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TECHNICAL NOTE

CENTRAL BANK DIGITAL CURRENCY AND FINTECH

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Glossary

AML/CFT	Anti-Money Laundering and Countering the Financing of Terrorism
ATM	Automated Teller Machine
BCP	Basel Core Principles
CBDC	Central Bank Digital Currency
CET1	Common Equity Tier 1
DGS	Deposit Guarantee Scheme
EBA	European Banking Authority
FI	Swedish Financial Supervisory Authority (Finansinspektionen)
FSAP	Financial Sector Assessment Program
IMF	International Monetary Fund
ML/TF	Money Laundering / Terrorist Financing
PFMI	CPSS-IOSCO Principles for Financial Market Infrastructures
RTGS	Real-Time Gross Settlement
PSD2	Revised Payment Services Directive
PSP	Payment Service Providers
SNDO	Swedish National Debt Office (Riksgälden)
TN	Technical Note
VASP	Virtual Asset Service Provider

EXECUTIVE SUMMARY

The Swedish economy is characterized by high adoption of digital services in the financial sector, as shown by a thriving Fintech sector, and the ongoing analysis on whether to issue a Central Bank Digital Currency (CBDC). This technical note looks at the systemic risks stemming from the potential issuance of CBDC in Sweden, as well as the growing significance of the Fintech sector. This note does not evaluate the benefits of CBDC, or the Fintech sector.

CBDC

The issuance of CBDC in Sweden (e-krona) may create systemic risks through financial and operational risks:

- i) Financial risks depend on whether the e-krona will be used for transaction purposes or also as a store of value, and whether there will be only domestic demand, or also foreign demand for the e-krona. Prominently, the risks to the financial system include the possibility of bank runs and structural outflow of deposits from the banking system (a slow run). In this latter scenario, banks can react to the introduction of the e-krona, for instance, by increasing remuneration of deposits, thus limiting the deposits outflow. The extent of disintermediation will affect monetary policy implementation and transmission. In case of foreign demand for e-krona, gross capital flows would increase and, potentially, become more volatile, with a resulting more volatile exchange rate, increasing financial vulnerabilities, and challenging monetary policy. Many of these risks depend on design features of the e-krona, which are yet undecided; and
- ii) Operational risks arise from the complexity and novelty of the undertaking for a central bank. They include, for instance, data privacy, integrity, and cyber risks. While the main financial risks potentially increase with e-krona demand, lower-than-expected demand for e-krona could also arise, leading to reputational risks for the Riksbank, especially if implementation costs are high.

The Riksbank has been one of the pioneers in the analysis of CBDC, has recognized these risks, and has put in place a plan to mitigate them. The breadth and depth of CBDC analysis done by the Riksbank is commendable. It has published several reports and in-depth analyses of various key topics related to CBDC issues, as well as contributed to different international working groups on the topic. Recently, it has dedicated resources to testing technical e-krona solutions. In addition, the Riksbank has set up 19 internal workstreams to analyze and propose design solutions for the operational model of the e-krona, and to identify and mitigate financial and operational risks. These workstreams are staffed by full- and part-time resources coming from several functional departments of the Riksbank. The Riksbank committed to an e-krona design that fulfills the “do no harm” principle; that is, support public policy objectives and do not impede the central banks’ ability to carry out its mandate.

Authorities are still evaluating the issuance of e-krona and a government inquiry is ongoing as of December 2022. While much has been done by the Riksbank, a great deal is still left to do before the launch of the e-krona, if authorities were to decide to do so. As central banks are tasked to uphold trust in the currency, particular care should be taken, so that e-krona provision does not erode trust. To this end, an extensive analysis of e-krona's design features and economic impact should be done. This should include an evaluation of incentives for e-krona adoption by the general public and the private sector, as well as extensive testing of financial safeguards to determine most effective designs. The analysis of incentives and safeguards will then feed into the more general analysis of impact on the financial system, monetary policy implementation and transmission. At the same time, the Riksbank should continue testing technical solutions to build a stable and resilient ecosystem, especially against cyber risk, and engaging in preparatory work on legal and regulatory frameworks. To perform in-depth analysis and testing, the number of dedicated staff should be increased and collaboration from all functional departments of the Riksbank, as well as other relevant authorities, will be needed.

Fintech

Different sources point to a thriving Fintech ecosystem in Sweden. Due to data limitations, only a limited review of Fintech was possible in this FSAP. Based on the review of a limited sample, Fintech firms appear to be, on average, small (the median firm has SEK 23 million in assets, or US\$2.3 million, with 12 employees), but some larger established firms exist, with only a small exposure to the banking system (liabilities toward credit institutions), with the median firm holding no liabilities toward banks.

While systemic importance of the Fintech sector seems limited, the sector should be monitored closely, as it could grow fast, firms are complex and highly visible. In this context, FI needs to enhance its data collection to allow for a comprehensive analysis of Fintech. Given that the development of the Fintech sector may also have systemic implications, FI should investigate to what extent there is room for cooperation on the data collection with Riksbanks' Statistical and/or Financial Stability Departments. Building on the monitoring, FI should regularly conduct a review of the completeness of the regulatory perimeter. While FI has been undertaking some scoping of the market to identify firms that may be providing financial services without the required license, this has not been done systematically.

FI should evaluate the adequacy of its supervisory resources to monitor and analyze Fintech firms, business models, and relevant risks. There appears to be a scarcity of specialized staff to review and assess evolving Fintech business models and the risks these entail. For Fintech firms that work across different financial subsectors (covered by different departments), FI should ensure that there is effective cooperation and communication to ensure FI has a holistic view on the risks of the supervised entity.

Finally, FI should review the adequacy of its points of contacts with Fintech firms. More communication with firms could help supervisors better understand the different business models and risks, facilitate forward-looking market scanning, and allow FI to provide more guidance to Fintech firms on the appropriate regulatory and supervisory approach.

Table 1. Sweden: Key Recommendations

Recommendations	Paragraph Reference	Responsible	Timing¹
Central Bank Digital Currency			
Perform extensive analysis of CBDC financial safeguards, incentives for private adoption and participation, impact on the financial system, and monetary policy implementation and transmission.	63, 58–61	Riksbank	ST
Continue testing technical solutions to uphold the stability and resilience of the e-krona.	63, 62	Riksbank	ST
Continue strengthening regulatory frameworks and providing support to enhancing the legal framework.	63, 62	Riksbank	ST
Fintech			
Review the adequacy of interaction between supervisors and Fintech firms, to facilitate the exchange of information and enhance understanding of risks.	81	FI	ST
Enhance data collection to support a more comprehensive analysis of Fintech and conduct periodically a review of the adequacy of the regulatory perimeter.	82–83	FI	ST
Evaluate the adequacy of the supervisory resources to monitor and analyze Fintech firms, business models, and relevant risks	84	FI	ST
¹ I Immediate (within 1 year); ST Short Term (within 1-2 years); MT Medium Term (within 3–5 years).			

INTRODUCTION

1. **The Swedish financial sector is characterized by high adoption of digital services.**

Sweden has been at the forefront of technological innovation in services provision. Many technological start-ups that are now household names (e.g., Skype, Spotify, Klarna) were founded in Sweden. Between 2017 and 2021, Sweden was the third largest hub for venture capital investment in technological firms in Europe.¹ This flurry of technological innovation widely influenced the provision of financial services as well. This is most evident in retail payments, where the cash circulation rate is low, and the use of digital means of payment is widespread.

2. **The Riksbank is exploring the issuance of Central Bank Digital Currency (CBDC).** It is not surprising that the high digitalization of the Swedish economy would have led to the exploration of digital options for existing services also among public institutions. The Riksbank has been one of the pioneer central banks in exploring the possible issuance of retail CBDC, a digital liability of the central bank that can be accessed, and exchanged, by the general population.² Currently, more than 100 of the Fund's country members are looking at the potential issuance of CBDC. Some central banks, like the Peoples' Bank of China and the Eastern Caribbean Central Bank, have already started pilots among the general population.³ Other central banks have officially launched their CBDCs, such as the Bahamas, Jamaica, and Nigeria.

3. **At the same time, the Fintech sector is growing.** The number of active Fintech firms has been increasing steadily in the last years, and Fintech is the third largest sector by venture capital funding in Sweden. The thriving Fintech environment has about 450 active firms, offering services ranging from payments to credit provision, from technical infrastructure to wealth management. For example, the Swedish Fintech Klarna,⁴ which provides "buy now, pay later" services to consumers, is one of the most valued startups in Europe,⁵ and is expanding in different markets, including several countries in Europe and in the United States.

4. **This technical note analyzes the potential systemic risks emerging from the issuance of CBDC and the Fintech sector, assesses current practices to mitigate risks, and provides recommendations to fill the gaps.**

¹ [Sweden Tech Report, February 2022](#).

² Differently from retail, there is also wholesale CBDC, which can be accessed only by a restricted number of users, usually financial intermediaries.

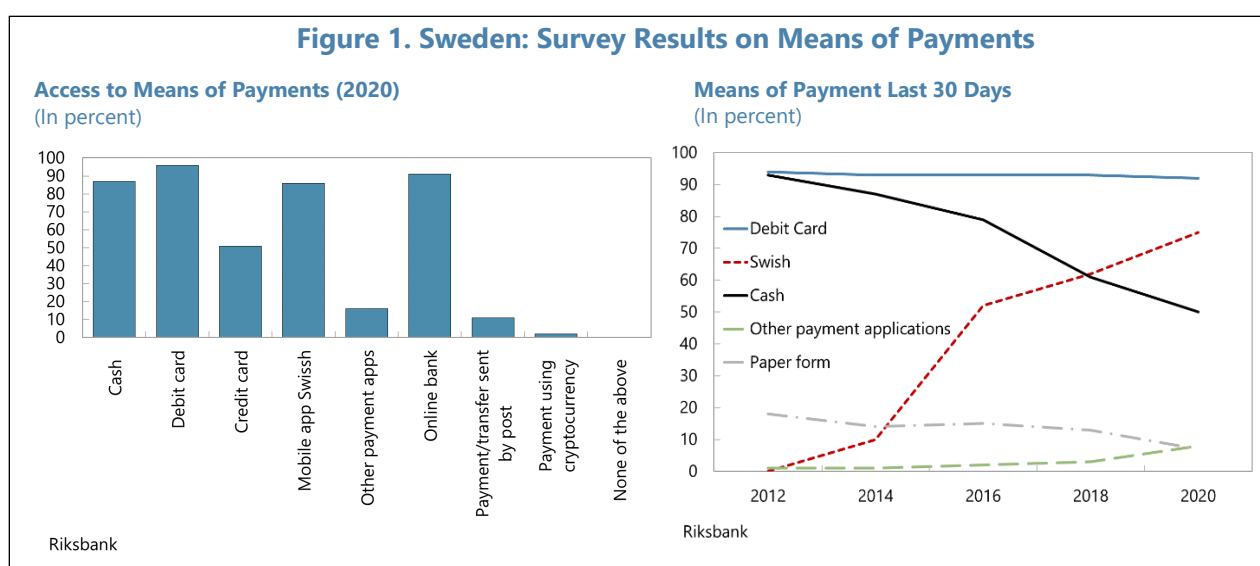
³ See Soderberg et al. (2022), [Behind the Scenes of Central Bank Digital Currency](#), IMF.

⁴ Any reference to fintech firms or products is based on publicly available information and does not constitute endorsement or analysis of risks by the IMF.

⁵ This status might change over time, depending on evolving evaluation of the company.

CENTRAL BANK DIGITAL CURRENCY

5. In Sweden, adoption of digital means of payments is very high; at the same time, the use of cash for payments is declining. The Swedish economy has been at the forefront of the digital payment and online banking revolution. More than 90 percent of respondents to the Riksbank survey in 2020 indicated that they have access to a bank card for payments connected to their bank account, and to online banking (Figure 1). The debit card is, and has been for over the last 10 years, the most common tool to pay for transactions. At the same time, the use of cash has been declining steadily. On average, only 50 percent of users commonly used cash for transactions in 2020, down from 92 percent in 2012. However, there are different patterns among the population. The elderly tend to rely more often on cash than younger people, the opposite being true for digital means of payments.⁶



6. Among digital means of payments, the mobile money app, Swish, has seen a rapid increase in use. Swish is an application-based payment method allowing instant transfer of funds between Swish app users (individuals, businesses, and e-commerce) by using a mobile phone number. The app links to the underlying bank deposit accounts of the users, which provide the source of funding. Since its launch in 2012, Swish has seen a large increase in its adoption and use among the Swedish population: 75 percent of survey respondents say that they commonly used Swish in the last month more than they used cash (Figure 1). In May 2022, there were 8.6 million users of Swish,⁷ of which 8.3 million were private accounts, and 319,000 businesses were offering payments via Swish. The average number of Swish transactions per customer in May was 9.7, an increase of 23 percent compared to the previous year, and the average value of transaction in the

⁶ Data from the 2020 survey. The COVID-19 pandemic might have decreased generational differences by fostering a wider adoption of digital means of payments.

⁷ The Swedish population in 2020 was 10.4 million.

same period was SEK 481 (around US\$48),⁸ which suggests the use of Swish for daily transactions of lower value.

7. At the same time, the payment infrastructure in Sweden is undergoing a major overhaul, which will affect the payment landscape in the near future. As part of the harmonization effort of the Nordic payment markets toward a common European standard, the Riksbank launched RIX-INST system in May to provide settlement of instant payments in central bank money, and major Nordic banks are working on joint Nordic infrastructure for payments (see Sweden FSAP 2022, Oversight Review of FMIs and Selected Issues, Technical Note).

8. Against this background, the Riksbank is looking at the potential issuance of CBDC, named e-krona. The Riksbank has been a pioneer among central banks in the analysis of CBDC. In 2017 the Riksbank started the e-krona project to discuss objectives for issuing a CBDC, and how this might look. Two project reports were published, as well as dedicated issues of the Riksbank's Economic Review (in 2018 and 2020). These publications entailed a preliminary analysis on most of the key issues for CBDC development. More recently, the Riksbank has started technical experimentations as well, with the objective being to build up knowledge in the technical means to issue CBDC.

9. The Riksbank highlighted several policy goals of e-krona issuance. One of the main arguments has been for the Riksbank to continue to provide access to central bank-money in the light of the declining role of cash and the digitalization of the payment market and, in this way, to continue to be relevant in the payments landscape. Other important objectives with the e-krona would be the increased contestability and resilience of the payment market, which are central elements of the Riksbank's mandate of promoting safe and efficient payments.

10. Widening the access to payment services could enhance competition and efficiency of the payment system. The Riksbank observed that the Swedish payment system is dominated by private means of payments, and the existence of network effects in the market naturally leads to market concentration, monopoly rents, and stifled innovation. In the central bank's view, issuing the e-krona as a public, universal, alternative means of payments could then lead to the benefit of increasing competition and efficiency in the payments market. Competition in the payments market could be particularly enhanced if the e-krona allows for the provision of new services by the private sector, for instance, by exploiting data use or programmability of money.

11. Resilience of the payments system could also be increased if e-krona were to be issued. Finally, the Riksbank emphasized that, as market concentration leads to fewer operators, disruption in one of these operators could create large consequences for the smooth functioning of payments, and, hence, society. The role of the state as guarantor of the smooth working of the payments system motivates a crucial role for the central bank in this market, in the Riksbank's view.

⁸ [Swish statistics, May 2022.](#)

12. Swedish authorities are evaluating the benefits and costs of e-krona issuance. The pursuit of the aforementioned policy goals could give rise to benefits, which are however difficult to quantify. What is the value of having access to a liability issued by the central bank? Does this change in crisis and normal times? What is the welfare value of the improved competition and resilience in the payment system? At the same time, the authorities are trying to assess the risks posed by e-krona issuance, such as evaluating what are the risks for the financial system, or how costly it is to build up the e-krona ecosystem. These are some of the difficult questions that the Swedish authorities are trying to gauge in order to decide whether to go forward with the issuance of the e-krona. At the same time, the Riksbank indicated that cash would be available even in a world with e-krona. An ongoing government inquiry on the means of payments in Sweden is looking into the merits of an e-krona, and is expected to inform authorities by end-March, 2023. In addition, a decision to amend current legislation will be needed to fully integrate e-krona issuance under the Riksbank's mandate.

13. This FSAP did not do a cost-benefit analysis, but it took the approach to analyze risks arising from the issuance of a CBDC, review ongoing activity at the Riksbank, and provide preliminary recommendation to fill gaps. The evaluation of the benefits is not in the scope of the FSAP, which focuses on system risks. As such, policy goals and possible benefits of e-krona are not further considered. Instead, the note analyzes potential risks of e-krona issuance and compares this with the ongoing activity of the Riksbank. Recommendations are aimed at filling potential gaps.

14. The potential issuance of CBDC could give rise to financial risks, as well as operational and reputational risks to the Riksbank. The e-krona would be a new asset in the financial system. Systemic risk could arise, depending on whether it has the potential to substitute other existing assets, and how fast. In addition, the issuance of e-krona will pose operational and reputational risks to the Riksbank. The technical note evaluates both sources of risks in turn, before turning to a description and assessment of the preliminary activity of the Riksbank on risk mitigation.

A. Financial Risks of E-Krona Issuance

15. Financial risks vary, depending on the source of e-krona demand, whether domestic or foreign, and its use within the Swedish economy, whether for means of payments or for store of value. Table 1 provides a synopsis of the potential financial risks arising from the use of e-krona. Demand for e-krona could come from its use as a means of payment and/or as store of value. By domestic demand, we mean demand for e-krona by Swedish residents or foreigners while within Swedish borders (e.g., tourists). With foreign demand, we mean demand for e-krona by foreigners not present in Swedish territory. We do not consider the situation in which e-krona could spur a demand for a foreign CBDC, as this is an unlikely scenario for Sweden, given its well-developed and stable economy and the strength of its institutions.

16. If demand for e-krona is only domestic, the three main financial risk scenarios are a bank run, a disintermediation of the banking system (a slow run), and a disintermediation of payment service providers (PSPs). If e-krona only substitutes cash, there will be minimal impact on the financial system and the main effect will be a change in the composition of the balance sheet of

the central bank. In the Swedish economy, commercial bank money is the principal liquid asset for transactions and short-term store of value. Since the e-krona will be used potentially as a means of payment and a safe liquid asset, the e-krona could replace the role of bank deposits in the economy. Looking at Sweden as a closed economy, there are three main risk scenarios: i) large e-krona demand for store of value in normal times: the e-krona structurally replaces deposits as means of payments and store of value; i.e., a disintermediation of the banking system, or a permanent run on the banking system; ii) e-krona demand for store of value in crisis times: the e-krona provides an asset that enables systemic bank runs, or runs from other riskier asset classes; and iii) e-krona demand purely as a means of payment: the e-krona does not structurally substitute deposits, but its use as a means of payment erodes banks' and PSPs profits, as they would experience increased competition; thus, leading potentially to increased vulnerabilities.

Table 2. Sweden: Financial Risks Scenarios Depending on Sources and Use of E-Krona

E-krona demand:			
Use ↓	Source →	Domestic	Foreign
Store of value	Fast	Bank run	Run to the e-krona
	Slow	Disintermediation of banks	Financial substitution (abroad)
Means of payment		Disintermediation of PSPs	Currency substitution (abroad)

17. If demand for e-krona is also from foreigners, risks can arise if the e-krona enables currency and financial substitution⁹ abroad and, thus, large inflows of capital. In case access to e-krona is granted also to foreign countries, there could be significant foreign demand for e-krona, especially if there are crises of confidence in foreign countries. This could lead to currency and financial substitution in foreign countries, and large and volatile inflows, which would affect the exchange rate and financial institutions' hedging costs, as well as the balance sheet of the central bank, and lead to increased vulnerabilities.

18. In what follows, the note looks more closely at all risks, starting first with those arising from a domestic only e-krona demand. While scenarios are described separately for expositional purposes, they are not mutually exclusive, and demand for the e-krona can take all the forms underpinning the different scenarios at the same time.

⁹ The extent to which asset and liabilities of the financial sector are denominated in a foreign currency. See for instance Levy Yeyati, Eduardo (2006), "Financial Dollarization: Evaluating the Consequences" Economic Policy Vol. 21(45), pp. 62–118.

Risks of a Disintermediation of the Banking System

19. Demand for e-krona depends on different factors, which in turn are also affected by e-krona design. Demand for store of value in normal times depends mainly on the remuneration of e-krona, and that of alternative liquid safe assets. An unremunerated e-krona is unlikely to create significant demand for store-of-value purposes in a positive interest rate environment. Demand for e-krona for transactions purposes will also depend on design features, such as usability and privacy, as well as endogenous network effects. However, use only as a means of payment would be unlikely to generate a large disintermediation of the banking system.

20. Given the large number of factors that affect CBDC demand, it is difficult to predict the extent of use for store of value in normal times, and the extent of substitution of bank deposits. The economic literature has pointed out different potential outcomes, from CBDC not disintermediating the banking system, or disintermediation taking place only under particular circumstances in the economy, to potential large disintermediation.¹⁰ In these studies, demand for CBDC arises because of demand for liquid assets, or because it has attractive features over cash and bank deposits, for instance, ease of use. Putting all these considerations into one single framework is difficult; hence, estimating potential demand for e-krona is a complex and uncertain task. Preliminary calculations by the Riksbank suggest that a demand for e-krona of about 1 percent to 3 percent of Swedish GDP would satisfy transactions and store-of-value needs.¹¹ Given the large and complex factors affecting demand, the note does not attempt a demand estimation, but points to key systemic risk consequences in case disintermediation takes place.

21. If e-krona demand disintermediates deposits, banks might need to find alternative sources of funding or shrink their balance sheets, with negative consequences for financial stability and credit provision. In the case of e-krona demand for store-of-value purposes, households, but also nonfinancial corporations, could substitute bank deposits with e-krona holdings. Given the role of banks as providers of payment services, deposits enjoy a liquidity premium with respect to other asset classes; hence, they represent a convenient source of financing for banks. Substituting deposits with other sources of funding will thus increase costs for banks. Depending on market power in the lending market, increased funding costs could pass through lending rates, or just impact the profitability of banks. In both cases, the banking system could become more fragile, as lower profitability implies lower capital generation capacity, and higher loan rates could imply lower demand for loans and selection issues toward riskier borrowers.¹² Instead,

¹⁰ See for instance: Andolfatto (2021), "Assessing the Impact of Central Bank Digital Currency on Private Banks," *The Economic Journal*, 131(634). Chang, Grinberg, Gornicka and Miccoli (2022), "Central Bank Digital Currency and Bank Disintermediation in a Portfolio Choice Model," IMF, mimeo. Agur, I., Ari, A., and Dell'Ariccia, G. (2022), "Designing Central Bank Digital Currencies," *Journal of Monetary Economics*, 125. Chiu et al. (2019), "Bank Market Power and Central Bank Digital Currency: Theory and Quantitative Assessment," Bank of Canada.

¹¹ Segendorf (2018), "How many e-kronas are needed for payments?," *Economic Review* 3, Riksbank. Juuks (2018), "When a central bank digital currency meets private money: effects of an e-krona on banks," *Economic Review* 3, Riksbank.

¹² Stiglitz and Weiss (1981) "Credit Rationing in Markets with Imperfect Information," *The American Economic Review*, Vol. 71, No. 3.

banks could simply let the balance sheet shrink, but this can have negative consequences for banks' credit provision, as well as create tension in markets if banks must liquidate assets to meet redemption demand by their depositors.

22. Banks could strategically react to deposits outflow by raising remuneration of deposits, but banks' profitability will take a hit. As demand for e-krona for store-of-value purposes depends on the differential remuneration of deposits and e-krona, banks could limit deposit disintermediation by increasing the remuneration of deposits; that is, reducing the liquidity premium that deposits offer to banks. This effect is pointed out by several studies in the literature (for instance, Andolfatto (2021) and Chang et al. (2022)). Depending on demand and supply elasticities in the deposits market, disintermediation might not arise at all. However, funding costs for banks would increase, which could impact banks' profitability and capital generation capacity.

23. The disintermediation of banks can also impact monetary policy stance, implementation, and transmission. In the new equilibrium, if banks' lending rates are significantly increased, the monetary policy stance might need to be changed, by lowering monetary policy rates, to stimulate an organic level of credit provision to the economy. The level of the natural rate of interest in Sweden might be affected.¹³ In the transition to the new equilibrium, as banks transfer deposits to the e-krona, they might use all their holdings of central bank reserves. Depending on the aggregate level of reserves in the economy and their distribution among banks, this could imply upward pressure on short-term money market rates, which represent the first step in the monetary policy transmission chain. The Riksbank will then need to offer additional liquidity to banks, provided that collateral of sufficiently high quality is available to banks.¹⁴ In the longer term, the Riksbank's balance sheet might increase if e-krona demand is substantial, increasing seigniorage in the case of an unremunerated e-krona, but overall, the central bank's footprint in the economy. The impact on monetary policy transmission depends on whether the e-krona is remunerated or not. An unremunerated e-krona will have minor effects on transmission during normal market conditions, provided there is no significant disintermediation of the banking system. A remunerated e-krona could reinforce the interest rate channel, as liabilities of commercial banks could become more sensitive to the policy rate, either because of competition with the e-krona of bank deposits, or because banks will resort to wholesale funding, which tends to follow more closely the policy rate.

24. In the very long run, e-krona could lead to a narrow banking system, but the welfare benefits of this system are unclear. The introduction of CBDC in the economy could lead to the separation of the provision of liquid assets and long-terms loans, currently both provided by banks, to different entities. E-krona could represent the new liquid asset, and banks would retain only the function of providing long-terms loans. In doing so, banks would substitute deposits with longer-term funding, introducing a narrower banking system with lower maturity transformation. However,

¹³ The natural rate of interest is broadly determined by the interplay of technology, consumers' preferences, and frictions in the economy. The e-krona might influence each of these elements.

¹⁴ See, for instance Malloy et al. (2022), "Retail CBDC and U.S. Monetary Policy Implementation: A Stylized Balance Sheet Analysis," Federal Reserve Board.

the welfare benefits, or losses, of a narrow banking system, compared to a fractional one, have long been debated by economists,¹⁵ and the net balance is yet unclear.

Domestic Run Risks

25. Demand for e-krona could materialize in times of a systemic crisis affecting the financial system, providing a safe asset to store value. Flight to the safety of e-krona could materialize during systemic confidence crises in the banking system, or when confidence affects other riskier assets classes, like, for instance, corporate bonds or investment funds share. In these situations, the very presence of the e-krona could provide an avenue that increases the possibility of runs from other assets. However, the presence of e-krona would be most relevant only when the crisis involves the private sector and is systemic. If the credibility of the Swedish economy is under strain, the flight to safety would likely take the form of increased demand in assets denominated in foreign currencies, rather than in e-krona. If there is an idiosyncratic crisis of confidence in some banks, or in some other asset classes, then the flight to safety could as well be to deposits issued by banks perceived as safe.

26. The increased demand for safe assets during periods of crisis of confidence in the banking system is likely to be the reason behind the increase in accounts at the Swedish National Debt Office (SNDO, Riksgälden) in late 2008 (Box 1). The SNDO used to offer deposit accounts to the general population as an alternative form of financing. As deposits offered by a branch of the Swedish government, these deposits were safe. During late 2008, the banking system in Sweden was affected by a global lack of confidence and liquidity. In those months, demand for the safe deposits offered by the SNDO increased by SEK 17 billion, a 60-percent increase, while amounts held in deposits at commercial banks decreased by similar amounts. As the turbulence in the financial system subsided, demand for the safe deposits decreased. The sums involved were marginal in relation to total bank deposits, but the event illustrates a mechanism that could be reinforced by an e-krona.

27. Deposit insurance could help in mitigating run risks, but significant demand from uninsured deposits might still arise. Sweden experienced two banking crises during the last 30 years; however, a bank run did not materialize. Among the possible reasons for the past absence of runs, one is that the guarantee on deposits was effective in providing confidence in the system. Commercial bank deposits are insured up to the amount of SEK 1,050,000 per institution, per person. Covered deposits amounted to about half of total deposits by households and nonfinancial corporations at end-2021.¹⁶ While the aggregate decomposition in overnight and term deposits is unclear, there could still be substantial “runnable” deposits. Moreover, wholesale investors not covered by the deposit insurance could also fly to the safety of the e-krona during crisis. All these

¹⁵ See for instance the review in Pennacchi, (2012), “Narrow Banking,” Annual Review of Financial Economics, Vol. 4.

¹⁶ Covered deposits amounted to SEK 2,000 billion at the end of 2021. At the same time, overnight and term deposits by households and nonfinancial corporations were around SEK 4,000 billion.

sources of deposit outflows, while maybe not leading to a widespread run on the banking system, could still create financial strains on banks.

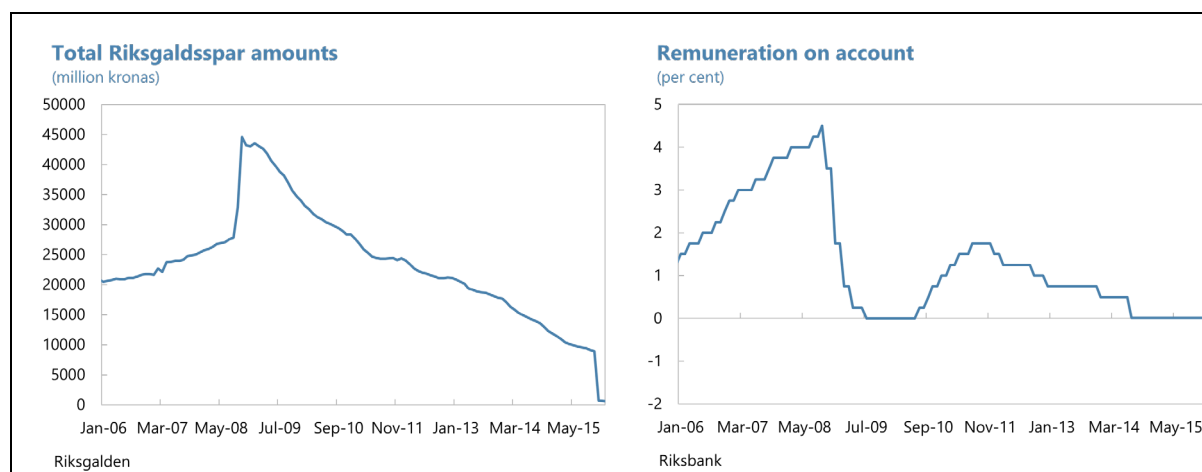
Box 1. Dynamics of Accounts at the National Debt Office During the Fall of 2008

The Swedish National Debt Office (SNDO, Riksgalden) used to offer deposit accounts (called Riksgäldsspar) to the Swedish population, as a way to collect funding directly from the public. The accounts offered both fixed and variable rate remuneration, but the vast majority of accounts opened were of the variable rate type. The remuneration of variable accounts was set at the repo rate minus 0.25 percent, with a floor at zero. While funds could not be directly used for purchases, withdrawals from the accounts could happen at any time. These characteristics made deposits at the National Debt office effectively risk-free, fairly liquid, and government backed. The accounts were discontinued in 2015, when the introduction of negative repo rates made this source of funding relatively more expensive for the National Debt Office.

During the initial stages of the Great Financial Crisis in the fall of 2008, the Swedish financial system was affected by a global lack of confidence and liquidity. The impairment of financial markets, for instance, in funding markets, brought heavy strains on the banks, which led Swedish authorities to take measures to facilitate banks funding.¹

The lack of confidence in the banking system was probably at the base of the increase in amounts deposited at the SNDO. Between August and October 2008, the amounts increased by around SEK 17 billion (a 60 percent increase). In the same periods, deposits of households in monetary and financial institution decreased by SEK 14 billion. Increased demand for deposits at the SNDO unlikely came from more favorable remuneration, as rates on the accounts were lowered by 1 percentage point in October 2008. The remuneration of SNDO deposits was about 1 percentage point higher than bank deposits' rates; however, this difference does not seem to be a driver of demand during this episode, as remuneration of bank deposits was equally higher in previous months.

The dynamics during the fall of 2008 point to an increased demand for a safer asset with respect to bank deposits during turbulent times. However, deposits at the SNDO, even at the peak achieved in October 2008, only represented about 5 percent of all household deposits in banks. While it is difficult to ascertain why there was not further demand for these accounts, anecdotal evidence points to difficulties in opening the accounts. Moreover, funds in these accounts could not be directly used for purchases. The possibility of digitally accessing a risk-free and very liquid asset in the form of an e-krona would increase incentives to transfer from bank deposits; especially during times of lack of confidence in the financial system.



¹ See Financial Stability Report 2008:2, Riksbank.

http://archive.riksbank.se/Upload/Dokument_riksbank/Kat_publicerat/Rapporter/2008/fs_08_2_en.pdf

28. Demand for e-krona could also increase if a crisis of confidence arises in sectors of the financial system other than banking. During a confidence crisis in other sectors of the economy, the financial asset linked to that sector might be subject to fire sales and runs. In this case, the presence of an easy safe asset to run to, like the e-krona, could potentially create another avenue for this run to happen. While it is uncertain whether the e-krona increases the probability of this type of runs, as several avenues are already present for this run to take place, the availability of e-krona could create compositional effects. For instance, while one could expect safer banks to gain deposits in the case of a run on investment funds, it would just change the destination of run from bank deposits to e-krona, if an e-krona is present.

29. Run for the e-krona during stress times may also complicate the monetary policy implementation of the Riksbank. As the safety of holding a liability of the central bank can look attractive during broader financial sector stress, the Riksbank might have to accommodate this demand by introducing more monetary reserves, so that the transfer from riskier assets to the e-krona can take place in an orderly manner. This could significantly impact open market operations by increasing the size and speed of refinancing operations, and also increasing the operational risk for the Riksbank.

Risks to the Viability of Payments Service Providers and Impact on Market Structure

30. If e-krona is used only as a payment instrument, it would generate lower aggregate risks, but it could still change the market structure of payments service providers by increasing contestability, and potentially eroding fee and commission income of banks. If the e-krona is used as a means of payment, individuals and businesses would likely only hold minor quantities in the e-krona wallet, possibly only for daily transaction needs, and top-up the e-krona wallet only when needed. In this case, demand for deposits, and the balance sheet of banks, would not be affected. However, e-krona would still compete with existing means of payments and, depending on the existing degree of competition in the market, it could potentially erode fee and commission income of current market players. For banks, as main providers of payments services to their customers, it would (in such a scenario) impact their capital generation capacity.

31. Effect on market structure will depend on the degree of competitiveness in the digital payments markets, as well as features of the e-krona. As discussed, Sweden can already be characterized by a high use of digital means of payments. The e-krona would thus compete with all existing digital means of payments. Impact of e-krona adoption on market structure depends to a large extent on whether the payments market is already sufficiently competitive, or whether it is characterized by substantial market power of firms. In the latter case, the introduction of the e-krona would likely lead to a large decrease in monopoly rents. If the market is already competitive, the introduction of e-krona could lower the viability of some of the existing market players, leading to their potential exit from the market. In addition, features of the e-krona will matter. If the e-krona allows for new technological attributes of money, for instance, programmability beyond what can be offered via, e.g., traditional bank accounts, then private players could provide new services based on these features and keep their market share. At the same time, an e-krona that is embedded in existing payments apps would likely have a smaller impact on the market.

32. The impact of e-krona issuance on PSPs and market structure is uncertain. Firstly, because features of e-krona are not yet certain. Second, because the degree of competitiveness of the payments market is unclear. On the one hand, the observed entry of new PSPs into the Fintech space (see Fintech section) seems to point to a market that is becoming more and more competitive. On the other hand, the importance of network effects in payments naturally leads to market power. In this scenario, some banks, as key providers of means of payments as well as PSPs, like Fintech newcomers in payments, could see their profitability decrease. There are no publicly available data on income coming from the provision of means of payments for banks; however, some evidence points to the fact that net fee & commission income consists of up to 40 percent of total income, depending on the business model of banks.¹⁷ This source of income could be substantially eroded.

Risks Arising from Foreign Demand for E-Krona

33. Demand for e-krona could arise from foreign countries, if access is allowed. Demand for e-krona from abroad would come mainly from two sources: i) a structural demand for e-krona for currency substitution abroad; and ii) a flight to the safety of the e-krona in case of financial system distress in other countries.¹⁸ Estimating potential demand through these two sources is a complex exercise, also because there could be complementarity. Temporary demand due to a crisis of confidence in one country could lead to permanent currency substitution.

34. Drivers of foreign demand depends on geopolitical and economic considerations, as well as transaction costs, which are difficult to evaluate. There is a constellation of factors that could drive foreign demand for the e-krona. In general, international demand for a currency depends on country characteristics like its geopolitical status, wealth, and economic stability. Sweden ranks high on all these characteristics; however, there has not been a substantial foreign demand for kronor yet. This could change if access to the e-krona would be easier and cheaper than the access to current assets denominated in kronor. Still, evaluation of foreign demand for the e-krona is a difficult exercise. Ease of access and lower transactions costs depend on e-krona design, yet unspecified, and potential capital flow management measures. Demand from abroad could also arise due to first-mover advantages, if Sweden were to be the first advanced economy to introduce CBDC, or due to broader geopolitical events. But these factors are far from given. Finally, an evaluation of foreign demand of e-krona depend also on the exchange rate. A large demand from abroad would put appreciating pressures on the krona, naturally decreasing further demand. While the exchange rate could act as a dampener of foreign e-krona demand, this would come with potential macro-economic consequences for Sweden.

¹⁷ SEB, Investors Presentation, Q1 2022, page 9.

[https://webapp.sebgroup.com/mb/mblib.nsf/alldocsbyunid/B151D202811A2F59C1258815002B9AE9/\\$FILE/Investor_presentation_2022_Q1.pdf](https://webapp.sebgroup.com/mb/mblib.nsf/alldocsbyunid/B151D202811A2F59C1258815002B9AE9/$FILE/Investor_presentation_2022_Q1.pdf)

¹⁸ The analysis does not consider the demand from nonresidents temporarily physically present on the Swedish territory, e.g., tourists, since the limited amount would likely result in minor implications.

35. Significant foreign demand could in turn lead to large capital inflows, volatility in case of sudden reversals, and appreciation and volatility of the exchange rate, increasing financial vulnerabilities. In the case that foreign demand of e-krona arises, larger capital inflows would ensue, but also increased volatility of capital flows, in case demand proves to be temporary. This in turn could lead to exchange rate appreciation and increased volatility. As local financial institutions' cost of funding in foreign currencies becomes more volatile, financial stability issues could arise. Moreover, hedging costs for financial institutions and the real sector might increase. These challenges would be more pronounced, depending on the size and depth of Swedish financial markets relative to capital flows.¹⁹

36. Increased and volatile money supply could lead to more complex monetary policy implementation, influence the constellation of interest rate, and decrease the efficacy of monetary policy. A larger and more volatile e-krona demand would translate into a larger and more volatile balance sheet of the Riksbank. This would increase the challenges for monetary policy implementation, as forecasting autonomous factors would be more difficult, requiring more frequent fine-tuning of liquidity provision by the Riksbank, and potentially impairing the smooth functioning of money markets. In addition, while it is not clear that the increased money supply would create inflationary pressures, the Riksbank could anyway want to decrease money supply to keep monetary balances under control. At least two competing effects would arise: on the one hand, foreign demand for e-krona could translate into higher foreign demand for krona-denominated assets (as discussed below), and therefore lower yields on these assets. On the other hand, open market operations to decrease money supply would involve the sale of krona-denominated assets and push toward increasing yields. The coupling of volatile exchange rates and the potentially impaired transmission of the monetary policy stance through rates could decrease the efficacy of monetary policy, with negative consequence for economic growth.

37. Finally, while there are also potential upsides from an increased foreign demand for the e-krona, they are very uncertain and might take several years to materialize. Demand for e-krona could increase demand for all krona-denominated assets, leading to reserve asset status. There are complementarities in the use of a currency for payments and the issuing of assets denominated in that currency, and the role of reserve status,²⁰ which could lead to higher capital integration and increased ease of financing for domestic firms. But these processes might not materialize, and, in any case, will likely take a long time.

B. Potential Operational and Reputational Risks for the Riksbank

38. The issuance of e-krona could give rise to several operational and reputational risks for the Riksbank. From the operational point of view, the Riksbank has to be able to guarantee that the e-krona is safe and efficient. As ultimate owner of the e-krona system, and guarantor of the

¹⁹ See IMF (2020), Digital money across borders: macrofinancial implications.

²⁰ See Gopinath and Stein, "Banking, Trade, and the Making of a Dominant Currency," *The Quarterly Journal of Economics*, 136(2), 2021.

currency, any glitch, failure to operate and mishap of the system, even if due to intermediaries or third-party providers, will likely be ascribed to the Riksbank, with consequential reputational loss.

39. These risks could have systemic implications by decreasing confidence in money and in the Riksbank. Central banks are tasked to create trust in the currency. Upholding public trust in the means of payment is one of the foundational objectives of a central bank.²¹ This implies making sure that the payments system works without anomalies and, specifically, that the means of payment issued by the central bank is safe, secure, and efficient.

40. The impact of operational risks can range from minor to major failures of services. Operational risks arise during the regular functioning of the e-krona, and may be due to issues structurally built into the system, or issues arising from improper supervision or maintenance. Impact of these shortcomings can go from minor loss of service to major failures. The note does not try to be exhaustive in the treatment of operational risks, as many of them depend on the technical solution and organizational model chosen, but provides a general overview.

41. Some possible operational risks are:

- **Treatment of personal data.** While the use of cash does not need the disclosure of personal information, the same will not likely be true for the e-krona. To access and use the e-krona, basic information on the identity of the users will need to be provided. Moreover, recording e-krona transactions could likely provide additional private information on the users. The failure to properly manage these personal data could give rise to breaches of information and expose the Riksbank to reputational and legal consequences.
- **Resilience to cyber-attacks.** The e-krona could be subject to cyber-attacks, with the objective being to steal e-krona or to damage the payments system and the economy of Sweden. The reward incentive has the potential to generate continuous attacks upon the system, which could give rise to operational stops in case of low resilience (see also TN on Cyber Resilience for Sweden FSAP 2022).
- **Integrity.** E-krona will need to satisfy AML/CFT regulations to avoid misuse of the currency for illicit purposes. Failures in the framework of AML/CFT checks and provisions will lead to operational risks.
- **Outsourcing to third-party providers.** Outsourcing to third parties, while cost-effective, could be a source of operational risks if proper safeguards and monitoring are not in place (see also TN on Oversight of FMIs and Selected Issues for Sweden FSAP 2022).

²¹ See Giannini (2011), "The Age of Central Banks," or Goodhart (1988), "The Evolution of Central Banks."

42. Reputational risks arise also due to broader implementation issues. The development and functioning of the e-krona can give rise to reputational risks that are not directly linked to operational risks. These can be due to:

- **Cost effectiveness.** The implementation of the e-krona will have significant costs. This will be due to the development of the infrastructure, to the maintenance and upgrade of the system, and to the staff needed to perform all these operations. As the development of CBDC is globally a novel topic, there is no benchmark for costs of CBDC issuance. Yet, if costs are very high, public scrutiny on the project will increase, doubting the capacity of the Riksbank to manage the issuance. Moreover, costs will have an impact on the budget of the Riksbank, which might be recovered depending on demand for e-krona and impact on seigniorage.
- **Lower-than-expected demand.** In case demand for the e-krona is lower than expected, the Riksbank will likely be asked to provide explanations, especially if there were high costs of development and deployment. This scenario might be particularly relevant, as no central bank has expertise in providing consumer products. Also, this scenario could arise in the case of a disintermediated distribution model for CBDC,²² when the intermediaries do not have enough incentives to enlarge the users base.
- **Sustainability.** The amount of energy resources necessary for the system to operate could generate reputational risks, if resources exceed alternative payment options or, in general, if sustainability was not a factor that the Riksbank took into account when designing the e-krona.²³

C. Riksbank Activity and Mitigation of Potential Risks

43. The Riksbank has been a pioneer in the study of CBDC and has published extensive analyses on the topic. The Riksbank started the analysis of a potential issuance of CBDC well ahead of many other central banks. In 2017, the Riksbank started the e-krona project and published the first interim report, introducing the discussion on the objectives for issuing an e-krona, and how the digital currency might look. The analysis continued with the publication of a new project report in 2018 and dedicated issues of the Riksbank's Economic Review (in 2018 and 2020). These publications tackled preliminary analyses on most of the key issues of CBDC development. A non-exhausting list of the topics include investigations on the demand for e-krona, its effect on monetary policy, and the monetary operational framework, banks and bank lending, seigniorage, competition, and CBDC rationale.

44. More recently the Riksbank started modifying its internal organization to further analyze the potential issuance of e-krona by starting the e-krona pilot. In February 2019 the Riksbank established the e-krona pilot division, with the task of exploring how a potential e-krona

²² An organizational model whereby the CBDC is issued by the Riksbank and distributed by intermediaries (see also paragraph 53).

²³ See "Digital Currencies and Energy Consumption," IMF Fintech Note No 2022/006.

could be designed, producing technical proposals, and investigating regulatory issues. This division has 11 Riksbank staff members. While the pilot focused on the blockchain as the technological choice for the e-krona, no final decision has been made yet on the technology to be used in case of a CBDC issuance. The reports of the first two phases of the pilot have been published, and phase 3 is currently ongoing. Several lessons have emerged from the pilot so far. Among them, a key one is on the need to establish a clear regulatory framework to assess risks for offline payments, set limits, and define ways to manage these risks (see Annex).

45. Furthermore, since 2022, 19 workstreams have been setup within the Riksbank to look at various aspects of potential e-krona issuance (Box 2). The workstreams are tasked with developing analyses and providing recommendations on their respective areas of interest. The areas range from the design of policy instruments to managing e-krona demand, to legal requirements, technological requirements, and setting up on the ecosystem with the private sector. These workstreams are staffed with around 40 Riksbank staff members from all functions of the central bank. As the workstreams have dependencies among them, a coordination group, which includes all the workstreams' leads, has also been established, with the task to share information, identify priorities, and manage dependencies. Together with these 19 workstreams, the Policy and Analysis Division in the Payments Department also works on e-krona analytical issues, even though not exclusively.

46. The Riksbank has also started activities to engage with external stakeholders, and to determine users' needs. The Riksbank issued a "Request for Information" in April to gather proposals for technical solutions for the e-krona from market participants. Customized tests of proposed solutions will be done throughout the year. Different activities to inform the Riksbank on e-krona design are ongoing. A forum with representatives from banks, Fintech, retail firms, and universities has been set up by the Riksbank, with the objective being to gather knowledge and information from stakeholders. The Riksbank is planning as well to develop user studies.

47. The Riksbank contributes with expertise to the Government Inquiry on payments. The ongoing work of the Government Inquiry on the role of the state in the payments market benefits from the expertise of an advisory group, to which one expert from the Riksbank has been appointed by the government, together with other authorities (e.g., the Financial Supervisory Authority).

Box 2. Riksbank Workstreams on E-Krona

Below are a list and description of the Riksbank current workstreams.

Workstream	Description
1. Emergency preparedness	Define the requirements for an e-krona from a preparedness, continuity, and resilience point of view.
2. Data Privacy	The Data Protection Regulation (GDPR) places high demands on how personal data may be stored and handled in a digital context. The e-krona network will handle personal data, workstream to handle key aspects of this in relation to solution.
3. Operational Services	Requirements for Operational Services for an e-krona such as service levels, support and staffing internally and potentially externally depending on solution.
4. System & Application Management	Define governance of the system in order to ensure functionality and robustness including its applications and hardware.
5. Protective Security	Protective security refers to protecting information and activities of importance to Sweden's security against espionage, sabotage, terrorist offences and certain other threats.
6. IT and Cyber Security	Both the infrastructure and participants of a CBDC system should be extremely resistant to cyber attacks and other threats. This should also include ensuring effective protection from counterfeiting
7. System availability	Based on the recommendations around continuity and resilience, define system requirements around availability that meet the objectives.
8. Performance	An e-krona system will need to be able to meet volume and throughput requirements at a justifiable cost. This means requirements on a scalable system that meets the highest performance requirements.
9. Laws and regulations	An e-krona system (infrastructure and participating entities) will need to conform to the appropriate national and international regulatory standards. Includes reviewing current legislation and suggesting changes as needed.
10. Sustainability	Define requirements for a sustainable future e-krona. There are environmental, social and other aspects that should be considered which are in line with Riksbanks Sustainability strategy.
11. Product Features and Functional Services	Define what services, features and product functions and e-krona should have.
12. Architecture	An e-krona must meet a number of needs from the start but can also be further developed over a long period of time to meet already identified needs but also needs that are identified in the future. Confidence in the system's security, but also requirements for functionality, accessibility and performance, together with the need for flexibility and scalability in functions, will place great demands on the architecture and choice of platform
13. Policy Instruments	An e-krona should be designed such that it supports the fulfillment of public policy objectives, does not impede the central bank's ability to fulfill its mandate and 'does no harm' to monetary and financial stability. Workstream to recommend tools and restrictions.
14. Cross-Border Payments	Explore how the e-krona might enhance cross-border payments, including through central banks and other organizations working openly and collaboratively to consider the international dimensions of CBDC design.
15. Identification	Define guidelines for identity schemes and how to preserve integrity while fulfilling the objectives with an e-krona.
16. Wholesale	Explore what an e-krona would mean for existing wholesale distribution with coexistence of a retail focused e-krona and create recommendations around the Riksbank's view on a wholesale CBDC in Sweden.
17. Offline	Explore the feasibility and risk allocation with offline functionality for an e-krona.
18. Schemes and Governance	Define the governance and scheme for an e-krona including roles, responsibilities, frameworks, agreements, certifications, communication, and distribution.
19. Information Security	Define and enforce requirements during the project and beyond related to Information Security.

48. Finally, the Riksbank benefits from collaboration with other central banks and international organizations in analyzing the implications of CBDC. The Riksbank contributes to several international working groups on the benefits and risks of CBDC issuance. As part of the G20 Roadmap to enhance cross-border payments, the Riksbank contributes to, and chaired up to the fall of 2022, the workstream on the Future of Payments, which looks, among other things, at how CBDC could be designed to be used for international payments. It has contributed to the G7 work on defining public policy principles for retail CBDCs, published in 2021. The Riksbank is also actively collaborating with a group of central banks (Bank of Canada, Bank of England, Bank of Japan, European Central Bank, Federal Reserve, and the Swiss National Bank, together with the Bank of International Settlements) to take forward their work on retail CBDCs, and to analyze policy options and practical implementation issues. So far, three reports have been published (on private-public collaboration and interoperability; on how CBDC could best serve people and businesses; and on impact on banking systems), while several other workstreams are ongoing.

Measures to Address Potential Risks

49. The Riksbank is investigating how to potentially mitigate financial and operational risks. The analysis of risks by the Riksbank is broadly in line with that presented in this note. Several of the workstreams are analyzing design options for the e-krona to mitigate risks. For instance, safeguards for financial stability are mainly analyzed by Workstream 13, together with the ongoing work at the international level. Many of the other workstreams focus on different aspects of operational risks.

50. The analysis is ongoing, and there are no firm design choices yet. Workstreams are in the early stages of their work, taking stock of existing contributions and defining the scope of their activities. This implies that there are no firm design choices yet. The Riksbank expressed that all activity coming from the different workstreams, technical experimentation, international collaborations, as well as policy needs, will feed into the requirements for e-krona design. In what follows, the note discusses some preliminary design choices put forward for operating models and financial safeguards, and how they could mitigate the risks.

51. The Riksbank committed to an e-krona design that fulfills the “do no harm” principle. “Do no harm” refers to the design of CBDC ecosystems that support public policy objectives and do not impede central banks’ ability to carry out their mandates (Group of Central Banks (2020), G7 (2021)). This implies that all financial and operational risks described in this work note should, at least in principle, be fully mitigated before the introduction of the e-krona.

52. With respect to mitigating financial stability risks, the Riksbank is considering an unremunerated e-krona, and is evaluating the possibility of introducing fees and/or quantitative restrictions on holdings, also differentiated by type of user. While the choice to have an unremunerated e-krona comes from legal constraints, this design choice will clearly have financial stability implications. An unremunerated e-krona will limit incentives to hold e-krona. More in general, incentives to hold e-krona vary according to the spread between e-krona remuneration and bank deposit remuneration, so that deposits’ elasticity to the policy rate also plays a role in

e-krona demand. Fees and limits are, instead, more customizable policy tools to steer e-krona demand in normal and stress times. Demand control could be achieved by two general tools: price incentives and hard limits on holdings. Price incentives, as in fees or penalty rates, could reduce e-krona demand by decreasing its relative attractiveness to deposits. Hard limits would instead cap maximum e-krona holdings, so that aggregate e-krona demand would not exceed predetermined values. Sweeping deposit accounts could be used, so that there is no uncertainty in settlement of payments when the maximum holding amount has been reached. Workstream 13 will also look at the potential impact of e-krona issuance on the payments market structure.

53. The Riksbank is considering an intermediated model of CBDC distribution, which, however, does not shield the central bank from operational risks. The Riksbank is considering a two-tiered model for the e-krona, where the CBDC is distributed by intermediaries. However, the exact roles of the Riksbank and those of the intermediaries are not fully defined yet. Workstream 18, “Schemes and governance,” is looking at how to structure the distribution model and how to formalize the arrangement, so that each participant has clear roles and responsibilities, as well as oversight and supervision needs. There has not been a decision on whether intermediaries will be only banks or also PSPs, including Fintech firms. Even if distribution of CBDC will be intermediated, the Riksbank will likely be the core owner of the infrastructure of the e-krona, as well as supervision of intermediaries, so that any operational risks by the infrastructure and the intermediaries will eventually affect the Riksbank.

54. Other workstreams are looking more in depth at other operational risks. Workstream 15 is analyzing the implications for AML/CFT of different distribution models. In the intermediated model, the intermediary would provide the onboarding and would be responsible for performing AML/CFT checks. Other workstreams are looking at measures on how to limit low e-krona demand (Workstream 11, Product Features and Functional Services), or how to be sure that the e-krona ecosystem is sustainable (Workstream 10). Many other workstreams deal with technology choices, for instance, offline capabilities. However, there are no clear options provided yet in terms of e-krona design.

55. On reputational risks, the Riksbank acknowledged that e-krona adoption by the general public could prove elusive in the Swedish context. As alternative digital means of payments are already widely used in Sweden, inertia in consumers’ choice might lead to low use of e-krona. Unless properly designed, demand for e-krona could also be low among the elderly, which have less familiarity with digital means of payments.

D. Assessment and Recommendations

56. The Riksbank has taken a very comprehensive approach to the potential issuance of e-krona and has recognized all risks. The Riksbank is one of the leading central banks for CBDC analysis. The breadth and depth of its analysis on e-krona issuance is commendable. At the same time, the Riksbank has always taken an open approach to potential risks and benefits, being very transparent in its communication, and being proactive in engaging with stakeholders and other public authorities.

57. The institutional setup of the Riksbank has been changed to tackle the difficulties, but an increased number of dedicated resources will be necessary. The Riksbank mobilized resources to staff all workstreams and other activities (see Annex I). The e-krona pilot division, initially focused on the technical pilot, has been subsequently renamed e-krona division, put under the Payments Department, and its scope enlarged to support the overall e-krona work, including to contribute to the workstreams. Further support to the analysis of the e-krona came from the Policy and Analysis Division in the Payments Department. The resources devoted so far have been proportionate to the project's current objectives, even though workloads for staff increased substantially. However, if the e-krona project goes forward, further increase in dedicated resources will be needed, especially to perform the analysis leading to the design of financial safeguards and the economic impacts, to set the model for a private-public collaboration, to continue legal and regulatory groundwork, and technological testing. In the IMF survey of central banks that are exploring CBDC, all central banks highlighted that CBDC projects are resource-intensive and become even more so as their scale increases, both in terms of staff and costs. The People's Bank of China (PBOC), which is running a CBDC pilot with users, has about 300 staff engaged in CBDC-related projects, not including private-sector employees who have been working in collaboration with the PBOC.²⁴ While the scale of the project between the two countries is different, the nature costs needed for development of CBDC are mostly fixed and independent of scale.

58. Plans to design the e-krona to mitigate risks have been put in place, but more concrete actions would probably need to be taken in the future. While there are still no firm design choices on e-krona, several workstreams are analyzing how to mitigate potential risks. Riksbank's cooperation with other central banks and international organizations also supports its thinking on how to design the e-krona. However, if the work on e-krona were to continue, extensive further analysis will be needed of both technical and analytical nature, and comprehensive testing of different designs. Some of the key areas where extensive further analysis will be needed are described below.

59. With respect to financial safeguards, no-interest-bearing e-krona, fees, and quantitative limits could be effective in limiting e-krona demand, but each has pros and cons. An unremunerated e-krona could reinforce the zero lower bound in monetary policy. Fees could mitigate this problem by implicitly imposing negative interest rates, when needed. Still, imposing fee on the e-krona could be seen as a fiscal measure and needs a clear communication on its motives. Both fees and limits require careful calibration, as too restrictive limits or too high fees will stifle demand. Moreover, any sort of control of e-krona demand could be questioned during widespread crisis of confidence in the financial system. In these situations, resorting only to fees or limits might be insufficient to control demand and, more in general, a mix of fiscal and monetary measures will likely be needed to bring in financial stability.

²⁴ Soderberg et al., "[Behind the Scenes of Central Bank Digital Currency](#)," IMF, 2022.

60. No consensus has yet emerged on the design of financial safeguards in CBDC, and taking an empirical approach could be helpful. It is uncertain which tools would be more effective in managing CBDC demand. The design of safeguards could be guided by experimental approaches and data. Testing, even in lab settings, on how the introduction of different types of limits will affect users' incentives to hold e-krona could provide initial useful evaluations. Empirical analyses on the introduction of digital means of payments in Sweden, or in other countries, could also provide further knowledge on e-krona demand. Safeguards should also be designed differently, depending on whether they are meant to address a bank run or disintermediation (a slow run). In this case, one can possibly consider fees and limits that are dependent on the rate of aggregate deposits outflows. If very high, limits could be tightened. This would require a permanent monitor on the balance sheets of banks and e-krona demand. Still the use of limits on e-krona would likely require sweeping deposit accounts to maintain operativity in payments, even when the threshold is reached, and reduce issues for the one-to-one convertibility between different forms of money. Extensive analytical work on all of these issues will be necessary to uphold financial stability before the e-krona is issued.

61. The scope and extent of private-public collaboration in e-krona provision is still under exploration. Workstream 15 is expressly analyzing how to structure the private-public collaboration. While the intermediated model of e-krona distribution could lessen the Riksbank's operational role in the e-krona ecosystem, clear regulation and supervision of private intermediaries will be needed to uphold trust in the currency. Particular care needs to be taken to differentiate between the provision of services by the private sector (e.g., the wallet provision) and by the central bank, so as to decrease reputational risks of the central bank. This is similar to the current provision of cash, where the fault of ATMs is not directly attributed to the central bank. Still, incentives for intermediaries to distribute the e-krona need to be further analyzed. The e-krona can potentially erode banks' income from payments' services provision, and they might not want to join the ecosystem. An e-krona ecosystem that allows private intermediaries to build services on top of the pure payment function as, for instance, wealth management, could provide further incentives for private participation. At the same time, incentive for merchants to provide e-krona as a payment option should be analyzed too.

62. Testing on technology has been extensive, but more needs to be done to build an e-krona ecosystem that satisfies the Principles for Financial Market Infrastructure (PFMI). The complexity and costs of the introduction of a new means of payments, with its dedicated infrastructure, are recognized by the Riksbank. Together with the analytical work, extensive testing on technology, systemic stability of the system, and resilience in the face of possible system failures and cyber-attacks need to be part of the Riksbank agenda going forward. In this respect, it will be useful to take the PFMI as guiding principles to build the e-krona ecosystem. The PFMI are the international standards for financial market infrastructure. While it is not clear whether the e-krona system can be defined as a payment system from the legal point of view, the PFMI will provide useful guidelines on how to build the system.

Recommendations

63. If the authorities go forward with the introduction of e-krona, capacity for analysis and testing of e-krona solution should be enhanced, to make sure that risks are mitigated and trust in the currency is upheld. Central banks are tasked to provide trust in the currency: particular care should be taken, so that e-krona's provision does not erode trust. Importantly, the Riksbank should:

- **Conduct extensive testing of financial safeguards features.** Introduction of e-krona in lab settings, exploiting experimental economics, or in restricted trials with users, could shed light on how to design financial safeguards and ground the implications for financial stability.
- **Evaluate incentives for e-krona adoption by the general public and the private sector.** While tests and experimentation could shed light on the effectiveness of financial safeguards, they must be complemented by an evaluation of incentives for banks to distribute the e-krona (in case of distribution intermediated by the banking system), merchants to accept it, and the general public to use it. Focus groups with the public and the private sector, as well as restricted tests to study patterns of adoption and use should be explored.
- **Enhance analysis of impact on the financial system, monetary policy implementation, and transmission.** Both the analysis of financial safeguards and adoptions' incentives need to inform the analysis on the evaluation of the impact of the financial system. In addition, the necessary changes to the monetary policy framework should be evaluated, as well as the effect on monetary policy transmission channels.
- **Assess and evolve the vision for the e-krona over time.** The Riksbank should regularly assess and, if necessary, evolve its vision for the objectives, functions, and design of the e-krona. While the Riksbank was a pioneer in the field of CBDC, the risk is that the debate and technology rapidly evolve and surpass the original vision. For instance, the e-krona's value might come less from being an efficient payment instrument, as originally envisioned, and more from being a platform to enable interoperable and safe private sector innovation.
- **Continue exploration of technical solutions, and follow PFMI as the guiding principle to build the e-krona ecosystem.** Exploration of technical solutions will inform design choices on stability and resilience of the e-krona system. Particular care should be taken such that the system is resilient to cyber risk.
- **Evaluate setting up partnerships with other central banks for the development of the e-krona.** As development of e-krona will have high fixed costs, we would encourage the Riksbank to evaluate the benefits and risks of sharing the development costs with other central banks that are considering CBDC issuance.
- **Continue working on legal and regulatory preparatory work,** to create a sound legal framework for the issuance of the e-krona.

- **Increase number of dedicated staff to e-krona development.** While it is hard to define exactly the amount of needed additional resources, some workstreams are understaffed for taking the project to the next phase; for instance, those on analyzing policy instruments and on defining collaboration schemes with the private sector. Collaboration of all involved departments of the Riksbank will be needed.
- **Cooperate with other relevant authorities,** for instance with FI and the SNDO regarding impacts on the banking system and existing financial safety net arrangements, to leverage different expertise.
- **Acknowledge risks of a low adoption of e-krona** and clearly communicate why issuance of e-krona would be beneficial in that case.

FINTECH

A. Scope of the Review

64. Fintech is technological innovation in financial activities. Financial activities have always been characterized by continuous technical innovation, as such, it is difficult to set a clear demarcation line between what is Fintech and what is not. This note uses the working definition of Fintech by the Financial Stability Board: “technologically enabled financial innovation that could result in new business, models, applications, processes, or products with an associated material effect on financial markets and institutions and the provision of financial services.”²⁵

65. The review focused on a preliminary evaluation of materiality of the Fintech sector in Sweden and FI’s monitoring, regulatory and supervisory approach to Fintech firms. While the definition also encompasses the use of Fintech by incumbent regulated financial institutions, the review abstracted from this. This note first proposes criteria for defining materiality of Fintech firms, then performs a limited analysis on some of the criteria. Finally, it evaluates FI’s approach to monitoring, regulating, and supervising Fintech firms. As the focus of the FSAP is on systemic risks, this note does not analyze the potential benefits of Fintech.²⁶

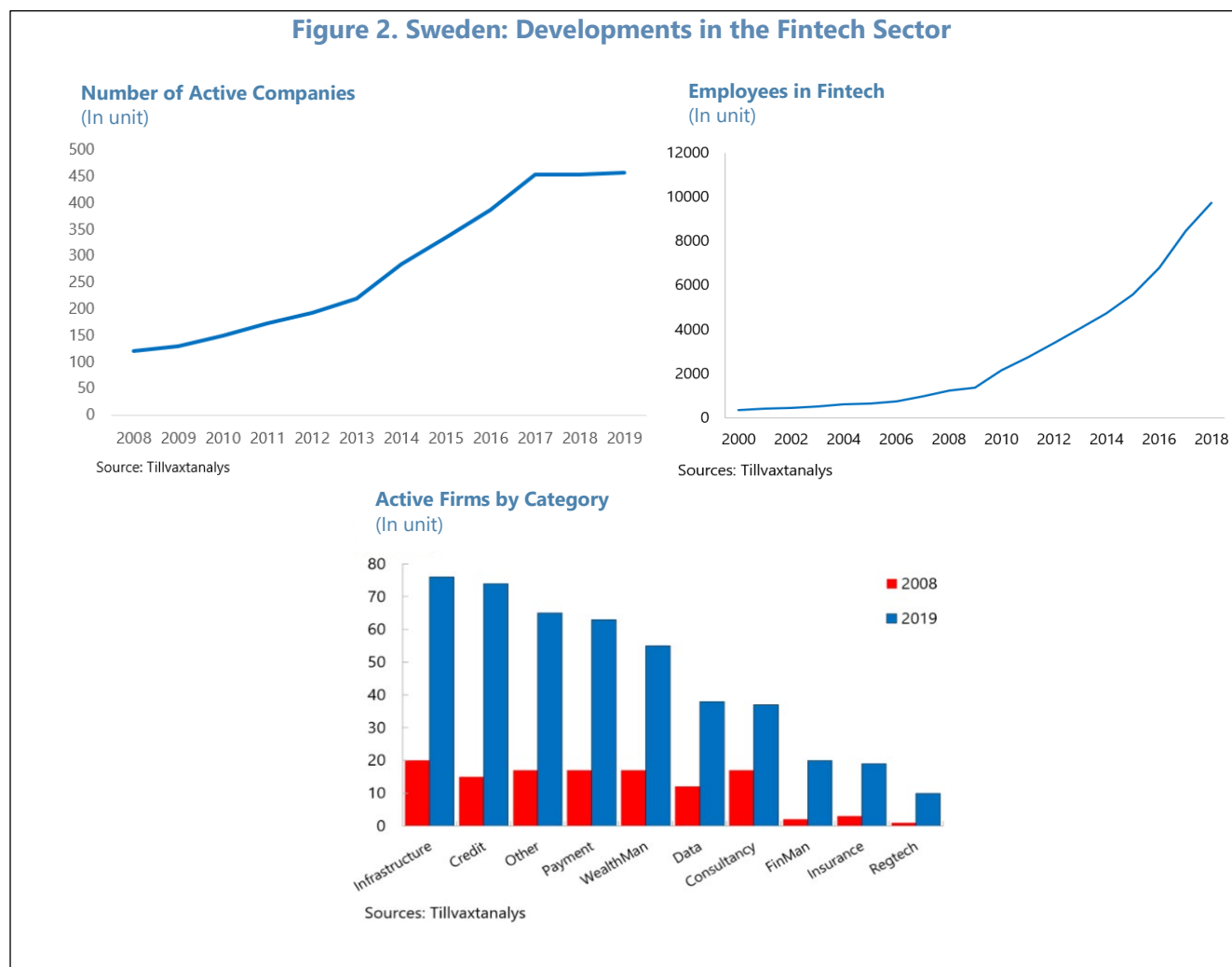
B. Fintech Landscape and Monitoring

66. There appears to be a thriving Fintech ecosystem in Sweden. Different information sources point to a large and innovative environment of Fintech firms. Tillväxtanalys, the Swedish Agency for Growth Policy Analysis, performed an analysis on available information to select and

²⁵ FSB, Financial Stability Implications from FinTech: Supervisory and Regulatory Issues that Merit Authorities’ Attention, June 2017.

²⁶ See FSB, Financial Stability Implications from FinTech (June 2017) for some benefits of fintech to financial stability.

categorize Fintech firms.²⁷ The analysis identified about 450 Fintech companies operating in Sweden in 2019,²⁸ steadily increasing over the last 18 years, with a plateau in the last 2 years due to consolidation in the industry. While many firms are small, the sector employs an increasing number of workers (Figure 2).²⁹



67. Fintech firms in Sweden mostly operate in payments, credit provision, and infrastructure; however, a clear-cut categorization is sometimes impossible. The study by Tillväxtanalys, using text analysis algorithms to analyze the firms' business description, identified

²⁷ [Swedish Fintech \(2020\)](#). The analysis combines machine-learning text analysis of well-known fintech companies and a text analysis of databases of companies registered in Sweden to come up with firms that can be categorized as Fintech. We are deeply grateful to Eva Alfredsson of Tillväxtanalys for providing the data.

²⁸ The scope of the fintech definition and the categories used by Tillväxtanalys for its analysis also include firms that provide auxiliary and support services that do not necessarily need registration or licensing requirements from a prudential financial sector perspective.

²⁹ The number of employees has increased from just over 340 in 2000 to almost 9,750 in 2018, which translates to a median growth of about 20 percent per year.

10 categories of Fintech companies (see Figure 2). Most firms provide services in payments, credit provision, and infrastructure. However, a clear-cut categorization for many Fintech firms is impossible. For instance, the Fintech Klarna is licensed as a bank, provides deposits services, but it also manages an infrastructure for payments services and provides consumer credit, relying on data analysis of payments. All these activities point to four of the categories (credit, payments, data, infrastructure) used in the study. The challenge in identifying the business model of Fintech firms is also exemplified in the analysis by the materiality of the residual “Other” category.

68. Regulatory authorities’ capacity to monitor fintech and determine whether their activities are adequately captured by the existing regulations and perimeter is key. Fintech firms usually have new and varied business models, challenging existing categories of financial firms, and need to be properly understood to refine and expand the definition of financial firms and to analyze risks. Some Fintech business models combine one or more licenses; for instance, some Fintech mortgage providers in Sweden have one license for the mortgage originator activity, and separate licenses for one or more Alternative Investment Funds that provide the funding for the mortgages. Some business models focus on a small part of the value chain of financial services, for instance, by providing payments services while also offering deposit-like liabilities, though not engaging in maturity transformation as would a full-fledged bank. As the services provided by Fintech firms can differ from those of existing categories of financial firms, Fintech’s business models need to be properly understood to see whether they fit into existing licensing categories, or whether a refinement and/or expansion of the licensing categories is needed to effectively regulate and supervise (micro and macro) prudential risks stemming from Fintech business models.

C. Materiality

69. The materiality and potential systemic relevance of the Fintech sector could be evaluated by size, risk profile, interconnectedness, and concentration.³⁰ These criteria should be considered holistically, rather than each measuring systemic importance.

- **Size** is measured by assets size and employments. For some business models, other metrics will provide additional important information. For instance, in the case of PSPs, the number of users, number and values of transactions—in absolute values and relative to the market size—should be analyzed.
- **Nature and risk profile** is linked to the type and nature of the Fintech firm’s activities. For instance, whether it provides services to households, or financial institutions, or how critical is time in the provision of these services (say, time of a transaction in the case of a PSP). For Fintech firms that provide credit, leverage, maturity, and liquidity mismatch should also be analyzed.

³⁰ As there is no international framework to measure and assess the systemic risk of fintech, the FSAP mission took a practical approach in evaluating the materiality and potential systemic importance of the fintech sector.

- **Interconnectedness** is measured by the financial and operational linkages to other parts of the real economy and financial system. For instance, whether there is significant exposure to banks, or whether there is cross-ownership of several different Fintech firms, which could create contagion scares. But the business, structural, and operational complexity of the Fintech need to be considered, as the higher the complexity, the larger the potential for interconnections, and the number of involved entities and propagation channels. The provision of services cross-border also increases interconnectedness.
- **Concentration** considers whether there are available alternatives to services being offered by the Fintech firm. In the absence of firms providing the same or similar services, the systemic importance of a single Fintech firm arises.

70. From a limited scope analysis on some of the criteria, Fintech firms seem generally of small size, with few large companies. For a sample of 51 firms, registered or licensed by FI, their balance sheet, profitability, and interconnectedness with the financial system was analyzed (Table 3).³¹ Looking at size, Fintech firms were in general of small size, the median Fintech firm has SEK 23 million in total assets and 12 employees. However, size is heavily dependent on type of business activity and age of the company. Firms that are involved in offering trading service, or that have been active for longer, generally have larger balance sheet size and more employees. The median firm has SEK 14 million in equity which, compared to the median assets size, suggests firms are depending mostly on equity funding for growth. Most Fintech firms in our sample were not profitable, with the median Fintech firm having an operating loss of SEK 1 million, suggesting that these are mostly new Fintech firms, still in the development and market building phase.

Table 3. Sweden: Selected Statistics on Fintech Firms (2020 Values)¹

	<i>Mean</i>	<i>Median</i>	<i>25 percent</i>	<i>75 percent</i>
<i>Assets</i>	5800	23	4.4	233
<i>Equity</i>	414	14	2.2	39
<i>Employees</i>	109	12	4	30
<i>Liabilities</i>	5340	5.4	1.2	112
<i>Liabilities/Equity</i>	6.9	1.1	0.4	3.3
<i>Liabilities/Assets</i>	0.5	0.51	0.26	0.76
<i>Liabilities toward credit institutions</i>	68	0	0	0.5
<i>Operating profits/losses</i>	26	-1.0	-19.6	4.0

Source: Swedish Financial Supervision Authority (FI).

¹ Values are in SEK millions, but for Employees, Liabilities/Equity, Liabilities/Assets. Values are for the year 2020.

³¹ The fintech firms were selected from the members of the Swedish Fintech Association.

71. Interconnectedness with the banking sector seems limited. Overall exposure to credit institutions was small: in total, firms had around SEK 3.5 billion of liabilities toward credit institutions, about 70 percent of which by a large single company.³² About 75 percent of the sampled firms had zero or very limited liabilities toward banks (Table 3). In addition, the names of active Fintech firms found by Tillväxtanalys were checked against the large exposure reporting of banks, i.e., exposures that exceed 5 percent of CET1. Among the 450 Fintech firms, only one instance of reported significant exposure was found.

72. Leverage of Fintech firms is contained, with some exceptions. The median firm has a liabilities/equity ratio of about 1.1. (Table 4). However, 10 percent of firms having at least a ratio of liabilities/equity of 15. Preliminary analysis revealed that some of these cases are due to the particular business models of Fintech considered (e.g., mortgage providers, or brokerage services).³³ The distribution of the ratio of liabilities over assets is instead fairly uniform, with the median firms having a 0.51 ratio.

73. Concentration and interconnectedness risks from outsourced or third-party services were not in scope of the analysis. While the size and financial interconnectedness appear to be limited, the analysis did not encompass an evaluation of concentration and interconnectedness risks as a result from outsourcing and third-party services. This is relevant, as fintech business models tend to rely on outsourcing and third-party services (e.g., cloud services). These risks are, however, also applicable to incumbents, and therefore should be assessed more holistically for the financial sector as a whole.³⁴

D. Regulatory and Supervisory Approach to Fintech

74. As part of the European Union, the authorities participate in the development of European legislation and regulation. Except for regulations pertaining to the EU's banking union,³⁵ Sweden's legislative and regulatory prudential frameworks for the financial sector are largely based on EU directives (which need transposition) and regulations (directly applicable). Current important European Fintech-related proposals concern: a) the introduction of the Markets in Crypto-Assets Regulation (MiCA), which covers crypto-asset systems, which are not regulated by current EU regulations (e.g., by MiFID II and the Electronic Money Directive); and b) the Digital Operational Resilience Regulation (DORA), which puts in place comprehensive operational resilience requirements for financial service providers. These proposals were published as part of the European Digital Finance Package in November 2020, but have not yet been enacted. The MiCa initiative is

³² It was not possible to ascertain whether there was concentration risk, i.e., whether liabilities were toward only one or more credit institutions.

³³ Remaining cases were of smaller firms, which nonetheless did not seem to present significant mismatch in maturities, or of firms whose business model was uncertain.

³⁴ For risks related to outsourcing and third-party services in Sweden related to financial market infrastructure, please see the Technical Note Oversight Review of FMIs and Selected Issues.

³⁵ Sweden is not a part of the European banking union and its Single Supervisory Mechanism (however, Sweden is a member of the European Banking Authority).

relevant, as crypto assets are largely unregulated in Sweden (only aspects related to AML/CFT are covered).³⁶ In November 2021, Regulation (EU) 2020/1503, a harmonized regulatory framework for crowdfunding services entered into force across the EU. In addition to this regulation, Sweden adopted supplementary legislation setting out, inter alia, supervisory, and investigatory powers of FI.

75. FI has been granted a wide legal mandate and clear responsibilities to supervise financial institutions in Sweden, including Fintech. FI is an integrated authority responsible for the supervision, regulation, and licensing of financial markets and institutions in Sweden, and for measures to prevent financial imbalances, with the aim of stabilizing the credit market while considering the impact of such measures on economic development. The Financial Supervisory Authority Ordinance (2009:93) specifically requires FI to ensure that the financial system: is stable and characterized by well-functioning markets that meet the financial services needs of households and companies, provides a high level of consumer protection, and contributes to a sustainable development. FI is also responsible for Money Laundering (ML) and Terrorist Financing (TF) supervision for all the supervised financial institutions, including specialized nonbank lenders and all registered entities.

76. In response to innovation in the financial market, including the emergence of Fintech firms, digital assets, and other innovations, FI has established the Innovation Center. The Innovation Center is the first point of contact for companies seeking information or clarification on regulations, processes, and principles that apply to financial information. The Center, which is staffed by employees from all of FI's operational sectors, is expected to: (i) give guidance to companies trying to establish new products and services; (ii) collect information on developments in the market; and (iii) catalyze internal discussions within FI on Fintech, digital assets, and other innovations. The Center also arranges seminars and informational gatherings, and participates in external events on innovations in the financial sector.

77. FI's monitoring of related risks for both incumbents and Fintech firms is embedded in its day-to-day supervision. FI does not consider digitalization as a separate risk, but increased digitalization can lead to new types of traditional risks, changes in consumer behavior, and new legal issues. FI's strategy has therefore been to take digitalization into account in all areas of supervision, irrespective of whether it is IT, credit risk, or consumer protection.

³⁶ The 2022-I edition of Riksbank's Financial Stability Report contains an article on "Crypto-assets and their impact on financial stability," and concludes that the financial stability risks posed by crypto-assets and stablecoins (there are no material stablecoins that are linked to the krona) at the current point in time pose only limited risks, as (financial) firms and households have either no, or very limited, exposure to these kinds of assets.

Box 3. Virtual Asset Service Providers in Sweden and ML/TF Risk¹

Virtual asset services have been expanding in Sweden recently, but are still far less material than the traditional financial sector. The number of virtual asset service providers (VASPs) increased from 3 in 2018 to 9 in 2022. The services offered in 2018 were exchange between virtual assets (VA) and fiat currency, while in 2022 those have expanded to include transfer, safekeeping, or administration of VAs, as well as provision of financial services related to issuance of VAs. The scale of these activities has grown exponentially in terms of total balance sheet as well as the number of employees, but the sector (with a balance sheet of SEK 193 million or US\$19.3 million) remains insignificant compared to the banking sector. About half of the VASPs engage in cross-border transactions.

Sweden has identified ML/TF risks from VAs activities but needs to deepen its understanding of risks at the national level and by supervisors. Sweden has recognized the ML/TF risks at the national level as early as 2013 and been regulating VA exchangers for AML/CFT since, but the risk understanding does not contain sufficient detailed information for all the different types of VAs, VASPs, and their activities, as such activities were limited in nature at that time. FI also rates VASPs as “very significant” for ML/TF risk, but it is unclear how this is compared to the ML/TF risks of banks. Deepening the understanding of ML/TF risks at the sectoral level would help the FI calibrate its resource allocation at the sectoral level. The FI is also yet to develop an understanding of ML/TF risks of VASPs at the entity level, as all VASPs have been rated medium-risk since 2017. The collection of more information about VASP activities would be a good first step toward developing a risk assessment system to advance FI’s understanding of ML/TF risks of VASPs to enable AML/CFT supervision targeted at higher risk VASPs, including the cross-border aspects of their businesses.

FI has recently become more active in supervising VASPs, which needs to be sustained and improved by applying a proper risk-based approach at the sectorial and entity levels. There has been little supervision of VASPs since 2015, but supervisory activities resumed in 2021 with two out of nine VASPs inspected. The two VASPs, according to the authorities, represent 95 percent of the market² regarding exchange between fiat currency with crypto performed by registered VASPs, but it is unclear how much of total VA activity these encompassed. However, increased supervisory focus on VASPs has occurred through diverting resources away from supervision of banks. Given the significant ML/TF risks carried by banks, this approach might not be advisable. Instead, the FI could look to make AML/CFT supervision more efficient, so that more supervisory activity across all of the higher risk sectors can occur.

The recent efforts of FI to identify unregistered VASPs and stop their operations should be enhanced, including by collaborating with a broader range of agencies. The FI has identified a number of individuals who may be conducting unlicensed VASP activities through information obtained from the Swedish Tax Authority. Supervisory actions are ongoing to obtain more information about their activities. To take these efforts forward, the FI should continue to expand collaboration with other agencies, such as the FIU, to obtain more such information and facilitate sanctioning of the unauthorized operators.

The authorities should also monitor ML/TF risks stemming from non-VASP actors in the Fintech space closely and take effective measures to mitigate such risks as warranted. Some of these actors provide services directly to customers domestically and abroad (instead of via traditional financial institutions) but are not yet regulated for AML/CFT. The FI attributes the gap to some existing exemptions, or regulatory ambiguity, and is actively engaging in policy discussions on related issues.

¹ Written by Steve Dawe and Ke Chen (LEG).

² The percentage is calculated based on the reported turnover for all registered VASPs in Sweden.

78. The increased reliance on technology that Fintech has, in some instances, necessitated a change in approach and scope of FI's supervisory activities. For example, automated credit approval process has made it necessary for FI to change the scope of its supervisory activities (for incumbents as well as for Fintech firms), such as onsite credit risk inspections. This is because, amongst others, when standardized (analytical) models are used in the credit assessment process, there is normally no difference between credit files and, sometimes, there are no credit files but only data records. During consumer protection inspections to review approach to credit risk assessment when granting consumer credit, FI has looked more closely into the information used in the process and the construction of the models.

79. Recent supervisory activities on Fintech focused mostly on AML/CFT compliance, in addition to scoping the market for unlicensed activities. FI conducted both on- and offsite supervisory activities on several Fintech companies regarding AML/CFT compliance, which, in some cases, led to warnings and sanctions. These activities were focused on PSPs and VASPs (see Box 3). Apart from AML/CFT activities, FI has been conducting an evaluation of compliance with PSD2 provisions on several supervised firms, which included Fintech companies. Recently, FI coordinated with the Swedish Tax Authority to identify financial activities that are being provided without a license. Further scoping is done through the Innovation Center, with an event-based approach to supervision of these entities.

E. Recommendations

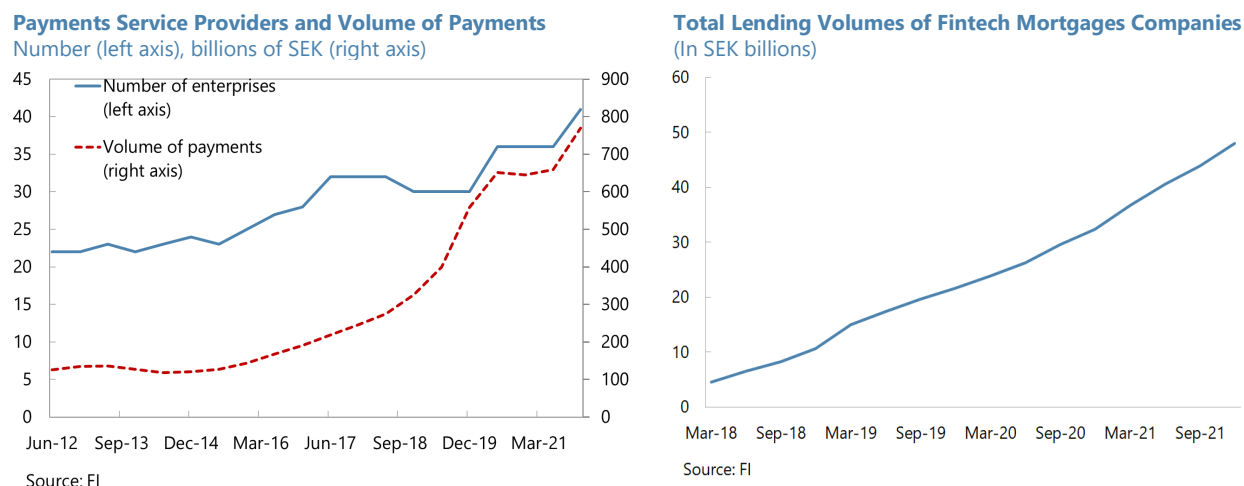
80. Systemic importance of the Fintech sector seems limited but it should be monitored closely, as it can grow fast, is a complex and highly visible sector, and requires attention from a consumer protection perspective. There are several reasons why Fintech should be monitored closely. Firms in some sectors (payments, credit provision) have been growing in the past years (Figure 3).³⁷ More in general, growth of Fintech firms and activities can be quite fast, including cross-border, hence continuous monitoring is necessary to fully understand their risks. Market reports indicate that between 2017 and 2021, Swedish Fintech firms received euro 4.4 billion in venture capital funding, apparently the third largest sector among Swedish technological start-ups.³⁸ In addition, as Fintech firms have many different business models and services provided, they are complex to analyze: time to learn about it might be short if a crisis arises. Moreover, the Fintech sector is highly visible despite its size, so that a supervisory failure will likely receive attention and could undermine the credibility of FI as an effective financial supervisor, and confidence in the

³⁷ The reported values for payments exclude Klarna, as it is licensed as a bank and is not required to report payment volumes.

³⁸ Klarna accounted for at least half of the funding. Removing funding to single dominant startups in other sectors as well does not change the result that fintech is still the third most funded sector in Sweden. The other two sectors are transportation, and energy or health, depending on excluding the dominant start-up. Fintech is also the sector with the second largest number of financing rounds between 2017 and 2021. Sweden is third among European countries in venture capital funding to start ups. Funding in Swedish startups in 2021 increased twofold compared to 2020. Sweden tech report, February 2022. <https://si.se/app/uploads/2022/02/dealroom-sweden-tech-report-feb-2022.pdf>

financial system. Finally, close monitoring is needed to ensure consumers are not exposed to fraud and unfair practices.

Figure 3. Sweden: Developments in Fintech Payments Service Providers and Mortgage Lenders



81. FI should review the adequacy of its points of contacts with Fintech firms also, in order to enhance its understanding of different Fintech business models and the involved risks.

Communication between FI and Fintech firms seems to be sparse, which may undermine FI's ability to identify risks. Some Fintech firms mentioned communication is not always effective; in particular, when the Fintech is seeking multiple licenses or is exploring a new product that is not explicitly covered by existing regulation. More communication with firms could help supervisors better understand the different business models and risks, and to provide more clarity on the appropriate regulatory and supervisory approach.

82. FI needs to enhance its data collection to allow for a comprehensive analysis of Fintech activities and firms.

While FI receives regulatory reporting from licensed institutions,³⁹ it does not collect comprehensive data on Fintech firms that would allow to assess the development of the sector more broadly, and to analyze whether new activities and business models are emerging that are not adequately covered by existing regulations, or may even be completely outside of the regulatory perimeter. Given that the development of the Fintech sector may also have systemic implications, FI should investigate to what extent there is room for cooperation on the data collection with Riksbanks' Statistics or Financial Stability departments.

³⁹ We note, however, that even information collected from licensed institutions might only provide a partial view on their activities. For example, instead of focusing on credit intermediation, fintech banks may view deposit taking and payments services as their core business. While statistics on payments are collected for payment service providers, these are not collected for fintech firms with a banking license.

83. The completeness of the regulatory perimeter should periodically be systematically evaluated. To illustrate the relevance of monitoring the perimeter, in its 2017 mapping of Fintech in Europe, the European Banking Authority, EBA, identified that about 30 percent of sampled Fintech firms were not subject to any regulatory regime under the EU or national law (the study did not provide figures for Sweden). Such firms were providing payments services, credit, deposit, and capital raising services, investment services, or a combination of all of them.⁴⁰ While FI has been undertaking some scoping of the market to identify firms that may be providing financial services without the required license, until now this has not been done systematically.

84. FI should evaluate the adequacy of its supervisory resources to monitor and analyze Fintech firms, business models, and relevant risks. There appears to be a scarcity of specialized staff to review and assess evolving Fintech business models and the risks these entail. FI has faced challenges attracting and retaining technical experts in the supervision of credit risk models and cybersecurity experts, who would be key to ensuring effective supervision of Fintech firms and activities. This lack of expertise and staff is not specific to supervision of Fintech firms and activities. Also, in the Detailed Assessment Report of the Basel Core Principles, it was noted that FI has limited experts to support supervision of specialized business lines. For Fintech firms that work across different financial subsectors (covered by different departments), FI should ensure that there is effective cooperation, communication, and a holistic view on the risks of the supervised entity.

⁴⁰ EBA, [Discussion paper on EBA's approach to financial technology](#), 2017.

Annex I. Riksbank Technical Experimentation

1. The Riksbank has launched the e-krona pilot, exploring technical solutions for the e-krona, as well as deepening legal understanding of the proposed technical solutions. In 2020, the Riksbank started a more practical phase of the e-krona project, launching the e-krona pilot with the technical support of Accenture. The pilot has so far undergone two phases, and a third phase is under way.

2. During phase 1 of the pilot, a technical platform for e-krona was developed. The platform relied on the blockchain technology and featured a token-based e-krona. This allowed building knowledge on how the technology would operate if it were to be used for e-krona issuance and distribution, under the assumption that the e-krona would be distributed through intermediaries, similarly to the distribution of cash. At the same time, an analysis on the legal underpinnings of the tested solution was performed.

3. In phase 2 the technical platform was further developed. The pilot saw the involvement of the private sector, with Handelsbanken and Tietoevry in the role of bank and supplier of financial IT system. The pilot tested integration of the e-krona network with the participants' internal customer, account and payment systems, the integration with Point-of-Sale terminals, as well as testing the developments of wallets for users, and offline transaction capabilities. Performance tests of the network were also realized. On the legal side, the analysis focused on applicability of laws on financial confidentiality and personal data protection for the blockchain technology, and on what legal properties should e-krona have.

4. The Riksbank will continue testing technical solutions and legal requirements during 2022. Phase 3 of the pilot will focus on programmability options to deliver innovation in payments, testing, and also whether the private sector can be involved in delivering innovations on top of the e-krona platform provided by the Riksbank, without prejudice for the safety of the e-krona. Phase 3 will also analyze how to cooperate with the private sector, discussing roles and responsibilities of Riksbank and involved private parties in the delivery of the e-krona. From the legal standpoint, Phase 3 will, for example, look further at settlement issues linked to the e-krona, as well as preliminary considerations on the legal categorization of the e-krona system. At the same time of phase 3 of the pilot, the Riksbank issued a "Request for Information" in April to gather proposals for technical solutions for the e-krona from market participants. Customized tests of proposed solutions will be done throughout the year.

Annex I. Box 1. Lessons from Phases 1 and 2 of the E-Krona Pilot

Phase 1 and 2 of the pilots offered several lessons, as well as presented new challenges. These are briefly summarized here:

- Caps and interest rates on the e-krona are technically possible with the blockchain technology; however, negative interest rates are incompatible with local storage of e-krona with exclusive control at the end user.
- The e-krona network can operate in parallel with existing account and payment infrastructures, enabling interoperability between the two. This will make the payments system more robust.
- Centralized alias services raise the issue of who is responsible for developing and managing the data. This could fall onto the Riksbank as owner of the e-krona network.
- Offline payments are feasible with the blockchain technology; however, they carry risks of fraud and integrity. A regulatory framework needs to be established to limit and manage these risks.
- Integration with payments terminal is possible, and this allows the Riksbank to leverage on existing regulations, procedures, and administration. However, the concept of what is a payment terminal is evolving, and regulatory frameworks and collaboration with retail trade operators are required to establish the e-krona as a means of payments.
- Performance issues arise once tokens multiply, and transaction chains increase. Some solutions are technically possible but will need to be tested.
- The e-krona in the pilot would be considered to belong to the same asset class as cash. Thus, it cannot be interest bearing.