What is money and what type of money would an e-krona be?

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Money fills a central function in the economy. But it is nevertheless difficult to define exactly what money is. In an age when technological developments have meant that money is increasingly in digital form, it is becoming even more abstract to many people. The Riksbank has now begun to investigate the possibility of issuing a new form of digital money, a so-called e-krona, as a result of the decline in use of physical money, cash, in Sweden. This article is about what money is and what type of money an e-krona would be. The conclusion is that the fundamental property of money is trust, regardless of what form it takes. The Riksbank's e-krona, if it becomes a reality, would be based on the same principles for trust as the existing Swedish krona. The e-krona would therefore be a continuation of the already established principles and a long historical interaction between the monetary system and technological advances.

1 Our methods of payment are changing

In recent years an increasing number of people have shown an interest in the question of what money actually is. This is due not least to technological advances and changes in payment patterns. Our money is increasingly digital and in Sweden a large percentage of the population manages entirely without using cash. Now there are also more than 1,700 crypto-assets, or even crypto-currencies as they are sometimes known, of which Bitcoin is the most well-known. These are not issued by national central banks and they are not official currency in any country. Nevertheless, advocates of crypto-assets claim that they are money and that in the long run they can replace national currencies. National central banks have also begun to discuss the possibility of issuing their own, official, digital currencies. In Sweden, this question has gained particular topicality in that the use of cash is declining so rapidly. If cash were to disappear, the general public in Sweden would no longer have access to state money, but only to money held in accounts with private banks. There are several potential problems with this (Sveriges Riksbank 2017). The Riksbank has therefore begun to investigate the possibility to issue a digital form of cash, a so-called e-krona.

Developments have raised a number of questions: What exactly is money? Are crypto-assets money? And what type of money would an e-krona be? This article aims to answer these questions. First I present a historical retrospective of the different forms that money has taken over the years, followed by a discussion of the main ways of describing what money is. After that I discuss crypto-assets and central bank issued digital currencies, with a particular focus on the Riksbank's possible future e-krona.

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2 Our money has a long history

No one knows exactly how money first arose, but there are two main theories (see, for instance, Ekenberg and Vestin 2017). According to the first theory, money was created spontaneously to bridge over the practical problems with the barter system. Barter between two people requires that both parties have something that the other wants. If, for instance, one person has pearls and wants furs, this person needs to try to find another person who both has furs and wants pearls. According to this theory, therefore, money was invented to avoid the costly search for the perfect barter partner. Money can therefore be regarded as a universally attractive commodity that everyone wants and that enables many more transactions than are possible in a barter system.

According to the second theory, money was created for the first time by early states or predecessors to states. It thus did not arise automatically, but through a political action. The theories are not entirely incompatible; early money could very well have been created spontaneously, but sooner or later needed some sort of authority to be able to function in the long run. Alternatively, early political authorities may have seen the problems with the barter system and created money to increase the trading volumes.

2.1 Money has existed in many different forms

The first money was in any case created a very long time ago. We therefore do not have access to historical documents that can give us an insight into the process. On the other hand, there are many objects preserved that have been used as money throughout history. It is therefore possible to note that money has been designed in many different ways. In its most simple form, money has been some form of commodity with an independent barter value, so-called commodity money (Davies 1994, p. 27). Historical examples of this include objects with a direct utility value, such as axes, iron collars, standardised grain volumes and cigarettes. But also ornaments or materials for ornamentation have been used as money: feathers, shells and precious metals, either in pieces or powdered. It is easy to see the idea behind this: these objects are somewhat uniform and have a direct value as a tool, material or ornament. It is therefore more likely that a person who accepts the commodity money also accepts that it has an inherent value, even if one doubts the honesty of the previous owner.

Most of this commodity money also needed some form of processing to produce, for instance, metalwork. This is of central importance: the form that money has also depends on the technological advances and the methods that are available for producing them. This is clear when it comes to coins that can be regarded as a further development of commodity money. A coin is really a standardised amount of precious metal, which has been processed into a form that makes it easier to transport, stack and count. However, there is an important difference from commodity money: coins are furnished with a symbol of political power, usually a head of state. This can be interpreted as an official guarantee – often not met in practice, however – of the value of the coin. Coins were first minted in what is now eastern Turkey around 2,500 years ago. The precursors to these coins were probably various types of pieces of metal. The development from piece of metal to coin was probably gradual, apace with metalworking becoming more advanced. Coins can be regarded both as a means of increasing the standardisation of pieces of metal and of increasing confidence in money as the coins were furnished with a sovereign's guarantee regarding authenticity and amount of precious metal (Davies 1994, p. 63). Since the advent of coins, but probably even before that, early states have been involved in issuing money and thus in the degree of trust in money.

2.2 Money can easily lose its value...

A constant challenge throughout history has been to preserve confidence in money and its worth. There are no types of money that are entirely immune to the threat of a change in

worth. Commodity money also varies in worth as its purchasing power depends on how common it is. So-called kauri shells, for instance, which were previously used as money in large parts of Africa, had declined in value considerably towards the 1920s because of increased imports of shells (Davies 1994, p. 37). Another example of this is cigarettes, which were used as the main means of payment in prison camps during the Second World War. The cigarettes were handed out regularly and their value therefore varied substantially. When a new delivery of cigarettes arrived, their value fell heavily. After that they gradually rose in value as time passed and the cigarettes were smoked, only to quickly fall in value again when the next delivery arrived and cigarettes were once again generally available (Radford 1945, p. 195). Metal coins are not safe from fluctuations in value, either. The coins can be debased (the expensive metal mixed with cheaper metals) and coins can also be cut or filed down, which reduces the metal content. Moreover, new finds of precious metals can contribute to a fall in the value of the coin. Central Europe experienced hyperinflation during the 17th century, for instance, despite its money largely consisting of metal coins (Schnabel and Shin 2018). The main reason was that the coins were debased, although the large findings of metals in the newly discovered America probably also played a role.

Inflation is primarily linked to paper money, however. These could be produced on a larger scale thanks to a further example of technological advances – the printing press. Early printing techniques, in the form of patterns carved into blocks of wood and coloured, were used in China from the 3rd century and onwards. Paper money was introduced on a larger scale during the 10th century as a complement to coins. The result was hyperinflation, which led to the world's first experiment with paper money being abandoned (von Glahn 1996).

More advanced printing presses were first manufactured in Germany in the middle of the 15th century. But the printing press was originally used not to print paper money, but to modernise the minting of coins (Davies 1994, pp. 179–180). Paper notes were a further development of the paper instruments that could be found in Europe since the Middle Ages. One example of this is the promissory note. The promissory note was a written certificate of debt and thereby entailed the right to receive a certain amount of money. The owner of the debt, and the certificate, could therefore use the certificate to pay someone else and allow them to cash in the debt at a later date. In this way, the promissory note was very much like a banknote.

2.3 ...and interacts with institutional changes

Banks existed even during the Middle Ages, but in the 17th century there was a clearer institutional development that led to the current monetary system and the form that money currently has. In London, goldsmiths began to specialise in receiving coins and issuing receipts of these holdings which could then be used to make payments with (Wetterberg 2009, pp. 19–20). The precursor to the Riksbank, Stockholms Banco, was established in 1657 and also soon began to conduct lending activities. Sweden had previously introduced the copper coin, partly to deal with the shortage of gold and silver, and also to ensure that copper prices did not fall. Stockholms Banco began to give loans in banknotes that could be redeemed against copper coins. However, there were no restrictions on how many banknotes could be issued. The result was therefore an excess of money issuing, severe inflation and a financial crisis. The bank was closed down and the Riksbank was instead started up by the state in 1668 (Persson 2018). In England, too, goldsmiths began to create banknotes that they issued as loans in the 1660s. These could be used to make payments, as the goldsmiths promised to give the bearer a certain amount of coins if they were handed in. Dissatisfaction with these early bankers, both with the state and the London merchants, and their monopoly on granting loans and issuing banknotes was one of the motives behind the establishment of the United Kingdom's central bank, the Bank of England, in 1694 (Davies 1994, p. 256).

This development continued during the 18th and 19th centuries. Private banks in a more modern sense were started in more countries, in some cases as a direct further development of the goldsmiths' activities. In Sweden, the first private bank after Stockholms Banco was started in the 1830s. Central banks were also established in several countries, sometimes as the first bank in the country, sometimes as a complement to and stabilising factor in an already established banking sector. The division of operations between banks and central banks was not always self-evident. For example, paper notes were for a long time also issued by private banks until the central banks were given a monopoly on it. This monopoly on issuing banknotes was a clear marker that the central banks were becoming the institutions that had overall responsibility for money (Söderberg 2018a).

Money was for a long time synonymous with metal, either directly in the form of coins or as a representation of metal, in the form of banknotes. Which metal was used varied between the different countries and different periods of time – silver, gold or both of them at once. However, the principle was the same: banknotes had a value because they could be redeemed for metal. At the end of the 19th century an international standard was developed, which entailed gold alone being the main source of the value of money. This was known as the gold standard, and the details differed from country to country, but on the whole it can be regarded as an attempt to establish an international system (Eichengreen and Flandreau 1997). Sweden joined the gold standard in 1873.

The gold standard was then abandoned for the first time during the First World War. Costly attempts were made to re-establish it during the interwar period, but the attempts finally came to an end during the economic depression of the 1930s. There were many factors contributing to this, but the main problem was that the gold standard made it impossible to conduct a sufficiently expansionary monetary policy (Eichengreen 1996, Federal Reserve Bank of Cleveland 2012). However, another version of it was launched by the United States after the Second World War in the form of the Bretton Woods system. Now the member countries' currencies had their worth linked to the US dollar, while the US dollar, as the anchor in the system, could be redeemed for gold. However, the system fell apart at the end of the 1960s for various reasons, including the fiscal policy effects of the Vietnam war. In 1971 the United States abandoned the system and the dollar could no longer be redeemed for gold (James 1996). The consequence of this was that money was no longer linked to any external worth.

2.4 Money has over time become increasingly abstract

Money as a phenomenon has thus developed from being a utility and precious metal to a paper representation of precious metal and finally to paper that does not represent precious metal. The digitalisation of money can be regarded as a natural continuation of this process.

Two factors lie behind the digitalisation process. The first is that the size of the financial sector started to increase substantially, and so did the number of financial transactions. This means that increasingly large volumes of information needed to be processed. The second factor was technological advances, and in particular the emergence of modern computers. However, technological advances did not have any clear-cut effect on the use of physical money. When the ATM arrived in the mid-1960s, it became easier to quickly withdraw cash to use in payment. But at the same time, further innovations in the payment field meant in practice that cheques became outdated. The smart card first appeared at the end of the 1960s and was improved during the 1970s. Payment terminals began to spread in the retail trade in the 1980s (Bátiz-Lazo and Wood 2002). These innovations revolutionised the possibility to use deposits in banks for payments.

In purely concrete terms, there are currently two main forms of money for the general public: money in accounts, which is in a digital form, and cash, which is in a physical form. That deposits began to be used as money was because different instruments, such as cheques and

direct debits, were developed further and made payments from one account to another much easier. The possibility to make payments directly from one's account means that deposited funds can in all practical aspects be regarded as money. However, it has not always been self-evident that funds in accounts could be regarded as money. During the early 19th century, for instance, the question was discussed of whether deposits in accounts with banks could be regarded as money (O'Brien 1997, p. 599). The technological advances, most recently with Internet and smart phones, have further increased the possibilities to quickly make payments from one's account and instantly see the balance there. There are thus few people today who would doubt that the funds in their account can be regarded as money.

To summarise, one can draw three conclusions from this retrospective. Firstly, that money's exact form changes over time. Secondly, that it has not been self-evident how to draw up a monetary system that functions smoothly. Thirdly, money has always had an institutional framework that consists of states and various types of institutions. The current discussion on digital currencies and how they should be defined is thus part of a long historical interaction, where technological advances and institutions' influences affect the design of money.

3 Different views on what money is

A simple definition, which is independent of the technologies and institutions involved, is that money is something that is generally accepted as a means of payment. The actual design is thus of secondary importance. Confidence is instead of central importance for money: by trusting the value of money we dare to accept it as a means of payment. A paper banknote or a series of binary digits in a computer may thus have a value as long as we believe that they do. This means that money to actually be money has to be based on some form of confidence principle. The next question is then how money must be constructed to be able to be generally accepted. The nature of money therefore becomes as much a normative as a descriptive question: *how* money should be is difficult to distinguish from *what* it is. There are three main views with regard to what money is and they all ultimately concern this: guaranteeing a functioning monetary system.

3.1 Metallism

According to the first view, money should either consist of or be attached to something that has an independent value. The link to historical systems of commodity money or coins is clear. As it has in recent centuries primarily been precious metals that has been a guarantee for the value of money, this view is often called *metallism* (Goodhart 1998). Paper money can in this view still be regarded as money, but receives its value primarily from banknotes being redeemable for precious metals. A banknote is in this case a claim for a certain amount of precious metal that can be redeemed if the bearer so desires. As long as the bearers trust that the banknote can be redeemed, the note can function as a means of payment. Historically, both silver and gold were used, often together with a reciprocal value relationship, for this purpose (Eichengreen and Flandreau 1997). The peak of metallism came with the gold standard, which was mentioned in the historical overview. The idea behind metallism is that the availability of precious metals, and the cost of quarrying more metal, should set an automatic limit on how much money can be created. This creates confidence and price stability. The trust in the system is ultimately based on the natural rarity of the precious metals.

3.2 Chartalism

According to another view, *chartalism*, money is instead something that is created in legal terms by a state. What money exactly consists of – precious metal, paper or ones and zeros in a computer – is therefore irrelevant. To be money, it must quite simply be defined as

money by a state. This may appear very categoric. But one way of interpreting this view is that only national states have the power to legislate that something shall be money and the resources to be able to preserve confidence in this money.

Chartalism was first advocated by a German economist called Georg Friedrich von Knapp in 1905, but later also by John Maynard Keynes. According to this view, money does not need to be issued directly by the state, but the state defines what is counted as money by accepting it as payment (Wray 2014, p. 6). For example, a person can pay their taxes to the state with money deposited in an account with a commercial bank. Money in accounts can therefore also be classified as money according to chartalism.

3.3 Functionalism

The third view, which is currently the most accepted, can be called *functionalism*. The reason for this term is that money, to be counted as money, must fulfil a number of functions. These were first proposed in 1875 by the British economist Stanley Jevons (Söderberg 2018b). Money must first of all function as a means of payment between buyer and seller. Secondly, money must function as a common standard of value so that various goods and services can be evaluated according to the same measure. Thirdly, money must have a sufficiently stable value so that decisions on buying and selling are not affected by changes in value. If money rapidly declines in value, the holder will want to get rid of it quickly. If money increases in value, the holder will instead want to hold on to it and therefore postpone purchases while waiting for the money to increase in value even more. In other words, money may neither rise nor fall too far in value to be classified as money. One usually summarises these three functions as money having to function as a means of payment, a unit of account and a store of value.

3.4 What type of money are the established currencies?

The three main ways of looking at money discussed above are summarised in Table 1.

Table 1. Different views on what money is

View	Conditions
Metallism	Consists of or is tied to an article 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

Source: Söderberg (2018b)

How shall we then classify the established currencies, for instance, the Swedish krona and the US dollar, in relation to this? Since the 1970s there has been no link at all, as mentioned in the previous section, between the national currencies and precious metals. Established currencies, such as the Swedish krona and the US dollar, can be regarded as a mixture of chartalism and functionalism. As their value is not linked to any external item, such as gold, they are sometimes called 'fiat money' from the Latin word *fiat* which means an order from above – in this case that money shall be created and have a value. The currencies are issued by national states, through a state central bank, and are then managed by the central banks in accordance with legislation, in Sweden the Sveriges Riksbank Act.

Cash is issued directly by the central banks, but the largest volume of money is not created by the central banks, but by private banks when they grant loans (Ekenberg and Vestin 2017, McLeay et al. 2014). One can therefore say that state and private money complement one another in the current monetary system (Committee on Payment and

Settlement System 2003). However, the state and the central banks have the ultimate responsibility for the total volume of money and the long-term value of money. States therefore affect the banks' creation of money with the aid of regulations and monetary policy. Funds in accounts are also now backed up by state deposit guarantees, which further increase confidence in them. The private funds in accounts therefore also have a large state component. Even a purely chartalist interpretation of money would therefore accept that funds in accounts are also money despite not being issued directly by the state (Wray 2014, p. 6).

What then are the principles that maintain confidence in the national currencies if there is no absolute limit on how much money can be created? The answer is the confidence in the national states and the competence in the bureaucracy at the disposal of the states. One could here talk about modern currencies resting on a 'Weberian' foundation, after the German sociologist Max Weber. Weber analysed the emerging modern national states in the late 19th and early 20th centuries. He said that they based their legitimacy primarily on an emerging bureaucracy that endeavoured to carry out critical societal functions in a rational manner.

With regard to money, the central banks have the decisive responsibility for maintaining the basic functions of money. If the politicians in charge had responsibility, they could be tempted to allow exaggerated money production to fund public expenditure, which would mean that the value of money was undermined. There are also several examples in modern times of states that have not managed to administer the money system, which has resulted in hyperinflation, for instance Zimbabwe and Venezuela. To further increase confidence in money, many countries including Sweden in 1999, have legislated that the central bank shall be politically independent. Within the EU, for instance, it is essential that governments have no mandate to influence monetary policy and that the central bank is not used to fund the government's budget. Legally independent central banks can be regarded as the latest state in the long institutional development that was outlined earlier.

According to metallism, the established currencies could not be classified as money, as they are not formally linked to precious metals. On the other hand, it is important to remember that central banks usually own, or have the possibility to rapidly acquire, large volumes of precious metal. One could therefore say that even modern fiat money is indirectly backed up by gold. Although gold, when regarded from a yield point of view would no longer be regarded as an optimal investment for central banks, its history and psychological effect probably play an important, albeit indirect role.

4 Crypto-assets

Many also wonder how crypto-assets, which have recently gained considerable attention, relate to established currencies. There is no established definition of crypto-assets. But one could say that they are digital units that are created and transferred between users with the aid of cryptographic calculations. Most crypto-assets are decentralised, which means that they are not issued by any formal institution.[1] Instead, they are created through an interaction between the users themselves according to a set of rules, what is known as a protocol. The oldest and most well-known crypto-asset, Bitcoin, was created in 2009 by an unknown person or group under the pseudonym Satoshi Nakamoto. Since then, many other crypto-assets have been created and in the second half of 2018 they numbered more than 1,700 (Coinmarketcap 2018). Taking into account total market value, Bitcoin is still the largest, but other crypto-assets, such as Ethereum, have increased their market shares.

1 Some crypto-assets are issued in more closed systems and therefore often have a company as official issuer. One example is Ripple.

4.1 Crypto-assets were created as a result of lack of confidence

Section 3 describes how the established currencies mainly rest on the confidence in national states and the competence of the authorities managing the currencies – the central banks. The emergence of crypto-assets is linked to a drop in confidence in the financial system during the financial crisis 2007–2008. Several of the technological innovations on which crypto-assets are based were already familiar to computer scientists and cryptographers (Lansky 2018). But the will to combine these into a hypothetically new payment system arose when the financial crisis, the banks' major losses and the state support to the financial sector undermined confidence in the monetary system. Nakamoto wrote:

> The root problem with conventional currency is all the trust that's required to make it work. The central bank must be trusted not to debase the currency, but the history of fiat currencies is full of breaches of that trust. Banks must be trusted to hold our money and transfer it electronically, but they lend it out in waves of credit bubbles with barely a fraction in reserve (cited in Davis 2011).

Nakamoto's fundamental idea was therefore to create an alternative means of payment that could function without confidence in a third party, for instance a bank or central bank (for a detailed description of how Bitcoin functions, see Segendorf 2014, Söderberg 2018b).

4.2 Are Bitcoin and other crypto-assets money?

So are Bitcoin and other crypto-assets money? The best way to discuss this question is to start from the three different views described above. According to metallism, the value of money shall be backed up by a commodity with an independent market value. Crypto-assets are not linked to anything like this. Many crypto-assets, especially Bitcoin, use large amounts of energy to create an artificial cost to create new crypto-units. But the electricity used to create Bitcoins cannot be re-used and sold and therefore cannot serve as a guarantee of their value.

According to the chartalist view, the answer is simple: as crypto-assets are not issued by a national state and not accepted by national states as payment for tax, they cannot be money. But what about functionalism? Here the question is whether crypto-assets, at least thus far, fulfil the three main functions (means of payment, unit of account and store of value). Crypto-assets are constructed to function as a means of payment, but in practice they are used to a very small extent as such. Probably the main reason for this is that one regards the holdings as an investment that one expects will increase in value. Most people thus do not regard crypto-assets as a means of payment, but rather as an investment. If one expects money to increase in value, one will of course make a loss every time one buys something with it – the increase in value one believes one would have had if one still had the money. Crypto-assets also vary quite substantially in value, which means that they cannot be said to fulfil the function of a store of value (for a more in-depth discussion on this, see Söderberg 2018b).

Crypto-assets thus cannot be classified as money according to any of the main views of what money is. However, there are many experiments under way in which the aim is to try to bridge over the problems described here.[2] Hypothetically, an already existing crypto-asset or a future crypto-asset could after technological improvements fulfil the conditions for functionalism. But it is still too early to determine whether or not this is possible.

2 For example, Bitcoin has been split up into other rival crypto-assets. Other examples of experimental crypto-assets are Saga, Ethereum and Dash.

5 Central bank issued digital currencies and the e-krona

The development of digital technology has raised questions regarding the future of the established currencies. At present, a private individual cannot own digital state money. An important question is therefore whether central banks shall issue digital money that is accessible to the general public and how it should then be designed. The idea is not a completely new one. The American economist James Tobin argued in 1987 that central banks should have transaction accounts for the general public (Tobin 1987). He said that this would enable cashless payments outside of the commercial banking sector. With today's technology, it would entail digital state money. Interest in state issued digital money has also increased as interest in crypto-assets has increased in the media (see, for instance, Konig 2014). Several central banks have ongoing projects regarding digital currencies issued by central banks, either in the form of analysis or testing of relevant technology (see, for instance, Bank of Canada 2017, Monetary Authority of Singapore 2017).

5.1 What type of money would an e-krona be?

In Sweden, the question of central bank issued digital currencies has become important because the use of cash has declined and the Riksbank has therefore begun to investigate the possibility of introducing a digital form of the krona, an e-krona (Sveriges Riksbank 2017). So what type of money would an e-krona be?

Firstly, regardless of how it is designed, it would be issued by the Riksbank, which is a state authority. It could therefore be classified as money according to chartalism. The state issuance would also, as at present, be managed by the Riksbank, which is politically independent. A large part of the confidence would thus, as today, rest on confidence in the Riksbank's ability to maintain price stability. The difference from crypto-assets is that confidence there is replaced with mechanical principles for creating money and confidence in the underlying protocol.

The e-krona would not be any form of independent currency. This means, quite simply, that the e-krona would be a Swedish krona in another form, in addition to the already existing cash and money in bank accounts. This would mean that its value would develop alongside that of other forms of Swedish krona in accordance with the Riksbank's task to maintain a stable development of the krona's purchasing power. Its value would therefore not vary in the same way as that of crypto-currencies. If it did so, the Riksbank's undertaking to maintain an efficient payment system would not be fulfilled. The Riksbank would in other words be obliged to guarantee that the e-krona fulfils the three basic functions of money. From both a chartalist and a functionalist point of view, the e-krona would therefore be classified as money. One could also, as mentioned above, argue that the Riksbank's holdings of precious metals constitute an indirect and psychological back-up of money in accordance with metallism.

Table 2 below summarises the main characteristics of the potential means of payment that the general payment in Sweden could have access to if the e-krona becomes a reality.

Table 2. Overview of potential future means of payment available to the general public in Sweden

	Cash	Funds in account	Crypto-assets	E-krona
Claim on?	Sveriges Riksbank	Bank	-	Sveriges Riksbank
Form?	Physical	Digital	Digital	Digital
Confidence in?	Sveriges Riksbank	Bank, deposit guarantee, regulations, the Riksbank's monetary policy	Underlying protocol	Sveriges Riksbank
Money?	Yes	Yes	No	Yes

6 The e-krona – a krona that meets the requirements we have of money

This article has discussed what money is and what type of money a potential e-krona could be. As the historical section showed, money can be many different things and take many different forms. Similarly, several different techniques can be used to produce and distribute it. Another conclusion is that money can never be separated from an institutional context that also changes over time. The underlying requirement for money to function, on the other hand, is timeless – confidence. The central issue is therefore what it is that maintains confidence in money. During the course of history, a physical reminder has often been needed that money has a direct value – in its most basic form money has consisted of something with a direct utility value such as axes or grains. In modern times, the national state with a well-developed bureaucracy is the main source of confidence in the established currencies. By making the central banks politically independent and ensuring that they are not used to fund government budgets, one has further increased confidence in money.

An e-krona, if it becomes a reality, would be issued and managed by the Riksbank, which is a public authority, in a way that guarantees that it fulfils the fundamental functions that are required of money. It would therefore be based on the chartalist and functionalist principles that are now the basis for our monetary system. Crypto-assets enthusiasts in many cases lack confidence in the ability of states and central banks to manage money. It is therefore very important to make a clear distinction between crypto-assets and central bank issued digital currencies – the former are usually issued in a decentralised process with no formal issuer, while the latter are issued by national states and managed by central banks. The principles for maintaining confidence in a potential e-krona and a crypto-asset are thus diametrically different.

It is easy to see historical parallels to the current situation. Historically, we have seen that technological advances create new forms of money and can force institutional changes. The primary example is perhaps when paper money was first established. This started up a long process of institutional development that resulted in the emergence of the modern central bank system. The current developments in Sweden, where information technology and reliance on digital technology have fundamentally changed payment patterns, are a further example of this. If the Riksbank was to decide to issue an e-krona, it would not be a departure from earlier established principles for the central bank's actions. It would rather comprise a continuation of the interaction between technological advances and institutional changes that we have seen earlier in history.

References

Bank of Canada (2017), 'Project Jasper: a Canadian experiment with distributed ledger technology for domestic interbank payments settlement', Bank of Canada.

Bátiz-Lazo, Bernardi and Douglas Wood (2002), 'A historical appraisal of information technology in commercial banking', *Electronic Markets*, vol. 12, no. 3, pp. 1–12.

Coinmarketcap (2018), 'All cryptocurrencies', web page, 13 september, Coinmarketcap. Available at www.coinmarketcap.com/all/views/all/.

Committee on Payment and Settlement Systems (2003), 'The role of central bank money in payment systems', Bank for International Settlements.

Davies, Glyn (1994), *A History of Money,* University of Wales Press: Cardiff.

Davis, Joshua (2011), 'The crypto-currency: Bitcoin and its mysterious inventor', newspaper article, The New Yorker, 10 October. Available at www.newyorker.com/magazine/2011/10/10/the-crypto-currency.

Eichengreen, Barry (1996), *Golden Fetters: The Gold Standard and the Great Depression, 1919–1939*, Oxford University Press: Oxford.

Eichengreen, Barry and Marc Flandreau (1997), *The Gold Standard in Theory and History*, Routledge: London and New York.

Ekenberg, Tomas and David Vestin (2017), 'Vad är pengar? [What is money?]' in *Nationalekonomins frågor* [*Economic questions*], Studentlitteratur: Lund.

Federal Reserve Bank of Cleveland (2012), 'The Gold Standard Loses its Lustre', Annual Report, Federal Reserve Bank of Cleveland.

von Glahn, Richard (1996), *Fountains of Fortune: Money and Monetary Policy in China, 1000–1700,* University of California Press: Berkely.

Goodhart, Charles (1998), 'Two concepts of money: implications for the analysis of optimal currency areas', *European Journal of Political Economy*, vol. 3, no. 4, pp. 407–432.

James, Harold (1996), 'International Monetary Cooperation since Bretton Woods', International Monetary Fund.

Konig, J. P. (2014), 'Fedcoin', blog post, 19 October, Moneynes. Available at www.jpkoning.blogspot.com/2014/10/fedcoin.html.

Lansky, Jan (2018), 'Possible state approaches to cryptocurrencies', *Journal of Systems Integration,* vol. 1, no. 4, pp. 19–31.

McLeay, Michael, Amar Radia and Ryland Thomas (2014), 'Money creation in the modern economy', *Quarterly Bulletin*, no. 1, Bank of England.

Monetary Authority of Singapore (2017), 'Project Ubin: SGD on Distributed Ledger', Monetary Authority of Singapore.

O'Brien, Denis (1997), 'Monetary base control and the bank charter act of 1844', *History of Political Economy*, vol. 29, no. 4, pp. 593–633.

Persson, Torsten (2018), 'The Riksbank's political economy', *Sveriges Riksbank Economic Review*, no. 2, pp. 5–15.

Radford, Richard (1945), 'The economic organisation of a P.O.W. camp', *Economica,* vol. 12, no. 48, pp. 189–201.

Schnabel, Isabel and Hyun Song Shin (2018), 'Money and trust: lessons from the 1620s for money in the digital age', Working Paper no. 698, Bank for International Settlements.

Segendorf, Björn (2014), 'What is Bitcoin?', *Sveriges Riksbank Economic Review*, no. 3, pp. 71–87.

Söderberg, Gabriel (2018a), 'Why did the Riksbank receive a banknote monopoly', *Sveriges Riksbank Economic Review*, no. 3, pp. 6–16.

Söderberg, Gabriel (2018b), 'Are Bitcoin and other crypto-assets money?', *Economic Commentaries* no. 5, Sveriges Riksbank.

Sveriges Riksbank (2017), 'The Riksbank's e-krona project', Report 1, Sveriges Riksbank.

Tobin, James (1987), 'A case for preserving regulatory distinctions', *Challenge*, vol. 30, no. 5, pp. 10–17.

Wetterberg, Gunnar (2009), *Money and Power: From Stockholms Banco 1656 to Sveriges Riksbank today*, Atlantis: Malmö.

Wray, Randall (2014), 'From the state theory of money to modern money theory: an alternative to economic orthodoxy', Working Paper no. 792, Levy Economics Institute of Bard College.