



SWEDEN

SELECTED ISSUES

March 2021

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THE PROS AND CONS OF CENTRAL BANK DIGITAL CURRENCY: INSIGHTS FROM THE RIKSBANK'S E-KRONA PROJECT

The Riksbank's e-krona project is more advanced than similar projects of most other central banks in developed economies. The e-krona could entail substantial benefits to Sweden, including further increasing the efficiency of the payments system while safeguarding against substitution of the Swedish krona by global stablecoins, enhancing crisis preparedness, and ensuring inclusiveness of digital payments. The e-krona pilot project—a proof of concept—will help the Riksbank to propose a design of the e-krona that will allow reaping the benefits while mitigating the risks, including those related to financial stability, the effectiveness of monetary policy, and the Riksbank's reputation.

A. Context

- 1. Cash usage in Sweden has fallen dramatically over the last decade.** The cash-to-GDP ratio is currently at around 1.3 percent of GDP, down from 3 percent of GDP in 2010. This decline has been faster than in most other advanced economies. Recent Riksbank surveys find that almost 75 percent of respondents withdraw cash less often than once a month, if at all, and that the share of people that use cash for purchases continues to decline rapidly.
- 2. A combination of factors contributed to the fall in cash usage.** These include the introduction and usage of Swish (a popular mobile payment system), refusal of some businesses to accept cash, incentives for the private sector to phase out cash usage partly due to the withdrawal of central bank subsidies of cash distribution (although there are plans to roll this back), a changeover of banknotes, and high levels of digitalization in society and the banking sector.¹
- 3. The rapid decline of the use of cash threatens its usefulness as a payment instrument.** Survey-based estimates show that two-thirds of Swedish retailers would no longer accept cash by 2030. The decline in cash usage mirrors the proliferation of digital means of payments, which are all operated by private providers, of which some are foreign.
- 4. The Riksbank is at the forefront of exploring central bank digital currency (CBDC) among advanced economies.** It embarked on the e-krona project in 2017. Since then, it has issued several reports and research papers to study the economic implications.² In addition, the government has launched an [inquiry](#) examining the role of the state in the payments market, including the need for an e-krona. If, depending on the government inquiry, issuance of the e-krona is decided, it would likely occur in a few years after all preconditions for its issuance and success are

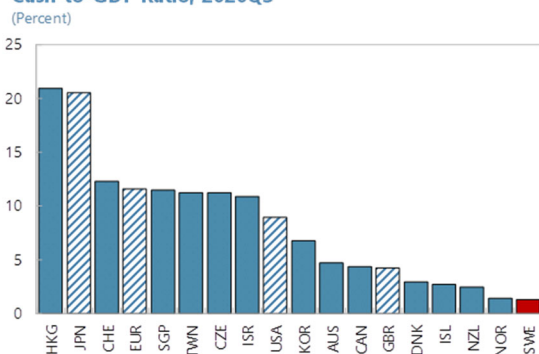
¹ Armelius et al. (2020c) discuss these and other reasons in greater detail, and Engert et al. (2019) discuss trends and drivers of cash in circulation in Sweden.

² The Riksbank produced two reports: [E-krona project, report 1](#) and [E-krona project, report 2](#) and also issued a special edition of its journal *Economic Review* devoted to the e-krona: [Economic Review 3, 2018](#) and [Economic Review 2, 2020](#). There is also a more detailed description of the pilot project.

in place. Other central banks are also embarking on CDBC projects. The ECB has recently completed a public consultation on the concept and potential introduction of a 'digital euro.' The People's Bank of China has run localized experiments of an e-Yuan, and the US Federal Reserve has recently expressed interest in exploring a digital currency. The Central Bank of the Bahamas is already in the process of rolling out its CBDC, referred to as the 'Sand Dollar.'³

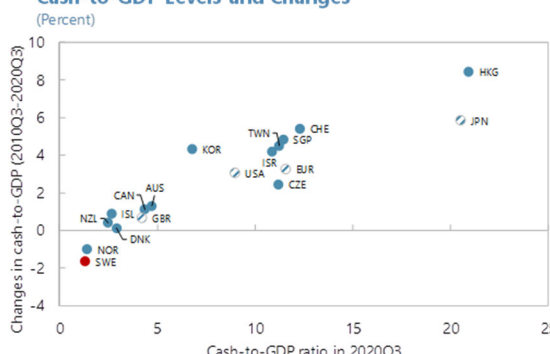
Figure 1. Cash in Circulation and Mobile Payment Usage

Cash-to-GDP Ratio, 2020Q3



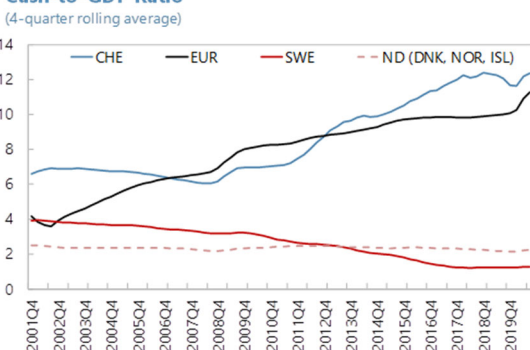
Sources: Haver and Central Banks.
Notes: Currencies used for JPN, EUR, USA and GBR are reserve currencies.

Cash-to-GDP Levels and Changes



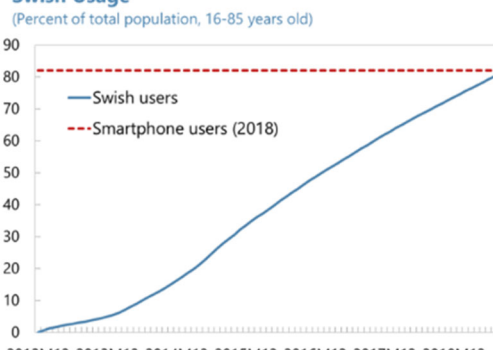
Sources: Haver and Central Banks.
Notes: Currencies used for JPN, EUR, USA and GBR are reserve currencies.

Cash-to-GDP Ratio



Sources: Haver and Central Banks.
Notes: Currencies used for EUR are reserve currencies.

Swish Usage



Sources: GetSwish, Statistics Sweden, IMF Staff calculation

Selected Jurisdictions where Central Banks are in the Advanced Stages of Retail CBDC Exploration (as of February 2021)

Bahamas (fully launched)	Sweden (proof of concept started)
China (pilot launched)	Ukraine (proof of concept done)
Eastern Caribbean (2021:Q1 pilot launch)	Uruguay (pilot completed)

Source: <https://kiffmeister.blogspot.com/2019/12/countries-where-retail-cbdc-is-being.html>

³ See [Bahamas 2022 IMF Article IV report](#).

B. Main Benefits

5. There are at least five main factors that the Riksbank identifies as motivations for considering issuing e-krona.

- **Promotion of competition and innovation in payments markets:** Payments markets are subject to network externalities, making them prone to monopolistic behavior. The e-krona, which could potentially be an attractive means of payment, could help ensure competition and continued innovation in the payments market.
- **Safeguarding against substitution of the krona by global stablecoins:** The proliferation of global stablecoins or cryptocurrencies in Sweden could undermine monetary sovereignty, financial stability, and the integrity of the financial system. Given the openness and level of digitalization of the Swedish economy, there could be the concern that the Swedish krona could be particularly vulnerable to stablecoins (Armelius et al., 2020c). An e-krona could discourage the use of such digital currencies.⁴
- **Creating an inclusive payments system:** Some small segments of the population are unable to use digital payment systems because of age or disability, and private payment providers may have no incentives to remedy that (Armelius et al., 2020c). There could also be denial of access by payment system operators in the future, effectively excluding some groups from being able to make payments efficiently. The e-krona could come in variations that cater to the needs of those that find it difficult to use the privately provided digital payments services.
- **Crisis preparedness and resilience:** An e-krona could help the Riksbank fulfill its mandate to promote a safe and efficient payment mechanism, in particular by safeguarding the continuity of the payments system in case cash usage is no longer an option and privately owned payment systems are disrupted.
- **Continued access to central bank money by the general public.** The e-krona would be a means for the Riksbank to offer universal access to digital state money as a complement to private digital money. The e-krona would be state money akin to cash and available to the general public.⁵

6. The above potential benefits must be evaluated in a forward looking way. Presently, the benefits of the e-krona may be limited although they could substantially increase in the future. The Riksbank (2018) notes that "Sweden is in the vanguard of technical developments on the payment market," with wide adoption of digital ID and mobile payment systems, suggesting that the present structure of the payments market does not currently stifle innovation. So far, disruptions in

⁴ See IMF (2020) for a detailed discussion on the effects of global stablecoins.

⁵ See <https://www.riksbank.se/globalassets/media/rapporter/ekonomiska-kommentarer/engelska/2020/future-money-and-payments.pdf>.

the Swedish payments system have been limited, and with cash still existing and being used, financial inclusion and trust in the monetary system have not been undermined. In view of this, the e-krona could be seen mostly as an insurance mechanism that becomes increasingly important as cash usage falls further, reliance on private and foreign payment operators increases, and proliferation of global stablecoins advances.

7. There could also be other, less direct benefits. First, the fact that Sweden could be among the first European and advanced economies to issue a CBDC could entail first-mover advantages. Using a two-country DSGE model, Minesso Ferrari et al. (2020) find that monetary policy autonomy is reduced in the country that does not have a CBDC and that the latter would have to react more strongly to spillovers from the country that has a CBDC. The e-krona could also promote digitalization and innovation in other areas. For instance, digital currency could facilitate the distribution of fiscal stimulus in future crises through the potential feasibility of direct government-to-peer (G2P) payments to households (Kiff et al., 2020).

8. The technical and economic design of e-krona will determine to what extent benefits of the e-krona materialize. It is unclear if the mere existence of the e-krona, rather than its widespread usage, will promote competition in the payments market and improve crisis preparedness. The Riksbank is still evaluating which business models would make the e-krona sufficiently convenient and competitive with private alternatives.

9. Further work should explore other policy options that could provide at least some of the potential benefits of the e-krona. In principle, some of the benefits of the e-krona can be achieved through a combination of reducing the cost of cash usage, introducing a de facto requirement to accept cash, and regulation of private means of payments and digital currencies (such as standards for business continuity and regulation of fees). Based on the proposed Riksbank Act, the Riksbank's responsibilities for the distribution of cash will increase. If cost reductions are passed through, this could make cash usage and handling cheaper for the private sector, which in turn could slow the decline of cash usage. However, given the extent of marginalization of cash in Sweden, reversing the decline in cash usage with such measures could be difficult.

10. The motivations to implement CBDC differ across countries to some degree. The benefits of the digital Euro as described by the ECB are broadly similar to the Riksbank's motivations. By contrast, the motivations of the Central Bank of the Bahamas differ slightly: The Bahamas' Sand Dollar aims to boost financial inclusion among the unbanked and underbanked. In addition, the objective of the Sand Dollar is to enhance the payment system's efficiency and resilience especially in the aftermath of natural disasters when access to, and use of, cash become difficult and costly.

C. Main Risks

11. The e-krona could pose risks for financial stability in broadly two interrelated ways. First, the e-krona could lead to bank disintermediation over time as bank deposits could be increasingly converted to e-krona, potentially resulting in a fall in the supply of credit, as the banks'

funding base shrinks or funding becomes more expensive. Second, the e-krona could enable and exacerbate ‘digital’ bank runs in times of banking crises whereby bank deposits are quickly converted into the safer option of e-krona.

12. The e-krona could lead to a steady decline in bank deposits over time, thereby resulting in bank disintermediation. Over time, and as usage of e-krona increases, deposits could increasingly be converted into e-krona, resulting in the shrinkage of the banks’ funding base. In turn, this could force banks to further rely on wholesale funding (which increases the cost and volatility of their funding) or to increase the remuneration of retail deposits to make them more attractive. This could undermine banks’ ability to provide credit as well as their profitability. A high demand for CBDC could also increase the central bank’s liabilities, thereby forcing it to acquire more (interest-bearing) assets such as government or private sector bonds. This could raise governance issues, as more credit would be intermediated through the central bank instead of the private sector (Assenmacher et al., 2018).

13. The e-krona could also facilitate bank runs in times of crisis. In the event of a bank run, bank deposits could be withdrawn in several ways, including through transferring funds to accounts at other domestic or foreign banks⁶ and saving accounts at the National Debt Office,⁷ or through converting them into cash or safe assets including government bonds. Converting deposits into e-krona in times of crisis could be easier and faster, and thus could increase the likelihood, speed, and severity of a run.

14. However, financial vulnerabilities from the possibility of bank runs are generally assessed to be small, at least under present conditions. Willett and Wihlborg (2013) suggest that bank runs have become rare as deposit insurance has become more widespread. In general, they see the drying up of access to short-term funding as a greater risk than bank runs. This could apply to Sweden’s banks which heavily rely on wholesale funding. While they concede that there has been at least one occurrence of a bank run in the early stages of the global financial crisis in advanced Europe, they attribute this event to imperfections of the deposit insurance scheme in place in that particular case. In Sweden, the deposit insurance scheme and the Riksbank’s role as lender of last resort are both well established. Even in 2008, which Laeven and Fabian Valencia (2018) classify as a systematic banking crisis in Sweden, there was no widespread transfer of bank deposits into accounts at the National Debt Office as the safest electronic assets available to the general public (Juks, 2018). While accounts at the National Debt Office are not perfectly comparable (they are savings accounts, and daily transfer amounts are capped), this could still imply a limited likelihood for conversion of deposits into e-krona in times of distress.

15. The e-krona could impact the effectiveness of monetary policy. Monetary policy is typically thought to be subject to a lower effective bound, given the option to hold cash. However, there are risks and costs of holding cash (Armeliu et al., 2018). If the e-krona is not remunerated

⁶ If the crisis does not affect the entire banking sector, bank runs could also occur digitally by shifting deposits from affected to non-affected banks.

⁷ To pre-pay their tax obligations, Swedes can open an account with the National Debt Office.

(i.e., non-interest-bearing) and not subject to any caps (see below), it could establish or raise the effective lower bound, if the risks and costs to hold e-krona are low compared to cash. By contrast, compared to bank deposits, e-krona can more readily be subject to negative interest rates. This, of course, is not an option for the physical krona.

16. The economic and technical design could therefore help avoid that the e-krona undermines financial stability or lowers monetary policy effectiveness. In particular, remuneration and caps on holdings could be considered to help prevent bank disintermediation and bank runs into e-krona, and on the other hand establish or raise the effective lower bound (see below). The technical architecture of the e-krona could also be such that to use e-krona, one would need to maintain a bank account (or an account at similar institutions). The need to keep bank accounts could in turn help safeguard bank deposits. In addition, some economists suggest that the effects of a decline in bank deposits over time as a result of CBDC could be mitigated by central banks. In principle, central banks could enlarge the set of eligible collateral (Juks, 2020). Brunnermeier and Niepelt (2019) suggest that under some conditions, central bank funding could completely offset the decline in bank deposits under a CBDC, thereby only changing the composition rather than the level of bank deposits.

17. There are also other risks that could be addressed through appropriate design choices. For example, the e-krona could undermine Riksbank's strong reputation if the technical design does not include sufficient safeguards against cyberattacks or digital robberies. Anti-money laundering and combating the financing of terrorism (AML/CFT)-related risks could arise if anonymous transactions are feasible. Finally, there could be large movements in capital flows if there are swings in the external demand for CBDC (which could be considered as safe assets) and if the CBDC further reduces transaction costs and frictions in international capital markets (IMF, 2020).

D. Design Issues

18. The Riksbank has committed to three broad and important principles that will guide the design of the e-krona (BIS, 2020). These include that the e-krona will (i) not compromise monetary or financial stability; (ii) need to coexist with and complement existing forms of money (i.e., exchangeable one for one for cash or bank money); and (iii) promote innovation and efficiency. While the exact architecture of the e-krona has not been finalized, these principles will help determine its technical, legal, and economic aspects of its design.

19. The Riksbank is currently testing an e-krona conceptual architecture based on decentralized ledger technology. The network in the e-krona pilot is private (i.e., permissioned) and fully controlled by the Riksbank. E-krona is issued by the Riksbank to banks or similar institutions which are referred to as 'participants' and which distribute e-krona to the end-users. There is therefore no direct contractual relationship between the end-user and the Riksbank. The participants need to verify the identity of the end-users, helping to mitigate anti-money laundering (AML)-related risks for the Riksbank. The e-krona pilot will enable the Riksbank to evaluate how and to what extent key technical features that are necessary for an efficient CBDC as proposed by BIS (2020) and supported by Riksbank can be simultaneously implemented. These include:

(i) convenience; (ii) security and resilience; (iii) ability to quickly process a large number of transactions; (iv) interoperability with other means of payments; and (v) flexibility and adaptability.

20. Legal aspects are also being addressed by the Riksbank and the government inquiry.

First, in order to achieve trust, it is important to have legal certainty on all aspects of issuance and use of the e-krona. As a starting point, this will require strong legal foundations that authorize the Riksbank to issue CBDC. Another important aspect that should be tackled by the authorities is whether e-krona will be considered as currency under the law and whether to give it legal tender status, which would necessitate further adjustments to the legal framework (Bossu et al, 2020). Finally, entities offering transfer, storage, or custody of e-krona should be held to equivalent regulatory and prudential standards as firms offering similar services for cash or existing digital money (BIS, 2020).

21. The Riksbank has concluded that the e-krona cannot have a “similar degree of anonymity” as cash.

This is because CBDC payments are to some extent traceable and recorded in a remote ledger (Armelius, 2021). The Riksbank has further observed that applicable AML/CFT regulations require the identification of persons making (cumulative) electronic payments above €150 in value. The Financial Action Task Force (FATF), the internationally-recognized standard-setter for AML/CFT, applies the same requirements to CBDC as to fiat currency in its traditional form. Financial institutions, designated non-financial businesses and professions, and virtual asset service providers will therefore need to apply to their handling of CBDC the same controls that apply to other electronic payments or to cash transactions so as to mitigate the attendant risks (FATF 2020).

22. Important areas of the economic design of the e-krona continue to be evaluated by the Riksbank:

- **Remuneration and caps on holdings** are central design features for monetary policy and financial stability. A non-interest-bearing e-krona that is not subject to caps on holding could likely further constrain monetary policy by establishing or raising a lower effective bound (Armelius, et al. 2018) and increase the financial stability risks. By contrast, an interest-bearing e-krona could ease the lower bound constraint on monetary policy, especially if it results in a further decline of cash (Assenmacher et al., 2018). Caps on individual holdings and/or an interest rate on e-krona set below the rate on deposits paid by banks could limit any substitution of bank deposits by e-krona. However, a variable spread between the key policy rate and the e-krona (as contemplated by Armelius et al., 2020b), tiering interest rates by volume or caps on holdings would all create additional complexity (BIS, 2020). In the case of the Bahamas, CBDC is subject to different caps on monthly transactions that depend on the degree of identity verification and know-your-customer requirements imposed.
- **Accessibility and usability for cross-border transactions** would determine whether nonresidents will transact in it in case they are legally allowed access. CBDC could lower the cost for cross-border transactions and its use by non-residents could increase seignorage revenue. However, swings in the external demand for the CBDC could drive large movements in capital

flows (IMF, 2020), and holdings of CBDC by non-residents would complicate the implementation of know-your-customer principles.

- **Cost of issuance and usage.** Issuing e-krona entails upfront capital and recurring costs for the Riksbank, and retailers may also have to invest in new infrastructure. Subsidies from the Riksbank would prevent that end-users have to bear these costs, either directly or indirectly, incentivizing usage (Armeliu et al., 2020b). However, depending on the e-krona usage and the Riksbank's balance sheet expansion, seigniorage revenue could help offset the cost. The size of the costs—and of any subsidies—remains uncertain.

Key Benefits	Key Risks	Key Remaining Design Issues
Promotion of innovation in payments markets	Bank disintermediation	Remuneration
Safeguarding against substitution of the krona by global stablecoins	Digital bank runs	Caps on holding
Promotion of an inclusive payments system and universal access to digital public money	Undermining effectiveness of monetary policy	Usability for cross-border transactions
Crisis preparedness and resilience	Other risks (reputational-, cybersecurity-, AML-related, and capital-account-related)	Cost of usage

E. Conclusions

23. An eventual launch of the e-krona could provide substantial benefits to the Swedish economy. However, some of these benefits may only materialize over the medium to long run. In part, they could be seen as an insurance against unwanted side effects of further digitalization of the payments market and help mitigate the effects of any disruption, monopolies, substitution of the krona by global stablecoins, and exclusion of some individuals from payments markets. The e-krona could also yield other indirect effects, such as innovation in the public and private sectors and greater efficiency through digitalization. An optimal design of the e-krona could also increase the effectiveness of monetary policy.

24. However, the e-krona could entail some risks, including leading to bank disintermediation. It is essential to design the e-krona in a way that mitigate risks related to financial stability and monetary policy effectiveness. This would entail calibrating remuneration and caps on holdings in a way that strikes a balance between addressing these risks while not rendering the e-krona unattractive and discouraging its use. In addition, the Riksbank should retain flexibility in setting the parameters underlying the e-krona's economic design to counteract any observed loss in deposits quickly. The Riksbank could also assess the feasibility and desirability of increasing its existing toolkit to safeguard the lending capacity of banks which could be undermined in the future

irrespective of the e-krona project. Other risks relate to AML/CFT, cybersecurity, the Riksbanks' reputation and swings in capital flows.

25. There needs to be a clear strategy about how to promote the acceptance and adoption of e-krona, especially in the presence of high adoption costs. The mere issuance and existence of e-krona may not be enough for these benefits to materialize. The payments market is subject to network externalities, making it difficult for new entrants to be widely used and accepted. The drivers and patterns of the rapid spread of Sweden's mobile payment system Swish, as documented in Beaumont et al. (2019), could provide important guidance for making e-krona attractive as a payment instrument.

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