

The Riksbank's e-krona project

Report 1

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Foreword

Recent years' technological developments and the changes we can see in the payment patterns of the general public are opening up a number of questions concerning payments in the future and how best to take advantage of modern technology.

Today, cash is used to an ever-decreasing extent in Sweden, which has led us within the world of central banking to start considering whether a digital complement to cash that is guaranteed by the state is needed so that we will be able to promote a safe and efficient payment system in the future too. Consequently, in mid-March, we launched a project with the aim of investigating the need for a so-called e-krona and the possible consequences of introducing such a complement. The project has also developed a concept for an e-krona, which is presented in this report.

As digital central bank money made available to the general public is a new and relatively unexplored area, we currently have no answers to all of the questions surrounding future payments and the role of an e-krona in this future world. With this report, we therefore hope to encourage an open dialogue to spread more knowledge about the development of the payment market and questions around the e-krona. We would like to receive the opinions of various groups in society, not only to learn more, but also because the matter of digitalisation will affect our entire society, regardless of whether or not the Riksbank chooses to issue e-kronas. We would particularly like to point out that the Riksbank has not yet taken any decision to issue e-krona.

The report is organised in the following way. Chapter 1 presents the reasons the Riksbank has for investigating the issuance of e-kronas. Chapter 2 reviews the characteristics of e-kronas and two feasible models for how they could function. Chapter 3 discusses what the Riksbank's operational role could look like under an e-krona system and the technical aspects of the design of an e-krona. Chapter 4 discusses the consequences of issuing e-kronas from the points of view of monetary policy and financial stability. Legal aspects of the introduction of e-kronas are dealt with in Chapter 5. Finally, a number of conclusions are drawn in Chapter 6. The project would like to express its thanks to the ECB for contributing valuable resources in the work on producing this report.

Stockholm in September 2017

Eva Julin
Project manager

Summary

The Riksbank is investigating whether it would be possible to issue a digital complement to cash, so-called e-kronas, and whether such a complement could support the Riksbank in the task of promoting a safe and efficient payment system. This is not a unique situation: several times previously, the government has had to reconsider its role on the payment market when this has changed. An e-krona would have the potential to counteract some of the problems that could arise on the payment market in the future when the use of cash is rapidly declining.

An e-krona would give the general public access to a digital complement to cash guaranteed by the state and several payment services suppliers could connect to the e-krona system. Currently the Riksbank only offers participants in RIX¹ digital payments. By functioning independently from the infrastructure used by the commercial bank system, the e-krona system could also make the payment system more robust in the event of disruptions to, for instance, the system for card payments.

Cash usage decreasing

During the 21st century we in Sweden have been able to note that the use of cash has declined, at the same time as card payments and, in recent years, Swish² payments have become increasingly common. The proportion of cash payments in the retail sector has fallen from close to 40 per cent in 2010 to about 15 per cent in 2016. Two-thirds of consumers say they can manage without cash and just as many mostly use cards for payments under SEK 100. In the not-too-distant future, Sweden may become a society in which cash is no longer generally accepted. Developments on the Swedish payment market are unique in an international perspective.

Digitalisation trend can have undesired effects

This development is a part of a greater trend towards digitalisation in society and a movement towards a mediation of payments in Sweden that could be entirely driven by private actors and consolidated among a small number of commercial participants, payment services and infrastructures. In the long run, this concentration could restrain competitiveness in the market and make society vulnerable.

The development towards an almost cashless society also entail households having little opportunity to save and pay with risk-free central bank money and this can ultimately lead to a decline in the resilience of the payments system. We are also aware that there are certain groups that at present do not have the opportunity to use digital payment solutions, or quite simply prefer cash to other means of payment. For these groups it is important that society can offer alternatives. The Swedish Post and Telecom Authority and County Administrative Boards are responsible for ensuring that the general public's need of basic payment services is met.

In a crisis or situation of financial unease, when demand for cash can be assumed to increase, it would take considerable time to get the distribution of cash to different

¹ The Riksbank's system for large-value payments between financial institutions.

² Swish is a commonly used Swedish real-time mobile payment service, see Sveriges riksbank (2013), chapter 3 for a short description.

participants to function, even if the Riksbank was ready and prepared for this eventuality. In the event of systemic shocks, there is a risk that there would be no rapidly available free-standing alternative such as cash is at present.

A register-based e-krona that is supplemented with a value-based e-krona

A register-based and a value-based e-krona are presented as two conceivable models for an e-krona. With a register-based e-krona, the balance would be stored in accounts in a central database, while a value-based solution would be more like cash is at present, as the value would be stored locally in an app or on a card. The current assessment is that a simple value-based solution would have a more limited potential for development than a register-based solution, but that it might possibly be introduced more quickly. A register-based solution is deemed to be more complex, but, at the same time, would give greater possibilities to extend the model in stages and make adjustments to future demands. The project proposes a combination of the two models, where a register-based solution is supplemented with a value-based e-krona that is primarily suited to small payments offline. The value-based solution will make the e-krona more accessible to groups that are unable or unwilling to have e-krona accounts and the solution can be further developed to meet special groups' need for basic payment services.

The choice of technology needs to be investigated

Which technology would work best for an e-krona is a matter for further investigation by the project. Both new and tried-and-tested technology could be used, and there could be cooperation with both public authorities and private actors.

Limited effects on monetary policy and financial stability

In a preliminary analysis of the consequences an e-krona, according to the concept in this report, could have for monetary policy, as well as the payment market and financial stability, no major obstacles to the introduction of an e-krona have been identified. We assume that the monetary policy framework will be adapted to a new reality. The Riksbank supplies the volume of banknotes and coins that the general public and the market demands. They can be assumed to determine the supply of e-krona in the same way as they currently determine the supply of banknotes and coins.

The legislation needs to be revised

The questions we raise are so large and so important that we assess that they require thorough deliberations by the legislator. The introduction of e-kronas is not obviously compatible with current legislation on the Riksbank's monetary policy assignment. However, according to a preliminary assessment, an e-krona could be compatible with its statutory assignment of promoting a safe and efficient payment system. It is the opinion of the project that the Sveriges Riksbank Act needs to be adapted if the Riksbank is to issue a digital means of payment. Sveriges Riksbank's mandate to issue an e-krona and the question of whether or not the e-krona should be legal tender are ultimately matters for legislators to decide.

The e-krona concept

The project proposes the following design for an e-krona in the event that the Executive Board of the Riksbank sees a need to introduce digital central bank money made available to the general public:

- The e-krona is primarily intended for smaller payments between consumers, companies and authorities.
- The e-krona constitutes a direct claim on the Riksbank, is specified in Swedish kronor and can be held by the general public, financial institutions and companies. It is accessible in real time, 24 hours a day, seven days a week, 365 days a year.
- The e-krona does not accrue any interest, but should have a built-in function to make it possible to accrue interest at a later point.
- A register-based e-krona is combined with a value-based solution that makes offline payments of small amounts possible and increases their availability for groups that do not want to or cannot have e-krona accounts.
- The Riksbank provides the basic functions for the e-krona, but investigates the possibility of using the existing digital infrastructure and invites external actors to propose how the interaction with end-users should be designed.

This concept is the result of the project's initial preliminary conclusions and may be amended as the work of analysis and inquiry continue and after the project has held a dialogue with interested parties in society.

Discussions with those concerned

The development of the payment market affects the whole of society and the Riksbank hopes that this report will open the way for a broad dialogue with various groups as to how the different questions and problems can be managed. The next stage in the project to investigate the conditions for an e-krona is to gather in views and questions from those involved. The Riksbank has not yet taken any decision on issuing an e-krona.

1. The central bank's role justifies an inquiry into the payment market of the future

In the not-too-distant future, Sweden may become a society in which cash is no longer generally accepted. This is a part of a greater trend towards digitalisation in society and a movement towards a payment market that could be increasingly consolidated among a small number of commercial participants, payment services and infrastructures. This development raises questions over the payment market's future security and efficiency, thereby giving reason for the Riksbank to look into a digital alternative to cash. The Riksbank already supplies digital money to the banks through RIX. This chapter describes the development of the payment market and discusses it from factual, theoretical and historical perspectives.

1.1 Possible problems on the future payment market

1.1.1 Bankgirot is the only Swedish clearing house

In total, payments were made in Sweden in 2016 to a value of about SEK 16,400 billion, corresponding to about 3.5 times GDP.³ Credit transfers account for almost half of this value, often as payments between companies, including authorities. Card payments only amount to just over 6 per cent of the total value.

The size of cash payments is unknown, but withdrawals from ATMs were SEK 136 billion, cash withdrawals in shops approximately SEK 20 billion⁴ and withdrawals over the counter at bank branches are probably relatively small. All in all, thus indicates that the total value of cash payments between consumers and companies should be about SEK 200 billion or less, which is to say about 1.4 per cent of the total value.

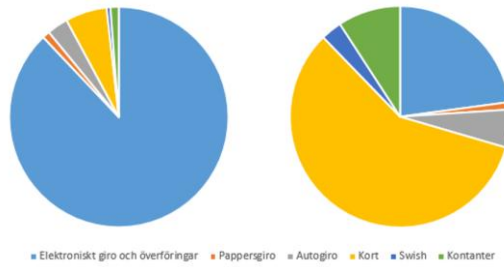
If we look at the number of payments, the picture is different. In total, about 5.4 billion payments were made in 2016. Of these, cards accounted for about three-fifths, credit transfers for a little more than one fifth. The number of cash payments is estimated at a round 0.5 billion, corresponding to almost one-tenth of the total number.⁵ In summary, a very large part of payments (in terms of value) are mediated via credit transfers in which seller and buyer do not meet, while the great majority of payments in the economy take place using cards or cash, see Chart 1.

³ Sources for the following statistics: (a) The Riksbank's payment transaction survey, (b) The Riksbank's interview survey "The Swedish people's payment habits 2016".

⁴ The Riksbank's calculations, based on responses in "The Swedish people's payment habits 2016".

⁵ The Riksbank's calculation based on "The Swedish people's payment habits 2016" and card statistics from "The Swedish Financial Market 2016".

Chart 1. Proportion of total mediated value (left) and number of payments (right) 2016



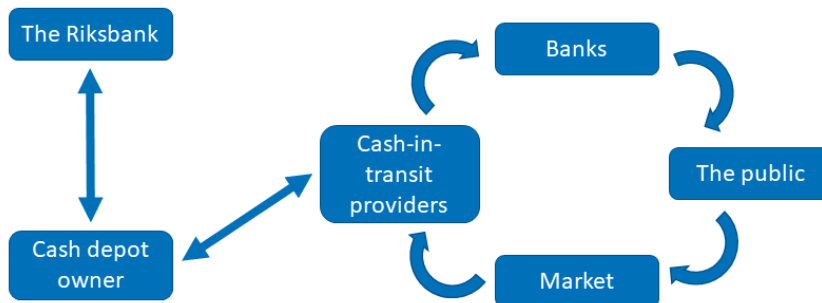
Source: see footnote 3.

One important participant in this context is Bankgirot, which is the only Swedish clearing house that manages account transfers, credit transfers and direct debit transactions. Bankgirot also runs BiR (BetaIningar i Realtid)⁶, which settles Swish payments. Plusgirot⁷ is a system for credit transfers between accounts in Nordea, but not for the clearing of payments between customers of different banks. The technical infrastructure that payment mediators use is thus highly dependent on Bankgirot.

1.1.2 Banks and cash-in-transit companies hold most of the responsibility for the distribution of cash

At the end of the 1990s, the Riksbank began work on making cash handling more efficient. In the inquiries it held, the Riksbank observed that the cash handling model used then was very costly and contributed towards the preservation of an obsolete structure. The Riksbank therefore wanted to make the cost of cash handling more visible and allow the banks and other participants to bear the costs, which would more clearly motivate them to streamline their operations. The aim was also to stimulate greater competition and increase product development of their services all along the cash handling chain, even outside the banks.⁸ Under the current cash handling model, the Riksbank is only responsible for the start and end of the cash life cycle by issuing banknotes and coins, destroying worn-out banknotes and coins and redeeming invalid banknotes and coins. Consequently, it is the banks' depot owners and cash-in-transit companies that supply society with cash according to the schedule in Figure 1 below.

Figure 1. The flow of cash in society

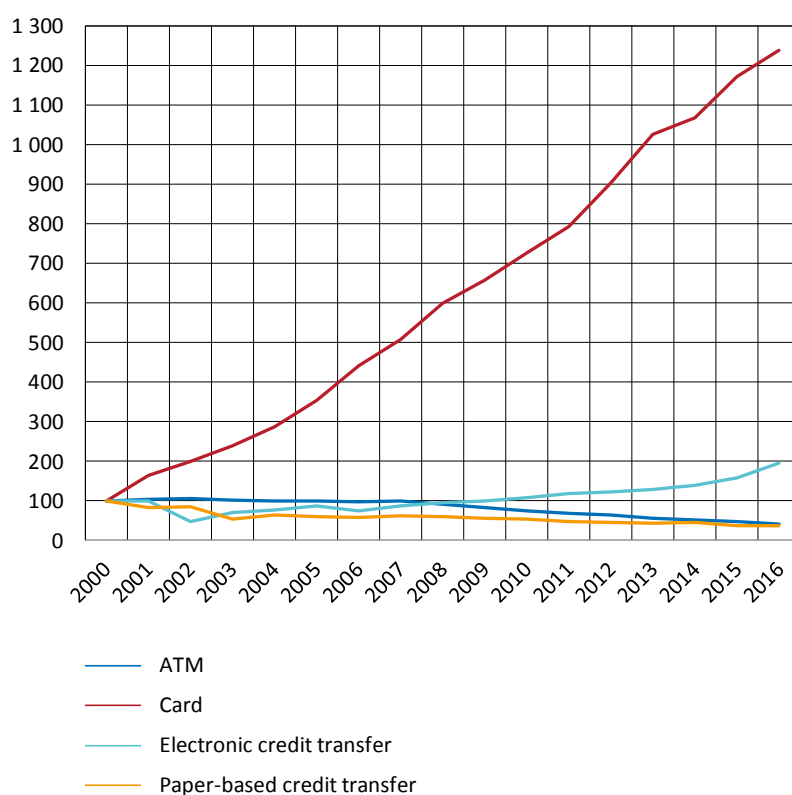


⁶ BiR is a real-time settlement system that enables the real-time mobile payment service Swish. For a short description, see Sveriges Riksbank (2013), chapter 3.
⁷ Plusgirot is the former postal giro system which was bought by Nordea, a commercial bank, in 2001.
⁸ See Daltung and Ericson (2004) for a description.

1.1.3 Electronic payments are increasing over the long term

This century has seen waning cash usage and the long-term increase of card payments in particular, together with, in recent years, Swish. Similarly, we see decreasing usage of paper-based credit transfers and increasing usage of online banking and mobile banking services. To this can be added innovative new payment service suppliers such as Klarna, iZettle and Trustly, which offer specialised payment services. These companies are generally not banks but innovators: either process innovators, technological innovators or both. Their entry onto the market is contributing towards reducing cash usage by offering alternative payment paths between private individuals and companies via existing infrastructures. These trends can be seen most clearly by examining the number of payments in which cash withdrawals from ATMs represent cash usage (see Chart 2).

Chart 2. Trend for ATMs, cards, electronic credit transfers and paper-based credit transfers (number of payments, base year = 2000).



Source: The Riksbank.

We are thus witnessing a transition from physical payment services in the form of cash and paper-based credit transfers to electronic alternatives (cards, electronic credit transfers, and new electronic payment services). It is also worth noting that the Swedish market practically abandoned cheques over 20 years ago – this was also a physical payment service. This change is a consequence of the way new behaviour patterns among consumers and companies are interacting, and structural transformations in the payment market and society.

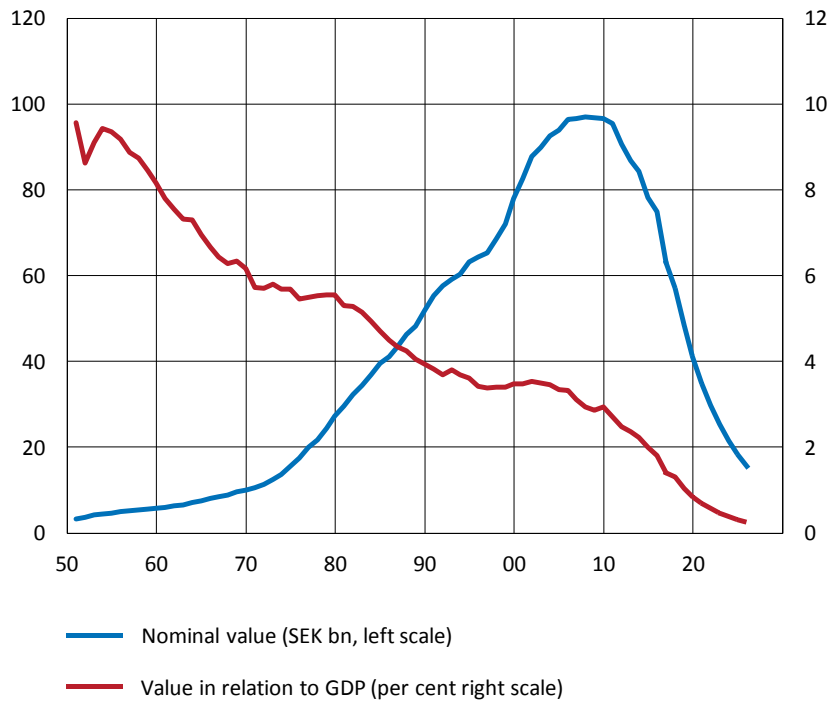
There are no regular statistics on the use of cash in Sweden. First and foremost, cash is used for payments between consumers and between consumers and companies, as well as for savings. The need for cash should be reflected by the amount of cash held by the general public, which is to say the more cash is used, the larger this holding should be.⁹ One common way of measuring the significance of cash in a country is to compare the value of cash in

⁹ Banks also hold cash, but this is as they have a logistical need to supply their customers with cash. In the event that the statistics make a distinction between banks and the general public's holdings of cash, the latter is considered to be a better reflection of cash use in the economy than the sum of both holdings. Swedish statistics make such a distinction and Figure 1.4 only presents the general public's holding.

circulation to the country's GDP. In 1950, the general public's holding of cash amounted to just under 10% of GDP, before showing a trend decline over time, as shown by the red curve in Chart 3. In nominal terms, however, the general public's holding increased until 2007, after which it quickly turned downwards, as shown by the blue curve in Chart 3. This development is unique to Sweden.¹⁰ The broken lines in the curves in the figure illustrate a potential development up to 2025, which is based on the assumption that the use of cash will continue to decline at the same annual rate as during the period 2010-2016. The way things actually develop will depend on several factors and it is difficult to assess now what will happen then.

Chart 3. Cash in circulation measured as an annual average, general public's holdings.

The period 2017-2025 is a scenario based on the use of cash and the demand for cash declining at the same rate as the use of cash during the period 2010-2016.



Sources: The Riksbank and Statistics Sweden (Financial market statistics and National Accounts, GDP on the user side, GDP by expenditure 2016).

The picture of rapidly-declining cash usage becomes stronger when we examine other sources. Interview surveys by the Riksbank indicate that the proportion of cash payments in the retail sector have fallen from close to 40 per cent in 2010 to about 15 per cent in 2016. Two-thirds of consumers say they can manage without cash and just as many mostly use cards for payments under SEK 100. The Riksbank's own investigations reveal that 97 per cent of consumers never or less often than once a month experience that they cannot pay in cash. It is thus the consumers that are abandoning cash, not the retailers. The problems primarily seem to revolve around the possibility of depositing cash in bank accounts. At more than half of all bank branches, it is not possible to conduct over-the-counter cash transactions.¹¹

¹⁰ A large part of the decrease comes from a reduced holding of thousand-krona banknotes. The comprehensive banknote and coin changeover held in Sweden in 2015–2017 may also have played some part. It is well known that many households have had both banknotes and coins stored at home. Part of this holding, such as jars of loose change, was not replaced, so it is not strange that the value of cash in circulation decreased during the changeover. However, even taking these factors into account, the demand for cash has clearly decreased recently.

¹¹ Swedish Bankers' Association (2015). Later editions of these statistics do not include information on so-called cashless bank branches. The country administrative boards (2016) observe that there are now more cashless bank branches than branches with traditional cash services.

1.1.4 Developments on the Swedish retail payment market are unique in an international perspective

Payment patterns can differ substantially from one country to the next.¹² However, in most countries the use of electronic payment services is increasing, although it is unusual to have reliable statistics on the use of cash that can be used to follow developments over time. The Committee for Payments and Market Infrastructure (CPMI) provides payment-related statistics for its member countries.¹³ Sweden is one of the countries that has the highest number of electronic payments per person per year. Sweden was one of only three countries where the ratio between cash in circulation and GDP had fallen between 2011 and 2015. The percentage of cash in relation to GDP in Sweden was, at 1.73 per cent, only one fifth of the average ratio. At the same time, Sweden was the only country where nominal demand for banknotes and coins had fallen.

The Swedish payment market thus differs substantially from the large majority of countries. The status of cash as legal tender is not as strong in Sweden as in many other countries, and in practice it is not compulsory in Sweden for most important actors, such as banks and the retail trade, to accept cash as payment.¹⁴

1.1.5 Several factors are pushing developments towards a cashless society

The development of the payment market is being driven by a number of factors, all pushing in the same direction. The first of these is new technology and innovation. Today, new electronic payment services exist where there were previously few alternatives to cash, for example for payments between consumers where the payment needs to take place immediately. Examples of such payments are trading at markets and making collections. Swish and iZettle are now well-established services and more electronic alternatives should appear in step with technological developments. In addition, the electronic alternatives are becoming both simpler and faster and thereby more attractive. Card terminals work faster and the introduction of contactless cards enables card payments for low values in the blink of an eye. In addition, it is relatively simple to launch new payment services on the Swedish market as households and companies have good knowledge and access to new technology, there is a high degree of trust between consumers, companies and banks¹⁵ and the banking sector has a long tradition of constructing shared infrastructures. The other factor is new consumption patterns and channels. One good example is provided by increased eCommerce, which now also includes food. The third factor is demographics. Younger consumers generally use cash to a significantly lower extent than older ones, which means that cash usage will probably continue to decrease as younger consumers, over time, replace older ones.

Households' decreased cash use should lead to business operators becoming less motivated to accept cash as this is associated with costs, both economic and in terms of labour. This reduced acceptance will in turn reduce the acceptability of cash and lead to a negative spiral of declining use and declining acceptance. At present, there is no binding legal obligation for market participants to supply cash and, as mentioned above, there is in most cases no obligation to accept cash as a means of payment. Thus, there is every indication that Sweden is moving towards a situation where cash risks no longer being generally accepted. In a practical sense, this means that Sweden can become a cashless society.

1.1.6 Increased consolidation on the future payment market?

According to the Riksbank's previous assessment, the Swedish retail payment market will develop in two phases over the foreseeable future.¹⁶ In the first phase, the retail payment

¹² See Sveriges Riksbank (2013), Chapter 2, for a more thorough comparison of the Swedish payment market.

¹³ See BIS (2016), comparing tables 2 and 6 and country-specific tables for the nominal value of the general public's holdings of cash.

¹⁴ This is due to an extensive freedom to enter into agreements, including informal ones. A shop-owner or bank can thus announce that they do not accept cash and when the customer goes into the shop or the bank branch they can be considered to have accepted the terms stated. There is a stronger obligation to accept cash with regard to certain social services, such as medical care. See section 5.8 for a discussion of the e-krona and legal tender.

¹⁵ See, for example, SOM Institute (2017).

¹⁶ See Sveriges Riksbank (2013).

market will move towards increased fragmentation with a large supply of different payment services from many actors. No single actor will be big enough to steer this development alone. In the second phase, consolidation on the market will increase instead. Competitiveness will benefit actors who mediate large amounts of payments and those whose payment services are generally accepted. Smaller actors and less competitive payment services will then be knocked out and the market will gradually move towards increasing consolidation. Decisive factors in the payment market moving towards increased consolidation in the long run are its endeavour to attain economies of scale, synergies and network effects.¹⁷

The banks already have a jointly-owned infrastructure and sub-contractors of payment services in the form, for example, of Bankgirot, Bankomat, Swish and Finansiell ID-teknik (Bank ID). This culture of collaboration, which is characteristic of the Swedish payment market and is relatively unusual abroad, allows banks to take advantage of economies of scale and network effects and to share certain costs.¹⁸

Innovative payment services are often a new way of initiating an already existing payment service. For example, ApplePay is a way of initiating a card payment. Innovative payment services therefore often, but not always, assume access to an existing financial infrastructure. Apparently increased competitiveness on the payment market can thus go hand-in-hand with continued high consolidation or even increased consolidation in the underlying infrastructure.

1.1.7 Consequences in the short, medium and long terms

Given developments on the payment market, it is likely that Sweden will gradually move towards what will, in practice, be a cashless society. Some groups of consumers and companies experience problems when access to cash services is reduced¹⁹ and the Riksbank has recommended that the banks be obliged to provide basic payment services, including cash.²⁰ It is likely that the problems will persist during the transition period towards a cashless society. However, the extent to which these problems will persist and which groups will be affected in a future cashless society, remains an open question.

New or smaller payment service providers, primarily non-banks but also small banks, are dependent on having access to settlement services²¹ and other infrastructures via other banks who act as agent for them.²² This is because some payment service providers cannot gain access to the settlement services as they do not comply with the participant requirements, while, in other cases, it is quite simply too expensive for them.²³ At the same time as the number of new and smaller payment service providers has increased, the banks' incentives for offering agent services have decreased, among other reasons due to the increasingly stringent regulations against money laundering and the funding of terrorism. The degree towards which the new payment services directive (PSD2), which guarantees payment service providers access to the banks' account structures, will result in more participants and new services on the payment market is an open question.

¹⁷ Economies of scale and synergies arise when there are high fixed costs and marginal costs are relatively low. For electronic payment services, this is due to investments in central IT systems, among other things. Network effects occur when the value of having access to a service or commodity increases with the number of other actors having access to the same service or commodity. The telephone is the most common example as the value of owning a telephone increases in proportion to the number of other people that can be reached with it. The same reasoning also applies to cash and electronic payment services. A special version of network effect arises on so-called two-sided markets, which consist of two distinct categories of actor and in which the value of being connected to a service depends on how many members of the other group use the service. For example: if many consumers have cards, it becomes attractive for merchants to be able to accept card payments, and vice versa.

¹⁸ However, it is worth noting the existence of Visa and MasterCard on the global level.

¹⁹ See Länsstyrelserna (2016).

²⁰ See Sveriges Riksbank (2016 b).

²¹ Settlement refers to the final discharge of liabilities between financial institutions and is usually conducted in the form of large and time-critical payments between them. The Riksbank's RIX system is designed for such payments and is therefore called a settlement system. If, for example, a payment service supplier does not participate in RIX, it could attempt to engage another party to act as agent (settlement agent) in RIX.

²² See also Swedish Competition Authority (2017).

²³ RIX is a settlement system notified in accordance with the Finality Directive. Such systems enjoy a special protection in the event that a part-owner of the system goes bankrupt. Companies licensed for the banking or financing business can become participants in a notified settlement system, but being a payment institution or an institution for electronic money is not sufficient. This kind of less-heavily regulated payment mediator is thus dependent on agents.

High and perhaps increasing consolidation in the underlying infrastructure for electronic payments increases the risk of significant shocks to the payment system should part of the infrastructure be incapacitated. There may be single points of failure, the functioning of which is entirely decisive for the functioning of the payment system. For payments at the point of sale, cash can often be used instead of cards, but, in a cashless society, this option only exists in exceptional cases. In a crisis or situation of financial unease, when demand for cash can be assumed to increase, it would take considerable time to set up efficient distribution of cash to different participants, even if the Riksbank was ready and prepared for this eventuality. In the event of systemic shocks, there is a risk that there would be no rapidly available free-standing alternative such as cash is at present.

Another consequence of the development towards a society where cash is no longer easily and generally available, is that households and companies will in practice no longer have access to risk-free claims on the Riksbank, which is what cash comprises.

1.1.8 Conclusion – decreased cash usage is creating various types of problem

The commercial payment system normally functions well and the general public currently has access to a number of different payment services, including cash. However, cash usage is decreasing and the use of electronic payment services is increasing. This is probably an irrevocable process, whose speed is hard to judge. Within the foreseeable future, Sweden could become practically a cashless society. The Riksbank's analysis of the development of the payment market identifies a couple of potential problems on a future market.

Firstly, there will remain, at least over a transitional period, the previously-identified problem of gaining access to cash services for certain groups of consumers and companies.

Secondly, there could be longer-term problems involving inadequate efficiency and resilience in the payment system due to the financial infrastructure, in which electronic payments are mediated, being consolidated in a small number of systems with a small number of owners. Consolidation is already high at present and there are forces in play that could make this consolidation eventually increase further.

Thirdly, the general public's access to risk-free assets in the form of central bank money will probably almost cease entirely. Households will thereby have very few possibilities to save and pay in central bank money, which could contribute towards reduced resilience in the payment system. It is also worth noting that in practice we may find ourselves in a situation reminiscent of the period prior to the banknote monopoly, that is, private actors competing with the means of payment provided by the state, although now to a much greater extent. The question today is, if banknotes issued by the Riksbank in practice disappear, will we then have a situation where the general public only has access to commercial bank money, and what would the concept of legal tender then entail?²⁴

An e-krona could constitute a government-guaranteed means of payment without credit risk and be available for the general public in digital form as a complement to cash. This type of digital krona could be regarded as a modernisation of the Riksbank's means of payment when the majority of society no longer wish to use banknotes and coins to pay for things and/or save money. A possible e-krona could also function as a complement to the payment forms that are currently offered in the private sector. This would benefit competition and options in the payment market. Moreover, the e-krona could fulfil an important function as an alternative means of payment in a crisis situation, as it could be difficult to require that private actors take an active crisis preparedness responsibility and look at the payment market as a whole. The way this would work in practice needs to be investigated further within the scope of this project.

²⁴ When the Riksbank was given the sole right to issue banknotes in 1904, the only means of payment was in a physical form and commercial bank money was not as readily accessible as it is now. At present, the general public has easy access to commercial bank money through, for instance, bank cards, while the only legal tender, cash, may disappear as a generally available means of payment if the digitalisation process continues. One can say that prior to 1904 there were banknotes issued by private banks and by the Riksbank and there were bank deposits. After the monopoly was introduced, there were only banknotes issued by the Riksbank and bank deposits.

1.2 Should the Riksbank take action?

Historically, the government's core tasks have included providing a means of payment, maintaining a payment standard and ensuring confidence in money and market participants. Most frequently, this has taken place via regulation and the exercise of public authority. The government, unlike the private market, is obliged to consider the social perspective. The Riksbank fulfils its assignment through its work on inflation targeting, through the promotion of a safe and efficient payment system, by providing a system for central settlement and by its sole right to provide Sweden with banknotes and coins. The Riksbank's responsibility for promoting a safe and efficient payment system is the task that is most closely related to the development of the payment market as a whole, while its cash supply assignment is more specifically related to the reduced usage of cash. A central bank can be expected to act if cash, the only legal tender, were in practice to disappear as a generally accepted means of payment. What a central bank should actually do, on the other hand, is an open question. The expectations need not mean that the Riksbank must act when the payment market changes, but a central bank should always be prepared to act, and the consequences of developments, and possible alternatives for action, should be discussed and analysed. An e-krona can be a means of meeting this development. In Section 1.1, the Riksbank has identified a number of risks and problems that could arise on the payment market in the future. Here, the Riksbank has an opportunity to act in a proactive manner and thereby prevent possible problems. There are a number of different ways to act and the following alternative courses of action are conceivable. Measures 2 and 3 aim to influence the prevailing development, while measure 4 aims to find a long-term solution.

1. Not influencing prevailing developments on the payment market.
2. Subsidising cash usage.
3. Acting for increased regulation and supervision of cash distribution and the supply of cash services.
4. Providing a digital means of payment.

Even if we discuss the alternatives one by one below, the Riksbank could of course choose a combination of the different alternatives. There are also different ways of implementing a particular measure, which means that the choices are greater than the text below implies.

If no measures are taken, it is likely that the situation will develop in the way discussed in Section 1.1.7: reduced cash usage, difficulties for the general public to gain access to a government-guaranteed means of payment and increased consolidation in the financial infrastructure, which, in turn, could increase vulnerability and reduce efficiency on the payment market. The other alternatives are discussed below.

1.2.1 Alternative courses of action: the Riksbank subsidises cash usage

To facilitate and increase cash usage, the Riksbank could choose to subsidise cash, either directly or indirectly. For example, we could fully or partly return to the 1980s structure of Riksbank branches across the entire country and the comprehensive service to banks and other market participants that was previously provided to the banks largely for free. This would reduce the banks' costs for cash, allowing them to provide a greater range of cash services. Ultimately, this could make it easier and more attractive for private individuals, retailers and other actors to handle cash.

However, as a matter of principle, the Riksbank's opinion is that all means of payment should carry their own costs and the various charges should be based on actual costs. The objective is the greatest possible efficiency on the payment market. Introducing government subsidies into an otherwise smoothly-functioning market could have a negative effect on efficiency.

If the Riksbank were to choose to introduce general subsidies to support the distribution of cash, it would still not be certain that the development towards decreased cash usage

would stop. Access to cash through ATMs and withdrawals in shops is still relatively good. The increased demand for digital forms of payment is instead driven by new technology and new consumer goods. On the other hand, there may be reason to actively support cash usage in certain areas or for certain groups in society during a possible transition towards the cashless society. Such support already exists today, to a certain extent, through the Swedish Post and Telecom Authority and the County Administrative Boards.²⁵

The large-scale subsidising of cash usage would probably entail considerable costs in relation to the benefit of the subsidy, particularly as the development towards a cashless society will probably continue regardless.

1.2.2 Alternative courses of action: increased regulation and supervision

The Riksbank could also take a legislative route to strengthen the position of cash as legal means of payment, which would involve forcing traders and banks always to accept cash as a means of payment. At present, this obligation is not binding in most cases²⁶. Such a measure would have to be combined with an increased obligation for the banks to also provide cash and the price regulation of the banks' cash services.

However, the fact is that, to a great extent, it is consumers who are abandoning cash, in addition to which most shops, restaurants and so on still accept cash as a means of payment. Consequently, it is not likely that measures like this would significantly slow down or stop the development. On the other hand, it would probably mitigate the problems that some groups of consumers and business operators are experiencing. It could also make it simpler to use cash as means of payment in a crisis situation, as the capacity to distribute cash and accept cash payments would, in such a case, be greater than otherwise. The access of the general public to central bank money would also be secured.

The costs that increased regulation and an increasing supervision would entail for each retailer, restaurant, bank branch and so on, would need to be weighed against the usefulness of the regulation for the groups one is trying to help.

1.2.3 Alternative courses of action: providing a digital means of payment

A digital central bank currency, here called an e-krona, has the following basic characteristics:²⁷

- It is specified in the national value unit, the Swedish krona.
- It constitutes a claim on the central bank (the Riksbank).
- It is electronically available 24 hours a day, 7 days a week, 365 days a year and available in real time or close to real time.
- It is available to the general public, i.e. is more broadly available than traditional central bank deposits in RIX, to which only the banks have access.

Like cash, an e-krona is a direct claim on the Riksbank, and both a means of payment and a form of savings. In addition, it can, like RIX, be seen as a payment system, in that a technical infrastructure is required to give the general public access to the e-krona and to initiate and carry out transactions in real time around the clock.²⁸

How effective an e-krona would be in confronting the potential problems we currently see on the payment market and what consequences an e-krona could entail for society will depend on how it is designed, which characteristics it has and how it is provided.

The characteristics it is desirable and possible to give an e-krona are discussed in Chapter 2. Below, we restrict ourselves to demonstrating, with more general arguments, that an e-

²⁵ See Sveriges Riksbank (2013), Chapter 5.

²⁶ See Segendorf and Wilbe (2014).

²⁷ Digital central bank money can be defined in different ways in different contexts. We consider that this definition suits the Swedish market well, and is largely based on considerations discussed by the BIS working group "Committee on Payments and Market Infrastructure".

²⁸ By being a claim on the central bank and being denominated in the national currency, the e-krona would differ from what is usually designated a cryptocurrency. These currencies use cryptology to verify transactions and when issuing the currency. They are not denominated in any national currency and they are not usually a claim on any financial institution or public authority. The most well-known of these is Bitcoin. Further information on Bitcoin and digital currencies can be found in Segendorf (2014) and Beck and Garratt (2017).

krona would be partly or wholly able to manage some of the potential problems identified on a future payment market.

- An e-krona is a digital means of payment, unlike cash, which is physical. Those people who wish to use cash will probably continue to prefer cash over a digital e-krona in the future. Otherwise, it is difficult, at present, to assess how an e-krona could affect cash usage.
- The e-krona's digital nature makes it less likely that it could contribute towards mitigating the problems that certain groups of consumers and companies experience as cash usage declines. On the other hand, under the framework of the e-krona, the Riksbank could create the conditions for other participants to develop payment services adapted to particular groups in society or even fund such a development, to a certain extent.
- If the e-krona offers a technical infrastructure that can function independently of the commercial, bank-owned infrastructure, then it could contribute to the payment systems becoming more robust, both against technological disruptions and in situations of financial unease. This is in line with the Riksbank's mandate to promote a safe payment system.
- An e-krona with its own settlement platform, accessible to payment service providers, could become a platform for new, innovative payment services.²⁹ This is in line with the Riksbank's mandate to promote an efficient payment system.
- An e-krona would safeguard the general public's access to central bank money, which is to say an asset without financial risk. This is in line with the Riksbank's task of promoting confidence in the Swedish krona.

1.2.4 Conclusions regarding the various alternatives

Measures aimed at counteracting the problems of reduced cash usage will give rise to various effects and costs. But it is currently difficult to make a detailed assessment, either qualitative or quantitative, of the effects of the measures. The overall conclusion is that none of the measures will be able to hinder or substantially delay the trend towards a practically cashless society. Supporting or regulating cash handling with the aim of strengthening the position of cash could, however, mitigate the problems faced by some groups during the transitional period. It could also provide the general public with access to central bank money, either in the short term or more permanently.

It is difficult to assess at present how a possible e-krona could affect cash usage. As e-kronas are digital, while cash is physical, and those preferring cash today will probably continue to prefer it over digital means of payment in the future, the effect on cash usage may be relatively minor. E-kronas should therefore be seen as a complement to cash.

An e-krona intended to be used for smaller payments between consumers and between consumers and companies could take market shares from other digital payment services and thereby grow to a certain size. It could thereby counteract the problems inherent in the increased consolidation of the payment market, which the other measures cannot. The size of the market share that an e-krona could take depends on what form it takes. An e-krona would also guarantee the general public continued access to central bank money.

1.2.5 An historical retrospective

From the perspective of economic history, the government is grappling with largely the same problems today as many times before, but these problems are manifesting in slightly different ways. A few examples of situations in which the government has intervened are the discussions over the banknote monopoly, the proposal for a Nordic currency union and the arrival of Postgirot (see box 1). The arrival of Postgirot acted as a catalyst for cooperation between the banks that established the bankgiro system as a private alternative to Postgiro. Consequently, analysing major international developments and drawing conclusions from them is nothing new, but instead an obvious task for a government and central bank.

²⁹ Regardless of the design of the e-krona, RIX's role as platform for the settlement of large-value payments between financial institutions and as designated payment system under the Finality Directive will remain.

Box 1: The government, an active participant on the payment market

Money in the form of cash has existed since the first coins were struck. The common factor for various types of money is that it fulfils three basic functions as means of payment, unit of account and store of value.³⁰ Money's ability to fulfil these functions in an economy is, in turn, based on it having become standard to use a certain currency when making payments, which is to say that it is used and accepted by most participants in the economy. An effective payment standard contributes towards low transaction costs and the efficient use of resources. There is also a direct public finance interest in establishing an effective payment standard, as this stimulates economic activity such as trade and manufacturing.

From the first issuance of coins in the 990s until the Scandinavian monetary union in 1873, Sweden had no uniform payment standard, but instead several that existed in parallel. It was not until the Scandinavian monetary union that a shared and uniform coin standard was established in the Scandinavian countries. Greater network effects could be utilised and transaction costs fell when the exchange rate risk disappeared. A more appropriate payment standard also arose when the decimal system replaced an older system and the gold standard replaced the silver standard. A joint currency for Sweden, Norway and Denmark resolved a number of problems and simplified matters such as trade. The monetary union made the coins into legal tender in all three countries, but set no limits for how many coins could be put into circulation.³¹ However, the outbreak of the First World War was the beginning of the end for the union. All three central banks announced that it would no longer be possible to redeem banknotes for gold. Over time, the value of the banknotes started to diverge from the agreed exchange rate and, in 1924, the union was formally dissolved.³²

Another historical example of how the government has acted to create uniform standards is the Riksbank's banknote monopoly, which is to say the ban on the issuance of banknotes by private banks, which was introduced in 1904. The banking committee appointed by the government in 1881 to investigate new banking legislation, and which led to the decision for a banknote monopoly, recommended a stricter division of roles for the Riksbank and the commercial banks. These latter were to be responsible for business operations and profiting from them, while the former was to be responsible for stability in the value of money, to act as a lender of last resort, and to make a profit on the banknote monopoly. The banknote monopoly thus meant that Sweden received a uniform banknote standard. This reduced transaction costs as nobody needed to worry any more about the credit risk involved in using the commercial banks' banknotes. Due to the banknote monopoly, the banknotes entailed no credit risk, and never have done since.³³

A third example of the government's actions on the payment market is the construction of Postgirot. When Postgirot was set up in 1924, the government established a state standard for credit transfers. There was a desire to make the payment process more secure and more cost-effective so as to make economies of scale possible and reduce transaction costs. The desire to make postgiro services available to a broad public also contributed to making it easier to utilise network effects.

Between 1925 and 1947, the number of accounts in Postspargen rose from around 739,000 to 4,176,000. For a long time, the most important form of payment was money orders redeemed against cash over the desk. However, for businesses, it was too administratively complex and not secure enough for slightly larger amounts. Consequently, it was also possible to carry out cashless payments, which is to say account transfers. These became an essential form of payment after only a couple of years. The number of Postgiro accounts increased from around 5,000 to 233,000 between 1925 and 1947. In this last year, almost SEK 120 billion was mediated, SEK 81 billion of which was by credit transfer between accounts.³⁴

The arrival of Postgirot acted as a catalyst for cooperation between the banks that established the bankgiro system as a private alternative to Postgiro. The banks started to cooperate and jointly own infrastructure (Bankgirocentralen). This was a way of creating economies of scale and network effects, as well as of keeping fixed costs down. In 1950, the commercial banks developed a joint bankgiro form for transfers and, in 1959, Bankgirocentralen was set up, with the main task of sorting bankgiro payments and notifying recipients and their bank accounts. Today, Bankgirot is the dominant standard for credit transfers on the Swedish payment market.

³⁰ For a review of money's role and potential problems in issuing currency, see Camera (2017).

³¹ Legal tender means that everyone is obliged to accept cash as payment. This is the government's way of implementing the government payment standard and giving the government means of payment high liquidity. During the middle ages, kings tried to achieve the same thing by committing to accept their own coins as taxes. In Sweden, the concept was used as early as 1726 in conjunction with tax collection (see SOU 1955:43). Today, the concept of legal tender is not binding, in practice, for most participants (see Segendorf and Wilbe (2014)).

³² See Jonung (2015) for a more detailed description.

³³ See, for example Fahlbeck (1900) and Wetterberg (2009).

³⁴ Of the total value of all payments in the economy, cheques answered for 38% and Postgirot for 28%. However, cheques were often used for large amounts and Postgiro for smaller amounts. The number of Postgiro payments was just over 1.2 million, while just over 200,000 were made by cheque.

2. E-kronas as a complement on the payment market

One way of dealing with developments on the payment market, as they are described in Chapter 1, is to introduce a digital alternative to cash, an e-krona. An e-krona could constitute a government-guaranteed means of payment without credit risk and be available for the general public in digital form as a complement to cash. The e-krona could therefore be seen as a modernisation of the Riksbank's means of payment when large group in society no longer wish to use banknotes and coins to pay for things and/or save money. This chapter provides a comprehensive description of what an e-krona is, what properties it can have and what two feasible models for an e-krona might look like.

Since Bitcoin was introduced in 2009, there has been an almost explosive growth in various types of cryptocurrency in recent years, which has aroused interest in the question of whether central banks should issue their own cryptocurrencies. Cryptocurrencies is a collective name for digital assets that enable transactions between individuals who might not trust one another. By using blockchain technology, which is based on a common log book of all transactions that is shared with all users, there is no need for an external party to initiate and validate transactions in the network. One important difference between cryptocurrencies and, for instance, the Swedish krona, is that a cryptocurrency does not constitute a claim on any central bank and it therefore lacks any inherent value. Instead, the value of the cryptocurrency is based largely on speculation regarding its future value, which means that the value of the currency can vary substantially over time (Bech and Garratt, 2017).

A cryptocurrency issued by a central bank can either be made available to a broad general public or limited to large and time-critical payments between banks. A cryptocurrency made available to the general public would mean that the new technology provided opportunities to make anonymous payments like cash payments but in digital form. If anonymity is not a decisive/desirable quality of the currency, the general public can instead be given access to accounts with the central bank to obtain access to cash in digital form. This is something that, although it has been technologically possible for some time, has not yet been introduced by any central bank. With regard to a cryptocurrency with access limited to banks, the new technology has the potential to increase efficiency and reduce settlement costs. Some central banks are conducting tests in this field, but at present a number of technical problems remain, and these must be resolved before the technology can be used for interbank payments. It is assumed that an e-krona will be broadly available to the general public, but it will not necessarily be a cryptocurrency, as this will depend on the choice of technology.

A digital central bank currency should fulfil the three functions associated with money in the theoretical literature, i.e. work as a means of payment, unit of account and store of value. All forms of money, both private bank money and central bank money, function as unit of account as they are all expressed in Swedish kronor. An e-krona should be available 24/7. As the e-krona is a claim on the Riksbank and guaranteed by the government, it also fulfils the function as a store of value. Similar to cash, the primary target group for the e-krona is the general public.

Were an e-krona to be introduced, the Riksbank would have to choose what properties to give it. This choice must be analysed and carefully considered so that the e-krona has the effects that the Riksbank wishes to achieve by its introduction. There are two feasible models for an e-krona: one register-based and the other value-based. The models need not rule out

one another, but can be expediently combined to create a more comprehensive payment solution.

With a register-based e-krona, the balance is stored in a central database. If the user loses his or her card or mobile phone, the value will not be affected as it is registered in the database. Transactions between holders of e-kronas can take place within the system independently of the banks' payment systems. When money is to be deposited or withdrawn from the e-krona system however, interaction is required with the banking system. It can be assumed that a register-based e-krona is possible to trace.

A value-based e-krona has many similarities with the current cash system. The balance is stored on a card or in an app. If the card or smartphone is destroyed or disappears, the balance is also lost, in the same way as if one were to lose one's wallet with cash in it, unless special security settings have been applied. A value-based e-krona can, depending on its design, can either be anonymous or traceable.

The properties both models can have differ as regards, for example, the possibility to make offline payments, the degree of anonymity and the requirement for physical presence when transferring money. The differences are presented in Table 1.

Table 1. E-krona properties compared to cash and commercial bank money³⁵

Properties	Cash	E-krona – value-based	E-krona – register-based	Commercial bank money
Credit risk	No	No	No	Yes*
A store of value	Yes	Yes	Yes	Yes
Payments in real time³⁶	Yes	Yes	Yes	No**
Offline function³⁷	Yes	Yes	No	No***
Option of anonymous payments	Yes	Yes, possible for card-based solutions	No	No
Physical presence required	Yes	Yes for card, no for app	No	No
Usability	Works without technical aids	Requires e.g. a card reader or special smartphone technology	Can be managed via apps or online	Can be managed via apps or online

*The deposit guarantee does, however, include holdings up to and including EUR 100,000.

**The exception is payments within the same bank and Swish.

***Cards can have an offline function.

The two feasible models for an e-krona are presented in more detail below.

2.1 A register-based e-krona

With a register-based e-krona, the Riksbank holds the e-krona account that is registered in a database, which can be compared to a normal bank account. Payments between e-krona accounts can happen in real time as they take place within a closed system without the involvement of other agents. A register-based e-krona system must also be able to communicate with other systems, however, including the commercial banking system for instance, so that money can be easily transferred between systems. To create an efficient payment solution (person-to-person, consumer-to-business, person-to-authority, business-

³⁵ Commercial bank money refers to money that constitutes a claim on a private agent, such as a credit institution, payment institution or institution for electronic money.

³⁶ Payments where the payee's account is credited (almost) directly, i.e. at the same time as the payment is initiated and the payer's account is debited.

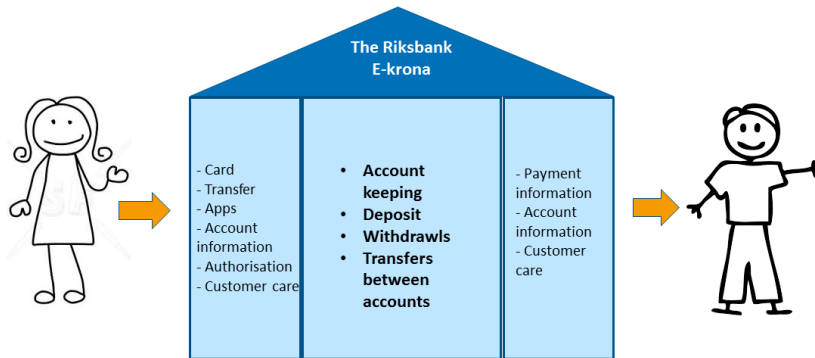
³⁷ Payments that do not require either an internet connection or the payer's payment instrument to be connected to the payment service.

to-business), both private individuals and legal entities should be able to open e-krona accounts.

The extent of the Riksbank’s commitment in a register-based e-krona is a matter for discussion. The fundamental structure of a register-based e-krona can be said to consist of the holding of e-krona accounts, transfer of money to and from external agents and payments between e-krona accounts within the Riksbank’s system. In addition, the Riksbank can choose the range of services it wishes to offer its customers itself and the extent to which it could supply a standardised interface to the e-krona system which external agents can connect to and use as a basis upon which to build their payment services. Below we present two alternatives, where the Riksbank either offers a holistic solution and is responsible for all services linked to the e-krona, or is solely responsible for a basic range of services and invites external actors to offer payment services linked to e-krona accounts with the Riksbank.

A version of a register-based e-krona could be to offer a traditional holistic solution, similar to the one the banks provide. Such a solution could include, in addition to the basic range of services, traditional payment services such as cards, apps, payment information to businesses and authorities, a authorisation of payments, customer service, etc. See Figure 2 for a graphical illustration. Such an alternative could be under the complete jurisdiction of the Riksbank and hence provide benefits in the form of control and supervision over transactions and flows. It might be expensive, however, both to set up the system itself and to run and maintain it, especially as payment services aimed at end-customers require considerable resources to be allocated to customer support, information and regulatory frameworks. Another disadvantage with this type of solution is that the Riksbank needs to build up a number of functions that we do not have today, see Chapter 3.

Figure 2. Register-based e-krona with significant Riksbank commitment

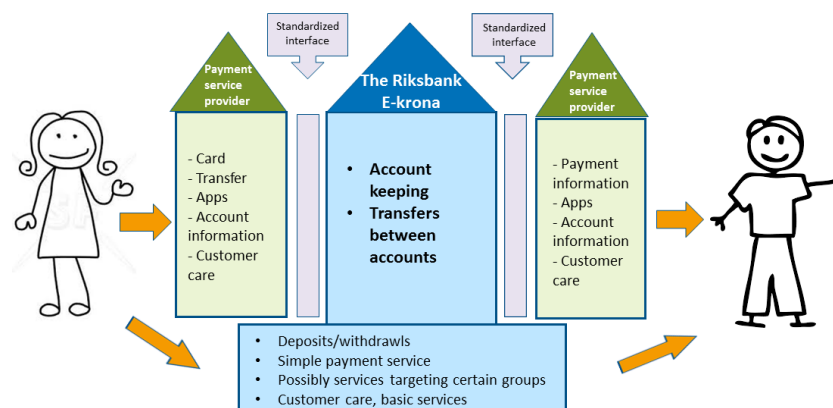


Another alternative could be for the Riksbank only to provide basic functions (account holding, deposit into/withdraw from e-krona accounts and transfer between e-krona accounts at the Riksbank). A standardised interface could give external payment service providers the opportunity of offering payment services linked to e-krona accounts at the Riksbank without the Riksbank having to be responsible for the direct relationship with the end-customer. Such a solution would be in harmony with the new Payment Services Directive (PSD2)³⁸, which gives authorised payment service providers the right to offer payment initiation, account information and card-based payment instruments linked to accounts held at another payment institution. The Riksbank should therefore only provide e-krona accounts and a limited number of services itself and leave it up to the market to provide e-krona services linked to accounts at the Riksbank (see Figure 3). In addition, the Riksbank could, as a

³⁸ See Section 5.11.

complement, offer a limited payment service to the general public and/or special groups. By only offering the basic functions, the Riksbank provides scope for collaboration and cooperation with more agents. Even with a small operational commitment from the Riksbank, it is assumed that the central infrastructure for an e-krona system will be time-consuming with regard to its development, particularly if the system is to be built up from scratch. The Riksbank wishes to investigate how a potential cooperation with sub-contractors and other public authorities could best be formulated.

Figure 3. Register-based e-krona with significant supplier commitment

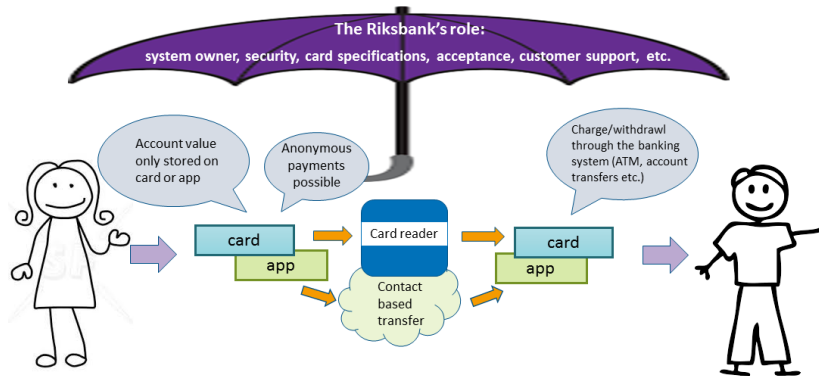


2.2 A value-based e-krona

A value-based e-krona has certain similarities with today's cash system and would be primarily intended for smaller payments where both the buyer and payee are present. A value-based e-krona is stored on a medium that belongs to the user as a card or app in a smartphone. The card-based solution can be likened to a public transport travel card loaded with a certain value. Payments and transfers would take place via card-readers, which could enable offline payments. A digital wallet in the form of an app could be a complement that enables transactions between private individuals, similar to Swish, without the need for a card-reader. See Figure 4 for a graphical illustration. E-kronas could, if it is considered appropriate, be anonymous up to the limit set by the money laundering directive, currently the equivalent of EUR 250. The Riksbank's commitment would include system development, security functions, card specifications, acceptance of cards, card distribution and customer support. A large proportion of these functions could be performed either partly or completely by market participants.

A value-based model normally means that transactions cannot be traced and is therefore similar to today's banknotes and coins. It is technically possible, however, to make a value-based e-krona that can have certain specific properties, which e-krona owners can define themselves. Such a property could be an option to limit the value of transactions, set personal security blocks, etc. Bearing in mind that the value is stored on the card/in the app, a value-based e-krona will probably be used mainly for small payments.

Figure 4. A value-based e-krona



2.3 Conclusions – A register-based e-krona has more development potential

Regardless of which e-krona model, register-based, value-based or a combination of both, the Riksbank chose to develop, there are a number of basic functions that must be dealt with directly by the Riksbank, including a regulatory framework, establishment, management and ownership. Some or all of the other functions, such as system development, customer due diligence, money laundering prevention, transaction authorisation and customer support could be performed by various market participants.

The Riksbank's preliminary assessment is that a value-based solution has more limited development potential than a register-based system, but secures access to a means of payment issued by the central bank. The advantage of a value-based e-krona is that it could be introduced more quickly than a register-based solution. A value-based e-krona can be seen as a new, more modern, technology-based form of cash.

A register-based e-krona is deemed to be a more complex solution, but to have more potential as it can offer a wider range of services aimed at more user groups. It is also easier to broaden and extend a register-based solution (scalability) to adapt to future requirements, but is deemed initially to be more expensive to develop and run.

The two models also differ with regard to possible properties and usability for different groups. This means that a combination of a register-based and a value-based solution could be appropriate. In this way, it could be possible to create a more comprehensive payment solution that can better counteract the problems identified in a future payment market. These conclusions are provisional and should be further examined. Cooperation with other authorities could simplify the development of an e-krona and provide more cost-effective solutions.

3. The Riksbank's operative role in an e-krona system and technical considerations

The introduction of an e-krona could, regardless of the choice of model, lead to the Riksbank introducing services aimed at the general public. This is a significant change compared with its current operations, in which it has no direct relationship with either consumers or other end-customers. An e-krona could therefore involve more operative working tasks for the Riksbank. Before the design of any e-krona system has been consolidated, it is difficult to discuss technical solutions in detail. This chapter therefore presents a number of technical properties that an e-krona should have regardless of how it is designed.

3.1 The Riksbank's operative role in an e-krona system

Irrespective of the degree of involvement, services for the general public imply a considerable commitment and responsibility as regards:

- System development and administration
- Regulatory framework and agreements with sub-contractors/partners
- Issue/account holding of e-kronas
- Customer due diligence, money laundering prevention, customer service
- Transaction authorisation
- System security in the form of IT security, operational reliability and information security as well as protection against cybercrime and fraud
- Interoperability with technical infrastructure and other digital solutions abroad existing and future

Some of these functions can be outsourced to sub-contractors or partners, but the ultimate responsibility will always be borne by the Riksbank. Of course, the extent of the Riksbank's operative role will also be related to the choice of e-krona model. A value-based solution probably involves less of a commitment, while a register-based solution involves a more extensive commitment, as discussed in Chapter 2.

If the Riksbank chooses to take the operative responsibility for a large number of services linked to the e-krona, it means that the Riksbank will be responsible for new areas of activity that will require new competencies within the bank. A model with a less operative role, where the Riksbank provides and is responsible for only a few e-krona services is based on other agents being given the opportunity and being prepared to provide complementary services. In this context, whether it is suitable and possible to utilise existing infrastructure and/or other existing solutions should also be examined.

Offering services to end-customers involves a different type of exposure and a different responsibility than only providing services for a limited number of financial agents as the Riksbank does today. If the Riksbank decides to set up a system for e-kronas that is to be offered to the general public, the costs, risks, responsibility and degree of the bank's operative control must be considered and assessed before a decision on the design of an e-krona is taken.

3.2 Technical considerations

The properties and functions of an e-krona are of considerable significance when choosing the technical solution. Feasible solutions shall be assessed based on the requirements for accessibility, reliability, interoperability and scalability they can fulfil.

There are certain technical properties that an e-krona should have regardless of how it is designed. These are listed below.

- **Scalability:** An e-krona must have a solid base, which can gradually be extended in different stages, as the requirements for the e-krona solution are developed, and needs and external conditions change. The base solution should therefore be constructed so that it can be integrated with new modules and functions via open, standardised interfaces. The aim should be that the technical solution is sustainable in the long run and that it can be developed by the Riksbank and/or other parties. In this way, the Riksbank's operative role will be more flexible. It is also desirable that technical innovations can be incorporated and utilised in a quality-assured way as such innovations become available. For example, Distributed Ledger Technology (DLT)³⁹ could be utilised when and if the technology is considered appropriate. An e-krona platform should be constructed so that different technologies can interact as much as possible.
- **Interoperability:** An e-krona solution should be portable as far as possible and function equally well regardless of the type of unit and operative system used. It should be possible to adapt the e-krona to future technical innovations. For this to work, the e-krona must be based on generally accepted standards and frameworks enabling it to work together with other digital solutions and technical infrastructures.
- **Reliability:** The e-krona solution must be robustly built so that it guarantees good operational reliability and can have the best available protection against cyber-attacks and different types of fraud. Another aspect linked to the concept of reliability is the issue of anonymity and integrity regarding traceability. The degree of anonymity that shall or shall not be offered by an e-krona can influence the choice of technology. The anonymity offered by today's physical cash may be difficult, and perhaps not even desirable, to recreate in a digital e-krona. There are legal requirements regarding the traceability of transactions that must be fulfilled.
- **Accessibility:** The technical solution for an e-krona must be designed so that it is easy and intuitive to use and offers good performance, for instance, with regard to transaction speed. It is also important that the solution offers functions adapted to different target groups. It should be accessible 24 hours a day, seven days a week, 365 days a year.

According to a preliminary assessment, both the e-krona models discussed in Chapter 2 (value-based and register-based) can be developed using traditional, tried-and-tested technology based on central databases and with DLT.

From a purely technical point of view, we can see nothing at this point in time that would prevent an e-krona solution built around a central register. RIX, the Riksbank's system for the transfer of funds in accounts, is, for example, built around a central register. An e-krona could in principle be constructed in a similar way.

With regard to DLT including blockchain technology, this is relatively new and untried technology that does not yet have any applications similar to the e-krona described in the report. Considerable research and development is being performed in DLT and many central banks are making efforts to research the technology, but there are only a few more significant DLT applications currently in production. This is partly due to the technology being so new and to it having some weaknesses, such as limitations in performance and a lack of

³⁹ A technology whose architecture is based on networks of distributed registers/databases in which all participants can create, transfer and store transactions in a secure and efficient manner without these necessarily being coordinated and administered by a central or known party in whom the participants have confidence. The frequently discussed block chain technology is one of many different forms of DLT. A block chain is a distributed trade repository based on DLT, in which all transactions are chained together in a block. The transactions/blocks are added to the chain in chronological order and in a linear fashion, so that all participants have a copy of the entire chain, including its history, in real time.

standards and regulations. Development in DLT is progressing incredibly rapidly, however, and many major players are taking part in it.

A value-based e-krona solution will be less complex from a purely technical point of view. There are already different value-based payment solutions in society, such as those used by public transport and coffee shop chains. A great deal of work and cooperation is required with other players, however, in order to create a good solution. A value-based e-krona must, for instance, work in the vast majority of retail terminals and be easy to acquire, it must also be easy to add and subtract values and there must also be a function for redeeming e-kronas. The solution must also have a very high level of security.

3.3 Conclusions – choice of technology needs to be investigated

The introduction of an e-krona could, regardless of the choice of model, lead to the Riksbank introducing services aimed at the general public. This is a significant change compared with its current operations, in which the bank has no direct relationship with the general public, consumers and other end-customers. This means that the Riksbank will have more operative working tasks, although to a varying extent depending on the choice of solution.

It is important that the development of an e-krona solution takes place in stages. The Riksbank should continuously evaluate new technology, including DLT, as well as look at existing tried-and-tested technologies that can be used for an e-krona system. The rapid development makes it currently inappropriate to choose which technical solution to use. It may also be appropriate to combine new and tried-and-tested technology if an e-krona is to be developed. An e-krona shall, however, maintain a good level of technical quality under all circumstances and have the best available security performance regardless of the technology used.

It is currently possible to develop the e-krona models presented in this report using today's technology. If the Riksbank itself were to be responsible for most of the development of a basic technical solution, infrastructure and user solutions, it could entail a considerable amount of protracted development work. Choosing to develop an e-krona in cooperation with others would involve less extensive work on the part of the Riksbank and the work may also progress more rapidly.

4. Potential consequences of issuing e-kronas

In an earlier chapter, we have discussed problems that might occur on the payment market in a situation where cash no longer is generally accepted and where the market is concentrated to a small number of private participants and payment services. We have also discussed in general terms the role of the state in this matter and how the introduction of an e-krona could combat some problems on the payment market. This chapter describes the feasible effects an e-krona could have on the Riksbank's balance sheet, monetary policy, financial stability and payment market participants. These questions are generally highly complex and the chapter should be considered more as an analysis of the problems than an attempt to provide clear-cut and concrete answers.

The size of the demand for e-kronas will determine to a large extent what the consequences will be for monetary policy, financial stability and the participants in the payment system. The size of the demand for e-kronas will in its turn be determined by the form the e-krona takes, by what measures the banks take to counteract an outflow of bank deposits and by the financial situation. In normal times, regardless of whether or not the e-krona accrues interest and regardless of whether the repo rate is above or below zero, it should be relatively unattractive to hold large amounts of e-kronas, as for the general public they will comprise a close substitute to bank deposits, which are expected to accrue more interest. On the other hand, the banks may wish to have a somewhat higher deposit rate to retain their deposits if the e-krona has a positive rate than if it accrues no interest. In times of financial unease or crisis, the demand for e-kronas will increase, on the other hand, as a result of the search for safer assets, which applies regardless of whether the e-krona accrues interest.

We start by discussing how an e-krona affects the Riksbank's balance sheet as this provides a natural way-in to discussing the potential effects on monetary policy and financial stability.

4.1 Consequences for the Riksbank's balance sheet

An e-krona affects the Riksbank's balance sheet in the same way as cash does. Let's assume that the general public demands e-kronas to a value of SEK 10 billion. For the sake of simplicity, we assume that the general public wants to change from having this money invested as deposits in bank accounts to holding e-kronas.⁴⁰ The banks then need to transfer money to the Riksbank, which we here assume they do via their accounts in RIX, which reduces their balances at the Riksbank by SEK 10 billion.

To highlight the consequences for the balance sheet, we will use a stylised balance sheet as a starting-point in two different cases. In case 1, the banking system's structural liquidity position in relation to the Riksbank is zero, i.e. the banks have no deposits at the Riksbank. Here, again for simplicity's sake, we assume that the Riksbank's balance sheet total is zero as this is the easiest way for us to show how the balance sheet changes. In case 2, the banks have a deposit at the Riksbank and the banking system's structural liquidity position in relation to the Riksbank is therefore positive. The Riksbank has used the banks' deposits to fund purchases of government securities and has in this case a positive balance sheet total.

⁴⁰ The general public might also wish to convert cash or transaction account balances at payment institutions and institutions for electronic money to e-kronas. The general public's liquid convertible assets primarily exist as bank deposits, however, and it is these accounts that are normally used for payments today. It is therefore reasonable to believe that the most of the conversion to and from e-kronas will take place via bank accounts.

4.1.1 Case 1 – The banking system has a zero position in relation to the Riksbank

In the event of the banks initially having no deposits at the Riksbank, they need to borrow money from the Riksbank to be able to pay for the e-kronas. This means that the banks now have a debt of SEK 10 billion at the Riksbank, which is recorded as a claim on the asset side of the Riksbank's balance sheet. On the liability side of the balance sheet, there is a corresponding item of SEK 10 billion, which is the claim the e-kronas represent on the Riksbank.

When the banks need to fund purchases of e-kronas using loans at the Riksbank, the Riksbank's balance sheet then grows by the same amount as the general public's demand for the e-kronas. The same applies if the banks initially have a negative position in relation to the Riksbank, i.e. the banking system's liability and the Riksbank's balance sheet grow by the demanded amount. Normally, the banks' liquidity deficit will be regulated by the Riksbank offering a weekly repurchase agreement on SEK 10 billion to the banks and the Riksbank acquires an asset in the form of loans to the banks.

4.1.2 Case 2 – The banking system has a positive position in relation to the Riksbank

Let's now assume that the banking system initially has a positive balance in relation to the Riksbank of, for instance, SEK 100 billion and that the Riksbank has invested the banks' deposits in government bonds.

The banks now transfer SEK 10 billion on behalf of their customers and the Riksbank creates e-kronas for the same amount. This means that the SEK 10 billion have been converted from a deposit liability to the banking system into an equally large liability to e-krona holders.

The size of the Riksbank's balance sheet does not therefore change when the banks continue to have a positive position even after the purchase of e-kronas. The balance sheet's liability side does change, however, as a result of some of the liability to the banks having been converted into a liability in e-kronas to the general public, in this case SEK 10 billion.

4.1.3 The banking system's structural position

The structural surplus, i.e. the banking system's net claim on the Riksbank, is currently about SEK 400 billion, which means that the same amount of e-kronas can be issued before the banks need to borrow money at the Riksbank. This applies under the assumption that the Riksbank continues to retain its large portfolio of Swedish government bonds in the future. The extent to which the Riksbank's balance sheet is affected is not limited, however, by the size of the banks' liquidity surplus in relation to the Riksbank. For example, the Swedish general public's deposits in accounts in Swedish monetary financial institutions currently amount to about SEK 3,200 billion. Hypothetically speaking, the Riksbank's balance sheet could increase that much if there was a bank run because the general public chooses to hold e-kronas instead of having their money in bank accounts. In normal times, however, it is reasonable to assume that the banks' will use interest on their deposit accounts to retain the deposits and hence subdue the demand for e-kronas.

4.2 Consequences for monetary policy

The effects on the balance sheet mean that the introduction of an e-krona could have different types of consequences for monetary policy. The e-krona could affect both the implementation of monetary policy as well as the transmission mechanism and policy framework. How large these consequences might be depends on how the e-krona system is designed.

4.2.1 Implementation of monetary policy

A concrete consequence for monetary policy is that the Riksbank would need to forecast how much e-krona is expected the following week in order to be able to plan its market operations. If the banks have invested all the structural surplus in Riksbank certificates and

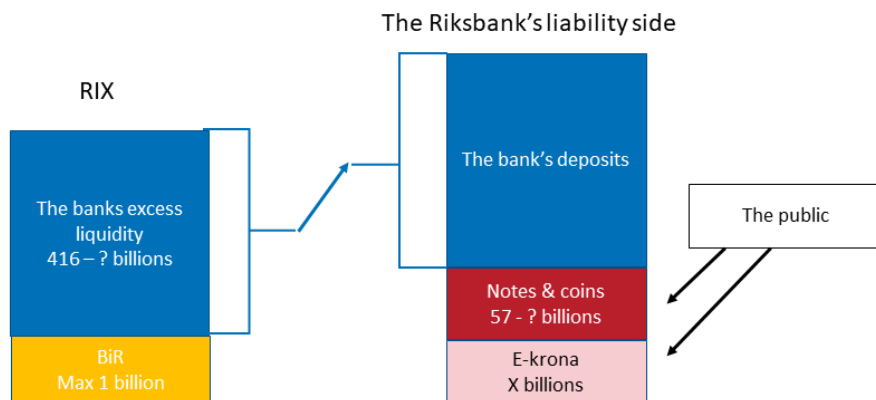
the demand for e-krona suddenly increases, the banking system will “tip over” to a deficit with the Riksbank. The banks would then be forced to borrow overnight in the Riksbank’s fine-tuning, or sell back some of their certificates to cover their liquidity deficit. In order to stabilise the overnight rate close to the repo rate, the Riksbank needs to be able to cope with changes in factors that are beyond its own control, such as the general public’s demand for banknotes and coins as well as for e-krona.

It is possible that it might be more difficult to forecast the amount of e-kronas than the amount of cash, as digital e-kronas can be expected to be more volatile because of its real-time properties. This is a question that the Riksbank will look at in more detail.

4.2.2 The transmission mechanism and the monetary policy framework⁴¹

How the pricing of an e-krona is calibrated and how access to the e-krona is controlled, will be the decisive factor as regards demand for e-kronas. If the e-krona is designed as an interest-free means of payment like banknotes and coins that the Riksbank provides to the extent demanded by the general public, the e-krona will be another factor outside the monetary policy implementation framework, a so-called “autonomous factor”, which the Riksbank cannot control but nevertheless needs to consider when implementing monetary policy (see Figure 5 below). If, on the other hand, the e-krona accrues interest, it will be an instrument that needs to be incorporated into the monetary policy implementation framework. Moreover, if the general public has access to e-kronas by having accounts directly at the Riksbank, current monetary policy counterparties (the banking system) will no longer be the only agents that the Riksbank needs to consider.

Figure 5. E-kronas constitute another autonomous factor in the implementation of monetary policy



A central bank’s task is to have a well-balanced framework for the implementation of monetary policy and adjustments to international changes are made when necessary. The Riksbank should regularly analyse and forecast the amount of e-kronas in circulation. One question that is usually raised in connection with digital currencies is concern over a bank run, whereby the general public would move money from their bank accounts to the central bank accounts and the difficulty in forecasting the banks’ liquidity positions in relation to the central bank. For instance, if there were to be a severe bank run, the Riksbank’s current terms and conditions regarding collateral would limit how much lending the Riksbank could offer to the banks, as the sums would easily exceed the collateral the participants have available. These questions need to be investigated further, but an initial assessment is that they are not serious obstacles to an e-krona. The Riksbank currently issues banknotes and coins in the volume demanded by the general public and the same should apply to an e-krona.

⁴¹ A conceptual model for how monetary policy affects the real economy and inflation is that the shortest market rate, the overnight rate, is controlled via the corridor and fine tunings so that it is very close to the repo rate. Longer market rates are in turn affected by expected future repo rates (in accordance with the expectation hypothesis) and risk premiums.

Another important issue for monetary policy which will become relevant if an e-krona is introduced is where the lower bound for the Riksbank's policy rate will be, i.e. at what level do cuts to the policy rate stop having an effect on real interest rates. If banks offer loans and investments at negative rates, the borrower, who has borrowed money at a negative rate, can make a profit by withdrawing the money in cash as the yield on interest-free cash is zero percent.

In practice, there are a number of costs associated with managing cash, which effectively means that the yield from cash is not zero but actually negative. The interest rate level at which the general public becomes indifferent towards having money in an account at a negative rate and holding cash will be under zero percent and therefore the lower bound for the policy rate will not be exactly zero, but slightly below. In this situation, it may be worth considering how an e-krona might affect the lower bound. If an e-krona does not accrue any interest, it may be more difficult to determine where the lower bound for the policy rate runs as management costs for an e-krona can be assumed to be lower than for cash. An e-krona that does not accrue interest could in other words mean that the lower bound is adjusted upwards, closer to zero, while an e-krona with a negative interest rate would retain the possibility of a negative policy rate.

4.3 Consequences for the payment market and financial stability

In Section 4.1, we saw that the banks would primarily satisfy their customers' demand for e-kronas by using their reserves at the Riksbank. The banking sector's balance sheet would then decrease on the asset side, offset by a reduced liability in the form of deposits from the general public. The banks' balance sheets would then decrease in this case by the same value as the value of e-kronas demanded.

If, however, demand were to exceed the banks' reserves at the Riksbank, currently standing at about SEK 400 billion, the banks could meet the demand by borrowing from the Riksbank against approved collateral. The size of the banking sector is not affected in this case, but part of the banks' securities holdings will be pledged to the Riksbank and on the liabilities side, loans from the Riksbank will replace the loss of deposits from the general public.

4.3.1 Potential effect of the e-krona on banks' liquidity and funding

The changes in the banks' balance sheets that an e-krona could cause would lead to a slight deterioration in their liquidity and funding situation. The decline in the banks' reserves at the Riksbank would reduce their total liquidity reserve and a reduction in deposits would cause them to lose some of their stable funding. However, the size of the effect an e-krona would have on the banks depends both on how large customer demand will be for e-kronas and what measures the banks take to stop the outflow of deposits.

4.3.2 The banks balance the demand for e-kronas in normal times

In a normal situation, bank deposits and e-kronas will be close substitutes for the general public as both have low credit risk and are directly accessible (high liquidity). In such a situation, demand for e-kronas will be determined by the relative difference between any interest the e-krona might give and the banks' deposit rate. If the e-krona does not give any interest, the banks can offer a deposit rate slightly above zero to continue to retain their deposits, which means that the negative effects on bank profits and financial stability will be relatively minor (see Table 2).

Table 2. Demand for e-kronas and the effect on bank profits

	Situation with a positive repo rate	Situation with a negative repo rate	Situation of financial unease/crisis and low confidence in the banking sector
E-krona offers no interest	Holding e-kronas is relatively unattractive. The banks offer a deposit rate slightly above zero to retain their deposits. The negative effects on bank profits and financial stability are negligible.	Holding e-kronas is attractive; the banks need to offer a deposit rate slightly above zero to retain their deposits. The negative effects on financial stability are negligible, but the effect on the banks' profits is greater than with a positive repo rate.	The search for safe assets means that it will be more attractive to hold e-kronas; assets that are not covered by the Deposit Guarantee will probably be exchanged for e-kronas, especially if the repo rate in crisis times is close to zero or negative. The implications for financial stability are unclear as the access to secure payments via the e-krona system is positive for the economy at the same time as the banks' funding and liquidity situation deteriorates.
The e-krona offers an interest rate that is tied to the repo rate (e.g. the repo rate - x points)	Holding e-kronas is attractive. Banks are forced to offer a deposit rate that is close to the repo rate to retain their deposits. Banks' profit growth is limited in times of increasing interest rates.	Holding e-kronas is not attractive. The banks need to offer a deposit rate slightly above zero to retain their deposits, or just above the repo rate in a cashless society. The effects on financial stability are negligible, and the effect on the banks' profits is lower than with a positive repo rate.	The search for safe assets means that it will be more attractive to hold e-kronas; assets that are not covered by the Deposit Guarantee will probably be exchanged for e-kronas, even in times of high interest rate levels. The implications for financial stability are unclear as the access to secure payments via the e-krona system is positive for the economy at the same time as the banks' funding and liquidity situation deteriorates.

On the other hand, if the e-krona gives an interest rate that is, let's say, tied to the repo rate, the banks will probably adjust their deposit rates to prevent households and companies from exchanging deposits into e-krona to a greater extent. This scenario could primarily be realised in a situation where the repo rate is positive as it is at such a point the interest rate on e-kronas could be greater than the banks' deposit rates.

From the banks' point of view, their customers' deposits constitute a long-term source of funding. The banks' maximum willingness to pay for their customers' deposits, i.e. the highest interest rate level that banks are prepared to pay for bank deposits, is equal to the cost of alternative funding via the market.⁴² In a positive interest rate situation, banks' deposit rates have historically been lower than the repo rate⁴³, while the cost of comparable long-term wholesale funding has been significantly higher than the repo rate (see Chart 4). The fact that bank deposits have been cheaper than equivalent sources of funding indicates that the banks would be willing to raise their deposit rates if it proved necessary in order to stop an outflow

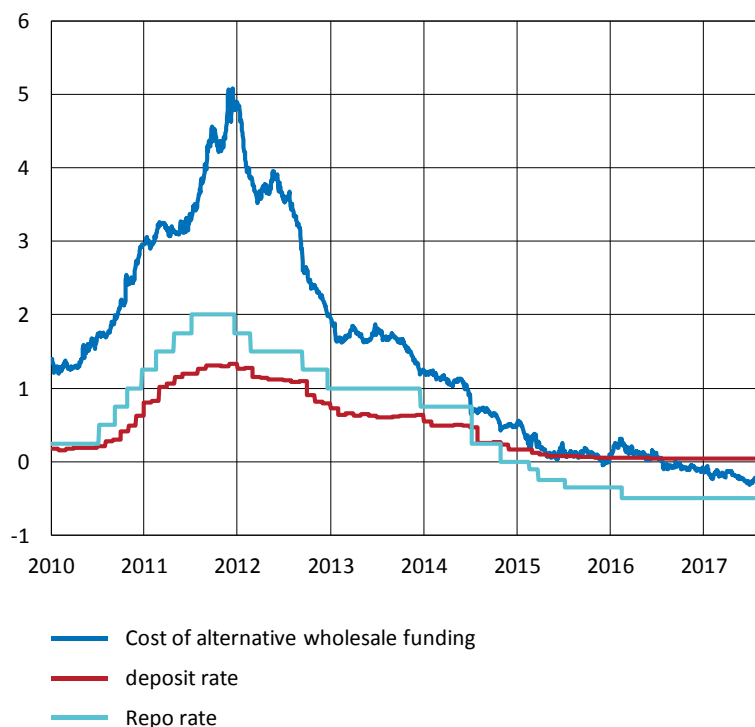
⁴² In the current situation, all the major Swedish banks already utilise wholesale funding, which means that it would not be a problem for them to replace bank deposits with wholesale funding on the bond market.

⁴³ This in turn suggests that bank deposits are probably not very sensitive to interest rate changes, which indicates that the e-krona must offer a significantly higher interest rate in order to attract bank deposits.

of bank deposits.⁴⁴ The demand for e-kronas can therefore be assumed to be low in a situation where the e-krona gives interest. On the other hand, the profit growth traditionally experienced by the banks, by not increasing deposit rates in step with the repo rate, would be restricted in this scenario.

Chart 4. Cost of alternative wholesale funding, deposits and the repo rate

Per cent



Sources: Bloomberg, Statistics Sweden and the Riksbank.

4.3.3 Demand for e-kronas can increase rapidly in times of financial unease

In times of financial unease, the demand for e-kronas could increase rapidly if confidence in the banking sector were to decline. In such a situation, private individuals and companies would probably elect to move their bank deposits, and in particular those deposits not protected by the Deposit Guarantee⁴⁵, into safer assets. The banks' capacity to retain deposits with higher deposit rates will in this case be weaker, as it is the absence of credit and liquidity risks in e-krona that will drive demand. The e-krona would be positive for economic agents in times of financial unease as it could offer continued access to a safe payment system. As far as the banks are concerned, large movements from bank deposits to e-krona would create additional stress and they would probably be forced to borrow from the Riksbank. The banks' borrowing at the Riksbank could be managed via normal monetary policy operations.

One fundamental function of a central bank is the role as lender of last resort. If the Riksbank's assessment is that financial stability is threatened, the Riksbank has the possibility to contribute liquidity to Swedish banks and other financial companies by granting what is known as emergency liquidity assistance, ELA, on special terms. In the same way, we always ensure that cash is available for those who wish to have it. We set no limits on the supply of cash. The general public knows that cash is always issued by the Riksbank when there is a demand for it. Setting limits for the supply of e-kronas would implicitly mean that the central bank was limiting the general public's access to central bank money, but it would not have

⁴⁴ Fintech and the development of different deposit options may provide greater competition for bank deposits, which means that the banks' margins may decrease in future irrespective of whether an e-krona is introduced or not.

⁴⁵ An estimated SEK 500-700 billion.

the same restriction for the banking sector. Limits for the supply of e-kronas would also entail an undesirable secondary market for them in a situation where demand exceeded supply.

The effects of an e-krona on the banking system will be analysed further within the project. The current liquidity requirements could be adapted to a world of more volatile deposits into the banking system as a result of exchanging to and from an e-krona. This could entail a banking sector that is better equipped to manage the effects of an e-krona. Which potential measures might be relevant and how they could be designed is a matter for further investigation within the project.

4.4 Effects on payment market participants

Chapters 1 and 2 highlighted the difficulty in identifying a single property that would make using e-krona so beneficial that it could outcompete other alternatives. It is therefore likely that a demand for e-krona will be determined by a combination of properties. What competition will look like on a future market is difficult to predict and the Riksbank's analysis is based on the assumption that a future market will be very similar to today's market but with a greater element of payments in real time and payments that are made automatically when purchases are carried out. We have in our analysis assumed that the e-krona will bear its own costs and that the regulatory framework and so on is designed so that the e-krona is not unduly favoured in the competition with private payment services.

The absence of clear competitive advantages means that there is no particular reason to believe that there would be any great rush to start using an e-krona. On the contrary, there is plenty to suggest that it would be a gradual and slow establishment process. For example, it has taken Swish four years to come to the fore. It took at least ten years before the use of cards really caught on; they were introduced on a broad scale in the early 1990s but it was not until 2005 that the value of card payments at points of sale purchase exceeded the value of cash withdrawals from ATMs.

How affected payment service providers will be by the e-krona system and how involved banks will be in it partly depends on how operative the Riksbank chooses to be and to what extent it chooses to have direct contact with the general public. Payment service providers can use the e-krona to a varying degree in their ranges of services and in their business models. Due to the fact that it will probably take time before an e-krona becomes established, the direct effects on the business models of already established agents should be relatively minor, both initially and in the longer term, so there will be time to adapt. An e-krona can, however, help to reduce the entry barriers on the payment market and stimulate innovation, which in turn may lead to greater competition and lower profits.

4.5 Conclusions – the consequences need to be investigated further

As the e-krona's properties and design are crucial to how it might affect the framework for and implementation of monetary policy, it is difficult to draw any conclusions at this stage. The aim of this chapter is more to identify and highlight the issues that need to be investigated within the framework of the project.

If we look at the consequences for the payment market and financial stability, it is the project's current assessment that there are no significant obstacles to the introduction of an e-krona. Even here, the properties and design of the e-krona may well affect its effect on the area, which means that a deeper analysis is required to try to gain a better understanding of the consequences. The e-krona shall be supplied in the same way as banknotes and coins, that is, without quantitative limits. The Riksbank's position, in principle, is that the e-krona shall bear its own costs and not be unduly favoured by the Riksbank. Principles for pricing the e-krona will need to be investigated further.

The demand for e-krona will probably be limited, partly because the banks will raise the interest rate on their deposit accounts, and partly because the e-krona will be most suited to small payments. This means that the effects on the Riksbank's balance sheet, monetary policy and financial stability are assumed to be only minor. Even the impact on the business models currently used by present-day payment service providers is expected to be small.

5. Legal questions

The questions we raise are so large and so important that we assess that they require thorough deliberations by the legislator. The Riksbank's task is determined by the Riksdag via the Sveriges Riksbank Act. The current Sveriges Riksbank Act is old in that it does not mention digital payments. However, the legislation is nevertheless interpreted to allow the Riksbank to issue e-krona under certain circumstances. Before a concrete proposal for an e-krona can be produced, a complete legal analysis needs to be made and this section should therefore be regarded as a preliminary attempt to respond in a general way to questions related to the introduction of an e-krona. In addition, consideration must be given to EU legislation.

5.1 The Riksbank's mandate

Pursuant to Chapter 1, Article 1 of the Sveriges Riksbank Act, 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.⁴⁶ These tasks and assignments complement and to some extent overlap one another.

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 convergence).⁴⁷ The possible introduction of an e-krona is assessed to be compatible with Sweden's obligations in this respect. However, it may be mentioned in this context that in the unlikely event that 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 two-thirds vote prevent such an introduction, if they consider that the task is in contravention of the ECB's objectives and functions.

5.2 The monetary policy assignment

Pursuant to both the Instrument of Government and the Sveriges Riksbank Act, the Riksbank has responsibility for monetary policy and its objective is to maintain price stability.⁴⁸ This objective takes precedence over all other tasks and assignments and these shall therefore be formulated in a way that does not disregard this objective.⁴⁹ A potential issuing of e-krona must thus be formulated in a way that does not counteract the objective of maintaining price

⁴⁶ From an economic perspective, one usually talks of two main tasks – to maintain price stability (monetary policy) and to promote a safe and efficient payment system.

⁴⁷ Art. 131 Treaty on the Functioning of the European Union. Art. 14.4 Statute of the ESCB and the ECB.

⁴⁸ This also follows on from article 105 of the Treaty of Lisbon and article 2 of the Statute of the ESCB.

⁴⁹ Government Bill 1997/98:40 page 53 onwards and page 89.

stability, regardless of whether the primary purpose of issuing the e-krona concerns monetary policy or something else.

The Sveriges Riksbank Act contains an exhaustive list of the monetary policy instruments at the Riksbank's disposal. These are to grant credit against adequate collateral and receive deposits, to carry out transactions in securities and foreign currency, to issue instruments of debt and to impose minimum reserve requirements on financial institutions.⁵⁰ These instruments are at the Riksbank's disposal if the measure in question has a monetary policy purpose, that is, to maintain price stability.

Depending on how the e-krona system is designed, it may mean that the Riksbank supplies lending or receives deposits from the general public. Given the preliminary works to the Sveriges Riksbank Act⁵¹, it is unlikely that it would be regarded as permitted to make such transactions with the general public. If the Riksbank were to supply e-krona accounts, especially if these could accrue interest, it would be regarded as deposits.

5.3 The foreign exchange policy assignment

The list of foreign exchange policy instruments⁵² must also be regarded as exhaustive. The foreign exchange policy assignment aims to defend the external value of the Swedish currency and the foreign exchange policy instruments all concern transactions in foreign currencies. It is thus difficult to see that a system with a Swedish e-krona could have a foreign exchange policy purpose.

5.4 The assignment of promoting a safe and efficient payment system

The Riksbank shall promote a secure and efficient payment system. This entails in practice several sub-tasks that are more or less explicitly regulated in the law. A stable financial system is also a prerequisite for the Riksbank being able to conduct an effective monetary policy, that is ensuring that banknotes and coins retain their value over time. Here there is a link to the risks we see with regard to a future payment market and a possible e-krona.

5.5 The assignment of supplying cash

The Riksbank also has the assignment of supplying Sweden with banknotes and coins. This assignment means that the Riksbank shall continue to issue banknotes and coins even if the Riksbank, as a complement, issues a digital means of payment.

5.6 The payment system and non-physical means of payment

The Riksbank may provide a system for the settlement of payments and may participate in the settlement of payments in other ways.⁵³ The legislative text implies that the Riksbank should have the possibility to supply several systems and the law does not regulate who should be allowed to participate in the payment system.

Providing means of payment both in physical form and as holdings in accounts in the country's own currency is a task usually considered fundamental for a central bank. The Riksbank already supplies holdings in accounts through its deposits from and lending to the commercial banks against collateral. There is no explicit ban on holdings in accounts and if an e-krona contributes to a safer and/or more efficient payment system, it could be considered to come within the framework of the mandate.

⁵⁰ Chapter 6, Sections 5 and 6 of the Sveriges Riksbank Act.

⁵¹ Government Bill 1997/98:40 page 53 onwards and page 89 and Government Bill 1986/87:143 page 44.

⁵² Chapter 7, Sections 3 and 4 of the Sveriges Riksbank Act.

⁵³ Chapter 6, Section 7 of the Sveriges Riksbank Act.

If a new payment system covers deposits or loans, the provisions regarding deposits and loans in the Sveriges Riksbank Act must also be applicable to the new activity. The permitted areas are currently only deposits and lending for the purpose of monetary policy, foreign exchange policy and as emergency liquidity assistance. At the same time, the supplying of a payment system usually entails some form of deposit. For instance, the RIX system entails overnight deposits without their being any special legal basis for the actual deposits. One could therefore consider that some deposits from the general public should be acceptable on the basis of the payment task, as deposits usually lie in the nature of a payment system. The issue of a digital means of payment probably needs to be regulated.

5.7 The mandate should be investigated

The current mandate in the Sveriges Riksbank Act is limited and the question of electronic money is not mentioned in the preliminary works to the Act. The Sveriges Riksbank Act is being reviewed at present and it is ultimately the legislator that must decide on any amendments.

5.8 E-krona as legal tender

The Sveriges Riksbank Act states that banknotes and coins issued by the Riksbank are legal tender, which according to the preliminary works means that "everyone is obliged to accept banknotes and coins as payment".⁵⁴ In practice, however, there are a number of exemptions from this obligation and the exemptions that can be made through contracts or agreements have the greatest practical significance. In Sweden, the concept thus does not have very great significance for payments in the retail trade and not for the banks either.⁵⁵

If the Riksbank is to issue an e-krona, it should be considered whether this should have the status of legal tender in addition to cash, or whether this concept should be abandoned or changed in some way. Awarding a means of payment the status of legal tender is common when introducing a new means of payment, to ensure that it gains acceptance and becomes established on the market.⁵⁶ Giving an e-krona the status of legal tender could also be justified by wanting to give them a special position in relation to commercial bank money. Another way of establishing a means of payment can be to ensure that it can be used for payment of tax, something that is not currently possible with physical cash.

The question of whether the e-krona should be legal tender is ultimately a decision that must be made by the legislator.

5.9 The Riksbank as issuer of an e-krona

If the Riksbank issues an e-krona to the general public, this could mean that the Riksbank is exposed to the same legislation as other market participants. In addition to anti-money laundering regulations, such as the "know your customer" regulations and overseeing transactions, this can involve data protection legislation, consumer protection legislation in the payment services field, responsibility for unauthorised transactions, tax legislation and so on. The regulatory framework that is relevant here will depend on which solution we choose and will therefore be investigated further.

In general, however, it can be noted that having private individuals as customers means that more regulations will be applicable, and similarly the more services that are offered, the more regulations will be applicable. Payments of large amounts will also increase the number of applicable regulations.

⁵⁴ Government Bill 1986/87:143, page 64.

⁵⁵ See Segendorf and Wilbe (2014).

⁵⁶ For instance, with the introduction of the euro.

5.10 The Riksbank is required to follow the Anti-Money Laundering Act

Formally, the Riksbank is not covered by the Anti-Money Laundering Act.⁵⁷ On the other hand, the EC Regulation on information on the payer accompanying transfers of funds⁵⁸, and also FATF's⁵⁹ lists and the EU's decision on financial sanctions will apply to the Riksbank.

Although the Anti-Money Laundering Act does not formally apply to the Riksbank's activities, this does not mean that the Riksbank could not be used for money laundering/financing terrorism. If this were to occur, we would have difficulty in defending ourselves with the argument that the Anti-Money Laundering Act does not apply to the Riksbank. Moreover, the bank and its employees are covered by the Act on penalties for money laundering offences (2014:307). According to this act, a person failing to exercise due care and attention can be found guilty of a money laundering offence. The assumption is therefore that the Riksbank should observe the anti-money laundering regulations in full.

The Riksbank may therefore need to adapt its routines and examine its activities pursuant to the Anti-Money Laundering Act. If the e-krona is account-based with direct contact with customers, the Riksbank will need to apply the "know your customer" regulations in the Anti-Money Laundering Act before opening an account. With regard to relationships with financial companies under supervision, the relationship normally entails a lower risk. On the other hand, if the Riksbank were to offer a payment system for e-krona to private individuals and companies that are not under supervision, it would require more of the Riksbank, both with regard to customer knowledge and follow-up. Several relations might moreover be assessed as high risk, which requires more in-depth checks of the customers. If transactions are to be made through accounts in the Riksbank, the Riksbank will need to also oversee the transactions. The larger the transactions that can be made with e-krona, the higher the requirements made by the anti-money laundering regulations. If the e-krona is value-based and can only be used for smaller payments, the requirements for customer knowledge will be lower. However, even here there need to be checks in the form of oversight.

It can be observed that even if some functions such as customer knowledge, money laundering checks, authorisation of transactions and customer support were outsourced to external contractors, the Riksbank would still retain full responsibility. This means that the Riksbank will need detailed contracts with the suppliers and a skilled ordering organisation in place to follow up and ensure that the suppliers carry out their services in the correct manner.

5.11 Second payment services directive

The first and second payment services directives⁶⁰ provide a regulatory framework for the relationship between payment services providers and their customers. The payment services inquiry's report "Payment services, interchange fees and basic payment accounts"⁶¹ was presented in August 2016. A draft government bill for implementing the directive will probably be presented in autumn 2018.

According to the directive, central banks have the right to supply payment services as long as they do not act in the capacity of monetary authorities or other public authorities. If the Riksbank were to decide to issue an e-krona to the general public, the regulations in the directive regarding information and the rights and obligations when supplying and using payment services would also apply to the Riksbank. The regulations concern, for instance, access to the payment system, information requirements, authorisation, access to payment

⁵⁷ The Act on Measures against Money Laundering and Terrorist Financing (2009:62). It is proposed that this act be replaced by a new one that enters into force on 1 August 2017 as a result of the fourth anti-money laundering regulatory framework.

⁵⁸ Regulation (EC) No 1781/2006. Will be replaced by Regulation (EC) No 2015/847.

⁵⁹ The Financial Action Task Force (FATF) is an intergovernmental body working to combat money laundering and the funding of terrorism.

⁶⁰ Directive 2007/64/EC on payment services in the internal market, which will be replaced on 13 January 2018 by Directive 2015/2366 on payment services in the internal market

⁶¹ SOU 2016:53, Payment services, interchange fees and basic payment accounts.

accounts, responsibility, implementation and value dating, risk management, security and resolving disputes.

5.12 Finality and risks in the event of bankruptcy

One of the purposes of the Finality Directive is to protect settlement systems against retroactive effects of insolvency proceedings. A register-based e-krona where transfers can be made between accounts will mean that the Riksbank supplies a payment system or settlement system. Systems that are registered in accordance with the Finality Directive enjoy a special protection in the event that a part-owner of the system goes bankrupt. The directive protects both transactions and netting in the system prior to a bankruptcy decision but also to some extent transactions and netting the same day as the bankruptcy decision. Such transactions and netting shall be lasting and not called into question by an official receiver.

If private individuals and non-financial companies are allowed to participate in the e-krona system, that is, have accounts in the system, it cannot be registered as a notified settlement system according to the Finality Directive (which in Sweden has largely been implemented through the settlements act). This is because the directive regulates who may participate in notified settlement systems and in principle only financial undertakings are included in the approved participant circle. This means that the e-krona system will be subject to the regulations and risks applying according to the bankruptcy legislation if a participant in the system were to go bankrupt.

The Riksbank can be expected to have a mandate to issue the e-krona in accordance with the assignment the Riksbank has of providing Sweden with a means of payment and through its responsibility for the payment system. However, the current legislation does not mention electronic means of payment. It is ultimately the legislator that shall make decisions on these issues.

5.13 Conclusions – the Sveriges Riksbank Act needs to be reviewed

The questions we raise are so large and so important that we assess that they require thorough deliberations by the legislator. It is appropriate to review the Sveriges Riksbank Act from the perspective that society is undergoing a process of digitalisation that was not relevant when the current legislation was passed. The Riksbank's assignment includes providing Sweden with banknotes and coins and safeguarding a safe and efficient payment system. It is ultimately the legislator that must determine whether a possible e-krona requires supplementary legislation. If the trend in the payment market described in the report continues, we may find ourselves in a situation where the only legal tender according to the legislation is no longer available. This also means that the concept of legal tender needs to be reviewed.

6. The project's conclusions

We have described in earlier chapters why the Riksbank is investigating the e-krona, how an e-krona could function as a complement on the payment market to counteract the problems we foresee there in the future, a possible model for the e-krona, what consequences an e-krona could have for monetary policy and financial stability, for example and the technical and legal issues that need to be investigated. This chapter presents the conclusions that can be drawn from the Riksbank's inquiry at present.

The use of cash in Sweden is declining steadily and has been doing so for some time. The two main reasons are the technological developments that have contributed to changes in consumption patterns and made electronic payments simpler and more accessible and the fact that the market no longer supplies cash in the same way as before. New methods and technologies for payments are constantly being developed, at the same time as the demand for rapid and simple electronic methods of payment can be expected to remain high going forward. The use of cash will probably continue to decline. The payment market endeavours to attain economies of scale and synergies as well as network effects, and this is driving the market towards a high degree of concentration. Within the not too distant future, Sweden can thus become an economy where cash is not generally accepted, and where the payment market is concentrated to a few private participants and payment services. This concentration could create risks and moreover hamper competition.

The Riksbank has the statutory tasks of promoting a safe and efficient payment system and of providing Sweden with banknotes and coins. One conclusion in the report is that the possibility to complete these tasks may deteriorate if developments on the payment market continue.

The introduction of a new electronic means of payment issued by the Riksbank, an e-krona, would counteract the problems that might arise. If the e-krona offers an alternative platform or infrastructure that can function independently of the commercial, bank-owned infrastructure, it can contribute to the payment systems being better able to withstand technological disruptions and situations of financial unease. It can also contribute to increased efficiency by making it easier for new participants to become established and by offering them the possibility to create payment services based on the e-krona. This is in line with the Riksbank's mandate to promote a safe payment system.

The Riksbank's role is to have a holistic approach to the functioning of the payment market that individual market participants can be expected to lack, for natural reasons. The purpose of a possible e-krona would be to manage potential problems on a future payment market and to ensure that the general public has access to central bank money. The Riksbank assesses that it will take time to establish and make an e-krona generally marketable. The investment that the Riksbank might then make in an e-krona must therefore be based on a long-term and strategic goal, not a short-term cost-benefit analysis.

In conclusion, the project presents a proposal for a possible design of the e-krona:

- An e-krona would primarily be intended for smaller payments between consumers, companies and authorities. It would not be intended for large and time-critical payments between financial institutions, nor to function as a monetary policy instrument.
- An e-krona is a direct claim on the Riksbank, is specified in Swedish kronor and can be held by financial institutions, companies and members of the general public. It is electronically accessible 24 hours a day, seven days a week, 365 days a year in real time.
- A register-based and account-based e-krona is supplemented with a value-based solution that makes offline payments of small amounts possible and increases their availability for those who do not want to or cannot have e-krona accounts.

- The e-krona does not give any interest, but should have a built-in function to make it possible to accrue interest at a later point. This is in line with the current Sveriges Riksbank Act, which does not allow for deposits from the general public. If an interest rate is to be introduced, then the Sveriges Riksbank Act needs to be amended.
- The supply of e-kronas shall be determined by demand for them. The general public and the participants in the payment market currently determine the Riksbank's supply of banknotes and coins. The supply of e-krona should be determined in a similar manner. As the e-krona is in a system that does not come under the finality directive, it is best suited for small payments. Large payments will continue to be made through the RIX system.
- The Riksbank supplies the central infrastructure for the e-krona, but the interaction with users of the e-krona will be entirely or partly through private or public sector agents with an authorisation to mediate payments. Thus, an interface is needed to which these payment mediators can connect. The Riksbank will be responsible at the very least for the issue, redemption and settlement of the e-krona. It is an open question whether the Riksbank should supply a very simple and fundamental payment service that allows users to access their e-kronas without going through a payment services provider.
- It should be possible to buy e-kronas through a transfer in RIX, but there should be alternatives for the payment services providers and users who are not participants in RIX.
- The e-krona can have a function that under certain circumstances, in accordance with the anti-money laundering regulations, allows partly anonymous payments. A register-based e-krona would mean that payments of small amounts could be made anonymously for the recipient up to a certain level, and a payment with a value-based e-krona, for instance, an e-krona card could be anonymous up to a certain amount.

The conclusion drawn by the project from the contents on this report is that the Riksbank will need to continue to investigate questions related to the e-krona. Much remains to be studied and decided on. The Riksbank wishes to discuss the ideas concerning the development of the payment market presented in the report with the parties concerned both regularly and in special dialogue meetings in the near future. This development comprises large, complex questions that affect society as a whole and the Riksbank therefore wishes to have a broad dialogue.

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