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# Utilizing Blockchain Trade Finance to Promote Financial Inclusion

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Abstract

This paper examines the use of blockchain, or distributed ledger, technology for the potential supplantation of the antiquated process of international trade financing. Using the technology for this purpose has the potential to narrow the enormous gap in unmet demand for trade finance experienced by small-and medium-sized enterprises in the developing world. The current process of trade finance is still paper-based and relies heavily on manual labor. After the 2008 Global Financial Crisis, banks became restrictive in their lending, especially to small-and medium-sized enterprises in developing countries, leading to the aforementioned trade finance gap. Blockchain technology could narrow this gap by digitizing and automating key steps in the trade finance process, which will lead to efficiency gains along the trade finance process. By allowing users to establish a verifiable identity, blockchain also increases compliance with 'know your customer' and anti-money laundering requirements. Currently, permissioned blockchains are better suited for trade finance as evidenced through recent initiatives, whereas permissionless blockchains have more to offer to individuals at the "bottom of the financial pyramid" who are typically excluded from the formal financial sector. Financial inclusion refers to the delivery of basic financial services in a non-discriminatory way. Blockchain can help lift the large unbanked and financially underserved populations in the developing world out of poverty and into the global economy, contributing to sustainable economic growth.

*Keywords:* blockchain, trade finance, financial inclusion, know your customer (KYC), anti-money laundering (AML), permissioned, permissionless, small and medium sized enterprises (SMEs)

## Introduction

Blockchain technology was first introduced with Bitcoin in 2008. The consensus was that Bitcoin would have a transformative effect on society by eliminating the need for physical currencies and decentralizing power over fiat money as a medium of exchange. It quickly became evident, however, that the Bitcoin cryptocurrency was too volatile and difficult to regulate to replace national currencies. Instead, the technology underlying Bitcoin began to interest scholars and businesses for its unique characteristics. Blockchain, also known as distributed ledger technology (DLT), is an online, peer-to-peer ledger that allows for the storage and transfer of digital assets, currencies, and documents. There are many use cases for the technology, but one area in which it has tremendous potential is trade finance.

Trade finance is the set of tools that banks and other financial institutions use to extend credit and other forms of lending to individuals and businesses so that they may engage in the international exchange of goods and services. The industry is long overdue for an overhaul, still relying on paper documents and manual labor that lead to shipping and payment delays as well as high transaction costs. Due to such inefficiencies, access to trade finance has never been easy for small businesses that lack the resources to comply with the requirements laid out by banks and other financial institutions. Since the Global Financial Crisis, access to trade finance has further contracted because of a “de-risking” trend followed by banks that adversely affects businesses in developing countries.

Blockchain technology will address key pain points in the trade finance process. It will allow for the instantaneous exchange of trade-related documents and provide verifiable identities for all parties to a transaction, thus enhancing safety and regulatory compliance. Banks and other financial institutions using blockchain technology to revitalize the process of trade finance will allow SMEs in developing countries to engage in international trade on a much larger scale, yielding higher income for their countries and for the world.

# Review of Literature

## Economics of Blockchain Technology

Catalini and Gans (2016) bring to light a major attribute of blockchain technology that gives it the potential to be a catalyst for economic growth and financial inclusion: its ability to lower transaction costs. Transaction costs in this context are the costs of agreeing to a contract, including measuring all the attributes relevant for the exchange of goods, services, or information and the cost of enforcing a contract, including the costs of detecting infringement, policing and punishing. Blockchain technology allows all parties involved in a transaction to verify its attributes without exposing the underlying information to a third party or intermediary. This trust is usually placed in an intermediary, but on blockchain is replaced with trust in the underlying code which is based on a system of consensus among agents. Integrated platforms supported by the Internet of Things maintain a continuous and credible link between offline events and their online record which, when paired with blockchain, have the potential to reduce moral hazard.

Blockchain is a General-Purpose Technology because of the flexibility in terms of what shared data represents across settings, be it currency, intellectual property, financial assets, or contracts. What makes blockchain more impactful than Bitcoin is its ability to prevent a double spending problem in which the same digital token is spent twice, falsified, or duplicated. Inherent in this preventive measure is the very nature of the block itself. Each block is linked to a previous block and in order to alter the nature of any one block, one must go back through the entire chain and alter each one individually, a process that would require more computing power and time than is feasible for any bad actor to attempt. Thus, widespread adoption of the technology further increases its impenetrability, which leads to the next point: blockchain significantly reduces the costs for economic agents to network and build new platforms. This “permissionless innovation” allows for the deployment of any

application on a blockchain network that is compatible with an established set of rules, through which individuals and organizations can freely source capital and labor and enforce contracts for digital goods and services on a global scale with substantially reduced frictions.

**Blockchain and Capitalist Institutions**

Davidson, Filippi, and Potts (2018) concluded that blockchains are a public database or ledger technology, which is significant because ledgers are a foundational institutional technology of market capitalism. A ledger is a collection of data structured by rules enabling information to be interpreted and shared by potentially large numbers of users. Shifting ledger technology from a centralized method of producing consensus to a distributed approach using blockchain could transform the transactional mechanics of the modern economy. As a trustless technology, blockchain can serve as a crucial first step in freeing up huge economic rents that are locked up in monopolies of trust, specifically large corporations or governments.

Operating on the internet grants blockchain universality so that every user around the world has access to the same ledger containing all of the previous blocks leading back to the first transaction. The fact that anything can exist on a blockchain in the form of a digital asset makes it factor augmenting whereby it can reduce inefficiencies and serve as an asset transfer register for many purposes, one being international trade. The technology offers a new way of coordinating economic activity that minimizes opportunism because blockchains ensure trust and traceability, and opportunism is the result of agents trying to exploit trust. Instead of competing with existing firms, blockchains can help to lower transaction costs for firms, plug information gaps, and minimize the costs of writing and enforcing contracts. The maximum gains from blockchain will be realized when it is used to contract up to the point where the marginal cost of supplying trust (accumulating agent specific experience, monitoring reputation) equals the marginal benefit of that trust (the surplus, compared to the next best

institutional alternative).

**Political Economy of Blockchain Technology**

In place of conventional networks, blockchain technology has the potential to fundamentally challenge the economic positions of legacy firms and governments by enabling economic actors to engage in non-territorial "crypto-secession" – a situation in which actors opt to participate in blockchain trust-galvanizing network structures in which information and knowledge flow more seamlessly and directly among agents. Allen, Berg, and Novak (2018) study blockchains in this vein and view their emergence as a by-product of the striving by individuals to secure gains of all kinds through cooperation with others among economic, social and political domains. This political economy analysis posits that corporations and governments with increasingly monocentric tendencies have fortified and monopolized trust on behalf of society.

The authors foresee widespread adoption of blockchain that will reduce the ability of large firms and governmental agencies to leverage their privileged access to data for the purpose of influencing economic, social, and political activity. Their arguments see governments as bearing a social responsibility to refrain from enacting discriminatory policies that would assist lobbied interests in locking up rents that blockchain could free up. Most important to the political economy approach is identity – the attribution and recognition of features attributed to people based on their personal characteristics or social affiliation – since it enables individuals and their entities to realize mutually agreeable and advantageous arrangements in the face of opportunism. A cornerstone of individual freedom and human flourishing has long been the right of people to acquire and transfer resources through mutually agreed upon exchanges which do not compromise the ability of others to undertake the same kinds of actions. The ramifications of blockchain for the developing world lie in its

function as a high-quality property and asset registry that can empower disadvantaged peoples and firms to leverage their assets in a credible way as collateral for finance.

**Blockchain and Trade in Supply Chain Finance**

*The CAPCO Institute Journal of Financial Transformation* reports that in 2017, the value of global merchandise exports totaled $15.5 trillion; of this, approximately $12.4 trillion required trade-financing solutions (DiCaprio and Jessel 2018, 36). Trade finance consists of two main products: the letter of credit and the bill of lading. Letters of credit reduce transaction risk because the issuing bank guarantees that a buyer's payment to a seller will be received on time and for the correct amount, whereas bills of lading help finance working capital requirements by serving as a receipt for shipped goods that allows sellers to access buyer funds before the goods are delivered.

De Meijer (2018) in a blog article on finextra.com wrote that various parties ranging from exporters, importers, banks, truckers, shippers, customs agents and regulators require checks and verifications at various points along the supply chain. It is for this reason that private, permissioned blockchains built within the regulatory framework of participating entities are the most realistic and appropriate for the characteristics of trade finance. By automating Know Your Customer (KYC) reporting, providing new sources of information to evaluate firms, and reducing administrative and transaction costs, blockchain can support an expansion of trade finance (Dicaprio and Jessel, 2018). DiCaprio and Jessel (2018) advocate for permissioned, or enterprise blockchains that will feature interoperability and thus allow them to meet data privacy requirements of international trade and address the scalability limitations of permissionless blockchains. 29% of trade finance rejections are based on KYC concerns, and enterprise blockchains have the power to address these concerns through live information sharing, active regulation and by including more data for retrospective analysis.

Banks play a large role in providing trade finance because they assume risk on behalf

of the exporter for insurance for the goods and the importer for payment for the goods. Using blockchain for trade finance grants banks greater visibility into what they are financing, thus making it easier for the bank to ensure that it is complying with all regulations, governmental and otherwise, and grants the bank greater control over its reputation as a secure investor (Rundell, 2018). Banks have an incentive to jump on the blockchain trade financing bandwagon as well, with Bain & Company estimating that blockchain-based solutions could increase the global banking industry's annual revenue by $2 billion by 2026 (Ganesh, Olsen, Kroeker and Venkatraman 2018). A main reason for the gap in trade financing is a lack of bank-to-bank correspondent relationships – such as when a bank provides services on behalf of another in the form of wire transfers, business transactions, deposits, and document gathering – that have disappeared disproportionately in emerging markets following the Global Financial Crisis. Banks themselves report that 74% of their rejections for trade finance are to Small Multinational Enterprises (DiCaprio and Jessel 2018, 38). A blockchain trade finance ecosystem that combines the different stages of trade from production to end final delivery has become a top focus for blockchain application because of the massive trade financing gaps that exist in developing parts of the world, namely in the Asian-Pacific region where 77% of export letters of credit originate (DiCaprio and Jessel 2018, 37).

Trade finance still relies on an archaic, paper-intensive process that is past due for an efficiency upgrade. The first trade finance transaction that took place on a blockchain took less than 24 hours to complete, down from the five-to ten-day window that paper-based letter-of-credit transactions take (Bain & Company). Blockchain poses considerable benefits to trade finance because of its immutability – a feature that renders it costly and difficult to alter the information contained in a block – which significantly reduces the likelihood of digital assets being tampered with by bad actors. The fact that data is decentralized makes it attractive for supply chains because suppliers can choose what they share with buyers –

including where and at what price they purchased their goods.

The top five expected benefits of blockchain in financial services include improved data management, greater transparency, improved risk management, increased speed of digitization, and streamlining of processes. The top five barriers to its adoption include understanding the technology, communicating it to key decision makers, evaluating the cost and benefits, the uncertainty surrounding the time until benefits will be realized, and other technology investments taking priority. A Bain & Company projection estimates that blockchain has the potential to increase global trade volumes by $1.1 trillion by 2026, an almost 7% increase in just eight years (Ganesh, Olsen and Kroeker, 2018). The business case for adopting blockchain in documentary trade is simple: increase trade efficiency, stymie risk and expand trade to SMEs and regions where a robust trading infrastructure is lacking.

**Trade Tech and The Fourth Industrial Revolution**

The Fourth Industrial Revolution is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres. The World Economic Forum, in collaboration with Bain & Company (2018) found that this paramount shift into blending technology and physical reality could help reduce trade barriers for SMEs in high-risk developing countries by reducing processing times and costs associated with the cross-border flows of goods. The International Chamber of Commerce estimated the global trade-financing gap at around $1.6 trillion (2016), with the largest gaps appearing in emerging markets for small and medium-sized businesses. Left unchecked, the trade finance gap could rise to more than $2.4 trillion by 2025 according to Bain & Company, which represents roughly 10% of both merchandise and commercial service exports for 2017. The three fundamental causes of trade financing gaps include compliance costs, profitability concerns, and a lack of information. Paper-intensive, manual processes are the major impediment to making trade more efficient because the costs associated with the processing and

administration of trade documents are up to one-fifth of the physical transportation costs (Olsen, Mattios, Di Marzo, 2018). The same study revealed that global demand for trade and supply chain finance is strong and expanding by 5-15% per year in the Americas and Western Europe and 10-25% per year in Asia.

The cost-to-income ratio in trade finance is 50-60%, meaning that over half the price charged to clients only covers operational expenses and does not address liquidity, risk, and capital expenditures (Olsen, Mattios and Marzo 2018, 7). The smart contract is the main tool used in blockchain trade financing and is defined as a computer protocol intended to digitally facilitate, verify, or enforce the negotiation or performance of a contract. Certified parties upload digital assets to the ledger and attach them to the smart contract through the process of tokenization – the process of substituting a sensitive data element with a non-sensitive equivalent, referred to as a token, which has no extrinsic or exploitable meaning or value. Certified parties using unique, encrypted digital signatures can alone initiate these digital, contractual agreements. If adopted correctly by all participants in the trade ecosystem, distributed ledger technology can reduce costs associated with trade financing by 50-70% and reduce processing times by a factor of three to four (Olsen, Mattios and Marzo 2018, 8).

**Blockchain Trade Finance Platforms**

Back (2017) in *The Blockchain Review* claims legacy trade finance platforms built on old-world technologies are rapidly proving ill- equipped to handle the globalized nature of the economy and increased speed of trade flows. The Global Financial Crisis of 2008 led many banks to engage in a practice of de-risking whereby banks terminate or restrict business relationships with remittance companies and smaller local banks in certain regions of the world. A survey conducted by the International Chamber of Commerce found that out of 357 companies located in 109 countries, 217 experienced a shortage of trade finance since 2008. Nowhere is this trend more apparent than in emerging economies, where SMEs lack the

collateral and auditing instruments required by banks to receive financing for trade. A shared blockchain ledger to administer trade finance would lead to economic growth and would give companies, financial institutions and government regulators granular traceability into a single source of the truth. The World Bank estimated that SMEs contributed to over 80 percent of employment in developing countries, so it is not hard to envision that an expansion of trade finance for these companies will lead to the realization of greater levels of financial inclusion for millions of people (Back 2017, 9).

**Blockchain in Emerging Markets**

The International Finance Corporation (2017) has linked anti-money laundering (AML) regulations – a set of procedures, laws and regulations designed to stop the practice of generating income through illegal actions – to the hindrance of capital flows, especially to individuals in poor countries. It is the most economically vulnerable people, and the organizations they make up, that stand to lose the most from these de-risking tactics. Blockchain can help relieve this strain by reducing regulatory compliance costs and by increasing the transparency of transactions. KYC costs – costs associated with due diligence activities that financial institutions and other regulated companies must perform to ascertain relevant information from their clients for the purposes of doing business with them – generate a $60 million annual bill for financial institutions (Ramachandran and Rehermann 2017, 2). Blockchain can vastly reduce costs associated with AML and KYC concerns, allowing countless SMEs in developing countries to access trade finance. Emerging markets meet many of the conditions that are ripe for blockchain adoption, including high verification costs, large, underserved populations, and the absence of powerful financial firms that would vehemently oppose any competing blockchain platforms. The smaller the financial infrastructure in a country, the lower the cost to transition from a legacy system to a new system. Blockchain has the potential to advance the longstanding developmental goal of

financial inclusion if it can prove viable as a business model in banking transactions. The iron is hot for the striking – with the IFC estimating an increase of $380 billion in revenues from serving previously unprofitable customers and SMEs (Niforos 2017, 2).

Two rationales help predict what blockchain adoption may look like under different circumstances. The process efficiency rationale occurs in countries that already have established financial market leaders and will see a gradual application of the technology in a semi-private, permissioned manner. The new market creation rationale, on the other hand, will occur in emerging markets and will involve startup businesses or large non-financial players that see value in expanding the value chain of a current service. Corporate venture capitalist investment rose 24% in 2016 in the blockchain space (Niforos 2017, 3), with financial services being the most active. Larios-Hernandez (2017) argues these investments will see their greatest return with the Bottom of the Pyramid (BoP)– the vast segment in excess of four billion of the world's poorest people that are underserved and face significant barriers that prevent them from realizing their full potential for their own and their families' benefit, and that of the societies in which they live. Larios-Hernandez (2017) argues the distributed architecture of blockchain mirrors practices that many people in the BoP have already adopted, such as peer-to-peer lending and an economy built around informal social circles where reputation equals credibility. Blockchain technology is in a position to fill the gap in viable solutions available to unbanked individuals in underserved markets by ensuring secure, transparent, and legitimate transactions within the informal social framework favored by the market. By bringing people together in an informal financial network, blockchain can pave the way to eventual formalization.

One market evaluated by Yermack (2018) for the implementation of digital financial solutions, is Sub-Saharan Africa. He claims that the greatest barrier to FinTech growth in the region is the underdeveloped electrical and communications infrastructure. For FinTech

applications to reach their potential in advancing economic growth and promoting financial inclusion, this infrastructure needs improvement. Growth in the sector is healthy, with African technology startups receiving a 51% increase in investment between 2015 and 2016. Yermack (2018) found that in 2017, 44 percent of adults in developing countries made digital payments and 73% of the Kenyan population used mobile money, so clearly the issue is not demand based but rooted in the supply of electrical grids and broadband connection. With these services expanded, FinTech applications have the potential to connect millions of people via cellular service or the internet in a low cost, simplistic way. The end goal of these products is to reduce poverty and contribute to goals of financial inclusion.

Permissionless blockchains make the most sense for countries in the early stages of electrical infrastructure and internet/mobile connectivity because they can exist without a physical connection to their users and they are free from taxation and regulation that would constrain them. The IFC (2017) characterizes emerging markets as having low banking penetration, a high exit rate of financial players, strong demand for financial inclusion from individuals and small businesses, high levels of mobile penetration, and a less-developed business infrastructure and fewer financial sector incumbents. These conditions can catapult such markets into an area of high financial inclusion and economic growth if they start from the ground up with blockchain-based financial solutions. McKinsey and Company found that the global banking industry was set to spend $400 million on blockchain projects by 2019, with expected value creation between $70 and $85 billion (Niforos 2017, 2*)*. Since 2011, anti-money laundering, or AML, costs have risen 53%; in 2015, European banks reduced their lending to emerging markets by $700 billion, and two billion adults worldwide still lack access to financial and credit services (Niforos 2017, 5*)*. Clearly the market for financial services in emerging markets exists and is starved by regulation and de-risking, while companies that attempt to enter this space will be faced with scalability issues,

interoperability concerns, network security problems and data privacy obstacles. Governments can encourage startup activity by establishing regulatory sandboxes – a framework set up by a regulator that allows FinTech startups and other innovators to conduct live experiments in a controlled environment under a regulator's supervision – that can help reduce risks associated with taking the leap of faith into an underserved market.

**Blockchain and Financial Inclusion**

Financial inclusion refers to the delivery of affordable and usable financial access for unbanked and underbanked people that one can assess with three metrics: whether an adult has a financial account with a bank or mobile company, whether they have saved money in the past year, and whether the individual owns an electronic debit card. Money transfers to the unbanked and underbanked face relatively higher fees, longer settlement times, and lower usage, thus choking off financial inclusion to most of the developing world. Out of all world regions studied by the World Bank, Sub-Saharan Africa faced the highest cost to send remittances from a bank or Money Transfer Organization at 9.48% of the overall transaction (Gallo, Jumamil and Aranyawat 2017, 6). Blockchain-based solutions can help lower these fees and increase the speed at which money can flow to developing markets by making it easier to open an account, use the account, and by reducing the cost of providing such services. Payments through a blockchain do not have to go through a national payments system but are instead transferred using a virtual currency, vastly reducing the fees added by banks along the stages of the money transfer and the time it takes for the money to reach its destination. Blockchain also eliminates the possibility of interoperability problems across borders. These revolutionary developments will substantially reduce the difficulty for previously unbanked or underbanked individuals and businesses to send and receive money and participate in the global financial ecosystem.

Another monumental barrier that blockchain helps erode is the lack of identity

verification for SMEs. It does so through the assignment of a legal entity identifier – a 20-digit, alphanumeric code that connects key reference information that enables clear and unique identification of legal entities participating in financial transactions. It is clear that the traditional banking model is not compatible with the ever-changing needs of the populations of emerging markets, and the versatility of blockchain finally offers financial institutions the opportunity to adapt to customers of all financial backgrounds. Blockchain can create a global, open network where funds can be sent anywhere and converted into almost any currency. Since unbanked individuals and businesses have so little, they are extremely risk-averse, which means that the distributed and trustless nature of blockchain will appeal to them and serve as an initial stepping stone to get them to partake in global transactions.

**Blockchain and Foreign Aid**

A major disconnect between donors of foreign aid and recipients lies in the difficulty of reliably measuring outcomes and verifying recipient behavior, finds Reinsberg (2018). Blockchain, with its immutable capabilities and one single source of truth, can alleviate these complications. The decentralized layout of blockchain stands in stark contrast to the centralized structure of multilateral institutions – the main vehicles of foreign aid. The technology can complement the activities of multilateral institutions by increasing the credibility of state-backed commitments, automating routing activities, and by leveraging sources of information to verify compliance and enhance policy decision making. It would be difficult for blockchain to substitute for multilateral organizations because they alone can authorize sanctions to enforce state commitments and verify compliance. However, the technology is likely to see adoption by governments because it supports their goals without challenging their role as central actors in aid governance.

Blockchain is hard pressed to replace multilateral organizations, but it could potentially diminish the influence of existing aid intermediaries such as donor agencies and

non-governmental organizations. This is because blockchain allows secure transactions to take place directly between charitable givers and ultimate beneficiaries, reducing transaction costs and processing times. Blockchain technology addresses the broken feedback loop – a situation in which donors impose decisions on recipients, without the latter having a say in the decision-making process – that exists in the delivery of foreign aid by having all parties stake resources upon their commitments and agree to terms with verifiable outcomes. A far-reaching goal in the development sector would be the introduction of a decentralized autonomous organization – an organization represented by rules encoded as a computer program that is transparent, controlled by shareholders and not influenced by a central government – focused on foreign aid. Such a platform would have to be permissionless and involve all parties from individuals to governments and would not likely come into existence without policing from governments.

**1.1**

Historically, finance for trade has largely been a paper based, manual process. Paper-based, manual processes, some created centuries ago, lead to complexity and delays, introduce errors and risks, and stand in the way of reliable, real-time information gathering and tracking that is required for credible decisions in financing (Olsen, Mattios and Marzo 2018, 6). Bills of lading, the paper proof that goods have been shipped, and letters of credit, the bank's guarantee that it will step in if a vendor isn't paid, are essential documents. On top of these are title papers, quality and quantity certificates, and customs forms; it is not surprising then that bureaucracy and inefficiencies cause companies to wait weeks for payment (Rundell 2018, 2). According to Jeremy Wilson, the vice-chairman of corporate banking at Barclay's Bank, one important document is the bill of lading, which he notes "can take weeks to get to the other side of the planet." To put this in perspective, in 2018 IBM and Maersk ran a test shipment of flowers from Kenya to the port of Rotterdam, The Netherlands, which produced a stack of nearly 200 communications documents. The costs associated with such processing and administration of trade related documents are estimated to be up to one-fifth of the physical transportation costs (Olsen, Mattios and Marzo 2018, 4). This antiquated method of financing such costs has left small, exporting businesses severely underserved by the trade finance market. In a world that is increasingly interconnected and technologically savvy, the time has come to address these inefficiencies, and blockchain is just the technology to answer the call. Digitalization and advanced communication technologies have the potential to significantly reduce processing times and the cost of cross-border movements of goods. By transforming paper-based documentation into electronic formats and applying smart tools and technologies to reduce barriers to trade, especially for small businesses and companies in developing countries, should on the one hand increase their volume of trade and on the other the profits of small businesses (Olsen, Mattios and Marzo 2018, 3). Distributed ledger

technology can make small-ticket transactions more attractive to the big players that provide financing for trade by significantly reducing the operational costs associated with them. Figure 1 compares the hierarchical structure of today's ledgers with the decentralized and interconnected structure of distributed ledgers and explains how this new layout shifts trust to the technology, increases efficiency and improves transaction transparency.

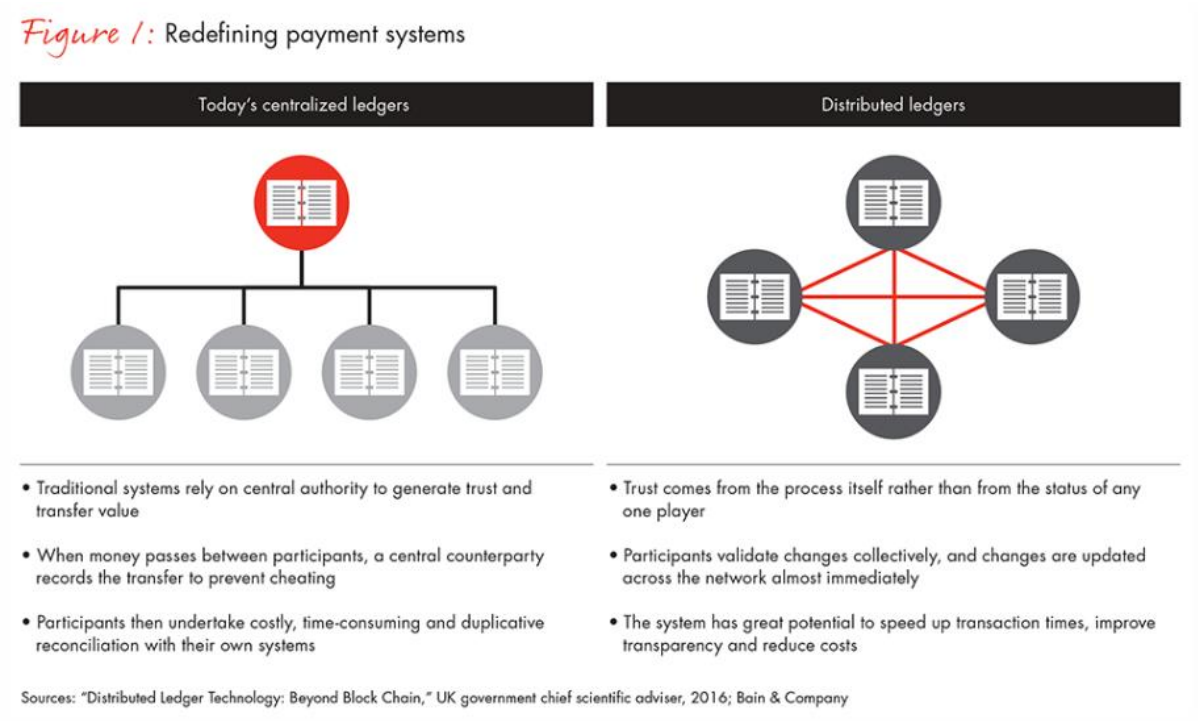


*Figure 1: Redefining Payment Systems*

## 1.2

Distributed ledger technology, which is what a blockchain runs on, at its very core is a system of trust. This feature alone is what allows it to speed up the process of trade financing and slash operational costs. On a shared database, each party to a transaction has a copy of the same data. Only certified parties can initiate transactions by using encrypted digital signatures, which underpin "smart contracts" (more on this later). The system's design itself guarantees one shared version of the truth; moreover, it is faster, cheaper and safer than manual systems. The following features make distributed ledger technology well suited to eliminate certain inefficiencies in trade: faster credit risk assessment from the transaction

history, minimized human error in document checks, instant verification and reconciliation of records, and the automatic execution of workflow steps through smart contracts, employing the instant, secure and low-cost exchange of data (Olsen, Mattios and Marzo 2018, 8). By cutting the number of middlemen and enabling direct transactions between counterparties, digital ledger solutions reduce transaction times. They also ensure that each participant has a complete view of the accounts and balances of its customers– the key building blocks of automated payment-tracking and notification tools (Williams, Gunn, Roma and Bansal 2016, 6). Improvements to the trade financing process will be realized in two key ways, according to Bain & Company. The first improvement will be to the paper-based system in the form of better fraud prevention through digital identification and tracking of documents. The second will materialize as the automation of the digital ledger itself, which has the power to speed up settlement times and reduce costs, by mechanizing the confirmation of receipt of goods and release of funds for payment. Figure 2 breaks down the evolution of letter-of-credit processing times from the current process to the future with blockchain implementation and details how processing time can be reduced by 80%.

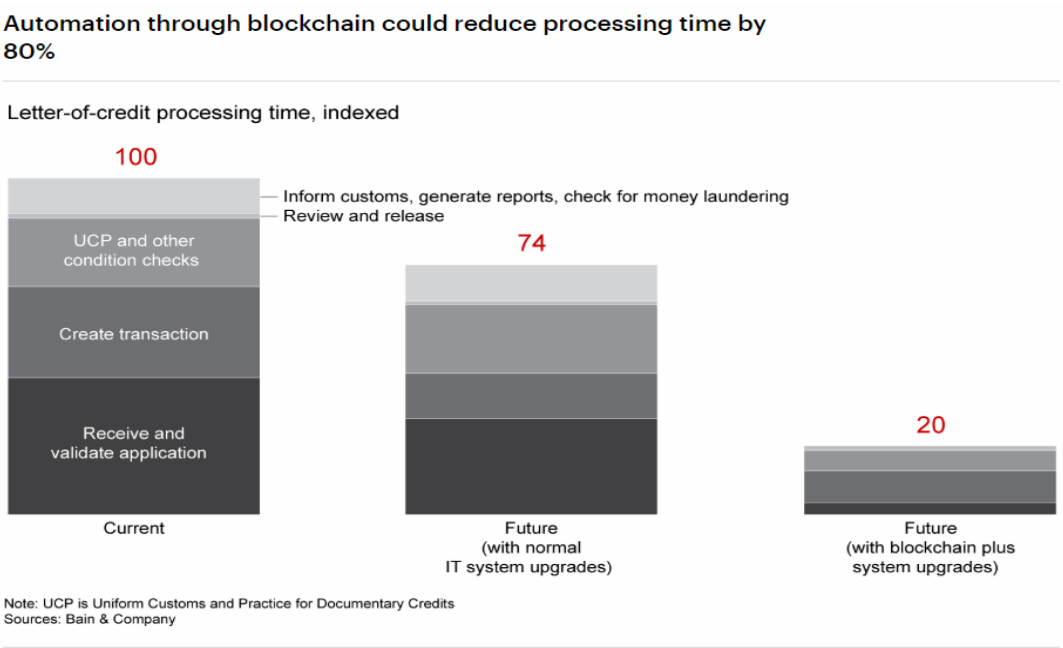


*Figure 2: Letter-of-Credit Processing Time*

**1.3**

Many large-scale initiatives have sprung up in regions around the world that are taking advantage of this groundbreaking technology to increase efficiency and promote economic wellbeing. For example, the United Nations Economic and Social Commission for Asia and the Pacific adopted the Framework Agreement on Facilitation of Cross-Border Paperless Trade in Asia and the Pacific in 2016 to advance regional coherence. Some estimates suggest that full implementation could boost Asia-Pacific exports by as much as $257 billion annually, while the time required to export could fall by 44% (Olsen, Mattios and Marzo 2018, 4). Another clear-cut example involves Banco Bilbao Vizcaya Argentina (BBVA), which applied a distributed ledger system to reduce the time for submitting, verifying, and authorizing an international trade transaction from over a week to 2.5 hours. The pilot ran on a transaction in which Spain-based FRIME bought 25 tons of frozen tuna from Pinsa Congelados of Mexico; payment was made using a letter of credit issued by BBVA in Spain and processed by Bancomer in Mexico (Olsen, Mattios and Marzo 2018, 8). This transaction involved the use of a permissioned blockchain, which will be introduced and explained in more detail later in this paper. The intermediary, the bank in this case, was not cut out of the transaction as we would expect to see with blockchain implementation, but rather facilitated the delivery of the letter of credit on its own blockchain ledger. This concept of a permissioned, or private, blockchain that banks can run themselves, has great potential to increase efficiencies and narrow the trade finance gap.

**2.1**

The Asian Development Bank estimates there was a $1.5 trillion trade-financing gap in 2017, representing roughly 10% of global merchandise trade volumes (Olsen, Mattios and Marzo 2018, 4). According to the same study, small-and medium-sized enterprises (SMEs) and midcap companies represent 75% of the total trade gap. This large shortage of financing

options for SMEs in the developing world is deeply troubling because emerging markets account for between 360 million and 440 million of the world's 420 million to 510 million micro, small, and medium-sized enterprises, according to an IFC/McKinsey study (Moore 2018, 4). Left unsolved, the trade-financing gap will swell to at least $2.4 trillion by 2025, according to a 2018 Asian Development Bank metric (Churchill 2017, 1). The data is clear: the majority of SMEs in the world, particularly those based in emerging markets, are seeing their requests for financing options to allow them to engage in international trade thwarted or denied. To provide a more practical example: in a survey of 1,336 firms, respondents report that in 60% of cases when their application for trade finance is rejected, they fail to execute the transaction (Jessel and DiCaprio 2018, 37). The main reasons cited by banks for rejecting these applications relate to Know Your Customer (KYC) or Anti Money Laundering (AML) concerns. The following sections will analyze these issues extensively. The implications of this disconnect are enormous and far reaching. Entrepreneurs who may have a great idea for a business are unable to start, and established companies see their growth stunted. A plant can only grow as large as the container it is in, and without access to capital, entrepreneurs and businesses in the developing world remain trapped in their tiny pots. Figure 3 (reproduced as Figure 1 from the source) displays the percentage of 2017 proposed and rejected trade finance transactions for different sized enterprises and breaks them down by region, showing that proportionally, micro and small companies see more of their trade finance transactions rejected than large multinational corporations do.

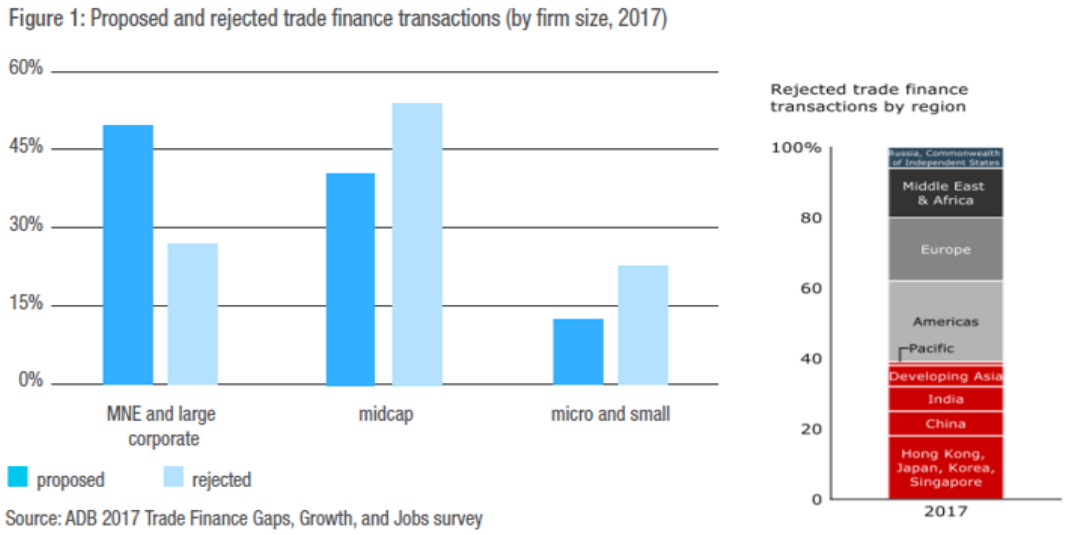


*Figure 3: Proposed and Rejected Trade Finance Transactions (by firm size, 2017)*

## 2.2

So where in the world is this gap in finance for trade most prevalent and pervasive? According to the Asian Development Bank, there is a gap of as much as $425 billion in trade funding in Asia alone (Back 2017, 2). Considering that almost three-quarters of total documented import and export trade transactions originate or arrive in Asia, this figure is even more staggering (Jessel and DiCaprio 2018, 37). As the countries of East Asia increasingly become engines for growth, having such a large underserved market will prevent economic growth not only for the region, but for the world. A recent African Development Bank (ADB) analysis on the trade finance gap in Africa notes that on average, the 10 largest trade finance customers in the region account for 58% of a bank's total trade finance assets (Moore 2018, 3). Such an unequal distribution of financing options on the world's second most populated continent is troublesome and is a contributing factor to the widespread poverty and stagnant economic growth experienced there. According to the World Bank, SMEs contribute more than 60 percent of total employment in developed countries and 80 percent in developing ones, including the estimated informal sector (Back 2017, 10). Although significant for developed countries, the job creation potential by SMEs cannot be

overstated for developing countries. It can be expected that there would be large-scale, positive economic effects if more of these enterprises could obtain financing for international trade and continue to expand their global presence. According to the ADB, a 10% increase in available trade financing would be associated with a 1% increase in employment by surveyed firms (Gonzalez 2018, 39).

**2.3**

Utilizing blockchain technology for trade finance has the potential to narrow this gap quickly and efficiently, increase employment levels in developing countries, promote economic growth and help turn a profit for lending institutions. Distributed ledger technology could enable approximately $1 trillion in new trade over the next decade, translating to 1.5% world GDP growth over 2017 levels (Olsen, Mattios and Marzo 2018, 7). By reducing the risk and uncertainty associated with lending to previously unprofitable customers and SMEs in emerging markets, blockchain could generate up to $380 billion in additional revenues for banks and other financial players (Niforos 2017, 2). It is becoming clear that adopting blockchain technology for use in trade financing operations is beneficial for both lender, borrower, and the global economy. Perhaps this is why corporate venture capitalists invested $52 million in the technology in 2017, a 24% increase from the previous year (Niforos 2017, 3). A 2018 survey conducted by the International Chamber of Commerce, which involved 251 banking institutions from 91 countries, found that 46% of respondents believed in focusing on emerging technologies such as distributed ledger technology (ICC 2018, 52). The next sections focus on the underlying causes of the trade-financing gap, the ways in which blockchain offers clear-cut solutions to these problems, and current initiatives that are propelling this revolutionary concept into real world applications.

**3.1**

The Global Financial Crisis that began in 2007 had catastrophic consequences for almost every sector of the economy. Although it began in the United States, it had far-reaching and long-lasting impacts on major world economies. Recovery has steady yet slow, however one area that has not been able to bounce back to its pre-crisis levels is the volume of financing available to SMEs in emerging markets. The International Finance Corporation (IFC) reports that between 15% and 20% of the decline in trade during the 2007/2008 crisis is estimated to have been accounted for by credit shocks related to working capital and trade finance (Moore 2018, 4). The International Chamber of Commerce survey mentioned in the last section found that 2016 was the fifth consecutive year of world trade growth falling below 3 percent and that 61 percent of the respondents cited a global shortage of trade finance as a major issue. Following this unprecedented financial meltdown, banks began a trend of de-risking their investments and narrowed their lending faculties to the safest opportunities. The International Chamber of Commerce suggests that increased regulation and wariness from the Global Financial Crisis contribute to a "de-risking" trend. That trend has raised the costs of trade finance and increased the potential of regulatory consequences for non-compliance within banking correspondent relationships (C2F0 2018, 5). Contrary to the fact that the financial crisis was ignited by large investment banks in the U.S. who were securitizing worthless mortgages along with secure ones, it is the poor and economically vulnerable that stand to lose the most from the de-risking trend that it caused. Among the groups disadvantaged by de-risking are SMEs in poor countries because their ability to apply for credit often depends on how they are rated by local banks vis-à-vis larger international financial institutions and the global financial system (Ramachandran and Rehermann 2017, 2). It is the case that distributed ledger technology can successfully address many if not all of the pain points that

make SMEs in emerging markets appear too risky for trade financing solutions to banks in the developed world.

## 3.2

Bank-to-bank (correspondent) relationships are central to the current trade finance architecture. Yet thousands of correspondent relations have been severed over the past few years due to cost and regulatory factors. The ranks of these correspondent financial institutions that are necessary to facilitate global trade finance have declined by approximately five percent during 2011 to 2015 (C2F0 2018, 5). SMEs in developing economies, given their lack of collateral or audited financial statements, are considered as high risk by banks (Back 2017, 2). It was mainly businesses in emerging markets that were cut off when banks began cutting off their correspondent relationships in recent years. Banks were put under pressure to de-risk by large MNCs, which in the aftermath of the global financial crisis consolidated their core relationships with banks. This action has put pressure on the prices and margins of the banks they still do business with (ICC 2018, 48). Another reason for the de-risking trend is due to a policy instrument passed by the Bank for International Settlements in 2011 known as Basel III. It requires banks to incorporate financial instruments that had historically been kept off their balance sheets into their calculations of leverage ratios. This is a measure that effectively weighs a bank's capacity to fulfill its financial obligations. Naturally, banks prefer higher-yield assets on their books and, as a result, the rule suppressed trade financing in emerging markets (Liao 2017, 5).

## 3.3

Blockchain technology can vastly reduce the riskiness of SMEs in emerging markets and therefore increase employment as well as the volume of world trade. It can help with de-risking by reducing costs associated with regulatory compliance while increasing the

transparency of transactions (Ramachandran and Rehermann 2017, 2). An entity that uses blockchain will have a verifiable identity that exists on the ledger and only that entity and the party that is opposite the transaction will be able to input data. This data entry is immutable, time-stamped and openly available to both parties. This added risk mitigation can stimulate trade, especially if improvements caused by blockchain make services and products more attractive (Ganesh, Olsen and Kroeker 2018, 2). Combining the use of legal entity identifiers, or LEIs, with blockchain technology can significantly reduce the riskiness of trade finance transactions, especially for SMEs in emerging markets. LEIs automate identity verification and allow for the digitization of several steps involved in trade finance transactions. According to a paper published recently by McKinsey and the Global Legal Entity Identifier Foundation, banks could make collective annual savings between $250 million and $500 million if LEIs were used (Bruno, Skouloudi, Usman, Wolf and Ruesing 2017, 17). “Cost reductions would support banks’ return on equity goals, while the enhanced economics of trade-related SME lending would help to make inroads into the trade finance gap by minimizing on-boarding costs (Moore 2018, 6).” What is most striking about the de-risking trend is that trade financing is a very safe bet for banks to make. According to the latest data published by the ICC Trade Register, which covers 17 million transactions worth over $9 trillion of exposures, default rates for short-dated import and export letters of credit are close to negligible, estimated at 0.08% and 0.04% respectively, rising to 0.21% for export/import loans and 0.19% for performance guarantees (Moore 2018, 7). A blockchain application to trade finance will increase the amount of information available to banks and unleash the export potential of SMEs in emerging markets.

**4.1**

The two main concerns cited by banks when deciding whether to lend to SMEs in emerging markets are Know Your Customer (KYC) and Anti-Money Laundering (AML) requirements.

KYC refers to due diligence activities that financial institutions and other regulated companies must perform to gather relevant information from their clients for the purpose of conducting business. AML refers to a set of procedures, laws and regulations designed to stop the practice of generating income through illegal transactions. Both requirements have increased in intensity in the wake of the financial crisis as banks have tightened their lending faculties. The importance of KYC practices and processes is clear: the ICC survey showed that 18% of trade finance rejections in 2017 were directly linked to incomplete or failed due diligence checks, specifically related to KYC requirements (ICC 2018, 50). The reinforced regulatory framework that followed the financial crisis has significantly increased the costs of compliance for banks, as anti-money-laundering compliance costs have risen 53 percent since 2011. In addition to the financial costs, KYC requests can delay transactions, stretching them to 30 to 50 days to complete (Niforos 2017, 4). The primary goal for a bank is to increase shareholder value through the maximization of profits. For most banks, complying with KYC requirements and abiding by the regulations set forth in Basel III is just too costly to be worth their investment of time and money. A Thompson Reuters survey found that KYC costs are, on average, $60 million per year for financial institutions (Ramachandran and Rehermann 2017, 1). In the 2018 ICC Global Survey on Trade Finance, 34% of respondents said they do not use a KYC utility, due to cost, operational considerations, and the challenge of complex technical integration (ICC 2018, 50). As with many regulations that seek to combat illegal activities in both developed and developing countries, the effects disproportionately fall on the shoulders of the weakest. “Although financial crimes such as money laundering, terrorism financing, and tax evasion are serious offenses which may have negative repercussions for both wealthy and poor nations, AML regulations intended to counter these types of financial crimes may sometimes hinder capital flows, especially to individuals and businesses in poorer countries (Ramachandran and Rehermann 2017, 1).” Through smart contracting and

establishing a shared trust among parties, blockchain technology can efficiently address these concerns and vastly increase the volume and size of trade finance transactions. Figure 4 (reproduced as Figure 2 from the source) breaks down the various reasons why banks reject trade finance applications and highlights that KYC concerns constitute the largest category.

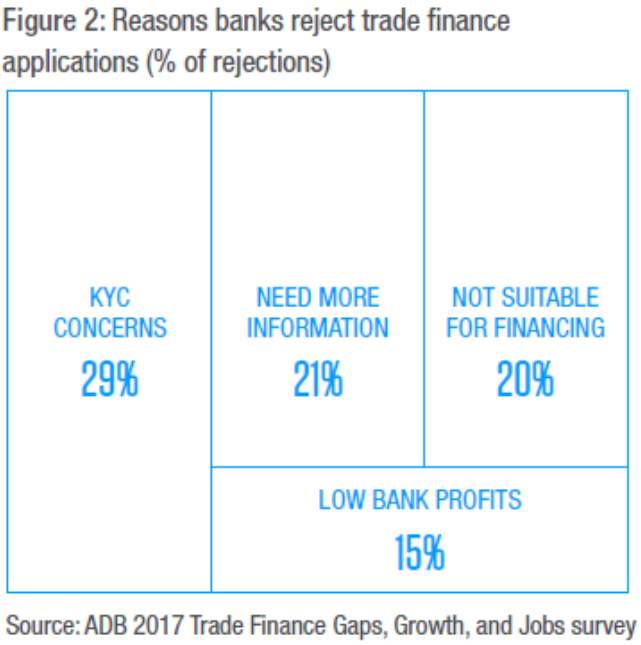


*Figure 4: Reasons Banks Reject Trade Finance Applications (% of Rejections)*

## 4.2

A smart contract is a computer code running on top of a blockchain that contains a set of rules under which the parties to the contract agree to interact with each other. If and when the predefined rules are met, the agreement automatically executes. In international trade financing the input action is the verification of shipment and delivery of goods, and the output is the release of funds from buyer to seller. Documents on the distributed ledger allow all parties to conduct due diligence for credit adjudication, check for AML and trace the location and ownership of goods. Smart contracts have the potential to remove a great deal of risk from trade finance transactions and increase compliance with regulatory standards. Trust in blockchain platforms substitutes for conventional trust in third parties to protect data from

counterfeiting, fraud, hacking, theft and misrepresentation (Allen, Berg and Novak 2018, 8). Banks need not employ intermediaries for the purpose of risk assumption any longer, and compliance officials can enforce AML and customs activities without delay (Niforos 2017, 5). At their core, KYC and AML concerns arise because of the inability to know with whom one is transacting. Blockchain could give banks and regulators access to far more detailed transactional and cross-institutional data than is currently available, allowing them to peer deeper into financial networks to identify bad actors (Ramachandran and Rehermann 2017, 2). Identity verified on a blockchain equips individuals with a greater sense of ownership and control over their identity attributes. Transacting individuals and groups that require identity verification from a given individual, business or other enterprise would be able to verify identity claims with minimal costs and reduced processing times and without being able to alter identity records (Allen, Berg and Novak 2018, 16). This same concept of identity verification has the power to reduce transaction costs, verification costs and settlement times when coupled with the immutable and time-stamped attributes of blockchain technology.

**5.1**

The power of blockchains to reduce information asymmetries and mitigate commitment problems on a trustless consensus engine makes them transformative for the activities to which they are applied. Because opportunism is caused by the intent and ability of agents to exploit trust, blockchain technology limits this behavior because it eliminates the need for trust (Davidson, Filippi and Potts 2018, 651). It will also improve the efficiency of economic systems by disintermediating many patterns of exchange and production and disrupt the existing economic rents that can be controlled and captured by large intermediaries that provide centralized trust, whether corporate or government (Davidson, Filippi and Potts 2018, 641). The technology is in essence a new way of producing consensus about the facts necessary for commerce to function. Its defining feature is decentralization, which unlocks

the enormous economic rents that are locked up behind centralized monopolies of trust like corporations and governments. As a trustless technology, blockchain can unlock and release the value of these economic rents and distribute them in an unbiased and inclusive way. This is what makes it so revolutionary for trade financing, especially for SMEs in developing countries. Blockchain innovations increase total factor productivity, or TFP, by reducing the production costs associated with any endeavor to produce a particular output (Davidson, Filippi and Potts 2018, 647). Reducing inefficiencies in international trade financing in the methods discussed earlier allows blockchain adoption to drive economic growth, which for developing countries translates into higher per capita incomes and increased financial inclusion.

**5.2**

By granting each party to a transaction with a unique, verifiable identity and through storing information on a decentralized ledger that is time stamped and immutable, blockchain by nature lowers verification costs, transaction costs, and settlement times. The ability to track transaction attributes, settle trades, and enforce contracts across a wide variety of digital assets is what makes blockchain technology a general-purpose technology (Catalini and Gans 2017, 3). As a GPT, blockchain has the potential to alter the nature of intermediation within digital platforms, and thus have a large scale socioeconomic impact. Commonly known intermediaries such as banks or payment services firms exhibit economies of scale, and thus can charge large fees due to their informational advantage. Blockchain technology, on the other hand, allows for the costless verification of transaction attributes in a privacy-preserving manner, because market participants can verify and enforce contacts without exposing the underlying information to a third party (Catalini and Gans 2017, 6.) This allows economic actors to share money, information, or other assets in a fully transparent, decentralized manner. It thus offers a new method for managing relationships under

incomplete trust (Reinsberg 2018, 6). In other words, parties that seek interaction for the sake of economic gain can use blockchain so that they do not have to blindly trust one another but rather shift that burden to the technology. As a result, the cost of those parties transacting is vastly reduced, which ultimately drives investment and increases economic activity per unit (Davidson, Filippi and Potts 2018, 648). Blockchain, in this sense, enables more to be done with less. Figure 5 (reproduced as Figure 1 from the source) compares the verification process when using an intermediary versus on a blockchain and shows how blockchain instantaneously verifies transaction attributes, saving both time and money that would be expended if an intermediary was used for the same purpose.

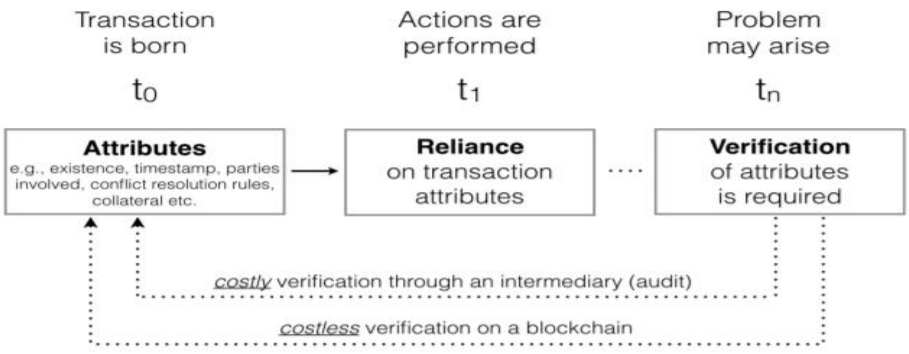


Figure 1: Costly Verification Through an Intermediary (Audit) versus Costless Verification on a Blockchain

*Figure 5: Costly Verification Through an Intermediary versus Costless Verification on a Blockchain. Source: Some Simple Economics of the Blockchain, Catalini and Gans (2017)*

## 5.3

Smart contracts, mentioned earlier, are central to cost savings and privacy preserving preservation because they can be automated in response to future events. Transacting parties can agree, ex-ante, on the rules for an audit, further reducing the need for dispute resolution should a problem emerge (Catalini and Gans 2017, 8). Although the digital attributes of a transaction are inexpensive to maintain, maintaining a credible link between offline entities and their corresponding digital representations can be costly. Therefore, the reduction in

verification costs depend on how credible the link is between online and offline products, identities or services. Here is where Internet of Things, or IoT devices, come into play. These devices include sensors and GPS devices, among others, that record real-world information and substitute labor-intensive verification with inexpensive hardware (Catalini and Gans 2017, 11). Linking these devices with digital identities on a blockchain that updates continuously in real time ensures market safety and compliance, lowering the risk of moral hazard. Smart contracts reduce uncertainty in relational contracting because parties must have staked resources upon their commitments, and evaluating whether a party complies with the terms of an agreement must be verifiable (Reinsberg 2018, 7). This reduces the likelihood of opportunistic behavior and adverse selection occurring prior to a transaction, and moral hazard following a transaction. Blockchains enable the known parts of a contractual relationship to be discovered from the unknown parts and executed automatically based upon stated conditionals (Davidson, Filippi and Potts 2018, 651). This eventually increases the ability for this type of economic coordination to persist into the future.

**5.4**

Blockchains essentially allow for property rights to be transferred and enforced securely, without exposing valuable information to actors that may harbor bad intentions. As a result, market power of the intermediary, privacy risk and censorship risk are drastically reduced (Catalini and Gans 2017, 12). Blockchains eliminate the problem of double spending because the computing power required to replicate any link in the chain is enormous and virtually unobtainable. The creation of new data on a blockchain requires consensus among participants to ensure that only one recognized blockchain exists at any given moment (Reinsberg 2018, 6). The technology levels the playing field between economic agents and intermediaries. By drastically reducing the cost of running decentralized networks of exchange, blockchains enable the creation of digital platforms where the benefits from

network effects and shared digital infrastructure do not come at the cost of increased market power and data access by an intermediary (Catalini and Gans 2017, 16). Thus, the barriers to entry to a blockchain-based system are lowered and innovation is readily encouraged. On blockchain-based platforms, individuals and organizations can source ideas, digital content, capital and labor, and enforce contracts for digital goods and services on a global scale with substantially reduced frictions (Catalini and Gans 2017, 17-18). For purposes of this paper, trade financing contracts are the focus. The impact of blockchain technology may be less to improve the efficiency of existing economic orders (for example dis-intermediating payments and finance) than to expand the scope and depth of economic governance through the evolution of new types of coordinating institutions that are native to blockchains (Davidson, Filippi and Potts 2018, 655). The next section will explore the recent emergence of such institutions, specifically in the realm of finance for international trade.

## 6.1

The transformative capabilities of blockchain technology for international trade financing have caught the eye of many international banks and world governments. There are currently multiple pilot platforms in development and working stages, and some that are already fully operational. Five such platforms will be explored briefly in this section.

1. **Batavia** is built on the IBM Blockchain Platform. Batavia aims to move away from the trade finance sector's reliance on paper-based records by digitizing and automating the arranging, securing, and financing of international trade transactions. The pilot was successful in facilitating the transport of Audi cars from Germany to Spain as well as other textile and raw materials for furniture production from Austria to Spain with corporate clients. The future of the platform may include joining forces

with other fin-techs, financial institutions or other innovation leaders in the market (De Meijer 2018, 2).

2. **Marco Polo** is another serious project named after the famous Venetian explorer and is comprised of blockchain consortium R3, trade finance company TradeIX, and several global financial players including Standard Chartered, DNB and OP Financial Group. The Head of Trade for Europe and the Americas at Standard Chartered, Michael Vrontamitis, said of the platform, "We see our participation in this initiative as an important component to drive financing deeper into global supply chains, which will in turn enable greater availability of financing for small and medium enterprises (De Meijer, 2018)." It works by using distributed ledger technology to manage data and enable smart contracts for post-shipment trade financing. It focuses on three distinct areas of trade finance: risk mitigation, payables finance, and receivables finance. Initial versions of the platform have run fast and smoothly and yielded positive results. Marco Polo is set to continue its expansion to include additional banks and third-party service providers, such as credit insurers, enterprise resource planning providers and logistics firms, with the goal of leveraging the collaborative nature of the platform to create a fully interoperable, open-sourced trade finance network (De Meijer 2018, 3).
3. **We.Trade** is one of the most exciting initiatives in this space. The platform manages and distributes the Digital Trade Chain, a blockchain prototype spearheaded by European banks to help SMEs increase trade across the continent. The nine founding banks of this joint venture are Deutsche Bank, HSBC, KBC, Natixis, Nordea, Rabobank, Santander, Societe Generale and Unicredit. The platform is specifically engineered for SMEs and aims to connect all parties in a trade deal to initiate new trading relationships and provide easy access to trade finance. In its first stage,

We.Trade will cover 11 European countries: Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, and the UK. Further stages will expand to additional European markets and beyond through the onboarding of new banks (De Meijer 2018, 4).

4. **The Hong Kong Trade Finance Platform** is a collaboration between the Hong Kong Monetary Authority and the Monetary Authority of Singapore and is supported by Deloitte and HSBC. Asia has seen an explosion of trade finance networks powered by blockchain technology because nearly 75% of total documented import and export trade transactions originate or arrive there (Olsen, Mattios and Marzo 2018, 4). The pilot, described as a global trade connectivity network – aims to digitize trade finance using distributed ledger technology and demonstrate the feasibility of using blockchain to reduce the risk of fraudulent activity, while increasing business transparency, operational efficiency and productivity in trade finance. The platform is just beginning to roll out at the time of this writing and will involve the participation of 20 global banks and financial institutions with the expectation that European financial institutions will also become involved as the project progresses (De Meijer 2018, 4). To put into perspective the effectiveness of this platform, some of the transactions that normally take ten business days to settle are now expected to be processed within 24 hours (Bryanov 2018, 3).
5. **ICICI Trade Finance Blockchain Platform** is India's answer to the call of blockchain-enabled trade finance. The Industrial Credit and Investment Corporation of India Bank, or ICICI Bank, recently announced its own Trade Finance Blockchain Platform that has already on-boarded over 250 corporates that hope to experience a more efficient and secure way of undertaking international trade transactions on the custom blockchain platform. The platform features nearly all the positive aspects of a

> blockchain trade finance application, including the digitization of all documents, a single shared source of information, real-time data viewing, tracking of digital documents, and ownership verification through encryption and smart contracting. The ICICI platform also allows for cross border remittance payments for employees and domestic vendors and is in fact the first pilot to successfully transfer funds from an ICICI branch in Mumbai to an Emirates NBD branch in Dubai. In the future, the platform seeks to invite more parties into the ecosystem, including buyers, sellers, logistics partners, insurance companies and other authorities, to reach the full potential of blockchain technology and to provide an end-to-end digitized trade solution (De Meijer 2018, 5).

**6.2**

The majority of the blockchain trade finance initiatives mentioned above are consortiums. This makes sense because the success of shared ledger and blockchain technologies requires significant levels of market participation, collaboration, and investment. The consortium is less about a technology or a business model and more about companies that have not been able to trust each other in the past but can now come together and collaborate and share information (Back 2017, 11). For these differing platforms to realize the full potential of blockchain-powered trade finance, they will need to think big, start small, and grow fast. "Consortiums should halt their silo development and instead form a larger, more valuable network, consolidating the initiatives that fail to gain broad support and focusing on the initiatives that support interoperability (Ganesh, Olsen and Kroeker 2018, 11)." Regional initiatives like We.trade and the Hong Kong Trade Finance Platform are on the right path because they will be able to work out region-specific kinks before expanding into other areas of the world. What is likely to materialize in place of one global trade network is a network of networks, some for banks, some for shippers, and some serving individual industries or

countries (Ganesh, Olsen and Kroeker 2018, 12). These initiatives are still in their development stages and will likely be for the medium term. The effective use of blockchain-based trade finance platforms will lead to the realization of greater levels of financial inclusion for millions of people living in developing economies (Back 2017, 11). This follows from the logic that as the foundation for a global trade finance network powered by blockchain technology is slowly put in place, the long-standing goal of achieving financial inclusion for SMEs and unbanked individuals becomes within reach.

**6.3**

Permissioned, or private blockchains, are far more likely to have a larger impact in the short term due to the entrenched market power of banks and MNCs that still rely on legacy database systems. The reason is that permissioned blockchains, built with the requirements of companies in mind, are most appropriate for the particular characteristics of trade finance. This is mainly because it is highly regulated, cross-jurisdictional, and involves the confidentiality of multiple parties exchanging information (Jessel and DiCaprio 2018, 36). Enterprise firms possess the market power and resources to take blockchain technology into the mainstream, and as profit-seeking organizations they will naturally seek to privatize their innovations. The initiatives mentioned in the previous section are examples of permissioned blockchain networks spearheaded by large firms or governments. Many, if not all of these organizations are already required to operate within a regulatory environment with industry standards, and thus they are better positioned to ensure a smooth rollout of blockchain trade finance platforms within this framework. Due to privacy-related considerations, permissioned blockchains are likely to see faster adoption as issues of this nature are more easily resolved between parties that know each other (Back 2017, 8). An example of a permissioned blockchain trade finance initiative is the We.Trade platform mentioned in the previous section. The Distributed Trade Chain platform that it operates will allow nine banks and their

networks of SME clients on the platform, which have already undergone KYC and AML checks with those lenders and so are known and permissioned entities (De Meijer 2018, 3). The collaborative nature of these platforms will undoubtedly lead to significant benefits from blockchain technology, however there is another type of blockchain that is crucial for future innovations and widespread financial inclusion.

**6.4**

Permissionless, or public blockchains, allow any user to transact on the network and have no barriers to entry. Permissionless innovation reduces expropriation risk that developers face when building on top of existing digital platforms because any application can be rolled out on the network that is compatible with the established protocol and consensus rules (Catalini and Gans 2017, 16). Many blockchain startup companies are experimenting with this network type in order to reach the individuals at the bottom of the financial pyramid. The reduction in the cost of networking on a blockchain allows startups and open-source projects to directly compete with entrenched incumbents (Catalini and Gans 2017, 16). Certain drawbacks of permissionless blockchains make them less viable as a model for widespread adoption. Because they lack any barriers to entry, they will not be compatible with established standards and regulations and therefore will not be usable by governments or large firms. This also makes it more difficult to establish a verifiable identity for actors on the network and to audit transactions under existing AML and CTF requirements. “The economic power of currently influential enterprises and other actors would continue to ramify throughout entangled political economy to the extent that genuinely open-ended and permissionless blockchains are curtailed by presently-dominant financial houses (Allen, Berg and Novak 2018, 21.)” The scenario whereby presently powerful financial institutions maintain their influence over the market for trade finance is likely to persist with the advent of blockchain-powered platforms. The decentralized nature of blockchain makes it better suited for

permissionless applications where there is no centralized authority dictating decisions on the network.

**6.5**

It is critical for both permissioned *and* permissionless blockchains to see implementation in order to create new efficiencies either one alone would not account for. Complexity costs are highest for so-called permissionless blockchains, where anyone can write consensus data and the proof of work that ensures the sanctity of the data is costly. In contrast, permissioned blockchains are not subject to the same problems, as they restrict access to pre-authenticated users and as a result reduce computational complexity (Reinsberg 2018, 8). Permissioned blockchains will be better able to address the trade financing needs of SMEs in emerging markets that have traditionally seen their requests denied by financial institutions. This is because these types of blockchains will experience the increases in efficiency without sacrificing security. Permissionless blockchains can take the form of a decentralized autonomous organization, or an organization represented by rules encoded as a computer program that is transparent, controlled by shareholders, and not influenced by a central government. Such an organization is unlikely to be created without support from governments, because any peer-to-peer donations through a permissionless blockchain do not come without the undesirable properties of such chains (Reinsberg 2018, 23-24). While permissioned blockchains are more effective at plugging the trade finance gap, permissionless chains will have a larger impact on providing aid to the most marginalized sectors of developing economies. One way in which they can achieve this is by allowing for cheaper and faster remittance payments.

**7.1**

In addition to narrowing the trade finance gap, blockchain technology can enhance the efficiency of remittance to the developing countries and can help create a peer-based system of exchange that will promote financial inclusion in low and middle income countries. Remittances, or payments that are sent from a foreign worker back to an individual in their home country (usually a family member), totaled $601 billion in 2016 (Niforos 2017, 6) and thus are a huge source of income for developing countries. Like trade finance deals, high fees and long processing times plague them as well. The global average cost of remittances as of December 2016 was 7.4% of the amount of the transaction (Gallo, Jumamil and Aranyawat 2017, 11). This figure is highest in sub-Saharan Africa, where it was 10% (Yermack 2018, 8). Mobile payments services have already been operating in this space for some time, with platforms like M-Pesa in Kenya and Coins.ph in the Philippines, however work remains to be done. The unbanked and underbanked are used to operating in an exchange system that is peer-to-peer, informal, and localized among their trusted communities (Larios-Hernandez 2017, 868). Because blockchain is also a peer-to-peer technology, this concept is not foreign to the unbanked and underbanked. For businesses to be successful at penetrating this underserved market, they must favor a business approach that preserves the informal peer-to-peer practices favored by the unbanked and underserved and integrates their habits into blockchain-based platforms. This effort would be more beneficial with public policy support and recognition. Blockchains can enhance efficiency in the market for remittances for both individuals and businesses by providing a cost-effective way of establishing a legal, digital identity.

## 7.2

Having a legal identity is something that most people in the developed world do not have to think twice about, yet it enables those in high income countries to enjoy a vast array of services and privileges. The story is much different for individuals in the developing world. Approximately 2.4 billion people worldwide have no legal identity (Larios-Hernandez 2017, 868). Lack of identity prevents such individuals from obtaining access to institutional financial services, particularly credit. Blockchain technology has the ability to provide such people with a digital identity in a rapid and cost-effective manner, thereby allowing for the financial inclusion of previously underserved consumer segments (Niforos 2017, 3). Where previously an individual would have to travel sometimes very far and pay high fees to obtain a physical identity card that would allow them to access certain financial services, all that is required to obtain and manage financial assets with blockchain technology is cellular service and a mobile device. "A blockchain identity system will allow end users to own and control their personal identity, reputation, data, and digital assets; securely and selectively disclose their data to counterparties; log in to and access digital services without using passwords; digitally sign claims, transactions, and documents; control and send value on a blockchain; and interact with decentralized applications and smart contracts (Niforos 2017, 4)." Having an identity will also protect individuals from the exploitation that they have historically been at high risk for through their informal methods of transacting. The benefits of this identity creation can only be fully realized on permissionless blockchains, however, where there are no barriers to entry.

## 7.3

Permissionless blockchains, mainly run by fintech startup companies, have the greatest potential to inspire change on an individual level. This is because management of the large-

scale ledgers that run the governable part of our economy happen to reside in central and commercial banks that co-evolved alongside ledger technology (Allen, Berg and Novak 2018, 20). For a blockchain to have a transformative effect on underserved individuals, it must be separate from entrenched financial institutions and open to the public. Blockchains are more likely to be received by individuals in underserved markets because they can exist mostly in virtual space with no physical connection to those countries where their users reside, and any regulator seeking to impose sanctions or collect taxes might have no direct method for doing so other than voluntary compliance by the blockchain promoters (Yermack 2018, 17). Thus, permissionless chains allow individuals to create an account without relinquishing trust to the platform. Being built on reputation, peer-to-peer communities of trust can be enhanced and extended by digital technologies, particularly blockchain, which would eventually advance informal practices, eventually to the formalization pathway (Larios-Hernandez 2017, 871). Therefore, steering individuals at the bottom of the pyramid toward greater financial inclusion requires a more informal, bottom-up approach. Figure 6 (reproduced as Figure 1 from the source) shows that as income and aspirations go down, the preference for informal financial practices grows and vice versa. This demonstrates that a blockchain-based entrepreneurship strategy for financial inclusion will have to mirror a sort or semi-formal financial service based on the existing habits and practices of unbanked individuals.

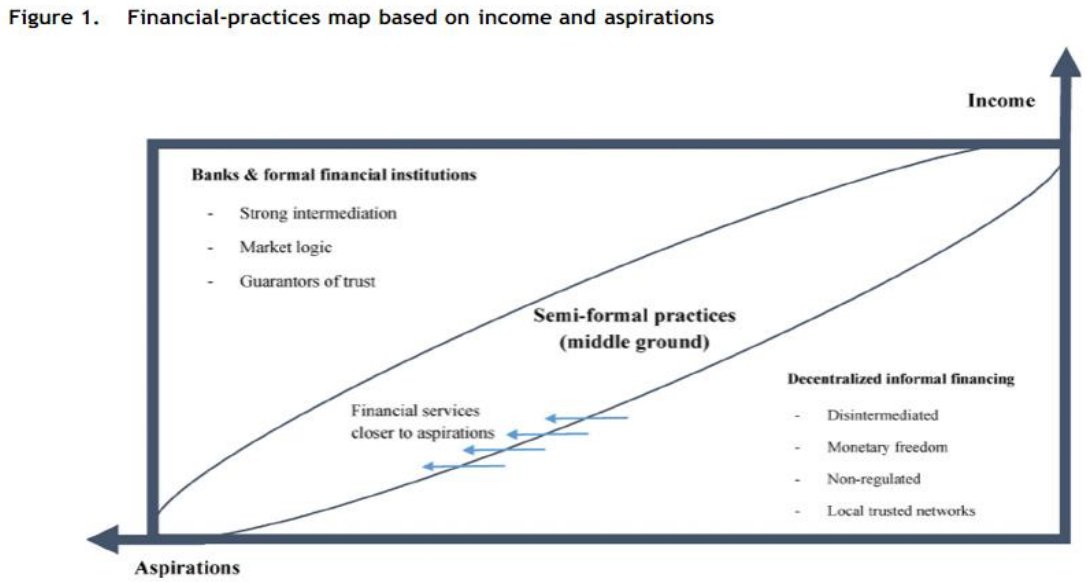


*Figure 6: Financial-Practices Map Based on Income and Aspirations [GIVE SOURCE FOR THIS]*

## 8.1

The best hope for the future of blockchain-powered trade finance lies in the capacity of banks, fintech companies, corporations, industry regulators and SMEs to collaborate and pioneer a way forward that effects positive change for the global economy. A serious impediment to the growth of the blockchain network originates from the significant computational power demanded by the consensus based nature of validation on a blockchain, which can delay transaction speed and also limit how scalable the blockchain system is (Niforos 2017, 5). On the flipside, this computational complexity enhances the safety and security of the network by making it extremely difficult if not impossible for malicious actors to penetrate the blockchain network. This caveat further reinforces the notion that permissioned blockchains are the way to go in the current environment because they restrict write-access to pre-authenticated users and thus reduce computational complexity (Reinsberg 2018, 5). Hopefully, as blockchain becomes a commonly used technology, the computing power required by operation on the network will decrease as innovations are developed. This

will of course depend on the ability of innovators to conduct research and development activities with minimal restrictions.

**8.2**

In order for blockchain technology to become an advanced, interoperable technology, it is key that technological as well as regulatory innovations are developed and tested consistently. Governments can encourage innovation in the blockchain space by setting up what are known as regulatory sandboxes, which provide safe harbors for innovators to launch new products and enjoy temporary regulatory exemptions (Yermack 2018, 17). Regulators have a lot to gain from allowing innovations in blockchain to come to fruition. Blockchain provides regulators an additional channel to monitor and understand money flow patterns in real time and a secure place to store information (Gallo, Jumamil and Aranyawat 2017, 17). The end goal should be blockchain network that acquires as many participants as possible. For this to happen, common regulation, industry-aligned common standards and a common platform are all prerequisites (Olsen, Mattios and Marzo 2018, 11). The challenge of establishing agreed upon standards will mostly come from the developed world, where blockchain adoption will be disruptive to the current functionality of markets. Part of the reason that blockchain has great potential for emerging markets is that regulators and existing financial institutions in these countries have less incentive to prevent widespread adoption of the technology, because it does not massively disrupt existing market conditions (Niforos 2017, 2). Of course, regulatory standards and technological innovations only work if the ecosystem itself is cohesive and working together like a well-oiled machine.

**8.3**

A final yet crucial step to facilitate and accelerate the digital journey to improved trade finance has to do with ensuring interoperability between all parts of the trade finance process

and in digitalizing across the entire ecosystem. This joining of key components in the trade financing process is made possible by blockchain in the form of a digital ledger. Yet another advantage of permissioned blockchains is that they feature full interoperation, and as a result are better able to meet the data privacy requirements of international trade. Permissioned blockchains can also address the scalability limitations of public blockchain systems (Jessel and DiCaprio 2018, 38). Larger firms have the resources to cover the high transition costs from legacy systems to a blockchain platform and are willing to do so because the benefits to their profit margins are abundantly clear. Figure 7 identifies the top five internal barriers to blockchain adoption relayed by financial service professionals, as well as the top five expected benefits. The challenge for the future will be in effectively communicating and demonstrating the positive effects of blockchain for trade finance so that key decision makers invest the time and resources required to diffuse the expected benefits throughout the ecosystem.

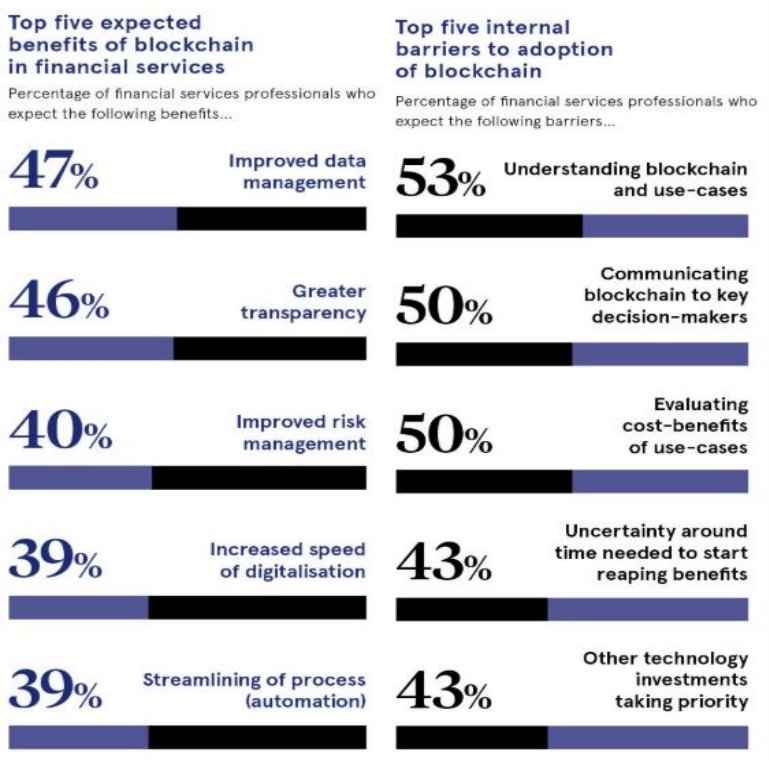


*Figure 7: Top Five Expected Barriers to and Benefits of Blockchain Adoption (Rundell, 2018).*

## Conclusion

Blockchain has emerged as a leading technology of the Fourth Industrial Revolution that has the potential to transform the way in which businesses and individuals around the world access finance for trade. This paper highlighted an opportunity to support SMEs in emerging markets by solving for a trade-financing gap that has grown wider since the Global Financial Crisis. The case for blockchain adoption lies in its ability to address the underlying causes of the shortage to produce efficiency gains that can be disseminated across the global economy.

Two of the largest impediments faced by SMEs when requesting trade finance are AML and KYC requirements. Through the use of binding smart contracts and the establishment of a shared trust among parties to a transaction, complying with these regulations is cheaper, easier, and faster. By granting users with unique, verifiable identities and allowing them access to the same time-stamped, immutable information, blockchain technology lowers transaction costs, verification costs and settlement times.

The potential of the technology has not been lost on firms and governments, as many of them have collaborated to launch blockchain trade finance networks. Each platform discussed in this paper is a private, permissioned blockchain, which at this point in time is the most capable of reaching widespread adoption. This is due to the entrenched position of large financial institutions, which have mechanisms in place to comply with existing and future regulations, and a monopoly on trade finance related information stored on their legacy systems.

Beyond its potential to narrow the trade finance gap, blockchain can also enhance the efficiency of remittance payments and help create a peer-based system of exchange among communities in developing countries. The market for remittances is often a large source of GDP for developing countries and is one of the largest shares of cross-border payments, but it

too is plagued by large fees and long settlement times. Using blockchain for remittances will could eliminate the need for a costly intermediary and enable instant money transfers. The financially excluded have been forced to manage their financial lives in informal ways that rely on communities of trust. Permissionless blockchains mirror the peer-to-peer method in which unbanked and underserved people transact and have no barriers to entry, allowing them to offer individuals a feasible pathway to financial inclusion.

How sizeable of an impact blockchain technology will have on trade finance and financial inclusion depends on the commitment of financial institutions to innovate and willingness of governments and industry groups to regulate. It is essential that permissioned and permissionless blockchains are developed and implemented simultaneously because they target different sectors and the results of their competition will be a better technology. Governments should proactively set up regulatory sandboxes for blockchain innovators to experiment for real world application and to afford the technology room to grow. Lastly, infrastructural advancements in developing countries will be crucial over the coming years and include expanding internet access and maintaining a technologically savvy workforce that is prepared for the blockchain revolution. The hope is that the findings presented in this paper are informational to its readership and innovative thinking about the potential use cases for blockchain as a revolutionary tool for financial inclusion and global economic growth.

# Glossary

A

**Anti-Money Laundering (AML):** refers to a set of procedures, laws and regulations designed to stop the practice of generating income through illegal actions.

B

**Bank for international settlements:** an international financial institution owned by central banks which "fosters international monetary and financial cooperation and serves as a bank for central banks.

**Bill of Lading:** the paper proof that goods have been shipped.

C

**Correspondent bank:** a bank that provides services on behalf of another, equal or unequal, financial institution. It can facilitate wire transfers, conduct business transactions, accept deposits, and gather documents on behalf of another financial institution.

D

**De-Risking:** The practice of terminating or restricting business relationships with remittance companies and smaller local banks in certain regions of the world.

**Decentralized Autonomous Organization (DAO):** an organization represented by rules encoded as a computer program that is transparent, controlled by shareholders and not influenced by a central government.

**Double Spending:** the risk that digital information can be reproduced relatively easily.

F

**Fintech:** computer programs and other technology used to support or enable banking and financial services.

G

**General Purpose Technology:** technologies that can affect an entire economy and have the potential to drastically alter societies through their impact on pre-existing economic and social structures.

I

**Immutability:** refers to the fact that a state of data cannot be changed or modified after it has been created. With private chains, data entry errors are easier to fix but with public chains, it is costly and complex.

**IoT [Internet of Things] Devices:** communications between a network of these devices can be built on distributed ledger technology to reduce the need for central control and the risk of data tampering.

L

**Ledger:** a way of producing consensus about the facts that are necessary for commerce to function.

**Legal Entity Identifier (LEI):** a 20-digit, alphanumeric code based on the ISO 17442 standard developed by the International Organization for Standardization (ISO). It connects to key reference information that enables clear and unique identification of legal entities participating in financial transactions.

**Letter of Credit:** the bank's guarantee that it will step in if a vendor isn't paid.

P

**Permissioned Blockchains (Private):** blockchain networks that have an access-control layer built into the blockchain nodes; they require permission to join and are controlled by an appointed group of network participants who are given the authority to provide the validation of blocks of transactions.

**Permissionless Blockchains (Public):** blockchain networks that are open and free to the public; anyone can join the network, participate in the process of block verification to create consensus and also create smart contracts.

**Property Rights:** the theoretical and legal ownership of specific property by individuals and the ability to determine how such property is used.

R

**Regulatory Sandbox:** A framework set up by a financial sector regulator to allow small-scale, live testing of innovations by private firms in a controlled environment under the regulator's supervision.

**Remittance:** a transfer of money by a foreign worker to an individual in their home country.

S

**Small and medium sized enterprises:** non-subsidiary, independent firms which employ fewer than a given number of employees. This number varies across countries. The most frequent upper limit designating an **SME** is 250 employees

**Smart contracts:** these verify and execute contracts automatically, which synchronizes delivery and payment of goods or services.

**Supply chain finance:** allows businesses to lengthen their payment terms to their suppliers. Not a loan, it is rather an extension of the buyer's accounts payable.

T

**Tokenization:** the replacement of sensitive data with a non-sensitive equivalent symbol to ensure security enables the creation of a digital identity for goods in transactions, such as labelling goods for supply chain transparency and traceability.

**Total Factor Productivity:** the portion of output not explained by the amount of inputs used in production. It is a measure of economic growth and real income.

**Trade finance:** consists of products, such as letters of credit, to reduce transaction risk and finance working capital requirements

**Transaction Cost:** the cost of agreeing to a contract – including measuring all the attributes relevant for the exchange – and the cost of enforcing a contract – including the costs of detecting infringement, policing, and punishing.

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