

VIRTUAL CURRENCIES

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INTRODUCTION AND SUMMARY

In a modern market economy, money is used to pay for goods and services, either in the form of cash, i.e. banknotes or coins that are transferred directly from the buyer to the seller, or alternatively in the form of a bank transfer through the payments infrastructure, typically after the buyer has initiated the payment using a payment instrument such as a card.

The growth of the Internet has spawned a variety of networks, from online games to social networks, where Internet users meet and interact with one another according to a common set of rules. Some of these networks have introduced their own units of payment – or virtual currencies – for participants' transactions. As long as these units are used only in the closed online environment, their economic significance is limited.

Other, more interesting, types of virtual currencies are those with wider application – virtual currencies that can potentially be bought and sold in exchange for traditional currencies like kroner, euro or dollars. The best-known example is Bitcoin, which has recently attracted considerable attention from both the media and regulators. A number of similar, less widespread solutions with the same characteristics also exist.

Bitcoins are created through a decentralised network of Internet users in a process called mining, which has often been compared to the mining of gold. Bitcoins can be bought and

sold on various online exchanges and, unlike national currencies, they have no central issuer. Therefore, they do not represent a claim against a company in the same way as, for example, a bank deposit. Unlike bank deposits, bitcoins are not protected by any form of guarantee.

Virtual currencies such as bitcoins are not regulated, either at the European level or in Denmark. Consequently, bitcoins are not subject to the normal protective measures for payments based on bank deposits, and consumers are not entitled to claim compensation for losses caused e.g. by hacker attacks. Recently, this has prompted several regulators to issue warnings about virtual currencies.¹

In spite of the considerable focus on bitcoins, their use as a means of payment remains very limited, and few Danish retailers accept them as payment. Against that backdrop, the risks linked to the use of Bitcoin and other virtual currencies are currently assessed to be limited to the individual user and they are not deemed to pose a threat to financial stability in Denmark.

MONEY AND VIRTUAL CURRENCIES

Throughout history, various assets have had the same characteristics as present-day money.

¹ See e.g. the Danish Financial Supervisory Authority's warning on virtual currencies, posted (in Danish) on its website, www.finanstilsynet.dk, on 17 December 2013.

Irrespective of their form, they have filled three basic functions:

- They have been widely accepted as a means of payment, i.e. they have been used for the purchase and sale of everyday goods and services.
- They have been used as a unit of account for determining prices of goods and services.
- They have been used as a storage of value, meaning that the purchase and sale of goods and services did not need to coincide in time.

Earlier, assets serving as money had an intrinsic value to the owner. For instance, gold and silver coins could be used in the manufacture of jewellery. Today, money in the form of banknotes and coins has no value in itself and its function as a means of payment is based on trust that others will accept it in payment.

A primary factor in this trust is that money is defined by law. In Denmark, Danish banknotes and coins are legal tender under the Danmarks Nationalbank Act and the Danish Coinage Act. Except in special cases provided by rules under these Acts, buyers are entitled to use Danish banknotes and coins in exchange for goods and services or for release from a payment obligation in Denmark.

Moreover, other legislation and public administration affirm the Danish krone as the national currency of Denmark. For instance, reference is made to amounts in Danish kroner in acts, and Danish kroner are also used for the collection of taxes, etc. in Denmark. Between them, these factors support the use of the Danish krone as the unit of payment – also in other contexts.

Trust in a country's currency is usually strengthened by giving its central bank the monopoly on issuing banknotes and coins. A primary objective of central banks is to maintain price stability, which ensures the purchasing power of banknotes and coins issued. This is also the case in Denmark, and it is done by pursuing a fixed-exchange-rate policy against the euro.

An alternative to money which has recently attracted increasing attention is virtual currencies. There is no clear definition of virtual

currencies, but, in broad terms, they may be defined as units of payment that are not issued by a central bank and are not denominated in a national currency with the status of legal tender. Another characteristic of virtual currencies is that they typically exist in electronic form only.

Many of the payment units designated as virtual currencies are used in online social networks and online games. Some of these networks and games have introduced special means of payment used in peer-to-peer trading in the virtual environment. As these types of currencies can typically be used only in the narrow environment for which they were designed, they have no de facto significance for the real economy.

Another example of a payment unit with limited application, which, in principle, complies with the definition above is bonus points earned from the issuer when purchasing services, e.g. points earned from airlines. Points can typically be used only for purchasing more services from the issuer and possibly a few partner companies, and consequently points are of limited economic significance.

Another type of virtual currency with potentially broader perspectives is virtual currencies with wider application, which can typically be bought and sold for national currencies. They can be seen as more of a monetary alternative, but, unlike money, they typically have no central issuer. This category includes Bitcoin and a number of similar, although less widespread virtual currencies, such as Ripple, Litecoin and Peercoin.²

REGULATION OF VIRTUAL CURRENCIES

In Europe, the payments area is regulated by the Payment Services Directive³ and the E-Money Directive. The former provides rules for payment services, while the latter contains provisions on the issuance of electronic money, i.e. a prepaid monetary value stored on a medium such as a card or a server, which can be used

² See e.g. the website www.coinmarketcap.com.

³ For a description of the Payment Services Directive, see Anders Mølgaard Pedersen, The Directive on Payment Services, Danmarks Nationalbank, *Monetary Review*, 3rd Quarter 2007.

for purchasing goods and services from others than the issuer.

In Denmark, the two directives are transposed into Danish law in the Payment Services Act, which came into force in 2009. The former Danish act also regulated a number of electronic systems for the payment of goods and services that were not covered by the two directives, e.g. electronic vouchers that represent a claim for a number of services rather than a monetary amount. Since Denmark wanted to continue regulating these systems, the concept of payment substitutes was introduced, cf. Box 1.

Virtual currencies as defined above are usually regulated by Danish law if they have an issuer. In that case, they are normally either electronic money or payment substitutes. Whether they belong in one category or the other generally depends on whether they can be used with others than the issuer. If this is the case, they are usually defined as electronic money.

Conversely, bitcoins and similar solutions with no central issuer are covered neither by European legislation nor by the Danish Payment Services Act. When virtual currencies are characterised as unregulated, this is the type referred to. The absence of regulation reflects that there is no issuer against whom statutory claims can be made. Both at the national and the international level, several regulators, e.g. the European Banking Authority, EBA, are analysing the need for regulating this type of virtual currencies and the possibilities of doing so.⁴

BITCOIN

Bitcoin is often referred to as the world's first digital currency and payment system that can be used without the involvement of traditional payment service providers such as card companies and banks. Bitcoin payments can be used for cross-border transactions and they usually have very low or no transaction fees.

⁴ European Banking Authority, *EBA Consumer Trends Report 2014*, 28 February 2014.

Payment substitutes

Box 1

Payment substitutes are defined in section 102 of the Danish Payment Services Act. The Act states that a payment substitute means "the following electronic systems to the extent that they can be used to acquire goods or services without this constituting a payment service:

- Cards and other physical means of proof of identity which are linked to specific users and which are intended for electronic reading.
- Codes and biometric values intended as proof of identity of the user.
- Electronically registered claims which the issuer is obliged to pay at the request of the user."

The Consumer Ombudsman must be notified of payment substitutes before they are put into operation, while providers of payment services and e-money must be authorised by the Danish Financial Supervisory Authority. According to the Consumer Ombudsman's practice, the following are examples of payment substitutes:

- Electronic vouchers for a single legal entity, e.g. a fitness centre, laundromat or transport operator.
- Electronic gift cards or credit vouchers to be used only for purchases of goods and services from the issuer.
- Prepaid electronic accounts for online gaming to be used only for purchasing services from the provider of the website.
- SIM cards for registration and invoicing of telephone calls.
- Electronic loyalty or discount programmes, the bonus points of which can be used for purchasing goods or services.

Issuers of payment substitutes are required to comply with a number of provisions set out in the Payment Services Act, including requirements for information to be provided to users and liability regulations, charges and redemption of any remaining balance.

According to several providers, the definition of payment substitutes is subject to some uncertainty, reflecting that the definition is open-ended, i.e. referring to electronic systems that are *not* payment services. As a result, providers may have to spend resources clarifying their legal position, potentially causing them to refrain from offering the respective payment solutions. The Consumer Ombudsman has announced that, in partnership with the Danish Financial Supervisory Authority, he will prepare a guide on payment substitutes, payment services and e-money.

HOW DOES BITCOIN WORK?

Bitcoin was invented by Satoshi Nakamoto in 2009⁵, but has undergone several changes since then. The bitcoin mining process and the rules and formats for transactions are described in the *Bitcoin Protocol*. The protocol is updated

⁵ Satoshi Nakamoto, *Bitcoin: A Peer-to-Peer Electronic Cash System*, www.bitcoin.org, 2009.

and amended regularly by developers in a *peer-to-peer* network, i.e. a computer network without a central server.

Bitcoins are created through an online network, open to everyone, in a process called *mining*. Participants have downloaded a special program for the purpose and contribute their computer processing power to the mining process. Mining can be seen as a form of network maintenance for which the reward is new bitcoins.

In practice, mining involves solving complex mathematical algorithms which requires much computing power. Participants compete to verify the most recent transactions by finding the solution for the algorithm. The first participant to offer the correct solution is rewarded with a number of new bitcoins. This method is designed to prevent double-spending of the same bitcoin.

The reward received for solving the algorithm is defined in the protocol. The original reward was 50 bitcoins, but approximately every four years the reward is halved, and the current reward is 25 bitcoins. In practice, this means that the total number of bitcoins is finite, 21 million which will be reached in 2140, cf. Chart 1 (left). At the beginning of March, approximately 12.4 million bitcoins had been mined, equivalent to about kr. 40 billion.

A bitcoin *wallet*, installed on a computer or smartphone, is needed to make and receive bitcoin payments. The wallet is a small program

that provide access to a number of *addresses*, each with its own balance of bitcoins. Alternatively, a wallet can be stored online and be accessed through various providers.

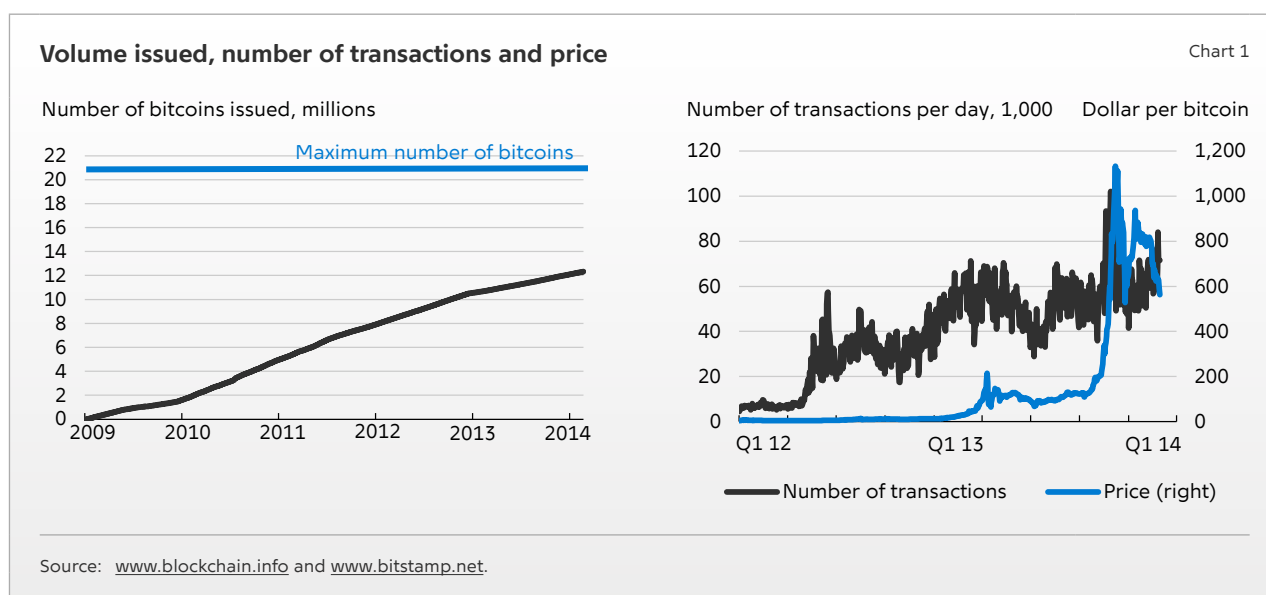
A bitcoin address is a string of numbers and letters, e.g. 1LmHSLndRdrfkX12AuTsqA3aEpwuPU9Jg. If a user wishes to pay by bitcoin, he needs to know the payee's address – just as it is necessary to know the payee's registration and account numbers to make an ordinary online bank transfer. The transfer is done from the user's wallet, which broadcasts it to the network for verification. Once verified by the network, the transaction is considered to be final.

TRADING AND USE

As mentioned earlier, bitcoins can be mined, but currently mining is extremely computing power intensive and, in practice, only specially designed hardware can be used for mining. For users who do not contribute their computer's processing power to the network, there are other ways to acquire bitcoins. For example, they can buy bitcoins directly from another user or via a bitcoin exchange.

A number of companies offer to exchange bitcoins for national currencies, including a few for Danish kroner. Moreover, some websites specialise in bringing private buyers and sellers together, and a few major cities have Satoshi Squares, which are open-air marketplaces for bitcoins.

The bitcoin price has been fluctuating considerably in recent months, cf. Chart 1 (right).



One reason is that the market volume is relatively limited, another that, on several occasions, news about government intervention and hacker attacks on exchanges has caused sudden price changes. Most recently, Mt.Gox, the world's largest bitcoin exchange at the time, suspended withdrawals after a number of system failures, causing a sharp price fall in February. In early March 2014, the value was slightly above 600 dollars.

Although recent years have seen an increase in bitcoin use for payments, cf. Chart 1 (right), the overall use remains relatively modest. Globally, an average of some 62,000 bitcoin transactions are processed daily in 2014 relative to about 3 million daily Dankort payments in Denmark, reflecting that relatively few retailers accept bitcoin payments. According to an estimate, bitcoins are currently accepted by just under 3,500 retailers worldwide, including about 30 in Denmark.⁶

Bitcoin has often been referred to as being pseudonymous, as the address for receiving bitcoins cannot necessarily be connected to the holder of the address. This feature has opened up the possibility of using bitcoins for illegal purposes. Thus, on several occasions, Bitcoin has been associated with illegal activities, for instance when the Silk Road website (used as a venue for buyers and sellers of e.g. illegal drugs and weapons to trade and settle in bitcoins) was closed down by US authorities in October 2013.

BITCOINS AS A MEANS OF PAYMENT

According to the developers of the Bitcoin Protocol, the system was originally intended as an alternative to money to be used broadly as a means of payment. As already mentioned, bitcoins are still accepted only by a small number of payees. In addition, a number of aspects make bitcoins less suitable as a means of payment than national currencies.

It is generally accepted that a core characteristic of money is that its value is stable, i.e. that its purchasing power is constant. This helps to provide a framework for sound economic development with appropriate use of society's resources. However, the value of the bitcoin, and thus its purchasing power, has turned out to fluctuate widely against national currencies, cf. Chart 2 (left).

Moreover, it has been stated that the finite bitcoin supply may exert an underlying upward pressure on its price. This could give bitcoin holders an incentive to hold on to their bitcoins as an investment rather than spending them. In a bitcoin-based economy, this would have deflationary effects, i.e. a trend of declining prices.⁷

Many people will also tend to see bitcoin payments as more cumbersome than cash or card payments, and most people will probably find it simpler to pay using e.g. the banks' new mobile payment solutions. Moreover, the complex process of generating bitcoins could make people insecure about using them.

Furthermore, bitcoins have often been heralded as a free alternative to traditional online payments. This could prove difficult to maintain in the longer term, since the computing power needed to mine bitcoins has increased exponentially over the last six months, cf. Chart 2 (right). Increasing computing power costs will presumably lead to a demand for higher compensation for bitcoin mining. In practice, the price may go up further or costs may be covered in other ways, e.g. through fees. In 2014, an average transaction fee of just under kr. 1 has been paid per transaction.⁸

RISKS OF USING BITCOINS

The use of bitcoins is associated with a number of risks that are not relevant to transactions based on bank deposits, reflecting primarily that bitcoin transactions are not regulated by law. Accordingly, users are not covered by the

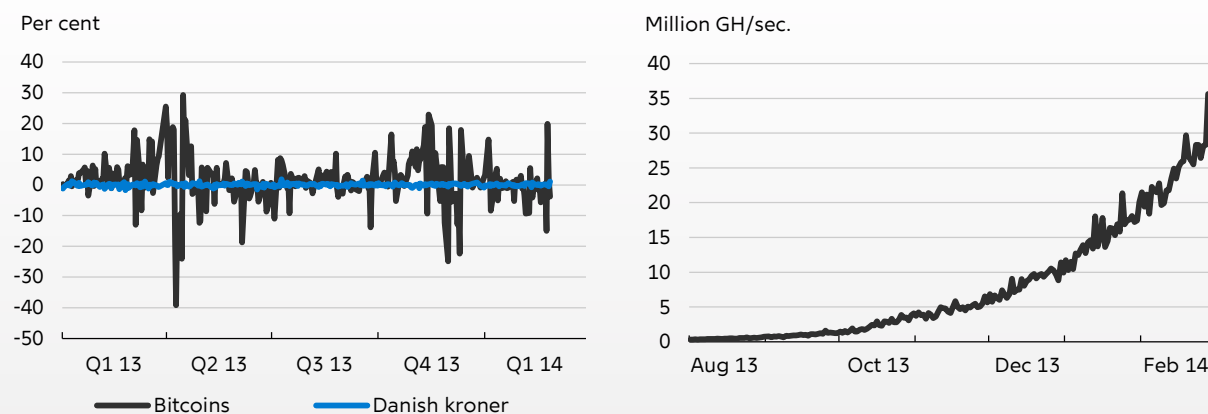
6 See the website www.coinmap.org, as of 28th February 2014.

7 See e.g. <http://krugman.blogs.nytimes.com/2011/09/07/golden-cyberfettters>.

8 According to the website www.blockchain.info/charts, 10-30 bitcoins are paid in transaction fees per day.

Daily price change and hash rate

Chart 2



Note: The daily percentage change in bitcoins and Danish kroner measured in terms of US dollars. The hash rate indicates the total computing power of the network. A GH - gigahash - expresses the number of potential solutions to the algorithm calculated by the network per second.

Source: www.blockchain.info, www.bitstamp.net and Danmarks Nationalbank.

provisions of the Payment Services Act on misuse, etc. and the use of bitcoins for payments is at the user's risk.

For instance, if the user's bitcoin wallet is subject to hacker attacks, he is not entitled to compensation. Conversely, bank deposit losses are subject to compensation, less deductible, after an online bank theft. Another risk of bitcoin loss is if the user loses his private key to his bitcoin wallet e.g. as a result of computer failure.

Moreover, there are examples of bitcoin exchanges and wallet providers that have closed down e.g. due to hacker attacks. Losses resulting from such events are not protected by law either. This is opposed to losses on bank deposits, which, in addition to being very rare, are covered by a depositor guarantee of a relatively large amount, in Europe up to 100,000 euro.

Furthermore, bitcoin transactions are not covered by other consumer protection provisions under the Payment Services Act, e.g. the special Danish chargeback rules for online purchases of goods and services. Under these provisions, online consumers paying by card have chargeback rights for merchandise that is not delivered or is defective. This does not apply to bitcoin transactions.

Overall, bitcoin transactions pose a number of risks for consumers that, as already mentioned, do not exist for regulated payment instruments. At the end of 2013, this prompted the EBA to issue a warning to consumers on virtual currencies, including bitcoins. The Danish Financial Supervisory Authority backed up this warning.