SINGAPORE AND DISTRIBUTED LEDGER TECHNOLOGY

Igniting technological transformation

OUTLINE

'The Future is Here' claims the catchy title of the report released by the Monetary Authority of Singapore, the country's central bank and financial regulator, on 8 June 2017. The report announces the results of completion of the first phase of Project Ubin that was initiated in November 2016 to develop a proof-of-concept to conduct transactions in digitalised token proxies of Singapore Dollar on the blockchain. Highly experimental enterprise seeking to get a better understanding of mechanics and potential of distributed ledger technology, now completed successfully for domestic payments will move to the phase of researching cross-border settlements. Willingness to experiment with the nascent technology can transform already highly progressive Singapore into 'a financial centre in Asia to fully explore he benefits of distributed ledger technology across the broad range of transformative applications.' Within this broad spectrum, a number of applications exist that are compatible with public sector services, including tax administration. The country can use its newly gained expertise and empirical findings to drive evolution of the technology in the area of fiscal policy. How can the academic community at home and abroad assist in smooth weave of the Blockchian-backed solutions into the fabric of society?

Vienna University of Business and Economics: Global Tax Policy Centre

The term 'blockchain' has seen an unprecedented rise in popularity, being searched 70% more in June 2017 as in the previous year[1]. Since its emergence in 2008, the blockchain in its original pubic/permissionless form as well as the private/permissioned alternatives offered by rivals such as Ethereum[2], have been steadily gaining solid recognition of technologist, general public, government officials and academics alike[3]. The technology promises to remove intermediaries from transactions between unrelated untrusting parties and allow direct peer-to-peer exchange in value, thus slashing transaction costs. It also allows for recordkeeping on transparent, immutable ledgers accessible to everyone and immune to tampering. It also provides the means for generating self-executing transactions that follow a pre-designed algorithm if a certain set of criteria is satisfied, thus downsizing the associated transaction costs and embedding compliance and practically eliminating a scope for fraud. These properties resonate with needs of governments to ensure improvements in compliance and an increase in the efficiency of public sector operations both domestically and internationally.

Asian region has also experienced a spur of research and innovation in the area of distributed ledger technology. Singapore and China have been conducting tests of using digital token proxies of home jurisdiction fiat currencies to execute payments using blockchain-based platform. On 8 June 2017, the Monetary Authority of Singapore (MAS) that functions as country's central bank, financial regulator and a clearing house has publicised the results of the Phase 1 of the Project Ubin. The multi-phase project conducted in collaboration between MAS, R3 and a number of financial institutions and banks, is experimenting with digitalised tokenised version of Singapore Dollar using distributed ledger technology. The first stage of the proof-of-concept trials has been focusing on testing central-bank-backed tokens for domestic inter-bank payments. The next stage will move towards testing cross-border payments. Singapore aspires to become 'the first major financial center in Asia to fully explore the benefits of the distributed ledger technology across broad range of transformative applications.' The competition in developing blockchain based solution within the Asian region is, however, quite intense. China has officially endorsed the blockchain technology in its Informatization Strategy[4], published in December 2016, stating that 'The Internet, cloud computing, large data, artificial intelligence, machine learning, blockchain…will drive the evolution of everything

[1] Statistics supplied by Google Trends, see https://trends.google.com/trends/explore?q=blockchain

[2] Ethereum is an open-source platform, that allows for formulation of both public/permissionless as well as private/permissioned networks.

[3] See for example: Kibum Kim and Taewong Kang, *Does Technology Against Corruption Always Lead to Benefit? The Potential Risks And Challemges of The Blockchain Technology*, OECD Global Anti-Corruption and Integrity Forum, 2107; Dong He, et al., *Fintech and Financial Services: Initial Consideations,* IMF Staff Discussion Note, IMF, June 2017; PwC 2017 Digital IQ Report, https://www.pwc.com/us/en/advisory-services/digital-iq.html; The Economist, *Blockchain: Land Grab,* June 3-9, 2017 Issue, p. 61.

[4] http://www.gov.cn/zhengce/content/2016-12/27/content_5153411.htm

– digital, network and intelligent services will be everywhere'. The seal of approval from the world's second largest economy and the country where digital payments reach USD 5.5 trillion or 50 times the same U.S: statistic[5], opens access of technology to an abundant environment and is destined to spur further innovation. A number of initiatives and applications in various stages of development cycle have been surfacing, including reports of the People's Bank of China testing the prototype of the government-based digital currency that should be introduced alongside renminbi[6], use of blockchain technology as part by auto-giant Wanxiang as part of the smart city initiative backed by intended investment of USD 3o billion, joint enterprise of Alibaba and PwC to fight food fraud (pilot stage) and many others.

This high-intensity blockchain research and building activity still concentrated within the financial sector. Governments should consider other areas that may be developed using the properties inherent in the blockchain that may yield direct benefit to the public sector, in areas ranging from health to environment to tax. How realistic are the promises of the proponents of the technology and what regulatory framework is necessary to foster this fast-growing trend? This paper examines these questions, emphasising the need and encouraging creation of a neutral multi-disciplinary dialogue involving government bodies, academics and business community that will promote cross-fertilisation of ideas to policy-relevant research and solutions. With technology still existing largely in nebulous state, this is the right time to approach it with an open mind recognising the transformative potential of the blockchain.

What is Blockchain?

In the not too distant past, the term 'blockchain' would not have been found in any dictionary. Nor was it coined in the 'début' Bitcoin white paper[7] released by the author(s) under the pseudo-name Satoshi Nakamoto in the wake of the financial crisis of 2008. After the release of the paper, it was almost exclusively the Bitcoin that stole the limelight. A virtual, or crypto-currency, permitted to use the Internet for exchange of electronic cash in direct peer-to-peer (i.e. no third intermediary party) transactions[8] under conditions where trust is lacking, via use of cryptographic tools as a replacement

[5] Bradley Fink, *China's Blockchain Invasion*, Bitcoin Magazine, May 1, 2017, see https://bitcoinmagazine.com/articles/chinas-blockchain-invasion/

[6] Will Knight, *China's Central Bank Has Begun Cautiously Testing a Digital Currency*, MIT Technology Review, 23 June 2017, https://www.technologyreview.com/s/608088/chinas-central-bank-has-begun-cautiously-testing-a-digital-currency/

[7] Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System, https://bitcoin.org/bitcoin.pdf

[8] Today, blockchain in likened by many to the emergence of the Internet in 1990s, and is called the Internet 2.0 as it allows for the use on Internet to exchange value in virtual realm, rather than traditional exchange of information only.

to the validation function supplied by independent authority. Since it removed intermediaries from transactions between unrelated parties, the Bitcoin quickly became a go-to mean of trade within the underworld, where owners of the currency wished to remain anonymous[9]. As a result, Bitcoin is often associated with illicit activities and this has diverted attention from the potential of open distributed ledgers and smart contracts, which lay behind blockchain.

Captivatingly simple and very complex at the same time, the technology resolves one of the most persistent challenges of the distributed network systems – the consensus problem, by allowing unrelated decision-makers with conflicting strategies to agree on a common value represented by the blockchain. The blockchain is essentially a continuous log of transactions that is synchronically updated across the distributed network, so that all parties store, control and access their copy of the database, but no control hub holds a master key, effectively eliminating a single point of failure. Transactions occurring on the network are bundled into blocks and each block contains new information as well as a validation, or hash, of the prior block and a time stamp. The new information must comply with a pre-defined set of rules, the fact of which must be attested to by a majority of special "mining" participants. As a result, not one single party can tamper with the database undetected, as inconsistencies will be identified elsewhere on the network.

It is in the core economic interests of the parties to maintain the robustness and reliability of the blockchain, as every addition of the block to the existing chain triggers an injection of the limited number of bitcoins onto the network. The 'miners' then have to discover or 'mine' these bitcoins[10]. Bitcoin, therefore, is simply an incentive meant to guarantee the parameters of the blockchain that primarily attribute to the appeal of this technology, namely decentralisation and distribution of data, the latter being kept on the transparent, permanent and immutable ledgers.

Another essential feature of the blockchain is the codification of the validation process that allows a transaction to be executed along the pre-defined algorithm. This is known as a 'smart contract', which is a misnomer, as it is neither smart nor a contract in a strict legal sense, but a piece of self-executing code. On the blockchain, the validation is embedded into a transaction by the miners

[9] Pseudonymity rather than full anonymity is ensured for Bitcoin traders.

[10] The bitcoins have real monetary value, which since the emergence of the cryptocurrency has fluctuated dramatically. The value of the bitcoins is a result of the economic principle known as a network effect. In words of David Perry: 'The network effect is a lovely piece of jargon that refers to the quite commonsense statement that networked products and services tend to have more value when more people use them. (…) Bitcoin creates value for the old investors and the new by splitting a finite currency supply in more ways. That's not trickery or theft, just good old fashioned supply and demand at work-a basic and ancient economic principle applied to the world's newest currency system.' (http://www.nasdaq.com/article/why-bitcoin-has-value-cm733313)

enforcing adherence to the pre-defined rules in order to accept the transaction. For example, a common rule is not to allow more to be spent than is in the user's account. Another is to ensure the user trying to spend has the rights to the account, as represented by a password and a private encryption key. Smart contracts can be thought of as extensions from a foundational set of pre-define rules to situation-specific rules. These situation-specific rules, which are also enforced by miners, allow the logic, validation and workflow traditionally performed by third party intermediaries to be programmed into the blockchain.

Blockchain as a whole, and it component parts, Distributed Ledgers and Smart Contracts, are said to be the 'formative' technology in a sense that it is capable of replacing a wide range of traditional processes with faster and more efficient alternatives. Governments need to explore in what areas public services and tax administration can most benefit from blockchain? Some ideas are provided in the following section.

How is blockchain relevant for public services and tax administration?

The principles underlying the operational mechanisms on which blockchain technology is based, such as transparency and decentralisation of control over data, or ability to program smart contracts to assume part of the function typically performed by a third independent party, demonstrate the potential of technology to produce a transformative or even disruptive effects on the way we execute processes today. Apart from the reductions in the clearly visible transaction costs, the additional benefit of embedded compliance (i.e. independently ensured trust that rules have been followed) is an outcome particularity suited to the tax domain. Although large-scale adoption of the blockchain and smart contract technology is likely to occur across numerous sectors of business and society, one needs to carefully examine the related limitations and risks in specific cases of implementation.

Blockchain can potentially provide solutions for the tax community through use either of distributed ledgers or smart contracts or applied as a whole. Some tax areas that contain most parameters compatible with blockchain are registers of the beneficial owners, transfer pricing and payroll tax. These are considered in further detail below.

Beneficial owner registers[11]

[11] Julia De Jong, Alex Meyer, Jeffrey Owens, *Using Blockchain for Transparent Beneifcial Ownership Registers,* International Tax Review 30 May 2017.

Corporate vehicles are oftentimes exploited by money launderers to provide 'front' businesses through which the proceeds of crime are being processed to conceal their sources as illicit gains and inject the money back into a financial stream. Opacity secured by the 'corporate veil' obstructs ready access of competent authorities to the information regarding ultimate beneficial ownership of those legal vehicles, creates conditions where individuals can shield their assets from the tax officials, including proceeds of crime, such as bribery and corruptions.[12] Availability of information regarding the ownership structure, including identification of legal and ultimate beneficial owner, of companies, trusts, foundations and partnerships, can assist law enforcement agencies and tax administrations[13] in identifying those persons responsible for the activity of concern, or who may have relevant information to further an investigation.

Enhancing transparency of the beneficial ownership registers to fight financial crime has been a high-priority items on the agenda of many international organisations, including Organisation for Economic Co-operation and Development (OECD), the Financial Action Task Force (FATF) and the Member States of the Group of Twenty (G-20). In particular the latter has consolidated the findings under various international initiatives and reiterated the principles by adopting the 'High Level Principles of Beneficial Ownership' at the Brisbane Summit in November 2014. Despite these efforts at the highest political levels, progress in actual implementation of reforms at a domestic level remains limited. Blockchain and Distributed Ledger technology, with its inherent feature of increased transparency should be considered in the context of beneficial ownership problem, as it allows for the collection and distribution of data regarding the persons holding the ultimate control.

Current iterations of centralised companies' registries provide a passive snapshot of asset or account ownership at a given moment in time. These registries are generally unable—and the companies themselves, often unwilling—to provide dynamic updates on changes to ownership and/or control of a given customer or entity. The blockchain, however, allows for the ledger to be updated in close to real-time with changes to the asset holdings or control levels of multiple parties. This could, for instance, reduce the risk of related parties disaggregating their holdings (to below, for instance, 25%) in the immediate lead-up to a reporting period, and then subsequently resuming control.

Current legacy registries also lack adequate verification mechanisms. Although many jurisdictions apply criminal and/or civil sanctions for supplying false or misleading information, it is both highly resource-intensive to conduct random audit checks of information, and difficult, if not impossible, to

[12] OECD, 'Behind the Corporate Veil: Using Corporate Entities for Illicit Purposes,' (OECD Publication Service: Paris, 2001), at 3.
[13] See FATF, 'Transparency and Beneficial Ownership,' Guidance Paper, October 2014, at 3.

distinguish in many cases between incidents of innocent mistake and deliberate obfuscation. However, utilising a permissioned version of the blockchain would allow for trusted third-party intermediaries (whether it be a government agency, financial institution, legal or accounting firm, or credit referencing agency) to authenticate documents or information and subsequently verify or 'stamp' the digital identity of the relevant individual or entity. Third parties could then rely upon the fact that the data has been co-stamped by a trusted validator as proof of authentication (though not necessarily of 'accuracy', as the blockchain mechanism does not in and of itself solve issues of reliability of beneficial ownership data arising from the use of nominees and corporate directors, etc. If incorrect or misleading data is used as an input, as long as the correct protocols are utilised, it will be accepted by the network and added to the blockchain).

The decentralised and distributed nature of the blockchain system architecture means that no single party retains control, and that there can be no single point of failure through which a hacker or insider could corrupt the ledger's contents. This means that an ownership register underpinned by blockchain technology could be deployed faster and with fewer resources, and with the added benefit of automatic reconciliation in real time.

Transfer Pricing [14]

Transfer pricing rules represent the most common kind of specific anti-avoidance rules (SAARs) and require related companies to apply arm's length principle, which us designed to ensure that companies do not misprice the intra-group transactions with the purpose of manipulating the tax burden by allocating the group profits in most tax efficient manner[15]. Therefore, transfer pricing rules are premised upon governments not trusting transactions between related parties.

The transfer pricing rules require that companies assign a price to intra-group transfer based on the arm's length principle (ALP), i.e. the price at which the transaction would occur between two unrelated parties. In order to achieve the comparison, entity that performs the transaction is subjected to the functional analysis to determine the parameters in relation to which a comparable can be found, and then the transaction priced by aligning the profit with the value-drives.

However, when applying the ALP, both tax administrations and customs authorities encounter a number of relevant challenges: the asymmetry of information between MNEs and government

[14] See also, TY Sim, Jeffrey Owens, Raffaele Petruzzi, Romero J. S. Tavares and Clement Migai, *Blockchain, Transfer Pricing, Custom Valuations and Indirect Taxes: the Potential of the "Trust Protocol" to Transform the Global Tax Environment*, Bloomberg BNA 15 June 2017

[15] This anti-avoidance aim of transfer pricing legislations, however, is highly debated.

officials,[16] the lack of or limited availability of data on transactions between unrelated parties, especially in some regions,[17] as well as the compliance burden related to the assessment of these principles might increase the above-mentioned mistrust between taxpayers and tax administrations. The significance of these issues is also highlighted by the considerable volume of guidance provided by the OECD, the UN, and the WBG on how to implement transfer pricing rules, and by the WCO on how to implement customs valuations.

The increasingly widespread adoption of blockchain will result in more and more transparent, retrievably ledgers of transactional records. The resultant transactional level data, if made available to both governments and taxpayers, can contribute greatly to data availability, address the lack of comparables and enhance comparability, given the tendency of blockchain transactions to be standardized. This will reduce the need for tax authorities to resort to secret comparables. Further, the use of smart contracts in a distributed manner to impose or enforce standardized contractual terms means more standardization at the micro-levels that will enhance comparability. Imogen Heap proposes using smart contracts to empower artists to control their outputs by allowing them to bypass studios in releasing their work, control terms under which they are released, determine the sharing of revenues among other things.[18] Smart contracts can therefore be used to impose standardized license or lending terms on the end user party, which must be accepted by the end-user in intra-group transactions before, for example, they can be granted rights to use a software.

Availability of data on the blockchain can also be advantageous for mitigating an expected upshot of the compliance costs following the Country-by-Country reporting requirement of the OECD/G-20 Base Erosion and Profit Shifting Action 13, that requires MNEs to disclose information in the Master File and the Local File about their structure and operations within various jurisdictions. Granting access to tax authorities to the permanent immutable log of transactions would significantly reduce the compliance costs through allowing more streamlined audit and substantiation to the contents provided in the CbC reports.

---

[16] See OECD, BEPS Frequently Asked Questions - http://www.oecd.org/ctp/beps-frequentlyaskedquestions.htm; OECD Public Discussion Draft BEPS Action 8: Hard to Value Intangibles June 14 – 18, 2015

[17] The Platform for Collaboration on Tax (OECD, IMF, UN and World Bank Group) Discussion Draft: A Toolkit for Addressing Difficulties in Accessing Comparables Data for Transfer Pricing Analyses available at http://www.oecd.org/tax/discussion-draft-a-toolkit-for-addressing-difficulties-in-accessing-comparables-data-for-transfer-pricing-analyses.pdf

[18] Imogen Heap, ´Decentralising the Music Industry with Blockchain´ May 14, 2016 - http://myceliaformusic.org/2016/05/14/imogen-heap-decentralising-the-music-industry-with-blockchain/

Payroll tax[19]

One other area that indicates its potential compatibility with the blockchain technology is payroll taxation. Underlying records necessary in order to assess an individual's tax liability tend to be numerous and collection of necessary information is often replicated by various departments with varied functions. Using blockchain to allow for assimilation of data relevant to an individual's employment status and income computation, such as age, length of service, family relationship, in one data[20] set by allowing consolidation of reliably data from other registers kept on the blockchain may significantly reduce compliance costs and eliminate a bulk of repetition.

In addition to secure sharing and transfer of data stored on the distributed ledgers, the functionality of the blockchain can be further expanded to allow for automation of the payroll tax withholding function using smart contracts and enabling split payments. Typically, the role of the involuntary tax collector on behalf of the revenue authority is assigned to the employer. However, in some cases, the tax liability intended for transfer is used to solve the short-term cash flow of the company. Self-execution of the transaction via codification of the necessary algorithm, whereby the tax liability is automatically calculated, deducted and paid to relevant parties, eliminated the paternal for perpetration of payroll tax fraud.

Hype versus realty

With popularity of blockchain technology growing an unprecedented speed it is important that tax authorities do not ignore or misjudge a potentially revolutionary technology capable of solving some of the most resistant issues faced by the tax community today and consider possible application of technology to fiscal policy, such as in examples considered above. On the other hand, it Is just as important not to succumb to the frenzy generated by publicity which pronounces new technology as almost a 'panacea' against a broad variety of modern socio-economic ailments.

---

[19] Richard T. Ainsworth and Ville Viitasaari, *Payroll Tax & The Blockchai*n*,* Tax Notes International, 13 March 2017.

[20] Area of identity is perhaps the most critical and fundamental to blockchain. Blockchain allows for the creation of the Blockchain ID as an authentication of the identity. The data pertaining to the user is updated to the blockchain and the public key is issued, which is then converted to the private key that is transferred to the data-subject. The individual can then use the key to sign, and the authenticity of then verified against the public key. Apart from verification function of Blockchain ID, the latter can be used to share the information of the user without disclosing unnecessary details and allowing for secure data transfers. For further information see Ben Cristello-Dittmar, *Application of the Blockchain for Authentication and Verification of Identity*, Nov 30, 2016, available on http://www.cs.tufts.edu/comp/116/archive/fall2016/bcresitellodittmar.pdf

For the blockchain to flourish, it has to be applied in the environment where its structural pillars, consensus, distribution and 'trustlessness', are relevant. In case where consensus is achieved by default due to the lack of conflict or trust is present, the blockchain applications may still be developed, but there are likely to be simpler, most cost-efficient alternatives.

One of the most persistent challenges of the blockchain is balancing transparency and privacy. Finding an optimum trade-off is fundamental for the technology to be fully operational and to enable it to replace some traditional processes. Strengthening of data and consumer protection laws should ensure that the perceived as well as apparent risks are mitigated. Going beyond data protection law, current governance vacuum should be filled with timely and relevant regulatory interventions to secure harmonious development of technology and building up of the blockchain's legal backbone.

Current academic initiatives of the Wirtschaftsuniversität Wien (WU)

The research teams at the Vienna University of Business and Economics within the Institute of Austrian and International Tax and well as IT and Business Processing departments have recognised the transformative potential of the nascent technology from its onset and initiated a ground-breaking study of the impact of technology on government. They seek to develop confidence and competence needed to integrate the blockchain into the design of future government and to enable early-adopters to map out the steps and begin the process of adoption at both levels - regulatory and technical.

To foster relevance and applicability of the research findings under this initiative, the project assimilates inputs derived from neutral multi-stakeholder dialogues in order to produce an output in the form of the policy-relevant research. Academic research conducted on the premise of joined effort and close co-operation of the representatives from various disciplines will provide a more systematised conceptual foundation that would act as a bridge between conventional order of tax administration and compliance and emerging realm of technology. The research is also seeking to deliver arguments on the subject of the opportunities and challenges associated with the blockchain technology and to feed into an international debate, involving the United Nations, the World Bank, the International Monetary Fund and the OECD. Currently, the University is cooperating with the Austrian State Ministry of Science, Research and Economics to assist the Austrian government to develop its Digital Roadmap and to position Vienna as a major blockchain hub.