Cryptocurrency Bitcoin: Disruption, challenges and opportunities

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ABSTRACT

Cryptocurrencies such as Bitcoin are a hot topic in the financial industry. Looking specifically at the purpose of cryptocurrencies for making payments, this paper aims to illustrate (1) the key challenges that cryptocurrencies must overcome to achieve widespread customer adoption, (2) the major risks regarding cryptocurrencies, when and how cryptocurrencies and their service providers will be regulated, (3) in their current state, what are the killer apps for cryptocurrencies, and (4) the more fundamental issues cryptocurrencies must address. In conclusion, while Bitcoin may not replace traditional and new payment methods to become a dominant alternative in the short term, banks should look at its underlying technology as a potential generic new way to transfer ownership of value in the longer term.

Keywords: Bitcoin, cryptocurrencies, alternative payment methods, payments

FOUR KEY QUESTIONS

Cryptocurrencies such as Bitcoin are a hot topic in the financial industry. Every day, new Bitcoin start-ups are announced in the press, and an increasing number of businesses are reported to accept it as a means of payment. Bitcoin prices are reported on Bloomberg and Thomson Reuters. The btc.com domain name recently sold for US$1.1m.

Payments industry players are closely watching these developments, because cryptocurrencies have the potential to dis-

rupt and transform the existing global financial infrastructure.

Invented as 'a peer-to-peer version of electronic cash [that] allows online payments to be sent directly from one party to another without going through a financial institution',[1] Bitcoin is considered by its supporters to be a faster, cheaper and more convenient alternative to other payment mechanisms such as sending payments via banks, transferring money via money transfer operators or buying goods and services over the internet, using a credit card.

More critical commentators believe that cryptocurrencies such as Bitcoin are over-hyped, that their potential is based on pure speculation, and that it is an insufficiently regulated payment channel, which is used for gambling or illegal purposes such as buying drugs or money laundering.

Amid these opposing views, one thing is certain: technology is evolving fast. What is a limitation today can be solved in the next release tomorrow. Bitcoin itself may actually not be the most advanced cryptosystem out there anymore, with faster and more generic challengers emerging.

Many more start-ups, applications and innovations are likely to emerge in the digital payments space. Together with an active developer community, cryptocurrency firms continue to attract venture capital investments. The all-time investment across 66 companies amounts to US$317m.[2]

One should therefore look beyond today's state and uses of Bitcoin, recalling the internet in the early 1990s, when it was a set of user-unfriendly hypertext pages pointing to a few newsgroups.

So, what is the bigger picture for cryptocurrencies? Could 'block chain technology', by providing a generic value-transfer capability, lead to innovative new services that transfer ownership of contracts or even physical property such as houses? Could it be used to settle payments in a way not seen before and, for instance, replace correspondent banking altogether?

Such opposing views, fast-paced technology and future uncertainty make cryptocurrencies the perfect topic for exchanging points of view and for critical dialogue.

This paper addresses the following four key questions from a payments perspective:

(i) What are the key challenges that cryptocurrencies must overcome to achieve widespread customer adoption?
(ii) What are the major risks regarding cryptocurrencies, when and how will cryptocurrencies and their service providers be regulated?
(iii) In their current state, what are the killer apps for cryptocurrencies?
(iv) What are some of the more fundamental, longer-term issues cryptocurrencies must solve?

First, the scene is set with a brief introduction to Bitcoin itself.

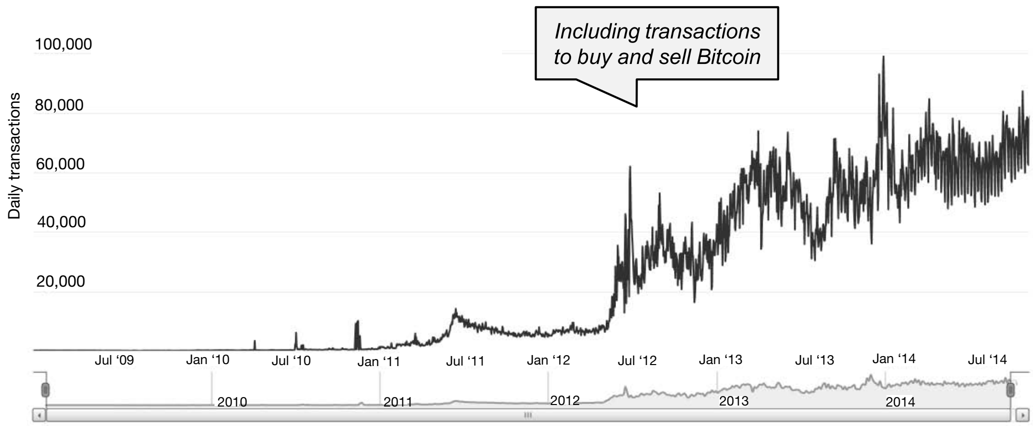
A BRIEF INTRODUCTION TO BITCOIN

Bitcoins are a digital representation of value not issued by a central bank, but accepted by businesses and persons as a means of payment that can be traded, stored and sent electronically.[3]

They can be bought at an exchange such as bitstamp or Bitcoin ATM and loaded to an electronic mobile, desktop or web-based wallet such as Coinbase. Companies such as BitPay provide payment gateways for merchants to accept Bitcoin for online purchases.

Transactions are signed by a private key and sent over the internet to another person or company using their public key,

Figure 1 Number of unique Bitcoin transactions per day



Source: Coindesk

along with the sender's public key. Ownership and transfer thereof is verified by a distributed network of computers, and recorded in a block chain acting as a history log.[4]

Bitcoin has been live since 2009, but not much happened at first. The Bitcoin price was low (US$5–10) and transactions were below 10,000/day until mid-2012 (see Figure 1). In 2013, there were several hacks and exchange crashes, but the number of transactions increased to 50,000/day, and its price shot up to over US$1,000 in late 2013, as the popular Chinese search engine Baidu said they would accept Bitcoin, and there was a positive tone towards Bitcoin at US congress hearings. In December 2013, the People's Bank of China prohibited Chinese financial institutions from using Bitcoins, after which its value dropped (Baidu no longer accepts Bitcoins for certain services).

At the end of September 2014, its price was US$383, following the collapse of Mt. Gox, one of its major exchanges in February 2014, and a number of announcements about considering Bitcoin as a taxable asset, and regulating Bitcoin exchanges and transfer service providers as money transfer businesses to subject them to anti-money laundering and counter-terrorist financing requirements (see Figure 2).

Meanwhile, digital currency activity across the world is increasing, with more schemes, service providers, merchants and individuals using it:[5]

- 483 cryptocurrencies exist, Bitcoin accounting for 92 per cent of total crypto market capitalisation;
- 76,000 businesses accept it, from local pubs and flower shops to Dell and airBaltic;
- 6.5 million 'wallets', a steep rise from 1.3 million in September 2013.

But to keep things in perspective, many wallets may have little in them, as more than 70 per cent of Bitcoins are owned by just over 10,000 individuals,[6] there were 5,292 venues with a physical presence accepting Bitcoin on 28th August, 2014,[7] 184,000 unique addresses were used per day in September 2014, and global Bitcoin transactions never exceeded 100,000/day (including to buy/sell Bitcoin).[8]

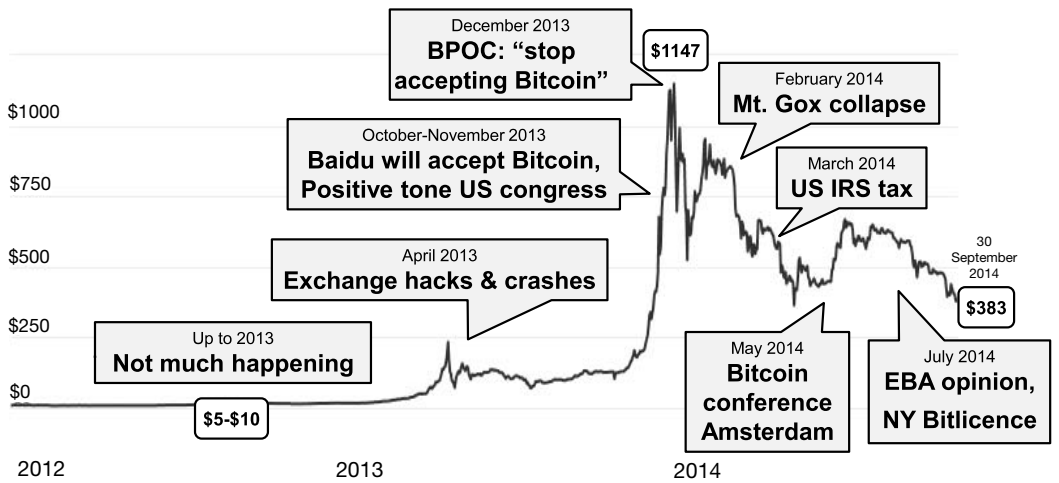


Figure 2 Bitcoin price

Source: SWIFT, Bitcoin price index by Coindesk

CHALLENGES AHEAD

Typically, after the initial technology trigger and peak of (inflated) expectations by enthusiasts and visionaries, pragmatists will now need to deliver real applications based on cryptocurrencies and turn those into a profitable business. That may not be easy.

As a first question, what key challenges need to be addressed before cryptocurrencies can achieve widespread consumer adoption? Here are five specific issues for the Bitcoin ecosystem to address.[9]

(i) *Trust in service providers.* Consumers must feel safe in the knowledge that their Bitcoins will not get stolen from their wallets or lost if their exchange disappears. Several Bitcoin exchanges (eg Mt. Gox, BitInstant, flexcoin) have been subject to security breaches in which Bitcoins were stolen and the exchange collapsed, resulting in losses for individuals. This has nothing to do with the ingenuity of the Bitcoin protocol. This is a service issue: there are some 'bad actors' in the Bitcoin ecosystem — as in the 'real' world. Online banking applications can be subject to cyber-attacks, and credit card details get stolen. Some consumers express lack of trust in a mobile login and authentication options from banks and worry about identity theft. In general, however, people trust banks with their money, and bank account deposit guarantee schemes exist in many countries. This is not the case yet with Bitcoin service providers in general.

(ii) *Price stability.* Wide fluctuations in the value of currencies can have a negative impact on customers. The same is true of cryptocurrencies. Currently, the price of Bitcoin varies significantly. In 2014, Bitcoin reached a high of nearly US$1000 in January, whereas in September its price was under US$400. This is why many businesses currently accepting Bitcoin immediately convert back to fiat currency or their payments processor accepts customer payments in Bitcoin, but pays the merchant in fiat currency (guaranteeing the price advertised, minus fees). This also explains why Bitcoin is currently not appropriate for international remittances, for example, as people at both ends of any given trans-

action depend on the value transferred.

(iii) *Technology performance*. The technology that underpins cryptocurrencies must be 'fit for purpose' if it is to handle millions of payment transactions. While artificially established and probably not a long-term sticking point, Bitcoin's current performance of seven transactions per second is nowhere near the performance of existing alternatives (such as credit card authorisation networks handling 10,000s of transactions per second). Nor are Bitcoin service providers at large comparable in terms of reliability, availability or customer support provided by the companies that manage traditional payment systems. Bitcoin's broadcast, distributed verification and central record approach — while an interesting concept for building consensus — is very resource intensive and may be less efficient, and less confidential, than point-to-point transfers.

(iv) *Clear regulation*. While a cryptocurrency itself cannot be regulated, its service providers are obliged to comply with applicable regulation in order for consumers to be adequately protected and to have confidence in those services. The potential use of cryptocurrencies by criminals and the risks posed to consumers is a primary concern of regulators. Today's regulatory frameworks related to cryptocurrencies are, however, very divergent and evolving fast.

(v) *Compelling benefits*. Bitcoin must live up to its promise of being faster, cheaper or more convenient, if consumers are to give up old habits and switch to new alternatives. Bitcoin may or may not be faster for making payments than current alternatives, depending on the situation. While it may be cheaper in some cases, it is not 'free', and the conversion from regular currency into and out of a cryptocurrency is not more convenient than using regular currency in cash, debit card or as e-money. User experience and expectation can be variable, depending on the context.

RISK AND REGULATION

A second key question is when and how cryptocurrencies service providers will be regulated. Whereas some of the original proponents of Bitcoin expressed 'libertarian' views and were principally against the intervention of any central authority, many cryptocurrency service providers and interest groups are now seeking to understand the regulatory environment better and to lobby and advocate for what they believe are appropriate forms of regulation.

Several Bitcoin service providers have hired Chief Compliance Officers, and sought to professionalise their services further in the knowledge that consumer confidence and risk management are vital if they wish to achieve broad adoption and commercial success.

At the same time, the understanding of risks around cryptocurrencies is evolving and increasingly documented. The European Central Bank,[10] Reserve Bank of India,[11] the Consumer Financial Protection Bureau in the US[12] and other regulators warned users of virtual currencies against risks. The European Banking Authority identified over 70 such risks. For example:[13]

- A user loses virtual currency units through theft or hacking, or suffers loss when an exchange is fraudulent.
- A wallet provider loses e-wallets provided for individuals.
- Criminals are able to launder proceeds of crime because they can

deposit/transfer virtual currencies anonymously, globally, rapidly and irrevocably, or criminals/terrorists use the virtual currency remittance systems and accounts for financing purposes.
- Payment service providers that offer virtual currency payment services suffer loss of reputation when virtual currency payments fail, because they gave the impression that virtual currencies were regulated.
- If regulators decide to regulate virtual currencies more leniently than fiat currencies, an unequal playing field may emerge in the market for payment services, or if regulation is excessive, new entrants could potentially be placed at a competitive disadvantage.

While Bitcoin does not have legal tender status in any country, several countries permit Bitcoin, yet others are more cautious, and some are overtly hostile (see Figure 3).

While cryptocurrencies are not directly regulated, since they are not under the control of a specific government, regulations may nevertheless apply, eg to cryptocurrency exchanges and service providers. In the US and Canada, as in several other countries, Bitcoin service providers are considered as money services businesses and required to obtain a licence,[14] which triggers the enforcement of numerous obligations, including bank-level customer registration, record keeping, sanctions screening and anti-money laundering facilities. The European Banking Authority recommends that national supervisory authorities discourage credit institutions, payment institutions and e-money institutions from buying, holding or selling virtual currencies and recommends that European Union (EU) legislators consider declaring market participants at the direct interface between conventional and virtual currencies, such as virtual currency exchanges, to become 'obliged entities' under the EU Anti-Money Laundering Directive, and thus subject to its anti-money laundering and counter terrorist financing requirements.[15]

Whereas many countries avoided outright restrictions, some may ban the use of cryptocurrencies. In Russia, the Finance Ministry may ban digital currencies because of their potential for illegal use in money laundering and in the underground economy.[16] The central bank of Bangladesh issued a statement suggesting that the use of digital currency is now illegal, making their use a 'punishable offence'.[17]

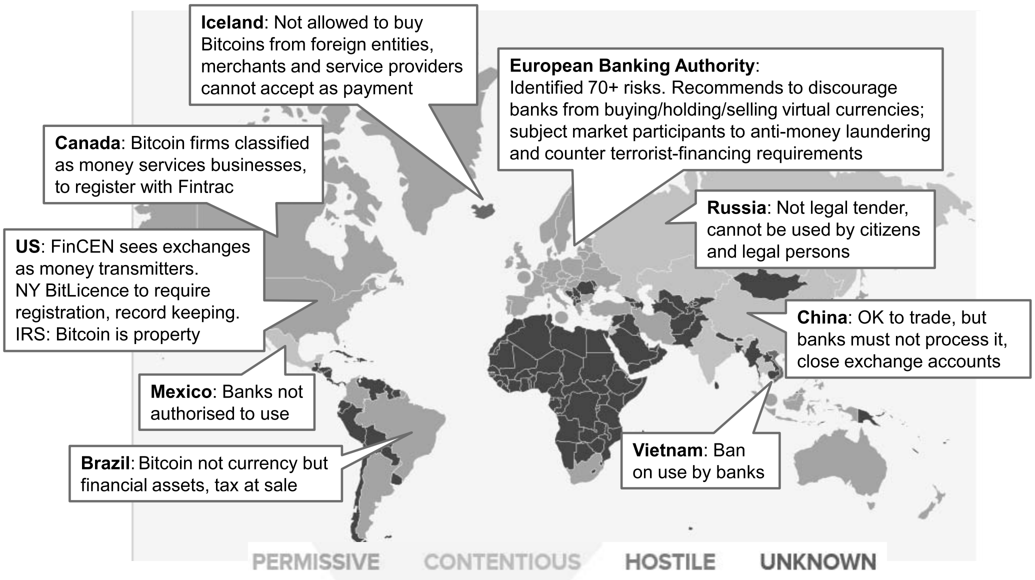
In China, banks have been ordered not to service Bitcoin-related business and close their accounts. Even in countries where it is permitted, banks may be wary of servicing Bitcoin service providers when not clearly knowing who those providers are servicing in turn behind their operation.

While the regulatory measures may provide increased assurance and safety, they will drive up costs for Bitcoin service providers over time.

Furthermore, the technology underlying most cryptocurrencies may pose specific regulatory challenges. For example, the screening of sanctions using public keys would be a real challenge. Public keys do not figure on any sanctions list, are pseudo-anonymous and difficult to link to a particular individual.[18] And individuals can create as many public key addresses as they like.

In contrast, the block chain, which serves as a public record of all transactions, provides a great tool for regulatory (and competitive) scrutiny. If a public key can be linked to a business or individual, it is possible to gain visibility on who is sending what to whom, as well as to examine the block chain retrospectively in order to determine how much money is contained

Figure 3 Divergent and emerging Bitcoin regulation



Source: SWIFT, underlying chart by BitLegal

in a given Bitcoin wallet.[19] Then again, new developments such as hierarchically deterministic wallets are moving away from greater transparency, by creating a key per transaction to make them more anonymous.

TODAY'S KILLER APP?

Innovators and visionaries are likely to look beyond the current practical and regulatory challenges and point out the longer-term disruptive potential of cryptocurrencies.

That is fine, but one must look at where cryptocurrencies could make a difference today. To tackle the third question: What are today's killer apps for Bitcoin, in its current state of technology?

There will certainly be Bitcoin applications, and there will be customers making payments in Bitcoins. But the question is: Can cryptocurrencies become a dominant payment alternative? Rather than convergence, there is actually more fragmentation and more competing payment methods.

Below, the payment alternatives, including cryptocurrencies, are reviewed across five use cases.

(i) *Micropayments*. Very small payments, such as paying to view a web page or read an article online, are a challenge for conventional payment methods, in terms of cost efficiency and speed. This is also the case for Bitcoin. Although evolving, Bitcoin transactions below 0.00005460 BTC (roughly US$0.03) used to be considered as 'dust' and not usually processed by the Bitcoin network. Some Bitcoin transaction processors accept very small Bitcoin payments 'off the block chain', aggregate them into a bigger transaction that is sent as Bitcoin transaction, and pay the merchant (in fiat currency). So the processor takes some risk, and one can hardly call this 'using Bitcoins to pay for micro digital content'. If mil-

lions of information pieces of, say, 30 dollar cents were transacted, Bitcoin's performance of 7 payments per second would have to be revisited. Even then, is Bitcoin's architecture, where every transaction is broadcast and stored on the block chain for ever, most suited as low-cost solution to micropayments?

(ii) *Online purchases*. Today, mainly credit cards, online bank account schemes such as iDEAL in The Netherlands, third-party online payment solutions such as Alipay in China, and electronic wallets such as PayPal, are used to buy goods and services from a website. Bitcoin merchant processors promise lower fees today, but their costs may go up with larger volumes and performance (while card fees could come down). Bitcoin payments are immediate vs the facility of credit one is used to. Anything that needs to be shipped could wait to see it confirm, but that would require checking back later. And who will want to wait even a few minutes before receiving a PDF or passbook code with tonight's cinema tickets (and not all merchants or processors may be willing the risk of non-verification)? Current payments methods, in contrast, confirm immediately within the online buying experience.

(iii) *Payments at point of sale*. Many alternatives exist, from cash to debit/credit cards, mobile payments, to electronic wallets and NFC devices. Apple recently joined the crowded market space with its launch of Apple Pay. But Google did not launch its wallet in Australia, saying that the 'innovation ecosystem in banking here is actually incredibly robust' and so efforts are better concentrated in other areas.[20] So what is the compelling advantage for using Bitcoin over and above these alternatives?

(iv) *Domestic money transfers*. Many alternatives to Bitcoin exist in this space. For example, Paym — a mobile payments system running on top of the UK's Faster Payments Service — registered over a million users in its first 100 days,[21] is free, real time, directly linked to a bank account, without the need for currency conversion. In several countries, the domestic payments clearing system is already real time, with more countries considering renewing their infrastructure. The global banking community is 'awash with national fast(er) payment initiatives'.[22] The ease of on-/off-boarding cryptocurrencies is crucial and is a key factor that needs to be addressed. One of the reasons the mobile payments system mPesa was so successful in Kenya was its large network of cash-in/cash-out agencies. The GSMA has identified 245 live and 113 planned mobile money services.[23] How is Bitcoin a better alternative?

(v) *International money transfers*. Again, many alternatives exist. Agency models provided by money transfer operators typically charge 7–8 per cent, but provide a large cash-in/cash-out network in local currency. More recent online money transfer services vary in price from 0.5 to 7 per cent, but the payment transfer between accounts is very quick and easy to use. Is it much cheaper to purchase Bitcoin using conventional currency and then use a Bitcoin remittance provider to send the money in local currency? International payments via banks for small amounts are typically more expensive (8–12 per cent) and slower (by several days), but provide the convenience of account-based transfers, offered by trusted service providers. Finally, while cryptocurrency providers operate at a lower cost base

today, that is likely to change as more regulation (in particular sanctions screening and anti-money laundering) applies.

It is perhaps ironic that what started out as a peer-to-peer concept now has a huge cryptocurrency ecosystem involving a multitude of intermediaries — exchanges, wallet providers, remittance providers, merchant payment processors — all charging a fee for their services. In fact, this may not be so innovative after all. What may emerge is a set of new players competing for a (niche) market in which it is becoming increasingly expensive to operate. Rather than looking to replace incumbents, some newer cryptocurrency players say they want to play 'within the industry' and position their service as a 'global switch' for payments between banks, signing up market makers on their network.

Even using Bitcoin peer-to-peer, the protocol takes a fee to give to the miner that successfully verified one's transaction. It is a small amount today, since miners are incentivised by receiving Bitcoin, but that reward diminishes over time, and they may seek to recoup their increasing costs via higher transaction fees.[24] There is 'without fee', but then it relies on the generosity of a miner to pick up the transaction.

MORE FUNDAMENTAL ISSUES

While Bitcoin, traditional and new payments methods battle it out for adoption and consumer preference, the fourth question is: What are the more fundamental, longer-term issues that Bitcoin and cryptocurrencies need to solve? Here are three key issues to address:

(i) *Encryption*. Bitcoin transactions are signed, but not encrypted. They are sent over the Bitcoin network and stored on the block chain 'in the clear'. Bitcoin transactions are not anonymous, but pseudonymous; the sender's and the receiver's public keys are recorded in the transaction. So, all Bitcoin transactions are completely transparent. Someone can link these public keys to people's identities, to see how many bitcoins there are in each wallet, what their income is if the same wallet was used to receive their salary, or how much money Bank A sent to Bank B. Flow-control tools can be devised to track Bitcoin transactions back into the past and forward into the future as they happen.[25] Researchers from the University of California and George Mason University did exactly that and made the Bitcoin flows globally visible.[26] This lack of privacy will have to be addressed when it comes to transacting payments or transferring value, by providing communication, storage and even end-to-end encryption.

(ii) *Identity*. Public keys are used to identify 'owners/senders' and 'receivers' in the Bitcoin network, and are at the heart of cryptocurrencies technologies. But how can one be sure who is behind a public key, what 'authority' issued that public key? Does the public key represent a company at the entity level, its treasurer with a certain sign-off authority, or a payments application within that organisation? Shall one send payments to one public key representing 'Bank ABC' or will they have multiple keys and identifiers? Rather than central authorities (or wallets) issuing or assigning public keys, there are some ideas in the cryptocurrency ecosystem to (re)use identities captured in online reputation systems and social networks — like a LinkedIn or Facebook profile. But even in the banking space, banks do

not rely on customers' identification of each other — if one has accounts at multiple banks, one needs to register with each bank. There are some domestic collaborative identification initiatives such as BankID[27] in Sweden, but this does not exist on an international level.

(iii) *Transaction standards*. The Bitcoin block chain is governed by a simple scripting language, limited in scope by design, and that works for simple payment instructions. But to convey rich corporate remittance information, provide additional processing instructions within the instruction, or process payments in a fully automated fashion, more and well-structured fields and code words are required. Structuring transactions will be a crucial element to convey smart contracts. One already sees the emergence of 'metacoins' that ride on top of the block chain or new alternative instances of the protocol for the transaction of non-currency digital goods and digital claims of non-digital rights and assets. The coders of these protocols are already looking at ISO 20022 as the basis to structure those transactions — why reinvent the wheel?

IN CONCLUSION

Bitcoin and cryptocurrencies in general are a hot topic in the financial industry. They are reported to have the potential to replace traditional and new payment methods. But to achieve that and become a dominant alternative, they must provide distinctive incremental value and overcome a number of critical challenges, such as regulatory uncertainty. That is unlikely to happen in the short term, as illustrated by the relatively low and flat number of Bitcoin transactions. But banks should look at the technology underlying these cryptocurrencies as a potential generic new way to transfer ownership of value in the longer term.

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