

The Wider Impact of a National Cryptocurrency

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Abstract

This study looks at the impact of a national cryptocurrency on the payment landscape in the midst of the rise of global public cryptocurrencies and interest from central banks in a possible national cryptocurrency. The impacts are analysed for consumers, merchants, banks, payment providers, international money transfer operators and central banks. The study analyses the pros and cons for each player with an overall impact ranking. There is a particular emphasis on central banks as they hold key regulatory oversight for economic and financial matters affecting a country. Whilst finding that there is an overall benefit, there are also significant risks. A sandbox approach is proposed for specifically mitigating some of the risks of introducing a national cryptocurrency.

Policy recommendations

- Governments should explore the potential benefits of the technology behind cryptocurrencies because the benefits to payment players is overall positive.
- Central banks should consider a crypto-sandbox approach to mitigate the potential risks of issuing a national cryptocurrency. The crypto-sandbox should include payment players and specific testing for special cyber-security attacks and economic changes.
- A possible area of immediate benefit from cryptocurrency technology is B2B transfers. Central banks should consider how this technology can benefit funds transfers between banks and companies without the complication that comes with using the technology among consumers at large.
- Once more experience and learnings is gained from the sandbox, the technology can then be slowly expanded to the consumer and cross-border markets after a thorough examination and controls have been put in place for possible risks and policy changes.

Introduction

A cryptocurrency is currently defined as “a purely peer-to-peer version of electronic cash [that] would allow online payments to be sent directly from one party to another without going through a financial institution”.¹ This definition is obviously meant to describe international cryptocurrencies like Bitcoin and Ethereum. On the other hand, a national cryptocurrency is more likely to have properties of being regulated and backed by the government since it would be issued by the central bank itself.

Amongst other questions on top of the minds of central bankers, one of them must surely be whether they should issue a national cryptocurrency to enjoy the benefits that the new technology offers. This paper attempts to analyse the wider effects of a government deciding to implement a national cryptocurrency and how risks could be mitigated. We included a wide range of players in the industry in our comparison. Central banks in particular have a macro environment mandate and their decision needs to take into account the overall effects on the whole economy including the industry and financial ecosystem.

Background of cryptocurrencies

There are many electronic methods for making domestic payments. Each country has their own domestic players, together with familiar international brand names like PayPal, SWIFT and Visa/MasterCard who offer their international clearing systems to domestic payments.

Cryptocurrencies on the other hand differ in that the transaction processing is no longer centralised to one company (e.g. Visa, PayPal) but is decentralised within a network, either public such as for Bitcoin, or in a consortium such as Ripple. No one company owns all the data and processing. All the participants in the network can access the transaction data which is kept in consensus within the network. This is a small change in the paradigm but a major shift in how the participants work together.

International cryptocurrencies are a recent invention. Early forms of online currencies surfaced even before 2008. Table 1 below contains a short historical background. We juxtaposed cryptocurrency’s growth against other developments in the global economy to highlight the larger forces contributing to its growth.

Table 1: History of Cryptocurrency & Key Global Developments ^{1, 2, 3, 4}

Period	Key Cryptocurrency Development	Key Global Developments
<i>Pre 2008</i>	Various attempts to create online currencies secured by encryption. B-Money and Bit Gold are some examples of early development in cryptocurrencies.	2006: WikiLeaks launched 2007: Steve Jobs announces iPhone
2008s	First cryptocurrency, Bitcoin, released around 2008 by “Satoshi Nakamoto” taking the pre-existing digital coin market further by decentralizing the currency and freeing it from	- Black Monday in worldwide stock markets and Bloody Friday where many world’s stock

	hierarchical power structure using a peer-to-peer network.	exchanges experience worst declines in history. - Start of global financial crisis, beginning in the US - Global financial crisis spreads across the world, plunging many countries into recession
2010s	First publically traded Bitcoin – owner swaps 10,000 Bitcoins for two pizzas.	- Countries slowly begin to emerge from the recession
2011s	Litecoin released. It modified Bitcoin's protocol by making it faster and more appropriate for daily transactions. Other cryptocurrencies also began to emerge, like Namecoin and thousand others.	- Other countries begin to recover from recession - Wikipedia turns 10 years
2013s	Price of Bitcoin crashes after reaching \$1,000 for first time.	- European Commission forecast 2013 growth of 0.1% - Japan remains in recession as economy shrinks by a further 0.1%
2014s	Ripple.com is launched using a model different from Bitcoin. Peercoin launches with technology using own mechanism, proof-of-stake (PoS), employing a hybrid network security mechanism. NuShares/NuBits introduced in August 2014, using a dual currency model. At the same time, scams started appearing, with world's largest Bitcoin exchange Mt. Gox goes offline with missing Bitcoins to the value of \$450 million.	-- Psy's Gangnam Style becomes first video to reach 2 billion views on YouTube
2016s	A blockchain organisation, Ethereum, becomes popular by attracting investors over its technology platform which facilitates blockchain-based smart contracts (code run on the blockchain) and decentralised applications. Initial Coin Offerings (ICOs) emerges, allowing investors to use these fundraising platforms to trade digital assets such as stocks or shares in start-up ventures, real estate and to raise funds	- UK votes to leave the EU through the Brexit referendum - Google's DeepMind artificial intelligence wins Go challenge against Lee S-dol - China's super computer tally overtakes the US

	for new projects. Chinese government bans ICOs while the US SEC warns investors of the lack of oversight over these ICOs. Other regulators, such as MAS in Singapore, clamp down on ICO tokens that appear to be investment schemes and need to be licensed.	<ul style="list-style-type: none"> - Pokémon Go released - Amazon announces first delivery by drone
2017s	Bitcoin's price reaches \$10,000 against a backdrop of increasing growth in places where the cryptocurrency could be used. More money starts flowing into cryptocurrencies. Market capitalization of all crypto coins rises from \$11 Billion to \$300 billion. Banks expand their experimentation of the technology and phenomenon – interested in harnessing the efficiencies while cautious about how the phenomenon might play out in the real financial economy. New crypto-currency Bitcoin Cash created due to a fork in the blockchain.	<ul style="list-style-type: none"> - Britain introduces first new pound coin in 30 years with secret security feature to stop counterfeiting - Apple becomes first company to be worth more than \$800 billion - Apple unveils premium iPhone X, together with iPhone 8 - US Federal Reserve starts to unwind bond portfolio employed in wake of financial crisis
2018	Bitcoin price rises to close to \$20,000 and then crashes to around \$10,000. A correction or the start of a demise?	<ul style="list-style-type: none"> - Google unveils a new quantum computing chip with 72 quantum bits

A few key developments seem to parallel the growth of cryptocurrencies as can be seen from Table 1 above – the recovery from the global financial crisis and the growth of computer and mobile power. Furthermore, the usage of the internet and social media has been perceived to have massively increased even affecting politics by allowing fake news to potentially influence voters.⁵ Online purchases have also doubled in the last four years and expect to quadruple by 2021.⁶

Cryptocurrencies were born during the tumultuous times of the global financial crisis. Their subsequent growth parallels the recovery of the world from the recession. Author Timothy Earle mentions the loss of trust in financial institutions as a side effect of the global financial crisis.⁷ It is possible that cryptocurrency growth rode on the lack of this trust. This is aptly described by the then Chairman of the Fed, Ben Bernanke, “As in all past crises, at the root of the problem is a loss of confidence by investors and the public in the strength of key financial institutions and markets”.⁸

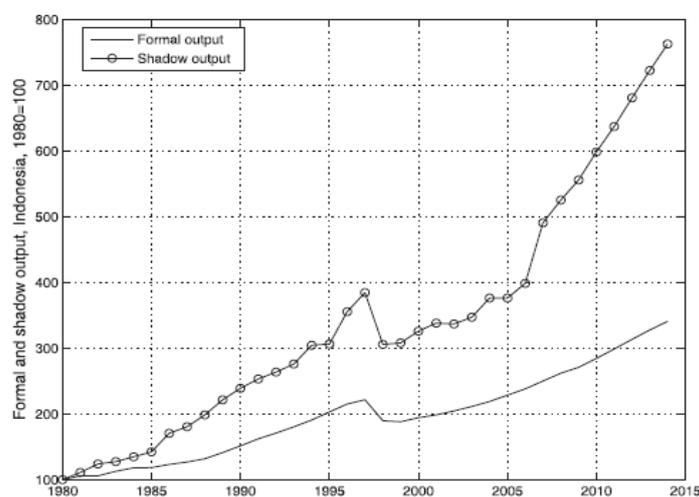
Another factor in the rise of cryptocurrencies which is not captured in the table above is money laundering. Author He Ping, writing in the *Journal of Money Laundering Control* as early as in 2004, mentioned that criminals everywhere try every possible way to launder money.⁹ However, with the continued efforts of national and transnational government efforts to reduce money laundering, launderers have started to switch their activities to cyberspace with the help of electronic money - due to having fewer know-your-customer (KYC) requirements and even less audit trails.

Cryptocurrencies, with no jurisdictional oversight, fit into this nicely. Furthermore, it remains unclear how cryptocurrencies fit into existing legal frameworks making it easier to escape anti-money laundering laws.¹⁰

Has the growth of cryptocurrency correlated with money laundering? Unfortunately, the statistics for such a shadow economy activity is difficult if not impossible to retrieve.

However, an estimate of the shadow economy output, using Indonesia as an example, can be seen in Figure 1 below.

Figure 1: Indonesia, formal and shadow output (1980=100)



Source: Solis-Garcia & Xie (2018)¹¹

Figure 1 above gives an indication of the size of the shadow economy for an average developing modern economy like Indonesia. The key point to note is that the shadow output increases in line with the formal output. Therefore, assuming a similar trend for the amount of total global shadow output given the recovery the world has enjoyed over the last decade, the global shadow economy must be 100s of billions of dollars. An area for further research could be to confirm the correlation and causal relationship between money laundering and the growth of cryptocurrency.

Growth of cryptocurrencies

There are various other practical reasons for the increasing popularity of cryptocurrencies.

Convenient. Blockchain technology offers fast, secure and convenient payment transaction processing. It is also easy to set up digital wallets with little or no requirement for KYC forms and background checks and there are no bank applications forms to fill in.

Low-cost. Blockchain infrastructure works without bank and other commercial payment intermediaries, thus cutting out the middlemen and making them generally lower cost than the conventional banking and money-transfer products.

Decentralized. There is no regulatory oversight and restrictions since the network and accounting is decentralized across many individual players in the global market.

Transparent: Blockchain technology allows storage of the details of every single transaction that ever happened in the network and these records or audit trails are available for everyone to inspect and cannot be modified.

Appreciating value. Investors and speculators alike have moved funds into cryptocurrencies as a hedge against various risks like currency devaluation, or simply to make a profit quickly from the rapid rise of Bitcoin.

Pseudonymity. With most public cryptocurrencies the users have a state of pseudonymity where accounts are not anonymous as they have a unique identifier, but as long as the identifier cannot be linked to an individual the owner of the account remains unknown. There are blockchains such as Monero which do claim to provide full anonymity.¹²

However, cryptocurrencies also have drawbacks alongside the inherent risks of new technologies and unregulated activities. These include:

Security. Whilst the bitcoin consensus protocol has never been hacked, the various components around bitcoin such as wallets and exchanges have been hacked. For example, Mt Gox, which was the largest bitcoin intermediary and the world's leading bitcoin exchange, had a security breach on 19 June 2011 when it announced that approximately 850,000 bitcoins belonging to customers and the company were missing and likely stolen, an amount valued at more than \$450 million at the time. On top of this, smart contracts have unique security issues that has led to problems such as the DAO losing US\$55 million in 2016.¹³

Power costs. The most popular method to maintain consensus in a cryptocurrency blockchain is "Proof of Work" which requires a significant amount of electric power.¹⁴ There are alternative consensus mechanisms such as "Proof of Stake" but must still prove themselves to be as reliable as Proof of Work at large scales.¹⁵

Performance. As with any technology, there are trade-offs with functionality, speed and volume. For a cryptocurrency the speed at which transactions are validated by the blockchain is one of the most important factors. For example, Bitcoin validates a few thousand transactions in each block in around every 20 minutes (equivalent to around 2 transactions per second). This is a reasonable speed but is much less than credit card transaction processing rates of around 24,000 transactions per second.¹⁶ Blockchains are now improving with Ripple claiming similar transactions speeds and a validation time of 4 second.¹⁷ However, transaction volumes in Ripple are around 5 million per day whereas Visa Net processes an average of 150 million transaction each day.^{18,19} While Ripple's transaction speed is becoming close to the average for credit card processing, the need for both volume and speed is necessary for cryptocurrencies to be a taken up as a national currency.²⁰

Analysis of central bank responses

The same reasons for cryptocurrency's popularity has been the very reasons for them drawing increasing regulatory attention.²¹ Central banks today are intrigued not only by the tremendous appreciation in value of Bitcoin over a short time, but also the technology behind it.

Below is a sample list of approaches taken by central banks on this issue including the use of a regulatory sandbox. A sandbox typically limits the amount of business that can be done and ensures that customers are aware that the technology is not mainstream. The UK's Financial Conduct Authority, in their report to Her Majesty's Treasury, defines a regulatory sandbox as "a 'safe place' in which businesses can test innovative products, services, business models and delivery mechanisms without immediately incurring all the normal regulatory consequences of engaging in the activity in question."²² The regulatory sandbox allows new financial service providers to implement innovative services without being too cautious because of normal regulatory requirements and avoids negative outcomes for promising innovations.

Table 2: List of Central Bank's General Responses To Date = 15 May 2018* ^{23,24,25}

Country	Global and National Cryptocurrency Status	Regulatory Sandbox Approach or Experimental Approach
Australia	Allowed, but regulated	Sandbox likely in 2018
Iceland	AuroraCoin, 2014	
Spain	SpainCoin, 2014; PesetaCoin, 2014	
Greece	GreeCoin, 2014	
Scotland	ScotCoin, 2014	
Cyprus	AphrodietCoin, 2014	
Ireland	IrishCoin, 2014, GaelCoin, 2014	
Portugal	CryptoEscudo	
Germany	Deutsche eMark, 2013	
Scandinavia	Ekrona, 2014	
Netherland	eGulden,	
North American Cheyenne tribe	MazaCoin, 2014	
Canada	MapleCoin, 2014	
Israel	IsraCoin, 2014	

China	ICOs banned	Considering sandbox
South Korea	ICOs banned	
Hong Kong	Allowed, subject to future regulations	
Taiwan		Considering sandbox
Thailand	Allowed, subject to future regulations	Sandbox likely as first step, 2017
Japan		Recognises BitCoin as legal tender, Apr 2017 Sandbox likely as first step, 2017
India		Sandbox likely as first step, 2017
US	Allowed, rules vary by state, need AML/KYC.	
UK		Sandbox implemented, 2017
Singapore		Project Ubin sandbox implemented, 2017

*Correct as at 15 May 2018, subject to change with passage of time

An analysis of the responses to date reveals a few key points on the history of regulatory approaches taken thus far:

- A rush to issue national cryptocurrencies took place in 2014 during the early days of cryptocurrencies (see table 2). The reasons for issuing national cryptocurrencies ranged from “fixing” the economy from the aftermath of the 2008 financial crisis, to “nostalgia coins” primarily among the Eurozone countries to drum up sentiments among citizens and introduced as alternatives to current financial systems.²³
- Amidst some exceptions, most did not have much economic design or planning behind them to allow these national cryptocurrencies to be accepted like a fiat currency as a medium of exchange, a unit of account and a store of value.
- The current approach to national cryptocurrencies seems to take a more experimental and analytical approach. This approach is to firstly implement a regulatory sandbox to experiment with the technology with the aim of harnessing the benefits while considering ways to limit the potential risk before coming up with a decision on how to implement the technology.

- Even those who may have earlier banned cryptocurrencies may be currently mulling over a sandbox approach before issuing new regulations or tweaking regulations further. The Chinese authorities whom earlier banned ICOs are now considering a sandbox approach to test the technology.²⁶ Japan is another case in point. Japan had earlier legalised Bitcoin as legal tender, but this did not prevent them from also considering a sandbox approach in 2018.²⁷

Analysis of players in the payment landscape

The impact of a national cryptocurrency affects many players in the payment processes and an analysis is now provided for each player in terms of its potential advantages and challenges and summarised in table 3.

Consumers

From a consumer point of view for purchases, having a national cryptocurrency alongside current payment options and a global cryptocurrency, merely introduces another electronic payment option for purchases which, if they are already free and fast, is unlikely to add any benefit. However, for international money transfers the current choices are costly and take significant time. Global cryptocurrencies typically have lower fees compared to traditional options like Western Union and PayPal. They are also faster but have higher exchange risks due to the necessity to convert to and from fiat currencies to cryptocurrencies on both sides, unless earning in the cryptocurrency or paying in cryptocurrency. The overall impact of the introduction of a national cryptocurrency for a consumer is expected to be positive due to possibly cheaper international money transfers and, possibly, even local payments.

Merchants

For the merchant, it is likely they will offer to accept national cryptocurrencies for payment of their goods and services if their customers request it, and the cost of acceptance is not prohibitively expensive. Therefore, a national cryptocurrency will exist alongside the prevailing domestic payment options. The impact is seen to be negative as merchants will need to further complicate the payment options they offer and will not see any benefit unless there is a significant reduction in the service cost by avoiding or “disintermediating” payment providers.

Corporates

Commercial organisations, especially the large corporates, would have another choice in inter and intra corporate transfers if a national cryptocurrency is introduced. If there is sufficient improved efficiency and lower cost from a national cryptocurrency, for example by disintermediating some of the banks in the processing of transfers, then we can expect greater uptake among commercial organisations overall. The impact for corporates is expected to be positive.

Banks

Banks will likely benefit from a more efficient payment mechanism for inter-bank payments, but they may lose out on a share of the domestic payment either directly or indirectly through local clearing houses. Introducing a national cryptocurrency, while benefiting local banks through a new option to transfer money between banks (interbank) beyond RTGS, would also disrupt banks’ business in local funds transfer and payments which they own through their direct participation in the scheme

payment providers (PayLah, Visa, MasterCard, SWIFT) and indirectly through their ownership of NETS. Note also that a national cryptocurrency may cannibalise the central bank's own RTGS system. When other banks have cryptocurrency infrastructure then cross-border inter-bank transfers become possible using global or national cryptocurrencies. Overall the impact is likely to be positive.

Local Payment Providers

Local payment providers may see some of their market share being eroded with the entry of a national cryptocurrency. Players like NETS and EZLink would be affected, especially if a mobile wallet version is implemented and widely accepted at retail establishments. On the other hand, a national cryptocurrency would allow payment providers to disintermediate banks and pay directly to corporates through bypassing the B2B transfer mechanisms like RTGS and SWIFT. So overall the impact on local payment providers is likely to be negative if national cryptocurrencies can be more efficient and lower cost than the current options, especially among local payment providers who are narrowly focused on only the payment business. These players stand a high chance of being disintermediated when a national cryptocurrency is introduced.

International Money Transfer Operators (MTO)

A national cryptocurrency is unlikely to have a huge impact on players like Western Union and PayPal whose business is focused on cross-border payments until national cross-border payments are possible. Once cross-border national cryptocurrency transfers are possible then the impact is likely to be negative unless the MTOs take up the technology.

Central Banks

A central bank is not merely a player in the industry. It is a regulator and clearing house and besides looking at the effects of a national cryptocurrency on each player in the industry, the central bank also needs to balance the benefits the technology brings versus the possible downside of a national cryptocurrency. In short, the central bank needs to adopt a holistic approach and take many factors into consideration before making a decision.

It's not just whether to issue a national cryptocurrency. The real question should be "what are the benefits and risks of this technology, and how can it be best implemented to benefit the country and industry?" From a macro level analysis, the benefits of blockchain technology for a distributed ledger can improve efficiency and lower costs for settlement giving a potential overall positive impact. If a national cryptocurrency is issued to consumers, then governments need to consider how consumers will be protected. This needs to be considered given the current shortcomings of the technology. It is not an easy task given the breadth of impact across many areas of the industry and the difficulty of quantifying the benefits versus the cost.

Overall, the decision on whether to issue a national cryptocurrency has wide impacts across society. And when it impacts the average man-in-the-street, then central banks need to be extra careful in ensuring all the possible legal, security and trust issues are mitigated before implementation.

Table 3: The wider effects on different players by a national cryptocurrency

Perspective	Descriptive Impact	Overall Impact
Consumers	<ul style="list-style-type: none"> - Just another option alongside other local payment options like NETS, PayLah, PayNow, debit cards, credit cards - Possibly lower the cost of payments due to lack of intermediaries - May have an advantage for international payments - Ramifications on govt responsibility with regard to price fluctuations and retail investor losses, consumers may request for government compensation or insurance to protect them from possible financial losses 	Positive
Merchants	<ul style="list-style-type: none"> - Another option to offer alongside other local payment options like NETS, PayLah, PayNow, debit cards, credit cards, EZLink etc - Possibly lower the cost of acceptance if merchant discount rate can be lowered from the current 0.3%-3% 	Negative
Corporates	May benefit from more efficient and less costly way to transfer large amounts of funds from one organization to another, without bank intermediaries	Positive
Banks	<p>Personal Money Transfer</p> <p>Banks may be cut off from personal local transfers and payments if the national cryptocurrency is issued to retail customers.</p> <p>Interbank Transfers</p> <p>Banks may benefit from interbank transfer efficiency through use of faster and cheaper technology versus SWIFT, BCS and RTGS</p> <p>Intercompany and International Transfers</p> <p>Banks may be cut off from corporate domestic funds transfer business as corporates bypass banks for national cryptocurrency</p>	Positive
Local Payment Providers eg SWIFT, PayPal, Visa, RTGS	<p>Personal Money Transfer & Purchases</p> <p>Local payment options like NETS, PayLah, PayNow, debit cards and credit cards may be displaced</p> <p>Interbank Transfers</p>	Negative

	<p>Banks have an alternative to a centralised RTGS</p> <p>Intercompany Transfers</p> <p>Banks may lose some business as corporates try out the national cryptocurrency as a form of payment</p>	
<p>MTOs</p> <p>eg Western Union</p>	<p>- MTOs focus on cross-border payments, so effect on them is small</p>	<p>Negative</p>
<p>Central Banks</p>	<ul style="list-style-type: none"> - Financial effect on local economy, money supply, legal tender issues - Market share impact on banks, payment providers, corporates, merchants and consumers - Prevent use of national cryptocurrency for shadow economy and money laundering activities - Position country as leading edge in banking services with own national cryptocurrency - Manage retail investor perceptions with respect to swings in market price of cryptocurrencies 	<p>Positive</p>

Risks for a central bank

Some of the main risk areas of a national currency are from the impact of a security lapse, the unknown response of decentralised systems to a global financial crisis situation, data privacy leaks and overall governance of the platform.

Security. As mentioned above, the behaviour and possibilities for bugs in blockchain application, consensus protocols and smart contracts are still in the early stages of discovery. The impact of a hack in any one of these areas could be huge and potentially affect the economic status of the country.

Financial Crisis. It is unknown how a national cryptocurrency and the associated systems would respond in a financial crisis. The higher level of automation of the processes such as settlements would certainly accelerate the response of currency movement in such situations and safeguards will need to be considered carefully.

Data privacy. Data privacy is a major concern for individuals and regulators. Decentralisation makes the implementation of safeguards more difficult and complex. National currency accounts and transactions will need careful consideration before implementation.

Governance. The governance of the platform supporting a national currency will need to be considered to allow both clear regulatory boundaries and integration with a, presumably, centralised control over cryptocurrency generation.

The use of the regulatory sandbox

Given the potential benefits and risk of a national cryptocurrency and the prevalence of regulatory sandboxes it is proposed that a national cryptocurrency could be investigated and rolled-out using this idea extended specially for national cryptocurrencies.

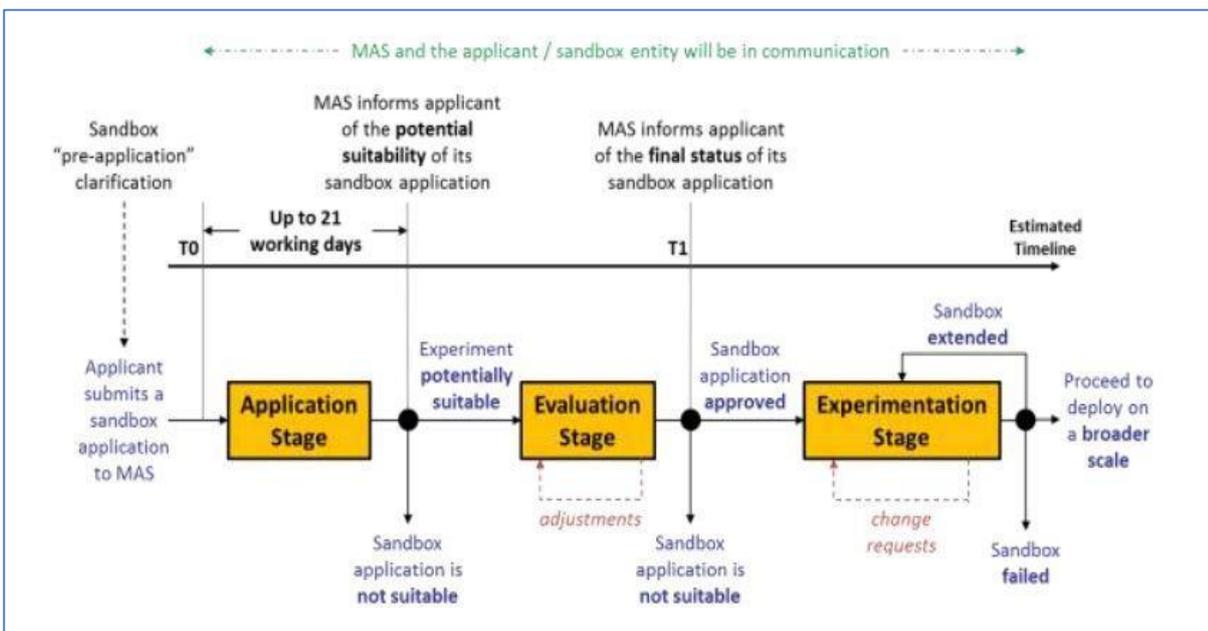
Common objectives of a sandbox approach are to encourage innovation of new and safe technology in the financial sector with the objective of increasing efficiency, managing risk better, creating new opportunities and/or improving people’s lives.

Common elements of a regulatory sandbox approach includes the following:²⁸

1. Fintech company apply to “play” in the sandbox
2. Regulator approves the application
3. Regulator determines the specific legal and regulatory requirements it is prepared to relax for each case for the duration of the sandbox
4. Fintech company is responsible for deploying and operating the technology
5. Decision made whether to deploy on a broader scale at the end of the sandbox’s term

The diagram below is one example of the process for a sandbox approach²⁸:

Figure 2: MAS Sandbox Process²⁸



After an application to use the sandbox is made an evaluation is typically performed to assess if the innovation and technology is suitable. The evaluation criteria often covers the following areas:²⁸

- Is the technology truly innovative?
- Does the technology service bring benefits to consumers or the industry?
- Does the fintech company have the intention and ability to deploy the technology?
- Are the test scenarios and expected outcomes clear?
- Are the significant risks assessed accurately, and sufficiently mitigated?
- Are the exit and transition strategy well articulated?

After that the applicant executes an experimentation phase and a decision made on whether to deploy on a broader scale.

We suggest the sandbox approach can be extended to be a crypto-sandbox to investigate the usage of a national cryptocurrency . Most likely the applicant will be a company that is or intends to provide a cryptocurrency platform. Secondly, the applicant would need to invite multiple players into the experimentation most probably including the regulator. Stress testing is suggested to be included in the experimentation alongside blockchain security testing to ensure resiliency from attack and in case of economic disasters.

The following would be a possible process:

1. A cryptocurrency platform owner applies to use the sandbox.
2. The applicant invites a representative from the payment players according to the use case.
3. The applicant includes a blockchain security expert to join.
4. Evaluation is performed by the central bank on the proposal implementation.
5. The applicant deploys and operates the technology
6. Experimentation phase is executed including security and resiliency testing.
7. Decision made whether to deploy on broader scale

Multiple cryptocurrency platform operators could propose solutions and a choice could be made in the evaluation phase for which proposal to execute as an experiment.

Outcomes from the use of a sandbox approach

The main outcome of the crypto-sandbox experimentation is to harness the benefits of the technology while discovering and reigning in the risk to consumers' safety and protection, in other words, a "don't throw the baby out with the bathwater" approach. Obviously, a crypto-sandbox

approach seems like a rational one given the many facets of cryptocurrency technology that is still unknown no matter how promising the benefits may seem.

Using a crypto-sandbox approach it would be possible to observe:

- Operational monitoring, processes and issues
- Technical issues
- Security needs and points of failure
- Volume scaling parameters
- Performance bottlenecks
- Governance for platform issue resolution and change management
- Potential uptake of a national cryptocurrency
- Overall benefits to the payment players
- Possible new opportunities from having a national cryptocurrency

One possible way to operationalise the technology is by at first limiting it to the B2B market, for example, for interbank and corporate transfers. This would limit the risk to the broader society where consumers are involved. After successful adoption for interbank settlement and adoption by more than one country, cross-border settlement could be introduced. Further to that merchants could be introduced and B2B payments increased on the platform. Finally, merchants can introduce the technology to consumers.

Once a national cryptocurrency is widespread, one of the advantages would be to allow an integration of payments within government services, for example, an ability to ensure payments are used as intended such as child benefit is only used for children's products.

Conclusion

The impact of implementing a national cryptocurrency extends far and wide across a nation's economy. The technology behind cryptocurrencies is worthy of further analysis and deployment and it is the authors' opinions that the benefits to the payment players is overall positive and governments should implement a national cryptocurrency. However, to mitigate potential risks, a crypto-sandbox enhancement of the current regulatory sandbox is an approach to consider. A crypto-sandbox needs to include payment players and specific testing for special cyber-security attacks and economic changes.

We believe that this technology could at first benefit B2B transfers between banks and companies without having to address issues of consumer protection if it were to be issued to consumers at large. Once a national cryptocurrency is widespread then it can be expanded cross-border for international trade. Furthermore, experimentation within a crypto-sandbox may provide evidence for policy changes and even lead toward global cryptocurrency policies.

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Authors' Note

All errors are the author's. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Lee Kong Chian School of Business, the School of Information Systems, Singapore Management University, Singapore.

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