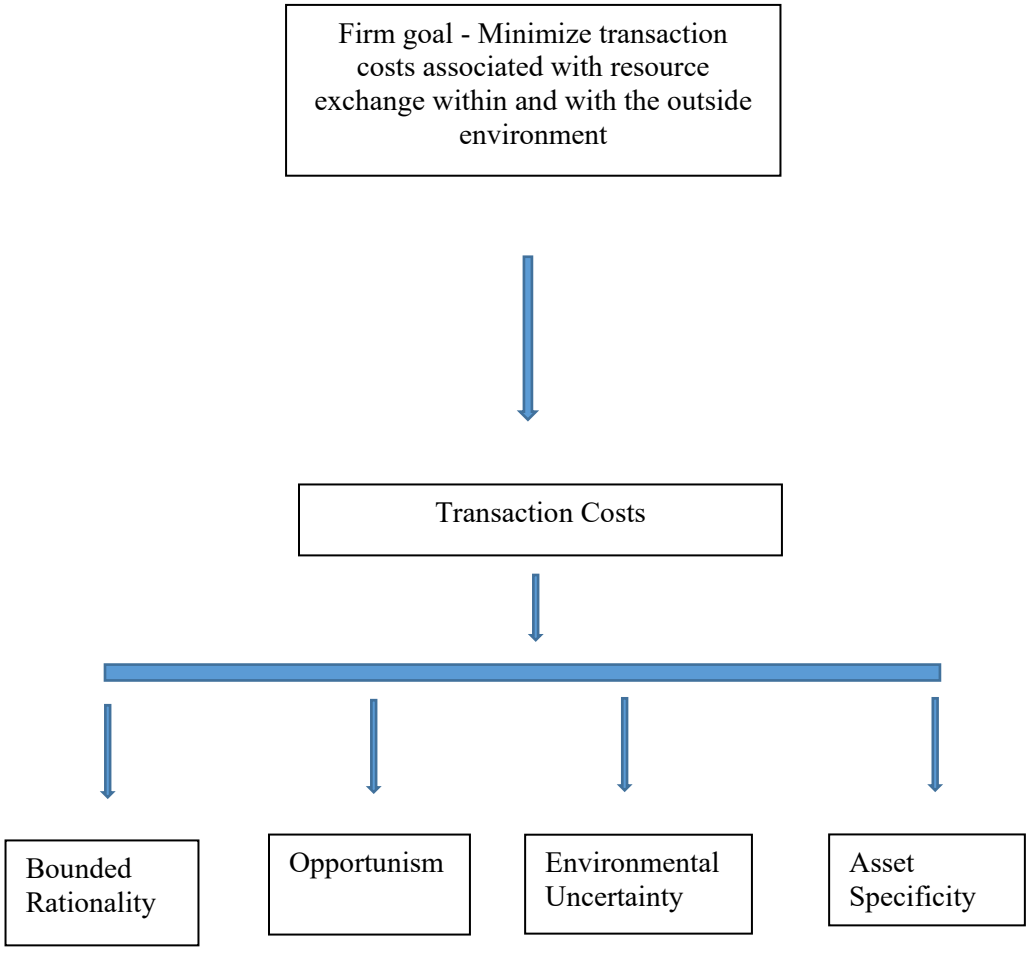

Figure 1: Traditional Transaction Cost Model

3. Literature Review

Coase's 1937 seminal paper was the first attempt at exploring the importance of transactions and related costs. The formal theory of Transaction Cos Economics (TCE) was developed in the

1960s and the 1970s drawing on insights offered by Coase's paper (Williamson, 1973, 1975, 1985). Over the last five decades, TCE has emerged as one of the primary theories to explain the nature of a firm and is additionally seen as a theory of management and governance (Chandler, 1990; Conner, 1991: Williamson, 1979, 1984). TCE examines complex transactions, undertaken by economic agents who are rational and indulge in opportunism, involving assets that are not easy to redeploy in an uncertain environment (Santos and Eisenhardt, 2000; Williamson, 1981).

In literature, the predictive validity of the theory has received mixed empirical support (David and Han, 2004). In aggregating empirical findings in the literature, David and Han (2004) find only 47 percent of studies published in premier business academic journals had findings consistent with TCE's prediction. This finding is consistent with arguments advanced by leading business scholars regarding TCE (Ghoshal and Moran, 1996; Moran and Ghoshal, 1996; Robins, 1987). However, arguments and findings in support of TCE are equally strong (Mahoney, 1992; Shelanski and Klein, 1995) with scholars attributing inconsistent findings in the literature to operationalization or sampling issues (David and Han, 2004). Further, as a framework, TCE has recently contributed to robust improvements in theory development (Tsang, 2006).

In entrepreneurial finance, a high environmental uncertainity and a high information asymmerty between entrepreneur(s) and investors significanty enhances transaction costs involved in financing (e.g., Mahto et al., 2018 a, Mahto et al., 2018b). The transaction costs involved in startup financing is so high that many entrepreneurial ecosystems have multiple redundant entities competiting with each other, thereby leading to significant inefficiencies in the system (Mahto et al., 2018a). Many investors, especially Venture Capitalists (VCs), design their own systems and practices to deal with high information asymmetry and uncertainties inherent in the entrepreneurial finance ecosystem (e.g., Mahto and Khanin, 2013). For example, most VCs and angel investors

specialize in only certain industries, while some VCs prioritize either entrepreneurs or venture quality in their investment decision (Khanin et al., 2008). Further, entrepreneurs reduce their transaction cost by preferring investment from reputable VCs even when it comes with significant cost (Mahto et al.,2018b). Even with prevalent strategies for dealing with high transaction costs, some investors (e.g., VCs) further refine their strategies by focusing on specific characteristics of either entrepreneur (e.g., reputation) or their venture (Mahto and Khanin, 2013). We believe the blockchain technology might be useful in reducing the hurdles in this environment.

In this paper, the blockchain technology is explained using the TCE perspective. Blockchain technology was initially developed to record transactions of encrypted digital currency (i.e., Bitcoin) (Nakamoto, 2008). Several researchers have shown how the underlying blockchain technology empowering various cryptocurrencies should be the focus of study (Tapscott and Tapscott, 2016; Walport, 2016). Blockchain technology allows for a distributed and non-centralized secure ledger (Walport, 2016). Blockchain records transactions in an encrypted, secure, verifiable, decentralized, and low-cost way (Catalini and Gans, 2016; Schatsky and Muraskin, 2015) thus minimizing the verification costs and the networking costs. Thereby, making the blockchain-based transactions more cost-efficient.

They use these two costs to show that the resulting digital marketplaces are characterized by increased competition, lower barriers to entry, lower privacy risk, and decentralization of power. Previous studies have examined the application of blockchain technologies to various financial, banking, crowdfunding campaigns, supply chain, and other business functions (Belleflamme, Lambert and Schwienbacher, 2014; Diedrich, 2016; Mollick, 2014). This paper examines the application of blockchain technology to the process of startup financing and explains how the TCE framework can be used to understand the effective implications of blockchain technology.

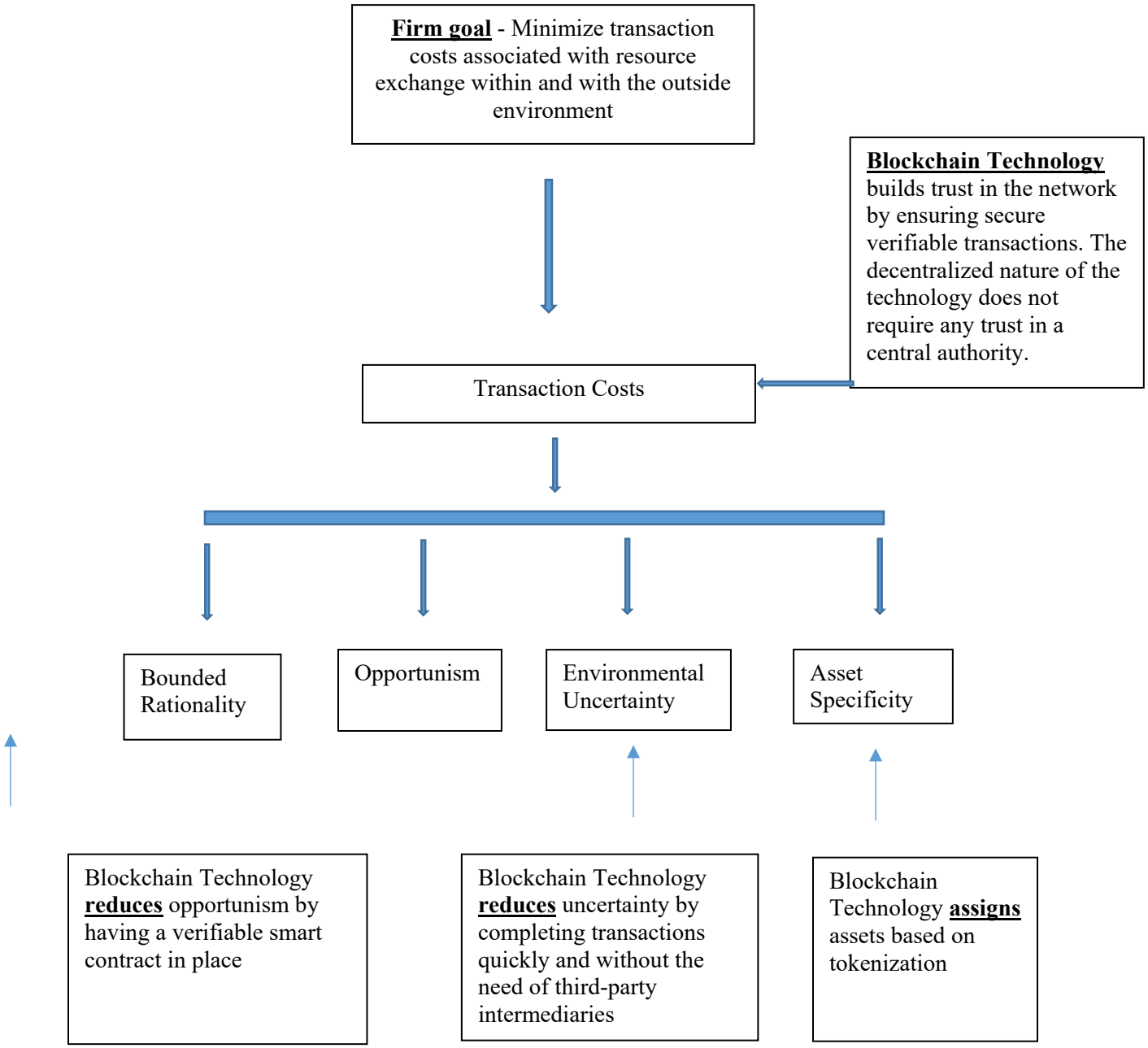

Figure 2: Modified Transaction Cost Model with Blockchain Technology

4. Theoretical Model

We first breakdown the transaction costs into its components to provide a better understanding of how blockchain technology impacts these transactional costs. Primarily, transaction costs can be divided into Search Costs, Verification Costs, Transportation Costs, Tracking Costs, Replication Costs, and Contractual Costs. Search costs are incurred when one party to the transaction looks for the counterparty. Verification costs are incurred to verify that the shortlisted counterparty has the wherewithal to complete the transaction. Transportation costs are incurred when the exchanged good or service changes hands. Tracking costs are incurred to track the transaction and to track the moment of the good or service to its designated place. Finally, replication and contractual costs are incurred to check the contract in the future and to ensure its validity for future actions. Blockchain technologies can contribute to the reduction in each of these costs and further reduces the environmental uncertainty by its unique approach to ensure trust.

In Figure 2, we present our model to show how blockchain technology at each critical juncture can improve the transactions costs by building a better trust mechanism in the system, by providing means to verify transacations, and reduce costs related to intermediaries. Blockchain Technology builds trust in the network by ensuring a secure verifiable transaction. The decentralized nature of the technology does not require any trust in a central authority. In the system opportunism can be reduced through tokenization by having a verifiable smart contract in place. At the completion of the smart conditions the asset can be assigned to the receiver. Since the underlying structures in blockchain technology provide all the above services the need for a third party intermediary to act as an escrow or guarantor of services and transactions is eliminated.

To illustrate how blockchain technologies can influence each of the costs and how transactions are done differently under the blockchain model we consider a simple example of a transaction where the money is sent from one country to another country. The sender in Country A wants to

send money to a receiver in Country B. The sender initiates the transfer through their bank in Country A. The bank gets in touch with Country A's correspondent bank. Country A's correspondent bank gets in touch with Country B's correspondent bank which in turn is linked to Country B's bank that the Receiver has an account in the bank. In each stage, the costs are incurred, and the exchange rate adds risks to the final amount of that the receiver receives. These costs are not finalized until the payment is received by Country B receiver's bank and can be as high as 10% and take several days to complete. The same transaction can be seamlessly done through blockchain. For example, through bank's enterprise blockchain system, the money can be transferred almost instantly from sender's bank to receiver's bank without the need of any intermediaries or third-party providers. This process does not only reduce the cost of the transaction but also mitigates the uncertainty (of the exchange rate risk) by significantly reducing the time it takes to complete the transaction. Various banks and even IMF are exploring how blockchain technology can be used to make cross border remittances efficient. Various apps such as Power Circle App claim to allow its users to transfer money overseas through its platform built on the blockchain technology.

Blockchain technology ensures various advantages over the existing ledger technologies used for transactions. Blockchain, by its construction, records the history of all transactions and provides the same copy to all users in the network. The process is democratic as all users in the network agree on the rules governing the blockchain. The transactions are secured using cryptography, digital keys, and digital signatures. Many blockchains allow the network to be segmented and be private by allowing only specific digital signatures to access a portion of the blockchain or even just one transaction. The records of transactions are updated quickly, and once the block is assigned to the blockchain it cannot be modified. It is thus providing a permanent

tamper-proof record of the transaction. Blockchain technology allows the creation of smart contracts that can be used to transact various functions that a company or market undertakes.

4.1. Smart Contracts Built on Blockchain Technology

While blockchain technology was initially developed to support Bitcoin, a digital currency, soon developers started extending the capabilities of the blockchain technology. The digital currency allowed for the creation of general-purpose platforms, digital tokens, and decentralized smart digital applications. Smart tokens are digital artifacts that are used to tokenize scarce assets and subject to certain conditionsbeing fulfilled the smart contract housed in the token assigns the ownership of the underlying asset. The digital tokens can be created on top of a blockchain and can represent a wide range of assets such as currencies, equity stakes, and preorders. Castellanos et. al. (2017) provide an exampe where using tokens based on the Ethereum Blockchain and Smart Contracts, one can sell tokenized GoOs to consumers willing to subsidize renewable energy producers. Chen (2018) also states that blockchain technology has given innovators the capability of creating digital tokens to represent scarce assets, potentially reshaping the landscape of entrepreneurship and innovation. Similarly, Tapscott and Tapscott (2016) provides various examplse of digital tokenization and smart contracts. The simple addition of tokenization within a blockchain has the potential to disrupt various functions within a firm such as supply chain, accounting, human resources, banking, and other digital transactions. With tokenization, the cost reductions, trust, and decentralization can be applied to whole gamut of business functions. We illustrate one such application of blockchain technology to startup financing.

4.2. Blockchain Technology and Startup Financing

Startups financing suffers from many of the costs discussed in transaction cost economics. Startups are new and upcoming private companies that operate in a dark world where information asymmetries between the startup and investors are enormous (Mahto et al., 2018a). In order to deal with these uncertainties, the market has adopted various financing models such as VC model, angel investor model or hybrid models involving convertible debt and more recently crowdfunding models. Further, startups face the search costs of finding a suitable investor. Different VC's and angels specialize in different industries and phases of a startup and may not be a good fit for all startups(Khanin et al., 2008). Other investors who may be willing to invest in the startup may not do so because of informational reasons (Cassar, 2004; Cotei and Farhat, 2017; Denis, 2004). Crowdfunding fills some of these gaps in the funding of innovative startups. A typical startup often requires less than $100,000 in its initial stages (Kauffman Foundation, 2007).

The traditional avenues of raising outside financing are the banks (debt), and angels or venture capitalists (equity or convertible debt) (Mahto et al., 2018b). Banks are reluctant to fund startups because they lack collateral and credit, however established SME often fair better. A startup typically has no assets to collateralize and has no history of accounts receivables or accounts payables. VCs are constrained by general partners' time devoted to grooming and developing their portfolio companies (Denis, 2004; Gompers and Lerner 2004; Sahlman, 1990; Zider, 1998). Thus, VCs rarely make investments under $1 million. In this sense, angel investors have historically filled this gap with a concentration in certain cities. Also, entrepreneurs are often unwilling to accept financing from angel investors due to aggressive equity negotiation tactics

employed by them. Thus, crowdfunding platforms like Kickstarter, Gofundme, and Indiegogo have become popular alternatives for entrepreneurs in recent years.

The crowdfunding platforms complement the blockchain technologies in reducing various costs associated with startup financing. Typically, in a crowdfunding campaign, entrepreneurs or companies seeking to tap customers and raise financial resources offer customers or audience of the platform access to their idea or products. In order to engage the audience and achieve success for their funding campaign, entrepreneurs employ marketing tactics that utilize multiple modes of communicating their messages (e.g., written, oral and video). In the popular crowdfunding models, potential customers and /or investors can decide to financially support the development of a product or idea by pledging a varying level of financial support that can range $1 to thousands of dollars. If the promoter of the idea can achieve the set funding goal, then the funds flow from investors to them minus the 3-5% fees charged by the crowdfunding platform.The investors and or potential consumers who support the product or service take an active interest in the development of the product or service. Active two-way communication between promoters and investors helps investors to understand the product while at the same time it helps promoters to understand the consumer needs. The developers also give frequent updates on the progress and development of the product or service and investors can give feedback and suggestions at each stage. While many startups avail the benefits of crowdfunding still the potential is not fully realized because of the absence of ownership stake and monitoring.

Blockchain technology helps to overcome these limitations. A startup project or product development can be structured such that the underlying product or project is tokenized using blockchain. These tokens are sold to the public, for example, through crowdfunding campaigns. These tokens can represent pre-orders where the customer will get the product when the project is

funded, or they can even represent an equity stake in the company. The equity stakes are possible now with the implementation of the 2012 "Jumpstart our Business Startups (JOBS)" act in the United States (Goulding et al., 2013). The act allows entrepreneurs and small business owners the flexibility to seek investment from the general public often in the form of Crowdfunding (Stemler, 2013). The new law allows startups to offer securities such as stocks and bonds directly to consumers as long as they meet specific regulatory requirements (Martin, 2012). Hence the tokens can now legally represent an ownership stake in the company. Further, these digital tokens can be governed by smart contracts that trigger specific actions when certain conditions are met. For example, successful completion of a stage in the development of the product or a project can signal a reduction in uncertainty and increase the value of the tokens. It is thus incentivizing early investors by allowing them to trade their initial investment for a profit. Such trades have not been possible in traditional crowdfunding campaigns. The smart contracts can even be something as simple as token acting as a pre-order, and when the development and manufacturing are complete the smart contract is triggered, and each token holder is shipped the finished product. The trade of tokens also helps the startup to gauge the interest and support of investors just as stock price movements help the management of a public company. Further, these tokens can allow the investors to monitor and control the progress of a startup and take corrective action in ways similar to the board of directors to do in a public company. Thus, we see that blockchain technology, not only overcomes various transaction costs associated with startup financing, but also empowers both startups and investors to complete the financing and development of the startup more effectively.

5. Discussion

Blockchain technology is a disruptive innovation underlying cryptocurrencies, such as Bitcoin and Ethereum. The technology has received significant attention from practitioners (for use in optimizing various market and organization functions) and academics (for research). The technology has been utilized extensively for not only creating many new cryptocurrencies but also for financial services, such as digital assets and online payments (Foroglou and Tsilidou,2015; Peters et al., 2015). The revolutionary technology has potential to significantly alter many other areas that include internet of things (IoT) (Zhang and Wen, 2015), security (Noyes, 2016), supply chain management (Tian, 2016), and delivery of services (Akins et al., 2014).

Entrepreneurial finance is an inefficient ecosystem (Mahto et al., 2018a), where transaction costs are quite high. The prevailing inefficient system has also resulted in the system where locational advantages are prohibiting the development of entrepreneurial firms in areas lacking availability of a strong network of financial stakeholders, such as banks, angels, and VCs. The ecosystem inefficiency is also partially due to specialization of financial intermediaries, such as angels and VCs, who specialize in a specific industry or a specific stage of the entrepreneurial venture. We believe the entrepreneurial ecosystem is fertile for application of blockchain technology to address some of the inherent inefficiencies. The distributed and cost-efficient characteristics of the technology will facilitate transactions in the system, where the probability of opportunism and uncertainty is low, and trust and security are high. The blockchain technology can significantly reduce the transaction costs for stakeholders in the entrepreneurial ecosystem, such as entrepreneurs, angels, and VCs. The primary cost reduction is achieved by reducing search cost and eliminating third-party intermediary in the system. Blockchain technology can address

many of the issues hindering the development of a robust entrepreneurial ecosystem at the local level for economic development (Mahto et al., 2018b; Mahto and McDowell, 2018).

5.1. Limitations

In this paper, our primary goal was to examine blockchain technology through a theoretical lens of TCE. As the blockchain technology is still in its nascent stage our study suffers from limitations of current state of blockchain technology and its implementation in the business organizations. As noted economist Nouriel Roubini has written: "As for the underlying blockchain technology, there are still massive obstacles standing in its way, even if it has more potential than cryptocurrencies. Chief among them is that it lacks the kind of basic common and universal protocols that made the Internet universally accessible (TCP-IP, HTML, and so forth). More fundamentally, its promise of decentralized transactions with no intermediary authority amounts to an untested, Utopian pipedream. No wonder blockchain is ranked close to the peak of the hype cycle of technologies with inflated expectations." Some other concerns that yet need to be addressed are that current state of blockchain technology is very enrgy intensive. Many of the nodes in a blockchain are needlessly repeating calculations done be other nodes needlessly slowing down the whole system. In current state blockchain technology is sluggish in executing transactions as the user base of people using blockchain technologies grow it is expected that the trasnactions will take even longer time. However, with rapid advances in technology we hope that speed issues will become less negative. The integeration with legacy systems is a substantial hurdle that needs to be addressed if blockchain technology has to become mainstream.

5.2. Future Research Directions

The model and arguments in this study are conceptual and require empirical assessments before application. We encourage entrepreneurship scholars to undertake studies to assess whether transaction cost minimization is a factor in investment decision made by system stakeholders. The two different approaches in studying TCE in entrepreneurial ecosystems are an evolutionary approach (population ecology) and managerial decision approach (firm governance). We believe the evolutionary approach is more appropriate for investigating blockchain technology in the entrepreneurial ecosystem. In evolutionary approach, scholars can examine whether cost minimization is associated with survival of stakeholders in the system. If the findings are confirmed empirically, then the scholars can further probe the financial system using various attributes of blockchain technology (e.g., trust and uncertainty) to see if the other areas of the business ecosystem are ripe for application of blockchain technology.

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