

## **Blockchain-Based Financial Technologies and Cryptocurrencies for Low-Income People: Technical potential versus practical reality**

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### **Abstract:**

Several blockchain-based financial technologies and cryptocurrencies have been launched for low-income people. Blockchain's technical potential can be used to serve the needs of unbanked and underbanked populations, but there is no evidence that these needs are being met.

**Keywords:** blockchain | cryptocurrency | market opportunities

### **Article:**

According to the World Bank's Global Findex database, roughly 1.7 billion adults were unbanked worldwide in 2017, which means they lacked an account with a formal financial institution or a mobile money provider. A number of blockchain-based financial technologies (fintechs) and cryptocurrencies have been introduced to improve the access to and affordability of financial services for unbanked and underbanked populations.

The lack of formal identity documents to prove who they are is the main reason why many people in developing countries lack access to financial services. In fact, according to the World Bank's Identification for Development (ID4D) database, 1 billion people lack any form of personal identification. An additional 3.4 billion people have some type of identification but lack the ability to use it in the digital world.<sup>1</sup> Worse still, in many countries, banks demand a variety of other documents in addition to identification cards to open an account. According to a McKinsey study conducted in five developing and two developed countries, in 2030, with full, digital ID coverage, countries could create economic value equivalent to 3–13% of its gross domestic product. More than half of this value is expected to be passed on to individuals.<sup>1</sup> In light of these observations, an encouraging development is that a key component of some blockchain start-ups' initiatives has been to build blockchain-based identity solutions for low-income people.

Blockchain's key features can make fintechs based on this know-how and cryptocurrencies superior to those offered by nonblockchain fintechs and traditional financial institutions. Some

fintechs and cryptocurrencies aim to capitalize on blockchain-led decentralization and disintermediation to directly connect borrowers with lenders, thereby reducing the costs of financial services. Another notable feature of these solutions is that it aggregates information from many sources to build an economic history. This aspect is especially important for developing countries, many of which lack reliable credit information on its people and companies, which is necessary to minimize banks' lending risks. In China, only 20% of the adult population has a credit score.<sup>21</sup> Theoretically, borrowers can show blockchain-based credit information to lenders and receive loans more easily.

Underdeveloped supporting technologies and infrastructures pose challenges to taking advantage of new technologies such as blockchain. Developing economies face unfavorable institutional arrangements, namely, contract enforcement procedures, property rights, and standards. Institutional environments in developing economies and the interaction of these environments with information flows, transaction costs and risks, and market access-related constraints hinder the implementation of new technologies.<sup>2</sup>

In other words, transaction costs include “(1) the costs of measuring the dimensions of whatever it is that is being produced or exchanged and (2) the costs of enforcement.”<sup>3</sup> Regarding the cost of measuring, many developing economies lack databases of reliable credit information on most people and companies. As a result, assessing a potential borrower's creditworthiness is a challenging task. In some developing countries, it costs up to US\$1,000 to examine a person's detailed financial and other background information.<sup>22</sup> Likewise, in many developing countries, due to forgery and fraud in ID cards and fraudulent birth certificates, it is difficult to determine whether people are who they say they are.<sup>4</sup> As to the cost of enforcement, formal contracts cannot be easily enforced in developing countries. These factors increase transaction costs.

With regard to information flow, empirical studies conducted in the agriculture and food and beverage industries indicate that farmers receive information from relatively restricted channels and that they learn about new technologies from very few sources. Moreover, the information they do receive is imperfect.<sup>5</sup> All of these factors hinder learning of new technologies within a village, and the use of new technologies is often limited to specific groups and networks. Barriers such as the lack of sufficient skills and opportunities to apply these solutions may prevent low-income families from benefiting from blockchain-based fintechs and cryptocurrencies. It is, therefore, important to consider whether these solutions can successfully overcome these barriers.

This article provides an overview of the benefits and limitations of blockchain-based fintechs and cryptocurrencies that are targeted at low-income families in developing countries.

### **Examples of Blockchain-Based Fintech Solutions and Cryptocurrencies for Low-Income Groups**

Table 1 provides brief descriptions of some blockchain-based fintech solutions and cryptocurrencies targeted at low-income populations in developing countries. The main focus of these solutions has been to increase access to IDs for low-income populations. Humaniq's Ethereum-based app creates user profiles based on biometric data, for example, facial- and

voice-recognition algorithms. Potential users are not required to have a passport or an email account; rather, a smartphone is used to take a selfie and record a video making facial gestures. The user also pronounces a randomly selected text shown on the screen to record his or her voice. Humaniq states that users can complete the bioidentification process in 20 s using the least-expensive smartphones.

**Table 1.** The blockchain-based fintechs and cryptocurrencies targeted at low-income groups.

| Platform  | Brief description   | Geographic areas of deployment   |
|---|---|--|
| Humaniq’s Ethereum-based user profiles and HMQ tokens                         | Profiles are based on biometric data. HMQ tokens can be used to buy and sell goods and services from the third-party services that utilize the token and also gain access to small business loans.  | September 2018: operated in approximately 50 countries, including 21 in Africa.  |
| Kiva’s digital identification system  | This provides blockchain-based IDs. Individuals retain secure and complete ownership of personal information: all credit-related events are captured in a ledger connected to an individual’s ID.   | August 2019: Sierra Leone launched a blockchain-based National Digital Identity Platform developed by Kiva. Sierra Leone’s government requires banks and MFIs to use the system by the end of 2019. The system worked with the United Nations Capital Development Fund and United Nations Development Program. |
| BanQu’s “economic passport”   | This establishes economic identities and proofs of record for people living in extreme poverty zones; it is also working to verify the authenticity of academic certificates and credentials.   | 2018: served more than 15,000 farmers, displaced people, and refugees in eight countries. April 2019: the platform was used in 12 countries.   |
| Moeda’s microfinance platform   | The platform works as a banking-as-a-service cooperative financial network by linking investors with cooperative businesses. Users can obtain microloans to start or expand a business. They can use Moeda’s app to pay for business-related items or services. | The project was initially launched in rural Brazil and is also incorporated in Uruguay.  |
| The World Food Programme’s (WFP’s) Ethereum-based cryptocurrency for refugees | This platform uses cryptocurrencies to pay refugees. The receivers can spend in participating stores, and Parity Ethereum is used.  | Mainly Pakistan and Jordan (for Syrian refugees) Early 2019: 1.1 million cryptocurrency transactions transferred more than US\$23.5 million.   |

MFIs: microfinance institutions.

Similarly, Kiva worked with the United Nations (UN) Capital Development Fund and the UN Development Program to create a blockchain-based ID system in the Republic of Sierra Leone. In August 2019, the government of Sierra Leone initiated the blockchain-based National Digital Identity Platform and wanted all banks and microfinance institutions (MFIs) to use the system by the end of 2019.<sup>23</sup>

Some of the previously described systems also include creditworthiness-related information to improve access to financing for low-income groups. For instance, BanQu utilizes Ethereum blockchain to establish economic identities and proofs of record (economic passport).<sup>6</sup> BanQu aggregates information from a number of sources, such as those related to financial history, land records, trust networks documenting trust relationships with others and business registrations, vaccination records, and remittance income. ID-related information sources include selfies,

biometrics, and key physical attributes. BanQu also provides know-your-customer information and other data to its partners, which may offer products and services to these disadvantaged individuals.<sup>24</sup>

Likewise, in Kiva's system, a borrower is assigned a digital wallet, which is accessible via an app. When a lender provides a loan, the borrower receives a verifiable claim with all the details. When the borrower accepts the claim, the loan is posted to the borrower's private credit ledger in the Kiva wallet. The same process is repeated when the borrower makes a loan repayment. The borrower approves a verifiable claim sent by the lender, which is then posted to the ledger. All credit-related events are thus captured in a single ledger connected to the wallet, which is controlled by an individual. Financial institutions, government agencies, and third-party agencies can access this information only with the owner's consent.

These systems also connect investors with impactful investment opportunities, lenders with borrowers, and aid givers with aid receivers. Moeda states that its aim is to develop systems that allow investors to track a project's progress and accountability in a transparent manner.<sup>25</sup> In theory, if lenders want to invest in projects that have social impacts, they can do so. With HumanIQ IDs, entrepreneurs can connect with investors using HMQ cryptocurrency anywhere in the world. It thus aims to facilitate small entrepreneurs' access to low-cost loans.

In much the same way, the World Food Programme (WFP) distributes food vouchers to refugees without relying on the services of financial institutions. In Jordan's refugee camps, supermarket cashiers are equipped with iris scanners to identify beneficiaries and settle payments, with each user's account linked to his or her iris.<sup>28</sup> UN databases verify biometric data about refugees. The WFP's Building Blocks ledger records the transactions on a private version of the Ethereum blockchain, the Parity Ethereum. Beneficiaries receive goods directly from the merchants.<sup>7</sup>

## **Benefits and Potential Opportunities Offered by Blockchain-Based Fintechs and Cryptocurrencies**

Blockchain-based fintechs and cryptocurrencies offer several benefits for low-income groups.

### **Speed and efficiency**

Processing speed and efficiency can be increased with cryptocurrencies. For instance, once refugees are registered, the WFP's blockchain system encrypts their data, and vouchers are transferred almost instantaneously. In this regard, a key benefit of blockchain-based fintechs and cryptocurrencies is their ability to intervene in a fast and efficient way for societies in the most difficult environments. For example, when remote places that lack financial infrastructures, automated teller machines, and banks face disasters, such as earthquakes or storms, blockchain can help humanitarian organizations provide cash assistance faster than other available means.<sup>26</sup> Cryptocash (cryptotokens) can represent local currencies such as Pakistani rupees and Jordanian dinar, which can be traded outside the banking system. The recipients can use the cryptocash to buy goods and services in participating shops. Cryptocurrencies can even replace scarce local cash, which allow aid organizations, residents, and merchants to conduct transactions.<sup>7</sup>

Hyperledger Fabric, used by Kiva and Moeda, also performs better than well-known cryptocurrencies in terms of the speed at which transactions are completed. For instance, as of early 2018, when deployed in a single cloud data center, Hyperledger Fabric had a throughput of more than 3,500 transactions per second (TPS), with a latency rate of lower than 1 s.<sup>8</sup> This efficiency compares favorably with the public Ethereum network’s peak throughput of 16 TPS and bitcoin’s 7 TPS.

### Creation of secure and authentic identity

Existing ID systems are biased toward men. In Uganda, for example, a 2014 study showed that only 63% of women had any form of ID compared to 83% of men.<sup>27</sup> A key advantage of blockchain-based IDs is that it can reduce existing gender disparities in access to IDs.

Blockchain increases the ability to acquire a secure and authentic identity at a low cost (Table 2). Although ID cards in many countries are paper based and susceptible to forgery, blockchain solutions are able to reduce fraudulent activities. It is extremely difficult, if not impossible, for nefarious actors to falsify information or make up fake profiles to disburse funds when a user’s account is linked to his or her iris.

**Table 2.** The advantages of blockchain-based IDs.

| Dimension                      | Nonblockchain world   | Blockchain advantages   |
|--------------------------------|---|---|
| Availability and accessibility | Due to underfunded identification agencies, many governments are unable to implement identification programs in countries such as the Democratic Republic of the Congo, Tanzania, and Zambia. Zambia’s Department of National Registration, Passport and Citizenship has suffered from a severe lack of funds, which limits civil registration operations. <sup>4</sup> | No need to rely on government agencies. Start-ups, such as Humaniq’s blockchain-based apps, allow users with a smartphone to create their own IDs.  |
| Cost                           | The average cost of enrollment and registration for a national ID system is US\$3–6 per person, including an additional 15–25% per year for maintenance, software, and data updating. The cost of card production and distribution is US\$1–5 per person. <sup>20</sup> Nigeria: a conservative estimate for the identity lifecycle is US\$5 per person. <sup>4</sup>   | 2018: the average cost of a transaction in the Ethereum network was US\$0.03. <sup>31</sup> To register a customer’s identity, companies such as BanQu may need to execute a few blockchain transactions. |
| Security and authenticity      | Susceptibility to forgery and fraud: ID cards in many countries (for example, Madagascar, Sierra Leone, and Zambia) are paper based, which can be forged. Zambia: national registration cards can be forged by substituting photos and altering texts. Sierra Leone: a fraudulent birth certificate can be obtained easily. <sup>4</sup>                                | Blockchain allows for a higher degree of security and authenticity.   |

### The availability and utilization of more relevant information to assess creditworthiness

Developing economies lack information about the creditworthiness of most of their populations. For instance, Sierra Leone has only one credit bureau with information on the country’s 2,000 people.<sup>29</sup> More than 75% of Sierra Leone’s population lacks access to formal banking services. Its people rely on informal institutions, such as community banks and MFIs, for their financial

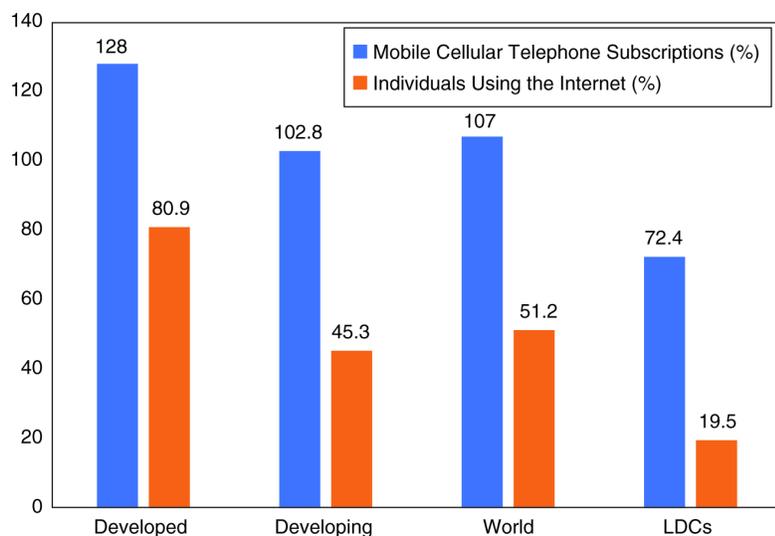
needs, which charge extremely high interest rates. Also, these institutions do not share credit information.<sup>23</sup>

Large nonfinancial firms, especially from technology sectors (referred to as *TechFins*), have leveraged their data aggressively to provide financial services.<sup>9</sup> In many cases, however, TechFins' data sets originate from sources such as social media that are unrelated to financial services. Big data analytics used to predict potential borrowers' creditworthiness rely on correlations rather than causations. It is not easy to determine which correlations shown by big data tools are random and which ones may reflect responsible financial and consumption decisions.<sup>10</sup>

A key benefit of blockchain-based application concerns the availability and utilization of more relevant information to assess creditworthiness. For instance, many women, small-scale farmers, migrant workers, refugees, and displaced people receive foreign aid and humanitarian assistance from the UN or international nongovernmental organizations (INGOs). Some receive microfinance loans while others participate in various training programs. The various categories of information are often stored in independent disjointed databases like those of microfinancing institutions, the UN, and relevant INGOs.<sup>10</sup> Such data are unlikely to be captured by TechFins' algorithms.

The blockchain systems discussed previously aim to capture and organize more relevant information compared to those used by TechFins. Kiva's blockchain system, for instance, captures all credit-related events in a single ledger connected to a borrower's wallet. BanQu's "economic passport" also aggregates financial history and other information from a number of sources.<sup>6</sup> These blockchain systems use more fundamental rather than proxy attributes to characterize a potential borrower's ability and willingness to pay. The future plan for the WFP's Building Blocks is to allow refugees and displaced people to control their own cryptographic keys and integrate personal data sources, like the World Health Organization, the UN Children's Fund, and the WFP,<sup>46</sup> to build their economic identity and creditworthiness.

Even more importantly, financial and other forms of exclusions are more likely to affect nonusers of certain services such as social media.<sup>10</sup> Compared to wealthy individuals, larger proportions of low-income people are nonusers of cell phones, the Internet, and social media, which are used by TechFins and fintech companies to analyze creditworthiness. In least developed countries (LDCs), which are low-income countries (Figure 1) that lack sufficiently developed human assets and face high economic vulnerability,<sup>30</sup> more than 27% of the population does not have cell phones and more than 80% lacks Internet access. For a population without any digital footprint, initiatives such as those implemented by Kiva and BanQu may be the only way to make information available to potential lenders.



**Figure 1.** The penetration rates of cell phones and the percentage of Internet users in economies with various levels of development. (Source: The International Telecommunications Union.)

Higher privacy protection and safer from misuse and abuse of data

Before proceeding further, it is important to note that TechFins are emerging as an important source of lending activities for low-income groups. Although banks store large amounts of consumer data on spending habits, strict regulations prohibit them from exploiting it. Banks' lending decisions rely largely on standard industry scores, while TechFins tend to think they can store and analyze any data. Tech companies are subject to regulations not as strict as those for banks and are more likely to misuse personal information.<sup>11</sup> In the developing world, TechFins lack good data-handling practices due to political, regulatory, and cultural conditions, which are indifferent toward privacy concerns.<sup>12</sup>

An additional point that deserves emphasis is that many tend to think that data privacy is something only wealthy people need. For instance, 90% of the discussion at the 2013 Internet Governance Forum held in Indonesia referred to big data as a surveillance tool. The debate that focused on developing countries, however, treated big data as a means to "observe" people in the hope of fighting poverty. The argument was that data can help provide key necessities, such as drinking water and health care. Indeed, a contrary case could be made. In some developing countries, there are interethnic tribal tensions and violence, while others are living in the aftermath of civil wars. In such countries, privacy breaches may lead to a physical risk.<sup>13</sup>

A key advantage of blockchain-based models over TechFins is that borrowers have control of their information. With Kiva's digital identification system and BanQu's economic passport, for instance, people retain secure and complete ownership of personal information.

Lower-cost solutions compared with other alternatives

The solutions discussed in the previous section also have lower installation and operating costs compared to those of alternative technologies. To register a customer's identity, for instance, BanQu may need to execute multiple write blockchain transactions. In 2018, the average cost of

this transaction was US\$0.03.<sup>31</sup> According to Ethereum Gas Station, which provides a tool for calculating the Gas required for an Ethereum transaction, the cost of processing a simple contract with a lower than 2-min lag was estimated at one-fifth of US\$.01.<sup>32</sup> With this rate, a million customers can be registered for a few thousand dollars. This is significantly lower than Amazon Web Services' operating costs of thousands of dollars every month. Once the data are written, the ongoing costs are insignificant because the costs to read data are very low.<sup>32</sup>

Directly connecting lenders with borrowers and aid givers with aid receivers

Blockchain-based solutions make peer-to-peer lending possible by directly connecting lenders and borrowers, thereby eliminating the need for intermediaries. As an example, consider Kiva; the company does not make direct loans. And although some investors mistakenly think that Kiva offers direct person-to-person connections, it actually works with local MFIs as middlemen. Kiva says that it conducts audits of its field partners to ensure that low-income groups are not exploited. However, due to high overhead costs and other sources of inefficiency, Kiva field partners charge exorbitantly high interest rates. For instance, a Kiva field partner in Senegal reportedly charged a borrower an interest rate of 40%.<sup>33</sup>

Such loans could be made more affordable by eliminating the middlemen (Kiva field partners). In this regard, programs such as Kiva's blockchain-based IDs are a first step toward improving access to finance for low-income populations. True decentralization will be complete when impact investors and philanthropic funders can directly reach low-income groups with cryptocurrencies.

Similar benefits can be derived from the systems used to distribute donations and aid. The WFP expects blockchain-based solutions to reduce its overhead costs from 3.5 to less than 1%.<sup>7</sup> What is even more important is that an estimated 30% of developmental funds do not reach the intended recipients due to problems such as third-party theft and mismanagement.<sup>14</sup> Blockchain holds great potential and promise to reduce such practices.

## **Challenges in Using Blockchain-Based Fintechs and Cryptocurrencies**

There are many challenges and obstacles that must be overcome for the widespread adoption of blockchain-based fintechs and cryptocurrencies.

Limited resources and capability of start-ups

A common observation is that most initial coin offering (ICO) projects, such as those of Humaniq and Moeda, are initiated by small groups of engineers who have little or no experience and understanding of real-world business practices.<sup>34</sup> Moreover, start-ups that have unveiled fintechs and cryptocurrencies for low-income groups have limited resources and capabilities to design products from which the targeted groups can benefit. The relative lack of success of start-ups can also be explained by the difficulty they face in competing for the market against more established companies. As an example, the fintechs and cryptocurrencies discussed previously may find it difficult to compete with Facebook's Libra cryptocurrency, which is planned to be launched in 2020.

Facebook's WhatsApp (whatsapp.com) has already tested a new feature called *WhatsApp Pay*, which lets users send money directly to each other's bank accounts. Currently, it is available only in India, where there were 1 million users in early 2019.<sup>35</sup> Fintech firms like Coinbase and PayPal, which are Libra Association's founding partners, may include Libra in their wallets. The plan is to run Calibra inside Facebook's WhatsApp and Messenger. As of 2019, WhatsApp is available in up to 60 languages on Android. In India alone, WhatsApp provides messaging in 13 languages,<sup>36</sup> while the Humaniq app is offered in English, French, and Swahili.<sup>37</sup>

Some start-ups have conducted training and development to bridge skill gaps. Researchers have found that the chance of adopting a new technology increases if a farmer's network has someone who has already adopted it.<sup>15</sup> Humaniq's regional ambassadors aim to educate users to encourage the adoption of its apps. Ambassadors in some African countries are already doing this.<sup>47</sup> However, there are too few ambassadors to facilitate the information flow and adoption of Humaniq apps. In June 2019, Humaniq listed a total of 15 ambassadors on its website, seven of whom were from Tanzania. Most countries in which Humaniq was operating at that time did not have any ambassadors.

#### Complex technology is difficult to grasp

Low-income groups in developing countries lack the skills necessary to use and benefit from technologies such as blockchain. Some estimates suggest that half of the populations in developing countries cannot speak the official language of their own country.<sup>16</sup> The challenges related to low-quality information flow are even more daunting for blockchain applications due to their high degree of complexity. Blockchain-based fintechs and cryptocurrencies are more complex and difficult to understand compared to traditional financial solutions. This is even more so for low-income groups in the developing world that may lack technological skills. Practitioners in the field have observed that individuals in Africa write their debit card personal identification numbers on the cards to make sure that it is not forgotten.<sup>6</sup>

More user-friendly apps can expedite information flow and communication to increase their adoption; however, efforts have not yet been undertaken to develop apps that are friendly to low-income people. A related mechanism that can facilitate information flow would be to ensure that someone is available to educate users regarding the benefits of blockchain-based fintechs and cryptocurrencies and how best to use the apps. Although Humaniq's plan to appoint regional ambassadors is a good idea, as noted earlier, the implementation has not been successful.

#### Lack of connectivity

The ability of low-income families to benefit from blockchain-based fintech and cryptocurrencies is hindered by a lack of connectivity. According to the International Telecommunication Union, LDCs had cell phone and Internet penetrations of 72.4 and 19.5%, respectively, in 2018 (Figure 1).<sup>38</sup> Only 15% of Sierra Leone's population has Internet access. Kiva's partners, such as banks, are expected to set up Internet hotspots for borrowers to access their private keys;<sup>39</sup> however, it is yet to be seen whether this action will be undertaken.

## Lack of supporting technologies and infrastructures

Developing economies are characterized by low-quality physical capital, for example, infrastructures, plants, equipment, and information technology.<sup>2</sup> Blockchain start-ups find it difficult to build well-developed ecosystems around their products. These conditions do not allow for the maximum utilization of fintech products and cryptocurrencies. A Moeda white paper claimed that it will combine Ethereum with machine learning, artificial intelligence, and the Internet of Things (IoT);<sup>40</sup> however, the company has not used any of these technologies. Building and maintaining an IoT system typically requires a large investment in software infrastructure and local skill development. Even if such systems are set up with outside help, small farmers cannot perform technical tasks such as troubleshooting and maintenance.

## Unfavorable market and institutions

Unfavorable markets and institutional arrangements act as major impediments that prevent low-income families from maximizing the potential of blockchain-based fintech and cryptocurrencies. Developing economies lack contract-enforcement procedures, property rights, and standards.<sup>2</sup>

Humaniq claimed that new users can buy phones for as little as US\$10 and start earning money immediately within a few weeks by performing tasks for outsourcing firms.<sup>41</sup> Humaniq app's Business Chats allow users to access a marketplace and buy and sell goods and services using HMQ. The company also wants to connect companies with the financial services sector and local enterprises. This approach, however, necessitates the highly unrealistic assumption that a sufficiently high number of companies will be engaged in business activities with low-income people as long as they have Humaniq IDs. In general, this assumption is highly questionable because companies are reluctant to outsource to countries that lack privacy protection and cybersecurity practices. There have been many data breaches in outsourcing destinations, which have affected Western firms. As an example, in 2003, a Pakistani medical transcriber working for a U.S.-based medical center threatened to post confidential voice files and patient records on the Internet if her pay was not increased.<sup>42</sup>

## Stockholder-centric bias in the actions of blockchain start-ups

There has been increased pressure to meet stockholder expectations.<sup>17</sup> Not surprisingly, the actions of blockchain start-ups that have launched fintech products and cryptocurrencies are more investor centric and less consumer centric. A technology start-up writer noted that "many of the highly publicized ICOs have yet to carry out much beyond upgrading the lifestyles of their founders and promoters."<sup>34</sup>

These start-ups have adopted strategies that increase profitability for investors. For instance, Humaniq tokens have been listed on many exchanges to facilitate their buying and selling.<sup>43</sup> Although Moeda claims that it combines microfinance, crowdfunding, and blockchain to help low-income families, it has focused on larger loans to increase profitability for its investors. Indeed, Moeda's loans are too big to be considered microloans. Small-size microloans result in high administration costs for lenders. As of January 2018, it had invested in 18 projects

with loans ranging from US\$50,000 to US\$300,000.<sup>25</sup> From a comparative perspective, Kiva's average loan outside the United States is US\$400. Moreover, the network of MFIs VisionFund's average loan size worldwide was US\$437.<sup>48</sup>

Big companies like Anheuser-Busch can benefit tremendously from blockchain's use to promote supply chain transparency and traceability. Blockchain can help guarantee the quality of products by using relevant data. Making digital payments to farmers may lower the costs associated with payments. Blockchain is being used by some firms to enhance their reputational value by demonstrating their ability to innovate and increasing consumers' perception of food safety.<sup>18</sup>

#### Low-income groups' limited power and financial/social capital

Low-income groups in developing countries have limited power or financial/social capital.<sup>2</sup> *Social capital* is defined as "features of social organization, in other words, trust, norms, and networks, that can improve the efficiency of society by facilitating coordinated actions."<sup>19</sup> The networks of low-income populations often only consist of other low-income groups. This means that powerful social and political actors, for instance, policy makers and NGOs, are less likely to pay attention to indicators related to whether the projects are achieving their stated goals of helping low-income populations. This is likely to be the case even when these actors notice that the projects are not performing well in terms of helping low-income populations, and they understand the meaning of it. They may also know what they are supposed to do under these circumstances.

A Medium article by the editor of Moeda Seeds claimed that "investors know all of the details of how their money is spent in each Seed Project, directly from Moeda's website."<sup>44</sup> However, the link provided, <https://moedaseeds.mybluemix.net/7a1e1a65-7d0f-446d-801f-edbf7e77407e>, listed two projects: Cooperval Craft Beer and Sustainable Coffee Seed Project, each with few details. Key pieces of information, including the investment amount, is missing in the Cooperval Craft Beer project. For the Sustainable Coffee Seed Project, it is stated that Moeda "is going to invest US\$13,000." Since the start of this US\$20 million ICO, Moeda provided few details regarding how investors' money has been used. This defeats the primary purposes behind using blockchain, which is described as a *trust machine*.

An upshot of increased pressures to meet stockholder expectations is that philanthropy activities have been in decline.<sup>18</sup> In many cases, the stated benefits for low-income populations are conditional, rather than guaranteed. For instance, small holder farmers that supply crops to Anheuser-Busch may theoretically enjoy additional benefits (that is, getting low-cost loans from financial institutions) using their identity and transaction information put on BanQu's blockchain. However, constraints related to information flows, transaction costs, and market access would prevent them from realizing such benefits. The farmers, for instance, may not be able to present the information in a way that meets the requirements of banks. They may also lack persons in their social network who possess the capability to understand the various available loan services. Due to a lack of education, many potential borrowers cannot complete loan applications and often need loans in small amounts, which is costly for financial institutions. In some cases, low-income people may face prejudice and stereotypes, with banks refusing their admission to bank branch offices.

Fintechs and cryptocurrencies for low-income people are among the most intriguing applications for blockchain. Transparency and accountability can be improved by giving cryptocurrency vouchers to refugees instead of cash. A blockchain-based economic history can address the problems associated with undeveloped record-keeping technologies and authentication models in developing countries. However, it is not clear whether the start-ups focusing on fintechs and cryptocurrencies are achieving their stated goals of helping low-income people. In some cases, the income levels of their user base is considerably lower than their stated expectations. Humaniq's goal was to attract 1 million app users in 2018;<sup>45</sup> this target was not met as of June of 2019.<sup>49</sup>

Start-ups lack the resources or technical expertise necessary to develop solutions useful for low-income people. An ecosystem has not been developed around blockchain-based fintechs and cryptocurrencies due to fundamental impediments, such as highly unfavorable economic and infrastructural contexts making it unprofitable to serve low-income people. Not surprisingly, the results in most cases have been far from promising.

The start-ups' claims are also based on the unrealistic assumption that partners in value chains (for example, buyers of agricultural commodities) and those in economic networks (such as banks and MFIs) must also adopt the fintechs and cryptocurrencies and engage in economic transactions with low-income people. This is a convenient assumption, but it has been contradicted by real-world, fundamental realities because most ICOs are initiated by individuals with little or no experience and understanding of everyday business practices. Network effects do not exist due to the lack of sufficient users. Without network effects and a rich market to ensure the low-income population's access to broader economic system, the expected benefits cannot be realized.

The best explanation for the relatively negligible success of blockchain-based solutions to expand financial inclusion has less to do with the technologies than it does with the users' lack of skills and availability of opportunities. More user-friendly apps can facilitate information flows and communication among different parties. Cryptocurrencies such as Libra may encourage better information flow and facilitate an effective response from low-income populations.

The needs of big companies are often the key determinant when blockchain solutions are developed to connect low-income populations. Indeed, they have the skills, resources, and financial capacity necessary to benefit from these technologies; however, those benefits are conditional on low-income populations having the skills required to use the technologies and the existence of opportunities in which to implement them. The lack of a well-developed ecosystem around blockchain-based fintechs and cryptocurrencies hinders their ability to take full advantage of these technologies.

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