

The Riksbank's e-krona project

Report 2

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Foreword

The Riksbank has a statutory task to promote a safe and efficient payment system, a task that may be more difficult if cash is no longer used as a means of payment by the majority of households and companies in the future. The Riksbank therefore needs to consider which role it should adopt in an ever more digital world. As part of this, the Riksbank started a project in the spring of 2017 to examine the scope for the Riksbank to issue a central bank digital currency (CBDC), a so-called e-krona, as a complement to cash.

Over the past year, the Project has continued its analysis of CBDC and had extensive dialogue with several national and international actors in order to hear their views on the e-krona. Based on this dialogue and the analysis performed at the Riksbank, the Project has now compiled a new report in which we analyse the need for an e-krona in more detail, and propose that the Riksbank start a legal inquiry into the Riksbank's mandate with regard to CBDC and that the Riksbank begin development work to build and test a technical proposal for a viable e-krona.

The question of whether Sweden should introduce a state-issued digital krona is one that will affect the whole of society. Continued dialogue with the general public, payment market participants and other central agencies will be important. No decisions have been taken to issue an e-krona or not, but by continuing to examine the scope for doing so, the Riksbank is preparing a possible way forward towards meeting a new digital payment market.

Stockholm, October 2018

Eva Julin
Project manager

Summary

Cash use continues to decline in Sweden. In future, cash may be so marginalised that it becomes difficult to use as a means of payment. For 350 years, the Riksbank has provided the general public with money but going forwards, the technical development and digitalisation of payments will bring the issue of the state's role to a head. If the marginalisation of cash continues a digital krona, an e-krona, could ensure that the general public still has access to a state-guaranteed means of payment. Alternatively, not to act in the face of current developments and completely leave the payment market to private agents, will ultimately leave the general public entirely dependent on private payment solutions, which may make it more difficult for the Riksbank to promote a safe and efficient payment system.

Central bank digital currencies (CBDC) are a new and relatively unexplored area that is currently being analysed by several central banks around the world. Adopting a position on whether Sweden should introduce an e-krona will take time. The analysis needs to continue so that we increase our knowledge about the consequences and effects of an e-krona. At the same time, technical solutions have to be devised so that an e-krona can be developed and tested. In this report, the Project proposes that the Riksbank begin to design a technical solution for an e-krona in order to test which solutions are practical and possible to realise. In addition, the project suggests that the Riksbank draw up proposals for legislative amendments that are needed to clarify the Riksbank's mandate and an e-krona's legal standing.

The use of cash continues to decline

According to the Riksbank's survey from 2018, only 13 per cent paid for their most recent purchase in cash. The corresponding figure for 2010 was 39 per cent. As more consumers turn to electronic payments, it will ultimately no longer be profitable for retailers to accept cash. If the trend continues, Sweden may find itself in a few years' time in a position where cash is no longer generally accepted by households and retailers.

The state needs to have a role on the payment market

For a long time, the state has provided the general public with banknotes and coins to use for payments. Cash has enjoyed the confidence of the general public and facilitated trade in goods and services. Today's digital payment market means that we face a new situation in which all means of payment accessible to the general public are issued and controlled by private agents. If the state, via the central bank, does not have any payment services to offer as an alternative to the strongly concentrated private payment market, it may lead to a decline in competitiveness and a less stable payment system, as well as make it difficult for certain groups to make payments. Ultimately, it may also risk eroding basic trust in the Swedish monetary system. Some of these problems could be neutralised or mitigated by an e-krona.

What can an e-krona provide?

The e-krona could become a modern krona in electronic form as a complement to physical cash. The public could then continue to have general access to central bank money. The e-krona could also strengthening preparedness, as the private market cannot be expected to

take all the responsibility for ensuring that payments function in crisis situations. In serious crises, when private payment systems may fail, an e-krona could work as an alternative system and thereby increase stability in the payment system as a whole. The e-krona could hence help to promote a safe and efficient payment system.

The e-krona could offer a competitively neutral infrastructure which payment service providers can join if they wish to offer services to households and companies. This could increase competition, benefit innovation and possibly slightly reduce the fees charged to the general public.

There are currently groups in society that are encountering problems as cash use declines because they find it difficult to use digital payment solutions for one reason or another. Such groups include older people, people with disabilities or those who, for different reasons, do not have access to payment instruments other than cash. Since it cannot be expected that the private market fully cater for these groups, the state can choose to take greater responsibility for them by. This could for example be done by designing a simple and user-friendly e-krona or by legislating and regulating so that the private sector is forced to take greater responsibility.

The e-krona – value-based or account-based

E-krona can be described as Swedish krona that can either be held in an account at the Riksbank (account-based) or be stored locally, for example on a card or in a mobile phone app (value-based). Both types of e-krona assume that there is an underlying register so that it is possible to record transactions and safeguard who is the rightful owner of the digital krona. This means that digital transactions with e-krona will be traceable.

For it to be practically possible to use e-krona for online purchases or in physical shops, the e-krona platform, which contains the underlying register for e-krona, needs to interact with a number of other systems and agents. Banks and other companies, for example, need to be able to join the e-krona platform in order to be able to develop and offer payment services to households and companies. Systems are also needed that enable money laundering checks and a link to a settlement system so that e-krona can be moved into and out of the platform.

Legally speaking, a value-based e-krona is classed as e-money, while an account-based e-krona can be likened to a deposit. E-krona could be offered in the same way as cash is today and be widely available to households and companies (regardless of domicile). However, an application to open an e-krona account may need to be assessed based on established rules and conditions just as when a bank account is opened at a private bank.

The Project's assessment is that the introduction of an e-krona is compatible with the Riksbank's task to promote a safe and efficient payment system. Its design affects the need for amendments to the Sveriges Riksbank Act, however. A value-based e-krona is considered compatible with the Sveriges Riksbank Act, but in order for the Riksbank to have a clear mandate to issue an account-based e-krona, the Act needs to be adapted. The Project proposes that the Riksbank start an inquiry to draw up concrete proposals for the amendments that need to be made in order to provide the Riksbank with just such a clear mandate.

The demand for e-krona determines the consequences for monetary policy and financial stability

How monetary policy and financial stability will be affected by the e-krona depends on how large demand for an e-krona will be. The demand depends in turn on how the e-krona is designed. The conclusion in the report is that if the e-krona were to be in substantial demand and be widely available, it would be beneficial to control its demand. Interest rate could in this case be one among other possible tools to limit possible negative effects on the efficiency of monetary policy and financial stability.

If demand were to be small, the effects on the financial system would be minor. Banks might perhaps receive slightly fewer deposits and therefore have to obtain slightly more

wholesale funding. In times of financial unease, when the public may wish to withdraw large amounts from weak banks, the e-krona could make the run from the banking system to state-guaranteed money both easier and quicker than a traditional run from the banking system to cash. However, the Riksbank already has tools to be able to cope with such situations if they were thought to pose risks to financial stability.

The Project proposes that the Riksbank build a technical solution for a value-based e-krona

The Project proposes that the Riksbank initiate a pilot programme to develop one or more possible technical solutions for a comprehensive e-krona concept that provides the Riksbank with greater room for manoeuvre and knowledge prior to a decision on whether to issue an e-krona or not. The proposed focus of this programme should be on developing an e-krona that constitutes a prepaid value (electronic money) without interest and with traceable transactions. An account-based e-krona requires coordination with other central agencies. It is therefore reasonable for any e-krona system for account-based krona to be built in agreement, and perhaps even in partnership, with other agencies. A Swedish position on digitalisation on the payment market should also be drafted. The project proposes that the Riksbank initiate cross-agency dialogue in this issue.

1. The need for an e-krona

The Riksbank has a statutory task to promote a safe and efficient payment system, and has for 350 years supplied the general public with money. Increased digitalisation means, however, that the use of cash is declining. Developments in the field are rapid and within a few years, if the current trend continues, we will find ourselves in a situation where cash is no longer generally accepted as a means of payment. New technology has brought to a head the matter of the Riksbank's responsibility towards the general public. The Riksbank can either choose not to react to developments on the payments market and pass responsibility for means of payment to the private sector, or choose to continue supplying a means of payment to the general public in a new digital form.

This chapter discusses the need for a continued state presence on the payments market. The question is whether an e-krona can give the general public continued access to a risk-free means of payment, increase resilience in the payment system, contribute to increased competition on the payment market and make digital payment services available to groups in society that currently find these difficult to adopt.

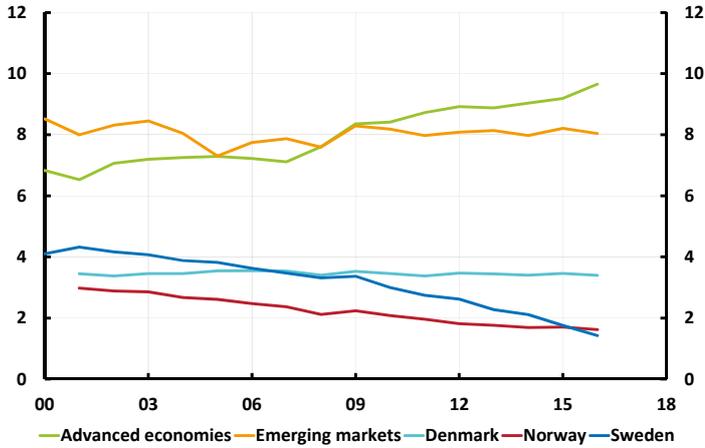
1.1 Cash use is decreasing in Sweden

Demand for electronic payments is increasing abroad, but at the same time, the demand for cash is stable or increasing (see Figure 1). In March 2018, the Bank for International Settlements (BIS) published an analysis of the use of cash and electronic payments, and concluded that the continued high demand for cash in many parts of the world can be explained by its function as a safe store of value in the wake of the financial crisis in 2008.¹ In Sweden and Norway, however, cash in circulation as a percentage of GDP has continued its downward trend even after the financial crisis (see Figure 1). The use of cash is declining particularly rapidly in Sweden, and since 2008 the value of cash in circulation has declined by around 50 per cent and is now down at SEK 53 billion.²

¹ See Bech et al. (2018).

² September 2018. Refers only to valid banknotes and coins.

Figure 1. Cash as a percentage of GDP
Per cent

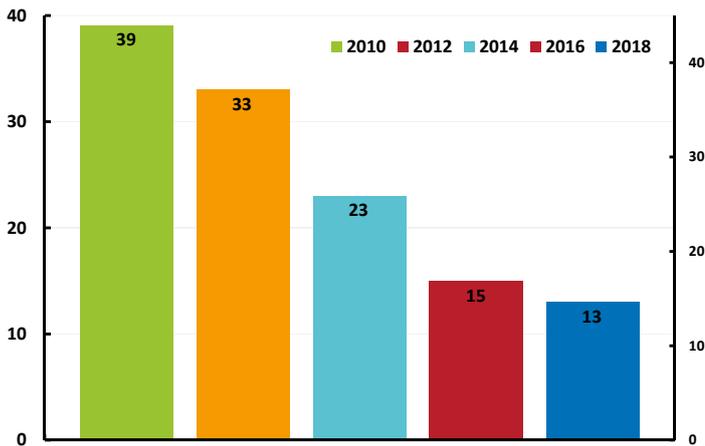


Source: Bech et al. (2018).

There are differences between countries in Europe with regard to the use of cash, but for the euro area as a whole the value of cash as a percentage of GDP is just over 10 per cent, which can be compared with Sweden where the corresponding figure is just over 1 per cent.³ In Sweden, the decline in the use of cash has also affected the trade sector’s expectations of the future. Half of the retailers in Sweden believe that they will stop accepting cash as a means of payment in 2025 at the latest, as it will ultimately become too expensive to accept cash if use continues to decline.⁴ This development is not seen abroad.

The development towards an increasingly digital payment market was discussed in interim report 1⁵ and since then a new survey has been made of payment patterns in Sweden.⁶ It shows that the decline in the use of cash has continued over the past two years. Figure 2 below shows that the percentage of respondents saying that they paid for their most recent purchase in cash has declined from 39 per cent in 2010 to 13 per cent this year.

Figure 2. Percentage who paid for their most recent purchase in cash⁷
Per cent



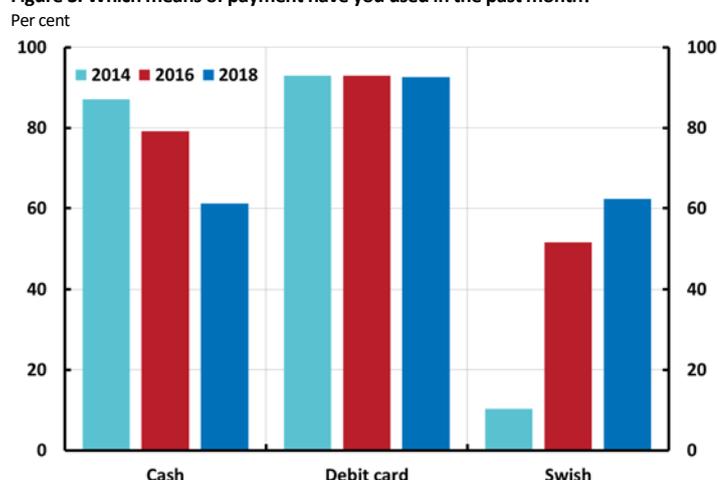
Source: The Riksbank

The survey also shows that it is becoming increasingly common to pay by mobile phone through the Swish payment app⁸ instead of cash (see Figure 3). This year’s survey shows that

³ Own calculations based on statistics from the Riksbank and Statistics Sweden.
⁴ See Arvidsson et al. (2018).
⁵ See Sveriges Riksbank (2017).
⁶ See Sveriges Riksbank (2018).
⁷ In 2018 the question refers to purchases in a physical shop.
⁸ Swish is a mobile service that enables instant account-to-account transfers.

slightly more than 60 per cent state that they have used Swish to make a payment in the past month.

Figure 3. Which means of payment have you used in the past month?



Source: The Riksbank

1.1.1 Why does the Swedish payment market look the way it does?

Sweden, like the other Nordic countries, is currently a pioneer with regard to digital developments.⁹ This is probably one reason why Swedes have begun to use various digital solutions, such as Swish, relatively quickly. The Swedish Bank-ID app that enables simple and instant identification has also strongly contributed to this development. Swedish legislation also makes it possible for private companies to waive the obligation to receive cash if they clearly provide information that they do not accept payment in cash, for instance by means of a sign beside the till or entrance.

However, it is difficult to determine with any certainty why the use of cash is declining. There are many indications that this development is mainly because digital payment forms are perceived as more convenient and easily accessible.¹⁰ The development does not appear to be because access to cash has deteriorated. In 2016 there were just as many ATMs as in 2006, just over 2,800 across the country, but the general public chose to withdraw ever smaller amounts from them.¹¹ It therefore cannot be said that it has become more difficult to get hold of cash through ATMs in Sweden as a whole. On the other hand, there are some regional differences. According to the Riksbank's interview survey,¹² Swedish households rarely perceive that shops refuse to accept cash. Almost 80 per cent of the respondents state that they rarely or never experience problems in paying by cash in shops. However, it is clear from the surveys that problems paying in cash are increasing over time and that there is lower acceptance in cities than in rural areas. The development towards ever lower acceptance is scarcely surprising. Cash handling gives rise to costs for the trade sector. When fewer consumers choose to pay in cash, it is no longer profitable to continue to accept it. It can also be mentioned there that the ongoing Riksbank inquiry has discussed the question of cash and produced a number of proposals aimed at maintaining good access to cash services.¹³ These can, according to the inquiry, help to slow down the trend of a rapid decline in the use of cash.

To summarise, it is difficult to know why the use of cash is declining so rapidly in Sweden. However, it should be noted that if this development is primarily due to consumers and

⁹ See, for instance, the EU's Digital Economy and Society Index (DESI). In 2017, Sweden was in third place behind Denmark and Finland.

¹⁰ For a more detailed discussion see Erlandsson and Guibourg (2018).

¹¹ The number of bank offices offering manual cash services has declined substantially since 2010 and this may have had some impact, albeit relatively limited. However, ATMs are the primary distribution channel for cash to the general public.

¹² See Sveriges Riksbank (2018).

¹³ See the interim report (only available in Swedish)

<https://www.regeringen.se/49cf6d/contentassets/79026c9e608946bdbfa60067ddae0c0d/tryggad-tillgang-till-kontanter-sou-201842.pdf>

payees becoming less interested in using cash, then the trend will not be broken because access to cash increases or is maintained.¹⁴

1.2 Many central banks are analysing central bank digital currencies

Central banks have been supplying a form of digital money since the 1980s, through their central bank settlement systems for large-value payments between banks.¹⁵ This money is banks' deposits with the central bank. A central bank digital currency (CBDC) refers to digital central bank money that is more widely available, for instance to the general public.¹⁶ Many central banks are currently investigating the possibility of issuing CBDC and different CBDC concepts are being discussed in various contexts. The Riksbank and Nordic central banks have mainly been interested in a version that is broadly available to the general public, while other international interest has been greater with regard to a CBDC with a more limited counterparty circle, and often in connection with questions regarding new technology in the form of distributed ledgers (DLT) and blockchains. The current systems for large-value payments are starting to become outdated in a number of central banks. The central banks in, for instance, Canada, Singapore, Japan and the euro area have started pilot tests to investigate whether interbank payments based on DLT can be made safer, more efficient and cheaper than in the current systems based on central databases.¹⁷ Technological developments in the field move very quickly and it is difficult at present to say what DLT can make possible both in terms of interbank payments and other areas of use in the future.

Some central banks have shown an interest in a CBDC that is also accessible to households and companies. Most of the investigations of this type are purely theoretical and analyse possible motives for issuing a CBDC and the consequences for the central bank's balance sheet, monetary policy and financial stability. The Bank of England and the Bank of Canada, for instance, have published a number of articles in this field.¹⁸ In the Nordic region, the question of a CBDC that is accessible to the general public has become topical as a result of the low use of cash. The Nordic countries have produced several reports and analyses concerning CBDC.¹⁹

The group of central banks interested in CBDCs offered to the general public also includes countries in Asia, Latin America and Africa.²⁰ The arguments in favour of analysing a CBDC to be offered to the general public have been based on the idea that a CBDC is expected to increase financial inclusion and reduce the use of cash, which is considered costly, risky, to have negative environmental effects and to facilitate the black economy.

¹⁴ See Erlandsson and Guibourg (2018).

¹⁵ The central bank settlement system in Sweden is the RIX system.

¹⁶ See BIS (2018). This is a very new area and the terminology has not yet converged on an established standard. On an overall level, CBDCs can be divided into two main groups; wholesale CBDC and general purpose CBDC, depending on the counterparty circle that will have access to them. A wholesale CBDC is in general aimed at a counterparty circle that is broader than those who can take part in the central bank's central clearing system and outside of the clearing system's opening hours. In addition to banks and clearing organisations, insurance companies, securities dealers and asset managers would also be able to hold this type of CBDC. With a general purpose CBDC, the counterparty circle is expanded even further to include all economic agents, that is, companies, associations and households.

¹⁷ See, for instance, Project Jasper https://www.payments.ca/sites/default/files/29-Sep-17/jasper_report_eng.pdf, Project Ubin <http://www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre/Project-Ubin.aspx>, Project Stella https://www.ecb.europa.eu/pub/pdf/other/stella_project_leaflet_march_2018.pdf and Project Khokha https://www.resbank.co.za/Lists/News%20and%20Publications/Attachments/8491/SARB_ProjectKhokha%2020180605.pdf

¹⁸ See, for instance, Engert and Fung (2017), Davoodalhosseini (2018), Kumhof and Noone (2018) and Meaning et al. (2018).

¹⁹ See, for instance, Central bank of Iceland (2018), Grym et al. (2017), Gürtler et al. (2017) and Norges Bank (2018).

²⁰ See, for instance, Uruguay http://www.bcu.gub.uy/Comunicaciones/Paginas/Billete_Digital_Piloto.aspx, Venezuela <http://www.bcv.org.ve/notas-de-prensa/presentaron-el-whitepaper-del-petro-en-el-bcv>, the Philippines: <http://congress.gov.ph/press/details.php?pressid=8212> Indonesia: <http://www.thejakartapost.com/news/2018/01/29/bank-indonesia-considers-issuing-digital-rupee.html>

Box 1. A payment market in transformation

The development described in this report has a national focus. However, the Swedish payment market will of course be affected by factors in the world around us. The participants in the payment market hope that collaboration will lead to economies of scale and network effects; the national markets are too small for these effects to be fully utilised at present. Both infrastructure and services will therefore, in the long run, shift increasingly from a national bias to being cross-border. Two important discussions at present are the question of a pan-Nordic payment market and the construction of a joint European infrastructure for instant payments between bank accounts.

The major Nordic banks are currently implementing an initiative, known as P27,²¹ which is investigating the possibility of creating a joint payment infrastructure with common products for the Nordic market. At present, talks are under way between banks and other stakeholders. We do not yet know how this will turn out.

However, the European Central Bank (ECB) is already in the process of creating a new joint European infrastructure for instant payments. They are building a system for the instant settlement of customer payments. It is called TIPS (Target Instant Payment Settlement)²² and will enable payment services with instant payments between accounts at European banks. TIPS will also have the technical capacity to settle payments in currencies other than the euro and can thus be used for accounts that hold SEK. The system shall be put into production during the autumn of 2018.

The Riksbank's assessment is that the development towards increased use of instant payments will continue. However, at present the Riksbank does not offer any settlement of instant payments. Given the increased interest in instant payments, the Riksbank is investigating the possibility of offering it. If the Riksbank were to offer such a system, it would not necessarily have to be operated by the Riksbank or even within Sweden. The Riksbank has therefore consulted with the market to find out how it would view an arrangement whereby the Riksbank enabled settlement of instant payments in SEK on the TIPS platform.

How does the e-krona relate to the developments in the payment market and to the Riksbank's thoughts on offering instant settlement in central bank money? The e-krona would probably become a complement to a potential future system for instant settlement. An e-krona would give the general public the possibility to hold central bank money. An e-krona would also offer, as cash has previously done, an alternative means of making payments if the system for instant settlement of payments between accounts in private banks were to suffer disruptions. The Riksbank will follow this development and take it into account during the work on the e-krona and when making future decisions.

1.3 The state's role on the payment market

If the use of cash continues to decline, we will face an historic event. For more than one thousand years, the Swedish state and its precursors, in the form of early royal powers, have provided the general public with means of payments, first in the form of minted coins, and then with the establishment of the Riksbank in 1668 also with banknotes. The state has, in this way, contributed to create a standardised method of payment that has had the general public's confidence. It has contributed to reducing transaction costs and facilitated trade in goods and services. Since 1904, the Riksbank has had a monopoly on issuing cash.²³ If the use of cash continues to decline at a rapid pace, Sweden is heading for a situation where the role of the state is changed and all means of payment to which the general public have access are issued and controlled by commercial agents. Apart from the RIX system for payments between financial institutions, the entire infrastructure for the payment market would be in private ownership. This would involve a new set of circumstances. Firstly, the general public would no longer have access to what we call central bank money, which has a lower credit

²¹ P27 refers to a joint payment infrastructure for the 27 million people living in Sweden, Norway, Denmark and Finland. For further information see, for instance, <https://www.bloomberg.com/news/articles/2018-07-15/banks-are-building-a-super-speed-money-highway-in-the-nordics>

²² For further information on TIPS see ECB https://www.ecb.europa.eu/paym/intro/news/articles_2017/html/201706_article_tips.en.html

²³ For an in-depth discussion, see Wetterberg (2009).

and liquidity risk²⁴ than private bank money. Historically, the possibility to convert money in a private bank to state issued banknotes has been considered fundamental to guaranteeing that confidence in private money is upheld.²⁵ Secondly, the vulnerability of the payment system will increase if the use of cash falls so low that it no longer functions as a practically usable alternative in the event of serious and prolonged disruptions. An e-krona could uphold the state's offering to the general public in the payment market. The Riksbank can also choose not to react to the developments in the payment market. This type of situation and what it would entail for the general public is discussed in box 2 below.

²⁴ Given that an e-krona can always be instantly converted to commercial bank money or cash, has the same status as cash and is generally available, we consider that the e-krona, like cash today, would not bear any liquidity risk.

²⁵ For an in-depth discussion, see Söderberg (2018b).

Box 2. How would the general public be affected if the Riksbank did not react to the developments in the payment market?

Digitalisation and the declining use of cash have many advantages and can contribute to increased efficiency on the Swedish payment market. But at the same time, these developments entail a number of challenges for the Riksbank when considering the various courses of action. In this box, we discuss how the general public will be affected if the Riksbank, or another agency, chooses not to react to the developments on the payment market. The effects we describe here will probably need to be taken into account and possibly managed by the state in a broader sense.

The trend towards a decline in the use of cash described in Section 1.1 may possibly be slowed down, but can probably not be reversed. Ultimately, it means that the general public will eventually stop using cash and that it will no longer be generally accepted in the trade sector. What might this mean for the general public?

- In practical terms, it would mean that **all Swedes must have an account with one of the private agents** to be able to store their money electronically, have access to it and to make payments. Although most Swedes already have a bank card issued by a private bank, there is currently an alternative to this in the form of cash.
- **The characteristics of the payment market mean that monopoly situations can easily arise.** Cash currently competes, albeit to a declining extent, with digital means of payment offered by banks. But just the fact that there is an alternative on the market means that there is a limit as to how high a charge banks can levy for their payment services before consumers or the trade sector choose to change over to cash. If cash disappears and is not replaced by any new state alternative, this limit will no longer apply and the banks can possibly raise their charges more easily. This has also been pointed out by the Swedish Consumers' Association in their report "Framtidens betalningsmedel" (Future means of payment).²⁶
- **Groups that experience difficulty gaining access to payment accounts** for various reasons will still exist. There is currently legislation stating that those who are resident within the European Economic Area (EEA) have the right to open a payment account if there is no special reason to deny them. If cash stops working as a generally-accepted means of payment, there is a risk that those outside the banking system will find themselves in a situation where they have difficulty making and receiving payments, which in practice will mean they can have difficulty accessing goods and services.
- **The developments in the payment market will to a large extent be governed by commercial agents.** Both a state agent and a commercial agent can be expected to want to maximise their utility. What distinguishes the two types of agents is that commercial agents want to maximise their commercial utility, while the state can take a broader societal perspective to maximise the benefit to society. On markets with "external effects", these two types of profit maximising will not coincide. With no state presence, therefore, prices may become too high and supply too low.
- **The fundamental trust in the Swedish monetary policy system risks declining.** In times of financial unease, the knowledge that money in bank accounts can always be converted to risk-free state money in the form of cash comprises a linchpin. If cash is marginalised, this feature will be eroded.

1.3.1 Central bank money has lower credit and liquidity risk than private bank money

The Riksbank and other central banks have a price stability target to safeguard the value of money over time. This is important to maintain confidence in both central bank money and private bank money. How does central bank money differ from the money that private individuals or companies have in accounts with a private bank?

The important difference lies in who we have a claim on. As customer in a private bank, we have a claim on a private owner, while as holders of central bank money we have a claim on the state. This has significance for the money's credit and liquidity risk. As a private bank, unlike a central bank, can go bankrupt, placing assets in a bank account in a private bank entails some risk. Central banks, on the other hand, can always meet their obligations in the national currency as they have unlimited capacity to create new money. Central bank money is thus a risk-free asset and at the same time a means of payment.

²⁶ See Swedish Consumers' Association (2018).

Even if private money has been made very safe with the aid of legislation and a state deposit guarantee, it is not risk-free in the same way that central bank money is. The deposit guarantee functions as a state insurance for money in private bank accounts, but only up to a certain amount.²⁷ However, if the deposit guarantee needs to be activated, it can take up to a week before the money is paid out. With the current legislation, private bank money is thus not as certain or as liquid as central bank money.

The fact that central bank money is risk-free is what makes financial institutions eager to use this when they pay one another. When institutions settle payments between one another, they use their holdings in the central bank and make use of the central bank's settlement system. Settlement in central bank money is preferable, partly because the system is provided by a competitively neutral party (the central bank) and partly because this type of payment carries no credit risk.

A relevant question is whether it is reasonable for a central bank to offer unlimited access to central bank money to credit institutions, but no longer to the general public, which would be the case if cash disappears. There is a point of contact here with the central bank's historical task of promoting the general public's confidence in money and the payment system.

In modern monetary systems, most new money is generated by banks and not by the central bank. To maintain confidence in money, the general public must have faith that a Swedish krona will have the same value regardless of whether it is central bank money or holdings in an account with a private bank. In the 19th century this was for instance guaranteed in that private banks were obliged to hold Riksbank notes, which the bank's own notes could be exchanged for. The general public thus had the possibility, when they so desired, of converting their notes into Riksbank notes which in turn could be redeemed for metal.²⁸ More recently, various forms of guarantee and regulation for the banking system have arisen, such as the deposit guarantee and banks' possibilities to borrow from the Riksbank in times of crisis (what is known as lender of last resort). Although the system we have in Sweden functions well at present problems could arise in times of financial unease if the opportunity to withdraw money in the form of banknotes and cash disappears. If trust in the banking system as a whole fails, it will not help if people can move money from one bank to another. If there is no possibility to exchange for central bank money, trust in the current monetary system will deteriorate.

1.3.2 The e-krona entails continued state presence in the payment market

As described above, the absence of a state presence on the payment market could give rise to some problems. If the state, via the central bank, does not offer any payment services on the strongly concentrated private payment market, it may lead to a decline in competitiveness and a less stable payment system, as well as make it difficult for certain groups to make payments. Ultimately, it may risk eroding basic trust in the Swedish monetary system. A few of these problems could be neutralised or mitigated by an e-krona.

The general public increasingly prefers to pay electronically rather than use cash. This is probably not a question of deliberately choosing private bank money over central bank money, but that the general public avoids the older technology, cash, that is not considered convenient in today's digital society. The Riksbank should therefore consider modernising the cash product.

- The e-krona could become a modern krona in electronic form as a complement to physical cash. The public could then continue to have general access to central bank money.
- The e-krona could also strengthen emergency preparedness. The private market cannot be expected to take full responsibility for ensuring that payments function in crisis situations or times of strife. Preparedness, in the form of extensive back-up systems, for

²⁷ The limit is SEK 950,000, for further information see Swedish National Debt Office www.riksgalden.se.

²⁸ See Söderberg (2018a) and Söderberg (2018b).

instance, entails major costs and private agents cannot be expected to have the same interest as the state in ensuring these systems are in place. In the event of serious crises, when private payment systems may fail, an e-krona could work as an alternative system and thereby increase stability in the payment system as a whole. The e-krona could hence help to promote a safe and efficient payment system.

- The e-krona would offer a competitively neutral infrastructure which payment service providers can join and offer services to households and companies. This can lead to increased competition, innovation and to somewhat lower charges.
- There are currently groups in society that have problems when cash use declines as they find it difficult to use digital payment solutions for one reason or another.²⁹ Such groups include older people, people with disabilities or those who, for different reasons, do not have access to payment instruments other than cash. Since it cannot be expected that the private market fully cater for these groups the state can choose to take greater responsibility for them. This could for example be done by designing a simple and user-friendly e-krona or by legislating and regulating so that the private sector takes greater responsibility.

The path that Sweden chooses to take will depend on what is considered to be most effective from a socio-economic perspective and how the state's role and responsibilities with regard to payments is viewed.

1.4 Summary

An increasingly digitalised society has led to the use of cash in Sweden declining rapidly and being replaced by various digital payment alternatives. Within a few years, we may be close to a situation where cash becomes increasingly marginalised and can no longer function as a generally accepted means of payment. In this situation, an e-krona can give the general public continued access to a means of payment that is risk-free and guaranteed by the state. In addition, a state presence on the payment market, in the form of an e-krona, can create increased competition that can generate lower charges, increased stability and a greater variety of payment services. The alternative, that the state leaves the payment market entirely in the hands of the private sector, would be a unique and entirely new situation for a modern, developed economy. It is therefore difficult to know exactly what this would entail for the general public's access to payment services, pricing and the development of the payment market. It could probably lead to certain risks and make it more difficult for the Riksbank to promote a safe and efficient payment system.

Sweden is not alone in analysing the ongoing digitalisation and developments on the payment market. Internationally, there is considerable interest in these issues, which will probably be analysed within the central bank world for many years to come.

²⁹ According to the Dalarna County Administrative Board, more than half a million Swedes remain outside of the digital society. The Dalarna County Administrative Board monitors access to basic payment services in the country and is working on regional support and development measures. For further information see <https://www.lansstyrelsen.se/dalarna/stat-och-kommun/samhallsbyggnad/utveckling-av-landsbygder/grundlaggande-betaltjanster.html>

2. The e-krona concept

In the Project's first interim report³⁰ an overall e-krona concept was presented, where the e-krona was described as follows:

An e-krona is a digital central bank currency issued by the Riksbank, which means that it is a claim on the Riksbank in the same way as cash. Its value is stated as SEK. The e-krona is broadly available to the general public 24/7/365 and can be used to make instant payments at the desired point in time. It is initially non-interest-bearing. An e-krona gives the general public access to central bank money even when cash is not available. E-krona can be either in an account with the Riksbank or value-based units that can be stored locally on for instance a card or in an app.

Over the past year, the e-krona concept has been described in a number of speeches and discussed in various forums.³¹ Based on the discussions held, with both national and international agents, the project has been further developed and the original concept has been clarified. A more detailed description of what an e-krona is and how it could be designed follows here. Initially, we describe how the e-krona relates to cash, and after that we describe the differences and similarities between an account-based and a value-based e-krona. In conclusion, we show how the technical e-krona platform could be linked to the existing payment infrastructure.

2.1 E-krona – similarities to and differences from cash

Put simply, the e-krona would be Swedish currency, in an account with the Riksbank, or a value that can be stored locally on, for instance, a card or in an app on a mobile phone. The e-krona would quite simply be a krona, the Swedish national currency and would have the same value as the krona in the form of cash or in an account with a private bank. Like cash, the e-krona would be issued by the Riksbank and have no credit or liquidity risk. The Riksbank would offer the volume of e-krona demanded by the general public in the same way that we issue the volume of cash in demand.

Just as with cash, e-krona would function parallel to payments offered by banks and be an alternative and a complement to them. Exchanging between krona in a private bank account and e-krona must be simple, and as an e-krona is digital, this exchange could be made faster than with cash. For this to be possible, the systems that manage e-krona and account-based payments offered by banks must be able to fully interact.

2.1.1 Continued simple and rapid payments

An e-krona would provide the opportunity for payments at point-of-sale and remotely, for instance, in e-commerce transactions, and at the relatively low costs that digital payments generally involve. Unlike digital payments, with the exception of Swish, and like cash, an e-krona could be used for person-to-person payments in real-time, that is, the payment would be instant and settled directly when e-krona are transferred from one individual to another.

³⁰ See Sveriges Riksbank (2017).

³¹ See for instance, speech by Stefan Ingves, Swedish Economics Association, Stockholm School of Economics, 4 June 2018 https://www.riksbank.se/globalassets/media/tal/svenska/ingves/2018/tal_ingves_180604_sve.pdf; Stefan Ingves, Going Cashless, Finance & Development June 2018. <https://www.imf.org/external/pubs/ft/fandd/2018/06/pdf/fd0618.pdf>

It must be convenient and simple to pay with e-krona, and there must be various payment services available adapted to different environments, situations and individuals. It must be possible to choose simple and intuitive options for payments with e-krona that everyone can understand. For instance, one possibility would be a mobile phone app with a picture of a banknote that is moved by means of a swiping motion on the screen to a payee, to visualise the payment. The starting point for the project has been that the Riksbank wants to be able to offer a technical infrastructure for the e-krona that payment service providers can join to develop and offer payment services to household and companies. This means that payment service providers with a license to operate in Sweden can offer services and products related to the e-krona, such as digital wallets. However, the possibility cannot be ruled out that the Riksbank may wish to offer a certain basic range of services to ensure that there are payment services that can be adapted to specific target groups, such as visually impaired or elderly people.

2.1.2 Preparedness function still central

Cash has historically fulfilled an important function as an emergency preparedness and continuity solution, but as cash has been increasingly marginalised as a means of payment, this function has weakened. The e-krona could be a means for the Riksbank to reinforce this function and thus protect the civilian population and make societal functions more effective. Future work on producing a technical solution for an e-krona system (see Chapter 6) should bear in mind that there is a difference between preparing a digital krona for an emergency situation in the event of war and preparing an e-krona that can manage a temporary disruption in the payment system. Here a balance needs to be attained with regard to risks and costs. The preparedness requirements imposed on an e-krona must be specified and discussed with other agencies.

2.1.3 Anonymity and traceability

Cash, unlike card payments, offers the possibility to remain anonymous, that is, to make a payment without having to identify oneself. However, anonymity should not be mistaken for integrity, which means that a payment can be made between two parties without third-party transparency.³² Digital payments are usually traceable, unlike cash payments, as they leave digital footprints that enable a transaction to be followed. The time of the payment, encryption keys and digital wallets are examples of digital footprints that could enable even an anonymous payment to be traced.

2.2 The e-krona can be value-based or account-based

As described in the first interim report, the e-krona can be either value-based or account-based, but what does this mean and what differences and similarities are there between these two options? A value-based e-krona can be described as a prepaid value that can be stored locally, for instance on a card or in an app on a mobile phone. The account-based e-krona can be described in the form of a balance that is found in a central register maintained by the Riksbank.³³ Payments with account-based e-krona are recorded in the same way as transactions with money in private bank accounts. In the case of shorter disruptions, however, it is possible to be able to offer an offline functionality by establishing a regulatory framework that defines, for instance, how the risks are divided between different agents, how many payments can be made offline and in how large an amount.

From a practical user perspective, there are major similarities between the two types of e-krona. The difference is in the underlying processes and the user will not normally be aware of these, as little as we now see the underlying processes when we use our bank cards to make payments. It will be as simple and convenient to pay with a value-based e-krona as with

³² See Grym (2018).

³³ This is how we use the concept value-based and account-based in this report. This is a simplification. From a conceptual and legal viewpoint, the concepts partly overlap one another, see Section 3.1.1.

an account-based one, both in e-commerce and physical shops. Both options have an underlying central register, where the holder and the number of e-krona will be registered, but in different ways. It is possible to create online and offline functionality with both an account-based and a value-based e-krona.

The properties for a value-based and an account-based e-krona will differ in some aspects as they fall under different legislation. An account-based e-krona is classed similar to money in private bank accounts as deposits, while a value-based e-krona is in legal terms e-money and consequently comes under the e-money directive (see Chapter 3 for an in-depth discussion of legal issues). According to the E-money Directive, it is generally not possible to pay interest on e-money. However, there is a possibility to pay interest on an account-based e-krona, as there are not the same legal limitations for deposits as for e-money. One could also imagine a number of different options for a value-based e-krona, where there on the one end of the scale is something similar to a gift card containing a prepaid downloaded value that can be purchased without showing identification, and where the card has a relatively low amount limit. At the other end of the scale, there is something similar to deposits, where there are no limits on amounts and the bearer of the value, krona on a card or in an app, is linked to an individual who is a registered user and thus not anonymous. Further investigation is needed into what type of value-based e-krona should be made available, or whether there should be several options.

2.2.1 Payments with e-krona will be traceable

Both the value-based and the account-based e-krona presuppose that there is an underlying central register for booking transactions, which means that digital payments will be traceable.

An account-based e-krona must therefore, according to current legislation, be based on an owner register to be able to establish who the owner of the account is. This means that it can be ascertained who is making and who is receiving a payment. In discussions with agencies that make payments to individuals and companies, they have emphasised the importance of being sure that a disbursement reaches the right person, which is possible with an account-based e-krona. Anonymous payments are not possible with an account-based e-krona.

Even a value-based e-krona needs to be linked to a register so that it is possible to ensure that the money is not used more than once, what is known as double spending³⁴ and also to enable statistics to be produced, for instance, to report the number of outstanding e-krona. The register shows that the payer has access to the amount of e-krona the payment concerns and notes the transfer. This also means that the bearer of value on which the e-krona is stored (such as cards and digital wallets) needs to be registered.

The digital form of the e-krona and the need of an underlying register thus mean that all transactions will be registered and will be traceable in all cases, with the exception of a prepaid e-krona card used as cash and handed over from one user to another. In the other cases, it would be possible to follow an e-krona transaction and to identify both the payer and the payee in the same way as for other digital payments made using, for instance, bank cards or Swish. When making bank payments, the user's integrity is protected by bank confidentiality that covers all data relating to a bank customer's dealings with the bank. The Riksbank would apply the corresponding regulatory system to safeguard the integrity of those holding e-krona.

2.2.2 Value-based e-krona can allow anonymous payments according to anti-money laundering regulations

For a value-based e-krona, there is some legal scope for anonymous payments allowed by the anti-money laundering regulations, that is, an opportunity for the payer to make a payment without needing to identify themselves. At present, this is when the payment amounts to less

³⁴ Double spending means that the stored value is copied and used more than once. This is the digital equivalent of counterfeiting banknotes.

than EUR 250.³⁵ This also entails an opportunity to allow anonymous purchases of prepaid cards where e-krona are already stored and allow such cards to be passed on to other people. The Project's view is that the Riksbank should make money laundering as difficult as possible. The limits and levels to be set for a potential e-krona card would need further investigation. At present, the banknote with the highest denomination is the 1,000-krona banknote. The Project would not advocate the introduction of a new anonymous means of payment, in the form of a value-based e-krona that had a higher denomination.

2.2.3 Summarising table of possible properties of an e-krona

To summarise what an e-krona is, and what similarities and differences there are between a value-based and an account-based e-krona, the *possible* properties are presented in Table 1 below. The dialogues held by the Project with technology suppliers, agencies and private agents in the payment market have shown that the properties we have developed in the E-krona Project are technically feasible. The properties that are *desirable* for an e-krona need to be specified in the Project's future work on developing a pilot.

Table 1. Possible properties of a value-based and an account-based e-krona

Possible properties	Value-based	Account-based
Instant payments	Yes	Yes
Underlying register	Yes	Yes
Legal form	E-money (prepaid value)	Deposit (account balance)
Interest	No, not as a rule	Yes
Anonymous payments	Yes (below EUR 250)	No
Traceability	Yes (but not if, for instance, a prepaid card changes owner person-to-person)	Yes
Offline payments	Yes	Yes

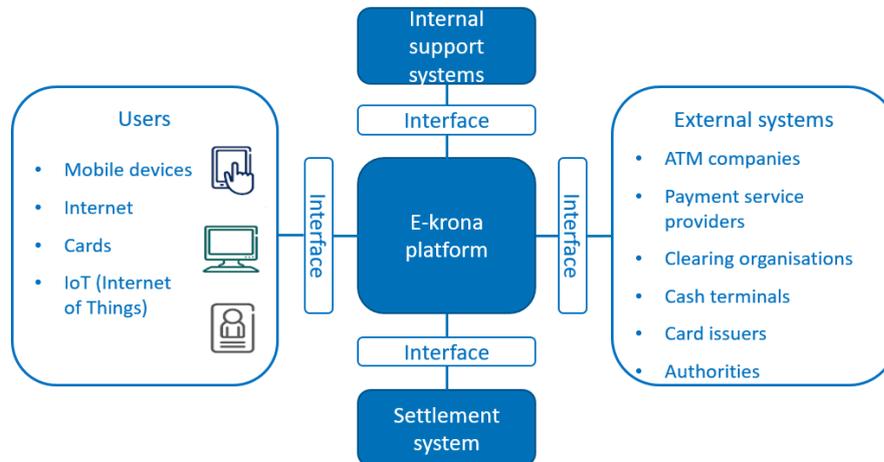
We have developed and clarified above some important properties and concepts linked to the e-krona concept. Below we describe how a possible e-krona system might be designed.

2.3 What would a technical system for an e-krona look like?

Figure 4 below presents a schematic picture of how an e-krona system could be designed. The Riksbank would supply a platform or technical infrastructure containing an account structure for account-based e-krona and a register that enables the issuing and redemption of value-based e-krona. The e-krona platform in turn needs to be able to interact with various types of system and/or application, namely user applications, external systems, internal support systems and settlement systems. This is described in the figure below.

³⁵ This limit will be lowered to EUR 150, see Section 3.5.

Figure 4. Possible design of an e-krona system



E-krona platform

The e-krona platform contains the central register for holders of e-krona and the regulatory framework and conditions to be applied. The platform has the logic necessary to process and implement different types of payment.³⁶ The e-krona platform is the central part of the e-krona system that also manages all interaction with the other systems and participants. The regulatory framework for the e-krona platform will be owned by the Riksbank. It is here that the payments between e-krona users will be settled.

User applications/users

For households and companies to be able to use an e-krona, there must be one or more applications or value-bearers that can be used to make payments. Examples of this are a payment app on a mobile phone, a website (for instance an online bank) and a payment card with a built-in chip. But there can also be other forms of what is known as the Internet of Things (IoT), that is, things with built-in smart functions, such as watches, rings, etc., that have been developed to be used for payments in various situations. The Riksbank does not itself need to supply e-krona to households and companies, it can instead offer an open infrastructure where other agents can create payment services that can be offered to the general public.

External systems

How the Riksbank chooses to design an e-krona may determine which external systems an e-krona platform may need to be connected to. Below are some examples of systems that the platform may need to be connected to. If it is possible to manage an e-krona in ATMs, there must be connections to the companies that supply these services. Payment service providers who wish to supply and administer e-krona accounts or supply other services need a connection to the platform. If agencies, companies and organisations want to use the e-krona to make disbursements to holders of e-krona accounts, they also need a connection for this. If the e-krona offers services via a card, the platform needs to have a connection to an underlying card infrastructure, such as a card issuer. If households and companies want to pay their bills in e-krona to Bankgiro or Postgiro accounts, the e-krona platform needs to have a connection to the payments infrastructure (usually a clearing organisation, Bankgirot in Sweden) that manages these payments.

Internal support systems

An e-krona platform also needs to have connections to internal support systems for administration and to various types of control functions. Examples of administrative systems

³⁶ This covers, for instance, a register of account holders listed, value bearers issued, which external parties may communicate with the platform, how often transactions are recorded and reported and so on.

are those that manage technical administration (in the form of support and certificates) or supply debit notification for distribution of costs and systems that manage various types of statistics and reporting. Examples of control systems include systems to carry out checks for money laundering and terrorist financing.

Settlement systems

An e-krona platform must also be linked to a settlement system for central bank money. It must be possible to move e-krona in and out of the platform smoothly and safely so that there is control at each given point over how many e-krona there are in total on the platform. This probably means that the e-krona system needs to have a connection to the Riksbank's settlement system, RIX. This would probably require transfers to and from the e-krona platform to be made instantly, which would mean that the platform also needs to have a connection to a settlement system in central bank money that implements instant payments. Payments that are made from the e-krona platform to a bank account or from a bank account to the e-krona platform would thus be settled between the Riksbank and the bank in question in one of these settlement systems.

2.4 Summary

Based on the e-krona concept developed by the Project, an e-krona can simply be described as a digital krona issued by the Riksbank. E-krona should always be exchangeable for other forms of Swedish krona, such as cash or money in bank accounts. The e-krona should be broadly accessible to all members of society and can either be held in an account with the Riksbank or comprise a prepaid value that is stored locally on a card or in an app on a mobile phone. Just as in the case of cash, the Riksbank does not itself need to supply e-krona to households and companies, but will instead offer an open infrastructure where other participants can create payment services to offer to the general public. However, this does not rule out the possibility of the Riksbank offering a basic range of services. There are a number of similarities between a value-based and an account-based e-krona. Both options mean that the general public will have the possibility to hold money with the Riksbank and both requires an underlying register, which means that they can expediently be supplied in the same technical system. On the other hand, there is as a rule no opportunity to pay interest on a value-based e-krona, because of its legal form and account-based e-krona cannot be offered anonymously, which are two important differences between the e-krona options.

A number of different connections to other systems and participants are necessary to enable the e-krona to be used in practice. For instance, there must be user applications or bearers of value in the form of, for instance, a card or a mobile phone app, so that households and companies can use e-krona to save and pay. Moreover, the e-krona platform, where the central register for e-krona is located, must have connections to other systems in the form of external systems, internal systems and settlement systems. This is so, for instance, payment service providers can supply services linked to the e-krona, to enable money laundering checks and to make it possible to move e-krona to and from the e-krona platform.

3. Legal questions

A possible introduction of e-krona raises large and important questions that require careful consideration. The Project's assessment is that an e-krona is compatible with the Riksbank's statutory task to promote a safe and efficient payment system. However, the design of the e-krona will affect to what extent the Sveriges Riksbank Act needs to be amended. It is the opinion of the project group that issuing a value-based e-krona to the general public would be compatible with the provisions of the Sveriges Riksbank Act, while the act will need to be amended if the Riksbank is to issue an account-based e-krona to the general public. The Riksbank's mandate to issue account-based e-krona is thus ultimately a question for the legislator.

In this chapter we analyse the legal prerequisites for the Riksbank to supply e-krona. To begin with, we analyse the legal differences between a value-based and an account-based e-krona and how this will affect the design of the e-krona. This is followed by a description of the Riksbank's current mandate and questions of accessibility, anonymity and interest-rate setting with regard to an e-krona from a legal perspective.

3.1 What is an e-krona in legal terms?

As described in Section 2.2, the e-krona can be issued as account-based (comparable with deposits in a bank) or as value-based (like electronic money). Here we describe what legal opportunities and limitations the two options entail, based on current legislation.

3.1.1 The design of value-based e-krona is governed by the Electronic Money Act

In legal terms, a value-based e-krona is electronic money, e-money. Electronic money refers to an electronically – or magnetically – acquired monetary value that represents a claim on the issuer, issued for the purpose of exchanging it for funds³⁷ in payment transactions pursuant to the Payment Services Act³⁸ and which is accepted as means of payment by parties other than the issuer.³⁹ There are provisions on electronic money in the Electronic Money Act, which implements the so-called E-money Directive from 2009 into Swedish law.⁴⁰

Electronic money has cash-like properties and is normally used for payments of relatively limited amounts.⁴¹ It can be stored on a payment device in the form of a card or an app, alternatively on various sorts of payment account, in registers for electronic money or on other media. However, e-money that is stored on payment accounts does not constitute an account balance and is therefore not classed as a deposit. According to the E-money Directive (recit 8), the definition of electronic money is a prepaid value that is either stored on a payment device that belongs to the holder or stored remotely on a server and managed by the money holder through a specific account. In cases where e-money is stored on a card, for instance, there are clear similarities to banknotes and coins.

³⁷ The Sveriges Riksbank Act (1988:1385).

³⁸ The Payment Services Act defines funds as banknotes and coins, balances on an account and electronic money.

³⁹ For instance, prepaid Visa and MasterCard cards, Paygoo, ICA cash card and SpendOn. See also the Swedish National Debt Office's general agreement with ICA Bank on reloadable card services/prepaid cards.

⁴⁰ See the Electronic Money Act (2011:755) and Government Bill 2010/11:124 New regulations for electronic money.

⁴¹ However, the Electronic Money Act does not contain any provisions on maximum amounts for e-money, which means that larger amounts may also come into question.

A central bank within the EU does not need a license to issue electronic money. And when a central bank acts in the capacity of monetary or public authority, it falls out of the scope of the E-Money Directive and does not need to observe the legislation regarding issuing electronic money. The Project assesses that the Riksbank – if it decides to issue e-money on the grounds stated in Section 6 – will be acting in its capacity as monetary authority. The issuance would therefore not fall within the field of application of the Electronic Money Act.⁴² One consequence of this is that the Act's ban on issuers paying interest on e-money would not apply to the Riksbank. The e-krona can therefore be made interest-bearing, even if it is value-based. Although the Riksbank falls out of the scope of the E-Money Directive, it can be obliged to observe certain other provisions, such as those aimed at preventing money laundering.

3.1.2 Account-based e-krona are similar to deposits

Account-based e-krona refers to money held in accounts with the Riksbank (account balance in the Riksbank). Legally, this almost equates to the activities as referred to in the Banking and Financing Business Act⁴³ and which include, for instance, deposits from the general public. However, the provisions in the Banking and Financing Business Act do not apply to the activities of the Riksbank. Instead it is the Sveriges Riksbank Act that applies. According to the Sveriges Riksbank Act the Riksbank may, for monetary policy purposes, accept deposits. According to the preparatory works to the Act, that means that the Riksbank can offer accounts to banks, but it is not clear whether accounts can also be offered to the general public. To clarify that the Riksbank has a mandate to supply account-based e-krona to the general public, it may therefore be necessary to propose amendments to the Sveriges Riksbank Act (see Section 3.3).

3.2 The Riksbank's mandate to issue e-krona

The Sveriges Riksbank Act⁴⁴ states that the Riksbank may only conduct, or participate in, such activities for which it has been authorised by Swedish law. The Sveriges Riksbank Act states that it is the purpose of a particular measure that defines the Riksbank's mandate in several important aspects. If an activity or measure contributes to one of the Riksbank's fundamental tasks then the activity should be considered permitted. The purpose of issuing the e-krona is thus relevant to the question of whether the Riksbank has the mandate to issue an e-krona. Similarly the issuing of an e-krona must be formulated so that it is not in conflict with, or counter-productive to any of the Riksbank's statutory objectives, tasks and assignments. In a legal sense, the Riksbank can be said to have three main tasks, to conduct monetary policy and foreign exchange policy and to promote a safe and efficient payment system. These tasks and assignments complement and to some extent overlap one another.

The task that should be highlighted in particular here with regard to the possibility to supply e-krona is to *promote a safe and efficient payment system*.⁴⁵ Within the scope of this task, the Riksbank has the right to supply systems for the settlement of payments.⁴⁶ The Riksbank shall also be responsible for the country's *supply of banknotes and coins*. Further, it is stated that the Riksbank may receive deposits for monetary policy purposes.⁴⁷

Given the problems regarding the rapid changes on the payment market as discussed in Chapter 1, the purpose of the e-krona should be regarded as compatible with the mandate to promote a safe and efficient payment system. Supplying e-krona should also be compatible with the Riksbank's mandate of responsibility for supplying Sweden with banknotes and coins.

⁴² This is also the case if the Riksbank offers payment services.

⁴³ The Banking and Financing Business Act (2004:297).

⁴⁴ See Chapter 1, Section 1 of the Sveriges Riksbank Act.

⁴⁵ See Chapter 1, Section 2, paragraph two of the Sveriges Riksbank Act.

⁴⁶ See Chapter 6, Section 7, paragraph one of the Sveriges Riksbank Act.

⁴⁷ See Chapter 6, Section 5, 1 of the Sveriges Riksbank Act.

As far as the Riksbank's possibility to receive deposits is concerned, it is stated in the preliminary works to the Sveriges Riksbank Act that the Riksbank may do so, but it is also clear that this refers to deposits from banks. However, the Act does not explicitly prohibit receiving deposits from the general public. As mentioned above, the Sveriges Riksbank Act prescribes that deposits may be accepted for monetary policy purposes. Although an account-based e-krona could be justified as having a monetary policy purpose, it is not certain that this purpose will be there from the start. The Riksbank would therefore need an extended mandate to be able to issue an account-based e-krona that could not be regarded as a monetary policy instrument.

3.3 Legal tender or means of payment with stronger position

As the use of banknotes and coins is declining, there may be reason to consider whether the e-krona should receive the status of legal tender. Of course, a possible introduction of an e-krona is not dependent on whether or not it receives the status of legal tender. But in connection with the review of the Sveriges Riksbank Act, it may be appropriate to look into this question. If the e-krona receives such a status, one should consider whether the possibilities to waive the obligation to accept e-krona should be limited.

To give the e-krona a strong position – and ensure that it becomes established and accepted by the market – there may be reason to state, for instance in the Payment Services Act, that there is an obligation to accept e-krona in the case that a payee accepts electronic means of payment and payment instruments of the same type.⁴⁸ Put simply, a trader should not be able to discriminate against a digital payment with state e-krona if they otherwise accept private digital money.

A similar obligation is contained in the EU Interchange Fee Regulation (IFR),⁴⁹ which applies to card-based payments. The regulation contains provisions entailing that a payee must accept all cards issued within the same brand (for instance, Visa or Mastercard) and in the same category regardless of which bank has issued the card.⁵⁰ The aim is to strengthen consumer protection by ensuring that their cards will be accepted by payees.⁵¹

As the obligation in the IFR only concerns certain types of card, there may be a need to introduce a similar obligation with regard to e-krona that are on payment instruments other than cards, for instance, with regard to payment transactions made with mobile phones.

3.4 Accessibility: What does the law say about limits?

To be able to take a stance on who should have access to account-based and value-based e-krona, one must first and foremost find out what is possible with the existing legislation. Must e-krona be offered to everyone regardless of domicile, or is there an opportunity to limit access if this should prove undesirable?

It follows from one of the EU's four pillars, free movement of people within the EU, that EU/EEA citizens may not in principle be discriminated against within the EU/EEA because of their nationality. The principle of non-discrimination has been expressed in the Payments Account Directive, which has been incorporated into Swedish law via the Swedish Payment Services Act. It is stated there that a consumer who is legally domiciled within the EEA has the right to open a payment account with the accompanying services in a credit institution. Exceptions may be made if this contravenes the Act on Measures against Money Laundering and Terrorist Financing, or if there are special reasons against providing a payment account (for instance, because of criminal activity).

⁴⁸ Such an obligation means that the e-krona is given a stronger position, but may not necessarily mean that the e-krona has the status of legal tender.

⁴⁹ Regulation (EC) No 2015/751 of the European Parliament and of the Council of 29 April 2015 on Interchange Fees.

⁵⁰ Categories of card are: prepaid cards for consumers, debit cards for consumers, credit cards for consumers and company credit cards.

⁵¹ According to information from the Swedish Trade Federation, traders do not appear to have used the opportunity to waive acceptance of certain card categories, such as company credit cards.

For natural persons and legal entities from a third country, there should not be regulations other than those stated in Swedish statutes (such as the Payment Services Act, the Deposit Guarantee Act, the Discrimination Act and the Act on Measures against Money Laundering and Terrorist Financing) or through international agreements.

The starting point should be that if limits to the access to account-based or value-based e-krona are to be introduced, then the criteria for these must be determined on the basis of transparent and non-discriminatory grounds.⁵²

Account-based e-krona

It should be possible to reject an application for an e-krona account if it were in contravention of legislation on money laundering to allow the applicant to open such an account, or if there is special reason, such as other criminal activity. Otherwise, an application to open an e-krona account must be assessed on the basis of established regulations and conditions, just as when one opens a bank account today. This could include requirements for physical identification, for instance.

Value-based e-krona

The starting point should be that the value-based e-krona shall be broadly accessible to both companies and households regardless of domicile. Value-based e-krona should be offered in the same way as cash is today. This means, for instance, that tourists and minors without bank accounts can easily have access to e-krona in this form. With regard to minors, it should be up to their legal guardian to determine when a minor is mature enough to manage a payment device. Potential limitations in the form of, for instance, amount limits and/or limits to topping up should as a minimum follow the requirements of the money laundering legislation.

3.5 Anonymous payments are possible with a value-based e-krona

What does the existing legislation say about the possibility to offer anonymous payments for account-based and value-based e-krona? The Act on Money Laundering⁵³ prohibits holding accounts anonymously. It is therefore not possible to hold account-based e-krona anonymously.

When it comes to value-based e-krona in the form of electronic money, it is possible, according to the legislation on money laundering,⁵⁴ to offer this with simplified know-your-customer procedures, for instance in the case that the amount that can be stored electronically is lower than EUR 250⁵⁵ and on condition that there is no suspicion of money laundering or terrorist financing. However, this opportunity may only be taken if the issuer of a device for electronic money oversees the business relationships and transactions so closely that unusual or suspect transactions can be detected. The possibility for anonymous solutions is largely dependent on what is decided at EU level. In other words, there is an option, but not an obligation, to supply value-based e-krona anonymously.

3.6 Summary

To summarise, the Project considers that the Riksbank already has the mandate, with the support of the Sveriges Riksbank Act, to issue a value-based e-krona.⁵⁶ It is the Project's

⁵² Limits regarding access may arise to fulfil monetary policy purposes (see Section 4.2)

⁵³ See Chapter 2, Section 6 of the Act on Measures against Money Laundering and Terrorist Financing (2017:630).

⁵⁴ See Chapter 3, Section 31 of the Act on Measures against Money Laundering and Terrorist Financing (2017:630).

⁵⁵ Today the maximum amount is set at EUR 250, but in the fifth Anti-Money Laundering Directive, which shall be incorporated into national legislation by 20 January 2020, this limit has been lowered to EUR 150.

⁵⁶ As described in the E-krona Project's first interim report (see Sveriges Riksbank 2017), according to the Treaty on the Functioning of the European Union, Sweden is obliged to adapt its legislation to the EU treaties and the Statute of the ESCB and the ECB (legislative

opinion that there may nevertheless be reason to consider clearer legislation as regards the Riksbank's mandate and scope for issuing account-based e-krona. The assessment is therefore that the Sveriges Riksbank Act should be clarified to clearly state that the Riksbank may receive deposits from both banks and the general public in the case that the Riksbank chooses to implement an account-based e-krona and that such deposits may be received even if their purpose does not concern monetary policy.

The Project considers that it is ultimately up to the legislator to decide whether the Riksbank shall have room for manoeuvre, and a future option, to issue an account-based e-krona. In this context, one should consider and investigate whether the e-krona should have the status of legal tender.

The Project considers that investigating the legislation concerning the e-krona and thereby putting forward proposals for legal amendments are in line with what has been stated in this report. The proposals should be referred to the relevant bodies for consultation. After that, the Riksbank can consider submitting a proposal to the Riksdag (Swedish parliament) with a request for the necessary legislative amendments.

convergence). The Project has assessed that the possible introduction of an e-krona is compatible with Sweden's obligations in this respect. However, if the introduction of an e-krona were to be considered a different task than that stated in the Statute of the ESCB, the ECB Governing Council could, with a majority of two-thirds of the votes, prevent such an introduction, if they consider that the task is in contravention of the ECB's objectives and functions.

4. Consequences for monetary policy and financial stability⁵⁷

The consequences of the e-krona for monetary policy and financial stability depend on how great the demand will be for it. The demand depends in turn on how the e-krona is designed. In this chapter, we assume that the Riksbank will design the e-krona so that it is universally available with potentially large demand. An analysis is presented of the consequences for monetary policy of the introduction of an e-krona without restrictions. The analysis indicates that if the e-krona is universally available, it would be advantageous for it to be interest-bearing or for the Riksbank to be able to control its demand in some other way. This would also limit the effect on the financial system, which is also analysed in this chapter. An e-krona that is in small demand is deemed to only marginally affect monetary policy and financial stability.

In this chapter, the analysis assumes that the Riksbank will not apply any limitations either on who may hold e-krona or on volume. This approach is reasonable as the Riksbank, similar to other central banks, provides the general public with the amount of cash in demand without setting a limit. We also assume below that the e-krona will be designed so that demand is substantial, as the implications for monetary policy and financial stability of an e-krona will only emerge when a large amount of money is converted, or can be converted, to e-krona. This is a necessary assumption to be able to discuss possible implications and should not be interpreted as a call to design an e-krona in this way or as a volume goal or objective for the e-krona. An e-krona in small demand will not have the monetary policy or financial stability consequences presented in this chapter.

4.1 What determines the demand for e-krona?

Demand for the e-krona will be determined by how attractive it is in relation to other means of payment and assets. Two determining factors are: the potential return (interest) generated by an e-krona over a time horizon and the fees that may be charged compared with other investments such as bank deposits and cash. Another factor is the benefit or value of the services provided by the e-krona, for example the ease with which it can be used to make payments. Finally, there is a difference in credit risk and liquidity between the e-krona and alternative assets. For there to be substantial demand for a non-interest-bearing e-krona, the return on alternative assets must be negative, the services linked to the e-krona be valued higher than the interest on other assets or the e-krona's lack of credit risk must be highly valued.

For the user, an e-krona account at the Riksbank would be largely similar to deposits at a private bank, for example a current account. However, private banks often have several different products they offer to their customers linked to the accounts opened by the general public. These include insurance policies, mortgages, advisory services, etc. A Riksbank account would offer a digital place, for example an account, in which to hold e-krona and a mechanism for the settlement of payments in e-krona. Many of the functions that consumers and companies would utilise when initiating e-krona payments are supplied by private payment service providers. Together, these functions create a customer benefit that may be different from the benefit created by commercial payment services.

⁵⁷ This chapter is based on a number of studies published in a special edition of the Riksbank's journal Economic Review No. 3 2018.

Sweden is in the vanguard of technical developments on the payment market, with solutions such as Bank-ID and Swish used by many people. It is therefore unclear how substantial the benefits of the payment services linked to the e-krona would be considered to be. If the Riksbank wanted to have a certain volume of e-krona use in normal times to ensure that the system also works smoothly in times of crisis, it would have to consider how to make the e-krona sufficiently attractive to achieve its objective. The e-krona could possibly be used for solutions that involve services linked to other central agencies. This could ensure that a certain level of use is achieved even if the e-krona does not have an attractive interest rate compared with deposits in private bank accounts. Correspondingly, the central bank could also choose to keep down the volume of e-krona. Either it can be given an unattractive interest rate, fees can be introduced or the design can cause friction that makes it less attractive as an alternative to money in private bank accounts.

4.2 Consequences for monetary policy of a non-interest-bearing e-krona

The properties of an e-krona will largely determine the extent of its effect on monetary policy. A key factor is whether or not the e-krona will be interest-bearing. The assumption in this section is that cash will continue to be available and that the general public and companies will be able to place assets in digital e-krona in an account or register, which constitutes a claim on the Riksbank, without restrictions.

4.2.1 Monetary policy efficacy

The Riksbank conducts monetary policy with the repo rate as its main instrument. In recent years, the Riksbank, like many other central banks, has also used other instruments such as purchases of government bonds, known as quantitative easing (QE), as a complement to the repo rate. Another such instrument is the publication of repo rate paths (forward guidance) aimed at influencing the expectations of economic agents regarding longer-term interest rates.

In this section, we analyse how the e-krona could affect the efficacy of monetary policy, that is monetary policy's scope for controlling developments in the economy.

A non-interest-bearing e-krona raises the repo rate's effective lower bound to zero

Even if the repo rate can technically be lowered indefinitely, there is a limit at which further rate cuts do not have any impact on other interest rates in the economy. In the current situation, the reason is that, if the repo rate is set low enough, it will be more beneficial to hold cash instead (as cash has an implicit interest rate of zero regardless of where the policy rate is set). This effective lower bound for the repo rate is below zero despite the implicit rate of interest of cash being zero.⁵⁸ This is due to the fact that there are certain costs associated with transporting and storing cash, insurance costs and the like. This is why a few central banks, including the Riksbank, have recently been able to cut their policy rates to negative levels. The repo rate has been negative in Sweden since early 2015 without the demand for cash rising.

Holding e-krona would not cost as much as holding cash. Furthermore, an e-krona would be as free from credit risk as cash and therefore be an attractive alternative investment when interest rates are negative. A non-interest-bearing e-krona could lead to repo rate cuts under zero per cent not having any impact on other interest rates in the economy.⁵⁹ For example,

⁵⁸ See Alsterlind, et al. (2015) for a more detailed description.

⁵⁹ In the event of the e-krona interest being higher than the interest on risky assets, investment in e-krona would clearly be better and no-one would be willing to take risk without being compensated for it. If banks wish to keep their customers' deposits, they must pay a rate of interest that is at least as high as the interest on e-krona (unless their other services are valued very highly). For other risk-free assets, such as government bonds, no-one would wish to buy them if they had a negative interest rate as e-krona are equally safe. Finally, we can ascertain that banks would not wish to borrow from each other on the interbank market at a negative interest rate if it were possible to invest in e-krona at a higher interest rate. There would hence not be a functioning market with negative interest rates if the e-krona were freely available at an interest rate of zero. See also Armelius et al. (2018) for a more detailed description.

banks would no longer be able to pass on a negative interest rate to their major corporate customers, something they are currently doing, as these customers could move their deposits into e-krona. In such a scenario, the e-krona's interest rate would basically act as a floor for all other interest rates in the economy. This change will basically lead to interest-rate policy having less room for manoeuvre.

It is difficult to say, however, how often the future economy will be in a situation which calls for a negative policy rate. However, some analysts believe that interest rates will continue to be low even in the future.⁶⁰ Low interest rates mean that the economy more often risks being in a situation where a negative policy rate is necessary.⁶¹

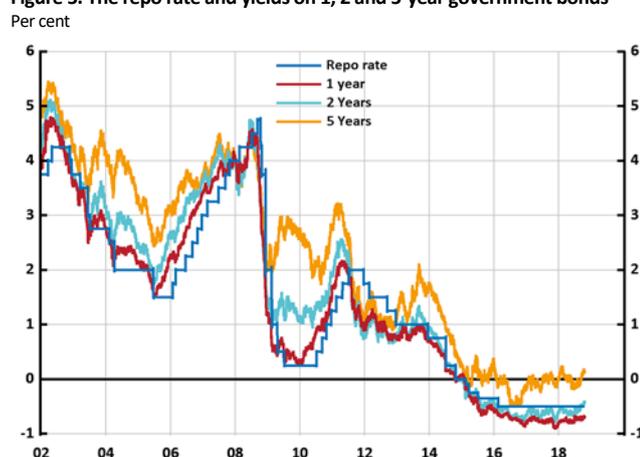
The next question will be: what would be the cost to the real economy if the repo rate's lower bound prevented monetary policy from stimulating the economy in a recession? Research indicates that the consequences for the real economy could be serious if no other tools were available.⁶²

As mentioned earlier, the Riksbank and other central banks have used several tools other than the policy rate since the financial crisis of 2008-2009. How the e-krona might affect the efficacy of quantitative easing and forward guidance is described below.

The effect of quantitative easing may be weakened by a non-interest-bearing e-krona

The Riksbank's quantitative easing, that is purchasing government bonds with longer maturities and paying by supplying liquidity to the market, has helped push yields on government bonds with up to two years' maturity into negative territory and even slightly below the repo rate, see Figure 5. With an e-krona without interest and without restrictions, either on who may hold e-krona or to what extent, this would no longer be possible. This is because any interest on the e-krona, as described above, would act as a floor close to zero for interest rates in the economy when individuals and institutions can choose to invest in e-krona.

Figure 5. The repo rate and yields on 1, 2 and 5-year government bonds



Note. Zero coupon yields calculated from government bonds.

Source: The Riksbank

The fact that government bond yields would not be able to fall below zero does not necessarily mean that quantitative easing would become entirely ineffective with an e-krona in a low-interest rate environment. It would still be possible to reduce positive yields with longer maturities down towards zero by focusing on purchases on bonds with longer maturities.⁶³

⁶⁰ See e.g. Rachel and Smith (2015) and Buiter and Rahbari (2015).

⁶¹ See e.g. Monetary Policy Report October 2014, July 2016 and February 2017.

⁶² See e.g. Ball (2014). Armelius et al. (2018) perform an analysis of the costs associated with the lower bound in a Swedish context.

⁶³ Theoretically, an e-krona, both with and without interest, could even make the purchases more effective. For example, Meaning et al. (2018) state that purchases can be more effective if they are made directly from the owner without going via a bank that can make

Correspondingly, the Riksbank's scope for influencing expectations with forward guidance in a low-interest rate environment is also weakened. It would no longer be possible to publish negative interest rate paths and the ability to influence expectations may therefore be weakened in certain situations.

Possible effects of introducing limitations on access to e-krona

It is often pointed out in the literature that the option of freely being able to convert different types of money constitutes a basic precondition for a well-functioning payment system, as it guarantees the standard value of money.⁶⁴ It is the Project's assessment that limitations on access to e-krona may be associated with problems. For example, it may be difficult to maintain parity between Swedish krona in the form of cash, deposits in bank accounts and reserves. Assume, for example, that the e-krona becomes very popular but that there is a maximum limit imposed on each person's holdings. This could lead to the emergence of a market on which those who have not fulfilled their e-krona quota would be offering those who have the opportunity to buy e-krona in cash or by depositing money in a bank account at a higher than one-to-one price. The same could happen if certain groups cannot access e-krona. Limitations may also cause an e-krona to function less efficiently as a payment instrument.⁶⁵ Credit risks between agents may also arise. An example is if those who have not fulfilled their e-krona quota offer others the possibility to hold e-krona in their accounts. A debt relationship will then arise between two agents with a corresponding credit risk. Restrictions that are sufficiently large as to reduce the risk of bank runs would probably significantly impair the e-krona's function as a means of payment.⁶⁶

An alternative to volume restrictions could be to introduce fees limiting how attractive the e-krona is as an investment option for various types of agents or in different situations.

Potentially more effective monetary policy if e-krona is interest-bearing

If the e-krona generates interest (even negative interest) the lower bound for the repo rate is unaffected. As long as cash still exists the yield on cash will constitute the absolute lower bound for the repo rate, even if the Riksbank introduces an interest-bearing e-krona. The lower bound would be some way below zero, just as it is today. Monetary policy's room for manoeuvre would therefore not be affected compared with the situation at present.

The transmission mechanism, the causal chain that allows changes in monetary policy to affect economic developments and inflation, could be affected, however, if the e-krona generates interest. This is because an interest-bearing e-krona would function as a separate monetary policy instrument that could potentially have a major impact on, for example, bank deposit rates. It is less clear, however, how the impact on bank lending rates would be affected compared with the current situation. This is because the e-krona would not have any direct effect on the lending market. Any effects would be indirect via its effect on banks' funding costs. When banks have access to wholesale funding, it is not evident that increased deposit rates lead to increased lending rates. This is discussed in greater detail in Section 4.3.1.⁶⁷

If the e-krona becomes attractive as an investment option, monetary policy's exchange rate channel may also be affected. At present, an increased demand for safe Swedish assets (government securities, for example) will cause the interest rate on these assets to fall. In the same way, the interest rate on such assets will increase if demand falls. The interest rate on the e-krona will not be affected by demand and will set a floor for interest rates on Swedish

counteractive adjustments on its balance sheet. However, it is unclear how great the difference would be in Sweden, where Riksbank Certificates can already be transferred, which is basically the same thing as the Riksbank paying the seller directly. Another argument that has been highlighted is that the e-krona could also pave the way for new forms of quantitative easing, for example general deposits to households of new money in e-krona accounts (known as "helicopter money"), see e.g. Dyson and Hodgson (2016). Swedish law prohibits the Riksbank from making such general deposits. However, the Government may do so within the framework of fiscal policy.

⁶⁴ See e.g. Engert and Fung (2017).

⁶⁵ See e.g. Gürtler et al. (2017).

⁶⁶ See e.g. Callesen (2017).

⁶⁷ See Armelius et al. (2018). Note also that the mathematical example in Box 3 refers to how the introduction of an e-krona may affect bank lending rates. The discussion in this section concerns how changes in the repo rate lead to changes in bank deposit and lending rates in a situation with an e-krona and a situation without an e-krona.

assets. This may, in turn, lead to greater flows in and out of Swedish krona in the event of a given change in (the expected) interest rate differential in relation to other countries. This means that a change in monetary policy that affects the interest rate differential may have a greater impact on the exchange rate when there is an e-krona that is available without restrictions.

4.3 Consequences for financial stability

The introduction of an e-krona may lead to major changes in the financial system, both in normal times and in times of economic and financial unease. How great the impact will be depends on the extent to which the e-krona is used as a means of payment and for saving. We firstly study the effects of an e-krona in normal times and then the effects in times of financial stress.

4.3.1 Effects on the financial system in normal times

The basic assumption of the analysis below is that the e-krona is interest-bearing with a sufficiently large margin in relation to the repo rate. In normal times, demand for the e-krona will be limited.⁶⁸

The e-krona may reduce deposits, which are a source of funding for the banking system

Banks fulfil an important function in society in that they allow households and companies to save and borrow money. Banks use short-term deposits, in wage accounts for example, to fund their long-term lending to households and companies. This is largely considered positive for society as it contributes to the efficient use of capital.

The introduction of an e-krona could lead to a reduction in bank deposits as bank customers would be able to choose to move some of their deposits to e-krona in the same way as they can move their money between bank deposits and cash today. However, a limited outflow of deposits to e-krona would not lead to banks reducing their lending.⁶⁹ This is because they are able to rebalance their funding and reduce their dependence on deposits. Already today, more than half of Swedish banks' lending to Swedish households and non-financial corporations is funded via different types of interest-bearing securities with short and long maturities.⁷⁰ If the e-krona were to take over a certain share of deposits, banks could compensate for this by using yet more wholesale funding. Historically speaking, however, wholesale funding has been more expensive than deposits. Increased wholesale funding could therefore lead to higher funding costs for the banking system. This would, in turn, either reduce banks' profitability or result in them raising their lending rates.

⁶⁸ Juks (2018) and Segendorf (2018) discuss demand for an e-krona from different perspectives. In normal times and with economically rational agents, everything points to low demand, perhaps equivalent to 3 per cent of GDP. In terms of size, in relation to GDP, this is equivalent to the size of cash at the beginning of the 2000s.

⁶⁹ Reduced deposits would indeed deprive banks of some liquidity and what is normally perceived to be stable and long-term funding. They would therefore need to use their liquidity reserves to meet the outflow. First of all, banks can use their reserves at the Riksbank. If demand for the e-krona exceeds the total volume of banks' reserves at the Riksbank, they can use securities in their liquidity reserves to borrow from the Riksbank in exchange for collateral (see Juks (2018)).

⁷⁰ In April 2018, total MFI lending to Swedish households and non-financial corporations amounted to about SEK 6,100 billion, while deposits and borrowing from Swedish households and non-financial corporations was about SEK 2,835 billion.

Box 3. How would bank lending rates be affected by a limited demand for e-krona?⁷¹

To better understand the potential interest-rate effects on banks and borrowers, we can consider a stylised mathematical example.

Imagine a scenario in which SEK 100 billion in bank deposits are converted into e-krona. We assume a situation in which the repo rate is 2.5 per cent,⁷² deposits cost 0.75 percentage points below the repo rate and wholesale funding costs 0.50 percentage points above the repo rate.⁷³ Total bank lending to the real sector amounted in April 2018 to around SEK 6,100 billion while deposits from the real sector⁷⁴ were about SEK 2,800 billion.⁷⁵

With the conditions specified above, banks' total funding costs would be 0.07 percentage points below the repo rate in a no-e-krona scenario. With an e-krona, and a lending volume of 100 billion changing over to e-krona, banks' funding costs would increase by a maximum of about 0.02 percentage points. If the cost were fully transferred to all borrowers, lending rates would therefore rise by about 0.02 percentage points.

If demand for the e-krona were to be significantly higher and be equal to, say, SEK 400 billion, just under 10 per cent of GDP, the effect would be greater, about four times as large as in the example above. Bank lending rates would have to be raised by about 0.08 percentage points, all else being equal, to fully compensate for the more expensive funding.

Another factor that may limit the effect of the e-krona on banks is that deposits are not necessarily always cheaper than wholesale funding. The relative cost of deposits in relation to wholesale funding is affected by the general interest rate level in the economy and by how much competition there is for deposits. In the current low interest-rate environment the cost of deposits, for example, is basically the same as the cost of wholesale funding. Furthermore, competition for deposits may very well increase regardless of whether the e-krona is introduced or not, for example as a result of Fintech companies helping customers to place their deposits in banks with the highest deposit rates.

However, the above analysis assumes that demand for e-krona will be relatively low in normal times. If, on the other hand, demand were to be substantial in relation to bank lending, uncertainty regarding the effect on banks could be significantly greater. For example, a major run to e-krona could result in the existing bank reserves in the system, currently around SEK 400 billion, not being sufficient to cover banks' purchases of e-krona on behalf of their customers.⁷⁶ Banks would then have to borrow from the Riksbank to meet the outflow of households' deposits, a need that the Riksbank would be required to consider. A significant demand for e-krona may also increase banks' need for wholesale funding. The pricing on the market as well as banks' funding costs could hence be affected.

The e-krona may make banks' funding more or less stable

Traditionally, deposits are considered to be a stable source of funding for banks. However, other developments, such as instant payments in combination with automatic saving products from Fintech companies, may make deposits more volatile than before. If wholesale funding with longer maturities becomes more common, risks that would otherwise arise when banks convert short-term deposits into long-term lending will decrease.⁷⁷ The possible effect of an e-krona on banks' funding, profitability or lending rates should therefore be weighed against potentially reduced risks.

⁷¹ For a detailed review of the e-krona's effect on interest rates, see Juks (2018).

⁷² The Riksbank's assessment is that the long-run repo rate can be expected to be between 2.5 and 4.0 per cent. See Monetary Policy Report February 2017 for a more detailed discussion.

⁷³ The cost for deposits and wholesale funding is based on historical data with regard to the difference between policy rate, deposit rate and wholesale funding rate.

⁷⁴ The real sector consists of households and non-financial corporations.

⁷⁵ Based on MFI data as from the beginning of April 2018, when total MFI lending to Swedish households and non-financial corporations amounted to about SEK 6,100 billion, while deposits and borrowing from Swedish households and non-financial corporations was about SEK 2,835 billion. The share of lending funded by deposits will be 46 per cent.

⁷⁶ See Juks (2018).

⁷⁷ In this context, it may be worth mentioning that there is no consensus in the research literature as regards the optimal volume of short-term bank deposits that can be converted into long-term lending. See e.g. Pennacchi (2012).

If a bank knows that depositors can quickly withdraw their money, they have a greater incentive not to take excessive risks and not to put themselves in a situation that may lead to a bank run. Such market discipline is an important complement to direct regulations aimed at safeguarding financial stability.⁷⁸

4.3.2 Effects in times of financial unease

An e-krona could be another place to move money to in the event of a crisis, and the e-krona could then be perceived as more attractive than other options. It may be a safer option than deposits, even in relatively robust banks. It may also be a simpler and smoother option than cash or tax accounts. As described above, withdrawing and storing large amounts of cash is associated with costs for transport and secure storage. Holding money in tax accounts may also involve costs. There are, for example, no payment services linked to tax accounts, making the money in them less useful. An e-krona would not have these drawbacks and this means that a run to e-krona may be more substantial than a run to other currently available options. Even if there may be economic reasons for giving the general public access to safe central bank money in such a situation, a sudden run to e-krona may lead to greater problems for banks. It is therefore important to analyse what it would mean for the stability of the financial system and how any problems can be dealt with on each given occasion.

It is important to point out that such a run scenario presupposes that it cannot be stopped by adjusting the e-krona interest rate and that the Riksbank refrains from introducing volume restrictions.

The risk of a bank run on individual banks or the entire system already exists

Situations in which there is an outflow of deposits from one or more banks can arise today irrespective of whether there is an e-krona or not. In the current system, investors try to leave a bank that is perceived to be too risky by moving their assets to a safer bank or acquiring safer assets such as government securities. The same thing can happen to the general public's deposits, most of which are only short-term and can be easily moved. A major outflow of bank deposits is normally referred to as a bank run. The expression was originally used to describe a situation in which bank customers "ran" to a bank that was considered unsafe in order to withdraw their money in cash. Nowadays, money can be moved digitally, for example to another bank. Regardless of where customers run to, the bank they run from will probably find it difficult to find wholesale funding, for example on the interbank market, and will probably turn to the central bank and ask to borrow money in order to tackle the outflow.

A bank run on the entire banking sector is less likely than one that affects a number of individual banks, but it can happen. If the general public exchange their bank deposits for cash, the Riksbank can act by lending new reserves to banks and then letting them exchange the reserves for cash. The general public may also choose to move their deposits to other risk-free investments offered by the state, such as tax accounts at the Swedish Tax Agency. An inflow into these accounts results in the Swedish National Debt Office having a liquidity surplus at the Riksbank and it is possible that the Debt Office chooses to lend this surplus to the banking sector to help them deal with the bank run. If the Debt Office chooses not to do this, banks will then turn to the Riksbank and ask to borrow money.

Tools already at the Riksbank's disposal can be used to tackle a major bank run

The Riksbank can already handle large outflows from individual banks or the banking sector as a whole. It can, for example, provide credit via its various monetary policy tools. Because the Riksbank can create an unlimited amount of liquidity, there is no upper limit to how much it can lend. The amount of credit the Riksbank can give to solvent institutions in an individual case is only limited by the size and quality of the affected banks' collateral and the Riksbank's

⁷⁸ See e.g. BIS (2001).

own willingness to take credit risks. Therefore, the Riksbank's capacity for dealing with bank runs is in practice determined by the size (and composition) of banks' assets. This in turn is affected by the regulations to which banks are subject.⁷⁹

Experiences from the most recent financial crisis show that central banks around the world demonstrated considerable flexibility in how they tackled liquidity stress that threatened the financial system.⁸⁰ This often took the form of ad hoc modifications to their existing toolboxes. There will be challenges in determining an institution's solvency and in valuing collateral as the liquidity and value of collateral can decline in a stress situation. A problem often highlighted is that banks risk being stigmatised if they utilise the central bank's lending facilities – it would be seen as a sign of weakness and in itself further weaken the bank's access to wholesale funding, both in Swedish krona and foreign currencies. In the event of a major bank run to e-krona, it is likely that the Riksbank might need to consider a number of factors with regard to its tools, regulatory frameworks and assessments of collateral and solvency.

In summary, it can be said that an e-krona may lead to reduced deposits in the banking system. In normal times, this can be dealt with by increased use of wholesale funding. In times of financial stress, demand for e-krona as a risk-free means of payment and store of value may increase significantly. Even if there may be economic reasons for giving the general public access to safe central bank money in such a situation, a sudden run to e-krona may lead to banks losing some of their funding. However, such funding problems are already a feature of the banking system and the central bank has various tools it can use to tackle the situation.⁸¹

4.4 Other possible effects on the macroeconomy

We have already noted that the effects on monetary policy and the financial system of an e-krona depend to a large extent on how attract it becomes, something which in turn depends on its design. In this section, we look at a few possible channels through which the e-krona could affect the macroeconomic situation if its use became relatively substantial. If demand for the e-krona can be controlled in some way, for example by setting an interest rate or using other tools, major effects on the economy can be prevented. In other words, any negative effects discussed in this section can largely be avoided.

4.4.1 The economy's sensitivity to shocks

There are several reasons why the economy could become more sensitive to shocks if an e-krona were to be widely used. If an e-krona were to lead to it being easier to move money from a bank or out of the banking sector, it may, as discussed above, make the banking sector, and hence the entire financial system, more sensitive to economic shocks. Further, the Riksbank's balance sheet may grow and become more volatile with an e-krona. An e-krona may even become attractive for foreign investors, for example in times of financial stress in other countries. As Sweden's economy is small seen in a global perspective, it could have a substantial impact on the Riksbank's balance sheet. It could also give rise to major flows in the Swedish krona, which could affect the exchange rate, inflation and the impact of monetary policy.⁸²

4.4.2 Effect on underlying growth

The e-krona could reduce various transaction costs as a result of increased competition and lead to more efficient payments, or prevent payment services from becoming more

⁷⁹ Liquidity requirements mean that banks must have sufficient liquid assets to manage an outflow for a period of 30 days in a stressed situation.

⁸⁰ Bertsch and Molin (2016) describe the central bank's role as liquidity provider, what the challenges are and how they can be met.

⁸¹ See Juks (2018).

⁸² An interesting historical parallel is the sharp rise in demand for National Debt Office treasury bills from foreign investors in 2008. The Debt Office choose to meet this increased demand by issuing new treasury bills causing the volume to rise sharply, see Swedish National Debt Office (2008, pp. 13 - 15). Later in 2008, the Debt Office chose to discontinue this procedure.

expensive in the future. In our meetings with agencies that make state disbursements, we have noticed that the disbursement processes via a number of banks could be rationalised with the help of an e-krona. Such a rationalisation would probably lead to a small level shift up in GDP and have a marginal effect on the growth rate. Currently, Sweden has an efficient payment market compared with other countries, and the socioeconomic cost of implementing payments amounts to just under 1 per cent of GDP, which is a relatively low figure.⁸³

As described in earlier sections, the introduction of a non-interest-bearing e-krona could lead to an increase in the repo rate's lower bound. This could restrict the Riksbank's room for manoeuvre in interest rate policy, which may have negative economic consequences in certain situations. It is currently unclear, however, how deep economic downturns affect the economy in the long run. Certain effects, such as the long-term impact on unemployment, can have long-run effects on the level of GDP after a deep crisis.

The fact that the introduction of an e-krona leads to reduced bank deposits, which could lead to banks reducing their lending, is sometimes highlighted as an argument against the e-krona. However, a well-functioning credit market is not necessarily directly dependent on the volume of bank deposits. For example, Swedish banks get a lower share of their funding via deposits than banks in many other European countries. Furthermore, even if banks did reduce their lending, it could possibly be compensated for by investment being funded in other ways, such as increased lending directly between private individuals via Fintech companies (known as "peer-to-peer" lending).

4.5 Summary

To summarise, we can ascertain the existence of a kind of dilemma: it is not possible to have a non-interest-bearing krona, with an attractive design and available without restrictions without there being possible negative consequences for monetary policy and financial stability. These negative consequences may arise when an e-krona comprises, or could comprise, substantial values. A central bank thus needs tools, as and when necessary, to influence the demand for e-krona and safeguard its capacity to stabilise the economy, safeguard financial stability and counteract recessions.

It is the Project's assessment that an e-krona of limited demand would probably not have any major consequences for banks and the financial system in normal times. Banks may perhaps receive slightly fewer deposits and therefore have to utilise slightly more wholesale funding. In times of financial stress, when the general public may wish to withdraw large values from weak banks, the e-krona enables a more general and faster run from the banking system to state-guaranteed money than a traditional run from the banking system to cash. However, the Riksbank has tools to cope with such situations if they were deemed to jeopardise financial stability.

⁸³ See Segendorf and Jansson (2012) for a review of the Swedish market and Schmiedel et al. (2012) for an overview of costs in a number of European countries.

5. Functions and technical solutions

In the Project's first interim report, we noted that the technical options need to be further investigated and that the scope for cooperation with other agencies and private agents needs to be examined. Since publication of interim report 1, the Project has had meetings with technical suppliers to gain an overview of what is currently possible to develop from a technical point of view. The Project has also met with agencies and private agents to find out their views on the e-krona and on what is needed in terms of range of services, properties and stability in the system. In this chapter, we present the conclusions drawn from these meetings.

5.1 What functions should an e-krona have?

After the publication of the first interim report, the Project has had a broad dialogue with companies and public authorities in order to discuss the proposed e-krona concept. During the first half of 2018 the dialogue has continued and, the Project has had meetings with ten agencies and five private agents in the payment field in order to discuss the e-krona and the payment infrastructure more generally. The aim of these bilateral meetings was to find out how agencies and private agents look upon an e-krona and what their views are on range of services, properties and stability in the system.

The agents agreed that an e-krona should have at least the following properties: (See the glossary descriptions of technical concepts)

An e-krona system should provide a **comprehensive range of services** in order for the end-user to derive benefit from it. The e-krona platform should be simple, scalable and flexible so that it can be integrated with other systems in the financial infrastructure. It should be possible to extend and adapt the range of services to existing and emerging needs if cash becomes increasingly marginalised. In addition, an e-krona should enable, for example, remote and online payments, functions which cash cannot manage.

An e-krona also needs to be designed so that everyone, as far as possible, can use it to manage their payments. This means that the e-krona must be **widely available and easy to use** and hence have a simple and instructive user interface. The aim is for it to be easy to use for groups in society that already find it difficult to manage digital solutions. As this overall target group is large and its various sub-groups have different needs, the work to design an e-krona must take this into account. Furthermore, accepted international standards for accessibility, design and usability must also be followed.

As instant payments are assumed to become the norm for future payments, an e-krona must fulfil tough requirements for **transaction capacity and performance**, that is it must be possible to handle a large number of payments among many different parties efficiently, and it must be possible to settle each individual transaction without delay.

The e-krona should help increase **robustness** on the payment market. It must be built with the aim of reaching the highest possible accessibility even when disruptions occur. When disruptions occur that put the telecommunications network out of action, the e-krona should be able to function offline. **Several e-identification solutions** should be available and adhere to the Swedish E-identification Board's free choice system. However, it is important that these components are designed in such a way as to be able to complement each other in the event of major crisis situations.

Security and reliability will be particularly important parameters in the work to develop the e-krona. A reliable technical solution is needed so that users and other agents can have confidence in the system. For example, there must be robust protection against cyberattacks.

This means that hardware, software, architecture and communication in the technical solution must fulfil the highest security requirements and be thoroughly evaluated once the project starts development and pilot tests of an e-krona (see Chapter 6). The same requirements must be imposed on the development processes of suppliers and the future operation and management of an e-krona system. The Riksbank will also put safety and security first. We attach substantial importance to developing secure cash that is difficult to counterfeit and the same will apply to any future e-krona.

The e-krona system must also guarantee **user integrity** by offering the option of implementing a payment without anyone else apart from the payer and the payee being able to see it (third-party transparency⁸⁴). On the other hand, the system should make it possible to **trace transactions**, to prevent fraud and money laundering.

A majority of agencies also felt that an account-based e-krona can rationalise disbursements from agencies to citizens, companies and organisations and make agencies less dependent on the banking system. The need for cash disbursements and payments via registered letter could also be reduced with an e-krona. The possibility to more easily be able to trace payments with an e-krona and have greater knowledge of the customer was something agencies felt was desirable.

In summary, the comments made by agencies and companies are largely in line with the views of the Project.

5.2 Technical solutions for an e-krona

In the Project's first interim report, it was noted that the choice of technology needed to be further examined before the Riksbank can decide how a development project could be designed. To gain an overview of what different technical solutions for an e-krona might look like, the Project has had a dialogue with technology suppliers since the first report. After posting an invitation on its website, the Riksbank received forty or so proposals and thoughts about the e-krona concept from suppliers and tech companies. The project chose to invite fourteen of these companies to bilateral meetings. An important conclusion from the meetings with technology suppliers is that there is already technology available that could be used to develop an e-krona and that fulfils the properties initially described.

Below we present a few important conclusions based on the Riksbank's own analysis and the discussions it has had with technology suppliers.

5.2.1 The e-krona system should be an open, flexible and scalable infrastructure

The Project proposes that an e-krona platform be based on an open architecture with a standardised interface. This is so that it could be an integrated part of the existing payment system and could interact with other systems, such as clearing institutions (including Bankgirot), the instant payment system and the Riksbank's system for large-value payments (RIX). It is also the opinion of the Project that the Riksbank should not have direct contact with the e-krona's end-users, but that payment service providers and other financial institutions should easily be able to join the platform and supply different services from it. Further, a technical solution is needed so that an e-krona could be used in and interact with other digital services and solutions, both private and public. An e-krona should be able to be used in different marketplaces and, for example, function in the retail trade, in e-commerce and for payments between private individuals. It should also be possible to use an e-krona in various types of public authority services. To guarantee the greatest possible flexibility, the solution should consistently apply international standards in addition to an open architecture and standardised interface.

Developing a technical solution for an e-krona involves substantial work. The technical solution will need to be developed in stages and must be able to be extended and further developed as, for example, the functions of an e-krona change, user volumes increase or new

⁸⁴ See Grym (2018).

technology becomes available. It is important that the solution is constructed in such a way that future adaptations can be made in a safe and efficient manner.

5.2.2 A combination of new and older technology is possible

In interim report 1, one of the conclusions was that it was probably best to use both new and old technology if an e-krona were to be developed. We wrote that blockchain technology or some other form of Distributed Ledger Technology (DLT) was considered immature in the current situation, but probably had future potential. In this report, too, our opinion is that it is not appropriate to develop an e-krona based on one of the current versions of DLT. This is mainly due to DLT still being inefficient technology with, among other things, inadequate performance (for example the number of transactions that can be processed per second and how long an individual transaction takes) and scalability, which makes it very difficult to sue the technology in the event of large payment volumes. Technological development continues apace.⁸⁵ The Project cannot therefore rule out a DLT solution becoming relevant in the longer term. Regardless of the choice of technology, an e-krona should be able to interact with DLT solutions. An important conclusion from the dialogue with technology suppliers is that traditional technology can currently be combined with DLT, which means that payment service providers should be able to base their services on different technologies, DLT or others, regardless of what e-krona platform technology the Riksbank chooses.

5.2.3 Technical preconditions for offline payments

For the e-krona to be constantly available, it must also be possible to use it when the payer and/or payee has no internet connection or telecommunications. This applies to both the value-based and the account-based solution. Offline functionality, which works without risk and when either the payer or the payee does not have access to the Internet/telecommunications and which is also completely safe, is not achievable using current technology. To prevent the same e-krona being used more than once (known as “double spending”), either the payer or payee needs a connection to be able to verify the payment against the payment service. Offline payments, where both the payer and payee lack a connection, are inherently possible, but since the payments cannot be checked in real time, the transaction involves some risk-taking by the parties. These risks can, however, be controlled and limited with the aid of regulations, which is currently the case with card payments. The parties agree on who bears the risk and on how many payments, and for what amounts, should be possible to make offline.

5.2.4 Complete anonymity and integrity cannot technically be fully offered

It is technically possible to build a value-based e-krona that can be used anonymously, that is, without the payer having to identify herself when making a payment. A pre-loaded card could also be transferred to another person after a purchase, in principle when cash changes ownership. However, this is not a question of a completely anonymous solution as an e-krona will always, due to its digital form, be possible to trace when used to make a payment and must also fulfil the traceability requirements stipulated in the Money Laundering Directive. In this way, the card will always be traceable to its buyer if it is used to make an electronic payment.

5.3 Summary

The conclusions drawn after our discussions with market agents and agencies is that for an e-krona to be accepted and widely available, it is important to develop a technical user interface that is easy to use. One objective should also be to give those people who already find it difficult to manage digital services the opportunity to easily switch to using digital payment services. As the whole of society moves towards instant payments, high transaction

⁸⁵ Work is being done to, among other things, rationalise the consensus models used to approve transactions.

capacity and performance will also be needed on the e-krona platform so that a large number of transactions can be settled without delay. It is also considered that the platform will also need to strengthen robustness on the payment market and make the services available even in situations when the telecommunications network is out of operation. In addition, the security requirements regarding hardware, software, architecture and communication, as well as the requirements for maximum cybersecurity will be crucial in the Project's future work. It is also considered that an account-based e-krona could rationalise payments from agencies and make them less dependent on commercial agents. Based on the discussions conducted, the Project has also drawn the conclusion that it is not currently appropriate to develop an e-krona platform based on DLT technology, as this technology cannot currently handle sufficiently large transaction volumes in an adequately efficient manner.

6. The Riksbank's e-krona pilot

Previous chapters have provided a general description of the requirements that may be imposed on an e-krona in terms of its properties and functions. If the Riksbank is to proceed and examine whether these requirements can be met in reality based on technical solutions, development work in partnership with selected technical and infrastructure experts needs to be initiated. The Project therefore proposes that the Riksbank starts a pilot programme aimed at developing the technical aspects of an e-krona.

The concept of a pilot is normally used in the final phase of an IT development project immediately before production launch. The pilot constitutes a live test of a finished product or service among a limited number of actual users. The Riksbank is not yet at this stage. The aim of the e-krona pilot programme is to develop a tested and ready e-krona that could be launched by the Riksbank in the future should it wish to do so. The programme will take the Riksbank's current mandate as its starting-point. This means that the initial focus will be on an e-krona that constitutes a prepaid value (electronic money) without interest and with traceable transactions. The starting-point for the pilot programme will otherwise be the e-krona concept presented in the two interim reports published by the Project. In box 4 below, the Riksbank's e-krona pilot is presented in more detail and box 5 shows an overall draft timetable for the introduction of a possible future e-krona.

Box 4. What does the Riksbank's pilot study involve?

What action are we going to take?

- Test of a feasible e-krona system, that is test a holistic concept that covers everything from the Riksbank's platform to payment solutions for various agents and users, in a limited environment, with specific technologies and selected suppliers.
- Test of different possible properties of an e-krona.
- Test of different technologies.
- Test of critical functions.
- Test of security using different technical options.
- Drafting of regulatory frameworks and the legal preconditions for the entire e-krona system.
- Test of an e-krona in limited experimental environments in partnership with various agents.

What is the purpose?

- To ascertain that certain technologies are viable, what limitations there are and how they can be solved.
- To ascertain that certain functions and certain services can be achieved using different types of technology, or that only one specific technology provides the functions demanded. The tests are to allow us to choose the appropriate technology.
- To ascertain that levels of security and accessibility are adequately achieved or that there are security limitations to solve and subsequently develop.
- To ascertain that we have a viable holistic concept and/or what limitations individual parts of the concept have. We should then be able to develop solutions that overcome any limitations.

What is the aim?

The Riksbank has not decided whether to issue an e-krona or not. The aim of the pilot programme is to present one or more feasible technical solutions for an e-krona system.

Box 5. What might the process for the introduction of an e-krona look like?

The Riksbank has not determined whether the bank should issue an e-krona or not. But issuing a new digital krona is something that would take a long time and affect us all. To provide a real choice, the Riksbank must therefore draft a plan for what such a process could look like. Some key components in a more complete basis for decision-making are as follows:

First, the Riksbank wishes to have an overarching dialogue with various groups about a digital krona, in order to discuss both the e-krona concept and the consequences for society and the individual.

Second, the e-krona needs to be developed technically, which will take time. The Riksbank needs to draft exact specifications for the e-krona, develop and test these solutions and then draft a concrete proposal for a functioning e-krona.

Third, a technical solution for an e-krona needs to be tested and implemented both in experimental environments and in the existing infrastructure with both financial market agents and the general public.

Fourth, if the Riksbank wishes to introduce an account-based e-krona that requires legislative amendment, the Riksdag must first adopt such amendments.

Fifth, if the Riksbank chooses to issue an e-krona, it must prepare society for the new krona. This in itself will take several more years. An overall draft timetable for the process is presented below.

A possible timetable for the e-krona pilot could be as follows:

1. The Riksbank investigates the need for legislative amendments to give it a mandate for issuing an account-based e-krona (2019).
2. The Riksbank drafts background material and procures technical support for an e-krona pilot (2019).
3. The Riksbank drafts a technical e-krona solution, tests and evaluates it (2019-2020).
4. The Riksdag has the option of adopting new legislation (2020-2021).
5. The Riksbank prepares implementation in a specific project in partnership with market agents and the rest of society (2021 and onwards).

7. Conclusions

An e-krona can fulfil important societal functions. If the marginalisation of cash continues, an e-krona could ensure that the general public will still have access to a state-guaranteed means of payment. State presence on the payment market, in the form of an e-krona, retains the option we have today of being able to convert money in a private bank into state-issued money, which is seen as safeguarding our trust in private money. Alternatively, not to act in the face of current developments and completely abandon the payment market to private agents, will mean that the general public will be entirely dependent on private payment solutions, which may make it more difficult for the Riksbank to promote a safe and efficient payment system. It is therefore proposed that the Riksbank continue to examine the scope for an e-krona.

Which arguments are important for an e-krona? In this report, we have highlighted several benefits and drawbacks but do not rank them. In our view, it is difficult to unequivocally say that one argument is more important than the other at this stage. Some arguments have a bearing on security and national preparedness, others on economic effects. A few arguments are also of a more political nature and concern, for example, issues such as the role of the state and citizens' access to and costs for payment services. Different groups in society would probably rank these arguments differently. Going forward we will analyse costs, risks and the role of the state in more detail, so that the various arguments can be weighed against each other. There will obviously be an element of value judgement in the analysis. The Swedish payment market currently functions smoothly and is considered cost-efficient. Why is it then natural to move on to a more operative phase of the e-krona project? It is clear that we need to prepare ourselves for a future payment market that is perhaps not at all as efficient as it is today. Furthermore, it takes a long time to build a technical solution for a possible e-krona system.

The Project considers issues relating to national preparedness, inclusion and risks of the state being completely outside the payment market in relation to the general public to be sufficient grounds for starting to develop a concrete technical proposal for an e-krona.

An e-krona will probably not have any major consequences for banks and the financial system in normal circumstances. Banks may possibly receive slightly fewer deposits from companies and the general public and may therefore need to obtain their funding via other market channels (wholesale funding). In times of financial unease, when we assume that general public will wish to withdraw their assets from weak banks, the e-krona enables a more general and faster run from the banking system to state-guaranteed money than a traditional run from the banking system to cash. However, the Riksbank has tools to cope with such situations if they risk jeopardising financial stability.

For monetary policy, we can ascertain that it may be advantageous to be able to control demand in a situation when the e-krona is widely available and demand becomes substantial. Interest rates could in such a scenario be one of several possible tools to limit any negative effects on the efficacy of monetary policy and financial stability. Overall, these consequences can be mitigated using the instruments already at the Riksbank's disposal, but the technical design of an e-krona should nevertheless take these aspects into consideration.

The Riksbank will continue to analyse issues relating to CBDC and digitalisation of the payment market more generally. In addition to this general analysis, the Project also wishes to continue to examine the issues below that affect the e-krona more directly.

Legislative review

The changes occurring on the payment market and in payment patterns are rapid and comprehensive. In this situation, the Riksbank wishes to have preparedness and room for manoeuvre as regards the possible development of an e-krona. The Project therefore proposes that the Riksbank review the legislative amendments that may need to be implemented to provide the Riksbank with a clear mandate in the issue. This review will be referred to the relevant bodies for consultation. This work will start in 2019 and when, or if, it is considered appropriate, the Riksbank will petition the Riksdag with draft legislative amendments.

In general, there may be reason for the Riksdag to consider clearer legislation as regards the Riksbank's mandate and scope for making an account-based e-krona available to the general public. The current legislation is obsolete in that it does not consider digitalisation. Any review should also take into account the concept of "legal tender" more generally and consider whether a possible e-krona should have legal tender status.

Develop a value-based e-krona

It is natural to move on to a more operative phase of the e-krona project. In 2019 and 2020, the Project wishes to draft, test and evaluate an e-krona which in legal terms is considered as e-money. The programme will take the Riksbank's current mandate as its starting-point. This means that the focus will be on a value-based e-krona that constitutes a prepaid value (electronic money) without interest and with traceable transactions. The technical solution should be flexible so that it can also be adapted to an account structure.

Continue to examine an account-based e-krona

An account-based e-krona requires coordination with other central agencies. It is reasonable for any e-krona system for account-based krona to be built in agreement, and perhaps even in partnership, with other central agencies. A Swedish stance on digitalisation on the payment market should also be drafted. The project proposes that the Riksbank initiate cross-agency dialogue in this issue.

References

- Alsterlind, Jan, Hanna Armelius, David Forsman, Björn Jönsson and Anna-Lena Wretman (2015), "How far can the repo rate be cut?", *Economic Commentary*, No. 11 2015, Sveriges Riksbank.
- Armelius, Hanna, Paola Boel, Carl Andreas Claussen, Marianne Nessén (2018), "The e-krona and the macroeconomy", *Sveriges Riksbank Economic Review*, No. 3, Sveriges Riksbank, forthcoming.
- Arvidsson, Niklas, Jonas Hedman, Björn Segendorf (2018), "När slutar svenska handlare acceptera kontanter?" (When will Swedish retailers stop accepting cash?) Swedish Retail and Wholesale Council research report, 2018:1.
- Ball, Laurence (2014), "The Case for a Long-Run Inflation Target of Four Percent", *IMF Working Paper* 14/92.
- Bank for International Settlements (2001), Basel committee on Banking Supervision, "Working Paper on Pillar 3 – Market Discipline", September 2001.
- Bank for International Settlements (2018), Committee on Payments and Market Infrastructure and Markets Committee, Central Bank Digital Currency, March 2018.
- Bech, Morten, Umar Faruqui, Frederik Ougaard and Cristina Picillo (2018), "Payments are a-changing' but cash still rules", *BIS Quarterly Review*, March 2018.
- Bertsch, Christoph and Johan Molin (2016), "Revisiting the role of central banks as liquidity providers – old and new challenges", *Economic Review*, No. 2, Sveriges Riksbank.
- Buiter, Willem and Ebrahim Rahbari (2015), "High Time to Get Low: Getting Rid of the Lower Bound on Nominal Interest Rates", *Citi Research*, Economics, Global Economics View, April 2015.
- Davoodalhosseini, S.Mohammad R. (2018), "Central Bank Digital Currency and Monetary Policy", Staff Working Paper 2018-36, Bank of Canada, July 2018.
- Dyson, Ben and Graham Hodgson (2016), Digital cash – Why central banks should start issuing electronic money, *Positive Money*, January 2016.
- Callesen, Per (2017), "Can banking be sustainable in the future? A perspective from Danmarks Nationalbank", Speech at CBS' 100 year celebration event, Copenhagen, 30 October 2017.
- Central bank of Iceland (2018), "Rafkróna? Central bank digital currency", interim report, *Special publication Central bank of Iceland*, September, 2018.
- Engert, Walter and Ben Fung (2017), "Central Bank Digital Currency: Motivations and Implications", Staff Discussion Paper 2017-16, Bank of Canada, November 2017.
- Erlandsson, Frida and Gabriela Guibourg (2018), "Times are changing and so are payment patterns", *Economic Commentary* No. 6 2018, Sveriges Riksbank.
- Grym, Aleksi (2018), "The great illusion of digital currencies", *Bank of Finland Economics Review*, No. 1, Bank of Finland.

Grym, Aleks, Päivi Heikkinen, Karlo Kauko, and Kari Takala, (2017), "Central Bank Digital Currency", *Bank of Finland Economics Review*, No. 5, Bank of Finland.

Gürtler, Kirsten, Sören Truels Nielsen, Kristine Rasmussen and Morten Spange (2017). Analysis – Central Bank Digital Currency?, Nationalbanken, December 2017.

Juks, Reimo (2018), "When a central bank digital currency meets private money: effects of an e-krona on banks", *Economic Review*, No. 3, Sveriges Riksbank, forthcoming.

Kumhof, Michael and Clare Noone, (2018), "Central bank digital currencies - design principles and balance sheet implications", Staff Working Paper, No. 725, Bank of England, May 2018.

Meaning, Jack, Ben Dyson, James Barker, and Emily Clayton, (2018), "Broadening narrow money: monetary policy with a central bank digital currency", Staff Working Paper, No. 724, Bank of England, May 2018.

Norges Bank (2018), "Central bank digital currencies", *Norges Bank Papers*, No. 1, 2018.

Pennacchi, George (2012), "Narrow Banking", *Annual Review of Economics*, vol. 4 2012.

Rachel, Lukasz and Thomas D. Smith (2015), "Secular Drivers of the Global Real Interest Rate". *Bank of England Staff Working Paper*, No. 571.

Schmiedel, Heiko, Gergana Kostova, and Wiebe Ruttenberg (2012), "The social and private costs of retail payments instruments – a European perspective", *Occasional paper series*, No. 137, September 2012, ECB.

Segendorf, Björn (2018), "How many e-kronas are needed for payments?" *Economic Review*, No. 2. 3, Sveriges Riksbank, forthcoming.

Segendorff, Björn and Thomas Jansson (2012), "Cards or cash. How should we pay?", *Economic Review*, No. 3. Sveriges Riksbank.

Swedish Consumers' Association (2018). Framtidens betalningsmedel – ur ett konsumentperspektiv (Future means of payment – from a consumer perspective, Report 2018.

Swedish National Debt Office (2008), Central-government-borrowing-report 2008:3, November 2008.

Sveriges Riksbank (2013), "The Swedish retail payment market", Riksbank Studies, Sveriges Riksbank.

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

Sveriges Riksbank (2018), "Payment patterns in Sweden", Sveriges Riksbank, May 2018.

Söderberg, Gabriel (2018a), "What is money and what type of money would an e-krona be?". *Economic Review*, No. 3, Sveriges Riksbank, forthcoming.

Söderberg, Gabriel (2018b), "Why did the Riksbank receive a banknote monopoly?". *Economic Review*, No. 2. 3, Sveriges Riksbank, forthcoming.

Wetterberg, G. (2009). Money and Power, Sveriges Riksbank, Atlantis.

Glossary

Account-based e-krona: a balance recorded on a central register at the Riksbank and that can be likened to money held in a private account at a credit institution (deposit).

Anonymity: state of a person not revealing their name or any other identifiable feature to others. A necessary condition of anonymity is that the person is untraceable (see Traceability).

Bank-ID: an electronic ID comparable to a passport, driving license or other physical ID document.

Bank run: an event when a large number of customers move or withdraw money from a bank in order to protect their assets from possible bankruptcy.

Central Bank Digital Currency, CBDC: digital money issued by a central bank that is more widely available than central bank reserves that can only be held by banks and other financial institutions that are participants in the central bank's settlement systems. CBDC can be held in an account or register at the central bank and either be widely available to the general public or to a more limited group in the form of banks and other financial institutions. In contrast to private bank money, which constitutes a claim on the private institution, CBDC constitutes a claim on the central bank.

Central bank money: money issued by a central bank. This can be banknotes and coins as well as assets held in accounts at the central bank. Their common characteristic is that they constitute a claim on the central bank.

Clearing organisation: companies that perform clearing, i.e. compile and handle payment instructions (in Swedish Bankgirot), and are licensed to do so by the supervisory authority (Finansinspektionen in Sweden).

Cyberattack: generic term for attacks on IT systems covering data security breaches, various forms of sabotage, IT systems being utilised to attack third parties, and so on.

Deposit facility: banks and other financial agents can deposit money with the Riksbank overnight at the repo rate minus 75 basis points. The interest the counterparty receives when it deposits money with the Riksbank overnight is known as the Riksbank's deposit rate.

Digital wallets: a way of enabling individuals to make electronic payments by using their mobile phones or some other electronic tool. Depending on the design of the wallet, it can be used to gather card details, delivery information, ID documentation and be linked to a bank account.

Distributed Ledger Technology (DLT): a technology whose architecture is based on networks of distributed registers/databases in which all participants can create, transfer and store transactions without these necessarily being coordinated and administered by a central or known party.

Double spending: refers to the possibility of paying several times with the same money. Digital money is a series of numbers that can be copied and without protection against "double spending", it could be possible to pay any number of times with the same electronic money.

Economies of scale: economic term for production in which the average cost falls as the production volume increases, i.e. where the marginal cost is lower than the average cost over a (large) output interval. Economies of scale normally occur when production is associated with major fixed costs. Economies of scale may give rise to natural monopolies.

E-identification: electronic identification for use, for example, online that enables identification, signatures and transaction approval.

E-krona platform: a technical infrastructure provided by the Riksbank and containing an account structure for account-based e-krona and a register that enables the issuing and redemption of value-based e-krona.

E-krona system: Technical systems and payment infrastructure needed for an e-krona to function in practice. The system includes the e-krona platform and all peripheral infrastructure, such as support systems for the e-krona platform and the Riksbank's settlement system for payments as well as links to e-krona users and other external systems.

Electronic money (e-money): every electronically or magnetically stored monetary value in the form of a claim on the issuer that is issued against the receipt of funds in order to implement payment transactions in accordance with Article 4.5 in the Payment Services Directive and that is approved by a physical or legal person other than the issuer of the electronic money. See Directive 2009/110/EC.

Encryption keys: infrastructure for public-key cryptography. PKI (Public key infrastructure) is a system that, using electronic certificates, makes it possible to check that a specific public key actually belongs to the purported owner. PKI requires there to be a certificate issuer who issues certificates and who can revoke them if necessary.

Exchange policy: measures that a central bank takes to influence its country's own exchange rate in relation to other currencies. Also called exchange rate policy. In Sweden, the Government decides whether the exchange rate should be fixed or floating. The Riksbank then has the task of managing the daily policy within the framework of the system decided.

External effects: are counted as one of all market failures. External effects are costs and damage to persons not participating in the market for a good, third parties. They occur because the market does not take all the costs of the production and sale of a product into account. External effects can be both positive and negative. Negative external effects lead to the production of a product being higher than what is socioeconomically desirable. Positive external effects lead to the production of a product being lower than what is socioeconomically desirable. To deal with external effects, the state can use price regulation, prohibition, quantity regulation, taxes and subsidies. Pollution is an example of a negative external effect.

Extraordinary measures (QE): measures taken by the Riksbank during the financial crisis, for example structural transactions in Swedish kronor, to help the banks gain access to liquidity, ease the workings of the money market and strengthen the impact of monetary policy on the economy.

Fine-tuning: transactions that the Riksbank uses to absorb surplus liquidity from banks or to enable banks to borrow money from the Riksbank against collateral to keep the overnight rate stable and close to the repo rate.

Fin-Tech: financial technology, the collective name for the most recent software developments in the area of financial services. Fin-Tech automates services and functions that have previously been performed by human beings, such as algorithmic equity trading.

Gold and foreign exchange reserves: Sweden's reserves of gold and securities in foreign currency managed by the Riksbank. This buffer can be used when necessary to defend the value of the Swedish krona and to provide emergency liquidity assistance to solvent banks which encounter difficulties.

Instant settlement: settlement that takes place virtually at the same time as the payment is initiated.

Integrity: can refer to different IT-related phenomena, including personal integrity - protection of private life and private data, the right to have secrets and be anonymous. In the case of the e-krona, it may involve two parties entering into a transaction without third-party transparency. Data integrity means that stored data is correct, not accessible to unauthorised persons and protected against misrepresentation and unlawful destruction.

Interbank rate: interest rate on unsecured loans that banks offer other banks. Stibor (Stockholm Interbank Offered Rate) is usually used to measure the Swedish interbank rate. Stibor is used as a reference for rate setting or pricing of derivative contracts.

Interchange fee: a fee paid for each transaction directly or indirectly (for example by a through a third party) between the issuer and the redeemer who participate in a card-based transaction.

Interface: enables communication between various software modules and/or hardware modules, such as API, Application Programming Interface, but an interface can also refer to the interaction between human and machine, known as the "user interface".

Internet of Things (IoT): things like clothes, cars, buildings, electricity grids, etc., containing electronics that enable online connections allowing them to communicate and be controlled via the Internet.

Know Your Customer (KYC): concept referring to the actual process of getting to know your customers in order to be able to combat criminal activity such as money laundering and the financing of terrorism. Companies operating in the financial sector must meet specific KYC requirements. For example, banks and other credit institutions must retrieve information about their customers in order to establish their identity and check where their money comes from.

Legal tender: banknotes and coins issued by Sveriges Riksbank are legal tender.

Lender of last resort: a role often taken on by a country's central bank. This is because it has unique scope to create means of payment and lend to agents to prevent them going bankrupt in the event of the market considering them high-risk.

Liquidity: measure of the ability of a company or organisation to meet its payment obligations in the short term.

Liquidity risk: the risk of not being able to meet payment obligations due to a lack of liquidity.

Natural monopoly: economic concept for an industry in which only one long-term profitable company can exist, often due to economies of sale.

Network effects: the (positive) effect of a new user joining a network on existing members of the network.

P27: an initiative examining the scope for creating a common payment infrastructure with common products for the 27 million inhabitants of Sweden, Norway, Denmark and Finland.

Money laundering: a process aimed at making illegally earned money appear legally earned.

Monetary policy counterpart: credit institution domiciled or with branches in Sweden that is a participant in RIX (The Riksbank's settlement system) and has access to credit facilities at the Riksbank. Since April 2009, credit institutions that have opted not to participate in RIX may become restricted monetary policy counterparties to gain access to the credit facilities.

Payment system: accounts, regulations and computer systems needed to execute payments and transfer securities between different parties.

Payment service provider: a collective term for actors who supply payment services. The group includes banks, credit market companies, payment institutions, registered payment service providers, institutions for electronic money, state agencies and municipal authorities, central banks and the foreign equivalents of these categories.

Private bank money: assets held at banks and other credit institutions in the form of deposits, etc. In contrast to central bank money, which constitutes a claim on the central bank, private bank money constitutes a claim on the private institution.

Redundancy: In the IT field, redundancy can refer to different things, such as data duplication, which is necessary in all communication to enable the recovery and reconstruction of lost data, but it may also refer to hardware: duplicate or multiple sets of key components to ensure the equipment works even if something breaks.

Repo rate: The Riksbank's most important policy rate by which the Riksbank can control short market rates with the intention of affecting inflation. The banks pay the repo rate when they borrow money from the Riksbank through the Riksbank's repo transactions. On occasions when the banks deposit money with the Riksbank, they may instead purchase Riksbank Certificates. The banks receive the repo rate when investing in Riksbank Certificates.

Repo rate path: forecast for the repo rate for a number of years ahead which is expected to lead to the Riksbank attaining its inflation target of two per cent and to contribute to generally healthy economic development. The repo-rate path is published at the same time as the Riksbank's decision on the repo rate, which normally happens six times a year.

Resilience: the long-term capacity of a system to resist, cope with and recover after changes.

Robustness: ability to withstand shocks and interruptions and the ability to minimise their consequences should they nevertheless occur.

Scalability: possible expandability without serious deterioration in performance (e.g. increased number of users).

Seignorage: revenue received by a central bank from its issuance of banknotes and coins. Equivalent to the return on a central bank's assets corresponding to banknotes and coins in circulation less the central bank's total costs for cash management.

Settlement: final regulation of debt when money or securities are transferred from one party to another, usually payment from one account to another.

Settlement system: the technical system used to initiate a payment process and record the settlement.

Single-point-of-failure: a critical component of an IT system, for example. If this component were to break or stop working in some other way, the entire system would fail.

Solvency: financial measure of a company's ability to fulfil its payment obligations. Also a measure of an insurance company's financial position that gauges the size of the companies' assets in relation to its debts, which mainly consist of their total commitments.

Swish: a smartphone app that enables instant account-to-account transfers.

Target Instant Payment Settlement (TIPS): a joint European infrastructure for instant payments built by the European Central Bank (ECB). The system shall be operational during the autumn of 2018.

Traceability: in information security refers to the capacity to identify who has added, amended or removed information in a system.

Transmission mechanism: the process through which monetary policy affects inflation and the economy in general.

Value-based e-krona: electronic money issued by the Riksbank. A value-based e-krona is a pre-paid value that can be stored on a payment device, for example, on a payment instrument in the form of a card or smartphone app or in a payment account for electronic money. Value-based e-krona do not constitute account receivables.

Wholesale funding: the part of banks' funding that does not come from deposits. It can, for example, be funding via securities borrowing.



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