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Blockchain disruption and decentralized finance: The rise of decentralized business models

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ABSTRACT

Blockchain technology can reduce transaction costs, generate distributed trust, and empower decentralized platforms, potentially becoming a new foundation for decentralized business models. In the financial industry, blockchain technology allows for the rise of decentralized financial services, which tend to be more decentralized, innovative, interoperable, borderless, and transparent. Empowered by blockchain technology, decentralized financial services have the potential to broaden financial inclusion, facilitate open access, encourage permissionless innovation, and create new opportunities for entrepreneurs and innovators. In this article, we assess the benefits of decentralized finance, identify existing business models, and evaluate potential challenges and limits. As a new area of financial technology, decentralized finance may reshape the structure of modern finance and create a new landscape for entrepreneurship and innovation, showcasing the promises and challenges of decentralized business models.

1. The emergence of decentralized finance

Intermediaries often play essential roles in reducing transaction costs and expanding transaction possibilities. In economic transactions, intermediaries often help transacting parties find each other, establish trust, and settle transactions (Roth, 2015). Without intermediaries, transacting parties may not be able to establish connections, negotiate contracts, or enforce agreements. Nevertheless, intermediaries often enjoy substantial power in shaping economic transactions, and they can leverage their power to maximize self-interests, raising concerns over their monopoly power (Cohen, 2019; Srnicek, 2017; Zuboff, 2019). The tension between the need for efficient transactions and the concern over monopoly power characterizes how human society approaches dominant intermediaries in economic transactions. This tension is especially pronounced in the financial system, where financial transactions are facilitated and controlled by large financial institutions.

For centuries, financial institutions have played important roles in mediating and structuring economic transactions that would otherwise be difficult to execute due to transaction costs (Benston and Smith, 1976). Financial institutions reduce transaction costs by connecting market participants and building trust (Shiller, 2012). As we move into the digital economy, financial technology (FinTech) has started to take up some roles traditionally played by large financial institutions. In some cases, digital technology can reduce transaction costs, expand transaction scope, and empower peer-to-peer transactions, spurring a new wave of innovation in FinTech (Chen et al., 2019). Although FinTech has reduced the need for financial institutions, it has not removed intermediaries. It often substitutes one intermediary (e.g., a financial institution) with another (e.g., a technology company). If decentralization and

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disintermediation continue to build momentum, blockchain-based decentralized finance may be the next step in this progression.

Recent developments in blockchain technology are empowering a new paradigm centered around decentralization and disintermediation. Blockchain technology can eliminate the need for intermediaries in financial transactions, as it can facilitate peer-to-peer transactions through distributed trust and decentralized platforms. As a result, blockchain technology can substantially increase the scope and efficiency of peer-to-peer transactions, turning previously infeasible business models into viable ones. Empowered by blockchain technology, financial services can become more decentralized, innovative, interoperable, borderless, and transparent.

This new paradigm is different from the one built upon transaction cost economics (TCE). First, TCE focuses on opportunism, while this new paradigm is founded on distributed trust (Seidel, 2018), a form of trust that "flows laterally between individuals" without pre-existing trusted relationships (Botsman, 2017, p. 257). Blockchain technology can produce distributed trust, because transactions recorded on a blockchain are valid, immutable, and verifiable—they have been validated through distributed consensus and are protected through advanced cryptography (Narayanan et al., 2016). As a result, a blockchain can serve as the common source of truth for transacting parties, facilitating efficient peer-to-peer transactions. Second, TCE recognizes the roles of hierarchies and intermediaries in reducing transaction costs, while this new paradigm focuses on reducing transaction costs through decentralization and disintermediation (Murray et al., 2019). Through decentralization and disintermediation, blockchain technology can reduce the costs associated with search, contracting, and enforcement, while expanding transaction possibilities by connecting peers directly to peers in innovative ways (Cong and He, 2019).

With distributed trust and decentralized platforms enabled by blockchain technology, entrepreneurs and innovators have recognized the possibilities of creating an open financial system that has limited or no involvement from financial institutions. By doing so, they intend to reduce transaction cost, broaden financial inclusion, empower open access, encourage permissionless innovation, and create new business opportunities (Financial Stability Board, 2019). Although this movement is still at its early stages, it showcases the potential of blockchain technology in spawning a new set of business models that are centered around decentralization and disintermediation. If this movement continues to gain momentum, it may start to disrupt existing industries and create new opportunities for entrepreneurship and innovation.

2. The promises of decentralized finance

2.1. Decentralization

In a centralized financial system, financial institutions are the key intermediaries mediating and controlling financial transactions. Intermediaries help reduce transaction costs, allowing financial transactions to be carried out efficiently and smoothly (Benston and Smith, 1976). As key intermediaries facilitating financial transactions, however, financial institutions can grow to dominate economic activities. When a centralized financial institution—such as Bank of America, PayPal, or Square—rises to dominance, it can accumulate disproportionate market power and profits. In a decentralized financial system, in contrast, financial transactions are facilitated not by centralized institutions but by decentralized peer-to-peer networks. By reducing the involvement of centralized institutions, decentralized networks can reduce transaction costs and create network effects without incurring monopoly costs (Catalini and Gans, 2019). When a decentralized peer-to-peer network rises to dominance, no single entity can accumulate sufficient monopoly power to monopolize the network and exclude others from participating, allowing everybody to benefit from the network effects to enlarge transaction possibilities (Huberman et al., 2019).[1]

2.2. Innovativeness

Decentralized finance promotes permissionless and combinatorial innovation. Although a centralized platform may encourage open innovation and experimentation, its platform owners often control access and can revoke access to exert governance control (Rietveld et al., 2019). As a result, third-party developers often have to bear the risk of being revoked access to their hosting platforms when platform owners make unilateral changes. Although most platform owners are benevolent and are accommodating to third-party developers, from time to time they have made unilateral changes that hurt developers (Dixon, 2018). In contrast, a decentralized platform does not have a controlling party and, therefore, allows for open access and permissionless innovation—that is, developers can freely build and experiment with new applications without asking for permission (Cerf, 2012; Chesbrough and Alstyne, 2015). By facilitating permissionless innovation, decentralized platforms empower developers by guaranteeing access, allowing developers to evolve decentralized finance in organic and unexpected ways.

Decentralized platforms can also facilitate combinatorial innovation. In a decentralized finance ecosystem, new financial technologies can become the building blocks for future innovations, promoting new combinations and new products (Brynjolfsson and McAfee, 2014). Combinatorial innovation is made possible by permissionless innovation and open sourcing in the decentralized finance ecosystem. For instance, decentralized financial applications and platforms—such as Bitcoin, Ethereum, and Libra—often publicly share their core technologies through permissive open-source licensing, allowing anybody to make use of their core technologies as well as to

[1] A blockchain can be permissionless in the sense that anybody can participate in validating the blockchain, or it can be permissioned where only select parties can participate. A permissionless blockchain is usually more decentralized than a permissioned one, as power is more decentralized and diffused (Antonopoulos, 2017; Antonopoulos and Wood, 2019). In this paper, we focus on permissionless blockchains and their applications in decentralized finance.

build new applications on top of them. In contrast, centralized financial services and platforms often carefully protect their intellectual properties through patents, copyrights, trademarks, and trade secrets, excluding others from using valuable technologies. Combinatorial innovation can accelerate the pace of financial innovation as well as increase the degree of market competition, potentially leading to newer, better, and cheaper financial services.

2.3. Interoperability

Decentralized finance can enhance interoperability. Traditional finance tends to work in silos, driving up transaction barriers. Different financial institutions have to maintain their own ledgers, so one financial service may not be interoperable with another. As a result, moving capital and value across silos can become costly and cumbersome. In contrast, decentralized finance is built on public blockchains and open standards, increasing the interoperability across different services. With high interoperability, financial capital and value can flow seamlessly across different services and borders, potentially creating an internet of value.

Although projects built on the same public blockchain enjoy high interoperability, decentralized finance has not achieved full interoperability yet, due to the lack of interoperability across blockchains. Entrepreneurs and innovators are exploring two potential options to achieve full interoperability. The first option is to encourage the emergence of one dominant platform and to persuade all projects to build on the same platform. Currently, Ethereum is the dominant platform for decentralized finance, and all Ethereum-based projects enjoy high interoperability. As Fig. 1 shows, 87 percent of all publicly funded projects—within and beyond decentralized finance—have been built on Ethereum. Moving forward, achieving interoperability through the dominance of one platform can be undesirable, since a single blockchain may not be able to serve projects with diverse needs. A better option is to increase interoperability across blockchains, so projects can be built on different blockchains but still enjoy full interoperability. Currently, many initiatives—such as Cosmos and Polkadot—are working on interconnecting different blockchains to achieve full interoperability.

2.4. Borderlessness

Centralized finance cannot be truly borderless, as it is tied to specific geographic locations with specific fiat currencies. As a result, moving capital and value across borders often encounters friction and delay. In contrast, decentralized finance is inherently borderless and thus allows for borderless finance, as it is not tied to geographic locations or fiat currencies. Relying on borderless cryptocurrencies, it is not tied to specific geographic locations but can be used by anybody across the globe. Moreover, it does not rely on any specific central bank or government (Ammous, 2018). With decentralized finance, therefore, transferring value across the globe may become as easy as sending an email, removing barriers to global value transfers.

2.5. Transparency

Decentralized finance can also enhance transparency in the financial system. Centralized finance cannot have full transparency, as centralized financial institutions have to secure their centralized ledgers by restricting access. Decentralized finance, in contrast, secures their public ledgers through distributed consensus and radical transparency. It records transactions on public ledgers that can be easily

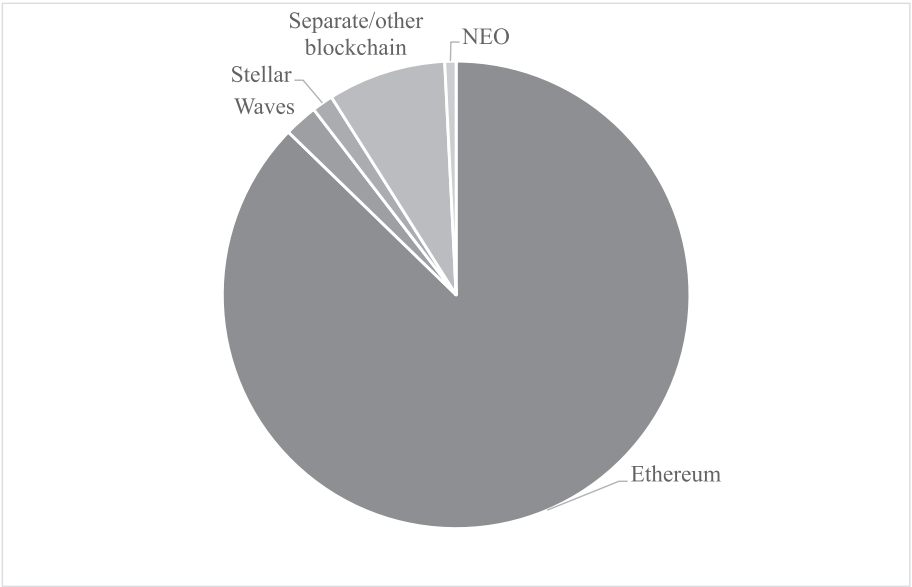

Fig. 1. The dominance of the Ethereum blockchain.

viewed and verified. With public ledgers, decentralized finance generates distributed trust, so transacting parties can transact with each other without pre-existing relationships or trusted intermediary, expanding the scale and scope of potential transactions (Seidel, 2018). In addition, decentralized finance is often built with open source code, so external parties can check business logics to expose all hidden risks and biases, assuring and protecting transacting parties (Narayanan et al., 2016). Moreover, transparent public ledgers and open source code help keep records of all historical transactions, which can help "get to the bottom of any serious financial accident" (Lo, 2012, p. 174).

3. Major business models in decentralized finance

Blockchain technology can lead to the emergence of new business models that were previously not viable. In the financial industries, blockchain technology can reduce the involvement of centralized institutions, encourage experimentation, and broaden access to financial services. Fig. 2 illustrates the rise of some business models. Currently, decentralized currencies are the most common model, followed by contracting and payments.

3.1. Decentralized currencies

National fiat currencies have existed for centuries. Until a few decades ago, currencies were backed by precious metals such as gold, and central institutions were relied upon to manage the backing of currencies with gold. In more recent years, however, fiat currencies are no longer backed by gold. Nowadays, the value of a fiat currency is purely tied to the trust that people have in the specific country's economy, government, and central bank.

Bitcoin is the first decentralized cryptocurrency that is not issued by any country but rather through a decentralized technology (Nakamoto, 2008). Unlike traditional currencies issued by central banks, Bitcoin's supply schedule is fixed and cannot be changed at will, making it anti-inflationary. Given its decentralization, Bitcoin has become the primary store of value in the blockchain industry and is often referred to as digital gold (Popper, 2015). Like gold, Bitcoin is inherently borderless and can be stored and transferred without the involvement of any central entity. Besides Bitcoin, other major decentralized cryptocurrencies include Ether, Litecoin, Monero, Dash, and Zcash, among others.

3.2. Decentralized payment services

Centralized payment networks—such as Visa, PayPal, and SWIFT—facilitate online and offline commerce, but they usually charge relatively high fees for their services, especially for cross-border payments. The cost of payment services remains high, even after the internet has significantly reduced the costs of a wide variety of services.

Decentralized payment networks—such as Libra (Libra Association, 2019) and Bitcoin Lightning Network (Poon and Dryja, 2016)—promise to bring about low-cost, instant, and global payments, solving problems associated with traditional payment services. With a minimal fee, for instance, the Bitcoin Lightning Network offers instant, secure, and irreversible payment services. Because of its low transaction fees, merchants can significantly lower their costs and improve their profitability. Furthermore, merchants that are not

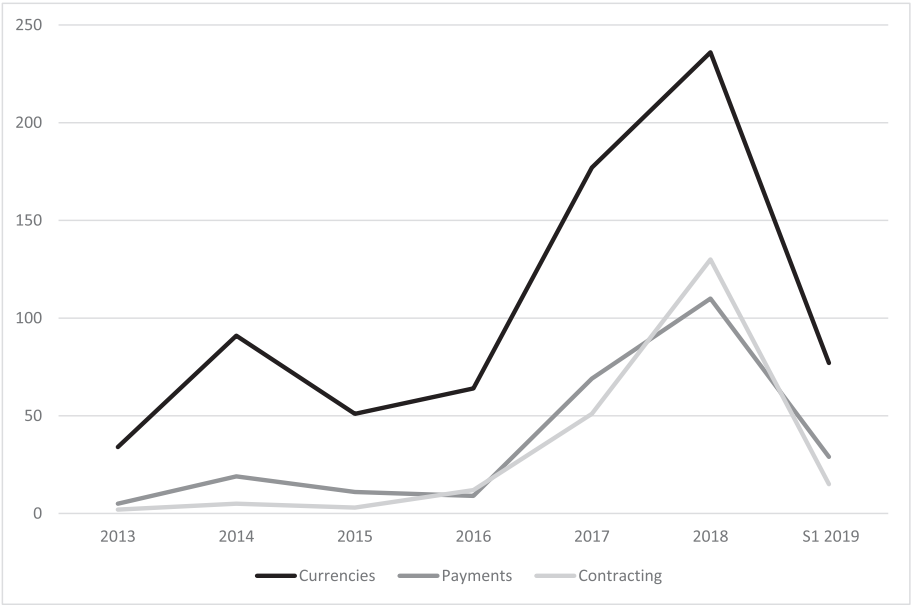

Fig. 2. The rise of blockchain-based financial services.

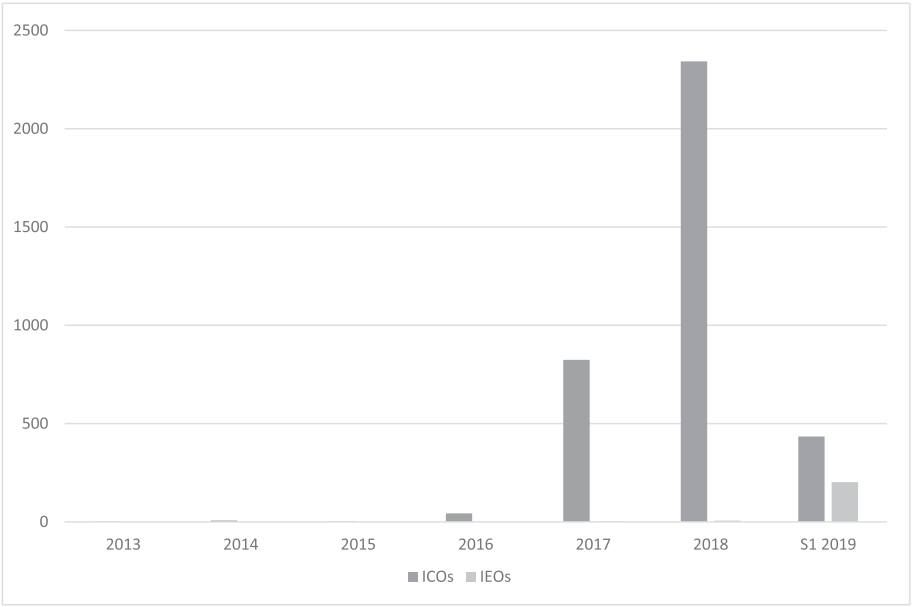

Fig. 3. The rise of ICOs and IEOs.

well-served by existing payment services can now have access to low-cost payments. More importantly, when payments become free or almost free, new business models that are not viable today may become possible (e.g., micropayments), potentially unleashing a new wave of innovation and entrepreneurship. Interestingly, Square—a centralized platform—plans to incorporate Bitcoin Lightning Network into its payment services in the not too distant future.[2] Since decentralized payment services rely on blockchain technology and cryptocurrencies that are inherently global, cross-border payments can now become fast and inexpensive. Ripple is currently a pioneer in this area and has partnered with numerous financial institutions (e.g., MoneyGram) to improve the efficiency of cross-border money transfers.[3]

3.3. *Decentralized fundraising*

Traditional venture financing often involves substantial friction in the fundraising process, as investors may only trust and invest in projects with strong network ties (Hallen, 2008; Hallen and Eisenhardt, 2012). Blockchain technology is reshaping the fundraising landscape (Chen, 2018; Fisch, 2019). One primary form of decentralized fundraising is an initial coin offering (ICO). In an ICO, a project would create a project-specific token on a public blockchain and sell the token to potential investors to raise funds for early-stage developments (Martino et al., 2019a). Over the past few years, ICOs have emerged as an innovative funding mechanism for early-stage ventures, enabling entrepreneurs and innovators to raise billions of dollars from global investors (for a review see Martino et al., 2019b).

An ICO is a potentially powerful way for a project to raise funds and create network effects. As a new form of crowdfunding, it allows a project to raise funds from investors across the globe—thanks to the transparency of blockchain technology, smart contracts, and open source code. By relying on distributed trust created by blockchains, decentralized fundraising can reduce the friction in fundraising, ease access to capital, and thereby promote entrepreneurship and innovation. Furthermore, an ICO is a new way for a project to coopt stakeholders to bootstrap the creation of a new ecosystem (Chen, 2018). Often, an ICO can be especially valuable when a token has inherent utility in the project's products or platforms. Such a token is often referred to as a utility token—it can either be redeemed for certain services or function as the primary medium of exchange. Some projects may issue security tokens, which represent direct ownership or claims on cash flows. A new variant—initial exchange offerings (IEOs)—have recently emerged. Unlike ICOs, IEOs relies on cryptocurrency exchanges to ensure the trustworthiness of potential projects and to connect high-quality projects to potential investors. In IEOs, cryptocurrency exchanges often examine potential projects, provide detailed information on promising ones, and endorse high-quality ones with their own reputation. Fig. 3 shows the rise of ICOs and IEOs in recent periods.

[2] Source: Square CEO Jack Dorsey Says Bitcoin's Lightning Is Coming to Cash App. Available at: https://www.coindesk.com/square-bitcoin-jack-dorsey-lightning-cash-app.

[3] Source: Ripple Announces Strategic Partnership with Money Transfer Giant, MoneyGram. Available at: https://ripple.com/insights/ripple-announces-strategic-partnership-with-money-transfer-giant-moneygram.

3.4. Decentralized contracting

Contracts are essential for markets, firms, and individuals, as they facilitate collaborations and transactions. Yet, contracts can be complicated and costly, due to the costs of negotiating, drafting, enforcing, and renegotiating agreements (Coase, 1937). Especially, financial contracting can be hampered by adverse selection and moral hazard, raising transaction costs while restricting transaction possibilities (Hart, 2001). Traditionally, transacting parties often rely on financial intermediaries to establish trust and reduce transaction costs (Benston and Smith, 1976). Over the past several years, blockchain technology has started to facilitate financial contracting by substituting financial intermediaries with smart contracts, leading to the rise of peer-to-peer financial contracting.

Smart contracts are "programs that automatically execute when pre-specified conditions (i.e., rules) in the protocols are satisfied" (Murray et al., 2019). Smart contracts promise to reduce the complexity and cost of contracting, thanks to their transparency, immutability, automaticity, and programmability. As Cong and He (2019, p. 1755) point out, "programmable decentralized consensus, if achieved, tends to make contracting on contingencies easier, thanks to its temper-proof and automated nature." Smart contracts expand the possible scope of contracting, reduce costs, and facilitate innovations and transactions. For example, decentralized platforms—such as MakerDAO, Compound, and Dharma—use smart contracts to facilitate decentralized lending and borrowing, reducing costs, friction, and delay in such processes (Delphi Digital, 2019).

4. Limits to decentralized finance

Decentralized finance has not reached its full potential yet, due to several challenges related to fraud, volatility, usability, and regulatory uncertainty. First, decentralized finance can be vulnerable to fraud as well as to the proliferation of untested financial innovations. To succeed, decentralized finance needs to cultivate a healthy ecosystem that encourages responsible innovation, such that it can weed out fraudulent actors. Second, decentralized finance tends to build on cryptocurrencies that are volatile, hindering stability and adoption. This problem, nevertheless, is currently being solved by stablecoins, whose value is often pegged to fiat currencies. Third, decentralized finance tends to follow the path of technology push rather than market pull. As the Financial Times reported, "too many projects started with the technology, tried to discern how to make money from it, and worked from there."[4] As a result, many projects tend to focus on technical advancement rather than usefulness and user-friendliness. To penetrate the mainstream market, decentralized finance has to be more user-centric and create real value for users. Fourth, decentralized finance faces substantial regulatory uncertainty and scrutiny, which can deter entrepreneurship and innovation. For instance, Facebook's foray into cryptocurrency and decentralized finance has been met with intense regulatory scrutiny, driving some corporate partners to withdraw their support.[4] For decentralized finance to evolve in constructive ways, a clear regulatory framework supporting responsible innovation is needed. Although challenges abound, many problems can be overcome with the progress of blockchain technology and decentralized finance.

Nevertheless, there may be some fundamental limits that are more difficult to overcome, potentially placing a ceiling on what blockchain-based decentralized finance may be able to accomplish. These limits often center around the nature and characteristics of decentralized platforms and distributed trust. First, building distributed trust on decentralized platforms can be costly. To achieve distributed trust through blockchain technology, a decentralized network often distributes available information to all parties publicly, validates information through distributed consensus, and stores duplicated information across peers (Cong and He, 2019). Achieving distributed trust can dramatically increase the costs of preparing, processing, and storing information (Kumar et al., 2019). As a result, distributed trust often comes with relatively high costs, potentially limiting its applications.

Second, although transparency is a cornerstone of decentralized platforms and distributed trust, extreme transparency may jeopardize privacy. To achieve distributed trust, transaction records are often stored and visible on public blockchains, and they can be misused to endanger user privacy (Feng et al., 2019). To protect user privacy, some public blockchains—such as Monero and Zcash—rely on advanced cryptography to hide user identities and transaction details while still maintaining public records of all transactions. Although this approach can enhance user privacy, it reduces transparency and increases information processing costs due to increased computational overheads.

Third, although the immutability of public ledgers and smart contracts enhance transparency and trust, it can also result in rigidity and inflexibility (Murray et al., 2019). Built on blockchain technology and smart contracts, decentralized finance often inherits such rigidity and inflexibility, potentially impeding experimentation, learning, and discovery. Although smart contracts and decentralized platforms can be upgraded through distributed consensus, achieving broad consensus among key stakeholders to implement major upgrades is often challenging. When consensus is not forthcoming, progress can stall.

Fourth, decentralized finance may lack accountability. With little to no involvement of central entities, it can become unclear who should be held accountable for potential wrongdoings on a decentralized financial ecosystem. In difficult and contentious situations, there may be no central party to resort to. When problems arise, no central party can take actions to freeze transactions, fix problems, and restore normal operations (Palatnick et al., 2019). Without sufficient accountability, decentralized finance may face serious limitations.

Fifth, decentralized platforms are more likely to achieve distributed trust on inputs that can be objectively recorded and verified. Yet, many aspects of businesses and lives cannot be objectively codified or publicly recorded on blockchains, so they may not become the inputs to a system of distributed trust. As a result, a decentralized system of distributed trust may not make full use of all available

[4] Source: How the wheels came off Facebook's Libra project. Available at: https://www.theguardian.com/technology/2019/oct/18/how-the-wheels-came-off-facebook-libra-project.

information, limiting its efficiency and potential usefulness.

Lastly, the operations of decentralized finance tend to rely primarily on the rule of code rather than human judgments. The reliance on the rule of code can be an advantage, as it can reduce subjectivity, uncertainty, and agency costs (Murray et al., 2019). Yet, it can also become a serious limitation, as it may fail to leverage human tacit knowledge and subjective judgment, potentially limiting what decentralized finance can achieve. If not properly addressed, these limitations may restrict the potential value of blockchain-based decentralized finance.

5. Summary

Blockchain technology can reduce transaction costs, expand transaction scope, and empower peer-to-peer transactions, creating a new paradigm for decentralized business models. This new paradigm has led to the emergence of decentralized finance, which leverages blockchain technology to create an alternative financial system that can be more decentralized, innovative, interoperable, borderless, and transparent. Although numerous challenges still need to be addressed, entrepreneurs and innovators have been experimenting with decentralized business models that are traditionally not viable without blockchain technology. If successful, decentralized business models have the potential to reshape existing industries and create a new landscape for entrepreneurship and innovation. Moreover, they may challenge researchers to come up with new theories to explain the potential benefits and costs of decentralization.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbvi.2019.e00151.

Fig. 1 shows the number of blockchain projects that have been built on different blockchains. The Ethereum blockchain has been used by 87% of the projects to date, according to data covering 5652 projects—financial and non-financial—from www.icobench.com by July 2019.

Fig. 2 shows the number of finance-related blockchain projects across several categories, according to data from www.coincheckup.com by June 2019. Currencies include “digital currencies”; Payments include “debit card” and “payments”; and Contracting includes “smart contracts”. The year 2019 includes projects released up to June 2019.

Fig. 3 shows the number of ICOs and IEOs—financial and non-financial ones—that have been launched over the years, according to data from www.icobench.com and www.coindesk.com by June 2019.

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