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# Blockchains with Chinese Characteristics

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## Blockchains with Chinese Characteristics

The Chinese blockchain industry and market have unique, unusual and idiosyncratic characteristics. Several established companies as well as startups in China have developed and deployed innovative solutions involving blockchain. On the other hand, some uses of blockchain such as initial coin offering for capital-raising have been banned. While blockchain is a disruptive technology with a potential to transform the economy and society, it promotes decentralized governance and thus can turn centralized political structures such as those of China upside down. This paper offers an analysis of seemingly conflicting actions of the Chinese government on the blockchain front. It analyzes how China is creating a delicate balance between encouraging the use of blockchain for the growth and modernization of the economy and making sure that the technology is not used to threaten the legitimacy of the Chinese Communist Party.

Keywords: blockchain; China; cryptocurrency; initial coin offering; product traceability; trade finance

### Introduction

China has become a global epicenter of blockchain-related activities. As early as in 2018, the country had more new blockchain companies than in the U.S. (Vidrih, 2018). According to blockchain and crypto data platform LongHash, as of August 2020, there were more than 84,410 registered blockchain companies in China and 29,340 of them were in operation. About 10,000 of them were registered in the first seven months of 2020 (Peng, 2020).

Some important practical uses of blockchain have been reported. For instance, during the COVID-19 pandemic, blockchain-based solutions allowed 17 million people to travel between Guangdong and Macau by mid-October 2020 (Feng, 2020). The mainland China-Macau blockchain health code system was developed by the Chinese open-sourced blockchain platform FISCO BCOS and the technology company Tencent's neobank WeBank. A consortium blockchain network was used, in which data can be accessed only by authorized organizations. The system uses blockchain to encrypt the identification and personal health information of travelers. Health authorities in mainland China and Macau need to verify the health information

submitted by users that cross the border. However, the regulations of the two jurisdictions do not allow the exchange of personal data directly with each other.

Blockchain solutions have also been launched to address trade finance needs of SMEs. In September 2018, China's central bank, the People's Bank of China (PBoC) started to pilot trade finance project referred to as the Bay Area Trade Finance Blockchain Platform (BATFP) for SMEs. As of September 2020, 48 banks participated in the platform, which had processed US\$29 billion in more than 50,000 transactions (Ledger Insights, 2020).

Blockchain-based solutions have also improved food safety and quality. Among many uses of blockchain in this industry, the most common one is for stopping fake and counterfeit products. For instance, blockchain solutions are being used to stop counterfeit versions of the Wuchang rice, which is known for high-quality (Sunny, 2018) and dairy and meat products imported from New Zealand and Australia (Hsu, 2018).

The Chinese government, however, has been strongly against some types and uses of blockchain. For instance, in September 2017, China banned the blockchain-based capital-raising method known as initial coin offering (ICO), also referred to as token offering. About 90 cryptocurrency exchanges and 85 ICOs were shut down that year. During that year, the world's total bitcoin traded in yuan also decreased from 90% to less than 5% (Marinoff, 2018). In general, the Chinese Communist Party (CCP) views more decentralized blockchains in a negative way. It prefers blockchains that it can access and control. In decentralized blockchains, the founders, development resources, and crypto-assets are out of the CCP's reach and are thus undesirable (McClurg and Talati, 2018).

In order to understand the opportunity that blockchain provides, the way that the modern economy functions must be clear. One way to view a modern market economy is as trusted

relationships that are maintained with various “ledgers” (Berg et al., 2018). For instance, ledgers maintained by governments consist of information about various aspects such as citizenship, tax obligations of businesses and citizens, social security and property ownership, passports, natural resources such as forests, land use and forms of land, and intellectual property. Likewise, businesses’ ledgers have information about their employment, assets, supply chain partners, and customers (Pearson, 2019). In the non-blockchain world, these ledgers and records are maintained by centralized entities such as governments and firms (Abadi. & Brunnermeier, 2018). Blockchain turns centralized management of records upside down by enabling decentralized governance of such records (Allen et al., 2019). Blockchain thus is an institutional governance mechanism for creating and maintaining distributed ledgers of information (Berg, 2017).

These opportunities are also accompanied by a number of challenges. For instance, centralized entities no longer have complete control over records. Such challenges are especially significant for authoritarian regimes, which tend to control and monopolize information flow within their boarder. The paper examines how this dilemma is being navigated in the Chinese blockchain industry and market. It gives an overview of blockchain solutions are being developed and deployed in China and their social, political and economic impacts. It also gives special consideration to the Chinese political structure that has led to different pattern of the development of blockchain industry and market compared to other major economies.

The paper is structured as follows. We proceed by first discussing key features of the Chinese blockchain industry and market. Next, we look at technological and innovation-related activities in blockchain in the country. Then, we analyze key blockchain applications in China. It

is followed by a section on discussion and implications. The final section provides concluding comments.

### **Key features of the Chinese blockchain industry and market**

The Chinese blockchain industry and market have unusual and idiosyncratic characteristics. It can be attributed to the fact that today's China is a unique political structure. China has been described as a combination of an empire and a modern nation (Terrill, 2005). In general, China's state strategies toward ICTs have been to balance economic modernization and political control (Kalathil, 2003). Regarding political control, Reporters without Borders noted that "China was one of the first countries to realize it couldn't do without the Internet and so it had to be brought under control" (McLaughlin, 2005). China thus focused its attention on the Internet before most other developing countries in order to maintain control (Yang 2001). This vision has broadly shaped the development of the Chinese blockchain industry and market.

One observation that is worth mentioning is that there have been instances of blockchain uses in China that have been problematic from the point of view of political control. Thanks to blockchain, Chinese Internet users achieved some victories in the fight against the country's strict Internet censorship. A historic moment was made on April 23, 2018. Peking University's former student, Yue Xin had written a letter detailing the university's attempts to hide sexual misconduct. The case involved a student, Gao Yan, who committed suicide in 1998 after a professor sexually assaulted and then harassed her. The letter was blocked by Chinese social networking websites, but an anonymous user posted it on the Ethereum blockchain (Kshetri, 2019).

In another case, in July 2018, Chinese citizens used blockchain to preserve an investigative story which condemned inferior vaccines being given to Chinese babies. The vaccines produced by Shenzhen-based Changsheng Bio-Tech failed to fight tetanus and

whooping cough. The company has also allegedly faked data for about 113,000 doses of human rabies vaccine.

Yue Xin's letter, which was written in English and Chinese, and the story about the inferior vaccines have been inserted into the metadata of transactions in the Ethereum blockchain. Each transaction cost a few cents. Since Ethereum transactions are permanent and public, anyone can read the letter. The posts cannot be tampered with. Since they are distributed among many computers in decentralized networks, it is not possible for Chinese Internet censors to pressure any company to remove them (Kshetri, 2019).

### **The techno-utilitarian model**

Among key aspects that underpin the advantage of blockchain concern its ability to protect privacy and strengthen security (Kshetri, 2017). In this regard, it is worth noting that China's approach to data privacy and security has been described as "techno-utilitarian". The utilitarian approach is a fundamental ethics principle where a decision is made based upon the greatest good for the greatest number of people. Thus, the protection of personal privacy and individual rights receives less emphasis. Some critics have noted that such arguments have been used to justify the use of AI for surveillance purpose and to suppress minorities and political opponents such as Muslims in the Xinjiang province (Thornhill, 2019). This broad pattern is precisely what one would expect in China's deployment of blockchain.

Some regulations have been laid down to control blockchains, which are directed towards addressing blockchain's censorship-resistance features. The "Regulations on the Management of Blockchain Information Services" became effective on February 15, 2019 (Kshetri, 2019). The regulation requires users to provide real names as well as national ID card numbers, mobile phones or company registration to use blockchain services. User anonymity is thus not allowed. Blockchain services are required to remove "illegal information" quickly in order to stop it from

spreading among users. Providers of blockchain services are also required to retain backups of user data for six months. Moreover, law enforcement must be able to get access to data whenever it is necessary (Liao, 2018). Blockchain service providers are required keep relevant records of transactions and report to authorities in case of illegal use. They are also obliged to prevent the production, duplication, publication and dissemination of contents that are banned by Chinese laws.

### **Unfavorable environment for certain uses of blockchain**

Some of the key areas that are driving the use of blockchains in other major economies are less common in China. One such application domain is increasing supply chain traceability to ensure that serious human rights abuses such as child labor and forced labor do not take place. From the 2010s, regulators in Western countries have started responding to serious human rights violations by their companies even if such violations take place in outside their jurisdictions.

The Dodd-Frank Wall Street Reform and Consumer Protection Act requires U.S. companies to vet their supply chains in Democratic Republic of the Congo and neighboring countries (Ayogu & Lewis, 2011). Section 1502 of the Act requires mining companies to disclose if they source conflict minerals: tin, tungsten, tantalum and gold – from DRC and nine neighboring countries (Mwai, 2018). The EU Conflict Minerals Regulation (EU Regulation No. 2017/821) was adopted in May 2017 by the EU Parliament and EU Council (European Union, 2017a). The new law is expected to come into force in the EU in 2021. From 1 January 2021, importers of tin, tantalum, tungsten and gold in the EU will be required to carry out due diligence on their supply chains. That is, they need to check the sources of the minerals and metals they import and ensure that they were processed responsibly (European Union, 2017b). This import regulation covers the so-called 3TG minerals (tin, tantalum and tungsten, their ores, and gold). Companies importing these minerals will be impacted by the regulation. The regulation is



expected to affect the activities of more than 1,000 importers directly and tens of thousands of economic actors will indirectly (Thomas, 2020). For instance, smelters, refiners, OEMs, component manufacturers and other businesses that use 3TG to manufacture products are required to source 3TG responsibly (Hussey, 2020). The European Union's 2020 report "Study on due diligence requirements through the supply chain" has recommended that the use of technology such as blockchain be explored to enhance supply chain visibility and reduction of supply chain complexity (European Union, 2020). The 2017 French Duty of Vigilance Law has taken responsible sourcing one step further by imposing a mandatory due diligence requirement for human rights and negative environmental impacts (European Union, 2020). Likewise, starting 2025, the London Metal Exchange (LME) plans to ban metals from its lists of approved brands if the extraction involves child labor and other abuses. In its initial plan announced in April 2019, the exchange had set 2022 as the deadline to comply with the guidelines. The deadline needed to be postponed because some major producers reportedly complained about the difficulties in meeting the requirements (Desai, Shabalala, & Daly 2019).

China lacks legislative commitment to responsible sourcing. Regarding the LME's plans to ban trading of metals involving child labor and other abuses, Chinese firms' support is especially important since China is the world's largest consumer of industrial metals. However, what is referred to as the "China barrier" has been a major concern in the implementation of responsible sourcing initiatives in the global metal and mineral industry (Desai, Shabalala, & Daly 2019). Whereas industrialized countries in North America, Western Europe, Oceania and other parts are strengthening regulatory and enforcement mechanisms to address the issues related to conflict minerals, China lacks such measures. Citing industry sources, news *website* Reuters stated that absence of legislation and the lack of experience in sourcing conflict-free

minerals have been major hindrances to China's engagement in the process (Desai, Shabalala, & Daly, 2019). For instance, in China, there are no regulations equivalent to the Dodd-Frank Wall Street Reform and Consumer Protection Act of the U.S. or the Modern Slavery Act 2015 of the U.K.

### **Compatibility of various blockchain types in China**

China's political structure has a strong impact on the types of blockchain likely to be used in the country, especially in terms of consensus mechanism. It is important to note that in a shared ledger, an efficient, fair, and secure mechanism is needed in order to make sure that only genuine transactions occur and participants agree on the ledger's status. A consensus mechanism performs this task by defining a set of rules to decide the various participants' contributions. The goal is to achieve the necessary agreement on a data value or the network's state (Frankenfield, 2020). There are three major types of consensus mechanisms: Proof of Work (POW), Proof of Stake (PoS) and Proof of Authority (PoA).

In a POW protocol, all users can compete to verify transactions. Major drawbacks of such protocol include high energy consumption and longer processing time. In a PoS consensus model, only a small group of nodes can validate transactions. A node's power to validate transactions or responsibility to maintain the public ledger is proportional to the number of virtual currency tokens associated with the node (Gazdecki, 2019). For instance, a node that owns 5% of the currency available theoretically can validate only 5% of the blocks. It is viewed as a low-cost and low-energy consuming alternative to the POW algorithm. Finally, a PoA consensus model relies on a limited number of trustworthy block validators, which are pre-approved. It is viewed as a modified form of PoS, in which a validator's identity rather than the role of stake is important. The nodes responsible for validating transactions are selected based on certain rules (POA Network, 2017).

What is clear is that the Chinese government is against truly decentralized blockchain systems such as the Bitcoin which use PoW protocols. Yao Qian, the head of the PBoC digital currency research institute argued that blockchain needs to be centralized (Wilmoth, 2018). He noted that in a multi-center system, in which consensus is managed by several main nodes, intervention can be applied in case of emergency, data can be rolled back and transactions can be reversed. Under the structure he proposed, the PBoC could shut down the system and reverse transactions and push software upgrades. There is no need for community consensus.

China has been the first nation to rank blockchains (Emsley, 2018). The country's Center for Information and Industry Development (CCID), under the Ministry of Industry and Information Technology has been regularly publishing its Global Public Blockchain Technology Assessment Index (GPBTAI). Most of the top-ranked blockchains in the CCID assessment are not top blockchain companies as measured by market capitalization. It published the 17<sup>th</sup> GPBTAI index in April 2020. The April 2020 index ranked EOS #1. Bitcoin (BTC) ranked 14<sup>th</sup> on the list (<http://news.ccidnet.com/2020/0413/10520453.shtml>) (Faridi, 2020).

EOS uses the delegated-proof-of-stake (DPoS) consensus model. The difference between DPoS and PoS can be compared to the difference between direct democracy and representative democracy. In a regular PoS protocol, every wallet containing coins is able to 'stake'. That is, it can validate transactions and form the distributed consensus. The wallet earns coins in return. In a DPoS system, a wallet with coins can vote for delegates. The delegates validate transactions and maintain the blockchain. They take the transaction fees as profit (cointelegraph, 2018).

In a DPoS model, users vote for representatives to make decision for them. Only the representatives can verify transactions and make decisions regarding system updates. A flaw of the DPOS consensus model is that an average voter's chance of impacting the delegates that are

selected is small. It is argued that a potential voter's incentive to vote based on the interest of community is small. Voters are thus more likely to be motivated by bribes offered to them (Buterin, 2018).

While EOS claims that it is a decentralized, democratic network, all transactions and governance decisions are processed and approved by only 21 users, known as supernodes or block producers (BPs). In 2018, twelve of the supernodes were in China (Faril, 2018). The fact that majority of the supernodes are in China makes it easy for the Chinese government to control their activities.

Likewise, VeChain uses PoA consensus. Its 101 Authority Masternodes work as validators. Anonymous nodes are not allowed. Disclosure of identity is required to become an authority Masternode (Frankenfield, 2019).

### **Technological and innovation-related activities in blockchain**

Many blockchain solutions have been launched by established companies as well as innovative start-ups. Among established companies, Alibaba, which holds more patents than any other Chinese firms, has launched many blockchain solutions (Table 1). In 2018, it launched food-focused blockchain platform, known as the Food Trust Framework, which provides traceability, visibility and transparency in supply chain. It is arguably China's first blockchain-based global product traceability program. Products sold in Alibaba's online retail system Tmall Global marketplace can be traced with blockchain and product tagging with unique QR codes (Taylor, 2018).

The Shanghai-based BaaS provider BitSE's VeChain is among the most prominent solutions launched by Chinese blockchain startups. VeChain combines blockchain and near field communication (NFC), RFID tag or QR code to fight counterfeiting. Note that NFC allows devices to communicate with each other when they are near. A customer's phone can

communicate with the VeChain chip that is embedded inside the clothing or accessory. Customers can also scan QR codes on the label. Each product is assigned a unique ID and VeChain stores the information on the blockchain. The information is also attributed to the product (e.g., with an NFC chip) (<https://boxmining.com/vechain/>).

Sensors are used to measure various indicators related to a product and record information at every stage of the supply chain. Customers can verify whether an item is genuine or not (Campbell, 2017). VeChain chip holds a unique public and a private key. The public key is stored in the blockchain, which can be verified by VeChain app. The app verifies the public key with the VeChain servers to know whether the public key is genuine (Campbell, 2016). At any point of the supply chain, distributors, retailers or consumers can interact with the chip, tag or code. Doing this, companies can access to information about how the products are handled. The information is linked to the product's identity.

VeChain designs the sensors and manufacturers such as Bosch and Qualcomm produce them. As of May 2017, BitSE was reported to have more than two million product identities on VeChain (Reutzel, 2017).

Consumers can verify the products they bought are legitimate and handled appropriately. When consumers scan a QR code, they will be directed to a website that displays detailed information about the product such as its journey from the origin to the store. Each transaction has a timestamp. Information about the supplier and logs of temperature measurements in the supply chain are recorded. The QR code also has information about the blockchain transaction ID, which shows where all relevant data is stored on the VeChainThor blockchain (vechaininsider.com, 2019). Additional information about appropriate ways to use and store the product can also be provided.

Using VeChain’s ToolChain, companies can become ToolChain Admin Center and build systems to handle transactions on the VeChainThor blockchain. Companies can upload product descriptions, features, photos and videos. ToolChain Admin Center also manages which supply chain participants can write information on to the VeChainThor blockchain. A ToolChain Admin can predefine the events to share in the blockchain and control and assign what different companies can do. It is also possible to see the transaction generated by the product’s journey (VePress, 2019).

ToolChain offers services such as product lifecycle management, supply chain process control, data deposit, and certification of data and process (Vechain, 2020). ToolChain is combined with cold-chain IoT<sup>1</sup> and different types of software and hardware sensors. All supply chain members upload logistics and manufacturing data in the VeChainThor blockchain. The products are tagged with secured QR codes. Customers can scan the QR code with their smartphones to see the product’s full logistical history such as country of origin, packaging information, storage temperature. Additional relevant information is included in pictures and videos.

<i>Table 1 here</i>
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The above blockchain-related activities are associated with and facilitated by China’s investments in intangible assets such as patents and research and development. China has consistently ranked No. 1 in the world in terms of blockchain patents filing (Table 1). While some argue that patents are irrelevant in blockchains, others argue that patents reflect technological or innovative activities and output, which are key in private and hybrid

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<sup>1</sup>Cold-chain IoT involves processes and technologies that are used to transport temperature-sensitive products from origin to destination.

blockchains (Heasman, 2020). China’s global dominance of blockchain patents has implications for blockchain-based solutions in the global market.

While Chinese firms have tendency to file a lot of blockchain patents, they lack behind the U.S. in granted patents (Gkritsi, 2020). According to China Patent Protection Association, as of May 14, 2020, there were 3,924 blockchain patents granted worldwide. China’s share was less than half that of the U.S. (Figure 1).

*Figure 1 here*

The problem of quantity versus quality of patents may also have implications for innovative blockchain solutions likely to be developed from China. Prior research suggests that 10% of patents account for about 90% of total patent value. Alternative measures such as patent citation are viewed as more useful indicators. In this regard, not a single one of the top 100 most cited patents during 2003-2019, came from China. It is also argued that China’s leading AI companies such as Tencent, Alibaba, and Baidu have just copied business models of U.S. companies such as Facebook, Amazon, and Google and tailored them to the Chinese market (Frey & Osborne, 2020).

**Key blockchain applications**

In this section, we discuss key blockchain applications in China. In order to narrow down the blockchain use cases in China for this discussion, we start with the annual Blockchain 50 list published in February 2020 by Forbes. The list consists of the world’s biggest brands with over US\$1 billion in annual revenue that are using blockchain. The list was first introduced in April 2019 (Castillo, 2019). An analysis of the Netherlands-based market intelligence platform for blockchain and DLT firm Blockdata found that companies in the Blockchain 50 were more likely to use blockchain for traceability and provenance, which are closely related to supply

chain, compared to payments and settlement (Fenton, 2020). Blockdata's analysis indicated that fifteen had used blockchain solutions in traceability and provenance, whereas thirteen had used such solutions for payments and settlements (*Blockdata, 2020*). Blockdata also found that six of the Blockchain 50 companies specifically developed supply chain management use cases.

PwC has also identified provenance as the No 1 use case of blockchain and estimated that by helping organizations to verify the sources of their goods and track their movement and enhancing supply chain transparency, the technology has the potential to increase the global GDP by US\$962 billion by 2030 (Pwc, 2020):

As noted above payments and settlements had the second highest number of use cases among the Blockchain 50 companies. More broadly the financial technology (fintech) sector dominates blockchain patents worldwide with applications focusing on cryptocurrencies, their exchanges and use of blockchain to support financial transactions<sup>2</sup>. More than half of Chinese blockchain projects have focused on fintechs (Jao, 2019). A related area of application concerns insurance technology (InsurTech). In this section, we look at blockchain applications in China in two broad areas: a) Improving supply chain traceability and provenance; b) Cryptocurrency, FinTech and InsurTech.

### **Improving supply chain traceability and provenance Addressing food and drug safety and quality**

Chinese as well as foreign companies have launched blockchain solutions for the Chinese market to track and trace products and enhance safety and quality in food and drug supply chains.

Blockchain-based food traceability systems can address various challenges facing the Chinese market. This is because food and beverage items such as milk, meat, rice, and vegetables sold in

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<sup>2</sup> The Current State of Blockchain Patents. *KissPatent*; <https://kisspatent.com/blockchain-patents-study>



China are heavily tainted and contaminated. For instance, three hundred thousand babies became ill in 2008 after drinking infant formula made from adulterated milk, which led to the death of six infants (Huang, 2014). It is estimated that more than 50% of wines that cost more than US\$35 per bottle are counterfeit in China and about 30,000 fake bottles of wines are sold every hour in the country (Ambler, 2017).

Blockchain systems have tremendous potential and provide a promising future to strengthen national food safety programs in China. The Chinese government has thus made food safety a top priority. Chinese regulators were part of the pilot project run by IBM and Walmart to make the retailer's supply network more transparent by tracing products such as pork and organic food (economist.com, 2017).

Below we briefly describe some of the blockchain-based food traceability programs in China.

*a) Alibaba*

Alibaba's international e-marketplace Tmall uses blockchain and product tagging with unique QR code assigned to each product. Tmall has partnered with the logistics company Cainiao to use blockchain to track cross-border supply chains.

Food products are tracked and monitored this way and relevant information is made available to consumers. Each step in the supply chain is authenticated and verified. Relevant data such as those related to production, transportation, customs, inspection and transfer of ownership are secured with blockchain. The blockchain with these proofs is stored by the Alibaba. The copies of the records are also stored and validated by other participants (Kaplan, 2019).

Since blockchain solutions are employed with QR codes, it is worth noting that QR codes have advanced which makes counterfeiting impossible or extremely expensive. Even before introducing blockchain, Alibaba launched its “Blue Stars” campaign in 2015 for high-end food and other products. The campaign used the next generation “dotless” QR-codes. Participating merchants selling on Alibaba’s online marketplace Taobao can attach a label containing a QR-code with colorful image with each package to verify the authenticity. A secure scanner developed by software company Visualead is used to scan the QR-codes. Each QR-code is unique, cannot be duplicated and brands can customize the code using different combinations of visually appealing images, logo and different colors (Williams, 2015). Theoretically it is possible for counterfeiters to sell fake goods with legitimate Blue Stars QR-codes. To do so they can buy legitimate products, get enough genuine QR codes and put them on the packages of fakes. However, each item has a unique QR-code identifier. When a customer receives the product ordered online and scans the code, it will “burn”, which means that each code can be used only one time (Alba, 2018). This means that counterfeiters will have to buy large quantities of legitimate goods to get enough genuine codes. This makes fraudsters’ business model less attractive (Erickson, 2015).

Alibaba’s blockchain systems have been implemented to track Chinese as well as imported products. In August 2018, Alibaba’s online payment affiliate Ant Group signed a strategic cooperation with the Wuchang municipality in China’s Heilongjiang province to track the rice supply chain (Sunny, 2018). Alibaba’s Tmall and Rookie Logistics are other partners in the project (Kode 2018). A major goal is to stop counterfeit versions of the Wuchang rice, which is known for high quality but has limited production and supply. Wuchang is widely counterfeited (Kshetri & Loukoianova, 2019). Each bag of Wuchang rice sold on Tmall platform

displays a QR code with a unique identification number. Consumers can scan this code using a smartphone app before paying for the rice. The details provided include the specific field the rice came from, seeds and fertilizers used to grow the rice, as well as information related to shipments (Chavez-Dreyfuss, 2018).

Alibaba teamed up with New Zealand dairy product maker Fonterra and New Zealand Post to track products imported to China from New Zealand. It also collaborated with Australian healthcare supply firm Blackmores and Australia Post to develop blockchain-based Food Trust Framework (Hsu, 2018). The goal is to develop a blockchain solution model that participants across food and beverage supply chains can use.

*b) JD.com*

A blockchain system developed by the Chinese e-commerce firm JD.com and inner Mongolia-based food supplier Kerchin connects these two firms. In 2017, the system went live (Xiao, 2017). Kerchin collects and stores data in its supply chain by scanning barcodes of its products. The information is then entered onto blockchain. After that any changes in data require a digital signature. Both parties are informed if there is any change and modification in the data (Huang, 2017). JD periodically implements random spot checks at Kerchin's factories to examine the accuracy and validity of information (Huang, 2017).

In early 2018, JD.com announced that it launched a blockchain platform to track imports of beef products to China from Australian meat merchant InterAgri (Zhao, 2018). The initial focus on high-end beef (Wood, 2018).

*c) Walmart*

In October 2016, IBM, Walmart and Tsinghua University announced a collaboration to improve the traceability of food products sold to Chinese consumers in order to enhance supply chain

transparency and efficiency and ensure food safety. Walmart trial-tested a blockchain-based solution to monitor pork products in the country. The trial took place in a farm operated by a company called Jinluo located in the northeastern city of Lingyi. Jinluo provided data about the pork products such as the farm inspection report and the livestock quarantine certificate (Wong, 2018). These documents were digitized by an industrial personal digital assistant, which is a smartphone-like device in a rugged case. These data were uploaded to blockchain in real-time.

Data provided include entire history and current location of individual food items such as products, farms, factories, batch number, humidity and storage temperature, and shipping as well as files related to farm inspection report and the livestock quarantine certificate were secured with blockchain. RFID tags sensors, barcodes and other sources provided relevant data (Kharif, 2018).

IBM's Food Trust was used, which is based on open- standard and open-governance platform Linux Hyperledger Fabric (Hackett, 2016). This means that the copies of the records are also stored and validated by other peers. It is a SaaS solution which provides immediate access to food supply chain data. Walmart is responsible for setting up its peers to participate in the network. The peers may also include relevant government agencies.

Walmart China commercially launched its Blockchain Traceability Platform in June 2019. By that time, 23 product lines sold in China used the platform, which was expected to increase to 100 by the end of 2019. Walmart aims to have 50% of packaged fresh meats and vegetables and 12.5% of all seafood sales tracked on the platform by the end of 2020 (Duckett, 2019). The company trained about 100,000 employees and suppliers to use the platform. The goal is to make sure that enterprises or consumers can use the system without additional costs (Zhuoqiong, 2019).

In June 2020, Walmart's membership-only retail warehouse Sam's Club China launched Sam's Club Blockchain Traceability Platform (creamandpartners.com, 2020). Sam's Club has positioned itself differently in China than in the U.S. It is viewed as a high-end shopping club in China. Sam's Club uses Chinese Blockchain-as-a-Service (BaaS) platform VeChain's food traceability platform.

In Walmart's trial of a blockchain-based solution to monitor pork products in China, blockchain enabled to digitally track individual pork products in a few minutes compared to many days taken in the past. Details about the farm, factory, batch number, storage temperature and shipping can be viewed on blockchain. These details help assess the authenticity of products. If an item is spoiled or the source of a product is compromised, the system acts proactively. In the case of food contamination, it is possible to pinpoint the products to recall (Yiannas, 2017).

### **Cryptocurrency, FinTech and InsurTech**

Chinese fintech companies have launched blockchain-based applications to apply in diverse situations and settings such as trade finance, remittances and reimbursement of employee expenses. For instance, as of mid-2019, Ant Group tracked charity donations of US\$50 million using blockchain (Orcutt, 2019).

OneConnect, Ping An Group's fintech company, has developed blockchain-based platform for small and medium-sized banks (crunchbase.com, 2018). The solution can evaluate potential customers' creditworthiness by extracting a wide range of company data. The company can do so at a low cost and reduces the amount of documentation and manpower needed to process transactions.

### **Trade finance**

Some blockchain-based fintech solutions have been launched to improve trade financing. As an example, in 2018, the PBOC started to pilot trade finance project referred to as the "Bay Area

Trade Finance Blockchain Platform” (BATFB). In March 2019, Ant Group’s blockchain supply chain finance subsidiary called Ant Shuanglian Technology also completed a trade finance pilot with a car manufacturer (thepaypers.com, 2019).

Especially the BATFB has grown significantly over the last few years. In May 2020, the BATFB received US\$4.7 million in “special funding” from the government over a three-year period for R&D.

The BATFB was launched in Shenzhen. Its originally targeted jurisdictions included Guangdong, Hong Kong, and Macau. The solutions are mainly designed for SMEs. Financial institutions such as Bank of China, China Construction Bank, China Merchants Bank, Ping An Bank, and Standard Chartered Bank and the auto manufacturer BYD participated in the project. In addition to lower interest rates, loan approval time is expected to be as short as 20 minutes. (Baker, 2020).

As of December 2019, 38 banks participated in the platform (Xinhua, 2020), which reached 48 by September 2020 (Ledger Insights, 2020). During this period, the business volume processed by the platform increased from US\$12.4 billion (Xinhua, 2020) to US\$29 billion (Ledger Insights, 2020). By August 2020, it had processed more than 50,000 transactions (Ledger Insights, 2020).

The BATFB’s jurisdiction of operation is no longer restricted to the Bay Area. New regions are being added regularly. In addition to trade finance, it covers supply chain accounts receivables and rediscounting<sup>3</sup> by the central bank. Additional services include automated tax

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<sup>3</sup> Rediscounting is a way of providing financing by a central bank to banks or other financial institutions. If a customer wants to borrow \$100, the bank may ask them to sign a paper document (also referred to as a note) promising to repay \$120 in one year. In this example, the bank is "discounting" the note because it is paying less than \$120. The central bank could provide financing to the bank by "rediscounting" the note (e.g., by paying \$110 for the note).

filing and supervision of international trades. The Institute is finding ways to expand the ecosystem. Especially it is interested in third parties that can build applications to integrate with the platform (Ledger Insights, 2020).

As noted, the auto manufacturer BYD is one of the participants. Majority of BYD's suppliers are SMEs, which include 10,000-20,000 tier one suppliers and even higher numbers of tier two and three suppliers. Especially the latter group is reported to have a more significant funding gap. By sharing data between the banks, a firm cannot submit the same invoice to two banks for funding. If an invoice is authenticated by companies such as BYD, it provides credibility for the bank.

### **Cross-border remittance**

Efforts have been undertaken by Chinese fintech players to develop low cost and fast remittance system based on blockchain. In 2018, Ant Group introduced a blockchain-based cross-border remittance system. AlipayHK and the Philippines-based mobile money service company GCash teamed up to offer real-time money transfer between Hong Kong and the Philippines, which charged significantly lower fees and higher speed and efficiency compared to traditional transfer services (fastcompany.com, 2020). Standard Chartered Bank has been a part of the initiative. Customers make a few clicks with AlipayHK and the money will reach into the GCash user's account within seconds. When a user submits a remittance application, all network participants including AlipayHK, GCash and Standard Chartered Bank get notification. The sender and receiver can track the money during the entire process (PYMNTS, 2018).

### **Detecting fake receipts in employee reimbursement**

Detecting fake receipts has been a challenge for Chinese tax collectors, businesses and state-run enterprises. In 2009, Chinese authorities detained 5,134 people and closed 1,045 fake invoice

production sites. Likewise, in 2010, Chinese authorities took actions against 1,593 criminal gangs and 74,833 enterprises that had filed false invoices. During 2007-2012, the pharmaceutical company GlaxoSmithKline's four senior executives at its China operation submitted fake receipts and defrauded millions of dollars (Barboza, 2013).

Some fintech players aim to address this problem by providing blockchain-based systems for the reimbursement process (known as fapiao in Chinese). In August 2018, Tencent's pilot project tested a blockchain-based feature using WeChat Pay data to inform employers of employees' purchases. Employees can use the system to automatically send transaction data to employers for reimbursement. The feature is expected to bring efficiency in corporate expense reimbursement process and reduce fraud and tax evasion (Idowu, 2019).

Currently reimbursement process requires merchants to issue different receipts for purchases with employer's taxpayer ID and other information. Merchants manually enter this information to generate receipts and process additional paperwork (Wang, 2018). In December 2018, Tencent announced that qualified merchants can use WeChat's blockchain-backed e-invoices using WeChat Pay to issue invoices (Wang, 2018).

### **State-backed cryptocurrency**

The media have widely reported that China will soon launch a state-backed cryptocurrency known as central bank digital currency (CBDC). As early as in 2016, China's central bank, the People's Bank of China (PBOC) had successfully completed a trial of a blockchain-based digital currency prototype system (Fei, 2017). In August 2019, a senior PBoC official said that the country's CBDC was ready to launch. The CBDC pilot was launched during April-August 2020. During that period the People's Bank of China opened 113,300 consumer digital wallets and 8,859 corporate digital wallets in three cities--Shenzhen, Suzhou and Xiong'an, which processed



US\$162 million in 3.1 million transactions (Hui, 2020). It explores the benefits of CBDC to the Chinese economy including and the ease with which the Chinese government would be able to trace financial activities of citizens and businesses.

The CBDC is expected to use a two-tier system to replace cash in circulation. The PBoC would issue the digital currency to commercial banks. The commercial banks will then issue it to the public (Zhao, 2019). Big Chinese banks (the Industrial and Commercial Bank of China, China Construction Bank, the Bank of China, the Agricultural Bank of China) and fintech companies (Alibaba and Tencent) and Union Pay (an association of Chinese banks) will receive the cryptocurrency to distribute to consumers and businesses (Del Castillo, 2019).

A main reason why the Chinese government wants to do it because of the ease with which it would be able to trace financial activities of citizens and businesses (Munster, 2018). The PBOC also hopes that subsequently the cryptocurrency will be made available in foreign countries (Del Castillo, 2019).

The cryptocurrency will handle about 300,000 transactions per second (TPS), which is faster than other cryptocurrencies and card networks. For instance, Visa handles 65,000 TPS (Emem, 2019). According to the Facebook's Libra's white paper, the cryptocurrency would handle 1,000 TPS (Zhao, 2019). Likewise, the public Ethereum network's peak throughput 16 TPS (Hanada, Hsiao & Levis, 2018) and bitcoin's is 7 TPS (Yli-Huumo et al., 2016). The PBoC official noted that the country's payment networks on the 2018 Singles' Day sale handled 92,771 TPS during the peak time (Zhao, 2019).

The Chinese government is against blockchain networks that follow decentralized and consensus-driven structures. This means that China's state-backed cryptocurrency will be different from well-known decentralized cryptocurrencies such as Bitcoin.

## **Virtual currency**

In April 2019, the Cyberspace Administration of China (CAC) released the first list of 197 companies that were approved to conduct business with blockchain (Global Times, 2019). There were only two virtual currency projects in the list: VeChain Token (VET) and ParcelX (GPX). Note that virtual currencies are only available in an electronic form and stored and transacted through designated software, mobile or computer applications, or digital wallets. Transactions of such currencies occur over the Internet.

Of the two approved virtual currency ParcelX (GPX) was planned to be a crypto-based parcel delivery service, but was not yet been launched. The cryptocurrency VET deserves elaboration. It employs so called native fee delegation feature, which means that the party that benefits from traceability covers the costs of using the network. Consumers and partners that interact with VeChain-powered DApps do not need to hold VET or VTHO. They do not need to pay to write transactions or use the network for other purposes as long as associated gas costs are sponsored, which are specified by the developers (Fenton, 2019). As of July 2020, VeChain Thor was reported to handle 100,000 transactions daily to track supply chains of fashion, food safety, sustainability (Simmons, 2020).

VeChain utilizes a dual-token economic model. VET is the primary token, which is used to represent value on the network. The utility token VTHO is a “gas” currency, which is required to send transactions or perform actions on the network (<https://boxmining.com/vechain/>). VTHO can address issues related to price fluctuations. For instance, if network activity grows and the price of VTHO increases due to higher market demand, it is possible to reduce the cost of a transaction in VTHO terms. In this way, transaction cost in dollar terms can be stable (Simmons, 2020).

## **InsurTech**

Blockchain-based solutions are likely to make insurance-related activities more efficient and fraud proof. The Chinese healthcare insurance industry suffers from rampant abuses and malpractices that are committed by patients and medical staff. In the Lipanshui city in the Guizhou province, fraud cases were found in 107 of the 135 hospitals and medical centers. All hospitals in Anshun were also found to engage in mismanagement of medical insurance. Some medical staff had provided fake medical records to get payments for treatments, which were not performed (Yan, 2015). Such frauds can be prevented with blockchain.

The Chinese payment processor and financial services company Ant Group (previously Ant Financial), which is an affiliate company of the Alibaba Group, teamed up with the life insurer Taikang Insurance to launch a blockchain-based free health insurance product. When a patient uses Ant Groups's mobile and online payment platform Alipay to pay hospital bills, the patient's identity is linked to Alipay. The electronic invoices issued by the hospital is entered on the blockchain. There is thus no need for Alipay to check their authenticity. After using the prescription once, it cannot be reused. The blockchain-based system thus addresses issues such as false reporting and fraudulent invoices (Ledger Insights, 2018).

## **Discussion and implications**

The Chinese government has recognized the potential of blockchain to change and disrupt major industries and economic sectors in the country. There have been efforts by Chinese and foreign companies to develop blockchain solutions for the Chinese market. One of the key uses of blockchain has been in supporting supply chain visibility and traceability. Chinese e-commerce firms JD.com and Alibaba are among the most high-profile companies to embrace blockchain in FBSCs. Chinese companies are less likely to use of blockchain to increase supply chain

traceability and visibility in order to address global problems such as human rights violations and environmental.

The internationalization of some Chinese blockchain firms suggests that China's blockchain-related activities in overseas markets can help to fulfill the ambition to internationalize the Chinese economy. For instance, the PBOC also hopes that subsequently the cryptocurrency will be made available in foreign countries.

Chinese blockchain companies such as VeChain are already active in several foreign countries. As early as in 2017, VeChain solutions were used also in Europe and South East Asia (O'Connel, 2017). In November 2019, VeChain reached into an agreement with logistics, supply chain and import solutions provider ASI Group to implement cross-continental logistics and trading solution using VeChainThor blockchain (Brown, 2019). Together with the global quality assurance and risk management company DNV GL, VeChain announced Foodgates (Brown, 2019). The plan is to develop a platform to monitor products along the value chain (e.g., cow selection, slaughter, packaging and shipping to the supermarket/buyer for beef products).

Italian startup Tokenfarm aims to introduce 4R technologies such as Blockchain, Artificial Intelligence, the Internet of Things, and 5G networks to the agrifood industry (Lucien, 2020). Tokenfarm, is an initiative of Confederazione Nazionale Coltivatori Diretti (Coldiretti), which is Italy's main farmers' organization that has over 1.6 million members. In July 2020, Coldiretti and food firm Princes signed a three years contract to track the value chain of Italian tomatos. every year, Princes plant processes 300 million kilograms of tomatos pass involving 300 companies, 17 cooperatives and six associations of producers (Lucien, 2020). The blockchain pilot is powered by VeChain's ToolChain.

As of early 2020, VeChain had developed more than 40 enterprise applications on its platform (Garg, 2020). VeChain is a co-founder of the Belt and Road Initiative Blockchain Alliance (BRIBA) established in December 2019. The BRIBA aims to contribute to the Belt and Road Initiative (BRI) by leveraging blockchain (VeChain 2019). Note that the BRI is a global development and industrial initiative proposed by the Chinese government in 2013.

Despite the mushrooming of blockchain companies in China, most of them have started the companies with extremely low investments. According to LongHash, 46% of the companies were registered with a capital of as low as 5,000 (US\$717) yuan or less (Daily Hodl 2020) and only 9% had a capital higher than 50,000 yuan (US\$7,170) (Crypto Browser, 2020).

A related point is that although many companies describe themselves as “blockchain companies,” few real use cases have emerged. For instance, among China’s 262 public companies that self-categorized themselves as “blockchain companies,” as of September 2020, only 23 had mentioned blockchain use cases that had gone live (Kong, 2020).

We described numerous innovation-related activities in the blockchain arena that are taking place in China. A caveat however is that patent count as a way to measure innovation has drawbacks.

Chinese consumers are skeptical about sellers’ claims regarding what their food products are and where they are coming from. Mislabeling of food products has led to significant distrust in labels of such products among Chinese consumers. Due to this deep-rooted distrust, Chinese consumers are likely to value food traceability more than consumers from most other countries. Such skepticism can be greatly alleviated by the application of blockchain to track FBSCs. With blockchain deployment in FBSCs, retailers can keep buyers’ confidence in their products and avoid the danger of consumers getting ill. A survey conducted among consumers in China

by Queensland University of Technology (QUT) and BeefLedger, which is an Australian provenance, blockchain security and payments platform for the beef supply chain, found that for a 150-gram BeefLedger branded Australian cut and packaged Sirloin steak with blockchain validated origin information, consumers were willing to pay between 31.57 yuan and 57.31 yuan more<sup>4</sup> than steak of the same weight without such information (Cao et al., 2020). The reference price for the product was about 90 yuan. This example illustrates that blockchain-based traceability is becoming a prerequisite for selling food products in the Chinese market. Companies can also obtain a price premium by deploying blockchain in supply chains because customers value blockchain-based traceability. Companies may be viewed as more credible and trustworthy if blockchain solutions are combined with other technologies such as QR codes. With blockchain solutions, by flashing a QR code before buying products in a store, shoppers can see a product's history in order to make informed purchase decisions.

The Chinese government has devoted relatively fewer resources to deal with issues such as food safety compared to other issues that it considers more urgent such as those related to maintaining national unity and social stability. Food safety-related issues thus have not received the same level of attention from the government as other concerns such as such as those related to thwarting the organization of physical protests and cyber-control (Kshetri, 2009). It has been difficult to control violations related to fake and inferior foods, which has created congestion in the law enforcement system. Due to deep rooted distrust in food companies and regulatory agencies in the food industry, Chinese consumers are likely to place a higher value on blockchain-traced food items compared to many other countries.

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<sup>4</sup> The average willingness to pay more varied across control group (not watching a 1-minute video before answering the questions) and treatment group (watching a 1-minute video before answering the questions) and respondent types (Chinese versus local).

Like other technologies, blockchain deployment tends to diffuse from larger to smaller organizations. This is commonly known as the rank effect (Gotz, 1999). Due to cost and complexity, blockchain systems are expensive to implement and manage. For this reason, blockchain is out of reach for many organizations. For instance, JD's supply chain partner Kerchin that has adopted blockchain had US\$ 300 million in revenue in 2017. Chinese firms also face human resources challenges. As noted above, Walmart needed to train employees and suppliers to use its blockchain platform in China. Most of the food products in China are produced on very small farms that lack access to technology or Internet connectivity. This is a main reason why food safety has been difficult to achieve in China (McMillan, 2018). Most of these small farms do not possess the capability to adopt a blockchain-based system and provide relevant information.

### **Concluding comments**

The Chinese blockchain industry and market offer many interesting features. Blockchain-based solutions are being used to address diverse challenges facing China ranging from trade finance to food safety. For instance, food companies have found that their reputation is likely to increase with these activities. Blockchain-based solutions have facilitated SMEs' access to low cost working capital.

The quality of entrepreneurial and innovative activities in the Chinese blockchain industry and market is not clear. Most blockchain businesses have been implemented with low investments. China's recent increase in patent filings in blockchain is often cited as evidence of its innovation prowess. While patents are a good measure of performance, it is too early to see the full effects of these patents and to say whether they lead to Chinese blockchain solutions that dominate the global market.

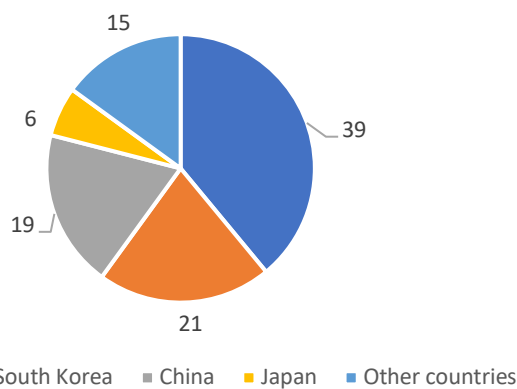
China's approach to blockchain regulation reflects the tension it faces between using modern technologies to maintain control and using them to stimulate economic growth. The above discussion makes it clear that China has solved this dilemma by effectively designing laws, regulations and enforcement mechanisms *to crack down* activities that threaten the centralized control. Its government entities have also played key roles in developing blockchain solutions. In the development of the blockchain industry, China has thus broadly followed the same pattern as the Internet. The Chinese government would not allow blockchain implementation without significant modification. In some cases, blockchain applications modified to satisfy China's regulations and policies have lost fundamental elements of the original technology.



**Table 1: Blockchain patents filed by Chinese firms**

Study conducted by	Period covered	Findings
Tokyo-based research firm Astamuse.	2009-2018	Total no. of patents worldwide 12,000. China: about 7,600, the U.S.: 2500. South Korea: 1,150, Japan: 380 China overtook the U.S. in patent submissions in 2016 (Hashimoto & Cho, 2019).
China Academy for Information and Communications Technology (CAICT)	2013-December 20, 2018	China applied for 4,435 patents (48% of the total), compared to 1,833 by the U.S. (21% of total) (Ledger Insights, 2019)
Patents filed with the World Intellectual Property Organization (WIPO)	2017	Chinese firms accounted for 99 of the 314 patents (Peyton, 2019).
IPRDaily (media outlet focusing on IP), and incoPat (Global patent database).	2019	Chinese companies took the top three spots (Alibaba, Tencent and Ping An) well as seven among the top 10 and 19 among the top 30 (Chilnadaily.com.cn, 2020).

**Figure 1: Shares of blockchain patents granted worldwide (%)**



Data source: China Patent Protection Association (<https://www.jinse.com/blockchain/747938.html>)

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