

Economic Commentaries

Are Bitcoin and other crypto-assets money?

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The phenomenon of crypto-assets has recently received considerable attention. There is as yet no established definition of crypto-assets and they are often called crypto-currencies. One can describe crypto-assets as digital units that are created and transferred between the users through the use of cryptography.² The first, still largest and one of the most well-known crypto-assets is Bitcoin. Bitcoin was created at the beginning of 2009 by an unknown person or group hiding behind the pseudonym of Satoshi Nakamoto. The motive was said to be dissatisfaction with the prevailing financial system, following the financial crisis 2007-2008.³ Technically, the concept was based on earlier innovations that were already known to computer scientists and cryptographers.⁴ Once Bitcoin had been introduced, new crypto-assets were created according to similar principles, for instance, Ethereum and Litecoin. Over the past year, the number of crypto-assets has increased rapidly and now amounts to more than 1,500.⁵

The considerable media interest has raised the question of what crypto-assets actually are, and also whether they need to be regulated, and if so, how.⁶ As mentioned above, crypto-assets are sometimes called crypto-currencies, which implies similarities with established currencies issued by central banks. This in turn leads to the question of whether crypto-assets should be regarded as money.

This Economic Commentary focuses on the question of how crypto-assets differ from money issued by central banks. At present, there is very little written about this subject, and this Economic Commentary should be regarded as an early attempt to describe the phenomenon and developments so far. The first section discusses the historical background of money and different theories of what money actually is. This is followed by a description of what crypto-assets are, how they work and their recent development, as well as what risks they can entail for financial stability and private individuals. Finally, there is a discussion of whether crypto-assets can be classified as money and how they differ from money issued and managed by central banks. As the Riksbank is investigating the possibility of issuing a new digital currency, the e-krona, there is also a discussion of how a potential e-krona could differ from a crypto-asset.

There are several different views of what money is

To answer the question of whether crypto-assets can be regarded as money, it is first necessary to discuss what money is. This question has been with us through history and

This Economic Commentary discusses what crypto-assets are and whether they can be classified as money. Although there are differing views on this, the conclusion is that crypto-assets cannot be classified as money. The main reasons for this are that these assets have no official issuer, and that they, at present, lack the ability to provide effective means of payment. Crypto-assets, for instance, have difficulties in maintaining a stable value. However, the risk of crypto-assets affecting financial stability is regarded as small, although there are major risks for individuals who own them.

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² Cryptography is the study of methods used to transfer information between a sender and a recipient without a third party being able to see it. This means that the information is encrypted. Only those who have the right to see the information have the key that enables them to understand it.

³ Davis (2011).

⁴ Lansky (2018).

⁵ See Coinmarketcap: <https://coinmarketcap.com/all/views/all/>

⁶ See, for example, Partington (2018).

is closely linked to the question of how to establish a functioning monetary system. These questions have become particularly important when various technical innovations have been introduced. It is therefore important to point out that the current discussion on crypto-assets and money is part of a long historical interaction between technology and society. Early printing technology made it possible, for example, for the Chinese to introduce paper money, in addition to metal coins, as early as 900 AD.⁷ However, technology also had its drawbacks. The possibility to print banknotes was abused on several occasions during China's history, which led to periods of severe inflation. In Europe, too, the possibility to print banknotes meant there were problems attaining a good balance between the needs of the economy and the volume of banknotes. For instance, the Riksbank was established in 1668 to replace an earlier bank, Stockholms Banco, which had been created in 1657 and was then liquidated after issuing too many banknotes.⁸ At the same time, experiences during the protracted and severe depression of the 1930s shows that inflation is not the only problem: if too little money is created, the economy risks entering periods with enduring unemployment and poor growth.⁹

Theories of money and how to create a functioning monetary system can therefore be understood on the basis of concrete problems that society has attempted to resolve throughout history. One usually talks about three main definitions that are all linked to how money should be constituted to function in practice as a means of payment.¹⁰

According to the first theory of money, money must be tied to an underlying good that has an independent market value. As it has often been a question of tying money to previous metals, this theory is called *metallism*.¹¹ The peak for metallism was the so-called gold standard. The value of money was then tied to a certain amount of gold. Sweden followed the gold standard from 1873 to 1914 in a currency union together with Norway and Denmark.¹² Today there is no formal link between precious metals and the established world currencies. However, crypto-assets are partially inspired by metallism.¹³ The idea behind metallism is that the availability of precious metals, and the cost of quarrying more metal, should set an automatic limit as to how much money can be created. With crypto-assets, the idea is instead that there are digital limits as to how much of these assets can be created. The link to metallism can also be seen in the terminology used with regard to crypto-assets, where so-called miners are named after those who quarry precious metals (read more about them in the next section). Perhaps one can therefore call the theory behind crypto-assets "digital metallism".¹⁴

According to another theory of money, known as *chartalism*, money is ultimately a legal creation, which can only be created by a state.¹⁵ This makes it irrelevant what money is made of – precious metal, paper or electronic ones and zeros; what gives them legal validity is that a state has expressly legislated on their existence. Indirectly, chartalism therefore also places the responsibility for a functioning monetary system with the state.

However, the most conventional definition of money used today was proposed by the British economist Stanley Jevons in 1875.¹⁶ This definition is based on money needing to fulfil certain functions to be counted as money. One could therefore call it *functionalism*. According to this theory, money shall fulfil three basic functions: be a means of payment, a

⁷ See von Glahn (1996).

⁸ Wetterberg (2009), p. 40.

⁹ This is the opposite of inflation, deflation. See, for example, Bernanke and James (1991).

¹⁰ Camera (2017).

¹¹ Goodhart (1998).

¹² Jonung (1984). After the First World War an attempt was made to reintroduce the gold standard, which however was abandoned in 1931.

¹³ Sanderson (2015).

¹⁴ Maurer et al. (2013), p. 2.

¹⁵ Chartalism was first described by the German economist Georg Friedrich von Knapp in 1905.

¹⁶ Jevons, (1875).

unit of account and a store of value.¹⁷ Means of payments means that a buyer pays a seller money instead of the two finding a good or service to trade. A unit of account means that money should be a common measure of value for the different goods and services in an economy. And store of value means that the value of money should not change appreciably. A person's decision to use his or her money should thus not be influenced by a change in its value.¹⁸

These three theories of money are summarised in Table 1.

Table 1. Different theories of money

Definition	Conditions
Metallism	Consists of or is tied to a good with a market value
Chartalism	Legal creation issued by national state
Functionalism	Must function as: 1) Means of payment 2) Unit of account 3) Store of value

Functionalism is particularly important for central banks as it provides guidelines as to how a monetary system shall be managed in the long run to function smoothly. The central banks have developed over the years and gradually taken on the role they have today – of maintaining a smoothly functioning monetary and payment system.¹⁹ One could say that the central banks, including the Riksbank, have been tasked by society to ensure that the three conditions of functionalism for money are met in the long term. For instance, most central banks have an inflation target, which can be linked to the function that money must be a stable store of value. At the same time, the central banks are state institutions, so when central banks have responsibility for money it can be regarded as a mixture of chartalism and functionalism.

Crypto-assets are based on decentralised networks without official issuers

There are thus different theories on what money is. How should one then view crypto-assets and how do they work?

Crypto-assets are normally based on what is known as blockchain technology.²⁰ A blockchain consists, as the name implies, of a chain of different blocks. Each block consists of a number of verified transactions. The blockchain can thus be said to be a digital ledger system that stores all of the earlier transactions. As there are many different crypto-assets using blockchain technology, there are also many technological variations and there is not room to discuss them all here. Bitcoin is the oldest and still the largest crypto-asset and we therefore choose to illustrate the workings of blockchain based on this asset. Most other crypto-assets function along the same lines, even if there are some exceptions.

Bitcoin is a decentralised system where the users comprise nodes in a network. Payments are made and new crypto-asset units are created through interaction between the users themselves. The system functions in accordance with a number of rules, the so-called Bitcoin

¹⁷ Riksbanken (2017), p. 17.

¹⁸ Mankiw (2012), p. 325.

¹⁹ For further information on the development of central banks, see for instance Singleton (2011), and Wettergren (2009).

²⁰ There are exceptions, such as Iota. Blockchain technology can also be regarded as the most well-known example of so-called Distributed Ledger Technology (DLT). For more information on this concept, see CPMI (2017).

Protocol.²¹ The basic idea is that the users shall have a profit motive in carrying out tasks that are necessary for the system to function. When a payer wants to make a payment to a recipient, a payment instruction is placed on the network together with payment instructions from other users. A special form of user, known as a *miner*²², then validates a collection of payments and puts them in a newly created block by finding the solution to a mathematical problem that is created and specified by the Bitcoin Protocol.²³ There are two different kinds of rewards that miners can receive in exchange for their work. Firstly, the miners that solve the problem first receive a certain amount of newly created Bitcoins. It is through this process that new Bitcoins are created.²⁴ However, to ensure that the number of Bitcoins does not increase too rapidly as more users join, the system specifies that this reward shall regularly be halved.²⁵ Secondly, the miners also receive a reward, in practice a transaction fee, that is paid by the person transferring Bitcoins to someone else when making a payment. The Bitcoin Protocol contains a specific size limit, which means there is also a limit as to how many transactions will fit in a block. One can therefore talk about a “market for block space”, where supply and demand together determine the transaction fee in practice. It is voluntary for the payer to provide an extra reward, but transactions without extra rewards may have to wait a long time to be executed. Many Bitcoin applications therefore suggest a suitable size for the reward to ensure transfers are made within a reasonable time.

Miners use computational power to randomly create proposed solutions to the mathematical problems validating the payments. Thus, considerable computational power is required to quickly generate a sufficient number of proposed solutions to have a reasonable chance of finding the right solution first. The process can therefore be likened to a lottery, where miners with large computational power can increase their chances of “winning”. This has meant that many miners join together in groups, what are known as *mining pools*, where they share both computational power and potential rewards. The level of difficulty of the mathematical problems is adapted automatically so that the time it takes to create a new block remains around ten minutes. When a payment has been validated, it is added to a new block that is added to the blockchain.

The Bitcoin structure is summarised in Figure 1.

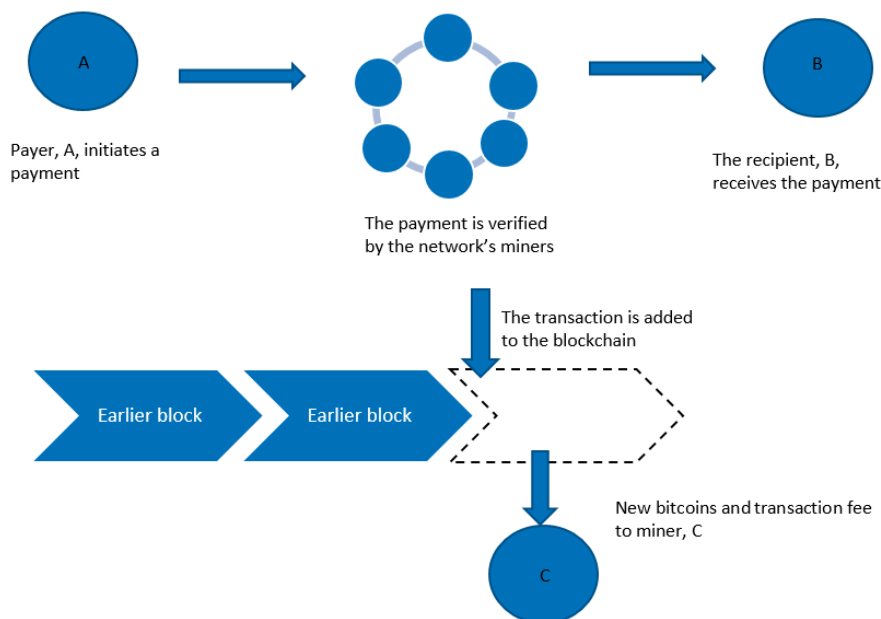
²¹ A protocol here refers to a collection of rules that determine how individual computers communicate with one another. For instance, e-mail is based on such a protocol.

²² So called because they are sometimes compared with miners digging for gold.

²³ The mathematical problem entails finding the solution to a so-called hash function. A hash function converts a volume of information, such as a series of digits of a text of a non-specific length, into a number of a specific length. The problem therefore is to find a solution to this hash function that is lower than a certain specified value, where a lower value entails a higher level of difficulty. The level of difficulty is automatically adapted so that it will take around ten minutes to create a new block. For a more in-depth description of this, see Segendorff (2014), p. 75.

²⁴ Segendorff (2014).

²⁵ This means that this reward approaches zero over time and that the other reward, the transaction fee, gradually becomes a more important incentive for the miners.

Figure 1. Overview of the Bitcoin structure

Source: Segendorff (2014).

Use of crypto-assets is still small-scale

One may own crypto-assets for two main reasons: to use them as a means of payment or as an investment. In the latter case, one buys crypto-assets mainly to hold them in the hope that the price will rise. It is difficult to form an opinion of the exact extent to which crypto-assets are actually used as a means of payment. However, it is probably a very small extent. For example, only three of the five hundred largest on-line stores in the world accept Bitcoin.²⁶ Nor is Bitcoin used as a means of payment in Sweden to any great extent. A rough estimate is that around 40 Swedish companies currently accept Bitcoin as a means of payment.²⁷

The number of Bitcoin transactions in the world per day, including purchases as an investment, has increased in recent years, although this varies substantially from day to day. During 2017, the number of Bitcoin transactions in the world was on average around 275,000 per day, which can be compared with an average of 60,000 transactions in 2014.²⁸ This is still very little compared with the total number of transactions made globally using more established forms of payment, such as cash and cards. In Sweden alone, for instance, almost one million transactions are made through Swish and almost nine million card transactions are made per day.²⁹ Other crypto-assets, which are much less common than Bitcoin, are probably used much more rarely as a means of payment.

The attention that crypto-assets have recently received has also led to an interest in derivatives, based on their price movements. For instance, future derivatives for Bitcoin was introduced in the United States at the end of 2017.³⁰ In Sweden, interest has mainly focused on so-called Bitcoin certificates, a financial instrument that is intended to reflect price

²⁶ Katz (2017).

²⁷ See bitcoin.se.

²⁸ Own calculations and Segendorff (2014).

²⁹ Sveriges Riksbank, statistics available on-line at <https://www.riksbank.se/en-gb/statistics/payments-notes-and-coins/payment-statistics/> [8 February 2018].

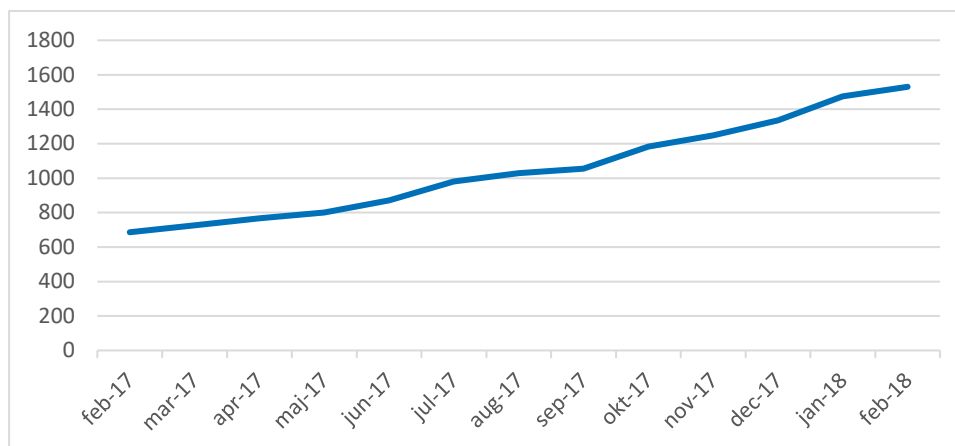
³⁰ See, for example, CME Group (2017).

developments in Bitcoin without the owner actually owning Bitcoins. At the end of 2017, around 40 000 Swedes owned Bitcoin certificates, a figure which has fallen since then, however.³¹

Recent years have seen an increase in the number of crypto-assets and considerable price volatility

Over the past year, the number of crypto-assets has more than doubled (see Chart 1). The driving force for creating new crypto-assets has probably increased as interest in them has increased in the media and among potential investors.

Chart 1. Number of crypto-assets in the world February 2017 - February 2018



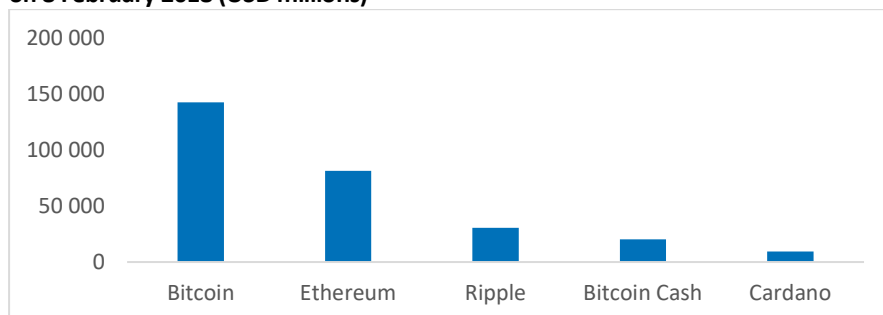
Source: *Coinmarketcap*

At the same time as the total number of crypto-assets has increased, there have also been considerable relative shifts between the leading crypto-assets. New crypto-assets have grown and Bitcoin's share of the total value of crypto-assets has declined.³² As shown in Chart 2, Bitcoin is still the largest, but other crypto-assets are growing.

³¹ "Bitcoin-febern kan ha passerat toppen" (2017).

³² "Bitcoin is no longer the only game in crypto-currency town" (2018).

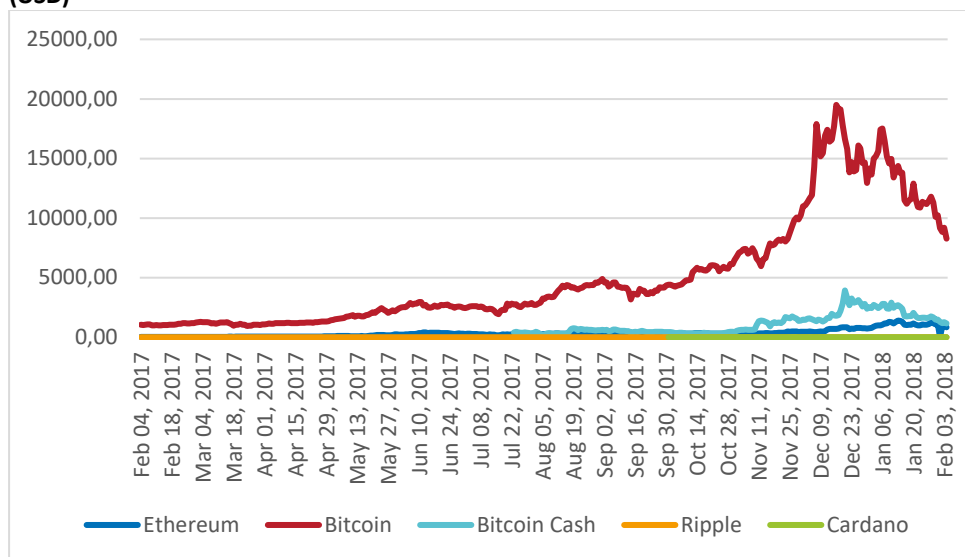
Chart 2. Market value of total number of crypto-asset units for the five largest crypto-assets on 8 February 2018 (USD millions)



Source: Coinmarketcap

Crypto-assets have undergone major price fluctuations over the past year. Bitcoin had an increase in value of 1,000 per cent in 2017. At the end of 2017 and the beginning of 2018, however, there were major price falls and increased volatility. Other crypto-assets, such as Ethereum, have also shown considerable price volatility (see Chart 3).

Chart 3. Price development for the five largest crypto-assets February 2017 - February 2018 (USD)



Source: Coinmarketcap

There are risks, but mainly for private individuals

The use and holdings of crypto-assets are thus low in relation to the economy as a whole in Sweden and the rest of the world. At the same time, crypto-assets are an area under rapid change. With around 1,500 different crypto-assets, it is also difficult to get an overview of developments. But the still relatively limited extent to which crypto-assets are used means that the risk to financial stability is at present very minor. However, the high volatility in crypto-assets entails a risk of continued price falls that can lead to major losses for private individuals. The European supervisory authorities Esma, EBA and Eiopa have therefore issued

a warning together with the Swedish financial supervisory authority, Finansinspektionen, among others, that crypto-assets are an unsuitable and risky asset.³³ At present there is no consumer protection for private individuals who incur losses from crypto-assets.

However, it is not possible to entirely rule out the possibility that use and holdings of crypto-assets could increase to a level that could also lead to an increased risk for the financial system as a whole. This could occur, for instance, if established financial institutions were to begin to invest in them, or make it possible for their customers to invest in them to a greater degree.

There are also questions regarding other potential societal problems

Crypto-assets have also been pointed out as a problem because they facilitate criminality by enabling anonymous payments. They have been used, for instance, in trade in illegal goods and also used in various types of cyber-crime.³⁴ According to a study, as much as one quarter of all Bitcoin users and around half of all Bitcoin transactions can be linked to some form of illegal activity.³⁵ However, a number of innovations have made it simpler to trace Bitcoin users. For this reason many criminals are now moving their operations to other crypto-assets that offer a higher degree of anonymity.³⁶ Bitcoin is nevertheless still the crypto-asset that is used most for criminal purposes, probably mainly because it is still the largest and most established crypto-asset.³⁷

Another aspect that has been discussed is the amount of energy that is needed to run Bitcoin in particular. As described above, the Bitcoin Protocol is constructed to require considerable computational power and thus a considerable amount of electricity. It has therefore been discussed whether Bitcoin further increases climate impact or leads to computer equipment and energy being used in a way that is not in the long term interest of society.³⁸ This has been pointed out in China, in particular, where the main source of energy of mining activities is coal.³⁹ At present, however, it is difficult to estimate how much energy is actually used by the network and Bitcoin's total environmental impact must therefore be regarded as another question for further investigation. Other crypto-currencies, such as Dash, use less energy-intensive means of validating transactions.⁴⁰

Several factors mean that crypto-assets cannot be classified as money

The earlier sections have discussed different theories of money and the nature and developments of crypto-assets. Should then crypto-assets be regarded as money? Representatives of many central banks, including the Riksbank's Governor Stefan Ingves, have expressed the opinion that crypto-assets should not be regarded as money, but as a form of asset.⁴¹ How should one understand this and what exactly do they mean?

³³ See FSA's website: <http://www.fi.se/sv/publicerat/nyheter/2018/olampligt-for-konsumenter-att-investera-i-virtuella-valutor/> [2018-03-09].

³⁴ Palmer (2016).

³⁵ Foley, Karlsen and Putnins (2018).

³⁶ Bloomberg (2017).

³⁷ Europol (2017), p. 11.

³⁸ See, for example, Hern (2018).

³⁹ "Coal is fuelling Bitcoin's meteoric rise" (2017).

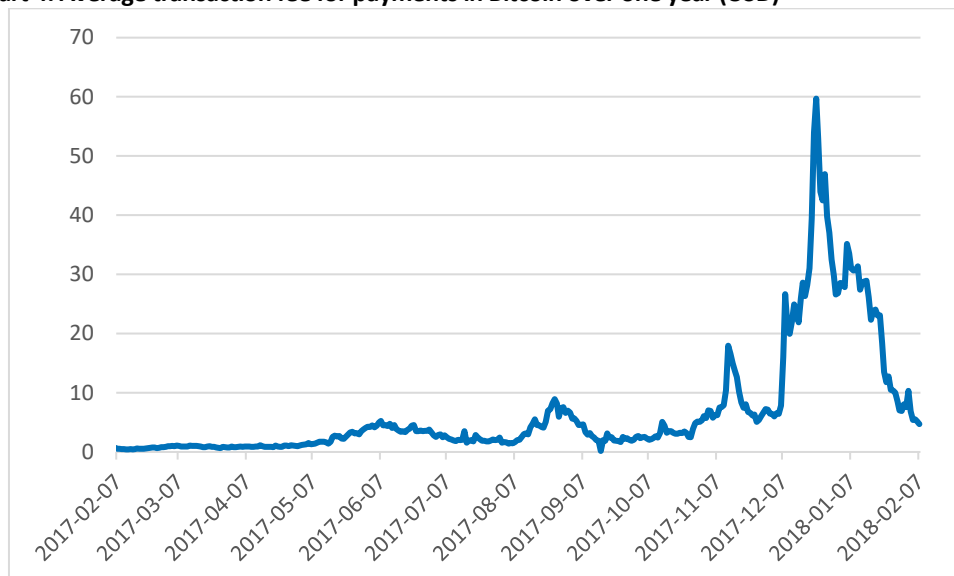
⁴⁰ So-called proof-of-stake instead of proof-of-work that is used in Bitcoin.

⁴¹ Schüch (2017).

As mentioned above, there are several different theories of money, and crypto-assets probably cannot be classified as money in any of them. They are not tied to any good with a market value and they are not issued by a national state. With regard to the third theory, what I have called functionalism, the answer depends on to what degree a crypto-asset can fulfil the three functions required. One main objection that can be raised against crypto-assets, and particularly Bitcoin, is that they are actually not primarily used as a means of payment. Instead, interest in owning Bitcoins has been linked to their development in value. Most users have thus chosen to use Bitcoin not as money, but as an asset.

The use of Bitcoin as a means of payment has also in practice been made more difficult because the transaction fees have been high and have fluctuated.⁴² As mentioned above, the extra reward to the miners is voluntary, but in practice the block space is limited, which means that transactions with a low reward may have to wait a long time before execution. The actual transaction fee is therefore determined by the available block space and the number of transactions, and therefore tends to fluctuate. Towards the end of 2017, transaction fees rose significantly. This is illustrated in Chart 4.

Chart 4. Average transaction fee for payments in Bitcoin over one year (USD)



Source: Calculated from Blockchain.info

These fluctuations entail practical problems for merchants. For instance, the on-line-based game retailer Steam stopped accepting Bitcoin payments in December 2017. The reason was that long transaction times, and fluctuations in fees and the value of Bitcoin meant that one could not guarantee that the price at the time of purchase was really what the buyer finally had to pay.⁴³

Interest in owning Bitcoins is explained, as described above, primarily by their steep rise in value in recent years and particularly during 2017. At the same time, the value has fallen by more than half since the peak in December 2017 – from around USD 20,000 to around USD 8,000 at the beginning of February. The dramatic fluctuations in value mean that Bitcoin is

⁴² Bershidsky (2017).

⁴³ See communication from Steam: <http://steamcommunity.com/games/593110/announcements/detail/1464096684955433613> [2018-03-09].

not a store of value in the way that is required to be considered money. Other cryptocurrencies have undergone similar price fluctuations.⁴⁴

There are thus a number of reasons why central banks and other authorities do not accept crypto-assets as money. However, several crypto-assets experiment with ways of resolving the functional problems, for instance, Bitcoin Cash uses larger blocks which can lead to faster transactions and lower fees. There are also projects under way that could increase the efficiency of already existing blockchains, such as Lightning Network, which is to enable transactions in a crypto-asset without having to burden the blockchain.⁴⁵ Theoretically, these initiatives could resolve the problems highlighted here.⁴⁶ But it is still difficult to assess whether this development is possible.

The decisive difference between crypto-assets and established currencies is thus that the latter are actively managed by central banks that have been given overall responsibility by law for the monetary and payment systems functioning in practice and for their being sufficiently flexible to meet the needs of society. Another way of wording this is that the central banks' task right now is to ensure that money fulfils its three basic functions over time. With regard to the crypto-assets, there is no one with overall responsibility for them. Central banks are also representatives of states or a union of states, as in the case of the European Central Bank. This means that these currencies can be regarded as issued by the state, unlike crypto-assets, which have no official issuer. For example, the Swedish Tax Agency has said that this fact means that crypto-assets should not be regarded as money, but as assets.⁴⁷

The Riksbank's potential e-krona would differ from a crypto-asset

Developments on the payments market, in particular the decline in the use of cash in Sweden, have led the Riksbank to investigate the possibility of issuing an electronic currency, a so-called e-krona. How would an e-krona differ from Bitcoin or other crypto-assets?

The main difference is that the e-krona would be issued by the Riksbank, which is a government authority. The e-krona would therefore be a claim on the Swedish state. This is very different from a crypto-asset, which is created by a decentralised network and not maintained through a legal obligation but through the users' profit motives and trust in the underlying protocol for the crypto-asset. The Riksbank's e-krona would have an official guarantor of its value, at the same time as there would not be any legal confusion regarding its status.

Also, the e-krona would be expressed in SEK. The e-krona would not be a currency of its own. This means that it would also be included in the Riksbank's legal obligation to strive to attain an inflation target and thereby a stable development in purchasing power. A fundamental principle for the crypto-assets is that no one can be entrusted with this responsibility. The purchasing power of the crypto-assets is to a larger degree determined by supply and demand. The results are, as mentioned above, major fluctuations in their price.

⁴⁴ In the long run, it is not impossible that the constant emergence of new crypto-assets may contribute to substantial inflationary pressures on all crypto-assets. Although each individual crypto-asset has underlying principles that prevent over-issuance of the assets, the rapid increase in the number of independent crypto-assets indicates that there is no obstacle to constantly creating new ones. Thus, an over-issuance could arise, in relation to the total number of crypto assets, and result in a loss of value. It is also here that the similarity to metallism ceases to apply: there is no given limit for the total number of crypto-assets. It is possible that one can liken this to continuously diluting the metal that money in a metal-based system consists of.

⁴⁵ See Lightning Networks' website: <https://lightning.network/> [2018-03-09].

⁴⁶ World Economic Forum 2017.

⁴⁷ See the website of the Swedish Tax Agency: <https://www4.skatteverket.se/rattsligvagledning/327766.html?date=2014-04-23> [2018-03-09].

Finally, the Riksbank would have responsibility for the e-krona's underlying infrastructure. The way that transactions with an e-krona would be priced has not yet been determined, but for a central bank it is essential that any fee would not vary beyond control. The reason for this is that the central bank's obligation to maintain an efficient payment system would not then be met.

The decisive difference in relation to crypto-assets is that the e-krona would be issued by a state and managed by the Riksbank in a way that guarantees that it would function as an efficient means of payment. In other words, the e-krona would not only fulfil the three basic functions, it would also meet the condition of being a legal creation issued by a state.

Conclusion – crypto-assets cannot be classified as money

This Economic Commentary has discussed different definitions of money, the nature and development of crypto-assets and the question of whether crypto-assets can be regarded as money. As mentioned in the introduction, this should be regarded as a contribution to the ongoing discussion, and not as a final document.

The questions raised by crypto-assets have also been discussed earlier in history. The current development can thus best be understood as a continuation of an interaction between technology and society that has been under way for a long time. It is also important to point out that new technology never arises in a vacuum, but is linked to and presupposes a societal and legal context. This means that a continued discussion of crypto-assets needs to be broadened to also include these aspects. Crypto-assets are, for instance, issued privately and are often contrasted with state issued money, but at the same time they assume that a state legislates on and maintains property rights. A precondition for crypto-assets to function is namely that their technical equipment is protected by a legal and, ultimately, police system that is supplied by the state. Without states, the crypto-currencies would paradoxically be unable to exist.

There is extensive technical experimentation regarding crypto-assets and many of these applications, such as blockchain, could very well find useful applications in society and make certain processes more efficient. Nor is it possible to rule out the possibility that the technology behind the crypto-assets will develop in the future and resolve many of the challenges discussed here. Given the different challenges and as there is no official issuer, the conclusion at present is, however, that they cannot be classified as money. At present, crypto-assets do not present any great threat to financial stability. However, it is important for central banks and public authorities to continue to follow developments in this field.

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