Will blockchain emerge as a tool to break the poverty chain in the Global South?

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***Note: Footnotes and endnotes indicated with parentheses

Abstract:

Just like its recent predecessors, blockchain – also known as the distributed ledger technology – is considered to have the potential to cause major economic, political and social transformations in the Global South. The visible effects of this technology are already being noted there. We present early evidence linking the use of blockchain in overcoming some economic, social and political challenges facing the Global South. The article highlights the key applications and uses of blockchain in developing countries. It demonstrates how blockchain can help promote transparency, build trust and reputation, and enhance efficiency in transactions. The article looks at opportunities and key triggers for blockchain diffusion in these countries. It also delves into challenges and obstacles that developing economies are likely to encounter in the use of blockchain.

Keywords: Blockchain | corruption | land registry | microinsurance | smart contract | transparency

Article:

Introduction

Just like its recent predecessors such as cloud computing(1) and the Internet of Things (IoT),(2) blockchain – also known as the distributed ledger technology – is considered to have the potential to cause major economic, political and social transformations in the Global South (GS). Some have touted blockchain as the biggest innovation in computer science.(3) Others consider this technology to be 'the biggest disruptor to industries since the introduction of the Internet'.(4) The World Economic Forum (WEF) considers blockchain to be among six computing 'mega-trends' that are likely to shape the world in the next decade.(5)

A blockchain can be viewed as a data structure which makes it possible to create a tamper-proof digital ledger of transactions and share them. Cryptography allows anyone access to add to the ledger securely. There is no central authority or a middleman such as a bank or financial institution.(6) It is impossible or extremely difficult to change or remove data blocks recorded on the ledger.(7) Due to these features, blockchain can arguably make it possible to reduce or eliminate integrity violations such as fraud and corruption, and reduce transaction costs.

According to the WEF, 10% of the global gross domestic product (GDP) will be stored on blockchain by 2027,(8) compared to 0.025% in 2016.(9) While most discussion of blockchain focuses on bitcoin, this paper addresses additional, potentially more important, influences of this technology in the GS.

Blockchain affects economic, social and political outcomes in the GS by many direct and indirect pathways. As noted above, the first of blockchain's direct benefits is potential reduction of corruption and fraud. For instance, blockchain can empower donors. It can ensure that donations reach the intended recipients. To give an example, donors can buy electricity for a South African School using bitcoin. A blockchain-enabled smart meter makes it possible to send money directly to the meter. There are no organisations involved to re-distribute funds. Donors can also track electricity being consumed by the school and calculate the power their donations can buy.(10) This programme was launched by South African bitcoin startup Bankymoon via the crowdfunding platform Usizo. It allows African public schools to use blockchain to crowdsource utility credits.(11)

Increase in efficiency and reduction in transaction costs constitute a second kind of benefit. There is no third party or central body involved. That is, blockchain transactions are conducted by the concerned parties themselves. There are already some signs of blockchain-led disintermediation in international remittances and international trade finances. In September 2016, the Chinese government announced that blockchain will be used in its social security system in order to lower transactions costs. In 2015, China's National Council for Social Security Fund managed US$285 billion.(12)

To be sure, blockchain is in its infancy. Some compare the current level of development to 'the World Wide Web in the early 1990s'.(13) Nonetheless, multinationals, local companies and policymakers have devoted considerable attention to blockchain. The renowned Peruvian economist Hernando de Soto, who is well known for his work on informal and unofficial economy, is involved in the development of a blockchain-based platform for property records in the Republic of Georgia.

Major global technology companies and software vendors such as IBM and Microsoft have extended their offerings to incorporate numerous services around blockchain. For instance, in September 2016, IBM announced an internal re-organisation to build blockchain capability. A new unit called Watson Financial Services integrates Watson, cloud, and blockchain-related offerings and strategy.(14) IBM also created new roles specifically devoted to blockchain. These companies' blockchain-related offerings are available in the GS. IBM's India research labs are involved in some of IBM's blockchain-related work.(15) GS-based firms are also susceptible to

pressure to adopt blockchain from their business partners and other value-delivery network members from the industrialised world.

We present early evidence linking blockchain use to overcoming economic, social and political challenges facing the GS. The paper is structured as follows. We proceed by first providing a literature review of key challenges in GS economies. Next, we look at blockchain's applications and uses to overcome these challenges. Then, we examine the opportunities and key triggers for blockchain diffusion. The section following this looks at the challenges and obstacles. It is followed by a section on discussion and implications. The final section provides concluding comments.

Literature review: key challenges facing the GS

Causes of economic prosperity and poverty

There are many and varied sources of underdevelopment, which include colonialism (Howard, 1978) dependence on commodities,(16) ethnic tension and political violence.(17) In this paper, we focus on institutional environments. Poor countries mostly lack good institutions that ensure strict enforcement of property rights, have the ability to deal with corrupt practices effectively, and provide equal opportunity to all members of society.(18)

The lack and poor enforcement of property rights

According to a 2011 report of the United Nations (UN) Food and Agriculture Organization (FAO) and Transparency International, in over 61 countries, weak governance led to corruption in land occupancy and administration. Corruption varied from small-scale bribes to the abuse of government power at the national, state and local levels.(19)

Enforcement of property rights increases incentives to invest and provides resources to get out of the poverty trap. Clear property rights would allow entrepreneurs to use the assets as collateral and thus increase their access to capital. A large proportion of poor people in the GS lack property rights. For instance, about 90% of land is undocumented or unregistered in rural Africa. Likewise, the lack of land ownership remains among the most important barriers to entrepreneurship and economic development in India.(20) One estimate suggested that over 20 million rural families in India did not own land and millions more lacked legal ownership to the lands they built houses on, lived on and worked.(21) Indeed, landlessness is arguably a more powerful predictor of poverty in India than caste or illiteracy.(22)

Disregard and lack of respect of the rule of law

In some GS economies, the rule of law is disregarded and not respected by corrupt politicians, government officials and other powerful groups. These groups sometimes expropriate the incomes and investments of poor people or create an uneven playing field.

Less opportunity for disadvantaged groups

Economically and socially disadvantaged groups have less opportunity to access finance, credit, insurance, education and other things. These groups thus cannot make investments and participate in productive economic activities. Consider for instance, insurance. In India, 86% of the rural population and 82% of the urban population lacks health insurance.(23)

Regarding access to finance, in China, small and medium-sized enterprises (SMEs) account for 70% of GDP but have access to 20% of financial resources.(24) Eighty-nine percent of SMEs in the country face difficulty in satisfying banks' requirements to get loans.(25) Small borrowers often lack sufficient collateral required by most traditional banks.(26)

Unavailability of financing is a more critical barrier faced by most entrepreneurs. For instance, despite high interest rates, demand for credit exists in most GS economies. Banks in the Democratic Republic of Congo (DRC) reject over one-third of credit and loan applications. The fact that they cannot enforce their legal rights as lenders has led to the risk-averse behaviour of the banking industry. This situation is a manifestation of a broader structural problem in the GS, such as the DRC in which a large proportion of the population lacks access to formal banking institutions.(27) The situation is not much different in other GS economies. For instance, in Africa, only 20% have bank accounts – 10% in Kenya, 5% in Tanzania and 15% in Liberia.(28)

Barriers related to measurement, implementation, enforcement and transaction costs

A related point is that poor-quality institutions lead to transaction cost-related barriers. To make this statement meaningful requires a more detailed discussion of what is meant by transaction costs. In the context of business transactions involving two or more parties, for Douglas North, 'transaction costs are … two things: (1) the costs of measuring the dimensions of whatever it is that is being produced or exchanged and (2) the costs of enforcement'.(29) He goes on to say that 'a lot of what we need to do is to try to measure the dimensions of what we are talking about in such a way that we can define them precisely'.(30)

Many GS economies are faced with challenges in enforcing commercial contracts, social and economic rights, laws and regulations (eg agro-environmental), and standards (eg pollution-related). Put differently, these economies are characterised by the lack of effective enforcement mechanisms. Emphasising the importance of measurements in enforcement, North argues: 'Without being able to measure accurately whatever it is you are trying to enforce, there cannot be effective enforcement, even as a possibility'.(31) The technology available is among the important factors that affect the costs of measurement and enforcement and hence the transaction costs.(32) In this regard, blockchain can make up for the lack of relevant institutions or the problems associated with high transaction costs.

Enforcement can be implemented at three levels: first party, second party and third party.(33) It is suggested that third-party enforcement mechanisms, which are often formal coercive enforcement measures by the state, have been relatively ineffective in the GS.(34) Blockchain has the potential to strengthen the governments' enforcement powers and sanctions against individuals or organisations that breach regulations.

Key blockchain applications to overcome challenges facing the Global South

Some of the key current applications and future prospects of blockchain are presented in Table 1. As is clear from the table, various barriers and challenges faced by the GS can be addressed through blockchain. In parentheses, we indicate how the use cases have the potential to address various causes of poverty by strengthening the rule of law (SRL), helping to enforce property rights (EPR) and creating opportunity for disadvantaged groups (ODR).

Table 1. Blockchain in the Global South: some applications currently in use or being developed.

Blockchain use	Explanation and examples
Promoting transparency and reducing fraud and corruption	Alipay's donation platform (ODR)[a]
	South Africa's Bankymoon allows public schools in Africa to use blockchain to crowdsource utility credits (ODR)[b]
	Standard Chartered and DBS Group's blockchain-based platform detects falsification and frauds in trade transactions (SRL)[c]
	Ukraine's blockchain-based eAuction platform (SRL, EPR)[d]
	A Peruvian political party, Peru Possible, told voters that it would use blockchain to fight corruption[e] (SRL).
Reducing friction and costs of property registration	Honduran government's plan to transfer land registry onto a blockchain-enforced digital database (EPR)[f]
	Bitland's blockchain-based land registry system based in Ghana (EPR)[g]
	BitFury and the Georgian government's agreement to develop a system for registering land titles using blockchain (EPR)[h]
Promoting efficiency in international B2B trade and increasing access to trade and supply chain finance	Skuchain's blockchain-based products for B2B trade and supply chain finance (ODR)[i]
Reducing costs and increasing efficiency in international payment systems	Bitspark's bitcoin remittance from Hong Kong to GS economies (ODR)[j]
	Bitsoko uses bitcoin for money transfer, remittance services and payment processing in Ghana, Zimbabwe, Uganda, Sierra Leone and Rwanda (ODR)[k]
	Mexico's mexBT uses blockchain for cross-border payments among firms in emerging economies (ODR)[l]
	Circle aims to focus on the Chinese international P2P payments market (ODR)[m]

Insurance and risk management	Mexican mobile payments platform Saldo.mx has launched a microinsurance service (ODR)[n]
	China's insurance company Ping An joined a global consortium of financial institutions to explore blockchain use (ODR)[o]
Banking	India's central bank, the Reserve Bank, was reported to be considering the use of blockchain to reduce cheque counterfeiting. Digitised cheques are expected to reduce paper use and the risk of theft and fraud[p] (SRL).

[a] See note 12.
[b] See note 11.
[c] See note 41.
[d] See note 44.
[e] RedHerring.com "Georgia Pilots and Sweden Ponders."
[f] See note 50.
[g] See note 54.
[h] See note 55
[i] See note 59
[j] See note 62.
[k] See note 63, 64.
[l] See note 65.
[m] See note 75, 76.
[n] See note 60.
[o] See note 78.
[p] Maiya "Benefit with Blockchain."
EPR: helping to enforce property rights, ODR: creating opportunity for disadvantaged groups, SRL: strengthening the rule of law.

Promoting transparency and reducing fraud and corruption

Blockchain can help achieve transparency in various settings. In mid-2016, Ant Financial, Alibaba's online payments affiliate, announced the launch of blockchain technology for payments. Blockchain was first applied to Alipay's donation platform. Donors on its 'Ant Love' charity platform can track transaction histories, and understand where their funds go and how they are used.(35) The goal is to increase transparency and provide a trust mechanism by recording each payment and spending of donations on the blockchain.

The use of fake export invoices to disguise cross-border capital flows has been pervasive in China. Since China has maintained strict capital control regimes, some importers and exporters falsify trade transactions in order to move capital in and out of the country. Many banks do not check the authenticity of trade documents.(36) During April to September of 2014, China found US$10 billion worth of fake trade transactions.(37) Some major fraud cases were in Qingdao, the world's seventh-busiest port. Some firms had used fake receipts to secure multiple loans against a single cargo of metal.(38)

The Qingdao frauds involved 300,000 tons of alumina, 20,000 tons of copper and 80,000 tons of aluminium ingots.(39) Due to the scandals, Chinese banks charge higher interest rates and have a lower tendency for collateral financing.(40) Blockchain arguably can stop scandals such as those in Qingdao.

Recent high-profile fraud has increased blockchain's attractiveness. The British multinational banking and financial services company, Standard Chartered, lost about US$200 million from Qingdao fraud. Standard Chartered has teamed up with DBS Group and Singapore's Infocomm Development Authority to develop a blockchain-based platform.(41) Other players such as Bank of America and HSBC are also exploring blockchain for trade finance and other applications.(42)

In November 2015, Bitcoin Foundation Ukraine and KUNA Bitcoin Agency signed an memorandum of understanding (MoU) with Ukraine's Kyiv Regional State Administration to implement a blockchain project to set up an e-governance system in the port city of Odessa. It was announced that the first project would be a government real estate auction. The goal is to ensure a fair, transparent auction and eliminate the chance of document forgery. Subsequent application areas are expected to be in various public services such as personal identification, public records and banking.(43)

In February 2016, Ukrainian technology innovation group Distributed Lab implemented an eAuction platform, which is among the largest and most important public blockchain initiatives in the country. Two banks – Oschadbank and PrivatBank – participated in the project.(44) Blockchain is connected to the banks' infrastructures. When someone bids, the payment goes to the seller's account. The bank produces a signed receipt for the transaction, which is added to the blockchain as a proof that money was sent.(45)

Reducing friction and costs of property registration

Blockchain can reduce friction and conflict as well as costs of property registration. Regarding the costs, it is possible to do most or all of the process including the use of a notary service using smart phones.(46)

In mid-2015, the US-based startup Factom and the Honduran government reportedly reached an agreement to transfer land registry in Honduras into a blockchain-enforced digital database. The goal is to create a land title-keeping system that is reliable and transparent. According to the United States Agency for International Development (USAID), only 14% of Hondurans legally hold their properties. Among those properties that are occupied legally, only 30% are registered.(47) It is not uncommon for government officials to alter titles of registered properties. In some case, government officials allocate properties with altered titles to themselves. The country's bureaucrats reportedly altered titles and registered beachfront properties for themselves.(48) They also allegedly accepted bribes in exchange for property titles. Citizens often lack access to records, and records that are accessible provide conflicting information. Property owners are often unable to defend themselves against infringement of property use or mineral rights.(49)

However, sufficient progress has not been made in the Honduran government's plan to transfer land registry to blockchain. It was reported in December 2015 that the project had 'stalled' due to political issues.(50)

The US-based platform for real estate registration Bitland announced the introduction of a blockchain-based land registry system in Ghana, where 78% of land is unregistered.(51) There is a long backlog of land-dispute cases in Ghanaian courts.(52) About 90% of land is undocumented or unregistered in rural Africa. Bitland records transactions securely with global positioning system (GPS) coordinates, written description and satellite photos. The process is expected to guarantee property rights and reduce corrupt practices. As of mid-2016, 24 communities in Ghana had expressed interest in the project.(53) Bitland is planning to expand to Nigeria in 2017 in collaboration with the Organization of Petroleum Exporting Countries (OPEC) Fund for International Development (OFID).(54)

Bitcoin company BitFury and the Georgian government signed a deal to develop a system for registering land titles using the blockchain.(55) As noted above, the Peruvian economist Hernando de Soto will assist in the development of the platform. In order to buy or sell land in Georgia, currently the buyer and the seller go to a public registry house. They are required to pay US$50–200, which depends on the speed with which they want the transaction to be notarised. The pilot project will move this process onto the blockchain. The costs for the buyer and the seller are expected to be in the range of US$0.05–0.10 range.(56)

Promoting efficiency in international business to business (B2B) trade and increasing access to trade and supply chain finance

The global trade finance market, which is valued at US$18 trillion, is likely to be transformed by the blockchain by disintermediation and other efficiency measures. First, the global trade finance market relies on paper documentation for most processes. Paper-based methods such as letter of credit (LoC) and factoring account for about US$5 trillion of annual trade worldwide.(57) It costs 1–3% of the trade's value to buy an LoC. The LoC involves mailing of physical documents and verification.

Factors are key intermediary players in the global trade finance market. They offer money to exporter. Based on the promised future payments, exporters borrow from factors. Exporting firms make an outright sale of accounts receivable to factors in order to maintain liquidity. For instance, a Chinese exporter selling to Walmart can take invoice for those goods to a factor, which can pay the exporter right away. For a US$100 invoice, the factor may pay as little as US$90. The upshot is that buyers such as Walmart pay more for goods they buy from GS-based sellers. The global factoring market is estimated at over US$2 trillion annually.(58)

Venture capital (VC)-funded startups such as Skuchain are creating blockchain-based products to address inefficiencies in B2B trade and supply chain finance.(59) The products are expected to eliminate the roles of intermediaries and financiers. Buyers and sellers agree on the terms of a deal. Blockchain can track and manage the transaction from start to finish.

Reducing costs and increasing efficiency in international payment systems

The transaction costs on remittances, especially small remittances, are very high. Immigrants use transfer services such as Western Union, which cost as much as 7% of the transfer amount.(60) In order to transfer 300 Rand from South Africa to neighbouring countries, transfer fees varied from 35 to 68.2 Rand by bank draft to 19.2 to 62.5 Rand by electronic transfer, 25.3 Rand by Moneygram and 6.2 Rand by iKobo's services.(61)

Bitspark, the bitcoin remittance in Hong Kong, was reported to charge a flat HK$15 (about US$1.90) for remittances of less than HK$1200, and 1% above that amount. For instance, when remittances are sent to the Philippines, Bitspark's local partner, Rebit, converts bitcoin into pesos for receivers.(62)

Bitcoin startup Bitsoko, which as of July 2016 had a presence in Ghana, Zimbabwe, Uganda, Sierra Leone and Rwanda, uses bitcoins for money transfer, remittance services and payment processing. It charges customers a fraction of the current rates.(63)

In mid-2015, Banco Santander launched a trial version of a blockchain-based app that can be used to transfer £10–10,000 (US$13.20–1,320) in euros to 21 countries, and dollars to the US.(64)

Mexico's mexBT uses blockchain for cross-border payments among GS-based firms. The company hopes that by lowering rates, payments and transfers of remittances can be made easier. mexBT launched the platform Pay.meXBT for international payment, mainly between Latin America and Asia. Pay.meXBT uses bitcoin and blockchain to facilitate cross-border payments. The platform allows payments in local currencies. The system is also expected to speed up payment processes.(65)

Insurance and risk management

Blockchain may provide risk managers with an effective way to protect individuals and companies from uncertain loss or catastrophe. Insurance and derivatives can be used as a tool to control or minimise the risk factors associated with unpredictable or uncontrollable events. By supporting decentralised insurance models, blockchain may make derivatives more transparent. A meaningful risk management process can be designed using reputational systems based on peoples' social and economic capital and online behaviour.(66) Blockchain-based insurance is connected to big data, the IoT and health trackers to ensure better pricing and risk assessment.(67)

The IoT makes it easier for cars, electronic devices or home appliances to have their own insurance policies. Using blockchain, they can be registered, and their insurance policies are administered by smart contracts. Damages are automatically detected, which trigger the repair process, claims and payments.(68) Payouts are made against the insurable event and the policyholder does not have to a make a claim. The insurer does not need to administer claims. The costs of claims processing are thus close to zero. Even more importantly, there is less likelihood of fraud.(69)

To take an example, Mexican mobile payments platform Saldo.mx has launched a microinsurance service, Consuelo, which allows users to buy blockchain-powered health and life insurance policies. The target groups are Mexicans living in the country as well as diaspora.(70)

Identity management has been a big issue. In financial institutions such as the insurance industry, the ability to prove someone is who he/she says online is very important in order to increase the accuracy of risk assessments and reduce fraud.(71) In this regard, the Delaware, USA-based blockchain startup Tradle is developing solutions for know-your-customer (KYC) data. A customer can grant access to identity data to companies such as Tradle for a contract closure. After verifying the KYC profile, a customer can forward the identity data to other companies for different contracts. There is no need to repeat the identification and verification process for each transaction, which speeds up the process and increases efficiency.(72)

Opportunities and key triggers for blockchain diffusion

Among the main triggers of blockchain diffusion is a rapid rise in investment in this technology. VC-backed investments in blockchain totalled US$3 million in two deals in 2011, which increased to 74 deals and US$474 million in 2015.(73) An estimate by Virtual Capital Ventures suggested that VC investments in blockchain-related startups would exceed US$2.5 billion by 2016.(74)

Blockchain investment is increasing in the GS. The Chinese search engine Baidu invested in the US blockchain company Circle. Circle China announced a plan to enter the Chinese peer-to-peer (P2P) payment market with bitcoin with the partnership of Goldman Sachs and Barclays.(75) Circle specifically aims to focus on the Chinese international P2P payments market.(76)

Chinese firms have launched major initiatives to develop the blockchain industry and market. Thirty-one technology and financial firms including the financial services firm Ping An Bank and Tencent formed a blockchain consortium, which focuses on capital markets technology, securities exchange, trading platforms, life insurance and banking.(77)

GS-based firms are also participating in strategic agreements such as global consortia built around blockchain, which can facilitate the sharing of technology and resources. China's second-biggest insurance company, Ping An, joined a global consortium of financial institutions led by the FinTech firm R3.(78) In September 2016, China Merchants Bank joined R3.(79) R3's consortium includes members from Asia, Europe and North America, such as Morgan Stanley, HSBC, UBS, Credit Suisse, Barclays, Societe Generale and Commerzbank. These members are working with R3 to use blockchain for a wide range of applications. In July 2016, Barclays Africa also joined R3.

In some GS economies, there is a strong horizontal linkage providing supports for blockchain diffusion. For instance, China is the world's biggest bitcoin market, with an estimated 800,000 bitcoin users in 2016.(80) Some argue that blockchain may allow China's banking system to leapfrog the west.

Industrialised world-based blockchain companies are also making inroads to the GS. For instance, the public blockchain-based distributed computing platform Ethereum, which features smart contract functionality, has a presence in many GS economies. The Chinese online insurance company Zhong An announced a partnership with Ethereum to use the platform in smart contracts.(81) Likewise, a number of South African banks were reported to be testing the use of Ethereum.(82) As of 2015, the US-based blockchain infrastructure provider and transaction processing company BitFury Group had a data centre located in Gori, Georgia.(83) In September 2015, the company announced a US$100 million investment to build second data centre in Tbilisi.(84)

Investments have also been made or are being planned in niche-market applications. A study suggested that finance and technology companies' investments related to capital markets would reach US$1 billion in 2016.(85) As of mid-2016, about 20 blockchain startups were focusing on insurance solutions.(86)

Many blockchain solutions are based on cloud services of global information technology (IT) giants such as IBM and Microsoft. For instance, verification of the microfinance operation on Mijin and some processes of the eAuction platform in Ukraine are performed on Microsoft Azure.(87) IBM's supply chain customers can build and test blockchain solutions on the company's LinuxOne system. Its target users are companies that want to track high-value items in complex supply chains.(88) Global IT companies' significant presence in the GS would help stimulate blockchain diffusion.

Opportunities

Blockchain has opened up new opportunities to solve a number of fundamental problems facing the GS. Among the positive externalities created by blockchain could be that it will be harder for corrupt government officials to hide financial waste or corruption. Among the benefits of blockchain is also that people across the world can more freely interact financially with each other.(89)

As noted above, blockchain can promote transparency and reduce fraud and corruption. Blockchain deployment for purposes such as crowdsourcing utility credits for schools is likely to become more commonplace since smart meters are increasingly affordable and accessible to organisations in developing countries. For instance, in the US, total capital costs per meter, including installation, were reported to be as little as $81.(90) Some utility companies such as Nevada's NV Energy instal smart meters for free.

Blockchain can also improve internal and external auditing. A public auditor can make a real-time audit of data. The auditor can examine the registry daily instead of yearly. More frequent auditing may lead to less corruption and more efficient economies.

Pervasiveness of fraud in the insurance sector has been a concern in the GS. One estimate suggested that false claims in the Indian healthcare insurance industry account for 10–15% of total claims. The industry is estimated to lose about US$90 million on false claims annually. Major fraud categories or schemes reported include misrepresented services, services not

provided and services provided to 'rented' patients.(91) Likewise, the Chinese insurance industry suffers from rampant abuses and malpractices that are committed by patients and medical staff. In Lipanshui city in Guizhou province, fraud cases were found in 107 of the 135 hospitals and medical centres. All hospitals in Anshun were also found to engage in mismanagement of medical insurance. Some medical staff had provided fake medical records to get payments for treatments which were not performed.(92) Such fraud can be prevented with blockchain.

Fraud is rampant in the microfinance sector too. During 2010–2012, in India's Kerala state, the president and secretary of the Adoor Sree Narayana Dharma Paripalana Union received loans of US$1.15 million from Bank of India on behalf of 5000 families. The families had no knowledge of the loans but faced debt collection proceedings.(93) Blockchain can prevent such fraud. In July 2016, two Japan-based firms, Tech Bureau and Infoteria, successfully demonstrated the deployment of microfinance service in Myanmar using the blockchain platform Mijin. They transferred loans and the account data located in the system of local microfinance firm BC Finance.(94)

Blockchain has the potential to drastically reduce administrative and operations costs in diverse economic sectors. According to Santander, by facilitating cross-border payments and securities trading, and streamlining regulatory barriers and processes, blockchain is likely to generate cost savings in the range of US$15–20 billion by 2022.(95)

In the insurance industry, for instance, an automated verification of policyholder identity and contract validity can be performed using blockchain. Submission and registration of claims are done online, and are auditable. Relevant data (eg encrypted transaction of data on injured parties prepared by hospitals and medical centres) are obtained from third parties, which are made accessible to the insurer to verify payment. Payouts for claims can be made via a blockchain-based infrastructure or smart contracts.(96)

Reinsurers can be provided with controlled access to claims and claims histories registered on the blockchain. Having access to auditable data in an automated way improves transparency for the reinsurer.(97)

The distributed nature of blockchain can promote trust. In a centralised database, some actors may corrupt the contents. They can be bribed to mark forged or stolen items as legitimate.(98) 'The Trust Machine' was the title of the cover story of an October 2015 issue of the *Economist* magazine which explained blockchain's potential impacts.(99) Blockchain enables the accrual of reputation to connect trading partners directly. For instance, global multinationals such as Walmart can provide supply-chain financing directly to their small GS-based suppliers.

In order to establish trust and verify identity, banks rely on rating agencies, data analytics firms, and retail and wholesale banks. These actors decide the access to finance and insurance. Blockchain lowers or eliminates the need for third-party trust-producing institutions.

Challenges and obstacles

GS economies encounter a number of challenges and obstacles in blockchain adoption. While bitcoin is just one of the applications of blockchain, currently it is the most popular way of using blockchain. The bitcoin network is already congested. It was reported in November 2016 that over 65,000 transactions were waiting to process during peak times. During some periods in October 2016, users were required to wait for an average of more than six hours.(100)

It is not clear how the capacity to meet blockchain's growth needs will be financed. For instance, there is a lack of a formal roadmap and action plans for how all global financial transactions could be transferred to blockchain. Analysts say that enough investments have not been flowing in blockchain. For instance, investments on the Internet during the early phase of its development were many times bigger than the current investment in blockchain. Marc Andreessen, of the VC firm Andreessen Horowitz, considered bitcoin in 2014 to be similar to PC in 1975, and the Internet in 1993, in terms of its levels of development and maturity.(101) In this regard, it is worth noting that as of early 2014, total VC investment in bitcoin was less than US$100 million, compared to more than US$500 million received by Internet startups in 1995.(102)

The attempts to regulate blockchain have been another area of controversy. The roles of regulators and state authorities are not clear. It is not also clear how best to determine relative priorities and allocate resources to different economic and social segments. The functioning of blockchain may also conflict with regulatory requirements. For instance, information stored in a public ledger cannot be modified or deleted. The information can be accessed by any user instantly. This feature is in contradiction to the right to be forgotten.(103)

A further concern is related to energy consumption. Due to the burden of proof-of-work consensus, writing data in blockchain is extremely energy intensive. The 'miners' that perform validation are required to show proof of work – consumption of electricity and use of computing power – and are paid in new bitcoins for their work. First, in order to add blocks of transactions to the blockchain, validation of all of the transactions is required within the block. Then it is required to perform repeated calculations (called hashing) to find a 'magic number' that makes the created block valid and acceptable to other participants according to the network's rules. The second step is computationally expensive and energy intensive.(104) They need to reach consensus to confirm each other's work in order to establish a new page, also known as a block, of the ledger.(105)

Energy consumption is also a function of the hardware. Data miners keep details of their hardware secret. It is thus difficult to estimate power consumed by the network. One estimate suggested that if the bitcoin miners use the most efficient hardware, the annual electricity usage could be about two terawatt-hours (more than that used by 150,000 people in the US). Under pessimistic assumptions, the amount of electricity consumed could be up to 40 terawatt-hours.(106)

Among the negative externalities created by blockchain is the additional bandwidth required to relay transaction across the network.(107) This may be even more severe in GS economies facing network congestion problems.

Many GS economies lack absorptive capacity to benefit from blockchain. For instance, in order to develop the eAuction platform in Ukraine, the platform needed to be integrated into the bank's system. Digital signatures and a special application programming interface (API) were integrated to retrieve signed receipts, which needed to be connected to core back offices. The entire process reportedly took only two days.(108) While Ukraine is known for technological achievement, many GS economies have limited technological capabilities.

The major obstacles also include the lack of education, information, and user-friendly applications.(109) There has been a lack of awareness of blockchain among key stakeholders. For instance, Saldo is reported to educate underbanked communities. The company also works with the Mexican foreign ministry in financial literacy events. Saldo found that it is too complex to talk about blockchain. It started educating financial institutions first, which are more familiar with blockchain.(110)

There are also negative perceptions of blockchain due to its association with bitcoin, which has been used in illegal and dark-side activities such as money laundering and illegal drugs.(111) Overcoming such perceptions remains a significant challenge.

Among key challenges are also interoperability and standardisation. For instance, the participants on a distributed ledger need to agree on common standards for an invoicing platform. For one thing, different banks need to have an agreement on the number of data fields used from an invoice to generate the hash value. They may also need common messaging standards. The banking industry, which is among the early adopters of blockchain, is characterised by a culture of competitiveness, which poses a challenge to working together.(112)

Finally, regarding the effect on the reduction of fraud and corruption, blockchain may face different risks and obstacles. For instance, systems such as Bankymoon's blockchain-enabled smart meter to crowdsource utility credits may be subject to other, different risks such as tampering and physical tapping of school meters in order to resell electricity to non-school users. In order to ensure that inappropriate actions do not occur, an appropriate party to audit and verify may be needed.

Discussion and implications

While it can be argued that it may be within the self-interest of providers of blockchain-related services to exaggerate the potential benefits of this technology, the above analysis suggests that blockchain, in combination with other technologies such as the IoT and cloud computing, has the potential to drive economic, social and political transformations in the GS. Among the most attractive features of blockchain is that once a record is created it is almost impossible to tamper with, forge or alter it. Blockchain will thus make data secure. Transactions can also be conducted to achieve any degree of privacy or openness depending on the need.(113)

An *Economist* article asserts that blockchain is '[t]he great chain of being sure about things'.(114) This technology helps make sure that corrupt officials do not engage in fraudulent activities. Organisations can make sure that their business partners play by the rules. Services providers can make sure that people are who they say they are when they enrol and participate in

various services. These features are of special interest in the GS economies that lack effective trust-producing institutions. Blockchain can compensate for the unavailability of such institutions.

The widespread adoption of blockchain may enhance a country's image. For instance, Georgia has been trying to promote itself as a corruption-free country with a modern and transparent governance model.(115)

Blockchain is especially likely to make contract enforcements more efficient and effective. For instance, a blockchain-based life or health insurance smart contract can be a powerful tool to improve the market mechanism. A smart contract can be executed either 'above' the blockchain or 'on' the blockchain. In the former, the software program runs outside the blockchain and feeds information to the blockchain. In the second case, the software program is coded into blocks.(116) It is possible to automatically activate policy based on diagnosis. For instance, if a diagnosis indicates the existence of a triggering condition for the policy that is written in the smart contract, the information is fed to the blockchain. The smart contract automatically authorises payments based on the policy. Smart contracts can also act as a warranty for down payment to the medical service provider, and there is no need to have a previous contractual relationship between the medical service provider and the insurance company. In this way, smart contracts drastically reduce administrative costs.

Some application areas discussed above are land registration (eg Honduran government), and tracking donations and payments (eg Alibaba and Bankymoon's crowdfunding platform, Usizo). Bitcoin as an interoperable system can more easily convert various currencies and facilitate cross-border trade.

Blockchain is particularly suitable for detecting widespread fraud in diverse industries such as insurance and banking. As Bankymoon's crowdsourcing of utility credits suggest, blockchain makes it possible for donors to directly make payments to the causes that they are passionate about. Donors no longer need to depend on other organisations to act as middlemen. In this way, blockchain helps prevent the misuse and abuse of donor money.

The GS needs to deal with various challenges and bottlenecks in successful blockchain deployment. Powerful actors that are against transparency and openness may oppose blockchain. In the land ownership example, blockchain can increase the transparency of land ownership records and make it difficult or impossible for corrupt officials to alter land registries after the records are on the blockchain. However, blockchain cannot address corruption in decisions about how land is registered in the ledger.(117)

Blockchain's takeoff hinges on harmonised standards and regulations. In order to realise the benefits of blockchain beyond what is possible with traditional database solutions, cooperation and coordination among a number of actors such as industry associations, competitors (eg cooperation among insurers), manufacturers, customers and other parties are needed.(118) If regulatory reforms are brought about to digitise the relevant regulatory information and transfer it to a blockchain ledger, compliance with disclosure laws can also be increased.

Countries vary in their ability to benefit from blockchain. Forward-looking politicians in some countries have recognised blockchain's potential. The lack of political motivation has acted as a barrier in others. For instance, compare Georgia and Honduras. Georgia's rank on Transparency International's Corruption Perception Index was 48th in 2015,(119) compared to the 112th place ranking of Honduras. Georgia has an efficient property registration process. According to the World Bank's Doing Business survey, in 2016, Georgia ranked third in terms of the ease of property registration for SMEs, compared to Honduras' rank of 88th.(120) Registering a property is costlier and more time consuming in Bangladesh, which ranked 185th in the world in 2016.(121) To register a property, Bangladesh requires eight procedures, which take 244 days and cost 6.5% of the property value. In countries characterised by dysfunctional institutions, such as Bangladesh, blockchain should hold even greater potential.

Regarding the transparency feature of blockchain, some caveats need to be made. Blockchain is in an infant stage of development, and various alternate models are evolving. For instance, many firms in the financial sector are unhappy with blockchain's transparent nature that gives other users access to the details of transactions conducted. In order to make blockchain more appealing to financial institutions, the cryptocurrency Zcash, which was launched in October 2016, has promised transactional privacy.(122) Zcash has envisioned two types of addresses: transparent and shielded. In transparent addresses, as in the case of bitcoin, the amounts sent as well as the receiver and the sender show up on the blockchain. On the other hand, if one opts to use a shielded address, the address is 'obscured' on the public ledger. Moreover, if the sender and the receiver of funds both use shielded addresses, the transaction amount will also be encrypted. This could be a big concern for regulators that are interested in countering money laundering.

Finally additional side effects associated with widespread adoption of blockchain may include a potential decline in jobs. Initiatives are needed to stimulate and encourage entrepreneurial activities to create new jobs to overcome the potentially adverse economic and social effects associated with blockchain-led job losses.

Blockchain from a diffusion-of-innovation perspective

Rogers(123) identified various characteristics of a technology affecting its diffusion pattern: relative advantage, compatibility, complexity, observability and trialability. Based on the examples discussed earlier, Table 2 presents how blockchain performs in terms of these characteristics. As is clear from the table, blockchain is likely to have a mostly favourable impact on social and economic aspects of development. From the perspective of the GS, there are some key roadblocks at present to the rapid diffusion of this technology, including a high degree of complexity and potential resistance from corrupt politicians and bureaucrats.

Table 2. Characteristics of a technology influencing diffusion: blockchain in the Global South.

Dimension	Explanation	Blockchain's performance	Example
Relative advantage	Perceived benefits of a technology over previous technologies and the extent to which it is better than the idea it supersedes.	Blockchain performs better than most other technologies in key areas including promotion of transparency, reduction of	Bitland's blockchain-based land registry system in Ghana[a]

		fraud and corruption, and reduction of friction and costs of property registration.	
Compatibility	The degree to which a technology and the tasks it performs are perceived as being consistent with the existing values, beliefs, past experiences and needs of potential adopters.	Corrupt politicians and bureaucrats are likely to resist blockchain since it enhances transparency and accountability.	The Honduran government's plan to transfer land registry onto a blockchain-enforced digital database was reported to face political roadblocks[b]
Complexity	The level of difficulty of installing and using a technology (variety and uncertainty increase complexity).	Most potential adopters consider blockchain to be a highly complex technology.	Saldo found it too complex to talk about blockchain and needed to educate financial institutions first[c]
Observability	The degree to which the features and benefits of a technology are visible, noticeable and understandable to self/others; the results can be described to non-users.	Blockchain-based remittance services providers have lower transaction costs.	Bitspark charges about 1% of the remittance amount, significantly lower than that charged by other money transfer companies[d]
Trialability	The ability to experiment or try (on a limited basis) before formally adopting.	It can be tried on a limited basis before full-scale adoption.	In order to enhance food safety, Wal-Mart announced a plan to build a blockchain online ledger to track the movement of pork in its Chinese supply chain. The project is scheduled to run for four months. After the trial period, Wal-Mart will evaluate results with technology providers IBM and Tsinghua University and make decisions about expanding[e]

[a] See note 51.
[b] Dale, "Three Small Economies."
[c] See note 60.
[d] See note 62.
[e] Nash, "Wal-Mart Turns To Blockchain."
Source: Based on Rogers (1995), and the author's research.

Concluding comments

Blockchain applications are in a nascent stage of development. Rather than viewing them as a self-contained phenomenon, they must be seen against the backdrop of economic and institutional realities facing the GS. In theory, there are many possible uses of the blockchain and several channels and mechanisms through which the GS may benefit. In practice, however, a number of challenges stand in the way of implementation and practical results. Blockchain-based innovations and business models are as yet far from inclusive of SMEs in the GS. If the technology is properly developed, utilised and implemented, some of the institutional bottlenecks can be alleviated. Overall, blockchain can unlock entrepreneurship opportunities.

Note on Contributor

Nir Kshetri is a professor at the University of North Carolina-Greensboro. He has authored seven books. His 2014 book *Global Entrepreneurship: Environment and Strategy* (Routledge: New York) was selected as an Outstanding Academic Title by *Choice Magazine*. He has also published around 100 articles in various journals. He participated as lead discussant at the Peer Review meeting of UNCTAD's Information Economy Report 2013 and Information Economy Report 2015. He is the winner of the 2016 Bryan School Senior Research Excellence Award. He is also a two-time winner of the Pacific Telecommunication Council's Meheroo Jussawalla Research Paper Prize (2010 and 2008). He has been interviewed and/or quoted by over 80 TV channels, magazines and newspapers.

Disclosure statement

Acknowledgements

Notes

1. Kshetri, "Cloud Computing in the Global South."
2. Kshetri, "Economics of the Internet of Things."
3. Tapscott, "How Will Blockchain Change Banking?"
4. PWCHK.com, "Blockchain the Biggest Disruptor."
5. WEF, "Deep Shift Technology."
6. Heires, "Risks and Rewards of Blockchain Technology."
7. Nash, "IBM Pushes Blockchain."
8. WEF, "Deep Shift Technology."
9. Huckstep,"What Does the Future Hold."
10. Higgins, "How Bitcoin Brought Electricity."
11. Mulligan, "5 African Crowdfunding Startups to Match."
12. Quentson "China's Social Security."

13. Ramada-Sarasola, "Want to Get an Insurer's Attention?"
14. Roberts, "America's Big Banks Are Staffing Up."
15. Mahalingam, "With India Type of Ideals."
16. Sindzingre, "Impact of the 2008–2009 Crisis."
17. Murshed, "Conflict, Civil War and Underdevelopment."
18. Acemoglu, "Root Causes"; Acemoglu, "Political Economy of Development and Underdevelopment"; Acemoglu, Johnson, and Robinson, "Institutions as a Fundamental Cause."
19. UN News Center, "Corruption Leading to Unequal Access."
20. Kshetri, "Fostering Startup Ecosystems in India."
21. Hanstad, "Case for Land Reform in India."
22. Ibid.
23. Bansal, "Health Cover: Too Little, too Scarce."
24. Klein and Cukier, "Tamed Tigers, Distressed Dragon."
25. Jing, "Alibaba, Lenders Team Up."
26. Wildau, "Alibaba's Finance Arm Launches;" Kshetri, "Big Data's Role."
27. Kshetri, "Global Entrepreneurship: Environment and Strategy."
28. Dovi, "Boosting Domestic Savings in Africa."
29. North, "Dealing with a Nonergodic."
30. Ibid.
31. Ibid.
32. Ibid.
33. Ibid.
34. Kshetri, "Economics of the Internet of Things."
35. Chen, "Jack Ma Takes on."
36. Shengxia, "China Uncovers $10b Worth of Falsified Trade."
37. Ibid.
38. Smith, "7 Ways Blockchain Technology."
39. Shengxia, "China Uncovers $10b Worth of Falsified Trade."
40. Smith, "7 Ways Blockchain Technology."
41. Chanjaroen and Boey, "Fraud in $4 Trillion."
42. Ibid.
43. Lyon, "First Blockchain-Powered Government."
44. Allison, "Ukraine's Government."
45. Ibid.
46. Shin, "Republic Of Georgia."
47. USAID, "USAID Country Profile."
48. Puiu, "How Bitcoin's Blockchain."
49. Jeong, "Bitcoin, Blockchain, and Land Reform."
50. HondurasNews, "Blockchain Land Title Project."
51. Ogundeji, "Land Registry Based on Blockchain."
52. Jones, "How Blockchain Is Impacting Industry."
53. Ogundeji, "Land Registry Based on Blockchain."
54. EconoTimes, "Bitland Partners with CCEDK."
55. Higgins, "Republic of Georgia to Develop Blockchain."
56. Higgins, "Survey: Blockchain Capital Markets."
57. Allison, "Skuchain."

58. Ibid.
59. PRNewswire, "Skuchain Developing Blockchain."
60. Valenzuela, "Bitcoin Remittances to Mexico."
61. Gupta, Pattillo, and Wagh, "Effect of Remittances."
62. Chan, "Bitcoin Transactions."
63. Prisco, "African Bitcoin Startup."
64. Williams-Grut, "Santander is Letting Staff Use."
65. Bogdan, "MeXBT Announces Its Cross-Border."
66. Tapscott, "How Will Blockchain Change Banking?"
67. Ramada-Sarasola, "Want to Get an Insurer's Attention?"
68. Lorenz et al., "Blockchain in Insurance."
69. Huckstep, "What Does the Future Hold."
70. Valenzuela, "Bitcoin Remittances to Mexico."
71. BoostVC, "5 Ways that Insurance Will Be Disrupted."
72. Ibid.
73. Maras, "VC Fintech Funding."
74. Palmer, "7 Emerging Trends for Bitcoin."
75. Maye, "China's Baidu Enters FinTech."
76. Meola, "Blockchain Payment Company."
77. Higgins, "China Merchants Bank."
78. Ferguson, "Blockchain Technology Coming to China."
79. Higgins, "China Merchants Bank."
80. Ferguson, "Blockchain Technology Coming to China."
81. Leung, "Chinese E-Insurance Company."
82. Finextra, "South Africa and Blockchain."
83. AGENDA.ge, "Bitcoin Industry."
84. Menezes, "Georgia, Attracts $100 m."
85. Higgins, "Survey: Blockchain Capital Markets."
86. Del Castillo, "McKinsey Report."
87. Phyo, "Japanese Firms."
88. Nash, "IBM Pushes Blockchain."
89. Ver, "Time to End the Block-Size Blockade."
90. King, "How much do smart meters cost?"
91. Bardhan, "Frauds in Health Insurance."
92. Yan, "High Levels of Medical Insurance Fraud."
93. The New Indian Express, "Micro-Finance Scam."
94. Phyo, "Japanese Firms."
95. Harwood-Jones, "Road to Mass Adoption of Blockchain."
96. Lorenz et al., "Blockchain in Insurance."
97. Ibid.
98. Greenspan, "For Genuine Blockchain".
99. The Economist, "Trust Machine."
100. Taylor, "Bitcoin's Governance Model?"
101. Andreesen, "Why Bitcoin Matters."
102. Hileman, "Following the Money."
103. Beloussov, "Blockchain: Panacea or Hype."

104. Lewis, "So, You Want to Use a Blockchain."
105. Lee, "Getting to Grips with Blockchain."
106. The Economist, "Trust Machine."
107. Ver, "Time to End the Block-Size Blockade."
108. Allison, "Ukraine's Government."
109. Valenzuela, "Bitcoin Remittances to Mexico."
110. Ibid.
111. Pearson, "Blockchain is the New Buzzword."
112. Chanjaroen and Boey, "Fraud in $4 Trillion."
113. Rangwala, "Will Blockchain be the Same."
114. The Economist, "Trust Machine."
115. Mougayar, "Blockchain is Perfect for Government Services."
116. Farrell et al., "10 Things You Need."
117. Jeong, "Bitcoin, Blockchain, and Land Reform."
118. Lorenz et al., "Blockchain in Insurance"
119. Transperency International, "Corruption Perception Index 2015."
120. World Bank Group, "Doing Business. Registering Property."
121. Ibid.
122. Clozel, "How Zcash Tries to Balance."
123. Rogers, *Diffusion of Innovations*.

Bibliography

1. Acemoglu. D. 2003. "Root Causes: A Historical Approach to Assessing the Role of Institutions in Economic Development." *Finance & Development*. 27–30. http://isites.harvard.edu/fs/docs/icb.topic637539.files/Acemoglu.pdf

2. Acemoglu, D. "Political Economy of Development and Underdevelopment." 2005. Gaston Eyskens Lectures, Leuven. http://economics.mit.edu/files/1064.

3. Acemoglu, D., S. Johnson, and A. J. Robinson. "Institutions as a Fundamental Cause of Long-Run Growth." 2005. In *Handbook of Economic Growth*, edited by Philippe Aghion and Steven N. Durlauf.Amsterdam: Elsevier. http://baselinescenario.files.wordpress.com/2010/01/institutions-as-a-fundamentalcause.pdf.

4. AGENDA.ge. "Bitcoin Industry Growth in Georgia, Attracts $100 M Investment." 2016. http://agenda.ge/news/43030/eng.

5. Allison, I. 2016. "Ukraine's Government and Biggest Banks Fight Corruption with Blockchain-Based Property Auction." http://www.ibtimes.co.uk/ukraines-government-biggest-banks-fight-corruption-blockchain-land-property-auction-1559295.

6. Allison, I. 2016. "Skuchain: Here's How Blockchain Will save Global Trade a Billion Dollars." http://www.ibtimes.co.uk/skuchain-heres-how-blockchain-will-save-global-trade-trillion-dollars-1540618.

7. Andreesen,M. 2014. "Why Bitcoin Matters." *The New York times*. http://dealbook.nytimes.com/2014/01/21/why-bitcoin-matters/?_php=true&_type=blogs&_r=2.

8. Bansal, S. 2016. "Health Cover: Too Little, Too Scarce." http://www.thehindu.com/sci-tech/health/policy-and-issues/health-insurance-in-india-too-little-too-scarce-reveal-national-sample-survey-data/article8462747.ece.

9. Bardhan, B. 2007. "Frauds in Health Insurance." http://www.scmp.com/news/china/policies-politics/article/1850183/high-levels-medical-insurance-fraud-found-rural-areas.

10. Beloussov, S. 2016. "Blockchain: Panacea or Hype or a Little of Both?" http://www.cio.com.au/article/599634/blockchain-panacea-hype-little-both/.

11. Bogdan, D. 2015. "MeXBT Announces Its Cross- Border Payments Platform." http://www.coinfox.info/news/3532-mexbt-announces-its-cross-border-payments-platform.

12. BoostVC. 2016. "5 Ways That Insurance Will Be Disrupted by the Blockchain." https://medium.com/boost-vc/5-ways-that-insurance-will-be-disrupted-by-the-blockchain-8ffc33674713#.4ng8nof0w.

13. Chan, B. 2015. "Bitcoin Transactions Cut the Cost of International Money Transfers." http://www.scmp.com/lifestyle/technology/article/1679904/bitcoin-transactions-cut-cost-international-money-transfers.

14. Chanjaroen, C. and Boey,D. 2016. "Fraud in $4 Trillion Trade Finance Has Banks Turning Digital." http://www.bloomberg.com/news/articles/2016-05-22/fraud-in-4-trillion-trade-finance-turns-banks-to-digital-ledger.

15. Chen, L. Y. 2016. "Jack Ma Takes on Murky Chinese Charities in Blockchain Foray." http://www.bloomberg.com/news/articles/2016-07-31/jack-ma-takes-on-murky-china-charities-in-first-blockchain-foray.

16. Clozel, L. 2016. "How Zcash Tries to Balance Privacy, Transparency in Blockchain." http://www.americanbanker.com/news/law-regulation/how-zcash-tries-to-balance-privacy-transparency-in-blockchain-1092198-1.html.

17. Dale, B. 2015. "Three Small Economies Where Land Title Could Use Blockchain to Leapfrog the US." Observer. http://observer.com/2016/10/benben-factom-bitfury-ghana-georgia-honduras/.

18. Del Castillo, M. 2016. "McKinsey Report Weighs Blockchain Impact on Insurance Industry." http://www.coindesk.com/mckinsey-report-blockchain-insurance-impact/.

19. Dovi, E. 2011. "Boosting Domestic Savings in Africa." http://www.un.org/africarenewal/magazine/october-2008/boosting-domestic-savings-africa.

20. EconoTimes. 2016. "Bitland Partners with CCEDK to Improve Blockchain Land Registry in West Africa." http://www.econotimes.com/Bitland-partners-with-CCEDK-to-improve-blockchain-land-registry-in-West-Africa-271517.

21. Farrell, S. Griffin, A. Hinchliffe, R. and Warren, C. 2016. "10 Things You Need to Know about Smart Contracts." http://www.kwm.com/en/knowledge/insights/10-things-you-need-to-know-smart-contracts-20160630.

22. Ferguson, N. 2016. "Blockchain Technology Coming to China." http://insuranceasianews.com/countries/china/blockchain-technology-coming-to-china/.

23. Finextra. 2016. "South Africa and Blockchain: Changing the Face of Africa." https://www.finextra.com/blogposting/13371/south-africa-and-blockchain-changing-the-face-of-africa.

24. Greenspan, G. 2016. "For Genuine Blockchain Use Cases. Available at: Gideon Greenspan." Four Genuine Blockchain Use Cases. http://www.multichain.com/blog/2016/05/four-genuine-blockchain-use-cases/.

25. Gupta, S., C. A. Pattillo, and S. Wagh. "Effect of Remittances on Poverty and Financial Development in Sub- Saharan Africa." *World Development* 37 (2009): 104–115. 10.1016/j.worlddev.2008.05.007

26. Hanstad, T. 2013. "The Case for Land Reform in India." https://www.foreignaffairs.com/articles/india/2013-02-19/untitled?cid=soc-twitter-in-snapshots-untitled-022013.

27. Harwood- Jones, M. 2016. "The Road to Mass Adoption of Blockchain." http://www.enterpriseinnovation.net/article/road-mass-adoption-blockchain-1237099721.

28. Heires,K. "The Risks and Rewards of Blockchain Technology." 2016. http://www.rmmagazine.com/2016/03/01/the-risks-and-rewards-of-blockchain-technology/.

29. Higgins, S. 2016a. "China Merchants Bank Joins R3 Blockchain Consortium." http://www.coindesk.com/china-merchants-bank-joins-r3-blockchain-consortium/.

30. Higgins,S. 2016b. "How Bitcoin Brought Electricity to a South African School." http://www.coindesk.com/south-african-primary-school-blockchain/.

31. Higgins, S. 2016c. "Republic of Georgia to Develop Blockchain Land Registry." http://www.coindesk.com/bitfury-working-with-georgian-government-on-blockchain-land-registry/.

32. Higgins, S. 2016d. "Survey: Blockchain Capital Markets Spending to Reach $1 Billion in 2016." http://www.coindesk.com/capital-markets-1-billion-2016-blockchain/.

33. Higgins, S. 2016. "31 Chinese Firms Form Financial Blockchain Consortium." http://www.coindesk.com/financial-blockchain-shenzhen-consortium-launch/.

34. Hileman, G. 2014. "Following the Money: Trends in Bitcoin Venture Capital Investment." Coindesk. http://www.coindesk.com/following-money-trends-bitcoin-venture-capital-investment/.

35. HondurasNews. 2015. "Blockchain Land Title Project 'Stalls' in Honduras." https://www.hondurastoday.com/2015/12/blockchain-land-title-project-stalls-in-honduras/.

36. Howard, R. *Colonialism and Underdevelopment in Ghana*. London: Croom Helm, 1978.

37. Huckstep,R. 2016. "What Does the Future Hold for Blockchain And Insurance?" https://dailyfintech.com/2016/01/14/what-does-the-future-hold-for-blockchain-and-insurance/.

38. Jeong, J. 2016. "Bitcoin, Blockchain, and Land Reform: Can 'Incorruptible' Technology Cure Corruption?". https://globalanticorruptionblog.com/2016/01/08/bitcoin-blockchain-and-land-reform-can-an-incorruptible-technology-cure-corruption/.

39. Jing, M. 2014. "Alibaba, Lenders Team up for SME Financing." http://usa.chinadaily.com.cn/business/2014-07-23/content_17901199.htm.

40. Jones, A. 2016. "How Blockchain is Impacting Industry." http://internationalbanker.com/finance/blockchain-impacting-industry/.

41. King, C. 2014. "How Much Do Smart Meters Cost?" SmartGridWatch. Siemens. https://blogs.siemens.com/en/smart-grid-watch.entry.html/957-how-much-do-smart-meters-cost.html.

42. Klein, B. P., and Cukier, K. N. 2009. "Tamed Tigers, Distressed Dragon." https://www.foreignaffairs.com/articles/asia/2009-07-01/tamed-tigers-distressed-dragon.

43. Kshetri, N. "Cloud Computing in the Global South: Drivers, Effects and Policy Measures." *Third World Quarterly* 32, no. 6 (2011): 995–1012.

44. Kshetri, N. *Global Entrepreneurship: Environment and Strategy*. New York: Routledge, 2014.

45. Kshetri, N. "Big Data's Role in Expanding Access to Financial Services in China." *International Journal of Information Management* 36, no. 3 (2016a): 297–308. 10.1016/j.ijinfomgt.2015.11.014

46. Kshetri, N. 2016b. "The Economics of the Internet of Things in the Global South." *Third World Quarterly*. http://www.tandfonline.com/doi/full/10.1080/01436597.2016.1191942.

47. Kshetri, N. "Fostering Startup Ecosystems in India." *Asian Research Policy* 7, no. 1 (2016c): 94–103.

48. Lee, P. 2016. "Getting to Grips with Blockchain." http://www.euromoney.com/Article/3501936/Getting-to-grips-with-blockchain.html.

49. Leung, A. 2016. "Chinese E-Insurance Company, Partners with Ethereum for Blockchain Insurance Platform." The Cointelegraph. https://cointelegraph.com/news/chinese-e-insurance-company-partners-with-ethereum-for-blockchain-insurance-platform.

50. Lewis, A. 2016. "So, You Want to Use a Blockchain for That?" http://www.coindesk.com/want-use-blockchain/.

51. Lorenz, J., Munstermann, B., Higginson, M., Olesen, P. B., Bohlken, N. and Ricciardi, V. 2016. "Blockchain in Insurance- Opportunity or Threat?" http://www.mckinsey.com/industries/financial-services/our-insights/blockchain-in-insurance-opportunity-or-threat.

52. Lyon, N. 2015. "First Blockchain- Powered Government to Launch in Odessa, Ukraine." https://cointelegraph.com/news/first-blockchain-powered-government-to-launch-in-odessa-ukraine.

53. Mahalingam, T. V. 2016. "With India Type of Ideals, IBM Stoops to Conquer." http://economictimes.indiatimes.com/tech/ites/with-india-type-of-deals-ibm-stoops-to-conquer/articleshow/53923955.cms.

54. Maiya, R.V. 2016. "Benefit with Blockchain." http://www.businessinsider.in/Blockchain-Benefits/articleshow/53490752.cms.

55. Maras, E. 2016. "VC Fintech Funding Sets Records in 2015, Fueling Bitcoin and Blockchain Growth." https://www.cryptocoinsnews.com/vc-fintech-funding-sets-record-2015-fueling-bitcoin-blockchain-growth/.

56. Maye, N. 2016. "China's Baidu Enters FinTech, Invests in American Blockchain Company." https://cointelegraph.com/news/chinas-baidu-enters-fintech-invests-in-american-blockchain-company.

57. Menezes, N. 2015. "Georgia, Attracts $100 M Investment from the Blockchain Infrastructure Provider BitFury." http://www.newsbtc.com/2015/09/24/georgia-attracts-100 m-investment-from-the-blockchain-infrastructure-provider-bitfury/.

58. Meola, A. 2016. "Blockchain Payment Company Circle is Aggressively Expanding." http://www.businessinsider.com/blockchain-payment-company-circle-is-aggressively-expanding-2016-6.

59. Mougayar, W. 2016. "The Blockchain is Perfect for Government Services." http://www.coindesk.com/blockchain-perfect-government-services-heres-blueprint/.

60. Mulligan, N. 2015. "5 African Crowdfunding Startups to Match." http://disrupt-africa.com/2015/11/5-african-crowdfunding-startups-to-watch/.

61. Murshed, S. M. "Conflict, Civil War and Underdevelopment: An Introduction." *Journal of Peace Research* 39, no. 4 (2002): 387–393. 10.1177/0022343302039004001

62. Nash, K. S. 2014. "Wal-Mart Turns to Blockchain for Tracking Pork in China." Observer. http://blogs.wsj.com/cio/2016/10/19/wal-mart-turns-to-blockchain-for-tracking-pork-in-china/"

63. Nash, K. S. 2016. "IBM Pushes Blockchain into the Supply Chain." http://www.wsj.com/articles/ibm-pushes-blockchain-into-the-supply-chain-1468528824.

64. North, D. C. "'Dealing with a Nonergodic World: Institutional Economics, Property Rights, and the Global Environment'. 1999. Duke Environment, Law, and Policy." *Forum* 10, no. 1 (1999): 1–12.

65. Ogundeji, O. 2016. "Land Registry Based on Blockchain for Africa." http://www.itwebafrica.com/enterprise-solutions/505-africa/236272-land-registry-based-on-blockchain-for-africa.

66. Palmer, D. 2016. "7 Emerging Trends for Bitcoin and the Blockchain." http://www.coindesk.com/emerging-trends-blockchain-bitcoin/.

67. Pearson, M. 2016. "Blockchain is the New Buzzword." http://www.experian.com/blogs/insights/2016/01/blockchain-is-the-new-buzzword/.

68. Phyo, A. 2016. "Japanese Firms Implement Myanmar's First Blockchain Microfinance Service." http://www.mmbiztoday.com/articles/japanese-firms-implement-myanmar-s-first-blockchain-microfinance-service.

69. Prisco, G. 2015. "African Bitcoin Startup Wins Bill & Melinda Gates Foundation Grant, Launches Blockchain Event Series in Nairobi." https://bitcoinmagazine.com/articles/african-bitcoin-startup-wins-bill-melinda-gates-foundation-grant-launches-blockchain-event-series-nairobi-1436993383.

70. PRNewswire. 2016. "Skuchain Developing Blockchain Solutions for $18 Trillion Trade Finance Market with Funding from Amino." DCG, and FBS Capital. http://www.prnewswire.com/news-releases/skuchain-developing-blockchain-solutions-for-18-trillion-trade-finance-market-with-funding-from-amino-dcg-and-fbs-capital-300214205.html.

71. Puiu, T. 2015. "How Bitcoin's Blockchain Could Mark the End to Corruption." http://www.zmescience.com/research/technology/bitcoin-blockchain-corruption-04232/.

72. PWCHK.com. 2016. "Blockchain the Biggest Disruptor to Industries since the Introduction of the Internet – PwC." http://www.pwchk.com/home/eng/pr_070716.html.

73. Quentson, A. 2016. "China's Internet Giant to Roll Our Blockchain Tech for Payments." http://coinjournal.net/ant-financial-blockchain-tech//.

74. Quentson, A. 2016. "China's Social Security to Use Blockchain Tech." https://www.cryptocoinsnews.com/chinas-social-security-use-blockchain-tech/.

75. Ramada-Sarasola, M. 2016. "Want to Get an Insurer's Attention? Just Say Blockchain." https://www.willistowerswatson.com/en/insights/2016/06/want-to-get-an-insurers-attention-just-say-blockchain.

76. Rangwala, A. 2016. "Will Blockchain Be the Same 'Bust' as the Internet?" http://insuranceblog.accenture.com/will-blockchain-be-the-same-bust-as-the-internet.

77. RedHerring.com. 2016. "Georgia Pilots and Sweden Ponders- is Blockchain the Future for Europe's Land Registries?". http://www.redherring.com/startups/georgia-pilots-sweden-ponders-blockchain-future-europes-land-registries/.

78. Roberts, D. 2016. "America's Big Banks Are Staffing up – For Blockchain." http://finance.yahoo.com/news/americas-big-banks-are-staffing-up-for-blockchain-173138163.html.

79. Rogers, E. M. *Diffusion of Innovations*. Fourth edition. New York: Free Press, 1995.

80. Shengxia, S. 2014. "China Uncovers $10b worth of Falsified Trade." http://www.globaltimes.cn/content/883512.shtml.

81. Shin, L. 2016. "Republic of Georgia to Pilot Land Titling on Blockchain with Ecoomist Hernando De Soto, BitFury." http://www.forbes.com/sites/laurashin/2016/04/21/republic-of-georgia-to-pilot-land-titling-on-blockchain-with-economist-hernando-de-soto-bitfury/#45d381296550.

82. Sindzingre, A. "The Impact of the 2008-2009 Crisis on Commodity-Dependent Low-Income African Countries: Confirming the Relevance of the Concept of Poverty Trap?" 2012. *Journal of International Development*, 24(8), 989–1007. 10.1002/jid.2877

83. Smith, P. 2015. "7 Ways Blockchain Technology Could Disrupt the Post- Trade Ecosystem." Kynetix White Paper. http://www.the-blockchain.com/docs/Seven%20ways%20the%20Blockchain%20can%20change%20the%20trade%20system.pdf.

84. Tapscott, D. 2016. "How Will Blockchain Change Banking? How Won't It?" http://www.huffingtonpost.com/don-tapscott/how-will-blockchain-chang_b_9998348.html.

85. Taylor, R. 2016. "Bitcoin's Governance Model? Bickering and Inaction with Misaligned Incentives." *Bankless times*. http://www.banklesstimes.com/2016/11/30/bitcoins-governance-model-bickering-and-inaction-with-misaligned-incentives/.

86. The Economist. 2015. "The Trust Machine." http://www.economist.com/news/leaders/21677198-technology-behind-bitcoin-could-transform-how-economy-works-trust-machine.

87. The New Indian Express. 2015. "Micro- Finance Scam: 5,000 Families Face Legal Action." http://www.newindianexpress.com/states/kerala/Micro-finance-Scam-5000-Families-Face-Legal-Action/2015/03/04/article2696654.ece.

88. Transperency International. 2015. "Corruption International Index 2015." http://www.transparency.org/cpi2015#downloads.

89. UN News Center. 2011. "Corruption Leading to Unequal Access, Use and Distribution of Land – UN Report." http://www.un.org/apps/news/story.asp?NewsID=40698#.WEMpP33QCWl.

90. USAID. 2010. "USAID Country Profile. Property Rights and Resource Governance. Honduras." http://www.usaidlandtenure.net/sites/default/files/country-profiles/full-reports/USAID_Land_Tenure_Honduras_Profile_0.pdf.

91. Valenzuela, J. 2015. "Bitcoin Remittances to Mexico See Huge Potential." https://cointelegraph.com/news/bitcoin-remittances-to-mexico-see-huge-potential.

92. Valenzuela, J. 2016. "Consuelo Offers Blockchain- Powered Microinsurance to Migrant Workers." https://cointelegraph.com/news/consuelo-offers-blockchain-powered-microinsurance-to-migrant-workers.

93. Ver, R. 2016. "Time to End the Block- Size Blockade." https://fee.org/articles/time-to-end-the-block-size-blockade/.

94. VillageCapital. 2016. "FinTech: Mexico 2016." http://vilcap.com/program/fintech-mexico-2016/.

95. WEF [World Economic Forum]. 2015. "Deep Shift Technology Tipping Points and Societal Impact Survey Report." http://www3.weforum.org/docs/WEF_GAC15_Technological_Tipping_Points_report_2015.pdf.

96. Wildau, G. 2015. "Alibaba's Finance Arm Launches Credit Scoring Service." http://www.ft.com/cms/s/0/34e77fe8-a6a3-11e4-9bd3-00144feab7de.html.

97. Williams- Grut, O. 2016. "Santander is Letting Staff Use the Tech behind the Bitcoin to Send Money to Each Other." http://www.businessinsider.com/santander-develops-blockchain-international-payment-app-with-ripple-2016-5?r=UK&IR=T&IR=T.

98. World Bank Group. 2016. "Doing Business. Registering Property." http://www.doingbusiness.org/data/exploretopics/registering-property#sub-menu-item-link.

99. Yan, T. 2015. "High Levels of Medical Insurance Fraud Found in Rural Areas of Southern Chinese Province." http://www.scmp.com/news/china/policies-politics/article/1850183/high-levels-medical-insurance-fraud-found-rural-areas.