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Lessons learned from the world's first CBDC

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Lessons learned from the world's first CBDC

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Abstract

Central banks worldwide are currently exploring so called Central Bank Digital Currencies (CBDC). The Avant smart card system created by the Bank of Finland in the 1990's can be considered the world's first CBDC and the only one so far that has gone into production. Avant cards were based on smart card technology similar to that used in debit and credit cards today. Even though the system was initiated, developed, and for the first few years operated by the central bank, it was eventually spun off and sold to commercial banks. Once debit cards became less expensive and were upgraded to use smart card technology, Avant became obsolete and was shut down. The story of Avant can give us valuable insight contributing to the ongoing discussion regarding CBDC.

[1] *This paper would not have been possible without the help from Antti Heinonen, who was one of the key people in the Avant project and a board member in Toimiraha Ltd, the business entity that issued Avant e-money. I am also grateful for support and feedback from Päivi Heikkinen, Esa Jokivuolle, Karlo Kauko, Jonna Ijäs, and comments from many other colleagues.*

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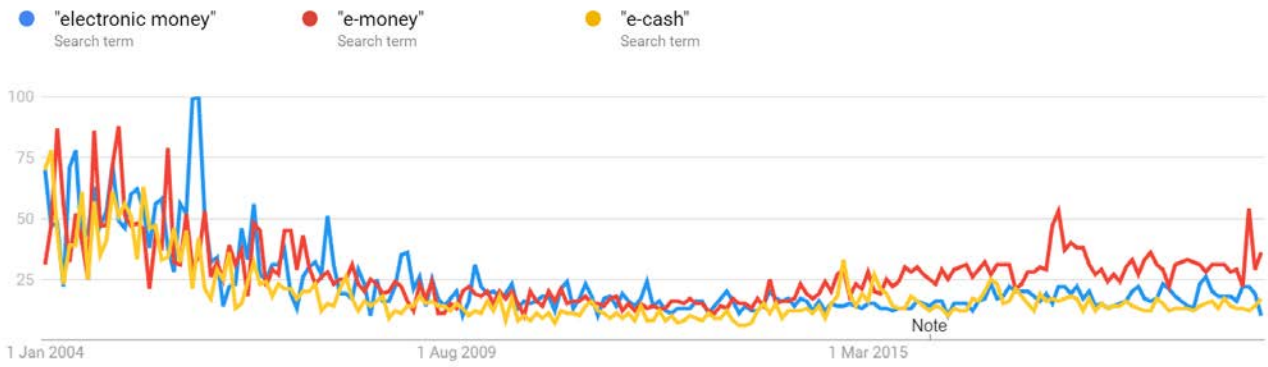
Editors: Juha Kilponen, Esa Jokivuolle, Karlo Kauko, Paavo Miettinen, Juuso Vanhala

Introduction

Central banks worldwide are currently engaged in discussions regarding Central Bank Digital Currencies (CBDC). To our knowledge, that specific wording was coined by Bank of England research staff in 2015, and ever since then the concept has been treated as a novel idea, with inspiration taken from cryptocurrencies, and motivation from the impending decline in the usage of cash. The literature on the topic has proliferated, with most publications focusing on theoretical models and semantic analyses of how the concept should be understood (see e.g. Adrian & Mancini-Griffoli 2019, BIS 2018, Bjerg 2017, Grym et al. 2017, Engert & Fung 2017, Ali et al. 2014).

What is now widely referred to as CBDC is closely related to electronic money, or e-money for short, and has been thoroughly analysed a quarter of a century ago. More than ten years ago, there had already been several historical accounts of the emergence of e-money as it had happened during the 1990's (see e.g. Arnone & Bandiera 2004, and Ramasastry 2008). One can also see from Google Trends that the search terms "electronic money" and "e-money" peaked in the early 2000's, then steadily declined, until they started to gain modest traction again from about 2015 onwards (see Figure 1).

Figure 1. Web searches for "electronic money", "e-money" and "e-cash"



Source: Google Trends.

The specific question of whether central banks should issue e-money, instead of leaving it to commercial issuers, received relatively little attention in the 1990's. Throughout the early literature, there seemed to be an underlying assumption that e-money will be issued and operated by non-banks. Even when the issuer might be a bank, it was usually assumed to be a commercial bank, not a central bank. The idea of a central bank issuing e-money has been explicitly raised, among others, by the BIS (1996), as well as Bank of Canada staff members Fung et al. (2014), and advocated by such authors as Konvisser (1997). Some, while touching on the topic, such as Arnone & Bandiera (2004), appear to consider it an uninteresting question. Fung

et al. (2014) have concluded that there is “no compelling case” for a central bank to issue e-money. Gormez & Capie (2000) conducted a survey asking industry professionals whether they saw a case for central bank e-money. The majority of their respondents considered central bank involvement in the issuance of e-money possible, but not necessarily desirable. The primary argument against central bank issuance was that central banks should not compete with commercial services providers.

Apart from research, there have also been some practical experiments. One in particular ticks many of the boxes we associate with CBDC today so that it can be confidently called the world’s first CBDC.[1] That project was called Avant and was set up by the Bank of Finland in the early 1990’s. Part 2 of this paper details the story of the Avant system. Part 3 highlights some key lessons from the case, and Part 4 reflects on the differences and similarities between CBDC and e-money. Where public sources regarding Avant are available, they are referenced in the paper. Some details about the Avant system and the key events regarding the case are based on non-public sources and are therefore not referenced.

The central bank issued Avant smart card

Background

The first experiment of pre-funded payment smart cards in Finland took place in 1987 as a collaboration between commercial banks and Helsinki University of Technology. Electronic money as a concept was already known and widely discussed at the time, but it was often seen as part of the development of smart cards. Payments was just one of many of the applications envisioned for smart cards (Malkamäki & Tanila 1990).

Shortly after the experiment, the Bank of Finland took interest in the payments use case of smart cards and hired a key expert to lead a new smart card unit within its banknote subsidiary. In 1990, the Bank of Finland organised a seminar and a number of stakeholder meetings to coordinate the discussion and to seek broad support for its initiative. The events also served as a way to collect feedback, to agree on tasks between different authorities, and to adjust the plan on how to move forward. During 1991, further discussions ensued with commercial banks as well as large retail groups to estimate the potential demand and size of the market for smart payment cards. The sentiment of the banking sector was mixed. Some banks were favourable to the idea, because they saw it as a way to reduce the cost of handling cash. Others were sceptical, because they saw it as a potential competitor.

[1] *BIS (2000) lists all e-money implementations known up to that date, and no other central bank led project appears on the list. Moreover, Todd & Rogers (2020) provide a timeline of all CBDC projects worldwide and identify Avant as the first.*

Around the same time, other public institutions had also shown interest in smart cards as a payment instrument. The Ministry of Transport had set up a task force as early as 1989 to explore new payment technologies in the context of public transport. The first sketches of a contactless payment cards came out as a result. A number of other government and municipal agencies also had ideas about using smart card technology in parking, phone booths, and other small-value payment situations. To avoid unnecessary fragmentation, and to ensure a sufficient level of security and oversight, the Bank of Finland decided to take a leading role in the development of smart cards for retail payments.

The design of a universal payment card

The plan for central-bank issued electronic money was presented to the board of the Bank of Finland in 1991. In addition to a technical schematic and legal evaluation, the plan also included estimates of the future usage of cash, the costs of handling cash, the expected uptake of electronic money, and the impact of central-bank issued electronic money on seigniorage income. Earlier internal memoranda furthermore analysed the impact of central-bank issued electronic money on monetary policy transmission and financial stability.

According to the plan, the new payment instrument should resemble cash as much as possible. Paying with it should be easy, anonymous, and the payment instrument should be widely accepted. On the other hand, operating costs should be as low as possible.

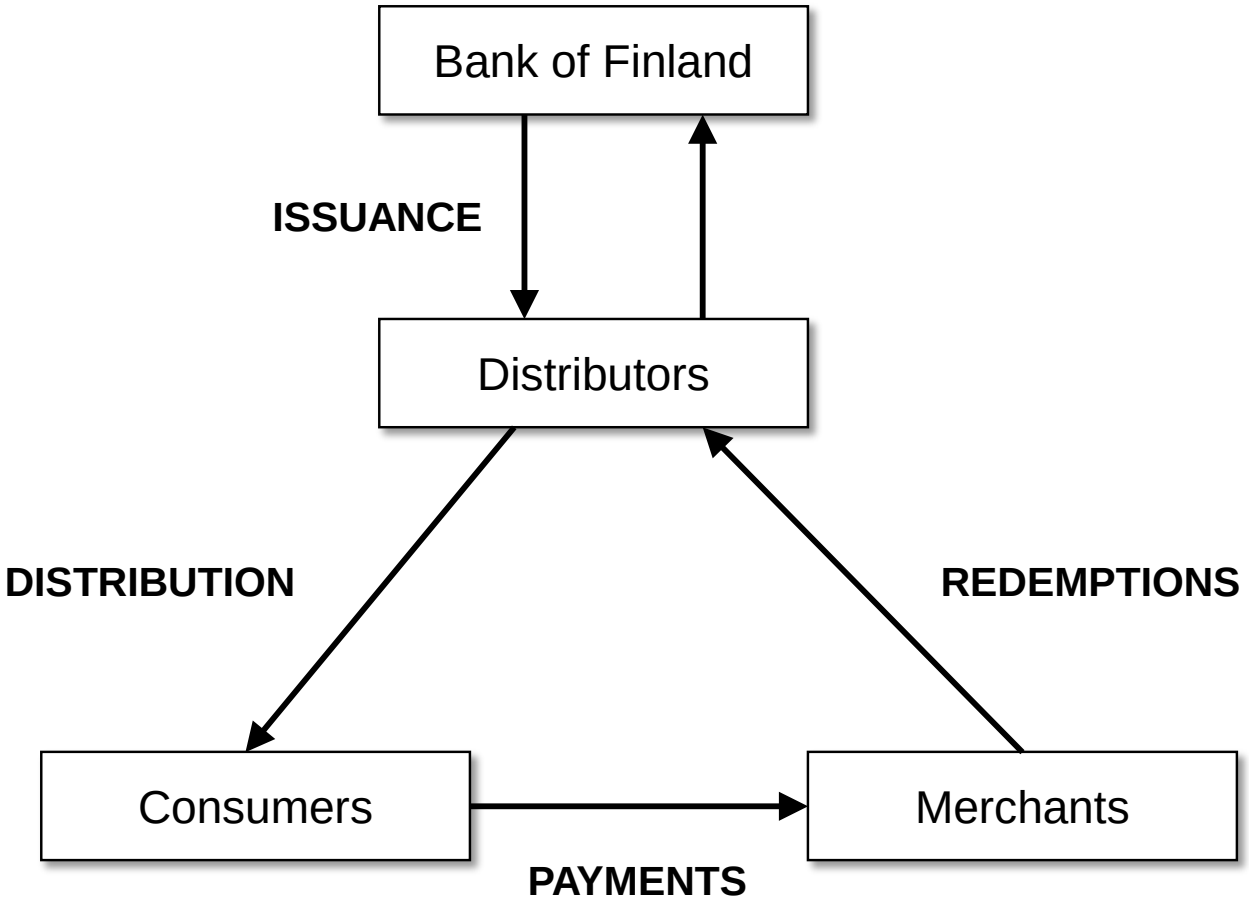
The payment card would have monetary value stored onto the card itself. The card issuer would keep account of the aggregate amount of outstanding balances, but the issuer would not try to track who held cards and how much money remained stored on each card. The monetary value on the card could be spent by using it on a merchant's payment terminal. When paying with the card, the balance on the card would be decreased and the balance on the terminal would be increased. At regular intervals, the merchant would redeem the accrued balance from the card issuer by having the equivalent amount transferred to the merchant's bank account. The system would not collect data about individual transactions, but instead only adjust balances after each transaction. The issuance cycle of Avant, depicted in Figure 2, was similar to the cash issuance cycle.

As general principles, the following design objectives were set for the electronic money system:

- General acceptance (the payment instrument will be accepted in a large number of merchant locations and can be used for payments in many different situations)
- Anonymity (card users will not be identified when making payments; no transaction data will be recorded; only card balances will be maintained)

- Efficiency (the main justification for building the new payment system is cost savings; the system shall function efficiently and should be easy to use)
- Safety (funds will be absolutely secure and backed by the central bank)

Figure 2. The issuance cycle of Avant



Decision to launch

The recommendation to the board was to proceed with issuing electronic money in the form of a smart card. The benefits from system-wide cost savings were seen as outweighing potential risks. What is more, the electronic money system was seen as an enhancement to the payment landscape, adding to its resilience. The rationale for the central bank to take the leadership in the project was to avoid a situation where multiple incompatible systems would be competing in a fragmented market.

Since the concept of electronic money was new, and there was no precedent or relevant legislation to refer to anywhere in the world, electronic money issuance was presented as a

parallel to cash issuance, and therefore as falling within the mandate of the central bank. However, electronic money would not be considered legal tender. This meant that while issuing electronic money was legally possible for the central bank, it was not considered its exclusive right, nor a necessary part of its mandate.

Issuance of the e-money card was to take place in three phases. In the first phase, only non-reloadable cards would be issued. In the second phase, due to begin in 1994, reloadable cards would be added. In the final phase, it was expected that reloadable Avant cards would replace up to 50% of coins and banknotes of small denominations, thereby becoming a dominant payment method for small-value transactions. There was no explicit timeline set for the final phase, but broad adoption of the new payment instrument was assumed to take several years.

Apart from acting as an overseer, the central bank was not necessarily assumed to have a major role in the e-money system in the long term. From the outset, the idea was to work in close collaboration with commercial banks, retail merchants, transport operators, telecom companies, government agencies, payment service providers, technology developers, and any other potential stakeholders, and to continuously evaluate to what degree it was necessary for the central bank to have an operational role in the system. The reason for its proactive approach in the very beginning was to avoid fragmentation of the market and the emergence of several competing systems, as this could lead to over-investment and a lack of standards. The central bank would spearhead the implementation of the payment system by focusing on a handful obvious use cases, such as pay phones and parking meters, but step back as and when other developers expanded the system to more use cases.

Among the preparatory work, the Bank of Finland had liaised with other central banks and concluded that it was the only central bank at the time planning to issue electronic money.

Launch and roll-out

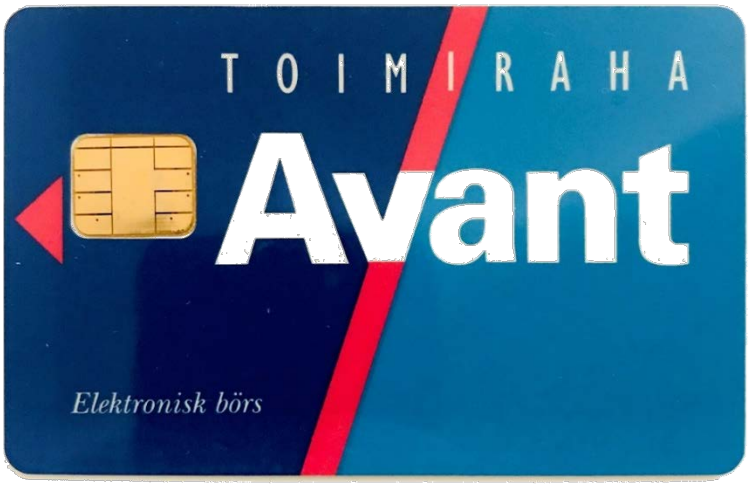
The development and management of the e-money system was assigned to a limited liability company that was set up in early 1992 as a fully-owned subsidiary of the Bank of Finland's printing works. Avant was chosen as the brand name for the smart card, and it was officially launched in December 1992 when board member Harri Holkeri made the first phone call using the Avant card.

According to the original plan, commercial banks were supposed to have a key role as distributors of Avant e-money to the general public. However, the timing of the project coincided with distressed economic conditions, so that commercial banks had to deprioritize the Avant project and were not able to make the necessary investments by the time Avant launched. As a result, the Bank of Finland developed an alternative plan for distributing the

product to its end users. An agreement was reached with a leading chain of convenience stores. This gave the Avant card a network of locations where cards could be sold and where they could be reloaded once that option became available.

In the first year, 125,000 non-reloadable cards were sold. Reloadable cards were introduced in 1994. By 1995, the card was accepted by most telephone companies, several municipal parking and transport services, as well as some retailers, who would also provide card reloading services. In the same year, the total number of outstanding cards reached 500,000.

Figure 3. The Avant smart card



Non-reloadable cards were easier to roll-out, but they were always meant to be a transitional product. Already during the planning phase it became clear that disposable cards could not become a profitable business model, nor would they be sufficiently user-friendly. Reloading, however, turned out to be a challenging issue. From a technical point of view, card reloading was simple, and the necessary hardware and software was already available. Even contactless cards were already a known concept. There were, however, major logistical and business related challenges. There would need to be a wide network of locations where users could reload their cards, ideally ranging from self-service points, like ATM's, to retail shops. This would require either agreements with existing business owners or an investment in a proprietary network. Both options were considered. The possibility of using existing ATM's for topping up Avant cards was explored. Card reloading was initially offered free-of-charge, but eventually a small fee would be added, as operating the system was costly. Later, this decision ended up affecting the demand for the card in a negative way.

From CBDC to commercial e-money

During the third operational year, decisive steps were taken to spin off Avant and to sell it to commercial actors. While the initial setting up of the operation was considered to fall within the mandate of the central bank, longer term its involvement was considered neither necessary nor beneficial. The central bank would retain the role of overseer in the payment system and of participating in the development of standards, but the business of issuing retail payment instruments would be left to commercial actors.

The best way to spin off the Avant business would be to combine it with an ATM business. Finland's major retail banks had previously set up a jointly owned company in order to create a shared ATM network throughout the country. Since Avant was looking for a way to enable the reloading of cards on ATM's, it would be logical to merge the Avant company with the newly established ATM company. The negotiations turned out to be difficult. The most contentious issues were related to how the financial costs and benefits from operating the system would be divided between the different parties. Negotiations stalled for a while, and the consortium of commercial banks started making preparations for a competing system. Terms were eventually agreed and the transaction finalised in late 1995. The stated rationale for the transaction was to combine the Avant card issuing business with the ATM business, and to also leverage the existing customer relationships of the commercial banks.

During its first 3 years, the business entity that issued Avant cards was fully owned by, and therefore on the balance sheet of, the central bank. When Avant became a privately held enterprise, it was no longer backed by the central bank. Instead, it became backed by a consortium of the largest commercial banks, but it ceased to be what we would now call CBDC. To everyday users, this distinction is almost imperceptible. The cards themselves and the payment system remained exactly the same, only the status of the owner changed. The new owner was no longer one that had the power to issue legal tender. Whether this detail changes the nature of the product remains debatable. Avant cards were pre-funded, and customer funds were segregated and safeguarded, so that the risk of loss was always extremely small, especially since the central bank retained the role of overseer also under the new arrangement.

Avant became one of the first examples of regulated e-money overall. The concept was formalised a few years later by the international community of banks and financial regulators. The European Monetary Institute (the forerunner of the ECB) published a report explaining the concept of electronic money and analysing its implications for central banks (EMI 1994). The European Central Bank followed up with another, more comprehensive report (ECB 1998). The Bank for International Settlements published a similar report in 1996, another one focusing on e-money risk management in 1998, as well as a survey of worldwide developments in 2000 (BIS 1996, BIS 1998, BIS 2000). Electronic money became a regulated business activity under EU law in 2000 with the introduction of the E-money Directive (originally Directive 2000/46/EC

and later revised as 2009/110/EC). In order to develop and harmonise the electronic payments market further, the European Union also introduced the Payment Services Directive in 2007 (Directive 2007/64/EC, later replaced by Directive (EU) 2015/2366, also known as PSD2). The legislation has ensured that e-money issuers are acting prudently and that customer funds are kept safe.[2]

Further developments and final years

Avant cards effectively became an additional product for commercial banks. As was the strategy since its launch, the Avant card was positioned as the low-value payment card alongside debit cards and credit cards. Users were not charged a fee even for small transactions when paying with the Avant card, whereas using a debit or credit card for small transactions usually involved limits or fees. Therefore, Avant cards were thought to be the best-suited option for low-value transactions, while debit cards were positioned as mid-value payment instruments, and credit cards as a payment method for high-value transactions.

It is important to keep in mind that smart cards such as Avant were vastly superior from a technological standpoint to the debit and credit cards of the time. Payment cards were generally based on magnetic stripe technology and did not use encryption. Smart cards represented a step change in terms of security, as they were based on microchips and used data encryption techniques. The EMV standard used in today's payment cards was created in 1994 but did not become widely adopted until over a decade later.

The integration of the ATM network with the Avant card system was accomplished in 1997. It was technically quite a challenge to enable the use of Avant cards on existing ATM's, because the machines were old and based on magnetic stripe technology. They had to be retrofitted with a separate card slot for smart cards, and customers were often confused about which card slot to use. Smart cards were gradually being used also for debit and credit cards, but it would take another decade before they would completely replace magnetic cards. To make the card experience more user-friendly, banks were offering combined cards, where one physical card could have all three functions in one: Avant, debit and credit. The advantage of using the pre-funded Avant feature was that it could be used offline and transactions did not require authentication. Avant payments, in that sense, were truly cash-like, at least compared to debit or credit card transactions.

E-money cards, such as Avant, were indeed expected to replace cash in the long run. There had been predictions that e-money could make cash practically disappear in a matter of years

[2] *It has also been argued that the development of e-money stalled after the adoption of the new regulation, as the requirements for e-money issuers had become quite stringent. This is an example of the difficult balance that regulators are trying to find in creating a market environment that is both safe for consumers and conducive to innovation.*

(see e.g. Good 1998, Gormez & Capie 2000, or Goodhart & Krueger 2001). This was also a key rationale for commercial banks to develop e-money. The handling of cash was an expensive undertaking, and any solution that would reduce those costs would be welcome. It was commonly assumed that at least coins could be largely replaced by e-money, but also that smaller denomination banknotes would be partially replaced by electronic payment instruments (see e.g. BIS 1996). Most of these predictions have later turned out to be grossly exaggerated, as cash is still widely used today and has not been replaced by e-money to any significant degree (see e.g. Hartmann 2006).[3] Instead, credit and debit card payments have become the only serious challenger to cash (see e.g. Esselink & Hernandez 2017).

Implications of e-money issuance on central bank functions

Monetary policy implications

As part of the background material prepared before launching the Avant project, the Bank of Finland had prepared detailed analyses on the potential implications of the Avant system, and e-money more generally, on monetary policy transmission. Due to the way it would be issued and used, the conclusion was that e-money would primarily function as a substitute for cash, and therefore have implications on monetary policy only if demand for it became very substantial. In the case of Avant, that possibility was considered very remote, firstly because there would only be a limited number of merchant locations where Avant could be used, and secondly because it was specifically designed to replace only the smallest denominations of coins and banknotes. On the other hand, because Avant would probably not have any impact on monetary policy transmission, it meant that Avant would also not have a useful role in supporting monetary policy. Therefore, monetary policy related viewpoints could not be credibly used as justification for why the central bank should pursue the issuance of e-money.

Seigniorage income

Because interest rates were much higher in the early 1990's than what they are today, the question of seigniorage income was important at the time when Avant was launched.[4] In terms of seigniorage, central bank issued e-money would work just like cash. There was expected to be some impact on seigniorage income for the central bank, mainly due to the lower unit production cost of e-money compared to cash, but because the volume of Avant e-money was assumed to remain relatively low, this impact would initially not be significant. In any case,

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[3] In fact, cash in circulation keeps increasing, see https://sdw.ecb.europa.eu/reports.do?node=1000004112.

[4] Interbank rates in Finland were generally above 10% in the 1990's. For historical rates, see https://www.suomenpankki.fi/globalassets/fi/tilastot/korot/documents/heliboreja_fi.xls

neither monetary policy considerations nor seigniorage per se were used as justification to launch the Avant project.

In retrospect, there was no discernible impact on seigniorage income. This can be explained by the fact that the central bank wasn't involved in operating the system for more than three years, and because its volumes during that time remained low.

Legal tender status

The question of legal tender status for e-money was also analysed in preparation ahead of launching the Avant system. On the one hand, the question was analysed from the point of view of the central bank's monopoly in issuing currency. On the other hand, legal tender status could mean that merchants might be obliged to accept e-money as payment. Neither viewpoint supported the idea that e-money could have the same status as coins and banknotes did. E-money, despite having some cash-like properties as a payment instrument, was more akin to bank deposits, and its issuance could therefore not be considered a monopoly of the central bank. It would also have been quite unreasonable to oblige merchants, or any other creditors, to accept e-money as payment, since this would have forced them to invest in new and possibly expensive equipment. The straightforward conclusion therefore was that central bank e-money would not have legal tender status.[5]

Financial stability

Because the only feasible model of e-money at the time was one based on smart cards, and because they were designed to be a substitute for cash rather than bank deposits, the analysis regarding financial stability focused on the prudential supervision of issuers. Other viewpoints which have been raised in recent years in the context of CBDC, such as the possibility of bank runs and the impact of CBDC on commercial bank funding, were less relevant during the time of Avant, because a card-based system like Avant did not make it particularly easy to use e-money as a safe haven. If someone were to withdraw all their money from their bank, the withdrawal would be done in the same way for both e-money and cash: either at an ATM or a branch. Moreover, the volumes of any e-money system, and Avant in particular, were expected to remain relatively low and therefore controllable. In the case of Avant, because the issuer was the central bank, there was no concern regarding whether the issuer was sufficiently capitalised and whether customer funds were safe. These would become important questions later though, once commercial e-money issuers started operating. Eventually, they were addressed in the regulation that was later adopted.

[5] *The question of legal tender status has also been raised in recent discussions regarding CBDC. As before, it has been found to be a complicated question (see e.g. BIS 2018 and Konvisser et al. 1997).*

Avant in the context of today's CBDC

Would Avant qualify as "proper" CBDC?

One might want to challenge the viewpoint presented in this paper that e-money based on smart cards is an example of CBDC. We will therefore analyse that question in more detail. The first difficulty in assessing whether a particular real-world case, such as Avant, qualifies as CBDC is that there is no commonly agreed definition for CBDC.

Let us look at some widely cited publications on the topic and summarise the definitions they suggest for CBDC, and compare them to the Avant card, which we consider a specific example of the more general concept of central bank issued e-money. The following are some examples:

> *Kiff et al. (2020) (IMF):*
> *"a digital representation of sovereign currency that is issued by a jurisdiction's monetary authority and appears on the liability side of the monetary authority's balance sheet"*
>
> *BIS (2018):*
> *"a central bank liability, denominated in an existing unit of account, which serves both as a medium of exchange and a store of value"*
>
> *Bank of England (2020):*
> *"an electronic form of central bank money that could be used by households and businesses to make payments and store value"*
>
> *De Nederlandsche Bank (2020):*
> *"consists of two elements that define the main preconditions for this form of money. It is digital currency and therefore only exists electronically. And it is central bank money and thus is issued directly by the central bank"*
>
> *Sveriges Riksbank (2018):*
> *"digital money issued by a central bank that is more widely available than central bank reserves that can only be held by banks and other financial institutions that are participants in the central bank's settlement systems"*

Banque de France (2020):
"a digital asset that only the central bank may issue or destroy, that is traded at par against banknotes and reserves, that is available 24/7, that may be used in peer-to-peer transactions and that circulates on digital media that are at least partially different from existing media"

Some central banks, such as the US Federal Reserve and the European Central Bank, have so far not explicitly provided an official view or definition of CBDC, but there are several publications by their staff members who have analysed the topic (see e.g. Bindseil 2020, Fernández-Villaverde et al. 2020, Engert & Fung 2017, among others). Their definitions are more or less aligned with the previous examples.

While there is variation in the wordings, all the cited definitions agree on the following aspects:

- CBDC is denominated in the national currency;
- CBDC is non-cash, in other words, based entirely on electronic records;
- CBDC is a central bank liability, in other words, the end user has a claim on the central bank;
- CBDC is widely accepted as a payment instrument, and that is its main purpose.

Probably the most specific definition is provided by the Banque de France (2020). Their definition requires, in addition to the previous points, that CBDC should be available 24/7, can be used for peer-to-peer transactions, and that it "circulates on media that are at least partially different from existing media". While 24/7 availability and peer-to-peer transactions seem straightforward, the last requirement is somewhat difficult to interpret. Presumably it means that CBDC should operate as a stand-alone payment system independent of previously existing ones, in which case the requirement is more or less consistent with the broader literature.

There is no doubt that the Avant card qualifies as CBDC according to these definitions. Firstly, the monetary value on the card was denominated in the national currency. Secondly, the Avant card system was based entirely on electronic record keeping. Thirdly, the monetary value on the card was a central bank liability. This may require some elaboration, however, because the central bank set up a wholly-owned limited liability company to run the Avant operation. Strictly speaking, the Avant card holders had a legal claim on that company and not the Bank itself. In the event of bankruptcy, or other situation where the power of those claims would have to be tested in a court of law, it is uncertain whether the central bank itself would have been held liable for its subsidiary's liabilities. But such speculation is far-fetched for two reasons. Firstly, the central bank could have kept its subsidiary out of bankruptcy indefinitely by providing it with additional funding. Secondly, the central bank had publicly communicated

being the backer and issuer of the Avant payment instrument. It therefore had not only a moral but possibly also a legal obligation to back its subsidiary's liabilities.[6] As for being widely accepted for payments, this is an aspect that will always be difficult to evaluate for any electronic payment instrument, but what is certain is that the Avant card did manage to gain nationwide acceptance in some product niches (e.g. phone booths and parking meters). Even though no detailed statistics exist, news coverage would indicate that the Avant brand was widely known, there were thousands of merchant locations throughout the country where Avant was accepted, at least for certain types of transactions, and that this number was continuously growing throughout Avant's lifecycle.

When we say "CBDC", do we usually think of a payment card?

Even though card payments are clearly the dominant electronic means of payment, more popular than cash in some countries, it may be that issuing a payment card is not the first thing that comes to mind when talking about CBDC. Indeed, it is often suggested that a mobile application would be the most probable implementation of CBDC. Cards are, however, seen as an additional way that CBDC could be used (see e.g. Kiff et al. 2020, or Miedema et al. 2020). This is logical, because cards are very widely used and a proven payment method. A new payment system could readily use many different devices to initiate payments, cards included.

It should also be noted that the payment cards we use today essentially represent the same technology of which Avant was one of the earliest examples. It would be misconstrued to consider smart cards an outdated technology. If CBDC were issued today, it would be entirely pertinent that it would include a payment card. Technologically, the card would not be significantly different from the Avant card, although many of the components and the software would, of course, be of a newer generation.

A key difference between Avant and the CBDC systems being designed today is that for modern CBDC systems cards would probably be an additional feature. In Avant, cards were the main component. Smart phones did not exist in the era of Avant, so the only available devices that could function as a digital wallet were desktop computers or smart cards. From a technical point of view, however, it doesn't matter what the external appearance of the digital device is, as long it has the necessary components. If the device has a microprocessor and memory for data storage, it can function as a payment instrument.

[6] *There are some conditions under which the parent of a limited liability company can be held responsible for the liabilities of its subsidiary, known as "veil piercing" in legal jargon (see e.g. Kärki 2020).*

Online and offline usage

While card technology today may look surprisingly similar to what it was in the days of Avant, what certainly has changed dramatically is the speed and reach of the internet network. At the time of Avant, it could not be assumed that the payment system would be continuously online. This was one of the key reasons why cards were such an important component of the Avant system. A digital payment system which needed to have nationwide geographical coverage could not rely on payment instruments being online all the time. Mobile data networks did not yet exist. Instead, data would be stored on the cards, and these would go online and transmit transactions in batches once they connected either to merchant terminals or ATM's.

As an interesting anecdote, consumers and businesses were also able to purchase an Avant card reader for their desktop computer. This made it possible to use Avant to make online payments on websites. What is noteworthy is that such payments were anonymous. The monetary value was stored directly on the card, and there was no user authentication process when making the payment. This possibility was not widely used, however, because the card reader devices were expensive, and because there weren't many online merchants. E-commerce was still in its infancy.

What is more, it would also have been relatively straightforward to enable offline payments from one card to another, but this possibility was deliberately disabled in the Avant system.

What type of CBDC was Avant?

The CBDC literature has elaborately broken down the concept into different subcategories, and we can now specify where Avant would fit in according to those taxonomies. First of all, Avant was designed to be used by the general public. In today's jargon we would say Avant was a case of *retail CBDC* (as opposed to *wholesale CBDC*, which would only be available to financial institutions). Since using Avant did not require authenticating the payer, a business could have used Avant cards as well. But what practically determined the user base for the card was the choice of merchants who accepted Avant. Since the products and services that could be bought with Avant were those that mostly consumers would use, there was no motivation for business users to get the Avant card.[7]

Another common differentiator for CBDC is whether it is a so called token-based or account-based CBDC (see e.g. Auer & Böhme 2020). An *account-based CBDC* would mean the issuer keeps account of CBDC holdings for each individual user. This requires that the CBDC holder is identified and authenticated in each transaction, and that their personal CBDC account is debited or credited as an outcome of the transaction. This is not how Avant worked. Instead,

[7] *The amount that could be loaded onto one card was capped to 2000 mk (roughly equivalent to €500 at current prices), which also made large payments impractical.*

Avant was a so called *token-based CBDC*, where the monetary value was stored on the payment instrument itself. In a way, each card represented one account, and the account balance was recorded on the card. There was no need to associate each card with any particular person. Instead, the card functioned as a bearer instrument, just like cash.

It is important to emphasise that using cards is not what made the Avant system token-based, but rather it was a design choice of the whole system. Modern debit and credit cards are not token-based payment systems, but account-based. Even though the card is technically similar, it performs a different function. There is no monetary value stored on a debit or credit card. The card merely functions as a way to authenticate the card holder and to sign transactions. A transaction message containing a digital signature is sent through the payment network to a payment processor, and the account of the card holder is updated by the card issuer. In the case of Avant, in contrast, the card functioned as the actual account, and was not used to sign transactions or to authenticate the card holder. Generally, whether an e-money system is account-based or token-based is not related to what kind of hardware components are used.

What is also causing confusion in the CBDC literature is to mix up token-based systems with distributed ledgers. A distributed ledger (DLT) would refer to a system where the responsibility of keeping accounts is shared between several parties. A distributed ledger would be a technical design choice regarding how the issuer operates, but not whether the payment system as a whole is account-based or token-based. Both a token-based and an account-based system can use a distributed ledger. In the case of a token-based system, a distributed ledger would mean that the responsibility of keeping account of the total outstanding value issued is shared between several parties. In an account-based system, a distributed ledger would mean that the responsibility of keeping account of all the individual holdings is shared between several parties.

What is the difference between CBDC and e-money?

When Avant was designed, there was an active discussion ongoing regarding e-money, and the concept had become well established during the preceding years. It was clear from the outset that Avant would be a prime example of e-money. The definition of e-money went through several iterations, and the wording that found itself into the EU legal framework has now gained worldwide acceptance. According to the E-money Directive, e-money means:

> *"electronically, including magnetically, stored monetary value as represented by a claim on the issuer which is issued on receipt of funds for the purpose of making payment transactions, and which is accepted by a natural or legal person other than the electronic money issuer"*

The E-money Directive mentions some important details which none of the cited definitions for CBDC address. In particular, it says that e-money is issued “on receipt of funds”. That is, it is a pre-funded payment instrument. There can only be as much e-money outstanding as has been funded by its users. Furthermore, such issuance can only take place for the purpose of making payments, so that e-money balances should exist solely for transactional purposes. Specifically, the e-money issued has to be accepted as a payment method by someone other than the issuer.

Any meaningful design or analysis of CBDC should take note of these details, that is to say, what the process of issuing CBDC is and how and where it can be spent. If no such details are given, one could probably not be faulted for assuming the conclusions drawn for e-money might also apply to CBDC. It can be therefore assumed that, firstly, CBDC refers to a pre-funded account or payment instrument. This would mean that monetary value would not come into being through the same money creation process as in the case of bank money (i.e. credit expansion), but instead CBDC would only be created, one for one, as a result of a user funding a CBDC account or payment instrument. This would make the issuance process for CBDC equivalent to that of cash. Secondly, there would have to be ways to spend CBDC, otherwise it would be difficult to justify its existence.

To summarise, the concepts of e-money and CBDC are largely, but not fully, overlapping. To some extent, they address different questions. E-money describes a claim which is distinct from a bank account and does not specify who the issuer is. CBDC, on the other hand, is specific regarding who the issuer is, but does not specify the nature of the claim. CBDC could be a bank account or it could be e-money. The Avant system can be described as both e-money and CBDC, at least up to the point when commercial banks took over its operation.

Conclusions

History tends to repeat itself. The discussion on the topic of central bank digital currency currently under way among central banks and academic researchers looks remarkably similar to the discussion about electronic money that took place a quarter of a century earlier. That earlier debate led to e-money regulation, which has since enabled the growth of new types of financial companies offering digital payment solutions to consumers. The question of whether a central bank should be directly involved in the retail payments business requires analysing the impact of that decision on competition, monetary policy, financial stability, the future of cash, the status of legal tender, and many other issues. Previously, central banks did not find a compelling case for it.

One of the most in-depth exploration of a central bank issued electronic payment instrument was the Avant system, which was initiated, developed and rolled out by the Bank of Finland in

the early 1990's. The Avant card was based on smart card technology, which was nascent at the time, but nowadays widely used in payment cards, identity cards, and many other applications. Using the jargon of today, Avant was a token-based retail CBDC.

The reason why the Bank of Finland took such a proactive approach in developing an e-money system was to avoid fragmentation of the market and the emergence of several competing systems, as this could have led to over-investment and a lack of standards. It was debatable whether such an initiative was within the central bank's mandate, but both its role as overseer of payment systems and the similarity of the new payment instrument to cash gave support to the idea.

Avant was positioned as a low-value payment instrument and it was expected to replace coins and small denomination banknotes. It thereby complemented debit and credit cards, which were more appropriate for higher value transactions at the time. Using the Avant card was initially cost-free for consumers, but fees were later added. Naturally, this affected the demand for the Avant card in a negative way. At the same time, the costs of using debit cards were decreasing, and their security features were improving, so that there was more and more overlap between the two types of cards. In the end, debit cards gained wider acceptance, and Avant was discontinued.

Despite competing for the same use cases, the Avant system and debit cards had very different design principles. Avant was a pre-funded anonymous e-money instrument where monetary value was stored on the card itself. A debit card, on the other hand, is a payment instrument which authenticates the user and initiates a transaction from a bank account. This observation can give us insight regarding the relative importance of certain suggested features of CBDC. Both the possibility to pay anonymously and the possibility to avoid using a bank account are often presented as potential reasons for choosing CBDC over existing payment services offered by commercial banks. Based on the experience from Avant, however, it seems that those features aren't as important to consumers as one might assume. Avant offered anonymity and was different from a bank account, but it didn't gain enough traction to survive in the payments market.

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