The Harmonic Triangle: Cryptocurrencies, Central Bank Digital Currencies (CBDCs), and Stablecoins

Introduction

Debate rages about the future for digital currencies: cryptocurrencies, Central Bank Digital Currencies (CBDCs), and stablecoins. The stakes are high: the smart contracts operated on cryptocurrency blockchains have the potential to be a transformative enabling technology for both finance and the broader economy, but this is unlikely to happen until a stronger bridge is built to the familiar world of fiat currencies – and there is no consensus on how this can be done while maintaining the essential integrity of central bank money. This article addresses that question by setting out a vision for an imagined future digital architecture in which there is a "Harmonic Triangle" between CBDC, cryptocurrencies and stablecoins, each playing key, complementary roles.

This issue is very much of the moment. Legislation to foster constructive development of cryptocurrencies has been introduced in some countries, including Switzerland, and planning is well advanced in the EU, though at earlier stages in the US and UK, and meanwhile many countries are considering, or experimenting with, CBDC.

Defining the technology

CBDC (whether 'retail', available to all, or 'wholesale', open only to banks), cryptocurrencies and stablecoins all use the same core technology of a blockchain – which is nothing more than an electronic ledger in which transactions denominated in a unit of account are recorded, with a complete update (a new 'block') occurring every few seconds. The key differences relate to control of the updating process, access, and issuance of new units (or their destruction).

For CBDC, all three of these key processes are centrally controlled, by the central bank. For cryptocurrencies and stablecoins, a decentralised process (based either on 'mining' or on the more energy-efficient 'staking') is used to update the blocks, access is open to all, while unit issuance or destruction is rule-based; both allow limited technical changes, and in some cases adjustment to issuance rules, through largely decentralised governance processes. Stablecoins use a variety of rule-based mechanisms intended to maintain parity against a reference fiat currency, aided by a pool of reserves assets denominated in that currency; but historically, they trade in a band around par, usually narrow but occasionally wider. This is a key issue discussed further below.

All the familiar macro-economic aspects of monetary policy, such as targetting inflation, exchange rates or financial aggregates, can be applied with a CBDC, using the familiar instruments (though their impact might change, see below); and for a retail CBDC, there is the new possibility of direct "helicopter drops" of new money into the wallets of all holders, or equally, if more controversially, of direct removal of some holdings.

Crucially, blockchains can record not just debits and credits in their native unit of account, but also other items: information from outside (such as the scanning of the barcode from a package received in a warehouse); and contracts, which are written in computer code and can be automatically executed in response to a trigger, such as the receipt of that barcode or the achievement of a price target. The latter are known as 'smart contracts' and can take many forms.

Many cryptocurrency blockchains support this extra capability, the largest being Ethereum, and it is this which really marks the new technology out from the old world of banking. If we think of the

clerks in a Victorian bank updating the ledgers with their quill pens, which is still essentially what modern banks do albeit with computers, it is as though the same office now also contains the agents from the back office of a shipping company or a corn-trading house, alongside lawyers writing and completing contracts, all at lightening speed. It is this integration across functions that are still separate even in today's world, that really marks cryptocurrency blockchains out as a quantum leap in technology.

There is nothing technical that prevents a central bank including such functionality in the blockchain that it uses to operate its CBDC; but doing so in a way that realises its full potential would require the central bank to give almost anyone access, and permit them to incorporate computer code that could robotically execute transactions in CBDC. It seems most unlikely that any central bank would ever feel comfortable with allowing this. That is why this article talks of a harmonic triangle: if designed to inter-operate, CBDC, cryptocurrencies and stablecoins can act in a complementary way to give an overall financial system that can exploit the full possibilities of the new technology, while also maintaining the familiar characteristics of central bank fiat money.

A possible future digital architecture that does this is described below, but before that, further issues need to be discussed, starting with the question of whether there is some fundamental basis to the prices of cryptocurrencies, for without this, they would seem an unstable unit to have at the heart of the economy.

Do cryptocurrencies have 'fundamental value'?

The transaction fees on smart contracts are paid in the cryptocurrency (such as Ether) native to the blockchain on which the contract operated (even though the contract itself could be denominated and settled in conventional fiat currency such as dollars). We could imagine a logistics company offering its clients a smart contract which ensured that the moment a package arrived at its destination and its barcode was scanned, the buyer's funds would automatically be debited to pay the seller; this could go even further and include automated factoring in which a third party offered credit to allow the seller to receive instant payment even where the contract gave a grace period.

The fees on such contracts would create an underlying transactions demand for the cryptocurrency involved and thus provide an anchor for its value. Many commentators talk of cryptocurrencies as "having no fundamental value". This assertion would be true if such fees were payments only for transactions within the cryptocurrency world itself, as was the case in the past. But once real economy transactions are handled on a cryptocurrency blockchain, an anchor for fundamental value is established, since the execution of each real economy smart contract creates a demand that has to be balanced against the rule-limited supply of the relevant unit.

This could be thought of as the price of a company's shares being influenced by its discounted stream of net revenues, or as the price level being determined by the number of transactions (at given velocity and supply) in the quantity theory of money – noting that in the digital architecture envisaged here, contacts would be mainly denominated in fiat currency, while the fees would be paid in cryptocurrency.

Bitcoin, in contrast to Ether and some other newer units, operates on a blockchain with limited functionality, but its importance as the largest and best-known cryptocurrency is encouraging innovations that allow it to be used to support smart contracts, which could indirectly provide it with a fundamental value metric.

The vast price swings in cryptocurrencies seen in recent years have caught the public imagination, while also causing concern among regulators about the involvement of smaller investors. If a basis

for fundamental value is established, this might help reduce the scale of such swings, as might the effective increase in free float as the concentration of ownership declines, and the development of derivatives that improve price discovery. Note that some commentators have argued that where such instruments allow leverage, using cryptocurrency as collateral, this could worsen the price swings, notably when automated margin calls force widespread liquidation, and especially in the absence of a central authority to control the leverage. Others argue that centralised regulation has often failed to prevent, or even exacerbated, asset price swings, and add that cryptocurrency derivatives can develop rapidly to incorporate automated, self-imposed limits to leverage based on the signals of an overheating market.

A changing role for banks

In imagining a future digital architecture, it is important to consider two radically different scenarios for the banks – noting that both are consistent with bringing the benefits of blockchain to the broader real economy.

Banks do three things that are not really compatible: they provide transactions services, they hold deposits as a store of value, and they also operate as highly leveraged institutions to provide credit. As limited-liability entities, there is no ultimate backstop to protect depositors once loan losses have burnt through their equity capital (and through any debt they have issued that stands below depositors in their capital structure). Moreover, even before loan losses reach this point, they may be sufficient to reduce a bank's holdings of liquid assets below the level needed to meet normal day-to-day transactions flows. Because depositors are aware of these issues, if they sense that a bank is approaching such limits they will withdraw their funds – a 'bank run' – which can precipitate the very crisis that they fear.

This contradiction came starkly into public view during the 2007-9 financial crisis, and in response, regulators tightened their earlier range of rules requiring minimum levels of capital and liquid assets, as well as tightening supervision. While such measures should reduce the likelihood of a financial crisis, they do not eliminate it, because the underlying incompatibility of having highly leveraged institutions providing basic utility services to the financial system has not been removed. Moreover, it could be argued that concern over such risks imparts an inflationary bias to macro-monetary policy, since a modest inflation, with low or negative real interest rates, can help to mitigate the likelihood of bank collapses. Arguably, it is this bias that has driven the policy stance of the last decade, which may be providing one source for the chronic asset price inflation of recent years that is now being followed by inflation in goods and services prices.

Blockchain technology offers the opportunity to remove this problem, by moving the transactions and deposit-taking functions away from banks to a retail CBDC, leaving them a more limited role in credit provision funded only via liabilities that offer attractive interest and/or premium services, and with the resulting gap made up by forms of peer-to-peer lending on cryptocurrency blockchains, where they would be operated by smart contracts but denominated in fiat currency. This would not only remove the contradiction at the heart of banking; it should also cut costs to charge-paying users of banking services, due to the inherent efficiency of blockchains, and be inclusive, since anyone could hold and use CBDC.

However, this is, of course, a very radical vision, and the transition to it would be risky and so would likely need to take place over a number of years, in a carefully controlled way. Were a retail (open to all) CBDC to be introduced overnight, it would tend to attract funds away from bank deposits, because of superior credit quality and lower charges. This might not only starve banks of the funds they needed for lending, creating a deflationary credit implosion, but might also have a risk of causing the bank runs that in the longer term it is designed to eliminate.

To avoid this, a phased introduction of CBDC could start with a wholesale version (open only to banks themselves), followed by an opening up to the general public that initially capped holdings at a very low ceiling, that could be gradually raised over time and eventually eliminated. This would allow banks time to progressively find alternative sources of funding and/or shrink the size of their loan books, while meanwhile giving time for an efficient and effective market in decentralised (peer to peer) lending to develop on cryptocurrency blockchains. During this adjustment, the ways that monetary policy was transmitted would change, in ways that are difficult to predict – one possibility is that movements in longer-dated yields would increase in importance relative to shorter, as the banks lost their current 'captive' deposit bases, forcing them to compete more for funding with bond issuance by end-borrowers on capital markets.

As an alternative scenario, it would be possible to introduce only the first step of this process, the wholesale CBDC. Stopping there, and leaving the current role of banks largely unchanged, would avoid the risks of transition, at the cost of abandoning the potential gains to stability, inclusion and efficiency in the banking area.

For the broader real economy, and for financial markets outside banking, realising the benefits of blockchain technology depends not on whether a CBDC is wholesale or retail, but rather, on how it is allowed to interact with stablecoins and cryptocurrencies.

An Imagined Future Digital Architecture: The Harmonic Triangle

Smart contracts running on cryptocurrency blockchains offer functionality that can power big efficiency gains in the real economy; stablecoins offer the mechanism to allow those contracts to be settled in a unit that is pegged to the familiar fiat currency which that broader real economy uses; but a stablecoin is not the same as fiat currency, since the peg is not perfect. So the missing link, to allow the full power of the smart contracts to be applied, is for the stablecoins to be pegged firmly to the fiat currency – which requires creation of a CBDC designed to facilitate that.

The way this might work is as follows. Let's suppose that in our imagined future digital architecture there are Authorised Stablecoins, privately operated but approved and regulated by the central bank of the country in whose fiat currency they are denominated, that are 100% backed by CBDC in real time. These would operate on a blockchain such as Ethereum and would interact with all of its functionality – so a holder of an Authorised Stablecoin could use it not only to make payments, but also to settle real economy and financial market contracts, buy securities, and all the other features that the Ethereum blockchain can offer. Crucially, at the same time, the Authorised Stablecoins would also interact with the CBDC ledger. This would allow them to act as a bridge between the new world of digital money and decentralised finance on one hand, and CBDC and the old world of banking on the other.

A technology such as an upgraded version of the Baseline Protocol could be used for the link between the Authorised Stablecoins and the CBDC ledger; critically, this technology would allow the central bank to maintain total control over its own ledger. Each Authorised Stablecoin would hold a CBDC balance on the central bank's ledger which would be updated in real time to maintain the 100% backing. To illustrate this: under a wholesale CBDC, when an individual switched funds from their conventional bank deposit into an Authorised Stablecoin, the latter's balance on the central bank ledger would be increased by a transfer from the individual's bank; simultaneously a message would be sent to the Ethereum blockchain causing creation of the same amount of new Authorised Stablecoin in the name of that individual. A transaction the other way round would see Authorised Stablecoin burnt (deleted) on the Ethereum chain while on the central bank ledger,

CBDC was transferred to the individual's bank account. Under a retail CBDC, much the same would apply but without the need for a bank account.

All this sounds quite fussy but the point is to eliminate the risk that the central bank's ledger can ever be compromised. Nothing ever actually moves between it and the outside world of open blockchains. All that comes in from outside are instructions to move CBDC from one holder to another. There is always some risk that these instructions are fraudulent, just as currently fraudsters cause money to be moved between beneficial owners at banks, although the audit trail of events leading up to a fraud will generally be much better in the digital world. But such frauds would not pervert the integrity of central bank money itself.

Over time, as the system grew more familiar to users and more functionality became available on the Ethereum or other blockchains, the scale of Authorised Stablecoins outstanding and of transactions using them would likely come to dwarf activity on the central bank ledger. Why would one want to keep switching from an Authorised Stablecoin, which was 100% backed by CBDC and allowed full access to the digital finance world, and take funds back into an old-fashioned bank which was slower and ultimately offered less functionality? The central bank's ledger might almost drop into the background, rather as the current real time gross settlement systems sit in the background, yet still provide an absolutely crucial anchor to the whole system.

Conclusion: An irony of The Triangle: cryptos play a crucial, central role, but almost all transactions are denominated in fiat

Note that in this imagined future, it's likely that a large majority, perhaps almost all, transactions in the real economy, and most financial transactions, would be denominated in conventional fiat – the currency issued by the central bank. And yet, crypto would be playing a large and crucial role, in the background: decentralised finance and real economy transactions on Ethereum and other smart blockchains, inter-operability between chains facilitated by units such as Polkadot, Bitcoin being used mainly as a longer-term store of value, and Authorised Stablecoins being used for a very large majority of day to day transactions.

In this sense, the Harmonic Triangle would bring out the best of each of its three elements. CBDC would provide the universal acceptance, familiarity and total security that comes from a unit operated by a central bank, while having the potential to be inflationary when needed, and yet for reasons of security offering very limited functionality. Cryptocurrencies would offer the capability for automated financial and real economy transactions on a secure network, and/or provide a deflationary (ie store of value) bias. Stablecoins, properly regulated, would take on much of the role in linking CBDCs to the financial and real economy that bank deposits currently perform for conventional central bank money, but without the risk of bank runs.

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