

DANMARKS NATIONALBANK

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Central bank digital currency in Denmark?

- It is difficult to see what central bank digital currency would be able to contribute that is not already covered by the payment solutions which exist today. Denmark has a secure and effective payments infrastructure and digital currency, in the form of bank deposits, already exists.
- Central bank digital currency would fundamentally change Danmarks Nationalbank's role in the financial system and make Danmarks Nationalbank a direct competitor to the commercial banks. The introduction would lead to risks of financial instability, for example by increasing the risk of systemic bank runs.
- The potential benefits of introducing central bank digital currency for households and businesses in Denmark would not match the considerable challenges which this introduction would present. Danmarks Nationalbank therefore has no plans to issue central bank digital currency.

Introduction and summary

Should central banks issue digital currency to households and businesses, as a supplement to physical cash and deposits with commercial banks? This is an issue that is currently being debated internationally.¹ One of the arguments in favour of introducing central bank digital currency is to achieve a more effective payment system. Another is to ensure that households and businesses still have access to a safe asset, as the use of cash declines. A third argument is the advantage of establishing a back-up system for the existing payments infrastructure.

In a Danish context, it is unclear what central bank digital currency would be able to contribute that is not already covered by the current payment solutions. Denmark has a secure and effective payments infrastructure, which among other things provides for immediate settlement of payments – for example via MobilePay, the privately developed mobile payment solution. Furthermore, deposits of up to euro 100,000 are covered by the depositor guarantee scheme, and every consumer has a statutory right to a basic payment account.

The potential benefits of introducing central bank digital currency in Denmark are not assessed to match the considerable challenges that this introduction would present. If Danmarks Nationalbank were to issue central bank digital currency, this would fundamentally change its role in the financial system, and would lead to risks of financial instability. Central bank digital currency could, for example, have a great impact on the banks' business model and

¹ See e.g. Sveriges Riksbank (2017), Callesen (2017), Mersch (2017), Nicolaisen (2017), Broadbent (2016), Skingsley (2016), Bech and Garratt (2017), Grym et al. (2017), Barrdear and Kumhof (2016), and Bordo and Levin (2017).

increase the risk of systemic bank runs. Depending on how it might be designed, issuing central bank digital currency could also present challenges with respect to Denmark's fixed-exchange-rate policy, and would impose significant legal and administrative challenges on Danmarks Nationalbank, without any clear benefits for society.

In countries that are in a different situation, for example those with a less well-developed payment system, the balance between benefits and risks might be different.

In the analysis the various reasons for introducing central bank digital currency in a Danish context are considered. First, central bank digital currency is compared to cash, bank deposits and the "cryptocurrencies". Then the effect of central bank digital currency on Danmarks Nationalbank's core tasks with regard to payment systems, financial stability and monetary policy is examined.

What is central bank digital currency?

A new type of money

Cash, in the form of banknotes and coins, is a claim on Danmarks Nationalbank, while bank deposits are a claim on the bank in which the customer holds an account. Households and businesses cannot hold claims on Danmarks Nationalbank in electronic form – but only as physical banknotes and coins. The banks, on the other hand, do hold electronic claims, since they hold accounts at Danmarks Nationalbank. Like other countries' central banks, Danmarks Nationalbank is banker to the banks.

Central bank digital currency (CBDC)² would be a new type of money, co-existing with cash and deposits at the commercial banks. Like cash, CBDC would be a claim on Danmarks Nationalbank, although it would be digital, like deposits with the commercial banks.³

² In the rest of this analysis, the abbreviation CBDC is used for central bank digital currency.

³ See also Bech and Garratt (2017) for a discussion of how CBDC relates to other types of money.

In the public debate, CBDC is often linked to the cryptocurrencies, such as bitcoin. Yet CBDC and private cryptocurrencies do not share the same characteristics, cf. the next section. This linkage may reflect that CBDC is often associated with the blockchain technology on which the cryptocurrencies are based.⁴ This technology is described in further detail in Annex 1.

Yet CBDC does not need to be based on blockchain technology, but can be created using existing technology, with a traditional account structure and bookkeeping at Danmarks Nationalbank. Grym et al. (2017) argue that blockchain technology in its current form is not a suitable basis for CBDC. However, new technologies such as blockchain can still be used in the Danish financial sector without introducing CBDC.

Characteristics of CBDC

The fact that CBDC is a claim on Danmarks Nationalbank means that, like cash, it is risk-free. However, the Danish depositor guarantee scheme entails that deposits with commercial banks of up to euro 100,000, or around kr. 750,000, are covered by the Guarantee Fund. The Guarantee Fund, previously the Depositor Guarantee Fund, is the Danish Depositor and Investor Guarantee Scheme. Its purpose is to cover depositors and investors if a Danish bank fails.⁵ The Guarantee Fund's target level is 0.8 per cent of the deposits covered.⁶ If this amount is not sufficient to fulfil the Guarantee Fund's obligations, it can raise

⁴ Central bank digital currency based on blockchain and similar new technologies is also sometimes called CBCC, Central Bank Crypto Currency. The reasoning in the analysis is independent of the underlying technology, and therefore CBDC is used consistently. In the international debate, a distinction is also sometimes drawn between CBDC for households and for financial enterprises, called retail and wholesale CBDC, respectively. Here, the focus is on CBDC that, as a minimum, is made available to households, and possibly to financial and non-financial enterprises as well. See Bech and Garratt (2017) for a taxonomy of various types of CBDC.

⁵ The Guarantee Fund was established by the Danish Act on a Depositor and Investor Guarantee Scheme, cf. Consolidated Act no. 917 of 8 July 2015 (as amended). The Guarantee Fund covers both natural and legal persons, but not financial enterprises. Branches of foreign banks may join the Guarantee Fund as a supplement to the guarantee scheme in the country in which they are registered, if the Danish scheme is more favourable than the scheme in that country, cf. Section 4. Branches of banks outside the EU must join the Danish scheme, cf. Section 3(1) 5).

⁶ Extraordinary contributions may be levied on the banks, if the Guarantee Fund does not have sufficient funds, cf. Section 7(6) of the Act on a Depositor and Investor Guarantee Scheme.

a state-guaranteed loan. Net deposits exceeding kr. 750,000 are not covered by the Guarantee Fund, and depositors with larger deposits may therefore risk losses.

By maintaining a fixed exchange rate against the euro, Danmarks Nationalbank ensures stable price development in Danish kroner terms. This means that the amount of goods and services that can be purchased for kr. 100, for example, does not fluctuate much from year to year. In other words, money issued by Danmarks Nationalbank maintains its real value. The same applies to bank deposits, since they are also denominated in kroner.

On the other hand, the price of cryptocurrencies, such as bitcoins, can fluctuate significantly, cf. Chart 1. This is because there is no central issuer to underpin their value. The value of bitcoins is based solely on someone being willing to acquire them at the price in question. These significant price fluctuations limit the value of bitcoins for payments and storing value.⁷

The special characteristic of cash is that it is tangible, taking the physical form of either a banknote or a coin. Cash, bank deposits, CBDC and cryptocurrencies thus have similarities and differences in terms of issuer, tangibility and retention of value, cf. Chart 2.

CBDC can be designed in several ways ...

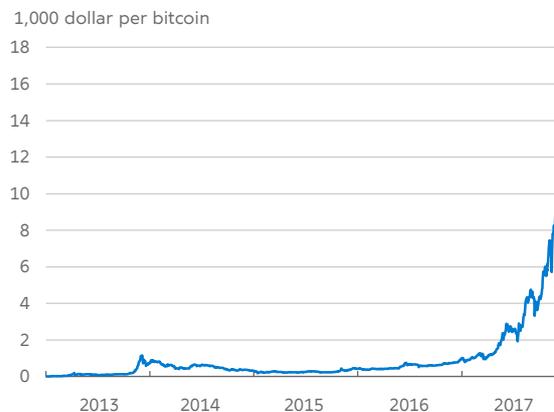
CBDC can be designed in several ways in terms of who is to have access, how it can be used, and whether it is to accrue interest.

... Structure and access

For example, Danmarks Nationalbank could allow everyone to hold a deposit account at Danmarks Nationalbank. This would require consideration of whether these accounts should only be offered to households, or should also be made available to businesses. In this situation, a distinction could be made between financial and non-financial businesses. It might be difficult, however, to exclude specific types of businesses in a situation where both banks and households hold accounts at Danmarks Nationalbank. A set of rules would also have to be

The value of bitcoins fluctuates significantly

Chart 1



Note: The chart shows daily observations of the average market price across the largest bitcoin exchanges. Latest data point is 10 December 2017.

Source: Blockchain.info.

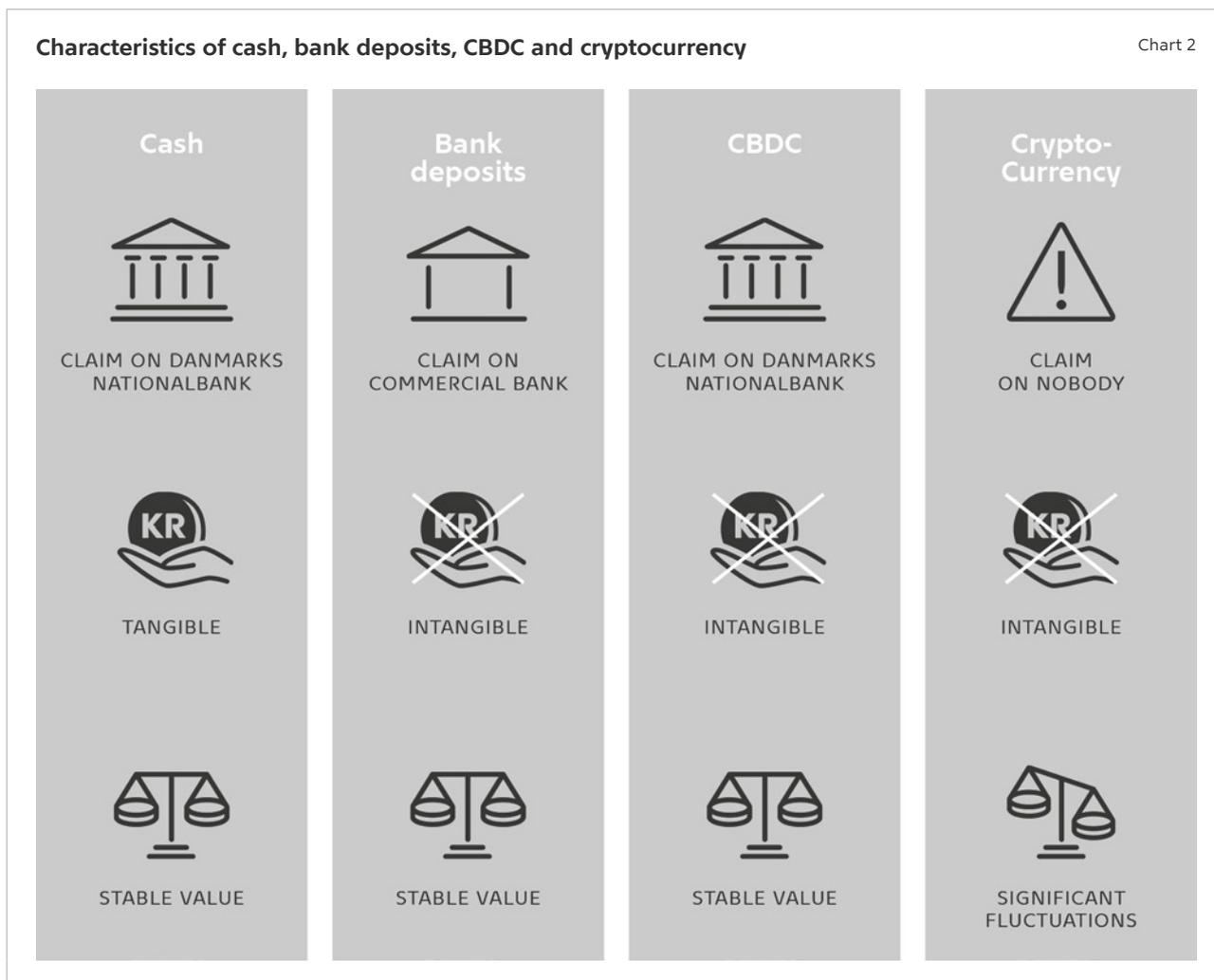
drawn up, to ensure that the restrictions concerning access to CBDC cannot be circumvented.

It would also have to be considered whether access to CBDC should be limited to, for example, businesses domiciled in Denmark, and persons resident or legally resident in this country, and how these restrictions could be handled in practice. The consequences of a person or business no longer fulfilling the requirement would also have to be considered. For example, would a person who moves abroad be obliged to move any deposit with Danmarks Nationalbank to an account in a commercial bank? Would a person who works in Denmark, but is not resident here, have access to CBDC?

It would also have to be considered how any restrictions concerning access to CBDC would comply with the EU single market, including the rules for the free movement of people and capital. With respect to consumers, the Danish Act on Payment Accounts⁸ requires the banks to offer a basic payment account not only to Danish consumers, but in principle also to consumers in the rest of the EU, or any country with which the EU has an agreement in the financial

⁷ See Laursen and Kyed (2014) for a discussion of the characteristics of cryptocurrencies.

⁸ Act no. 375 of 27 April 2016 (as amended).



area. The Act does not apply to Danmarks Nationalbank, since consumers cannot open accounts at Danmarks Nationalbank⁹. If this premise were to cease with the introduction of CBDC, the regulatory authority would have to assess the consequences – for instance whether all EU consumers would have the right to a CBDC account. The consequences of introducing a CBDC would depend on who is to have access to it.

As an alternative – or possibly as a supplement – to an account-based CBDC, Danmarks Nationalbank could issue CBDC as a prepaid means of payment, such as a card (like Rejsekort – the Danish electronic travel payment card), or digitally (like PayPal)

in a mobile wallet. If CBDC were to be issued as a prepaid means of payment, it would be impossible to restrict access to selected groups, such as households.

Like cash, a prepaid CBDC would probably be used primarily for smaller payments. On the other hand, it would be less suitable for larger payments, or for storing value – among other things, there is a risk of losing the device on which the value is stored. The effects of issuing a prepaid CBDC – including the risks identified below – would therefore be less extensive than for an account-based CBDC. On the other hand, the opportunities for use, and thereby the expected demand, also appear to be limited, as also empha-

⁹ Cf. Section 1 (3) of the Act on Payment Accounts and Folketingstidende A, 2015-2016, Bill no. L 103, page 16.

sised by Grym et al. (2017). The analysis therefore focuses primarily on an account-based CBDC.

... Interest

Physical cash does not earn interest. Cash has a fixed, nominal value – after one year, a 100-kroner note will still have a nominal value of kr. 100. An account-based CBDC, on the other hand, can be structured with or without interest. If CBDC accrues interest at 2 per cent annually, a person holding CBDC for kr. 100 today will thus hold CBDC for kr. 102 in one year's time. Whether CBDC earns interest or not will be of significance to the financial sector and to monetary policy, cf. the section below. Interest-earning CBDC would also challenge the perception that money issued by Danmarks Nationalbank has a fixed, nominal value. This would attract particular attention in situations where the interest on CBDC is negative – for monetary policy reasons, for example.

Independently of how CBDC is designed, it must be assumed that it would have to be equally suitable for making payments as is the case with deposits with commercial banks. It would therefore be a requirement that CBDC can be transferred between persons and businesses without delay, at any time of the day or night. CBDC in the form of an account at Danmarks Nationalbank must be expected to be offered with a number of basic services, such as online banking and a payment card. As described in further detail in the section below concerning payment habits and infrastructure, it is unclear how CBDC would contribute to offering Danish households and businesses more effective payments than they have access to today. Nor is it clear that CBDC would make payments more secure, cf. below.

Anonymity

Cash is anonymous, i.e. cash payments cannot be tracked. Sometimes cash payment is made for transactions in order to conceal them from the authorities, for example involving money laundering, including tax evasion, and financing of terrorism. In Denmark, this problem is limited by the relatively small amount

of cash in circulation. In addition, several legislative initiatives are designed to limit large cash transactions.¹⁰ In countries such as the USA, where the circulating cash volume is much larger, the use of cash for illegal activities is a bigger problem. This has led to proposals to reduce the amount of cash in circulation by starting to phase out banknotes above a certain value, while coins, and possibly also small-denomination banknotes, would remain in circulation.¹¹

In contrast to cash, bank deposits are not anonymous. Banks and certain other undertakings and persons are subject to extensive regulation, to ensure that a record is made of who owns a bank deposit, and who is the remitter/recipient of any transaction. This makes it possible to track transactions, which the authorities can use to solve crime. The recording of payment information may also form the basis for the banks' reporting to SKAT (the Danish Customs and Tax Administration), in order to prevent tax evasion.

Depending on the technical solution used to establish CBDC, it can, in principle, be arranged whether CBDC is to be anonymous or not. Yet in practice it will probably not be possible to make CBDC completely anonymous, since all use of information technology leaves tracks. Performing transactions without specifying remitter or recipient would also significantly increase the risk of money laundering, including tax evasion, and financing of terrorism. If the technical solution were also to support international transfers in real time, it would be impossible to stop payments that are intended to finance terrorism, for example.¹²

It would therefore not be appropriate or acceptable to make CBDC anonymous, since CBDC transactions must be expected to achieve a far greater volume than the cash payments made today.

Non-anonymity would impose legal obligations on Danmarks Nationalbank

The introduction of a CBDC based on a non-anonymous solution would impose a number of legal obliga-

¹⁰ See Danish Payments Council (2016a).

¹¹ See Rogoff (2016).

¹² In any investigation of possible infringement of the Danish Anti-Money Laundering Act, information held by Danmarks Nationalbank might, as required by legislation, be passed on by Danmarks Nationalbank to another administrative authority.

tions on Danmarks Nationalbank under anti-money laundering legislation, for example, cf. Box 1.

If information concerning CBDC-based transactions, holdings, etc. could be attributed to a specific person, this information would also be subject to the processing rules and security requirements laid down in the Danish Act on the Processing of Personal Data, cf. Box 2.

Irrespective of whether Danmarks Nationalbank were to outsource the execution of the aforementioned tasks to an external contract partner, it would still be responsible for compliance with the regulations and would have to verify continuously that this task is performed in accordance with the requirements.

Issuing CBDC would affect all of Danmarks Nationalbank's core tasks

Danmarks Nationalbank's core tasks are to maintain a secure payment system, support financial stability and ensure stable prices.¹³ Serving as banker to the banks plays a significant role in fulfilling all of these three objectives. As providers of services to households and businesses, commercial banks are encouraged to develop new solutions for payments and financial services, based on demand and needs.

Offering CBDC directly to households and businesses, thereby serving as their bank, would be a fundamental departure from the existing model. It would have an impact on all of Danmarks Nationalbank's core tasks, and the financial sector in general. Below it is analysed how a Danish CBDC would influence the payment system, financial stability and monetary policy.

Payment habits and infrastructure

Denmark has a modern and well-functioning payments market. Besides cash, there are a number of electronic payment solutions offered by private operators. The solutions include the Dankort (national debit card), international credit and debit cards, and

Obligations for Danmarks Nationalbank on issuing non-anonymous CBDC Box 1

Issuing non-anonymous CBDC, whereby households and businesses become customers at Danmarks Nationalbank, would inter alia impose the following obligations on Danmarks Nationalbank under anti-money laundering legislation¹, and in order to comply with UN resolutions implemented in EU legislation:

- The performance of customer due diligence measures, i.e. obtaining proof of identity documents for all customers, and determining the purpose and scope of the individual customer relationship.
- A continuous duty of attention and investigation concerning all customer relationships, in order to be able to identify unusual transactions.
- Documentation of transactions using CBDC.
- Identification of remitter and recipient for all transactions.

1. Act no. 651 of 8 June 2017 on Measures to Prevent Money Laundering and Financing of Terrorism and Regulation (EU) 2015/847 of the European Parliament and of the Council of 20 May 2015 on information accompanying transfers of funds.

Rules concerning protection of personal data Box 2

Issuing CBDC might result in the following challenges and obligations for Danmarks Nationalbank under the rules for the protection of personal data¹:

- Security requirements for the protection of data disclosed to Danmarks Nationalbank.
- The effective erasure of data that is no longer necessary and relevant might present challenges in certain technical solutions, for example a blockchain.
- The registered parties' right of access to their own information.

1. Act no. 429 of 31 May 2000 (as amended)) on the Processing of Personal Data. The Act will be replaced by the new General Data Protection Regulation, Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016, which will enter into force on 25 May 2018. The Regulation is supplemented by the Danish Bill for a Data Protection Act, Bill no. L 68, tabled on 25 October 2017.

13 See Section 1 of Act no. 116 of 7 April 1936 (as amended) on Danmarks Nationalbank.

the MobilePay mobile payment solution that makes it possible to use a smartphone to transfer money electronically to both persons and retailers. Mobile payments are not unique to Denmark, since both Sweden and Norway, for example, have similar solutions, called Swish and Vipps, respectively.

Payment habits are changing

In step with the advance of electronic payments, the use of cash for retail payments is declining. This tendency has taken place over many years, cf. Chart 3. The same development can be seen in the other Nordic countries. The declining use of cash is a key reason for the analysis by Sveriges Riksbank of the potential for issuing CBDC, cf. Sveriges Riksbank (2017).

In 2017, cash accounted for 23 per cent of payments in physical trade, cf. Chart 4. This is in marked contrast to the euro area, where Esselink and Hernández (2017) find that, on average, 79 per cent of all physical trade was cash-based in 2016.

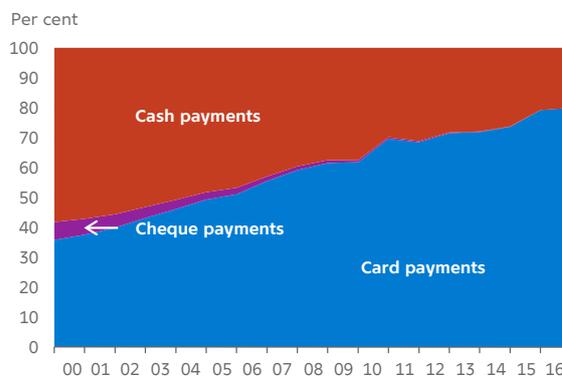
The declining use of cash reflects that households and businesses to a great extent prefer electronic payment, because it is convenient, and that up-to-date solutions, such as the contactless Dankort, are available. A survey by Danmarks Nationalbank shows that 96 per cent of households seldom or never find that it is difficult to be able to pay in cash.¹⁴ The declining use of cash therefore does not reflect problems with using cash.

The statutory universal right to a basic payment account,¹⁵ combined with the depositor guarantee scheme, which protects the customer's deposits up to approximately kr. 750,000 if the bank fails, makes it safe to both pay and store money electronically.

With regard to the payment system, there are no practical challenges as a consequence of the declining use of cash. On the contrary, the economic costs of paying cash far exceed the costs of Dankort payments, cf. Danish Payments Council (2016a). Moreover, the declining use affects neither the sta-

Declining use of cash for payments

Chart 3

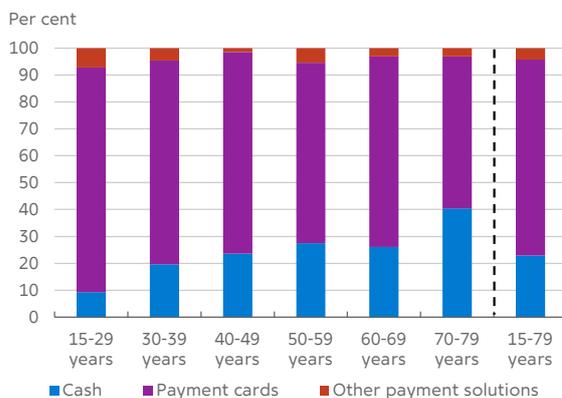


Note: The chart shows retail turnover, etc. by payment method used. Payments using MobilePay with an associated payment card are included in card-based payments. Cheques have by and large not been used in recent years, and as from the end of 2016 Danish banks no longer cash cheques. Turnover in the retail sector, etc. is a wider compilation than Statistics Denmark's retail turnover statistics.

Source: Statistics Denmark, Finance Denmark, Nets, Danmarks Nationalbank and own calculations.

Payments at retailers by payment type and age

Chart 4



Note: Payments by payment type and compiled by number of payments. This solely includes payments at physical retailers, so that Internet shopping is not included in the figures.

Source: Danmarks Nationalbank.

¹⁴ See Danmarks Nationalbank (2017b).

¹⁵ The Danish Act on Payment Accounts, Act no. 375 of 27 April 2016 (as amended) entails that all consumers have access to hold a basic payment account in a bank, cf. also Danish Payments Council (2016a) for further details.

bility of the financial sector nor Danmarks Nationalbank's ability to fulfil its monetary-policy objective, cf. the relevant sections.

Some groups of the population still prefer cash

Cash is still preferred by some groups of the population, especially those aged over 70. They make around 40 per cent of their payments in cash, cf. Chart 4. Moreover, for children and certain vulnerable groups, such as the disabled people, cash plays a special role as a means of payment.

As stated above, CBDC would probably have an account-based structure, and thereby resemble bank deposits rather than cash. CBDC would therefore not be likely to appeal to the sections of the population who are unable to use the existing electronic payment solutions, or who prefer the tangibility of cash for other reasons, cf. Chart 2.

Legal tender

In Denmark, cash is legal tender. This means that if a buyer of a product or service does not wish to pay electronically, he or she is entitled to pay in cash. This does not apply, however, if agreed otherwise, for instance that payment is to take place using electronic means of payment, or if special statutory provisions apply. Denmark also has a "cash rule" that, with a few exceptions, requires physical retailers, for example, to accept cash payment, cf. Box 3.

CBDC would probably not be covered by the statutory provisions concerning legal tender, since these provisions refer to physical banknotes and coins. If CBDC were to have the status of legal tender, this would have to be stipulated by law, but in practice it would not be of any great significance. Since CBDC cannot be deemed subject to the cash rule, as a consequence of the freedom of contract the parties would merely have to agree that a means of payment other than CBDC would be used.

Denmark has a modern payments infrastructure

Every day in Denmark, electronic payments take place for a value of approximately kr. 24 billion, as Internet purchases, in physical retailers, and to private individuals.¹⁶ The payments are made by transferring bank deposits from the payment remitter's bank ac-

Legal tender, freedom of contract and the cash rule

Box 3

Danish banknotes and coins – *cash* – are legal tender in Denmark. For banknotes, this is laid down in the Danmarks Nationalbank Act, while for coins it is stipulated in the Danish Coin Act.¹ Legal tender is a legal term which denotes the means of payment, which can be used to fulfil a payment obligation. Unless agreed otherwise between the parties, or special statutory provisions curtail the right to use cash, Danish banknotes and coins will always be legal tender in Denmark.

Under Danish law, there is a principle of freedom of contract. This means that, as a general rule, two parties can freely agree that means of payment other than cash are to be used. With the exception of purchases in shops with counter sales, for example, cf. the next section, it will in practice typically be agreed that payment is to take place using electronic means of payment. In this way, the concept of legal tender refers to the fulfilment of a contract that has already been established, where no other means of payment has been agreed. In practice, the significance of banknotes and coins' status as legal tender is therefore limited. There is, however, a legal obligation to accept cash in the case of a "counter sale", cf. the next section.

The cash rule

In Denmark, a payment recipient of payment instruments, such as payment cards, has a statutory obligation to accept cash in the case of a counter sale.² This means that, for example, shops which are staffed may not refuse to accept cash. There are some cases, however, where the cash rule does not apply, namely to remote sales, such as online shopping, and to payment in unmanned self-service environments. Nor does the cash rule apply to cases that are subject to special legislation, for instance in order to combat money laundering or undeclared work.

The statutory cash rule concerns "cash". It is doubtful whether this term would include CBDC. This would at any rate require a more specific definition in the Act. It must be considered, however, whether this would be appropriate, since – if the requirement is for CBDC to operate on a separate infrastructure – this would require shops to establish and maintain a technical set-up that enables payment in CBDC.

1. Section 8 of Act no. 116 of 7 April 1936 (as amended) on Danmarks Nationalbank, and Section 4(1) of the Danish Coin Act, Act no. 817 of 21 December 1988 (as amended). For further details regarding legal tender and the cash rule, see Buchter and Gürtler (2006) and Danish Payments Council (2016a).
2. On 2 June 2017, the Folketing (Parliament) adopted a new Payments Act, Act no. 652 of 8 June 2017, which enters into force on 1 January 2018. It alters the obligation to accept cash in the case of a counter sale, so that, as a general rule, this obligation no longer applies during evening and night hours.

16 See Danmarks Nationalbank (2017c).

count to the payment recipient's bank account. Like other highly-developed countries, such as Norway and Sweden, Denmark has a modern payments infrastructure which ensures individuals and businesses rapid and secure payments.

In a cash payment transaction, the recipient receives the money immediately. In an electronic payment transaction, the recipient will not always receive the money immediately. The time which elapses, called the settlement time, depends on the means of payment used, cf. Chart 5. A payment using a payment card goes through the *Sumclearing* system, and the settlement time is one banking day.

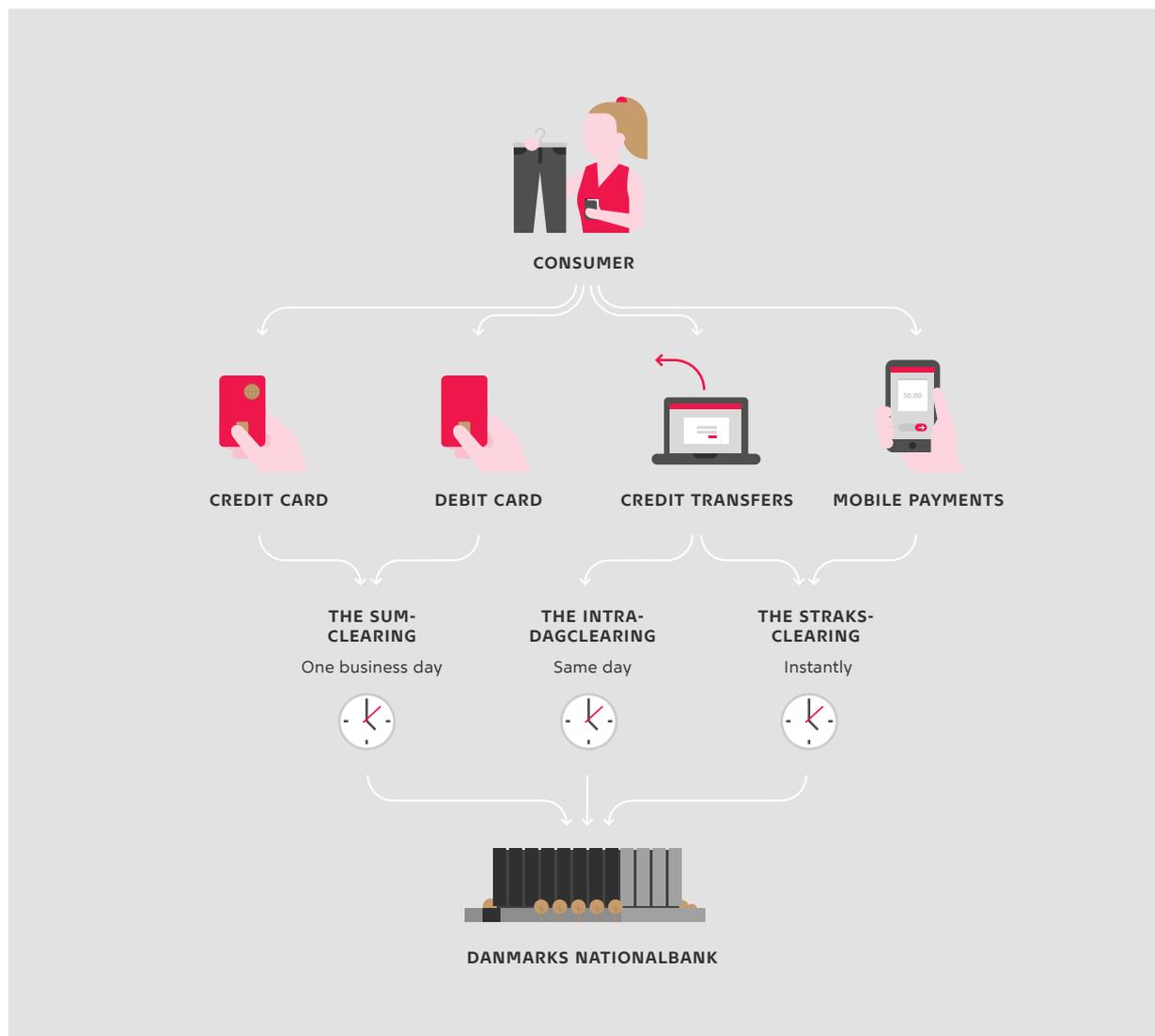
For an account-to-account transfer, the remitter may choose whether the payment is to be settled as an instant payment via the *Straksclearing* system, or via the *Intradagclearing* system as an ordinary payment, which the recipient typically receives in the course of a few hours. Payments using MobilePay are typically settled via the *Straksclearing* and are always received by the recipient within a few seconds. See Box 4 for more information about MobilePay.

The payments infrastructure is still being developed

The payments infrastructure is continuously being developed. The development in the Danish payment market is predominantly driven by private agents.

The transfer of funds through the systems

Chart 5



This means that it is the product of a demand for more rapid and more effective payment solutions.

Contributing to this development is in line with Danmarks Nationalbank's objective. Danmarks Nationalbank has therefore assisted the financial sector in modernising the infrastructure which today enables households and businesses to make payments within just a few seconds. Another example is that Danmarks Nationalbank is currently replacing the existing systems, for settling large, time-critical payments with a new modern system, called Kronos2. The system also supports final settlement between the banks of the payments made by private individuals and businesses.

There is no immediate reason to assume that the more direct involvement of Danmarks Nationalbank by making CBDC available would give households and businesses access to a better or more effective means of payment than the solutions developed by private agents.

Important to consider competition in the payment market

The market for payment solutions has traditionally been dominated by the banks, which have had the know-how and systems to handle households' and businesses' payments. In the future, this may change. Major international technology companies such as Apple have already moved into the payment market, and other agents can be expected to follow suit, facilitated in Denmark by the new Danish Act on Payments, cf. Box 5.

Both the Danish Payments Council (2016b) and Sveriges Riksbank (2013) find that new agents could contribute to increasing the competition in the market for payment solutions. Sveriges Riksbank (2013) furthermore argues that, in the longer term, there may be a concentration on a few solutions. The market for payment solutions is characterised by significant economies of scale. This means that the costs of offering a payment solution do not increase in linear proportion to the number of users and transactions. On the contrary, the cost per transaction declines as the number of users increases, and the solution can thus be offered at a lower price, for the benefit of the user. On the one hand, many users of the same solution is a benefit for society, yet on the other hand, if the lack of competition means that a payment service provider can set artificially high prices, this could lead to monopoly-like conditions in the market.

MobilePay

Box 4

In 2013, the MobilePay mobile payment solution was launched in the Danish payment market. This made it possible to transfer funds between private individuals via smartphones. Today, MobilePay has more than 3.6 million users, who make over 214 million payments per year.

Since its launch, MobilePay has become a separate company as a partnership between the Danish banks. In this model, payments can take place as direct account-to-account payments between different banks' customers, instead of the combination of a card-based payment and an account-to-account payment.

Act on Payments

Box 5

On 2 June 2017, the Folketing (Parliament) adopted the Act on Payments, which enters into force on 1 January 2018.¹ The main purpose of the new regulations is to ensure that the framework for the provision of electronic payment services reflects the technological development, and that the regulations make it easier for financial technology enterprises to offer payment services.

Under this Act, third-party providers, i.e. a provider other than the party holding the user's account, will be able to obtain authorisation to offer payment initiation services, for example to perform payments on the account holder's behalf (such as MobilePay), as well as account information services. The Act imposes an obligation on the banks to give such third-party providers access to customers' payment accounts, if the account holder so consents, so that providers can offer their services.

Like the current Danish Act on Payment Services and Electronic Money, the Act also stipulates a number of requirements concerning information to the payment remitter and payment recipient, as well as rights and obligations regarding the delivery of payment services.

If Danmarks Nationalbank were to open CBDC accounts and offer payment services to all households and businesses, the extent of the aforementioned obligations in the Act on Payments, to which Danmarks Nationalbank would be subject, would have to be clarified. The same issue has been identified by Sveriges Riksbank (2017).

1. Act no. 652 of 8 June 2017. The Act implements the Second Payment Services Directive (Directive 2015/2366/EC of the European Parliament and of the Council of 25 November 2015) and continues the implementation of the Second E-Money Directive (Directive 2009/110/EC of the European Parliament and of the Council of 16 September 2009) in Danish law.

It is therefore important that the relevant authorities continuously monitor the terms of competition and intervene if a market failure is observed. But if the market is well-functioning, society will benefit from private agents competing for customers. This will also encourage innovation.

Foreign CBDC can influence Danish payment solutions

If a central bank in another country issues CBDC, this could affect the use of the Danish payment solutions. If e.g. the European Central Bank (ECB) were to issue euro-CBDC, it is possible that Danish households and businesses would also have access to this, depending on how it were to be designed. This might affect the use of the existing payment solutions. Especially with regard to cross-border payments euro-CBDC would probably be an attractive proposition. This would also be of significance to monetary policy and financial stability, cf. the relevant sections.

CBDC as a contingency measure

Today, society relies completely on the systems that are used for electronic payments. If the systems do not function, even for short periods, this may have negative consequences for confidence in the financial system.

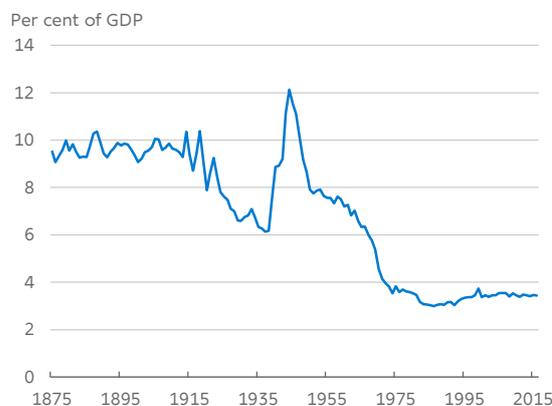
Cash is not a contingency measure

If the systems used to make electronic payments were to be affected by prolonged downtime, or were otherwise unavailable for prolonged periods, cash would not be a contingency measure to electronic payments. Even though cash does not depend on electronic systems and payments can therefore take place without payment systems, or even electricity, the amount of cash in circulation is nowhere near enough to effectively cover the payments of private individuals and businesses. This has been the case for many years, cf. Chart 6.

Since the start of the 1970s, cash in circulation has accounted for less than 4 per cent of GDP. In 2016, this was around kr. 70 billion. Since households alone make electronic payments for goods and services for a value of approximately kr. 24 billion per day, it would not be possible to meet the demand that would arise if electronic payments were unavailable.

Cash circulation has been low for many years

Chart 6



Note: Cash circulation (banknotes and coins) as a share of GDP in current prices.
Source: Abildgren (2017).

CBDC as a back-up for other infrastructure

Sveriges Riksbank (2017) assesses that if CBDC were to be designed so as to function independently of the existing infrastructure, this could make the payment systems more robust. In this way, households and businesses would still be able to make payments, even if part of the payments infrastructure were unavailable. In terms of the system's usability, there would also be drawbacks, however, from isolating CBDC from the rest of the infrastructure.

The actual CBDC accounts would in all circumstances still have to be held in a separate system, as they cannot be held in Danmarks Nationalbank's existing payment system, Kronos. Firstly, Kronos has not been technically developed to handle millions of accounts and related transactions. Secondly, Kronos is a payment system that is protected under the Finality Directive, which is implemented in Denmark in the Danish Securities Trading Act. The regulation governs who may participate in the system, cf. Box 6.

One thing is how accounts will be handled, while another is whether there should be a link to the rest of the payments infrastructure. If CBDC were completely separated from other payment systems, it might be difficult, for example, to transfer funds from a CBDC account to a bank account. It is difficult to imagine widespread use of CBDC if it cannot be used to pay at a retailer that has an ordinary bank

account. CBDC would therefore need to have a link to the existing payment systems.

In addition, like the existing payment systems, CBDC would always be fundamentally dependent on the electricity network, for example. It is therefore neither possible nor practical to create a completely isolated system. In today's Denmark, for better or worse, households and businesses depend on central infrastructures, including for electronic payments.

The Danish payments infrastructure is secure

There is continued focus on maintaining a robust payments infrastructure. The most important systems that support private individuals' and businesses' payments use two-center operation, for example, whereby a secondary center can take over if the primary fails. In this way, households and businesses can continue to transact payments while the outage at one operating centre is rectified. Also the cabling to ensure communication between the banks, for example, is designed to ensure that communication can take place via several cables. If one cable is disconnected, for example as a consequence of excavation work, communication, and thereby electronic payments, can still continue via other cables.

Moreover, Dankort and certain other card payments can take place offline. This means that if an internet connection fails, or there is technical disruption, for a certain period payments can take place offline in shops. Once again, the aim is to ensure that households and businesses are not affected by minor technical problems.

Finally, local crisis response plans have been established by the individual financial institutions, for example Nets and Danmarks Nationalbank, and across the financial sector under the auspices of the Financial Sector Forum for Operational Robustness (FSOR). The local crisis response plans are activated in the event of a technical failure or a cyberattack on a single financial institution, and ensure that operations are restored as quickly as possible. The sectorwide FSOR crisis response plan is activated in the event of a serious crisis with consequences for the entire financial sector. The crisis response plans

Finality Directive

Box 6

Kronos is a real-time gross settlement (RTGS) system for settlement of large, time-critical payments in Danish kroner that is used by Danmarks Nationalbank's account holders (primarily banks and mortgage-credit institutes). Kronos has been notified as a designated payment system in accordance with the rules in Part 18 of the Danish Securities Trading Act, which implements the Directive on settlement finality in payment and securities settlement systems (the Finality Directive).¹

Kronos is thus a payment system that is protected by the Finality Directive. This protection concerns such aspects as the finality of payment transactions, i.e. when payments are final and can no longer be revoked, irrespective of whether a participant in the system fails. If a payment order were to be revoked, this would interfere with the completion of settlement and have derived consequences for the other participants in the system.

The Finality Directive governs who may participate in a payment system protected by the Directive, such as credit institutions, investment companies and public authorities. If business enterprises and private individuals were to participate in the system, it could not be designated as a payment system protected by the Directive. The same issue has been identified by Sveriges Riksbank (2017).

1. Directive 98/26/EC of the European Parliament and of the Council of 19 May 1998 on settlement finality in payment and securities settlement systems, implemented in Part 18 of the Danish Securities Trading Act, cf. Consolidated Act no. 251 of 21 March 2017. As from 3 January 2018, the Act will be replaced by the Danish Act on Capital Markets, Act no. 650 of 8 June 2017.

ensure that roles and responsibilities in a crisis situation are defined and that the right internal and external stakeholders are involved or informed.

The stakeholders are also collaborating closely with regard to new threats from cybercrime, for example, in order to enhance the security of the financial infrastructure, including under the auspices of FSOR, cf. Box 7. In collaboration with the Danish Financial Supervisory Authority and Danmarks Nationalbank, the stakeholders have assessed the robustness towards cyberattacks and are working continuously to improve security.¹⁷

17 See Danmarks Nationalbank (2017a).

Danmarks Nationalbank oversees the systemically important parts of the infrastructure and makes recommendations to the owners of the payment systems if there are areas which do not comply with international standards for financial market infrastructures.¹⁸ The Danish Financial Supervisory Authority is tasked with IT supervision of the banks and the infrastructure companies providing IT to the Danish financial sector, for example Nets.¹⁹ If security is inadequate, the Financial Supervisory Authority can order banks and infrastructure companies to improve their practice.

If the purpose of introducing CBDC is to ensure that households and businesses have access to a contingency measure, if other payment systems should fail, from an economic perspective it would be more profitable to invest in better security measures in the existing systems. This is already taking place to a great extent today, cf. above.

Significance for the financial sector and financial stability

Issuing CBDC would entail risks for financial stability and change Danmarks Nationalbank's role in the financial system.

CBDC would give everyone unlimited access to claims on the central bank

The availability of a risk-free asset is named by Sveriges Riksbank (2017) as one of the arguments for issuing CBDC; as the use of cash declines, issuing CBDC is considered to be an important task for the central bank, so that households and businesses can hold their assets safely, and confidence in the monetary system can be maintained.

Today it is already possible to take safe asset positions by holding cash (a claim on Danmarks Nationalbank) or buying a Danish government bond (a claim on the Kingdom of Denmark). In Denmark there is also a depositor guarantee scheme to protect deposits in commercial banks

Financial Sector Forum for Operational Robustness (FSOR)

Box 7

Together with authorities and key stakeholders in the financial sector, Danmarks Nationalbank established the FSOR cooperation forum in 2016. Its aim is to enhance the sector's operational robustness, including its robustness towards cyberattacks, and thereby

- continue to provide a secure and efficient infrastructure, and
- support the Danes' continued trust in the digital solutions of the Danish financial sector.¹

1. Cf. FSOR (2016).

up to approximately kr. 750,000. Households and businesses can thus place their assets safely by holding cash, buying government bonds, or making deposits in commercial banks. Full risk-free coverage of larger deposits can be obtained by spreading deposits on several banks, so that the limit of kr. 750,000 is not exceeded in any one bank.

It is not part of Danmarks Nationalbank's objectives to make unlimited claims on the central bank available to the general public, but instead to support stable prices, financial stability and secure payments, cf. above.

CBDC would entail a fundamental change in the banks' business model

Despite the depositor guarantee scheme, households might consider a claim on Danmarks Nationalbank to be more safe than a claim on a commercial bank. If there was free access to CBDC, households might choose to convert a large proportion of their bank deposits to CBDC, which would have a great impact on the banks' funding opportunities. Today, deposits are an important funding source, especially for smaller banks, while the larger banks (which via their mortgage-credit institutes have significant mortgage-credit lending on their balance sheets), obtain financing directly in the market to a greater extent, cf. Chart 7.

18 See CPMI-IOSCO (2012) and Danmarks Nationalbank (2017d).

19 See Danish Financial Supervisory Authority (2015).

The direct effect of a transfer of bank deposits to CBDC, equivalent to a decrease in the banks' deposits, is a corresponding reduction of the banks' assets in the form of a decrease in their reserves at Danmarks Nationalbank. The reserves, comprising current-account deposits and certificates of deposit, fluctuate over time, and amounted to kr. 195 billion in mid-November 2017, cf. Chart 8.

If the households were to transfer a significant share of their bank deposits to CBDC, the banks would not have adequate central bank reserves to offset the decline in deposits. In this situation, a bank could increase its market financing, or alternatively, borrow from Danmarks Nationalbank, in order to cover the bank's liquidity deficit in kroner, cf. Chart 9. Yet the banks and households cannot overall increase their market financing, since a krone-denominated claim will always be offset by a krone-denominated liability elsewhere. The krone-market is thus a closed system and transfers of deposits between banks do not affect their overall reserves at Danmarks Nationalbank. This means that the banks would have to borrow from Danmarks Nationalbank, if the demand for CBDC were to be sufficiently high. The impact on the banks' funding needs would be greater if businesses also converted bank deposits to CBDC.

It is not a problem as such that the banks are net borrowers from the central bank, rather than net depositors. Yet it is important that the banks do not base their business model on being able to borrow from Danmarks Nationalbank. This principle is also reflected in financial regulation, whereby liquidity requirements are intended to ensure that the banks can fund themselves and have sufficient liquidity to offset a shortlived liquidity stress.

If the banks' deposit base becomes less stable as a consequence of CBDC, this will increase the demands on the banks' liquidity and funding management.

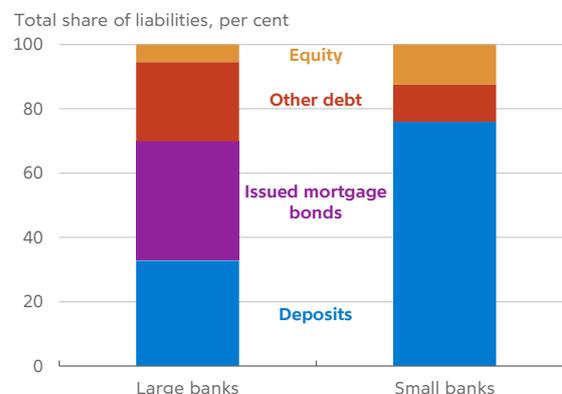
Greater fluctuation in the banks' deposits is reflected in greater fluctuation in the banks' reserves, and thereby in their net position vis-à-vis Danmarks Nationalbank. This can affect the transmission of the official interest rates to the money market interest rates, cf. below.

CBDC can change Danmarks Nationalbank's role in the financial system

The issue of CBDC would fundamentally change Danmarks Nationalbank's role in the financial system.

Structure of the banks' liabilities

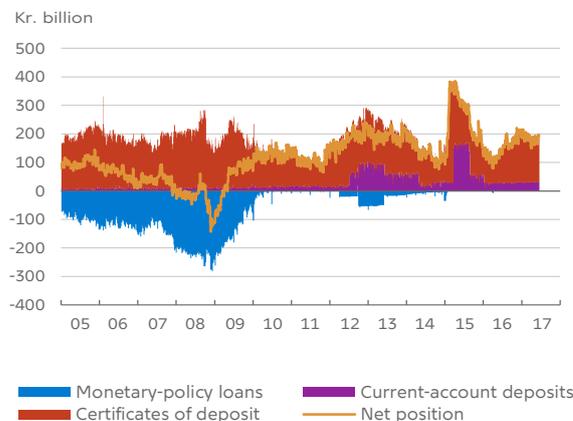
Chart 7



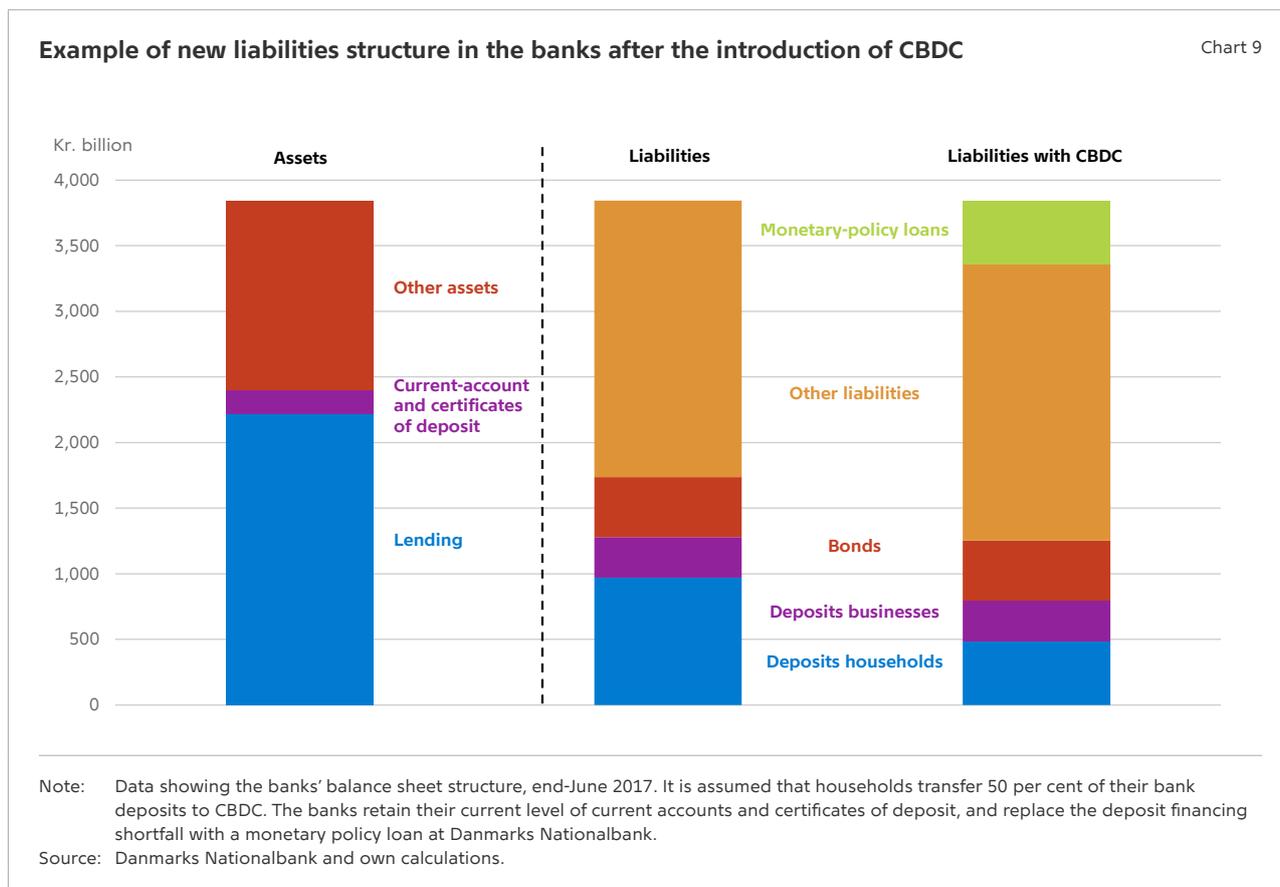
Note: The large and small banks are banks in the Danish Financial Supervisory Authority's groups 1 and 3, respectively. Data is as at 30 June 2017 and compiled at Group level.
Source: Danish Financial Supervisory Authority and own calculations.

The banks' reserves comprise current-account deposits and certificates of deposit

Chart 8



Source: Danmarks Nationalbank.



Danmarks Nationalbank would become a bank for the general public, rather than banker to the banks. This would make Danmarks Nationalbank a direct competitor to the commercial banks by offering deposit accounts and payment services, for example, which lie outside the traditional role of central banks.

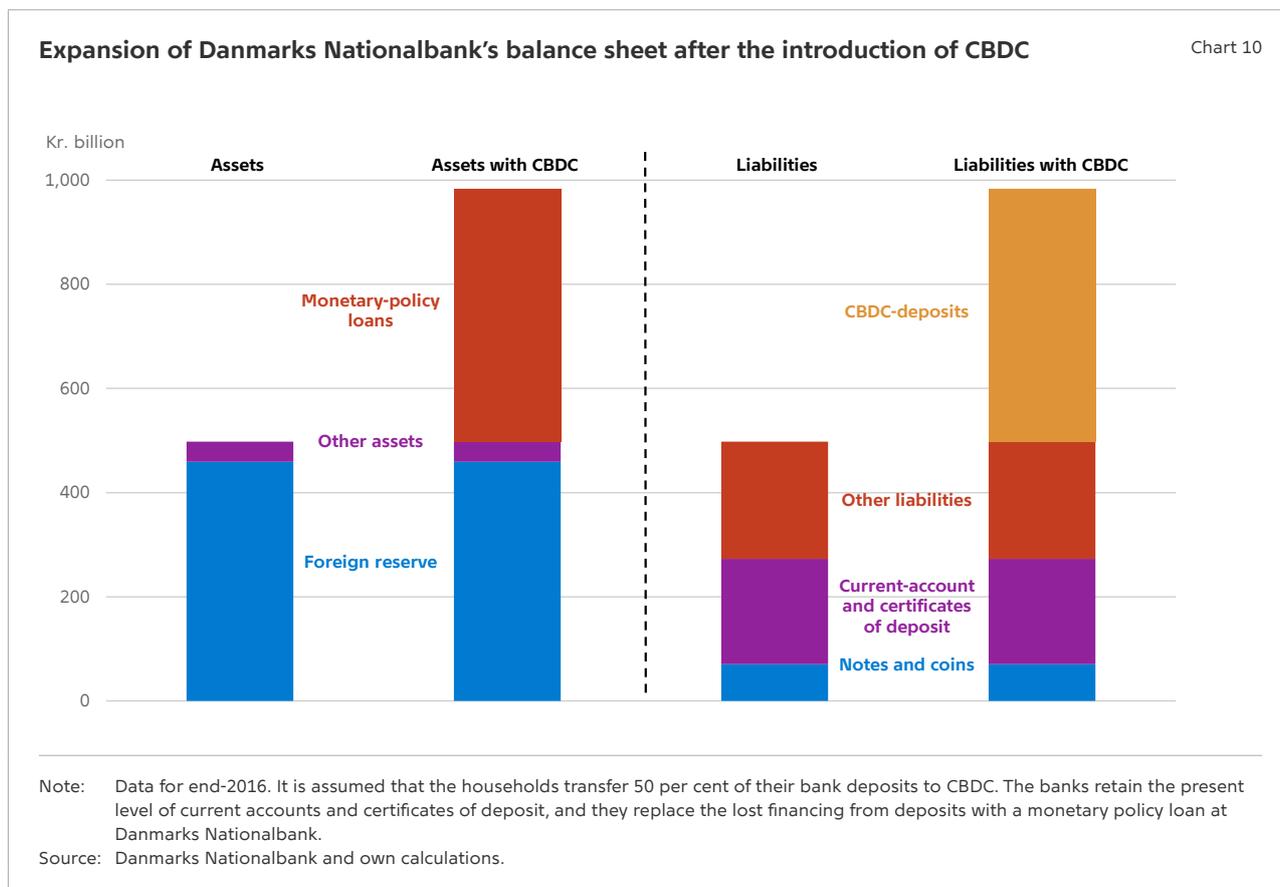
Danmarks Nationalbank's objective is not to compete directly with the banks, but to contribute to supporting financial stability and secure payments. The legislative framework to safeguard this includes statutory requirements concerning the banks' capital and liquidity, the right to a basic payment account and a depositor guarantee scheme. Yet the framework also covers the sector's work on instant payments and cyberrisk, cf. the sections above. This is important work, to which Danmarks Nationalbank contributes actively.

If Danmarks Nationalbank's balance sheet were to be expanded, this would expose Danmarks Nationalbank to higher risk

The demand for CBDC would be expected to exceed the demand for cash, since cash is cumber-

some to handle and store, compared to modern payment solutions. This would lead to an expansion of Danmarks Nationalbank's liabilities side, cf. Chart 10. The equivalent expansion of the assets side might entail an increase in Danmarks Nationalbank's risks in the form of increased lending to the banks and/or increased securities holdings.

The introduction of CBDC would lead to increased monetary policy lending, to the extent that the banks do not reduce the asset side, in step with declining deposits. Banks can borrow from Danmarks Nationalbank against adequate collateral. In normal times they can provide collateral in liquid securities, in the form of Danish government and mortgage bonds. But in periods of financial unrest and a greater need for borrowing, Danmarks Nationalbank may decide to expand the collateral base with other assets. Danmarks Nationalbank handles the risk of a change in the value of the pledged collateral during the term of the loan by only lending up to a certain fraction of the value of the collateral as of the loan date. The deduction which Danmarks Nationalbank makes



from the pledged collateral's value is often referred to as a haircut.

CBDC entails risks of systemic bank runs

One of the greatest risks to financial stability from introducing CBDC is the increased risk of systemic bank runs.

Today, a bank (or several banks) may be exposed to a bank run, whereby significant deposits are withdrawn from one bank at the same time, and transferred to another bank. But it is more difficult to have a run on the overall Danish banking sector. This is because it is not possible in practice to convert all bank deposits into cash. The only possibility of a systemic bank run is that customers transfer their deposits to foreign banks.

With CBDC, households and businesses would have an incentive to transfer their bank deposits to CBDC in a systemic crisis situation, unless there were a ceiling on the outstanding amount of CBDC. In step with declining confidence in the banking sector, this might happen, despite the depositor guarantee

scheme and any higher interest rate on bank deposits.

Today, deposits can in principle be converted to cash, but the practical challenges concerning cash make this less attractive. Furthermore, the general conversion of bank deposits to cash would take time, whereas conversion to CBDC could take place immediately. CBDC might therefore increase the risk of bank runs.

Measures to counter risks of financial instability

As stated above, there might be a risk of financial instability and negative effects on the banking system from introducing CBDC. These risks can be countered by a number of measures that might also lead to a number of new challenges.

The banks can counter the risk of bank deposits being converted to CBDC by increasing deposit interest rates in relation to any interest rate for CBDC, to make it more attractive to hold bank deposits than CBDC. Depending on the terms of

competition between the banks, they might compensate for the loss of income from paying higher deposit interest rates by increasing lending rates, or charging higher fees.

If Danmarks Nationalbank were to issue CBDC without interest, CBDC might be perceived primarily as a substitute for cash – at least during periods when the banks’ deposit interest rates were positive, and when the financial system was considered to be stable. Interest-earning CBDC, on the other hand, would to a high degree be a substitute for bank deposits. In the current low-interest-rate environment, the interest rate on a basic deposit account is typically zero, but historically, bank deposits have accrued positive interest. In normal times, higher interest rates for bank deposits than for CBDC would limit the demand for CBDC. But in periods of market unrest, households and businesses might move their deposits from the banks to CBDC, even if there was an interest rate differential between the two.

Unless the total issue of CBDC was limited, the interest rate for CBDC would in practice constitute the lower bound on the banks’ deposit interest rates, cf. the section concerning monetary policy and the krone rate below.

The risk of systemic bank runs could also be countered by setting a limit to how much the individual person or business may hold as CBDC. The limit could be set so as to make it possible to use CBDC for transactions, but not for savings, for example as a fixed ratio of GDP. Limitations to *transaction size* are known today from Straksclearing, for example, in which a payment may not exceed kr. 500,000.

However, there are a number of problems with setting a ceiling for *holdings* of CBDC. A fixed quota per account holder would limit the number or size of payments, since the recipient’s ceiling would have to be observed for a payment to take place. The ceiling would therefore have to be set sufficiently high for customary transaction sizes to be executed, so that payments could not be refused, and the effectiveness of the payment system could be maintained. No matter how high the ceiling were to be set, some

might prefer to stay relatively close to it. It is not expedient for the ceiling to be reached, so that the payment cannot take place.

Alternatively, an overall ceiling could be set for the amount of CBDC. This would not be unproblematic, either. If the overall supply of CBDC were lower than demand, it would no longer be possible to convert 1-1 between bank deposits and CBDC. This would not be expedient.

Monetary policy and the krone exchange rate

Moderate significance for the implementation of monetary policy

In Denmark, monetary policy is conducted by Danmarks Nationalbank in order to maintain a fixed exchange rate against the euro. This takes place by setting the level of the monetary policy interest rates, which specify the interest rates for the commercial banks’ deposits with and borrowing from Danmarks Nationalbank.²⁰

In the current situation, in overall terms the banks have considerable reserves at Danmarks Nationalbank – primarily as certificates of deposit, cf. Chart 8. This means that the inter-bank interest rates – the money-market interest rates – are closely linked to the interest rate for certificates of deposit, cf. Chart 11.

The money-market interest rates are central to monetary policy. First and foremost, the difference between the Danish money-market interest rates and the money-market interest rates in the euro area determines the demand for Danish kroner and thereby the krone’s exchange rate vis-à-vis the euro. The money-market interest rates also have a strong influence on the banks’ deposit and lending rates vis-à-vis their customers. Historically, these interest rates have been closely linked to the official interest rates, but since the introduction of negative interest rates

²⁰ See Spange and Toftdahl (2014) for a description of monetary policy in Denmark.

in 2012, the deposit interest rate has adjusted more sluggishly, cf. Chart 12. This is because the banks have been reluctant to introduce negative deposit interest rates for households and small businesses.

If there was substantial demand for CBDC, this would reduce the banks' reserves at Danmarks Nationalbank, cf. the section on financial stability. Instead, the banks might need to borrow from Danmarks Nationalbank. In this situation, Danmarks Nationalbank's lending rate would set the course for interest rates in the money market. Unless Danmarks Nationalbank's lending rate is equivalent to the rate of interest for certificates of deposit, the transition from the current situation, in which the banks need to deposit funds at Danmarks Nationalbank, to a situation in which they are net borrowers, would affect interest rates in the money market. Where there is an adverse impact on the exchange rate, Danmarks Nationalbank can handle this by intervening in the currency market or adjusting the level of the official interest rates.

While the banks play a central role in the implementation of monetary policy, Danmarks Nationalbank's outstandings with households do not currently play any role in this respect. The declining use of cash thus does not weaken Danmarks Nationalbank's ability to maintain a stable krone rate against the euro. This would also be the case if the households were to completely stop using cash and exclusively rely on bank deposits.

The interest rate on CBDC could not be used as a monetary policy instrument in Denmark

As the CBDC interest rate would affect households and businesses directly, it might be seen as a strong instrument to regulate the private sector's demand, and thereby stabilise the economy.²¹ As a consequence of the fixed-exchange-rate policy, the level of Danmarks Nationalbank's interest rates is determined solely by what is compatible with a stable krone exchange rate. This would also apply to the interest rate for CBDC. In a Danish context, interest on CBDC would therefore not present any new monetary-policy opportunities, since the interest rate on CBDC would be set to keep the krone exchange rate fixed.

The money-market interest rates are linked to the interest rate for certificates of deposit

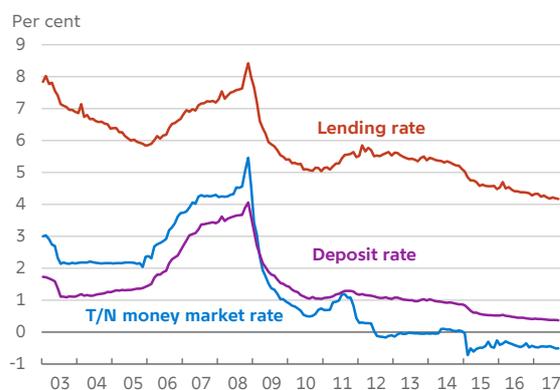
Chart 11



Source: Thomson Reuters Datastream.

The banks' deposit and lending interest rates

Chart 12



Note: Deposit and lending interest rates for households' outstandings.

Source: Danmarks Nationalbank.

²¹ Bordo and Levin (2017) argue that the interest rate on CBDC would be the primary monetary-policy instrument. See also Barrdear and Kumhof (2016) for a discussion of how the interest rate on CBDC can be used as a monetary-policy instrument.

The interest rate on CBDC would constitute a lower bound

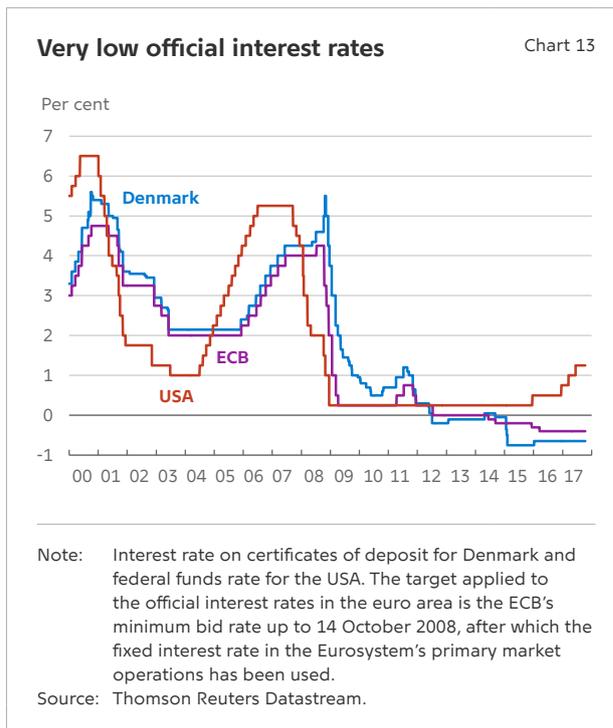
In reaction to the financial crisis and the subsequent economic slump, central banks all over the world have reduced interest rates to very low levels, cf. Chart 13. There is a limit to how low interest rates can fall. This is because households and businesses can avoid negative interest rates by holding cash. The lower bound is somewhat below zero, since there are costs associated with holding and using large amounts of cash.

An account-based CBDC would be free of the frictions applying to cash. Unless the overall issue of CBDC is restricted, the interest rate on CBDC would therefore set a lower bound for the deposit interest rates for the economic agents with access to CBDC. This reflects that CBDC would be a very safe and liquid asset. If the interest rate for CBDC were at the same level as could be achieved from alternative positions, households and businesses might place all of their savings in CBDC. In situations with financial instability, households and businesses might be willing to accept a lower interest rate for CBDC than they could achieve elsewhere.

Today, households typically receive little or very low interest on their bank deposits, while businesses' deposits are often subject to negative interest rates. This applies especially to large deposits from institutional investors, for example, such as insurance companies and pension funds. To avoid these deposits being converted to CBDC, it would therefore be necessary to have a negative interest rate for CBDC. Alternatively, the banks would be obliged to raise their deposit interest rates. Issuing CBDC could thus have consequences for interest rate formation in the financial markets. The markets are characterised by how liquidity, risk and other conditions enter into the formation of prices, thereby contributing to the best possible allocation of capital.

Difficult to manage demand for CBDC

The amount of CBDC could be restricted by a ceiling on how much CBDC each agent in the economy could hold. A ceiling would also have unintended consequences, however, cf. the section concerning financial stability. Alternatively, if the interest rate on CBDC is assumed to be zero, there might be a model in which the groups of agents that so far have experienced negative deposit interest rates at the banks could be prevented from holding CBDC. In practice, this would mean that CBDC could only be offered to households.



The demand for CBDC would depend on its interest rate, relative to the general level of interest rates in the economy. If CBDC were not to accrue interest, changes in the monetary policy interest rates, which determine the general level of interest rates in the economy, would therefore affect the demand for CBDC. In principle, the same is the case today for cash. The practical disadvantages of cash make the demand relatively inelastic, however. To avoid households and businesses to a great extent switching backwards and forwards between CBDC and bank deposits, it might be necessary to have a close relation between CBDC interest rates and the monetary policy interest rates. It would not be appropriate if non-interest accruing CBDC were to increase fluctuations in the banks' deposits, which are normally considered to be a stable funding source.

CBDC could intensify international capital movements

The krone/euro exchange rate depends on the relative demand for the two currencies. If foreign agents were to consider a Danish CBDC to be attractive, this might lead to an inflow of capital, for example, if Danmarks Nationalbank introduced a non-interest bearing CBDC in a situation with very low or negative interest rates. In this situation, a non-interest bearing claim on Danmarks National-

bank would be attractive to investors in the euro area, for example, if the alternative were a money-market position at a negative interest rate. The fixed-exchange-rate policy means that investors in the euro area do not incur an exchange-rate risk by investing in krone-denominated assets, rather than euro-denominated assets.

An increase in the demand for kroner would strengthen the krone against the euro. To counteract this, Danmarks Nationalbank would issue kroner against foreign currency, and thereby increase the foreign exchange reserve. This was the case in January and February 2015, cf. Chart 14. Yet if this inflow were to continue, it could be necessary to lower interest rates, including for CBDC. In these situations, non-interest bearing CBDC with access for foreign agents would not be compatible with the fixed-exchange-rate policy.

In a situation where the general level of interest rates was increasing again, non-interest bearing CBDC would gradually become less attractive, and capital movements could be assumed to be reversed.

CBDC could thus, in the longer term, lead to greater capital movements both into and away from kroner, in step with changes in the relevant interest rate spreads. This could make it necessary to have a larger foreign-exchange reserve than today, to ensure an adequate buffer if households and businesses sell kroner.

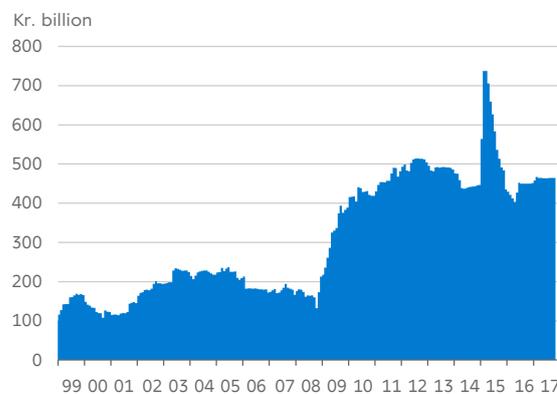
Also implications for monetary policy, if other countries issue CBDC

If other countries issue CBDC, this could further increase the fluctuations in capital movements. Today, it is primarily large businesses and institutional investors that demand financial assets in foreign currency, and thereby influence the demand for Danish kroner. But if central banks in other countries were to begin to issue CBDC, it might be more interesting for households to move their savings around between different currencies.

For example, it might be attractive for Danish households and businesses to hold electronic claims on the ECB, since it would probably be easy for Danish shops to receive payments in euro-CBDC. On this basis, Danish households might exchange parts of their deposits in Danish banks for euro-CBDC.

The foreign-exchange reserve reflects the demand for kroner

Chart 14



Source: Thomson Reuters Datastream.

If the issue of CBDC were to lead to households increasingly moving their savings across currencies, this would make the demand for kroner more interest rate sensitive. As a consequence, Danmarks Nationalbank would have to make major interventions in the currency market. The potentially substantial capital movements could be handled, however, within the existing monetary-policy framework, cf. above.

The challenges in relation to financial stability might increase, on the other hand, if Danish households and businesses were to have access to CBDC issued by other countries' central banks. If financial turmoil were to arise in Denmark, it might be attractive for Danish households and businesses to withdraw their deposits from the Danish banks and instead hold CBDC issued by the ECB.

Higher seigniorage

When Danmarks Nationalbank issues money, this has historically generated significant revenue, which is often called seigniorage. This arises when Danmarks Nationalbank obtains financing by issuing interest-free cash and investing in financial assets at positive interest rates. The costs of producing banknotes and coins must be deducted from this. In the current low-interest-rate environment, seigniorage is at a very modest level.

The seigniorage is part of Danmarks Nationalbank's profit, most of which falls to the state. If the demand for cash declines, seigniorage will also decrease.

This could potentially be offset by issuing a non-interest bearing or low-interest CBDC.²² Yet it is not Danmarks Nationalbank's objective to achieve the highest possible profit.

CBDC could entail political and reputational risk

Issuing CBDC would increase the direct contact between Danmarks Nationalbank and households and businesses. This would increase the risk of dissatisfied customers for Danmarks Nationalbank. This might be due to system failure, or if the facilities offered in relation to CBDC – for example the user interface which enables households and businesses to access their CBDC – were not considered to be sufficiently user-friendly. The extent to which this type of criticism of Danmarks Nationalbank would influence Danmarks Nationalbank's credibility with regard to the task of ensuring financial stability and stable prices is an open question.

Depending on how a CBDC is designed, this could also exert political pressure on Danmarks Nationalbank. In the event of financial unrest, there might be pressure from politicians or the media for the CBDC ceiling to be raised, even if the ceiling were to be fixed beforehand.

Conclusion

In the international debate, a number of potential benefits of introducing CBDC are mentioned, including opportunities to achieve a more secure and effective payment system and to establish a back-up system for the existing payments infrastructure.

However, the potential benefits of introducing CBDC for households and businesses in Denmark are not assessed to match the considerable challenges that the introduction would present.

In a country like Denmark, with a secure and effective payment system, it is difficult to see what CBDC would contribute that is not already covered by the existing payment solutions. In a Danish context, digital currency thus already exists, as bank deposits.

On the other hand, the analysis shows that the introduction of a CBDC would change the role of Danmarks Nationalbank in the financial system and create a number of challenges with regard to financial stability. Depending on how it were to be designed, issuing CBDC would also present challenges in relation to the fixed-exchange-rate policy. The drawbacks of introducing CBDC in Denmark are thus assessed to be considerable. Danmarks Nationalbank assesses that the central bank must continue to be the banker to the banks, rather than the bank for all of Denmark's population.

If another central bank were to decide to introduce a CBDC, this would be of significance to Danmarks Nationalbank and the financial system. This makes it important to monitor developments.

²² Barrdear and Kumhof (2016) emphasise the income from issuing CBDC as a positive effect thereof.

Annex 1 - Blockchain

A blockchain is a chain of (information) blocks that are connected by digital cryptographic “fingerprints”. Besides a number of transactions or other information, each block contains a reference to the previous block’s cryptographic fingerprint. The structure means that previous transactions can only be changed by updating all fingerprints for the subsequent blocks. The integrity of a blockchain is also verified across the parties that share information in the blockchain. This takes place by each of the parties holding a copy of the shared blockchain, so that they can compare their copies with the other parties’ blockchain. This is also called a distributed ledger.

To ensure that all parties have the same copy of the shared ledger, new blocks must be added to the local copies in the same sequence. This is ensured by new blocks being verified and ordered either jointly through an agreed consensus mechanism, or via a process called proof-of-work. A consensus mechanism sets requirements for the number of participants and is typically used in networks with access restrictions. Proof-of-work, on the other hand, may be used on open networks, since one participant can designate the next new block by being the first

to solve an energy-intensive calculation linked to the specific block.

The unique sequence also ensures that the same money is not used several times, when a blockchain holds monetary transactions.

Cryptographic fingerprints thus protect the integrity of the individual blockchain, while maintaining uniform local copies of the shared blockchain or distributed ledger ensures data integrity between the parties. This is the basis for the technology’s built-in security and for the parties being able to establish and maintain a shared outlook – even though there is no central independent third party to establish this.

In recent years, the blockchain technology has been used in many ways in the financial markets, besides cryptocurrencies. An example is initial coin offerings, ICOs, which can help new start-ups to raise capital. The company issues tokens on a blockchain, which resemble shares, and investors can buy them. In November 2017, the European Securities and Markets Authority, ESMA, warned of the considerable risks of investing in ICOs.²³

23 Cf. ESMA (2017).

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ABOUT ANALYSIS



As a consequence of Danmarks Nationalbank's role in society we conduct analyses of economic and financial conditions.

Analyses are published continuously and include e.g. assessments of the current cyclical position and the financial stability.

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