# DISTRIBUTED AND COLLABORATIVE MARKETPLACES

Blockchain Serving the Unbanked

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Realizing the new promise of the digital economy

In 1994, Don Tapscott coined the phrase, "the digital economy," with his book of that title. It discussed how the Web and the Internet of information would bring important changes in business and society. Today the Internet of value creates profound new possibilities.

In 2017, Don and Alex Tapscott launched the Blockchain Research Institute to help realize the new promise of the digital economy. We research the strategic implications of blockchain technology and produce practical insights to contribute global blockchain knowledge and help our members navigate this revolution.

Our findings, conclusions, and recommendations are initially proprietary to our members and ultimately released to the public in support of our mission. To find out more, please visit www.blockchainresearchinstitute.org.

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Foreword

The New York Times business books bestseller list of 24 August 2014 was one of remarkable contrasts.[1] At the top was Malcolm Gladwell's *Outliers: The Story of Success*, where the successful "are invariably the beneficiaries of hidden advantages and extraordinary opportunities and cultural legacies that allow them to learn and work hard and make sense of the world in ways others cannot."[2] At the bottom was Michael Lewis' *Flash Boys: A Wall Street Revolt*, where trader Brad Katsuyama of the Royal Bank of Canada recounts the moment when he saw the US stock market for what it was—an illusion. "'I realized the markets are rigged,'" he told Lewis. "'And I knew it had to do with the technology.[3] That the answer lay beneath the surface of the technology.'" In a commentary on the book, then-PhD student Elaine Wah wrote,

> *What [University of Michigan professor Michael Wellman and I] found may be even scarier than Lewis' book-selling punchline: it's not simply a matter of the [high-frequency trading] crowd taking profits away from regular investors. Predatory strategies like latency arbitrage have the potential to reduce trading gains for all market participants—high-frequency traders and Average Joes alike.[4]*

Halfway between them, at number five on the list, was Thomas Piketty's *Capital in the Twenty-First Century*, translated from French to English by Arthur Goldhammer. In this 700-page tour de force of academic scholarship, Professor Piketty explained why economic inequality is accelerating and will likely continue to do so as long as the return on capital exceeds long-term economic growth. He wrote about a "modern redistribution" of wealth, not as an explicit transfer of income from the rich to the poor, but as a rights-based "equal access to a certain number of goods deemed to be fundamental," perhaps the "cultural legacies" leveraged by Gladwell's outliers or the high-speed technologies leveraged by Lewis' flash boys.[5]

To us, the bestseller list was a vivid reminder of the disparity between the advantaged and the disadvantaged, those with access and those without, by fate rather than by virtue. For the first time in modern history, the global economy is growing but few are benefiting. On one hand, the digital age is bringing limitless possibilities for innovation and economic progress. Corporate profits are ballooning. On the other hand, standards of living and quality of life have barely moved. Last year, median life expectancy actually

declined in the United States for the second year in a row—something not experienced since the 1960s.[6] Median wages are stagnating in 35 member countries of the Organisation for Economic Cooperation and Development.

According to the International Labour Organization, youth unemployment in most of the world is stuck at about 20 percent. "Young people [are] nearly three times as likely as adults to be unemployed," the ILO reported.[7] In many developing nations, the numbers are significantly higher. Such unemployment is corrosive to all societies, no matter what their level of development. Most citizens want to contribute to their community. Anyone who has been jobless knows how it erodes self-esteem and well-being. Those with power and wealth are getting ahead, and those without are falling behind.

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In Chapter 7 of our book, *Blockchain Revolution*, we called this the "new prosperity paradox." We are reminded of the words of 19th century economist Henry George: "Discovery upon discovery, and invention after invention, have neither lessened the toil of those who most need respite, nor brought plenty to the poor."[8] In 1880, he dedicated his book, *Progress and Poverty*—a prosperity paradox—"to those who, seeing the vice and misery that spring from the unequal distribution of wealth and privilege, feel the possibility of a higher social state and would strive for its attainment."[9]

Setting aside the merits and disadvantages of modern redistribution, we found ourselves wondering whether blockchain technology could enable individuals to begin deriving benefits from the data they generated from their birthday forward. For every newborn, could we create a digital identity, protect it in "digital black box," and license the baby's parents to decide whether to share that information, with whom, and for access to which services—without ever revealing their child's identity? Could we change how wealth gets created in the first place by democratizing wealth creation, engaging more people in the economy, and then ensuring that they get fair compensation? Could we hold these truths to be self-evident, that all human beings were created equal and endowed with certain inalienable rights, that we could codify and capture on the blockchain in perpetuity? In other words, could we pre-distribute wealth through blockchain technology?[10]

Could we change how wealth gets created in the first place by democratizing wealth creation, engaging more people in the economy, and then ensuring that they get fair compensation?

In our book, we explored several ways to do this, among them eliminating the middleman in personal financial transactions such as remittances and turbocharging peer-to-peer transactions involving such assets as spare rooms, ride-shares, or underutilized equipment such as lawnmowers, special kitchenware, boat motors, musical instruments, or sports paraphernalia—without such intermediaries as Airbnb and Uber. We examined putting land titles on blockchain to ensure that the rightful landowners—especially in volatile developing countries—could leverage their property rights.

Are these disruptive? Yes. Fairer? Yes. Vital to global stability? Absolutely! Are we making progress? Not nearly enough. "Our collective inability to secure inclusive growth and preserve our scarce

resources puts multiple global systems at risk simultaneously," said Klaus Schwab, founder and executive chairman of World Economic Forum. "Our first response must be to develop new models for cooperation that are not based on narrow interests but on the destiny of humanity as a whole."[11]

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◇ KLAUS SCHWAB
  Founder and Executive Chairman
  World Economic Forum

We couldn't agree more. Rachel Robinson feels as passionate as we do on the matter. This research project was designed to catalyze entrepreneurial thinking and action in the area of global economic inclusion, where financial inclusion is a prerequisite. Rachel interviewed several of the pioneers in the collaborative marketspace—among them Elizabeth Rossiello, founder of BitPesa; Vladimir Grinevsky, project advisor to MicroMoney; and George Li, co-founder of WeTrust—and analyzed the start-ups, M-Pesa and Veem. We see the potential of blockchain to open up the economy so that it works for everybody, and everybody's rights work for them. It is our hope that this research will motivate Blockchain Research Institute members to explore how their own organizations could innovate to be more inclusive.

◇ DON TAPSCOTT AND ALEX TAPSCOTT
  Co-Founders
  Blockchain Research Institute

Children of Uganda by Charles Nambasi (Numbercfoto), 2005, used under CC0 1.0.

Idea in brief

» Intermediaries facilitate the functioning of our financial system by coordinating the exchange of value by acting as a trusted middleman and performing business logic like clearing, settling, and record keeping. They should use blockchain technology to extend their reach, and offer financial services to the unbanked and underserved, thereby creating new revenue streams and increasing financial inclusion.

» Intermediaries cost market participants money and time at each phase of a transaction by collecting fees to support overhead costs of physical facilities, human resources, regulatory compliance, and profit. While intermediaries play a crucial role in the current financial system, the fees create a barrier to entry for many, thus limiting opportunity and innovation in the global market.

» Blockchain technology creates a platform for people to trade with each other directly without the hierarchy, cost, and friction inherent in the current financial infrastructure. As with all new technologies, this shift to distributed and collaborative marketplaces may be a perceived threat to incumbents who do not see the potential and who are afraid to move on it.

While intermediaries play a crucial role in the current financial system, the fees create a barrier to entry for many.

» Future financial intermediaries will build customer ecosystems around blockchain technology into previously unreachable markets and improve service provisions in current markets. Blockchain will increase participation and competition in financial services, unlocking creative potential, and opening doors to greater global prosperity.

» While some intermediaries have embraced blockchain as a cost-saving tool, they would be smart to consider the revenue side of their business and ask themselves what new products, services, and markets open up because of the blockchain.

Introduction

A network of heavily regulated intermediaries facilitates transactions between parties by reconciling transaction data and assuming some of the inherent risk to make the current financial system possible. This network was developed piecemeal, in response to different needs at different times and utilizing different technologies. Within this network, financial institutions maintain proprietary ledgers of transactions with minimal transparency into each version. Therefore, these institutions, and all market participants must invest in costly software to reconcile transaction data, which remains vulnerable to error and fraud. They must also submit to periodic audits to ensure their proprietary ledgers have been recorded accurately.

If all relevant parties could see the same ledger of transactions at the same time, then it could eliminate the expensive inconveniences and much of the accompanying risk; everyone could easily work from one accessible source of truth. Enter blockchain.

Blockchain technology is computer software that provides an immutable, transparent, fraud-proof ledger that shares transactions between participants in real-time via the Internet. With an Internet connection, a smart device, and access to a blockchain ecosystem, financial opportunities can be at the fingertips of those in previously unreachable markets. Blockchain can function within, without, or alongside current financial systems, opening economic possibilities for newcomers and incumbents alike. Indeed, some estimates predict that blockchain technology can save the financial sector as much as $20 billion annually in compliance and infrastructure costs.[12]

The solution to financial exclusion around the world

The primary hallmark of financial inclusion is access to financial services, namely a bank account that affords the basic kinds of services: a means to move and store value and access credit. Those currently excluded from the global economy are sometimes served—if they are served at all—by micro finance organizations such as the Grameen Foundation, Vaya India, Bharat Financial Inclusion Limited (formerly SKS Microfinance), and Oxfam International. Traditional banks rarely serve these people. Indeed, the World Bank's recent *Global Findex r*eport, which measures financial inclusion around the world, estimated that two billion adults are unbanked.[13]

The unbanked and financially underserved span the globe: Africa, Latin America, India, and even the United States. Some populations are excluded from the financial sector for three reasons:

» Lack of government resources to build an infrastructure to reach physically hard to access people

» Corruption in the financial sector

» Inability to create an economic identity

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Blockchain technology requires little infrastructure and is an inherently trustworthy, agnostic technology; it can disrupt corrosive practices and support equitable economic growth throughout the world's poorest regions.

Woman in Black Hijab Headscarf Walking on Field by Samuel Silitonga, 2017, used under CC0 1.0.

The current system

Trade used to be relatively simpler. A merchant or an investor exchanged assets of value for payment. Financial transactions are now complex and multinational, and we have a system of intermediaries (e.g., securities clearing houses, banks, exchanges, and broker-dealers) that manage and verify them. As markets became more complex, governments created regulations to protect investors from abuses and harmful systemic practices of intermediaries and other financial institutions. As a result, the current global financial infrastructure consists of many different service providers who handle different aspects of the trade process and are subject to different regulations.

Every legal jurisdiction in the world has its own laws and procedures governing financial transactions, sometimes even within their national borders. For example, in the United States, federal and state governments regulate securities differently. The federal government focuses on disclosures while states regulate risk. That is, an entity issuing corporate shares violates federal securities laws when it fails to disclose required information and leaves the risk-reward analysis to investors themselves. A state, however, may disallow an offering within its jurisdiction if it deems an offering too risky.

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Meanwhile, international financial institutions and service providers must be mindful of cross-border requirements. Many regulators have joined regulatory consortia that attempt to set broad principals to guide regulators in their rule-making and supervisory roles to lessen the potential of unduly restricting international trade through redundancy and expense.

The Financial Stability Board (FSB) is an international body made up of prudential and securities regulators that make recommendations about the global financial economy. The International Organization of Securities Commissions (IOSCO) gathers to set global standards for securities transactions. The Basel Committee on Banking Supervision (Basel) provides an international forum for analyzing banking supervisory issues and prudential regulation.

These entities seek to ease regulatory friction through collaboration and consensus on general financial principals. They intend to increase predictability and decrease compliance redundancy for regulated entities. Similarly, these consortia likely hold the key to coherent regulation of blockchain as applications rapidly move from ideas to proofs of concept to pilots to mass release on the global stage.

Peer-to-peer collaborative markets in the making

Weaknesses in the current system

Silos of information maintained in centralized databases require costly software to reconcile and are especially vulnerable to cyberattacks and technical failure. Because each part of the current system has been assembled piecemeal over time, it is not well integrated.[14] Moreover, many processes are still manual, causing delay and risk of error and fraud. Though digital technology has been sutured to this technology stack, it's mere digital wallpaper, concealing the kludge of technologies beneath.[15]

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The global financial system's evolution has been a "march against friction."[16] An IBM executive report identified three persistent and interrelated frictions that impede global business and trade: information friction, interaction friction, and innovation friction.[17]

» *Information friction*. Imperfect or inaccessible information puts transaction participants at a disadvantage when making decisions. Incorrect or inconsistent information reduces transaction value by causing delays in reconciliation. In this new age of big data, the technical challenges, including cyberthreats to data storage on centralized databases, accompany data processing and analysis, which diminishes the value of information.

» *Interaction friction*. Transaction costs resulting from complex business practices limit interactions and create barriers to certain markets.

» *Innovation friction*. "Institutional inertia and restrictive regulation" stifle innovation in larger organizations that are subject to comprehensive regulations.[18] Regulatory uncertainty deters innovation and investment in start-ups.

Many individuals and businesses have been excluded from the benefits of a robust suite of financial services because of the costs associated with these frictions. Fixing these problems in developed markets, where legacy financial and technology infrastructure is firmly rooted, will be challenging. But in the developing world, where most of the world's unbanked live, we have less to tear down and, thus, have a better chance to reinvent the industry from the ground up with new ideas and, importantly, blockchain.

In the developing world we have a better chance to reinvent the industry from the ground up with new ideas and, importantly, blockchain.

Financial exclusion and inclusion defined

Financial exclusion refers to individuals' lack of access to financial services. The most common indicator is the lack of a bank account; however, even those with bank accounts may not know how to use them. As a result, some individuals may abandon their accounts and suffer economic consequences such as overdraft penalties. In contrast, financial inclusion is a broad concept that speaks to the convenient, affordable, and safe access to financial services and education.[19] Within this group, people have access to the full suite of financial services that include provisions for ensuring that they make informed financial decisions.[20]

According to the World Bank's Global Findex Database, two billion people around the world are unbanked.[21] The Center for Financial Inclusion reported that the lower 40 percent of the population in emerging economies constitute $3 trillion in annual spending and disposable incomes continue to rise.[22] In total, the financially excluded make up a $380 billion market revenue opportunity for institutions that can find a way to provide services efficiently and inexpensively.[23]

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Peruvian economist and president of the Institute for Liberty and Democracy Hernando de Soto, one of the world's foremost economic minds, suggests that as many as five billion people in the world are barred from participating fully in the value created through globalization because they have a tenuous right to their land. Blockchain, he argues, could change all that.

> *The central idea to blockchain is that the rights to goods can be transacted, whether they be financial, hard assets or ideas. The goal is not merely to record the plot of land but rather to record the rights involved so that the rights holder cannot be violated.*[24]

Universal property rights could lay the groundwork for a new agenda of global justice, economic growth, prosperity, and peace. In this new paradigm, rights are protected, not by guns or militias or minutemen, but by technology. "Blockchain is for a world that's governed by real things instead of fictitious things. And I think that's good," said de Soto.[25] And it's decentralized. No central authority controls it, everybody knows what's happening and it remembers forever.

Financial exclusion deprives individuals of access to life, liberty, and property, and it impedes development.

Financial exclusion deprives individuals of access to life, liberty, and property, and it impedes development. The overall economic participation of a nation's citizens increases its overall wealth. To that end, financial inclusion strengthens society because it spurs innovation and creates more wealth. By tapping into the potential of as many citizens as possible, a nation builds a strong economic base that can adapt to changes in the global economy.

Blockchain can construct new bridges leading to a more innovative, frictionless, inclusive future. By developing resilient economic bridges, nations can tap into each other's potential and further strengthen their economies while contributing to advancing humankind.

Action Analysis Business 2277292 by rawpixel, 2017, used under CC0 1.0.

Causes of financial exclusion

There are many reasons for financial exclusion: politics, war, natural disasters, corruption, lack of physical infrastructure, and lack of capability. In certain emerging economies, a wealthy minority may purposefully promulgate laws that perpetuate their monopoly on the country's wealth in what economists call "rent seeking behavior." Corruption lowers trust in emerging markets, thus restricting liquidity and impeding foreign investment. Those who would open a

bank account, start a business or pay taxes may think twice when the possibilities for corruption and abuse are commonplace. The upshot is that most economic activity is informal, trapped in the grey economy or black market. In less-developed countries, the physical infrastructure required for traditional financial institutions may not exist, compounding the difficulties for individuals to access and use available financial services.

For example, individuals who live in rural areas in less-developed countries may not have access to proper roads or public transportation to go to a bank and open an account physically. Nor do they have access to education that would enable them to learn online: while literacy rates continue to rise with each generation, an estimated 750 million adults (two-thirds of whom are women) remain illiterate.[26] Because of this lack of access, these populations are not able to learn about how financial services can improve the quality of their lives.

Underserved populations in highly developed nations also suffer from a lack of financial capability and access. For example, according to England's Financial Inclusion Commission, at least one million of its citizens are unbanked, and nine million have no access to credit.[27] In the United States, the Federal Deposit Insurance Corporation (FDIC) estimates that nine million households are unbanked, and 24.5 million households are underbanked.[28]

For the financially excluded, access to financial services is more expensive because this population may only qualify for high-interest loans and credit cards and may miss out on discounts those who are included are given for using digital payment systems.[29] Consequently, many new bank account holders incur penalties that supersede the amount they deposit. Ultimately, these expenses add up to a "poverty premium" that prevents the financially excluded from enjoying the benefits of financial services.[30]

Resolution of friction

Blockchain technology cannot prevent wars, natural disasters, or other political instabilities, but it can help individuals and businesses overcome some of the frictions.

Blockchain technology cannot prevent wars, natural disasters, or other political instabilities, but it can help individuals and businesses overcome some of the frictions identified above in the following ways:

» *Information friction resolved.* All transaction participants access the same source of truth in near real time, making reconciliation unnecessary. Additionally, information stored on a blockchain is highly resilient. That is because the data are replicated on all computers on the network and persists even if one or even many computers fail.

» *Interaction friction resolved.* Transaction participants can trust the authenticity of data on a blockchain, which eliminates data reconciliation costs. This increases interactions and lowers barriers to underserved markets.

» *Innovation friction resolved.* Despite regulatory uncertainty, entrepreneurs, investors, technologists, and large financial institutions have charged ahead into the blockchain territory. These innovators seek to use the technology to solve important problems in the world and they endeavor to understand how they can improve it so that solutions can move from proofs of concept to scale.

Because payment systems administered on a blockchain do not require intervention from the government or intermediaries, users can circumvent unstable currencies, corrupt practices, or abuses of power that negatively affect trade and finance.

The potential for blockchain solutions

Digitization and agent banking

The digitization of financial services is allowing financial institutions to go where no other institutions have gone before—into the $380 billion global market made up of low-income customers and small and medium enterprises.[31] In July 2016, the Center for Financial Inclusion published a study of 24 banks in emerging economies to determine what they are doing to increase financial inclusion in their regions.[32]

The primary ways that these banks reach excluded regions are through digitization and agent banking. Digitization takes advantage of the proliferation of mobile devices to provide access to account holders. Agent banking consists of a network of agents that replace bank branches as the in-person touch point for customers. These tactics help banks in emerging economies leap frog the cultural and physical barriers that typically impede customer access to traditional banks.

A major obstacle that these banks encounter when trying to administer agent-banking networks is the lack of internal technological capability. Traditional banking systems were created to function within a bank branch.[33] Any technology serving the agent networks must address compliance, risk, operations, and information security in order to be viable.[34] Additionally, these agents operate in low-margin markets, so the cost of service provision, data collection and analysis, and identity verification can prevent outreach altogether.

There are also concerns surrounding data management: privacy, security, cost, lack of ability to analyze data, lack of parties' willingness to share data, and regulations surrounding these issues.[35] Existing protocol for sharing data are weak or non-existent in some emerging economies, which creates confusion, especially where regulators have a hard time keeping up with the pace of technology.[36]

Blockchain could be an efficient, low-cost, and safe technology solution for managing banking agent networks. Costs would stay low because the settlement of transactions would be automated;

usage data could be easily accessed and shared with different bank divisions and across financial institutions so that each unit could identify and cross-sell appropriate financial products. Data would be maintained on internal servers, eliminating the cost and risk of maintaining those data on centralized servers, thus safeguarding identities and reputation.

Grandmother kids laptop by Sasin Tipchai (sasint), 2016, used under CC0 1.0.

Identity management

Many governments have begun to create digital identities based on biometrics. These digital identities are stored on centralized databases, where data can be used to prove identities across platforms. The most notable example is aadhaar in India.

Besides lack of access and capability, another key reason for financial exclusion is that individuals cannot prove their identity. Those financially excluded may reside in highly developed nations as well as in emerging economies. In response, many governments have begun to create digital identities based on biometrics. These digital identities are stored on centralized databases, where data can be used to prove identities across platforms. The most notable example is *aadhaar* in India.

In 2009, India passed the Aadhaar Act, which empowered the Unique Identification Authority of India (UIDAI) to create a 12-digit unique identification (UID) number, called an *aadhaar* (which means *foundation* in Hindi) for all the residents of India.[37] The purpose of aadhaar is to provide a digital identity that can be authenticated anywhere at any time.[38] Enrollment agencies spread throughout the country to collect demographic information, including eye scans and digital fingerprints. The identity information is stored in the Central Identities Data Repository (CIDR), which answers requests for verification instantaneously.

The Aadhaar Act stipulates that the aadhaar number must be accepted as proof of identity any time identity information is required.[39] In April 2016, the National Payments Corporation of India (NPCI) unveiled the *unified payment interface* (UPI) which makes peer-to-peer (P2P) and e-commerce payments easier by, among other things, allowing the aadhaar number to serve as payment verification. This system works well in India, with 99 percent of adults participating according to *The Hindu*.[40] Anyone with an aadhaar number can use it to complete any transaction, such as exchanging commerce or receiving government benefits. There are, however, three potential weaknesses to using digital identities:

» The system stores all of the identity information in a centralized database, which must be monitored and secured from cyberthreats or system failures. Were these systems to be hacked or damaged, many people could lose their identities. (In January 2018, a journalist provided evidence that the aadhaar system had indeed been hacked, exposing the personal data of 1.19 billion Indians.)[41]

» While other, lower income countries could benefit tremendously from digital identities, P2P commerce, e-commerce, government benefits, and intervention by NGOs, the process of creating these identities may be too expensive.

» The government, not individuals, owns identities; therefore, citizens can use their digital identities only within the country's borders for purposes prescribed by the government.

Blockchain technology could improve this system by decentralizing it (making it more secure) and giving more agency to individuals over their data (making it more private). In practical terms, governments could avoid the costs and risks of maintaining large databases. Digital identities would require little physical infrastructure: computers, Internet connections, and biometric scanners. The government could strategically place agents throughout the country to collect biometric information. Those data could then be cryptographically hashed (stored in a way where the original information is obfuscated) on a blockchain so that individuals can use the "proof" of their biometric data without having to give it to the government or a corporation, where it could be misused, hacked, or stolen.

It's a win-win. Individuals win because they have better privacy, and firms win because they have better and more accurate information to satisfy regulatory requirements.

Biometric information is but one example: using their mobile phones, individuals could also upload various data such as their addresses and then prove their residency without revealing the actual address. We could use this capability in a myriad of applications, from opening a bank account to voting in an election. It's a win-win. Individuals win because they have better privacy, and firms win because they have better and more accurate information to satisfy regulatory requirements, such as *know your customer* (KYC) rules. The identity information is portable: individuals could use it to identify themselves for any purpose in any location, such as for medical treatment, foreign aid, or international travel.

Indian Street Vendor Selling Sweets by Vitamin (M Ameen), 2014, used under CC0 1.0.

BanQu is a for-profit software technology company that seeks to use blockchain technology to connect unbanked and underserved people to the global economy and to provide them with secure and portable digital identities. BanQu has created an identity application on a blockchain that runs on any cell phone and allows individuals to control their own data and share their identities as needed and to build a credit history that they can use in the global economy.[42] Thus, an individual's identity and the associated data belong to that individual and confer benefits to that individual.

BanQu's vice president of account management, Shailee Adinolfi, explained, "Our belief is that end users should have control of their data and permissioning capabilities."[43] Because over 60 percent of the unbanked have access to cell phones, BanQu's application will provide economic access to more people than ever before. The identity stored on BanQu's application is different from that of current centralized digital identities in that it is transactional; it presents a full identity by tracking an individual's various transactions rather than static characteristics.[44]

"Our belief is that end users should have control of their data and permissioning capabilities."

SHAILEE ADINOLFI
*Vice President of Account Management
BanQu*

Individuals are on-boarded into the BanQu system by trusted organizations within the country where they are located. The BanQu application program interface then pings all of the individuals' activities and aggregates it onto one platform secured on a blockchain.[45] Unlike aadhaar and other centralized identities, BanQu is more than just a digital identity; it is the combination of an "ID, wallet, and records together in one small package, accessible by any Internet enabled device."[46] The application is currently live in Jordan, Kenya, Indonesia, and will soon be operating in the Congo.

The minimum infrastructure required to trade is a smartphone with Internet. In regions where traditional financial services are lacking, people can use cryptocurrency.

Payment systems

Blockchain technology can improve current systems by simplifying information sharing and securing digital identities, but its potential is truly unlocked when it is used to transfer value. Blockchain secures and transfers digital representations of value via cryptocurrencies to provide the possibility for full economic participation because transaction participants do not need bank accounts. The minimum infrastructure required to trade is a smartphone with Internet. In regions where traditional financial services are lacking, people can use cryptocurrency.

Consider Venezuela, where political unrest has caused hyperinflation of the Venezuelan bolivar. As of this writing, the official exchange rate was around 10 bolivars to one dollar.[47] However, the black market rate (the rate that the Venezuelan public uses) was approximately 41,153 bolivar to one dollar, and has been fluctuating wildly.[48] CNBC interviewed Daniel Osorio of Andean Capital Advisors in late September 2017. He described how citizens have resorted to utilizing bitcoin mobile payments to purchase a five-dollar lunch:

> *The equivalent of a four to five dollar lunch at the black market exchange rate is well over 100,000 bolivar. Up until recently, the largest denomination was 100 bolivars. Therefore, you needed an entire backpack full of cash to pay for lunch … The country is not yet dollarized. Usually, in a place … that experiences hyperinflation, the…people just start transacting in dollars. There is not enough dollars in Venezuela for that to have happened. [So] you wire the money to the owner of the restaurant. … It's becoming a cashless society. … And we are beginning to see, potentially, the first bitcoinization of a sovereign state.[49]*

Marches in Protest in Venezuela by Maria Jose Ramirez Braiz, 2009, used under CC0 1.0.

Several countries are experimenting with cryptocurrencies. A sovereign cryptocurrency could drastically change how the financially excluded participate in the economy. Currently, those who use mobile money must typically still use cash to reload their phones, or they may want to exchange their mobile money for cash. Obtaining cash requires traveling to store fronts that may be far away. Even if the stores are nearby, they may be out of cash because of the difficulties in transporting cash to rural areas.

If we digitized all sovereign currency, then we wouldn't have as great a need for cash. Individuals with mobile devices could manage their finances. Combined with digital identity systems that use blockchian, banks could more easily get to know their customers and provide appropriate financial services. Likewise, regulators would more easily be able to detect irregularities in the market early enough to prevent crimes and crises.

Remittances

Blockchain technology allows for cheaper and more transparent remittances in two ways:

» *The transmission of sovereign currency from one bank account to another.* An individual or entity would initiate a payment from a bank or through a money transmitter that is operating on a blockchain. The payment would automatically be added to the receiving bank account in near real time without the risk of error or fraud.

» *The transfer of cryptocurrency from one wallet to another.* An individual or entity could transfer cryptocurrency through the same, simple mechanism with instantaneous transfers and minimal or zero fees.

Remittances are cross-border payments that can be peer to peer, business to business, or business to consumer. According to the World Bank, "Remittances are an important and fairly stable source of income for millions of families."[50] In 2015, $431.6 billion in remittances were reportedly sent to developing countries.[51] Payments are also sent to businesses in emerging economies, especially *small and medium enterprises* (SMEs) that are not able to support high transaction fees. Blockchain technology could potentially allow this "missing middle" to buy and sell on the global market.

Small and medium enterprises play an important role in emerging economies, contributing up to 60 percent of formal employment and creating an estimated four out of five new jobs.

An SME is a business that generates revenue, maintains assets, and/ or employs a number of people below a certain threshold defined by the jurisdiction within which it is domiciled.[52] SMEs play an important role in emerging economies, contributing up to 60 percent of formal employment and creating an estimated four out of five new jobs.[53] The World Bank estimates that SMEs make up 40 percent of GDP in emerging economies.[54] Nevertheless, these important businesses are constrained by the inability to access proper financing. Although the expanding workforce will need an estimated 600 million jobs over the

next 15 years, around 70 percent of SMEs lack access to the formal credit that will allow them to meet this demand.[55]

With blockchain technology, SMEs can thrive and expand in three ways:

» They can receive funds from investors cheaply and easily from anywhere in the world.

» They can begin to establish credit histories on the blockchain that they can use to secure financing as lenders can attest to their accuracy.

» They can reach a wider market with their goods. For example, the rural carpet maker in Mexico can sell her wares on the Internet for cryptocurrency, which, if she so chooses, can then exchange for pesos from her mobile device. She can also accept cross-border payments directly into her bank account in any currency if her bank or local money transmitter implements a fee-free, blockchain-based payment system.

Economy Barclays Remittance Money Transfer by AMISOM Public Information, 2013, used under CC0 1.0.

Initial coin offerings are opportunities to buy tokens that represent a stake in a new company, technology network, or protocol or that provide access to the application the company is building.

Investing opportunities: Initial coin offerings

Initial coin offerings (ICOs) are investment vehicles wherein people buy tokens that represent a stake in a new company, technology network, or protocol. Sometimes, the tokens provide access to the application the start-up is building. In that case, a token represents membership to the service that the start-up provides (like a high-tech book of the month club).

ICOs are similar to *initial public offerings* (IPOs) of corporate shares in that investors can hold and resell their tokens later for a profit if the company becomes successful. However they are different from IPOs in that they can be tailored and customized to virtually any kind of asset, rather than simply shares. ICOs are also different from IPOs in that the purchase and sale of tokens are P2P transactions that take place on a blockchain—no need for investment bankers, custodians, clearinghouses, and stock exchanges.

If investors decide to sell their tokens on the secondary market, they can do so peer to peer, through a centralized exchange or increasingly, through decentralized exchanges, essentially smart contracts where order books are maintained and transactions in tokens self-execute peer to peer. Because of the lack of intermediaries or heavy regulation, ICOs are a more seamless, immediate way for start-ups to raise funds for their projects.

One benefit of ICOs for start-ups is that they provide a fast, direct, and convenient way for individuals to invest in innovative ideas at the early stage. Individuals may see ICOs as a way to get involved with start-ups at the grass roots and be part of their community as they scale to launch their products or platforms.

Another benefit is liquidity. Whereas a typical venture capital investment might remain private for years, if not indefinitely, ICOs offer investors liquidity early in the life cycle of an investment.

ICOs provide capital and public buy-in for their innovations. Not only do these start-ups garner the money needed to innovate quickly in this fast-paced space, they also have a market for the product once complete. Creating a market is especially important for blockchain

If investors decide to sell their tokens on the secondary market, they can do so peer to peer, through a centralized exchange or increasingly, through decentralized exchanges, essentially smart contracts where order books are maintained and transactions in tokens self-execute peer to peer.

Gambian Women on the Beach by Hella Nijssen, 2013, used under CC0 1.0.

ICOs come with their own set of risks but they also provide opportunities for more people to invest in the blockchain space and for start-ups to receive funding for their innovations.

start-ups, as they require communities that cross networks of participants. Having networks in place once the products launch helps to ensure success.

Nevertheless, there may be problems with the relationships start-ups have with ICO investors. There are also concerns about fraud and proper disclosures. When a start-up launches an ICO, the founders may not build relationships with their investors. In contrast, those start-ups that turn to venture capital firms, angel investors, or incubators, may benefit from mentorships that can help them succeed. Such start-ups are more accountable and more inclined, or contractually obligated, to spend investment funds wisely.

ICOs do not enforce that type of responsibility on the founders of start-ups nor do they present the same opportunity to learn from people who have succeeded at business before. This lack of accountability, to say nothing of minimum regulatory oversight, may contribute to fraud. Some promoters of ICOs create websites and announce projects that they do not intend to complete. They may also be utilizing the promise of this new technology to carry out unlawful investment schemes.

To help monitor and prevent this harm to investors, the US Securities and Exchange Commission (SEC) has assigned its cyber unit to oversee ICOs. The SEC also determined that some ICOs are, in fact, securities offerings and that their issuers must register with the SEC.[56] According to the SEC, an investor should consider the following before investing in an ICO:

» *Whether the offering must be registered with the SEC or is subject to an exemption.* Under the Howey Test, the SEC defines a security as an investment of money in a common enterprise with an expectation of profits earned predominantly from the efforts of others.[57]

» *What the funds will be used for.* The start-up should have a clear business plan that includes how investors can spend the funds and an explanation of investors' rights.

» *Whether the investor can afford to lose the money invested.* If an ICO is found to be fraudulent or to violate securities laws, law enforcement has limited ability to recover the funds. The promoters, third-party wallet services, payment processors, and virtual currency exchanges are located all over the world and may be outside of local law enforcement's jurisdiction.
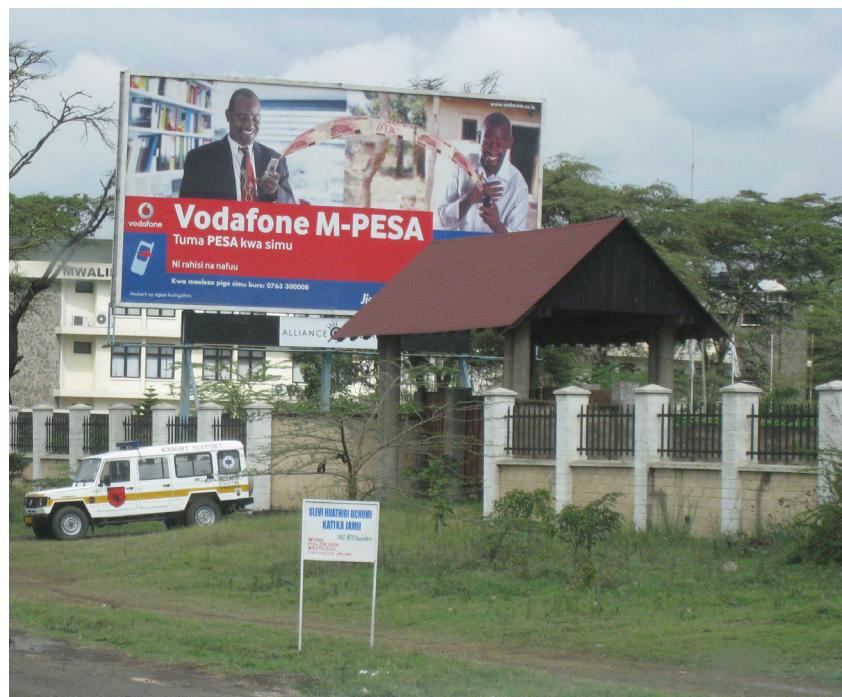
ICOs come with their own set of risks. However, they also provide opportunities for more people to invest in the blockchain space and for start-ups to receive funding for their innovations.

M-Pesa versus BitPesa

M-Pesa

In 2002, the Department for International Development UK funded research that revealed information that led to possible mobile banking solutions in Africa when it reported that people in Uganda, Botswana, and Ghana were trading airtime minutes as currency.[58] Five years later, in March 2007, Vodafone, launched M-Pesa initially to allow microfinance borrowers to receive and repay loans from their mobile phones.[59] In Kenya, Safaricom, a local telecom company, operates M-Pesa and Vodafone owns, hosts, and develops it.[60]

Mobile Phone Payment Service by Jerry Michalski, 2008, used under CC BY-SA 2.0.

A blockchain-based mobile payments app could eliminate the cumbersome and sometimes dangerous repayment process of a microfinance institution.

M-Pesa's pilot began in 2005 in collaboration with the *microfinance institution* (MFI) Faulu Kenya. Faulu was a local MFI with thousands of borrowers, most of whom ran small businesses. M-Pesa developers thought that Faulu's customers would benefit from the mobile payments app because of its cumbersome repayment process. Borrowers made loan payments in person to a group treasurer every week.[61] A group of the borrowers would then act as bodyguards and escort the treasurer on the risky journey to the nearest bank.[62] Mobile payments were to eliminate the time, cost, and physical danger involved in that process.

Unfortunately, because of Faulu's complicated manual back-end processes, Vodafone decided a mass-market launch with an MFI was not feasible.[63] Instead, the developers decided to use M-Pesa for cash

withdrawals and deposits, P2P payments, and to buy prepaid airtime from Safaricom.[64]

As an alternative to signing up for a bank account, users register an M-Pesa account with a Safaricom dealer, exchange cash for e-money, and then use their mobile phone to transfer money to other mobile phone users within Kenya.[65] While the service and deposits are free, M-Pesa charges senders a fee that varies based on the type and amount of the transaction.[66]

As an alternative to signing up for a bank account, users register an M-Pesa account with a Safaricom dealer, exchange cash for e-money, and then use their mobile phone to transfer money to other mobile phone users within Kenya.

BitPesa

In November 2013, Elizabeth Rossiello founded BitPesa, which utilizes the Bitcoin blockchain to facilitate remittances in and out of Africa. Rossiello started this company to solve the problem of "… the very high cost of remittances in Africa."[67] An apt example is that Western Union and MoneyGram International Inc. charges up to a 12 percent fee to send funds to Kenya from the United States.[68] These transactions are both expensive, and they take up to five days or more to process.[69] BitPesa promised to provide immediate payment processing for a three percent fee, which is a fourth of what traditional money transmitters were charging.[70] BitPesa kept its promise with fees that range between one and three percent, depending on the size of the transaction.[71]

Rossiello also wanted to remedy the risky, cumbersome ways SMEs completed international payments. For example, some SMEs would send a representative abroad with large amounts of cash. Traditional intermediaries would wire money to a hotel abroad, send a representative to retrieve and exchange the money, then hand-deliver it to the intended recipient.[72] She saw bitcoin as a simple, intuitive, secure alternative.[73]

BitPesa promised to provide immediate payment processing for a three percent fee, which is a fourth of what traditional money transmitters were charging.

Initially, to use BitPesa, a sender would buy bitcoin and specify where to send it. This process was fine for the early adopters who were technologists familiar with bitcoin and excited to use it for their international P2P remittances. BitPesa now accepts any currency and submits the equivalent bitcoin to an exchange that then delivers the local currency equivalent into the receiving account. While transactions can be bank to bank, bitcoin transactions obviate the need for the respective banks to have a corresponding relationship.

M-Pesa and BitPesa similarities and differences

While M-Pesa and BitPesa both seek to simplify payments through mobile technology, they have their differences. M-Pesa started as a platform for *intra*national payments for the extremely poor in rural Kenya while BitPesa immediately provided intra and international payments for SMEs and urban individuals in Kenya. M-Pesa is mobile money, which is a closed system. That is, users can make payments only on the mobile network. Bitcoin is a borderless currency that BitPesa can transfer across systems, including mobile money rails. Finally, unlike BitPesa, M-Pesa places limits on transfer amounts, limiting its usefulness to growing businesses.

M-Pesa and BitPesa both dealt with implementation challenges. At the start, M-Pesa had to contend with users' technological education, many of whom were semi-literate and had never accessed financial services.[74] BitPesa customers, on the other hand, were more financially and technologically savvy from the start. Also, for BitPesa to use bitcoin, it did not require teams of experts from various sectors. Rather, a software developer could log BitPesa into the Bitcoin ecosystem and start doing business.

M-Pesa had to collaborate with global telecommunications companies, banks, and microfinance institutions while addressing their respective, at times contradictory, regulatory requirements.[75] Similarly, although bitcoin is not subject to the burdensome regulations with which M-Pesa had to grapple, BitPesa has dealt with regulatory resistance.

Initially, African regulators put BitPesa in a state of limbo because, while they did not go so far as to make bitcoin illegal, some simply disallowed BitPesa to enter their market. In an interview with *Forbes* in June 2016, Rossiello opined, "It's sad to say that, in some markets, the regulator is just not investing the time to really understand it and realize that this is just a piece of technology that can be used by all the businesses here."[76]

At the start, M-Pesa had to contend with users' technological education, many of whom were semi-literate and had never accessed financial services.

Then Rossiello struck a more optimistic tone:

> Two thousand thirteen [when BitPesa was founded] was still very early to be a bitcoin company and BitPesa was the first. … Much has changed globally since then. South Africa, Nigeria, Tunisia, Senegal, and many other African countries have regulators very open to the technology.

M-Pesa Kenyan Kiosk by RealtOn12, 2005, used under CC BY-SA 3.0.

In one year, BitPesa has jumped from managing $1 million in transactions per month to $10 million, with a monthly growth rate of 25 percent.

Still, BitPesa's home country is putting up a fight: "Kenya remains the only country where we have had resistance."[77]

Although Rossiello founded BitPesa in Nairobi, it has been enjoying international success; however, Kenyan regulators have prevented BitPesa from opening bank accounts. As of 1 September 2017, BitPesa froze acceptance of new Kenyan subscriptions and imposed a $25,000 minimum for transactions in Kenyan Shillings.[78] Rossiello noted, "Even now in Kenya, the Capital Markets Authority has invited us to lead them in understanding bitcoin and blockchain and they are creating a regulatory sandbox to welcome fintech companies."[79]

These regulatory obstacles have not slowed BitPesa's momentum elsewhere. In 2017, Q1, BitPesa obtained $2.5 million in investments and landed Greycroft Partners venture capital firm as a lead investor.[80] In one year, BitPesa has jumped from managing $1 million in transactions per month to $10 million, with a monthly growth rate of 25 percent.[81] BitPesa has added three more offices in Lagos, Nigeria; Dakar, Senegal; and in London, England. It planned to launch services in Ghana and Morocco in December 2017 and to open offices in the United Arab Emirates and South Africa in the first quarter of 2018.[82]

M-Pesa has seen similar success. Within one month of its 2007 launch, M-Pesa obtained 20,000 registrants.[83] In celebration of M-Pesa's ten-year anniversary, it now has 30 million users in ten countries.[84] M-Pesa started processing local micropayments; it has grown to include international transactions, and savings, loans, and health products.[85]

While M-Pesa began using mobile technology to overcome challenges of moving money, BitPesa's utilization of bitcoin demonstrates how much further blockchain technology can take these solutions.

Other use cases

Veem: Blockchain simplifying international B2B payments

In celebration of M-Pesa's ten-year anniversary, it now has 30 million users in ten countries.

Veem, formerly Align Commerce, utilizes the Bitcoin blockchain to provide free cross-border payments for SMEs. Align's mission is to improve the global economy by supporting SMEs.[86] It seeks to modernize international payment systems by eliminating the outdated process of wiring funds.[87]

To send or receive payments from any of the 60 countries in which Veem operates, a customer signs up with an email address and verifies their business information. The customer can then log in and make payment requests.[88] Payments are then transferred directly from the sender's bank account to the receiver's. Veem offers a

tiered authorization system, which allows a business to assign appropriate roles and permissions.

> » An "admin" updates account information and assigns privileges.

> » An "agent" sends invoices and payments, manages contacts, and views reports.

> » A "clerk" manages contacts and views reports but can create only payments and invoices.

Veem processes international transactions in one to three days, and the transactions are insured against errors, cyberattacks, and theft.[89]

At Consensus 2017, Sheila James, vice president of operations, explained that Veem's clients value transparency over speed, noting Veem's unique ability to use blockchain technology to provide end-to-end transaction visibility.[90]

MicroMoney: Blockchain providing credit scoring, loans, and big data

The MicroMoney founders view access to savings and lending services as a human right.[91] This start-up was established as an MFI in 2015 and has evolved into a "decentralized open source and big data bureau."[92] Its proprietary credit scoring system allows it to determine creditworthiness of the financially underserved in seconds, and it can use aggregated customer data to provide access to crypto and traditional financial services.

Veem processes international transactions in one to three days, and the transactions are insured against errors, cyberattacks, and theft.

Figure 1: MicroMoney (AMM) price movement and market capitalization

Wednesday, Jan 10 2018, 14:49:18 UTC
- Market Cap: **0 USD**
- Price (USD): **2.39**
- Price (BTC): **0.00017272**
- 24h Vol: **12,095,400 USD**

Source: CoinMarketCap.com/currencies/micromoney, 18 Dec. 2017–18 Jan. 2018.

MicroMoney provides unsecured loans to customers through a mobile application that can approve a loan in 15 seconds. Funds are delivered to a cryptocurrency e-wallet within the hour.

MicroMoney provides unsecured loans to customers through a mobile application that can approve a loan in 15 seconds. Funds are delivered to a cryptocurrency e-wallet within the hour.[93] The application utilizes artificial intelligence to analyze a customer's behavior through data points accessible through their mobile phone. This information predicts creditworthiness and builds a detailed profile that the customer can use to obtain other financial services.[94] This method of predictive scoring minimizes risk and lowers the cost of assessing creditworthiness. As the product expands, the data set grows, which improves the self-learning system's ability to predict the risk of non-repayment.

MicroMoney targets unbanked individuals who have access to smartphones and social media and who earn between $200 and $500 monthly.[95] These individuals live on cash and do not have credit histories or debt.[96] In 2015, MicroMoney successfully launched its application in Cambodia. In 2016 and 2017, it expanded into Myanmar and Thailand, respectively, and it aims to expand worldwide.[97] Within the next six months, it will launch in the Philippines, Indonesia, Sri Lanka, China, Hong Kong, and Malaysia.[98] It currently has 95,000 registered users, 90 percent of whom took their first ever loan through MicroMoney.[99] In 2015, MicroMoney issued 21 loans that amounted to $800. By the end of 2017, it expects to have disbursed $4.9 million.[100]

This start-up plans to contribute to the development of a "crypto ecosystem" by sharing its data to enable other blockchain companies to provide services at scale.[101] It has already partnered with Everex to provide e-wallets. Going forward, it plans to join forces with Golem, Civic, HIVE, Tether, Cosmos, uPort, SONM, and OmiseGo to provide a full suite of crypto services to the unbanked and facilitate the growth of its partners.[102]

With the consent of its customers, the big data that MicroMoney collects will also be available to traditional financial service providers.[103] This access to big data will allow users to evolve from microloans into established financial institutions that can service, for example, mortgages and business expansion.

We asked Vladimir Grinevsky, project advisor to MicroMoney's $4 billion enterprise, how he intended to deal with its biggest challenges. He recounted the famous Rothschild brothers' sentiment, echoed by Sir Winston Churchill: "He who owns the information, owns the world."[104] Grinevsky recalled the excitement that the discovery of big data stirred in the financial market. "Now, companies use the data to enhance services, automate processes, gain insights into target markets, and improve overall performance."[105]

MicroMoney employs its neural network to collect and analyze big data then applies its proprietary credit-scoring algorithm to determine creditworthiness within seconds. This process has been found to predict default risk with around 95 percent accuracy.[106]

Grinevsky identified MicroMoney's significant challenges as the inability of traditional financial institutions to adapt to blockchain innovations, government regulations limiting social lending and microfinance, and general restrictions on cryptocurrency that impede expansion into certain markets. However, he explained, "As it was shown with recent attempts to ban ICOs in China, South Korea, [and] with the stricter regulations in the western world, the market bounces back quickly."[107] With that in mind, MicroMoney still has its sights set on reaching one million people by 2020. "Our system is transborder, transnational, and unstoppable," he told us.[108]

WeTrust: Blockchain administering rotated savings and credit associations

WeTrust has created the *trusted lending circle* (TLC), which utilizes blockchain technology to administer *rotated savings and credit associations* (ROSCA). A ROSCA consists of trusted associates who contribute funds to a fund pool in agreed upon intervals. Depending on the type of ROSCA, it will disburse the money to participants in accordance with an agreed upon method for lending or insurance. For example, money may be disbursed based on a bidding or lottery system. Similarly, the WeTrust's TLC is composed of "a group of individuals who agree to meet for a defined period in order to save and borrow together, a form of peer-to-peer banking and peer-to-peer lending."[109]

ROSCAs suffer scalability issues because they depend on relational trust "commonly built along clan, geographical, social, or professional networks."[110] The TLC utilizes smart contracts to automate fund

Figure 2: WeTrust (TRST) price movement and market capitalization

Saturday, Jan 13 2018, 12:09:10 UTC
● Market Cap: **120,695,716 USD**
● Price (USD): **1.31**
● Price (BTC): **0.00009132**
● 24h Vol: **1,800,460 USD**

Source: CoinMarketCap.com/currencies/trust, 18 Dec. 2017–18 Jan. 2018.

and trust disbursements efficiently, building it into the blockchain technology, thereby unleashing the ROSCA model from its local roots. That is, participants no longer need to have close social or professional ties. WeTrust ameliorates the conflict of interest inherent in the role of banks and insurance companies as intermediaries by utilizing blockchain technology to scale the ROSCA model.

Co-founder George Li first learned about ROSCAs while working at Google. "I learned about *chit funds* (as they are called in India), and how they were used by my fellow colleagues when on a business trip in India," he recalled in a recent interview.[111] After some research, he learned that "[ROSCAs] are used across the world, and (have) helped communities sustain and thrive for thousands of years."[112] Li then created WeTrust on the premise that blockchain technology "could help this system operate with greater transparency, safety, and (help) its users build a credit identity."[113]

WeTrust's TLC taps into social capital and democratizes access to financial services with less risk of abuses and fraud. It intends to build on the TLC platform to develop credit identities people can use to demonstrate their creditworthiness in other contexts. It is currently working on a mutual insurance platform to enable peer-to-peer (rather, peer-*with*-peer) wealth accumulation on a blockchain.

WeTrust was created on the premise that blockchain technology "could help this system operate with greater transparency, safety, and (help) its users build a credit identity."

GEORGE LI
Co-Founder
WeTrust

According to Li, the newness of blockchain technology presents the greatest obstacle to widespread adoption of WeTrust. "The blockchain ecosystem is still nascent and in its infancy. The ease of use for users and their ability to communicate and interact with blockchain aspects will have to be made much smoother before there will be widespread user adoption."[114] Despite these challenges, WeTrust's TLC may have an advantage because it is not creating a new product but improving upon one with which its target users are already familiar.

Michael Casey, a WeTrust consultant and co-author of *The Truth Machine: The Blockchain and the Future of Everything* recently remarked on the difficulty other blockchain start-ups face when trying to convince people to forgo the old ways and try something new.[115] He observed that WeTrust's TLC "seeks to enhance the impact of an established cultural tradition. … In this case, the application seeks to build on something that already exists."[116]

Obstacles to mainstream implementation of blockchain

A number of obstacles preclude blockchain implementation: regulatory, interoperability and scalability, and sociopolitical. The financial services using blockchain technology must show how this technology will be cost efficient and effective.

Regulatory obstacles

Blockchain developers and potential users face legal uncertainty. Legal costs are inevitable, but incumbents and developers must be confident enough to invest and innovate when they can predict legal exposure and understand how regulated entities that share information will protect it. Dispute resolution across jurisdictions is another concern. The regulatory consortia are responsible for handling legal questions. Three major concepts dominate the regulatory debate:

» Lack of regulation in some jurisdictions

» Trust boundary regulation

» A piecemeal imposition of current regulations onto technology applications in areas that are already heavily regulated, such as securities disclosure requirements for ICOs

In spring 2016, Commissioner Giancarlo of the US Commodity Futures Trading Commission warned regulators to "do no harm" to blockchain technology by overregulating it too early. He compared the development of this technology to the evolution of the Internet.

In spring 2016, Commissioner Giancarlo of the US Commodity Futures Trading Commission warned regulators to "do no harm" to blockchain technology by overregulating it too early. He compared the development of this technology to the evolution of the Internet, stating that blockchain "has the potential to link legal recordkeeping the same way the Internet connects networks of data and information."[117] In that speech, Commissioner Giancarlo encouraged regulators to consider the United States' approach to the early Internet, specifically, the "Framework for Global Electronic Commerce" launched during the Clinton Administration.[118] Accordingly, the private sector should initiate an innovative, predictable, simple regulatory environment that respects bottom-up development of blockchain and avoids undue restrictions.[119]

In 2016, the Depository Trust and Clearing Corporation suggests another approach to regulating blockchain technology—to focus on the trust boundary. Because blockchain is an open source, agnostic technology, this approach would allow regulators to protect consumers and investors by regulating the administration and use of blockchain technology and providing guidance for start-ups and established financial institutions that want to implement the technology.

In his spring speech, Commissioner Giancarlo intimated that the private sector should initiate an innovative, predictable, simple regulatory environment that respects bottom-up development of blockchain and avoids undue restrictions.

Similar to trust boundary regulation, current piecemeal regulation on technology focuses on blockchain technology users. A difference in this approach, however, is that this approach is piecemeal regulation reacts rather than predicts. That is, regulators enforce actions after a certain use of the technology that seemingly contravenes existing law. This approach is problematic in two ways:

» It does not provide the predictability and simplicity that will facilitate blockchain achieving its full potential

» It may lead to regulatory overreach

This approach is unpredictable because innovators may not know when they are doing something wrong. Because of the experimental nature of start-ups, especially in this space, outcomes may be unknown such as the mishaps at Mt. Gox and the *decentralized autonomous organization* (DAO). As a result, using a piecemeal implementation of regulations may stifle development.

To avoid regulatory overreach, regulators must understand the nature and actual risks that blockchain poses and then (1) define blockchain technology in a way that lawfully brings it within their jurisdiction, or (2) alter existing definitions to include blockchain technology.

Regulation through reactive enforcement rather than prospective rules negates the constitutional requirement that individuals have fair notice of their duty under the law. Publishing administrative guidance that is not subject to notice and comment seems to push the Administrative Procedure Act to its limit. The SEC has decided on a different regulatory approach.

The "do no harm" efforts of US regulators and policymakers in the technical space is a positive step.

In a recent briefing before the House Financial Services Committee, new SEC Chair Jay Clayton explained, "Instead of starting with enforcement actions, we decided to start by level-setting … to notify people in the space that there are ways to do this right and some things that trouble us."[120] This openness to regulatory engagement versus enforcement is more likely to educate regulators without discouraging necessary risk-taking and experimentation.

In the United States and elsewhere, we are encouraged to see regulators and policymakers engaging in this fast-paced, highly technical space. Their continued effort to "do no harm" by being responsive, uncovering risks early, and dispensing with unnecessary regulation is a positive step.

Transportation System Water Sea Boat, used under CC0 1.0.

Interoperability and scalability obstacles

Interoperability and scalability are two related issues in the blockchain debate. How well can traditional financial service providers integrate blockchain technology into their legacy systems? If they cannot, they must decide if the benefits of functioning on a blockchain-managed network outweigh the cost of replacing their systems. Over time, a blockchain network would seem more efficient and cost-effective because financial institutions would no longer bear the cost of centralized data management and information reconciliation. Many argue that, in order for blockchain to replace the traditional system, it must be able to handle hundreds of thousands of transactions per second.

A financial transaction consists of a series of messages that customers, banks, and intermediaries relay from one to another: they check and double-check the information. Blockchain automatically updates the messages on the ledger; this process often causes delays in the verification of bitcoin transactions because there is a limit on how many interactions can fit in each block. Once a block is full, subsequent transactions must wait for the next block to be created before it can be verified and updated.

Block size affects another scalability issue: fees. The Bitcoin blockchain provides a low-cost alternative to traditional commercial banking for the unbanked, especially for remittances. Nevertheless, there are cost considerations that may pose challenges to widespread implementation. Participants on the Bitcoin blockchain voluntarily attach rewards to their transactions to incentivize miners to bundle their trades in the immediate block. This process has caused Bitcoin blockchain fees to increase over time, as more usage means scarcer block space.

One solution to these two problems was the recent proposal to increase the block size on the Bitcoin blockchain. This referendum ultimately failed, but developers have faith that this will change if fees become unsustainable.

With a permissioned blockchain, only those with authorized access can participate.

Another way to lower fees is to operate on a permissioned blockchain. The Bitcoin blockchain was developed for the general public under the assumption that there would be some bad actors. For that reason, the verification process is increasingly difficult by design. With a permissioned blockchain, only those with authorized access can participate; this speeds up the verification mechanism, making it less cumbersome. In addition, data miners would not require fee incentives.

The downside to this solution is that some of the benefits of operating on a blockchain may be lost. That is, if too many networks decide to operate within permissioned blockchains, the financial system will remain a set of silos, thus undermining blockchain's potential to facilitate a fully connected, seamless global ecosystem that everyone can access and utilize to their benefit.
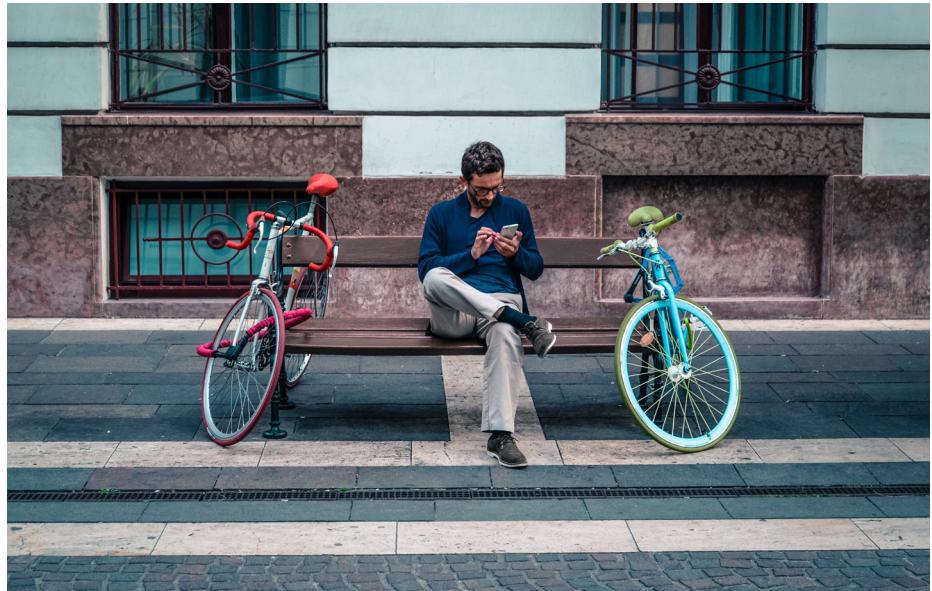
The financially excluded are unbanked because traditional banks with their traditional technology cannot adequately adapt to serve them. Intermediaries drive up costs.

Ultimately, payment systems managed on a blockchain remain cheaper and more accessible than traditional payment mechanisms. For example, despite fee increases on the Bitcoin blockchain, Rossiello does not foresee any effect on BitPesa's being able to continue to maintain its low fees, which have remained between one and three percent. She stated, "The increase in voluntary bitcoin fees have not affected us as we transact in larger amounts for our mainly B2B clients."[121]

The financially excluded are unbanked because traditional banks with their traditional technology cannot adequately adapt to serve them. Intermediaries drive up costs. Whether blockchain is used to improve the provision of traditional financial services or to transfer cryptocurrencies, it will provide a viable alternative.

Man Sitting on Bench Between Two Road Bikes by Skitterphoto, 2017, used under CC0 1.0.

Sociopolitical obstacles to blockchain implementation

Sociopolitical obstacles prevent widespread blockchain technology adoption. Misinformation abounds, making potential customers, investors, and interested politicians wary. For example, some commentators have asserted that criminals have carried out terrorist attacks and drug trafficking using blockchain technology. While the vast majority of innovators do not use this space (which, notably, includes central banks, IGOs, and NGOs) to carry out negative actions, criminals use all methods of communication and trade available to them. Nevertheless, industrialized societies rely on sensible policy and law enforcement that specifically targets these hostile, illegal activities. It is important to remind the public not to forgo the value of blockchain technology by holding it to a standard that even the status quo cannot meet.

Conclusions and recommendations

Blockchain technology is not the future; it is now. Many are already using it to solve important problems, thereby creating opportunities for the global financial ecosystem to become more efficient and inclusive. The Depository Trust and Clearing Corporation described blockchain technology as "a once-in-a-generation opportunity to reimagine and modernize its infrastructure to address long-standing operational challenges."[122]

For blockchain to emerge fully in the mainstream, participants must invest their financial, intellectual, and human resources using the following strategies.

"DLT may be able to provide regulators with visibility into the trading portfolios of swaps counterparties that they lacked during the financial crisis and that Dodd-Frank mandated."

J. CHRISTOPHER GIANCARLO
Commissioner
Commodity Futures Trading Commission

Existing regulatory consortia should coordinate their efforts. Banks and other financial institutions seeking to use blockchain for improving systems and reaching more customers across jurisdictions need coherent and predictable policies. The rules must clearly spell out obligations pertaining to data sharing and privacy. Blockchain automates many of the roles that trusted intermediaries currently play. As Commissioner Giancarlo suggested, blockchain technology could have prevented the 2008 financial crisis.[123] Therefore, it requires a lighter regulatory touch.

Global standards should support financial inclusion. Certain *know your customer* (KYC) regulations identify low-income customers as higher risk, thus impeding incumbents' outreach.[124] Blockchain-based identity applications could allow banks to reach the unbanked and underserved by satisfying KYC requirements in an efficient and inexpensive way, especially in jurisdictions that apply a risk-based approach.

KYC approach should align compliance mechanisms with actual risks. The Financial Action Task Force first introduced the KYC concept in 2007 with the underlying principle that countries assess and understand the financial risks within their jurisdictions and take action to mitigate them.[125] Tiered-KYC has been instrumental in serving the underserved because it allows for a more common-sense approach to compliance requirements.

Financial institutions and regulators should have the flexibility to reduce controls. While low-income customers may not have all of the required documentation to prove their identity, they likely do not pose the kind of financial risk that banking regulations seek to prohibit. As Grinevsky of MicroMoney pointed out, with the widespread proliferation of mobile phones, "coupled with blockchain-based KYC customer record keeping, the unbanked suddenly can become bankable."[126]

Blockchain technology can unshackle the economic potential of the millions constrained by the inability of the current financial infrastructure.
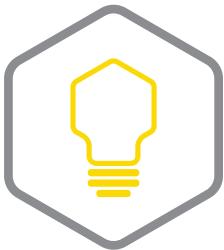
Blockchain need not fix everything. While blockchain technology can revolutionize how way we do business, it may not be necessary for every aspect of the financial system. Those organizations considering where they may want to implement blockchain technology should ask:[127]

» *Is there a shared database?* Certain types of information, such as financial transactions, naturally lend themselves to a database format. If the information needs to be accessed by multiple people or easily shared, blockchain technology may provide an efficient alternative.

» *Are there multiple writers?* Blockchain technology requires a network of users and writers. That is, more than one participant must be generating transactions that change the database.

» *Is there an absence of trust between writers?* Blockchain technology was created for transaction participants who have different incentives and, therefore, would not allow others to modify the contents of a database that it owns. Blockchain technology allows these parties to trust each other through its automated verification mechanism.

» *Are database entries interrelated or dependent on each other?* That is, does one transaction depend upon a previous transaction? For example, where one person pays another person who then pays another person, the last payment depends upon the first. Consider data that are cross-correlated, yet independent, as in shared identity database where multiple entities verify different aspects of a person's identity, contained neatly on a blockchain.

Blockchain technology can unshackle the economic potential of the millions constrained by the inability of the current financial infrastructure. Blockchain can also provide full access, greater efficiency, and financial rewards for those with the foresight and innovative spirit to invest in its possibilities.

About the Blockchain Research Institute

Co-founded in 2017 by Don and Alex Tapscott, the Blockchain Research Institute is a knowledge network organized to help realize the new promise of the digital economy. It builds on their yearlong investigation of distributed ledger technology, which culminated in the publication of their critically acclaimed book, *Blockchain Revolution* (Portfolio|Penguin).

Our syndicated research program, which is funded by major corporations and government agencies, aims to fill a large gap in the global understanding of blockchain technology and its strategic implications for business, government, and society.

Our global team of blockchain experts is dedicated to exploring, understanding, documenting, and informing leaders of the market opportunities and implementation challenges of this nascent technology.

Research areas include financial services, manufacturing, retail, energy and resources, technology, media, telecommunications, healthcare, and government as well as the management of organizations, the transformation of the corporation, and the regulation of innovation. We also explore blockchain's potential role in the Internet of Things, robotics and autonomous machines, artificial intelligence, and other emerging technologies.

Our findings are initially proprietary to our members and are ultimately released under a Creative Commons license to help achieve our mission. To find out more, please visit www.blockchainresearchinstitute.org.

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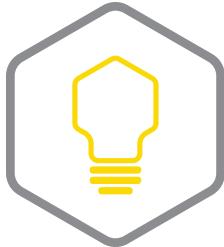
About the author

Rachel W. Robinson, Esq., is a researcher, columnist, and attorney who completed projects on cryptocurrency and blockchain technology during recent internships with the US Securities and Exchange Commission and the US Commodity Futures Trading Commission. She holds a Master of Public Administration with a specialization in Leadership and Management from Bowling Green State University and a Juris Doctoris with a certificate in Public Interest Law from Washington University in St. Louis School of Law.

Disclosures

Ms. Robinson is not affiliated with any of the organizations mentioned in this white paper.

Notes

1. Malcolm Gladwell, et al., "Business Books - Best Sellers - August 10, 2014," *The New York Times*, The New York Times Company, 24 Aug. 2014. www.nytimes.com/books/best-sellers/2014/08/10/business-books, accessed 14 Jan. 2018.

2. Malcolm Gladwell, *Outliers: The Story of Success* (New York: Little, Brown and Co., 2008): 19.

3. Michael Lewis, *Flash Boys: A Wall Street Revolt* (New York: W.W. Norton & Company, 2014): 23, 40.

4. Elaine Wah, "Michael Lewis Says the Market's Rigged. But His 'Flash Boys' Rigged Themselves," *The Guardian*, Guardian News and Media Ltd., 4 Apr. 2014. www.theguardian.com/commentisfree/2014/apr/04/michael-lewis-market-rigged-flash-boys-high-speed-trading, accessed 17 Jan. 2018.

5. Thomas Piketty, *Capital in the Twenty-First Century*, trans. Arthur Goldhammer (Cambridge, Mass.: The Belknap Press of Harvard University Press, 2014): 479.

6. "Life Expectancy in America Has Declined for Two Years in a Row," *The Economist*, The Economist Newspaper Ltd., 4 Jan. 2018. www.economist.com/news/united-states/21733980-thats-not-really-meant-happen-developed-countries-life-expectancy-america-has, accessed 17 Jan. 2018.

7. International Labour Organization, *World Employment Social Outlook: Trends 2017* (Geneva: International Labour Office, 2017). www.ilo.org/global/topics/youth-employment/lang—en/index.htm, accessed 14 Jan. 2018.

8. Henry George, *Progress and Poverty* (New York: E.P. Dutton & Co., 1911): iv, 9. Digital Library of India, archive.org/stream/in.ernet.dli.2015.264119/2015.264119.Progress-And#page/n3/mode/2up, accessed 14 Jan. 2018.

9. Henry George, *Progress and Poverty.* (New York: E.P. Dutton & Co., 1911): iv, 9.

10. Don Tapscott, "How the Blockchain Is Changing Money and Business," *TED.com*, Technology Entertainment Design, June 2016. www.ted.com/talks/don_tapscott_how_the_blockchain_is_changing_money_and_business, accessed 21 Dec. 2017.

11. "World Economic Forum 2018 to Call for Strengthening Cooperation in a Fractured World," *Press Release*, World Economic Forum, 16 Oct. 2017. www.weforum.org/press/2017/09/world-economic-forum-2018-to-call-for-strengthening-cooperation-in-a-fractured-world, accessed 14 Jan. 2018.

12. Mariano Belinky, et al., "The Fintech Paper 2.0: Rebooting Financial Services," Santander, InnoVentures, Oliver Wyman, and Anthemis Group, 2015. santanderinnoventures.com/wp-content/uploads/2015/06/The-Fintech-2-0-Paper.pdf, accessed 28 Oct. 2017.

13. Asli Demirguc-Kunt, et al., "The Global Findex Database 2014: Measuring Financial Inclusion around the World," *Policy Research Working Paper* 7255, World Bank Group, April 2015. openknowledge.worldbank.org/bitstream/handle/10986/21865/WPS7255.pdf, accessed 13 Jan. 2018.

14. DTCC, "Embracing Disruption: Tapping the Potential of Distributed Ledgers to Improve the Post-trade Landscape," *White Paper*, Depository Trust and Clearing Corporation, 25 Jan. 2016. tinyurl.com/yd39p9vd, accessed 13 Jan. 2018.

15. DTCC, "Embracing Disruption," Jan. 2016.

16. IBM, "Fast Forward: Rethinking Enterprises, Ecosystems, and Economies with Blockchains," *Executive Report*, IBM Institute for Business Value, June 2016. www-935.ibm.com/services/us/gbs/thoughtleadership/blockchain/fastforwardii, accessed 8 Jan. 2018.

17. IBM, "Fast Forward," June 2016.

18. IBM, "Fast Forward," June 2016.

19. Susy Cheston, et al., "The Business of Financial Inclusion: Insights from Banks in Emerging Markets," Center for Financial Inclusion, Accion International and Institute of International Finance, July 2016. www.centerforfinancialinclusion.org/fi2020/roadmap-to-inclusion/the-business-of-financial-inclusion, accessed 13 Jan. 2018.

20. Susy Cheston, et al., "The Business of Financial Inclusion," July 2016.

21. Asli Demirguc-Kunt, et al., "The Global Findex Database 2014," April 2015.

22. Susy Cheston, et al., "The Business of Financial Inclusion," July 2016.

23. Gerry Boyle, Simon Whitehouse, Louise C. James, and Finn Erik Kolnes, "Within Reach: How Banks in Emerging Economies Can Grow Profitably by Being More Inclusive," Accenture and CARE International, Nov. 2015. tinyurl.com/y7t7h2fq, accessed 13 Jan. 2018.

24. Hernando de Soto, interviewed by Don Tapscott and Alex Tapscott, 27 Nov. 2015.

25. Hernando de Soto, interviewed by Don Tapscott and Alex Tapscott, 27 Nov. 2015.

26. UNESCO Institute for Statistics (UIS), "Literacy Rates Continue to Rise from One Generation to the Next," Fact Sheet No. 45 (FS/2017/LIT/45), United Nations Education, Scientific, and Cultural Organization, Sept. 2017. uis.unesco.org/sites/default/files/documents/fs45-literacy-rates-continue-rise-generation-to-next-en-2017.pdf, accessed 17 Jan. 2018. According to UIS, the lowest literacy rates were found in sub-Saharan Africa and Southern Asia. In 2016, adult literacy rates were below 50% in these 20 countries: Afghanistan, Benin, Burkina Faso, Central African Republic, Chad, Comoros, Côte d'Ivoire, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Iraq, Liberia, Mali, Mauritania, Niger, Senegal, Sierra Leone and South Sudan.

27. Financial Inclusion Commission, "Financial Inclusion: Improving the Health of a Nation," *Commission Report*, UK Financial Inclusion Commission and MasterCard, March 2015. www.financialinclusioncommission.org.uk/pdfs/fic_report_2015.pdf, accessed 13 Jan. 2018.

28. FDIC Unbanked/Underbanked Survey Study Group, "2015 FDIC National Survey of Unbanked and Underbanked Households," Federal Deposit Insurance Corporation, 20 Oct. 2016. www.fdic.gov/householdsurvey, accessed 13 Jan. 2018.

29. Andrew Wayland, "Financial Exclusion in the UK," *Brink: The Edge of Risk*, 8 Sept. 2017. www.brinknews.com/financial-exclusion-in-the-uk, accessed 8 Oct. 2017.

30. Andrew Wayland, "Financial Exclusion in the UK," 8 Sept. 2017

31. Gerry Boyle, et al., "Within Reach," Nov. 2015.

32. Susy Cheston, et al., "The Business of Financial Inclusion," July 2016.

33. Susy Cheston, et al., "The Business of Financial Inclusion," July 2016.

34. Susy Cheston, et al., "The Business of Financial Inclusion," July 2016.

35. Susy Cheston, et al., "The Business of Financial Inclusion," July 2016.

36. Susy Cheston, et al., "The Business of Financial Inclusion," July 2016.

37. Unique Identification Authority of India, "[Aadhaar Authentication] Operation Model," Government of India, n.d. uidai.gov.in/authentication/authentication-overview/operation-model.html, accessed 13 Jan. 2018.

38. Unique Identification Authority of India, "[Aadhaar Authentication] Operation Model."

39.   Unique Identification Authority of India, "[Aadhaar Authentication] Operation Model."

40.   Special Correspondent, "Aadhaar Covers 99% of Adults in India: Prasad," *The Hindu*, The Hindu Ltd., 27 Jan. 2017. www.thehindu.com/business/Aadhaar-covers-99-of-adults-in-India-Prasad/article17104609.ece, accessed 17 Jan. 2018.

41.   Anita Babum, "Rachna Khaira: I Was Offered an Aadhaar Master Software for Rs 2,500," TheWeek.in, Malayala Manorama Co, 28 Jan. 2018. www.theweek.in/theweek/specials/rachna-khaira-interview.html, accessed 24 July 2018.

42.   BanQu, "Our Technology," *BanQu: Dignity Through Identity*, BanQu, Inc., 26 Feb. 2017. www.banquapp.com/our-solutions/our-technology, accessed 17 Jan. 2018.

43.   Shailee Adinolfi, interviewed by author, 8 Oct. 2017.

44.   Shailee Adinolfi, interviewed by author, 8 Oct. 2017.

45.   Shailee Adinolfi, interviewed by author, 8 Oct. 2017.

46.   "BanQu & Ashish Gadnis," *Blockintel Influencer Report*, Blockchain Intel, 4 Oct. 2017. us15.campaign-archive1.com/?u=18e20038501db73ea1db849f7&id=c01ddf8338, accessed 13 Jan. 2018.

47.   "XE Currency Converter: VEF to USD," *xe.com*, XE.COM, Inc., 27 Oct. 2017. www.xe.com/currencyconverter/convert/?Amount=1&From=VEF&To=USD, accessed 27 Oct. 2017.

48.   "Noticias y Dólar Paralelo," *DolarToday.com*, 27 Oct. 2017. dolartoday.com, accessed 27 Oct. 2017.

49.   "Without Help, Venezuela Cannot Pay Liabilities: Daniel Osorio," *Power Lunch*, CNBC, NBC Universal, 22 Sept. 2017, www.cnbc.com/video/2017/09/22/without-help-venezuela-cannot-pay-liabilites-daniel-osorio.html, accessed 13 Jan. 2018.

50.   World Bank, "Remittances to Developing Countries Edge Up Slightly in 2015," *Press Release*, The World Bank Group, 13 April 2016. www.worldbank.org/en/news/press-release/2016/04/13/remittances-to-developing-countries-edge-up-slightly-in-2015, accessed 13 Jan. 2018.

51.   World Bank, "Remittances to Developing Countries Edge Up Slightly in 2015," 13 April 2016.

52.   "Small and Midsize Enterprises—SME," *Investopedia.com*, Investopedia LLC, n.d. www.investopedia.com/terms/s/smallandmidsizeenterprises.asp, accessed 7 Oct. 2017.

53.   World Bank, "Small and Medium Enterprises (SMEs) Finance," The World Bank Group, n.d. www.worldbank.org/en/topic/smefinance, accessed 13 Jan. 2018.

54.   World Bank, "Small and Medium Enterprises (SMEs) Finance."

55.   World Bank, "Small and Medium Enterprises (SMEs) Finance."

56.   US Securities and Exchange Commission, "Investor Bulletin: Initial Coin Offerings," 25 July 2017. www.sec.gov/oiea/investor-alerts-and-bulletins/ib_coinofferings, accessed 8 Oct. 2017.

57.   *SEC v. Howey Co., 328 U.S. 293 (1946).* See also "A Securities Law Framework for Blockchain Tokens," Micromoney, n.d. www.micromoney.io/wp/Test_howey.pdf, accessed 8 Jan. 2018.

58.   Kevin McKemey, et al., "Innovative Demand Models for Telecommunications Services: Final Technical Report." *Technical Report*, Department for International Development, Sept. 2003.

59.   Nick Hughes and Susie Lonie, "M-Pesa: Mobile Money for the 'Unbanked': Turning Cellphones into 24-Hour Tellers in Kenya," *Innovations: Technology, Governance, Globalization*, Vol. 2, No. 1, The MIT Press and Tagore LLC, 12 June 2007, pp. 63-81. www.mitpressjournals.org/doi/abs/10.1162/itgg.2007.2.1-2.63, accessed 13 Jan. 2018.

60.   Nick Hughes and Susie Lonie, "M-Pesa," 12 June 2007.

61.   Nick Hughes and Susie Lonie, "M-Pesa," 12 June 2007.

62.   Nick Hughes and Susie Lonie, "M-Pesa," 12 June 2007.

63.   Nick Hughes and Susie Lonie, "M-Pesa," 12 June 2007.

64.   Nick Hughes and Susie Lonie, "M-Pesa," 12 June 2007.

65.   Nick Hughes and Susie Lonie, "M-Pesa," 12 June 2007.

66.   Nick Hughes and Susie Lonie, "M-Pesa," 12 June 2007.

67.   Eric Ombok, "Bitcoin Service Targets Kenya with Cut-Rate Fees," *Bloomberg Technology*, Bloomberg LP, 28 Nov. 2013. www.bloomberg.com/news/2013-11-28/bitcoin-service-targets-kenya-remittances-with-cut-rate-fees-1-.html, accessed 13 Jan. 2018.

68.   Eric Ombok, "Bitcoin Service Targets Kenya with Cut-Rate Fees," 28 Nov. 2013.

69.   Eric Ombok, "Bitcoin Service Targets Kenya with Cut-Rate Fees," 28 Nov. 2013.

70.   Eric Ombok, "Bitcoin Service Targets Kenya with Cut-Rate Fees," 28 Nov. 2013.

71.   Laura Shin, "BitPesa's Elizabeth Rossiello on Necker Island," *Unchained Podcast*, *Forbes*, Episode 1, 14 June 2016. www.forbes.com/podcasts/unchained, accessed 27 Oct. 2017.

72.   Laura Shin, "BitPesa's Elizabeth Rossiello on Necker Island," 14 June 2016.

73.   Laura Shin, "BitPesa's Elizabeth Rossiello on Necker Island," 14 June 2016.

74.   Nick Hughes and Susie Lonie, "M-Pesa," 12 June 2007.

75.   Nick Hughes and Susie Lonie, "M-Pesa," 12 June 2007.

76.   Laura Shin, "BitPesa's Elizabeth Rossiello on Necker Island," 14 June 2016.

77.   Elizabeth Rossiello, e-mail to author, 3 Nov. 2017.

78.   Team BitPesa, "An Update on KES Payments," *BitPesa Blog*, 1 Sept. 2017. www.bitpesa.co/blog, accessed 25 Oct. 2017.

79.   Elizabeth Rossiello, e-mail to author, 3 Nov. 2017.

80.   Laura Shin, "Bitcoin Payments Firm BitPesa Secures Greycroft As Lead Investor For $10 Million Total Funding," *Forbes Magazine*, Forbes Media, 30 Aug. 2017. www.forbes.com/sites/laurashin/2017/08/30/bitcoin-payments-firm-bitpesa-secures-greycroft-as-lead-investor-for-10-million-total-funding/#20ff57df6066, accessed 13 Jan. 2018.

81.   Laura Shin, "Bitcoin Payments Firm BitPesa Secures Greycroft," 30 Aug. 2017.

82.   Elizabeth Rossiello, e-mail to author, 3 Nov. 2017.

83.   Nick Hughes and Susie Lonie, "M-Pesa," 12 June 2007.

84.   Kieron Monks, "M-Pesa: Kenya's mobile money success story turns 10," *CNN*, Cable News Network, 24 Feb. 2017. www.cnn.com/2017/02/21/africa/mpesa-10th-anniversary/index.html, accessed 28 Oct. 2017.

85.   Kieron Monks, "M-Pesa," 24 Feb. 2017.

86.   "SMBs Can Now Send International Wire Transfers Direct From QuickBooks For Free With Veem Integration," *Press Release*, MarketWired, 27 June 2017. www.marketwired.com/press-release/smbs-can-now-send-international-wire-transfers-direct-from-quickbooks-for-free-with-2223835.htm, accessed 8 Oct. 2017. See also "Our story," *Veem.com*, n.d. www.veem.com/our-story, accessed 8 Jan. 2018.

87.   Veem, "FAQ," *Veem.com*, n.d. www.veem.com/faq, accessed 28 Oct. 2017.

88.   Veem, "How to Send and Receive Wire Transfers," *Veem.com*, n.d. www.veem.com/how-to-send-and-receive-wire-transfers, accessed 28 Oct. 2017.

89.   Veem, "FAQ," *Veem.com*, n.d. www.veem.com/faq, accessed 28 Oct. 2017.

90.   Sheila James, Harry Newman, Michael Kleinsteuber, and Elizabeth Rossiello, "Cross-Border Payments," mod. Noelle Acheson, *Panel Session*, Consensus 2017: Making Blockchain Real, New York Marriott Marquis, 22 May 2017. www.coindesk.com/events/consensus-2017/video/day1, accessed 26 Oct. 2017.

91.   "MicroMoney for People, Big Data for Business," *White Paper*, MicroMoney International, 20 Sept. 2017. github.com/micro-money/prime/blob/master/WhitePaper/MicroMoney_whitepaper.pdf, accessed 13 Jan. 2018.

92.   MicroMoney White Paper, 20 Sept. 2017.

93.   MicroMoney White Paper, 20 Sept. 2017.

94.   MicroMoney White Paper, 20 Sept. 2017.

95.   MicroMoney White Paper, 20 Sept. 2017.

96.   MicroMoney White Paper, 20 Sept. 2017.

97.   MicroMoney White Paper, 20 Sept. 2017.

98.   MicroMoney White Paper, 20 Sept. 2017.

99.   MicroMoney White Paper, 20 Sept. 2017.

100.   MicroMoney White Paper, 20 Sept. 2017.

101.   MicroMoney White Paper, 20 Sept. 2017.

102.   MicroMoney White Paper, 20 Sept. 2017.

103.   MicroMoney White Paper, 20 Sept. 2017.

104.   Vladimir Grinevsky, e-mail to author, 7 Nov. 2017.

105.   Vladimir Grinevsky, e-mail to author, 7 Nov. 2017.

106. Vladimir Grinevsky, e-mail to author, 7 Nov. 2017.

107. Vladimir Grinevsky, e-mail to author, 7 Nov. 2017.

108. Vladimir Grinevsky, e-mail to author, 7 Nov. 2017.

109. George Li, et al., "WeTrust: For the people, by the people," *White Paper*, Brave New Coin, n.d. bravenewcoin.com/assets/Whitepapers/WeTrustWhitePaper.pdf, accessed 8 Jan. 2018.

110. George Li, et al., "WeTrust: For the people, by the people."

111. George Li, e-mail to author, 7 Nov. 2017.

112. George Li, e-mail to author, 7 Nov. 2017.

113. George Li, e-mail to author, 7 Nov. 2017.

114. George Li, e-mail to author, 7 Nov. 2017.

115. Michael J. Casey and Paul Vigna, *The Truth Machine: The Blockchain and the Future of Everything* (New York: St. Martin's Press, Feb. 2018).

116. Michael J. Casey, e-mail to author, 30 Oct. 2017.

117. CFTC Commissioner J. Christopher Giancarlo, "Regulators and the Blockchain: First, Do No Harm," *Depository Trust and Clearing Corporation 2016 Blockchain Symposium*, New York City, 29 March 2017, updated 20 Dec. 2017. www.cftc.gov/PressRoom/SpeechesTestimony/opagiancarlo-13, accessed 13 Jan. 2018.

118. J. Christopher Giancarlo, "Regulators and the Blockchain: First, Do No Harm," 29 March 2017.

119. J. Christopher Giancarlo, "Regulators and the Blockchain: First, Do No Harm," 29 March 2017.

120. US House Financial Services Committee, "Examining the SEC's Agenda, Operations, and Budget," video 01:41:19, *YouTube.com*, 4 Oct. 2017. www.youtube.com/watch?v=rrUsAqT5wxA, accessed 13 Jan. 2018.

121. Elizabeth Rossiello, e-mail to author, 3 Nov. 2017.

122. DTCC, "Embracing Disruption," Jan. 2016.

123. J. Christopher Giancarlo, "Regulators and the Blockchain: First, Do No Harm," 29 March 2017.

124. Susy Cheston, et al., "The Business of Financial Inclusion," July 2016.

125. Neil Jeans, "Risk-Based Approach to KYC," *Answers On Blog*, Thomson Reuters, 14 June 2017. blogs.thomsonreuters.com/answerson/kyc-risk-based-approach, accessed 13 Jan. 2018.

126. Vladimir Grinevsky, e-mail to author, 7 Nov. 2017.

127. Gideon Greenspan, "Do You Really Need a Blockchain for That?" *CoinCenter.org*, Coin Center, 26 July 2017. coincenter.org/entry/do-you-really-need-a-blockchain-for-that, accessed 13 Jan. 2018.