Blockchain and Cryptocurrency

6 September 2017

Riding the Cryptocoaster

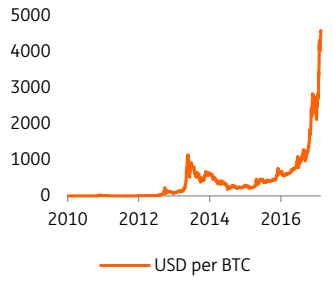
Decoding the black box: can this money be trusted?

Is bitcoin real money? Will it reach FX stability? As investors are scratching their heads, we show why trust is ultimately the key component for its development.

The Distributed Ledger Technology (DLT) will transform the way we pay, clear and settle transactions. Being a combination of peer-to-peer networks, distributed data storage, and cryptography, it is no surprise it is gaining traction in becoming the backbone of the future of finance.

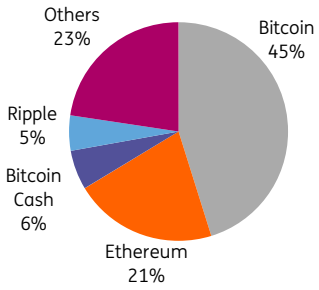
The focus of this note is Digital Currency (DC) and in particular bitcoin (BTC), a peer-to-peer payment system that was created in 2009. It is currently managed by an open source algorithm which looks after its creation and exchange. This is possible thanks to blockchain, a public ledger where all bitcoin transactions are executed and stored. Figure 1 shows that digital currency is only a subset of blockchain which, in turn, is a subset of the broader DLT technology.

Bitcoin's price action



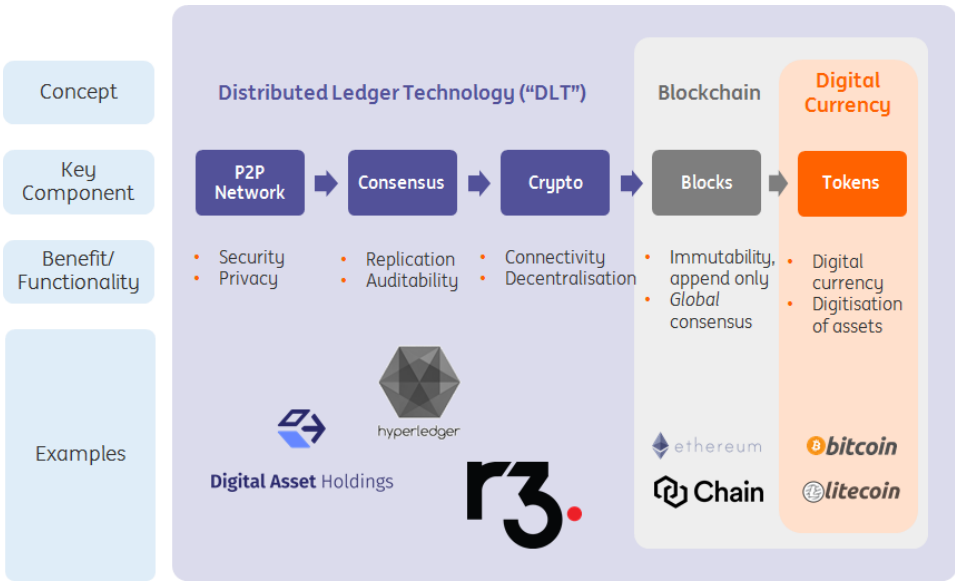
Source: ING, Macrobond

Crypto market share (%)



Source: coinmarketcap.com

Fig 1 A taxonomy of Distributed Ledger Technology (DLT)



Source: ING

DC may become real money in the future, but in the current shape and form there are some missing elements. Money is typically defined by economists as having three features: it functions as a medium of exchange, a unit of account and a store of value. Our view is that bitcoin may tick the first box, but not (yet) the remaining two.

The big elephant in the room is the absence of a central bank. In modern financial systems, the central bank is ultimately responsible to ensure a stable currency. In the case of bitcoin, however, there is no central bank or any other public authority which ultimately conducts monetary policy or bears the risk of a run on the market.

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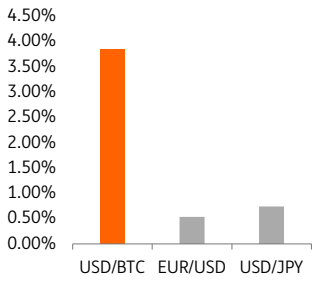
Fig 2 Volatility of USD/BTC, USD/JPY, EUR/USD



Source: ING calculations on data from January 2017 to August 2017

FX stability: is it a mirage?

High volatility may be an issue for risk-averse investors. Between January and August 2017, USD/BTC's volatility has been approximately five to seven times greater than other currency pairs such as USD/JPY and the EUR/USD (see Figure 2). We don't know what's driving this volatility, but one immediate thought strikes us: standard economic analysis suggests prices will go up after an increase in demand (given the same supply) or after a reduction in supply (given the same demand). Equally, higher prices may reflect market inefficiencies.

Fig 3 What does a change in BTC exchange rate tell us about the market?

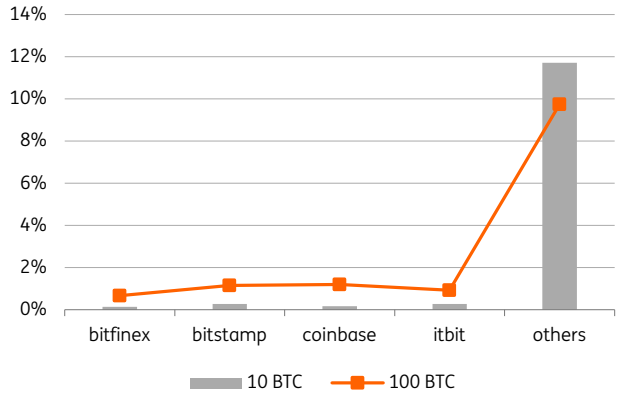
	With market clearing	With no market clearing
Why exchange rate up?	Positive demand shock or Negative supply shock	It signals excess demand over supply
Why exchange rate down?	Negative demand shock or Positive supply shock	It signals excess supply over demand

Source: ING

Liquidity plays an important function for FX stability. A run on BTC may force latecomers to sell BTC at a fire sale price. This would feed into expectations of a BTC crunch, with valuations spiralling down to the bottom. With no central bank ready to unleash a "crypto purchases programme", there would be no cushion to such a fallout. One way to measure liquidity is to look at the bid ask spread, which is the difference between the ask price and the bid price of a security, sometimes divided by the average price (in which case it becomes a percentage rather than a difference).

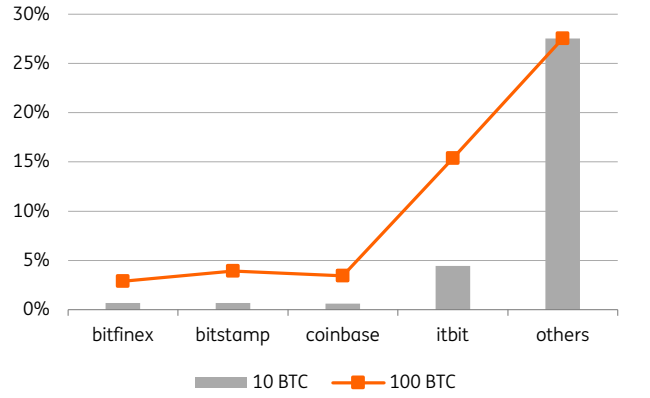
Bid-ask spreads on BTC exchanges remain remarkably high, suggesting far-from-ideal liquidity conditions. According to data from bitcoinity.org, a transaction of ten bitcoins over the past year generated a median bid-ask spread of between 0.14% and 0.28% with the most liquid bitcoin exchanges. But if we look at the most illiquid exchanges, we see median values of around 10% and, under severe market stress, peaks of 27%[1].

Fig 4 Median bid-ask spreads (%)



Data from August 2016 to August 2017
Source: ING, bitcoinity.org

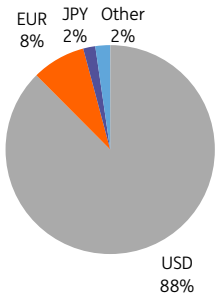
Fig 5 Max bid-ask spreads (%)



Data from August 2016 to August 2017
Source: ING, bitcoinity.org

[1] Word of caution: we cannot guarantee the reliability of the data used by bitcoinity.org

Fig 6 FX global turnover 2016 (%)



Source: ING, BIS

Even the most liquid bitcoin exchanges produced a 2% to 3% bid-ask spread for a transaction of 100 bitcoins. As a comparison, the bid-ask spread for the Singapore dollar peaked 0.39% during the Asian FX crisis of 1997 (IMF). The FX market is one of the most liquid in the world and FX global turnover is still dominated by the US dollar. Will a cryptocurrency ever top that rank in the future?

The limitations of bitcoin don't need to hold for any other digital currency. Competitors such as Ethereum or Ripple are on the rise and may ultimately overcome bitcoin's undisputed supremacy. For this reason, we summarise a complete taxonomy of virtual currencies in Figure 6. The current missing ingredients include lower FX volatility and, most importantly, price stability.

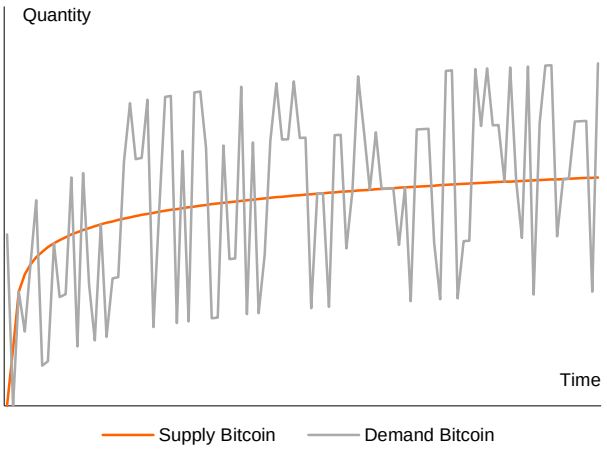
Fig 7 Decoding the crypto-taxonomy

	Bitcoin	Virtual currency
Medium of exchange	Partly satisfied, increasingly accepted	Could be satisfied in principle
Unit of account	Not satisfied, FX volatility too high	Requires price stability
Store of value	Partly satisfied, seen as "investible" despite high volatility	Works best under price stability

Source: ING

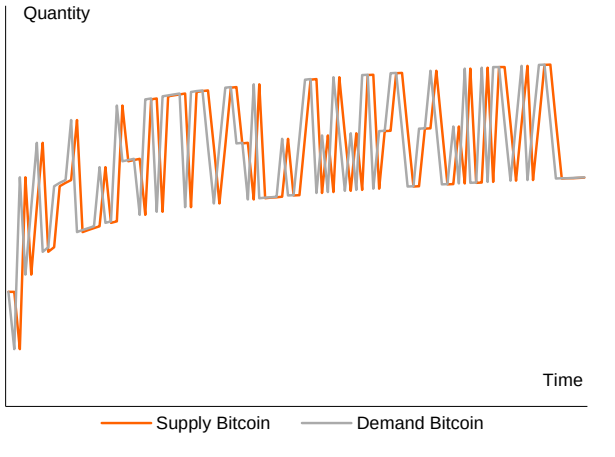
One way to achieve price stability may be to switch from an exogenous to an endogenous algorithm. In this case, the algorithm could be calibrated to offset very large positive or negative excess demand over supply. This is possible only if the algorithm is able to detect demand conditions in real time. If demand is higher, the algorithm should be able to mine more coins. Conversely, if demand is lower, things get more complicated. There is a difference between the aggregate supply which is mined and the one that is traded in the market, which includes pre-existing supply. In theory, the algorithm should only need to manage traded supply to stabilise prices but it is very difficult to imagine an algorithm selling reserve currencies in exchange for bitcoins or to operate on secondary markets. For that, you really need a centralised institution like a central bank with the specific mandate to support the coin. Alternatively, the algorithm would need to manage total supply by "resetting" all coins in circulation, with proportional haircuts for all coin holders. For instance, if the algorithm decides that aggregate supply needs to be reduced by 10%, then an investor holding 100 coins at time 1 will hold 90 coins at time 2. In other words, the algorithm achieves FX stability by sacrificing volume stability. From a coin holder's perspective, it is not clear which method is preferable.

Fig 8 Switching from an exogenous...



Source: ING

Fig 9 ...to an endogenous algorithm?



Source: ING

Trust: the central theme of cryptocurrency

One of the touted revolutionary aspects of cryptocurrency is that it has solved the trust problem. In existing payment and trading systems, participants put their trust in the authorities that manage the transaction database. The authorities should make sure that no dispute arises around transactions, and if it does, it is handled correctly.

The bitcoin blockchain was designed to not need authorities to keep track of transactions. That means that transaction recording is done by the members of the network. This raises two issues:

1. **How to incentivise participants to process (verify) transactions?** This is accomplished by rewarding them, for example with a "mining fee" of newly minted coins or by levying transactions fees.
2. **How can each node (member of the network) trust the verification work done by other participants?** Remember, the network is an environment in which nodes do not know one another and hence have to assume the worst about other node's intentions. The trick here is to make it sufficiently costly for participants to verify transactions. Theoretically, there are various ways to accomplish this: a "proof of work" (PoW) approach versus a "proof of stake" (PoS) approach.
    a. PoW is the original approach introduced by bitcoin. "Mining" new transaction blocks (that is, verifying transactions contained in it) has been made very computationally intensive. As it stands, maintaining the bitcoin ledger consumes as much electricity as the whole of Cuba or Lebanon.[2]
    b. This is very environmentally unfriendly; moreover, it may run into scalability problems. Which is why PoS approaches are being considered as an alternative. Participants put their stake (eg, funds) in escrow when verifying transactions. While this approach is still being fleshed out, it does appear that stakes required for PoS are extremely high. This risks creating a form of plutocracy over the network.

The blockchain community is still working on "the trust problem", and we are likely to see further developments on this front in the future. Meanwhile, it is worth spending some more time on trust. Human beings are social creatures, and trust has always been a vital component of human society. The trust mechanisms employed in a cryptocurrency blockchain are new implementations of familiar forms of trust. Essentially, both PoW and PoS approaches are forms of collateral put up by miners, which can be seized or forfeited when they turn out to be untrustworthy. The problem with both PoW and PoS is, however, that there is a positive relationship between the ability to put up collateral and the degree of trust that can be earned. This creates a tendency towards concentration of trust on the blockchain, and makes it difficult for newcomers with limited resources to establish themselves. The formation of a small number of mining groups on the bitcoin blockchain illustrates this point.

To be fair, this problem is not unique to blockchain. It is, however, particularly relevant for blockchain, because this tendency towards concentration goes against the original cryptocurrency philosophy of a ledger that is fully decentralised. We expect such concentration to occur on any PoW- or PoS-based permission-less blockchain over time. This effect is further reinforced by the fact that computer enthusiasts willing to spend a lot of time on maintaining and scrutinising the blockchain form only a small

[2] Source: https://digiconomist.net/bitcoin-energy-consumption. Country ranking varies daily based on actual BTC energy consumption. Our reading taken on 4 September 2017.

subset of the population. While these enthusiasts dominate the “bleeding edge” of cryptocurrency developments, when the currency scales up and goes mainstream, it will have to draw in people that are less engaged with maintaining the infrastructure. Most people just want to pay or transact, without having to worry about the integrity of the system. It is therefore a major challenge for the cryptocurrency community to design a system of trust that avoids excessive concentration of power over the network.

Conclusion

The recent rise of the cryptocurrency market has gained some traction (and raised some eyebrows) across the investment community. DLT technology, in particular blockchain, has the potential to become part of the future infrastructure of finance and beyond. We see a promising future for blockchain. Cryptocurrency is a particular application of blockchain which could radically change the setup of the monetary system. However, we should issue a word of caution as cryptocurrency has some hurdles to clear before it can rise beyond the niche product it currently essentially is. Firstly, the absence of a central bank makes it difficult to deal with unforeseen crises. Secondly, liquidity conditions remain largely untested but, most importantly, more work needs to be done on trust and concentration. With so many uncertainties, cryptocurrency for now remains inherently volatile and hence unsuited for mass adoption, in our view.

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