



# **Report of the team to examine the issue of Central Bank Digital Currencies**

**November 2018**





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### Executive Summary

At the end of November 2017, the Governor of the Bank of Israel appointed a team to examine the issue of central bank digital currencies (CBDC).<sup>2</sup> The team was very glad for the opportunity to deal with the issue that has been the focus of much interest both among central banks and among the business sector and technology companies around the world. This document summarizes the team's work. The publication of this document is intended to bring the work done at the Bank of Israel to the public's attention and to allow for public discussion of its contents.

The team's work raised a number of main conclusions and findings:

- Many central banks are examining the possibility of issuing digital currency and/or using distributed ledger technology in payment systems.
- No central bank in any advanced economy has thus far issued digital currency for broad use. There are a few banks, primarily the central bank of Sweden, that are examining the issue. In contrast, there are others, such as the central banks of Denmark and Australia, that have declared that they are not planning to issue digital currency in the near future, because the payment systems in their countries are efficient and provide good alternatives.
- There is currently no uniform specification for a CBDC. The specification can be made in terms of its accessibility—to the entire public or only to financial institutions; how it is issued—balance based or token based; the extent of anonymity in its use; and whether it will bear interest. This document presents the advantages, disadvantages, and risks inherent in various specifications.
- CBDC is similar to immediate payment systems. Both means are convenient and accessible, and both settle immediately. But CBDC differs from immediate payment systems in three aspects: (a) it is an asset that constitutes a central bank liability, similar to cash; (b) it is possible to enable offline transactions to be made through it; and (c) users of CBDC can be granted elements of anonymity (even if it is limited, for instance, to transactions that total up to a certain ceiling).
- The main purpose of issuing digital currency is to maintain the public's access to a central bank's liability in the event that the use of cash declines significantly, as is happening in Sweden, but that issue is not currently relevant to the Israeli economy, since there is no significant reduction in the use of cash. Making payments more efficient and supporting the

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<sup>2</sup> In this document, the term "digital currency" applies to currency issued by the central bank, unless otherwise noted.

payment system (including improved redundancy) are also worthy purposes for the issuance of digital currency. Under certain specifications, and particularly if it bears interest, digital currency can serve as an additional monetary tool, but that is not a main purpose in issuing it.

- The issuance of digital currency can generate other benefits, including assistance with combating the unreported economy, adaptation with the advanced technological environment, and advancing the fintech sector in Israel. Another important consideration is coordination with possible advances in this field made by other countries.
- There are expected to be quite a few material and technological difficulties and risks in the issuance of CBDC that are mainly derived from the possible effect on the financial system. In addition, such issuance is expected to have an effect on the central bank as the issuer of cash, on its management of monetary policy, and on the payment system.

**The team does not recommend that the Bank of Israel issue digital currency (e-shekel) in the near future. We must continue to examine and monitor this field before we can form the proper foundation for a decision on whether to recommend digital currency. Accordingly, the following recommendations have been formulated:**

- The team established by the Bank of Israel will continue its activity to study and monitor the issue, in coordination with departments at the Bank dealing with interfacing topics, including the payment system, distributed ledger technologies, and cryptocurrencies. The team will report to the Bank's management semi-annually regarding its activity and significant global developments in the field.
- In order to make decisions regarding digital currency, the team will examine the following issues on an ongoing basis:
  - ✓ Developments abroad, mainly at other central banks. Attention will be paid to possible issuance of digital currency in advanced, and to the ramifications on the foreign exchange market in Israel.
  - ✓ Scenarios that concern the effect of digital currency on various areas, in accordance with the extent to which it becomes an alternative to cash and to other means of payment in Israel and abroad.
  - ✓ The public's positions regarding digital currency (which can be learned about, for instance, by integrating the issue in surveys of the use of cash).
  - ✓ Technological developments connected with digital currency. The team will pay particular attention to relevant initiatives by domestic companies, and will strive to create a dialogue with them with the aim of learning about developments in the field.
- Further to the publication of this report, the team intends to hold meetings with relevant parties in the private and public sectors, in order to discuss and follow the issues arising from the report.
- The Bank of Israel is examining and encouraging the establishment of an infrastructure for immediate payments. It is important to examine the extent to which digital currency will complement or replace the system, and whether the decisions made regarding it must already take into account considerations regarding digital currency. Within this, attention must also be paid to how immediate digital payments will affect demand for cash and the Bank of Israel's service targets concerning cash.
- We recommend considering the possibility of holding an international workshop in the future, with the participation of parties dealing with the issue in the major central banks, in order to create a forum for learning and information sharing. In particular, it is worth examining cooperation with the relevant international bodies, including the BIS, the OECD, and the IMF, since they have also begun working on the issue.

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## 1. Introduction

Distributed electronic means<sup>3</sup> have, in recent years, attracted increasing attention in public discourse. The advancement in the field, including activity through private distributed means of payment<sup>4</sup> such as bitcoin, has aroused discussion of the possibility of also implementing the technology for national currencies issued by central banks (central bank digital currency—CBDC).

The discussion of CBDC is closely related to other issues that are the subject of professional and public discussions, but differs from those other issues in various aspects. In particular, it is important to emphasize that there is a basic difference between a central bank currency and distributed electronic means of payment in the private sector such as tokens or bitcoin and other similar currencies, both in terms of the risks and in terms of their financial and monetary significance.

No central bank in an advanced economy has yet issued digital currency that is legal tender, and there is not yet any clear or agreed upon specification for such currency. Many countries are studying and examining the issue (a review appears below and in the Appendix), and have reached various stages on this long and complex process. It is very important that the Bank of Israel also take part in this learning and thinking—even if we cannot expect any decision regarding an e-shekel in the near future—so that we will be able to make prudent decisions in the future, particularly to prepare for a situation in which central banks in other advanced economies decide to issue digital currency. Therefore, in November 2017, the Bank of Israel Governor appointed a working team with the aim of starting to examine the new means of payment, and particularly its advantages and disadvantages, and to review developments abroad while taking long-term strategic considerations into account. This is the first step in a long journey, the end of which—where we are heading and when we will get there—remains unknown.

The issues that should be dealt with include, among other things:

- What is the significance of maintaining the public's direct access to central bank means of payment, both at normal times and during crises, independent of technological developments?<sup>5</sup> Most means of payment are already digital/electronic, as are the public's bank and other deposits. However, this is “internal money” that the banks create, and not the high-powered money of the monetary base, meaning it is not a liability of the central bank. The commercial banks' deposits with the Bank of Israel are also digital, but the ability to operate digitally vis-à-vis the Bank of Israel is reserved only for them. An e-shekel would differ from these two since if it is issued, it will be a liability of the central bank, not of the business sector, toward the general public.

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<sup>3</sup> DEM—A computerized digital unit, the ownership of which by a certain person is ensured through distributed encryption, meaning encryption that does not depend on one central entity. This definition is based on the Israel Tax Authority's definition from its circular of May 2018, and is used only for the purpose of the discussion in this document.

<sup>4</sup> DMP—A unit of DEM that may be used in commerce. This use led the public to refer to it as “virtual currency”, “digital currency”, “distributed token”, and other names. This definition is based on the Israel Tax Authority's definition from its circular of May 2018, and is used only for the purpose of the discussion in this document.

<sup>5</sup> See, for instance, the speech by the Governor of the Riksbank in February 2018. <https://www.riksbank.se/en-gb/press-and-published/notices-and-press-releases/debate-articles/payments-in-the-future-and-legal-protection-for-the-swedish-krona/>

- What are the main characteristics of digital currency, and what are the advantages and disadvantages? The document will deal with this question and examine what characteristics will enable digital currency to replace cash (wholly or partially), and how it may affect the payment system, monetary policy, the banking system, and the financial system in general, as well as households and businesses. Our discussion will only briefly and generally cover the technological aspects of digital currency.
- Does the immediate and final (faster payments) system render digital currency redundant? Such a system already exists in a few countries—including Sweden, Denmark, the UK, Singapore, Thailand and Australia—and Israel has begun working to establish one. We must therefore ask whether, given such a system, there is any advantage to an e-shekel. Assuming that the answer is positive, we must ask to what extent the system should be designed taking the e-shekel into account.
- What is the most appropriate technology for the e-shekel? Can it also serve other purposes? Distributed ledger technology (DLT) first appeared in the form of blockchain with Bitcoin, but it became a significant field on its own, and now no longer serves only to create and enable distributed means of payment, but also serves broader purposes. Some countries are not focusing only on the issuance of currency, but also on other purposes, including use in the payment system. For instance, in the UK, a parliamentary committee was established to examine distributed means of payment and distributed technology.<sup>6</sup> However, our discussion of DLT and other technologies will concentrate on the digital currency.

The issuance of digital currency is connected with all areas of work at the Bank of Israel. Therefore, the team included representatives from many divisions within the Bank—the Accounting Payment and Settlement Systems Department (APSS), the Banking Supervision Department, the Information Technology Department, the Currency Department, the Market Operations Department, the Legal Department, and the Research Department. The team met with people in the business sector who work in related fields, talked with representatives of other central banks and of the private sector, and read copious material published by central banks and business, international, and academic institutions.

**This document sums up the team’s work, mainly providing an outline of the situation abroad and in Israel, and presents the main issues that must be examined in discussing a central bank digital currency.**

The document contains 8 chapters. Chapter 2 presents basic terms. Chapter 3 outlines the main purposes of issuing digital currency and the advantages that it may have. Chapter 4 provides a short summary of the discussion on the issue around the world. Chapter 5 presents the attributes that digital currency may have. Chapter 6 deals with the possible ramifications of issuing digital currency. Chapter 7 discusses technological issues. Chapter 8 presents summary tables. In addition, the document includes a detailed bibliography, including central banks’ discussion of the matter. These sources serve as a basis for such discussion both abroad and in Israel.

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<sup>6</sup> <https://www.parliament.uk/business/committees/committees-a-z/commons-select/treasury-committee/news-parliament-2017/digital-currencies-17-19/>

## 2. Basic terms

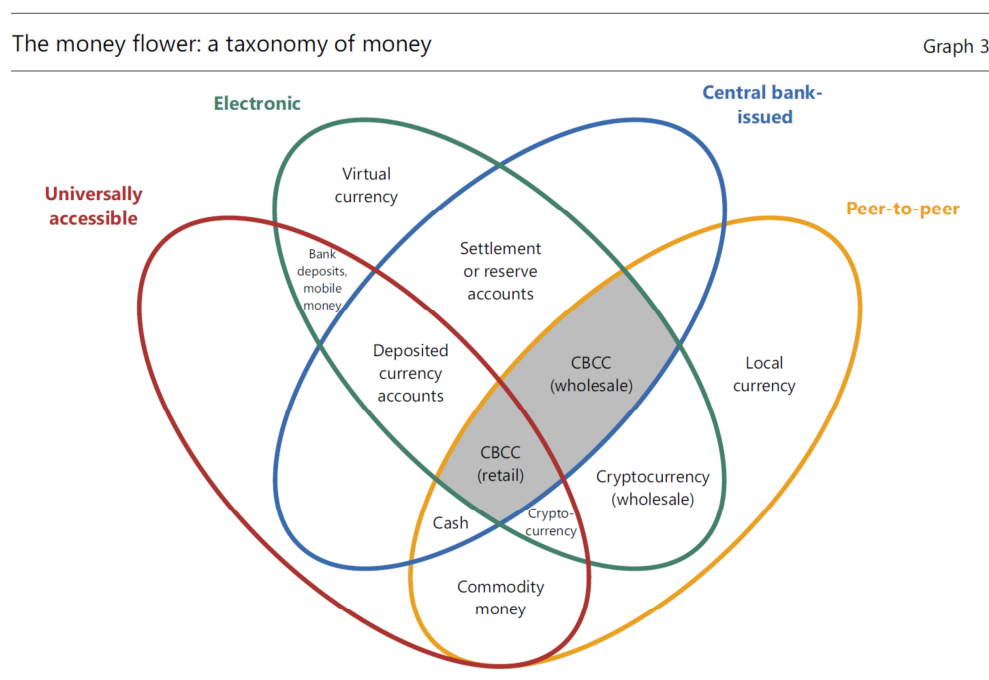
### a. Basic definition of central bank digital currency (CBDC)

Central Bank Digital Currency (CBDC) is an electronic liability of the central bank that can be used for executing transactions and for maintaining value.<sup>7</sup> If Israel decides to issue a digital national currency, it will back the currency's value and its existence as currency, and the currency will serve as legal tender of the State. The State will be able to decide how much digital currency to issue, just as it decides how much cash to print.

Digital currency should serve as a means of payment and a proper substitute for cash. It is therefore reasonable to assume that **we would want it to have the basic attributes required of money—to serve as a unit of account, a store of value, and a medium of exchange.** As opposed to CBDC, the private distributed means of payment traded on the markets are not backed by any sovereign entity, and in most countries are not considered currency, especially not legal tender, and are characterized by very high volatility.<sup>8</sup>

Bech and Garrat (2017) propose characterizing the CBDC<sup>9</sup> as **money that is central bank-issued, electronic, universally accessible, and enabling payment with no intermediary (P2P).** They make their proposal through the “money flower” presented in Figure 1.

**Figure 1: Different forms of money**



SOURCE: M. Bech and R. Garrat (2017).

<sup>7</sup> See, for instance, Meaning, Dyson, Barker and Clayton (2018).

<sup>8</sup> Currently, private distributed means of payment called “Stable Coins” are being developed, and their main qualities include maintaining stability of value. To illustrate, the initiators of the prominent example, Tether, commit to maintain a fixed conversion rate against the US dollar. Another example is the Saga initiative. These currencies are not meant to replace national currencies, but to be a complementary means of executing various types of transactions.

<sup>9</sup> The authors use the term CBCC – Central Bank Cryptocurrency.



It is common to require that **there be a fixed conversion rate of 1:1 between CBDC and cash in a nation's currency**, even though it may be determined otherwise.

Beyond that, there is still no agreed-upon specification for CBDC, and an examination of its desired characteristics—their advantages and disadvantages—takes up a significant portion of the discussions being held in central banks and other institutions. Below, we will present and discuss various alternatives for defining CBDC.

## **b. Technology: A Brief Description**

Even though it is not necessary to use advanced technology in order to issue digital currency, the discussion of such issuance involves an examination of the technologies that enable it in an advanced and efficient manner.<sup>10</sup> The following are basic technological terms:

**Distributed Ledger Technology (DLT):** An architecture that makes it possible to manage information in a way that is protected from counterfeits, is encrypted, and is distributed (over a number of sites, institutions or countries), and is accessible to any authorized user without intervention from a central party. Thus, entities that do not rely on each other can agree to carry out a transaction. There is a rigid protocol that synchronizes the distributed information in order to ensure that all instances of the ledger are identical. In a permissioned distributed system, the ledger can only be updated by recognized and trustworthy participants who have received authorization from some central authority. In a permissionless distributed system, everyone can participate, and the ledger can be updated only through consensus among the participants.<sup>11</sup>

**Blockchain:** The technology that realizes DLT. The information in the ledger is kept in the form of digitally signed blocks, and each block contains a collection of transactions that have been approved and verified. Each block is identified by a digital signature and connected to the previous blocks by keeping their digital signatures. Thus, the ledger obtains a great number of identical copies, and the information cannot be counterfeited. This is the technology that enables bitcoin.

**Distributed Electronic Means (DEM):** A computerized digital unit, the ownership of which by a certain person is ensured through distributed encryption, meaning encryption that does not depend on one central entity.<sup>12</sup>

**Distributed Means of Payment (DMP; digital currency or cryptocurrency):** A unit of DEM that is created through technological means and may be used in commerce.<sup>13</sup> The entire process of its creation and verification is done by mathematical encryption, and it has no physical existence. Today, DMPs are traded mostly over a distributed network, and are stored in a cryptowallet. This means of payment does not require a central settlement system<sup>14</sup>, because as soon as its ownership is recorded in the ledger, it moves from one wallet to another.

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<sup>10</sup> See, for instance, Simon Scorer (2017) at the Bank Underground blog published by the Bank of England.

<sup>11</sup> See Chapter 5 of the BIS Annual Economic Report, 2018

<sup>12</sup> This definition is based on the Israel Tax Authority's definition from its circular of May 2018, and is used only for the purpose of the discussion in this document.

<sup>13</sup> This definition is based on the Israel Tax Authority's definition from its circular of May 2018, and is used only for the purpose of the discussion in this document.

<sup>14</sup> Such as an RTGS system. In Israel, the system is called Zahav—the Hebrew acronym for “Real-time credits and transfers”.

**CryptoWallet:** A software program with an easy user interface that enables the practical and orderly use of DMP. It can be installed on personal computers or on mobile devices. Each wallet has an address to which two keys—public and private—are linked. The keys enable the wallet to be encrypted and given a unique identifier. The private key is used to derive the wallet's address, which is used in the DMP transfer.

**Digital wallet:** While the cryptowallet enables the storage of only distributed means of payment, the digital wallet enables the storage or accumulation of all means of payment, and is intended for the transfer of payment and the purchase of services and assets between two parties.

### 3. e-Shekel: The main purposes for issuing it and additional advantages

The discussion of an e-shekel should begin with the question of what purposes there are to issuing digital currency in Israel, and how it may serve the Bank of Israel's main purposes as set by the law. The advantages of the digital currency should help with this conversation. In the second stage, we will examine what additional benefits there are to issuing an e-shekel. Further discussion of the ramifications of the e-shekel can be found in Chapter 6. **Table 1 in Chapter 8 sums up the main purposes and additional advantages of issuing an e-shekel.**

#### a. The e-shekel and the main purposes and functions that the law sets for the Bank of Israel<sup>15</sup>

According to the Bank of Israel Law, 5770–2010, the Bank of Israel has three objectives: (1) To maintain price stability as its central goal; (2) To support other objectives of the Government's economic policy, especially growth, employment and reducing social gaps, provided that, in the Committee's opinion, this support shall not prejudice the attainment of price stability over the course of time; and (3) To support the stability and orderly activity of the financial system.

The Bank of Israel Law also sets out the Bank's functions, which include the management of monetary policy, the regulation of the payment and settlement systems, the issuing of currency and the regulation of the cash system, support of the proper functioning of the foreign exchange market, and supervision and regulation of the banking system.

Decisions concerning digital currency must relate to the question of whether issuing such currency supports the Bank's ability to achieve its objectives and fulfill its functions, or makes it more difficult.

**Among the Bank of Israel's functions, issuing currency and responsibility for the cash system and for the payment and settlement systems hold a central place in the discussion of the objectives of digital currency. The management of monetary policy and responsibility for financial stability also have an important place.**

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<sup>15</sup> Chapter 6 also discusses the ramifications of the e-shekel on the topics discussed here.

## Issuing the currency

According to the law, the Bank of Israel has the exclusive authority to issue the currency that serves as legal tender, and it therefore must fulfill this function in the most efficient way for the good of the public. Does the issuance of digital currency serve this purpose? In a situation where the use of cash is declining and there is concern that in the future it will be impossible to pay in case because businesses will not agree to accept it (as is happening in Sweden)<sup>16</sup>, the central bank must examine ways to enable the public to carry out transactions with the direct use of the central bank's liabilities. This concern does not exist in Israel (or in many other countries), and therefore is not currently a main consideration in favor of an e-shekel.

However, even though cash remains an accepted means of executing transactions, consideration may be given to streamlining the way in which the central bank makes it possible to use its liabilities. Other fields have undergone digitization for reasons of efficiency—including mail, books and checks—and cash could join them. In this context, the cost involved, and whether the change will reduce or increase costs, particularly in the short term, should be examined. At this stage, it is very difficult to assess the costs involved in establishing and operating a digital currency system. Moreover, it is also difficult to assess the savings that will be generated in the costs of issuing coins and banknotes, since we can expect that cash will not disappear, and that the Bank of Israel will need to continue issuing it as a means of backup as well. On the other hand, streamlining the way in which transactions can be made is expected to contribute to the wellbeing of individuals and to GDP, and this benefit may overcome any additional cost to the central bank.

**It is important to remember that the Bank of Israel does not operate for profit, and if other considerations lead it to the conclusion that in order to achieve its objectives and fulfill its functions it should continue to issue cash, or to issue digital currency, it can choose to do so even if the cost involved is higher than the cost of the alternative.**

## Payment and settlement systems

The Bank of Israel acts to advance effective and reliable payment systems and means of payment, including cash alternative means of payment. The Bank has begun examining and encouraging the establishing a faster payments system similar to what exists in many countries. This system will enable person-to-person (P2P), person-to-business and vice-versa (P2B), business-to-business (B2B), and person-to-government and vice-versa (P2G) transactions rapidly and efficiently, since settlement is immediate and final. The adoption of the system will be accompanied by building an advanced settlement infrastructure.

**Given the existence of an immediate payments system, it is not clear whether there is a need for digital currency.** The team found that some countries, including Denmark and Australia, decided that they did not need to advance a digital currency, since the payment systems in those countries includes an immediate payment system, which answers the need that a digital currency would have provided—a convenient and available means of payment that enables the beneficiary to make immediate use of the money transferred into his account.

In addition, we must examine through which payment system the digital currency will be settled:

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<sup>16</sup> In Israel, the shekel is legal tender, meaning that payment using the shekel cannot be refused.

1. Is it possible to settle it in an existing system, or must a designated settlement system be established?
2. If a designated system is to be established, will it enable payments to be made through various advanced means of payment and connect them? In other words, will the payer and the payee be able to use different advanced means of payment? Will the system be able to contribute to increasing competition in the payments system and increase the redundancy in it by serving as a backup for existing systems?

## Management of monetary policy

How will a digital currency affect the Bank of Israel's ability to manage monetary policy? For the currency to serve as an alternative to the existing monetary tools used by the bank—interest-bearing deposits (loans) at (from) the central bank or open market operations—it is reasonable to assume that it will be necessary to allow it to bear interest. In general, the tools that currently exist enable optimal management of monetary policy. While we cannot set negative interest on cash, but it is possible with digital currency, as long as cash continues to exist alongside the digital currency, users can move to cash, thereby avoiding (the payment of) negative interest (meaning payment of interest on the currency). This issue requires an in-depth discussion, but it seems that **the fact that digital currency can serve as an additional monetary policy tool does not need to be a central consideration in the decision on whether to issue it.**

## Stability of the financial system

One of the Bank of Israel's objectives is to maintain the stability of the financial system. **A digital currency can be expected to significantly affect the financial system, particularly the banking system.** While it can contribute to increased competition, it also may create negative effects on the system's stability, for instance by reducing the sources of credit for the banking system. This is an important and central consideration that must be taken into account in a discussion of the risks and disadvantages from which the process may suffer.

### b. Additional advantages

In addition to the main objectives that can be served by the e-shekel, there are advantages for the economy in general that may be considered, since the law sets out that the Bank of Israel must also support other economic objectives as set by the government.

## The struggle against the shadow economy

The government decided to wage a struggle against the shadow economy. The promotion of advanced means of payment in Israel may help to reduce the shadow economy, mainly in view of the law to reduce the use of cash<sup>17</sup> that was passed in March 2018. This law restricts the use of paper-based means of payment, and is complemented by promoting the development of advanced means of payment complements it. **Digital currency will help in the struggle against the shadow economy to the extent that it reduces the possibility of executing unreported transactions,** that is if it is not characterized by complete anonymity. Various

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<http://main.knesset.gov.il/Activity/Legislation/Laws/Pages/LawBill.aspx?t=lawsuggestionssearch&lawitemid=568297> (in Hebrew)

extents of anonymity can be set for digital currency, and any such decision will have advantages and disadvantages, and does not depend on considerations related solely to the Bank of Israel, but also to the economy in general and to the good of individuals in the economy.

In this context, it should be noted that the adoption of other advanced means of payment, such as immediate retail payment, will also contribute to the struggle against the shadow economy.

### **Support for the high-tech sector**

The high-tech sector in Israel is developed and continues to advance. **Digital currency can contribute to the high-tech sector (fintech)**, thereby contributing to economic growth in the short term and in the long term as a result of specialization in areas with relatively high productivity.

### **Following developments in the world**

**It is important to relate to advances by other central banks in the area of digital currency.**

Quite a few central banks in advanced economies are examining the issue, particularly the central bank in Sweden.<sup>18</sup> While none of them have yet issued digital currency for general use, and some (such as Denmark's central bank) have declared that they have no interest in doing so, if some countries do decide to move forward, their decision may also have an effect on the currencies of other countries. While it is reasonable to assume that such a decision will mainly affect the major currencies and have less of an effect on the shekel, it is also likely that new dynamics will evolve in the attitudes of other central banks to the issue, particularly if it turns out that issuing digital currency generates positive results. Constant monitoring of developments in this area will make it easier for the Bank of Israel to react when necessary to changes taking place in other countries.

## **4. The global situation<sup>19</sup>**

No advanced economy has yet issued digital currency for broad use. However, some countries are at advanced stages of research and experimentation. The following is a view of the situation in some countries that are prominent in this regard. **The appendix summarizes how various countries relate to digital currency, and refers to documents published in those countries.**

Sweden is among the first countries to have shown an interest in digital currency, but it has not yet reached the implementation stage. The Swedish project, which was initiated in 2017, is called the "e-Krona project". In the first stage, a general proposal was formulated for the structure of the currency and the entire system, and at the end of 2018, the bank published a summation of the second stage of the project, containing a recommendation to begin examining technological solutions to implement CBDC, as well as an examination of what legislative changes will be necessary. The monetary situation in Sweden is different from that in Israel, since in Sweden, the use of cash is declining, and cash is expected to completely disappear in a few years. Therefore, digital currency in Sweden can serve as an alternative to cash—an objective that the Swedish central bank views as important. The Riksbank will continue examining the issue in conjunction with the public and relevant institutions.

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<sup>18</sup> See Sveriges Riksbank (2017) and Sveriges Riksbank (2018a).

<sup>19</sup> For more details and references see the Appendix.

Uruguay is in the advanced stages of examination, and has even successfully completed a pilot study of the digital peso. This is the first pilot study in the world to examine in practical terms the use of CBDC. The study included 10,000 participants and about 20 million pesos (about \$700,000) were converted to digital currency. An initial report issued by the central bank stated that the study was completed without any technological breakdowns, but it is important to note that it was on a very small scale. The project was conducted in conjunction with companies that deal with payment systems, technology and communications. The commercial banks also asked to participate in the project, but the central bank left them out at this stage, and announced that it would consider including them at later stages.

Singapore began a project to examine the feasibility of DLT-based CBDC. At this stage, the project is focusing on the specification of blockchain-based infrastructure in the banking system. In the first stage, DLT technology was examined in interbank transfers, and in the second stage a number of versions of DLT-based RTGS systems were examined. Both experiments were considered successful, but they do not show that Singapore will issue CBDC in the near future.

Similar to Singapore, the United States is interested in the possibility of implementing blockchain technology in various markets more than in the possibility of issuing digital currency to complement or replace the dollar (“FedCoin”). The Fed does not currently see a need to issue digital currency, since its assessment is that the banking system is efficient and sufficiently innovative, and that demand for cash is not declining, in contrast with the situation in Sweden.

ECB publications show that the bank holds a similar position to that of the US relating to digital currency. It does not currently see a need for CBDC since the use of cash is not declining, the bank intends to initiate a faster payments system in the future, and the need to reduce the shadow economy is not a major objective. However, the ECB is studying a number of alternatives to CBDC and examining their implications. The study is currently focusing on specifications for the currency and examining the need to issue it, and not on the technological-application aspect.

England has started a multi-year study in order to examine the implications of issuing a digital pound, mainly with the aim of providing the public with an asset that is (a) risk-free like cash, and (b) convenient and fast like electronic means of payment. The Bank of England believes that digital currency may ease the transmission from changes in the central bank interest rate to the economy, and even increase GDP as a result of an increase in the supply of risk-free assets. However, it is also looking at potential disadvantages, such as undermining financial stability as a result of lower bank liquidity. In view of the complexity of the issue, the Bank of England expects that it will not issue CBDC in the coming years, but is continuing the in-depth and comprehensive study of the matter.

Canada is examining the implications of issuing CBDC. The Bank of Canada believes that study should continue of various alternatives to CBDC as well. In parallel, it is examining the feasibility of a DLT-based wholesale payment system (“Project Jasper”). The Bank of Canada’s assessment is that the technology is not yet sufficiently advanced to serve as an infrastructure for a payment system, but they argue that it has made significant advances and will continue to do so.

The central bank of Denmark analyzed the Danish economy and concluded that it has no need for digital currency. First and most important, there is an immediate payment system from

current deposits in Denmark, which provides a response to the need for faster payments. The system enables the immediate interbank transfer of funds, from one current account to another. Moreover, in Denmark, each citizen has access to a payment account, so weaker populations are not excluded from the online payment system. Finally, the central bank of Denmark is not interested in competing with commercial banks' money.

In Australia, the Governor announced that the central bank does not intend to issue digital currency (the "e-Aud") in the foreseeable future, but noted that the bank has started examining the advantages and disadvantages of issuing it. In Australia digital means of payment are preferred over cash, and because those means are based on services provided by the traditional financial institutions, the commercial banks will continue to play an important part in the payments system in the future as well. The Australian governor emphasized that in Australia, there is a faster payments system, and since it serves Australians well, there is no economic incentive to issue digital currency.

Norway set up a team to examine digital currencies, and also began a study with the aim of examining the ideal form of future money. In Norway, the assessment is that cash will not disappear in the coming years, and it is assumed that the public's deposits in the commercial banks will continue to serve as the common means of payment in the country. The Norwegian central bank does not intend to make a decision concerning CBDC in the near future.

Venezuela is the only country that has issued a government-backed cryptocurrency. The president announced that each coin is backed by a barrel of oil from the country's reserves. The currency is complementary to the bolivar—the official currency—and serves as legal tender in the country. Venezuela rushed to issue digital currency mainly due to the financial sanctions imposed by the US. The currency was supposed to attract foreign investors to the country and to attract capital inflows that would bypass governments, but at this stage, the project has not borne fruit and the currency is not fulfilling the purposes for which it was issued. We note that the country is suffering from increasing financial and economic difficulties.

The Marshall Islands is also advancing a state-issued cryptocurrency, with the help of a private Israeli firm called "Neema". The country's official currency is the US dollar, and issuing the digital currency means, among other things, monetary sovereignty. They are therefore calling it the SOV, short for "sovereignty". The currency will be pegged to the dollar. The state plans to issue 24 million tokens, half of them to the government (of which 6 million to foreign investors and 2.4 million to the public), and half to Neema. However, when a small country works toward monetary sovereignty that will lead to economic sovereignty, the IMF actually recommends that it avoid issuing an independent digital currency. The biannual report issued by the IMF on the Marshall Island states unequivocally that if it issues a digital currency to serve as legal tender in parallel with the dollar, it could lead to financial instability and even cause harm to cooperation with the large American banks.

In addition to countries, international organizations are also interested in CBDC. The BIS issued a report noting, among other things, that wholesale digital currency will be beneficial in the area of payments, but that the technology is not sufficiently advanced and requires more research and development. In terms of retail currency, the BIS's position is even more conservative. It argues that a country interested in issuing currency must carefully consider the economic ramifications of such a step. The report also stated that a careful examination must be made of whether CBDC can be beneficial in countries that use a faster payments system. Despite their caution, the writers of the report call on central banks to study digital currency in depth and examine how issuing it will affect financial stability and monetary policy.

The International Monetary Fund announced at its most recent annual conference (October 2018) that fintech issues, including digital currency issued by central banks, will be on its agenda for the coming year.

## 5. The possible attributes of a central bank digital currency

CBDC can complement or replace physical currency—banknotes and coins—as a means of payment that constitutes a central bank liability. CBDC can have qualities that make it an alternative that is as similar as possible to the current cash, but it can also have other qualities. The choice of any specification has advantages, disadvantages, and ramifications on the use of the currency and its effect on monetary, financial and other areas.

Since no advanced economy has issued CBDC for public use, there is no cumulative experience in the advanced world. The discussion of CBDC is therefore mostly theoretical, and is accompanied by tremendous uncertainty regarding the implications of the possible specifications. Moreover, the relevant technology is young and developing, so the analysis is being done cautiously with the understanding that technological possibilities are changing constantly. It is therefore desirable that the characteristics that are chosen will enable CBDC to be adapted to the experience gained (should there be any) in the future, and will maintain the ability to react to technological and other changes.

The following are the main specification possibilities. **Table 2 in Chapter 8 summarizes the advantages and disadvantages of each of the possible specifications of an e-shekel.**

### a. Method of issuance

- 1) Value based, token – The central bank will issue a code instead of printing a banknote. After deposit in the citizen's wallet, the central bank does not need to keep accounts, and private companies will be able to provide wallet services to keep the token. In this alternative, the code is parallel to a banknote and the digital wallet is parallel to a physical wallet. The central bank knows how much money has been issued, but does not necessarily know who holds it at any time or for what transactions it is being used. Even so, each token can be tracked through its transfer history on the distributed ledger.
- 2) Balance based, current account at the central bank – The central bank will record the holders of digital money in its balance sheet, meaning that it will maintain a separate account for each holder. It will be able to do so directly, but account management involves high costs and activities with which central banks have no experience so far, and is not part of their core business. Alternatively, offices can be established to manage private accounts on behalf of the central bank and provide additional services, and only they will maintain accounts at the central bank. In other words, the central bank will manage only a few accounts. These offices will be required to hold 100% liquidity, and the digital funds will not be registered in their name but in the name of the private owners, as opposed to how banks manage the money supply.<sup>20</sup>

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<sup>20</sup> Further discussion of the proposal to establish Digital Currency Account Providers appears in Dyson and Hodgeson (2016).



## **b. Settlement mechanism and maintaining value**

- 1) Distributed – A DLT-based transfer mechanism without the involvement of a central body. This mechanism is more able to withstand attack and enables coordination with various entities.
- 2) Limited distribution – A DLT-based mechanism with a limited number of nodes with “privileges”. For instance, commercial banks may serve as nodes and the central bank would serve as a node with privileges. The privileges include the ability to cancel transactions and take other actions in accordance with need and the rules that the bank wishes to enforce.
- 3) Central – The central bank would manage the transfer records, as commercial banks currently do for transfers between individuals, and there would be a central settlement through a single payment system.

## **c. Anonymity**

- 1) Full anonymity – The payer and the payee maintain anonymity vis-à-vis each other and vis-à-vis the central bank (similar to the current cash system).
- 2) Limited anonymity 1 – The payer and the payee maintain anonymity vis-à-vis each other, but the central bank (or another authority) can identify both of them. This will make it possible to restore tokens whose code has been lost, and thereby prevent the loss of money.
- 3) Limited anonymity 2 – The payer and the payee will be required to identify themselves only if the transaction amount is higher than a certain level (similar to the current cash system), or if other conditions are met.
- 4) Lack of anonymity – The payer and the payee do not maintain anonymity vis-à-vis each other or the central bank (similar to the current credit card or bank transfer system).

## **d. Interest**

- 1) Interest-bearing – It would be possible to credit the digital currency balance with interest. In such a case, the holder of the money would not be able to maintain anonymity, since his account would have to be credited with interest and the yield would be taxable. It is possible to create a CBDC that would enable interest that could be used when necessary, but the interest rate would be set at zero.
- 2) Not interest-bearing – Similar to cash. Can be defined as a unit of account.
- 3) Bears only negative interest – In such a case, the CBDC would bear zero interest as long as the interest rate is positive, and would bear negative interest when the central bank sets such an interest rate.<sup>21</sup> It should be remembered that it is likely that cash will continue to exist alongside the CBDC, so individuals will be able avoid negative interest.

## **e. Accessibility**

- 1) Accessible to all (retail) – Every individual and financial institution would be able to hold digital currency (similar to cash). It would be determined whether only citizens could hold it or whether nonresidents and/or tourists could also hold it. This is the most likely option.

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<sup>21</sup> Such a proposal appears in Mersch (2017).

- 2) Limited access (wholesale)<sup>22</sup> – Only financial institutions would be able to hold the currency. Since the banks can already hold digital currency that bears the central bank interest rate, in the form of deposits or loans, the CBDC would basically expand the possibility to households and firms. Therefore, this option is not likely if CBDC is meant to serve as a cash alternative, but it can work as an interim stage in order to test the technology.

#### **f. Transfer amounts**

- 1) Unlimited – The holders of CBDC would be able to transfer any amount between them (similar to the cash situation before the Reduction of the Use of Cash Law was passed).
- 2) Limited – The holders of CBDC would be able to transfer only a limited amount between them (for instance, similar to the restriction created by the Reduction of the Use of Cash Law). Such a restriction could give them an incentive to deposit the money with commercial banks, because transfers between deposits would not be restricted.

#### **g. Holding amounts**

- 1) Unlimited – It would be possible to hold any amount of digital currency.
- 2) Limited – It would be possible to hold a limited amount. Such a restriction would moderate the decline in bank deposits and would contribute to the reduction of risks in the case of a bank crisis.

#### **h. Conversion possibilities**

- 1) Free – It would be possible to convert digital currency into traditional money (cash or current account balance) freely and without restriction on amount or time.
- 2) Limited – Conversion would be restricted to certain amounts/times or subject to other limitations.

#### **i. Exchange rate**

- 1) Fixed – A ratio of 1:1 would be maintained between the digital currency and cash. This is the reasonable and accepted option in discussion on this issue.
- 2) Variable – Demand for CBDC would be regulated by changing its exchange rate. In this case, the CBDC would be similar to a financial asset whose value is set by supply and demand, such as securities. This option is not reasonable.

## **6. The possible ramifications of issuing digital currency**

### **a. The use of cash**

Issuing an e-shekel means that the public will be able to hold CBDC instead of cash. The discussion must take place with attention paid to the Reducing the Use of Cash Law, which will come into effect in January 2019, and with the assumption that cash will not disappear but will exist alongside digital currency, at least for some time.

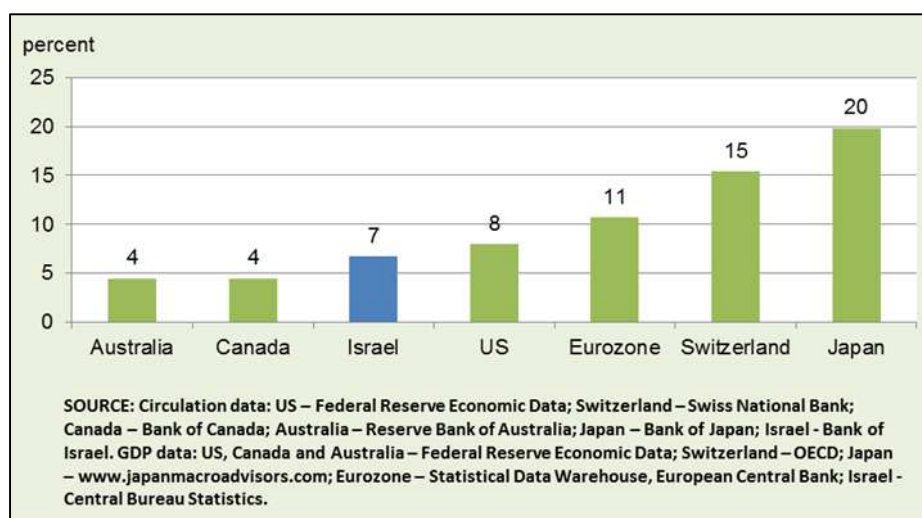
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<sup>22</sup> This possibility is generally referred to as Wholesale CBDC (or WCBDC).

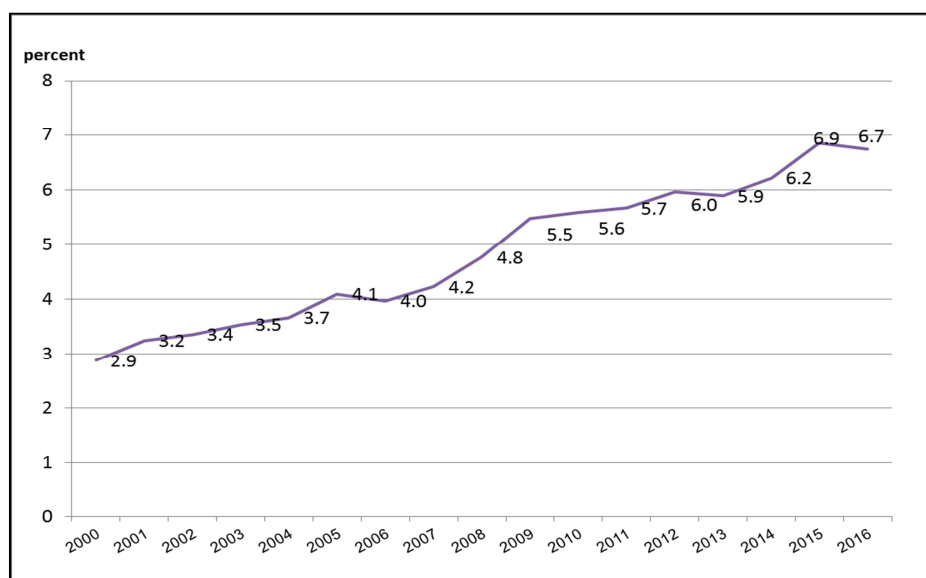
## 1. Trends in the use of cash in Israel and abroad

Cash circulation in Israel currently stands at about NIS 86 billion. The use of cash—in Israel and in most countries around the world—continues to show an upward trend. This is also reflected in the fact that the ratio between cash circulation and GDP continues to expand. In Israel, the ratio increased from 3 percent in 2000 to 7 percent in 2017, and Israel is not exceptional in this respect (Figure 2a). In the past decade, the growth rate of cash is higher than the growth rate of GDP in all surveyed countries except Sweden. Israel is in 14<sup>th</sup> place out of 16 countries surveyed that belong to the OECD.<sup>23</sup>

**Figure 2a: Cash Circulation as a Share of GDP, 2016 (percent)**



**FIGURE 2b: Cash circulation as a Share of GDP, Israel, 2000–2016 (percent)**



SOURCE: Bank of Israel.

<sup>23</sup> Federal Reserve Bank of San Francisco (2017).

## 2. The use of cash to make transactions and to hold monetary value

Cash is used both as a means of payment in the execution of transactions, and as a means of holding monetary value. The discussion of digital currency also relates to both of these dimensions.

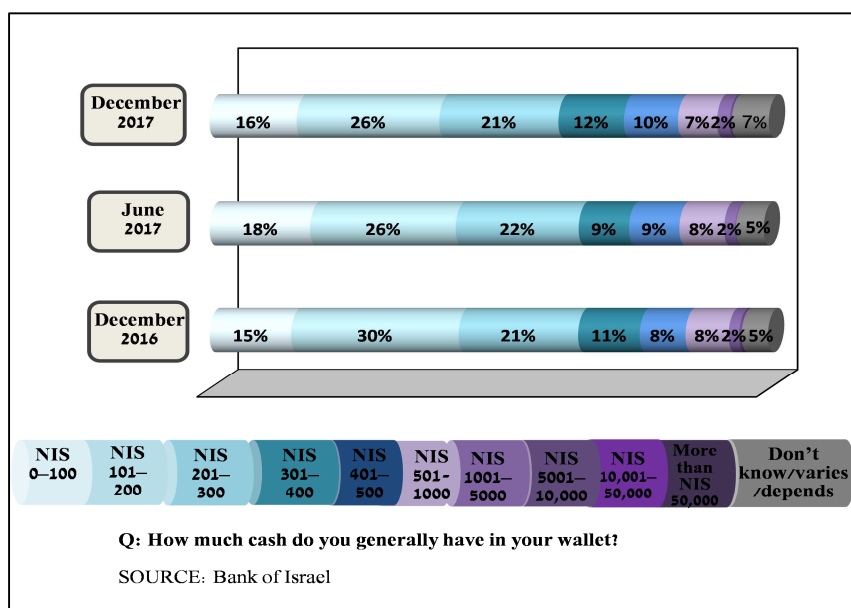
### 2.1. Holding monetary value in cash

The monetary value of cash held in circulation (by the banks and by the public) depends on macroeconomic variables and the public's preferences. The factors that explain the increase in demand for cash include higher GDP, low inflation, and low interest rates.

The extent of the public's trust in the banking system is an example of a factor that has a significant potential to influence the amount of cash held by the public. If there is concern, the public may transfer its deposits from a risky bank to other financial entities, and in certain cases, particularly when public trust in the entire banking system is impaired, the public may significantly increase its cash holdings and reduce its deposits in the banking system.

Total public demand for cash is also influenced by the frequency of cash withdrawals—cash in the hands of the public is used to carry out transactions during the period that elapses until the next withdrawal. In this context, the accessibility of means of distribution and withdrawal, as well as their cost, are significant because they affect the frequency of withdrawals, and thereby also affect the value that the public holds in its wallet. The greater the accessibility, the lower the average amount of cash that the public wants to hold in its wallet.

**Figure 3: Average Amount of Cash in the Wallet**



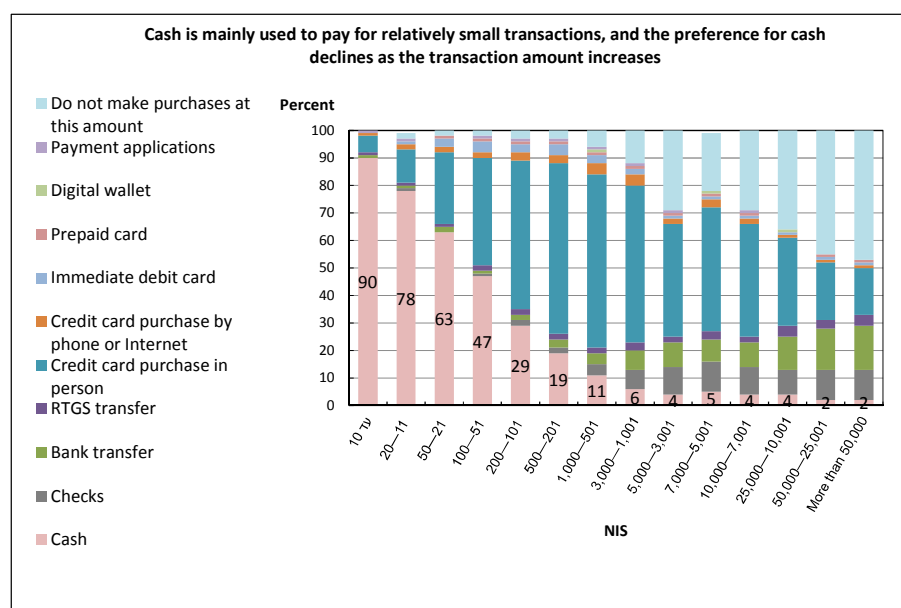
A survey conducted by the Bank of Israel raised the following findings regarding the monetary value held by the public in its wallet:

- 90 percent of the population commonly holds less than NIS 500 in their wallet (Figure 3).
- The average amount held in the wallet increased from about NIS 260 in mid-2016 to about NIS 340 at the end of 2017.

## 2.2. The use of cash to carry out transactions

The data show that cash plays a central role in Israel as a means of carrying out transactions. A survey conducted on behalf of the Bank of Israel shows that cash is used mostly for day-to-day payments of low amounts. Most of the public prefers using cash for transactions worth up to NIS 100, and the public prefers paying in cash at the market, between individuals, on taxis and on public transit. When the transaction amount exceeds NIS 500, the cash use rate is only about 10 percent, and it declines as the value of the transaction increases. For such transactions, payment is generally made by credit card, and when the amount is very high, bank transfers are generally used. The data also show that advanced means of payment—remote payment by credit card (for instance over the Internet) and digital wallets—are used relatively infrequently. The distribution of means of payment by transaction value is presented in Figure 4.

**Figure 4: Distribution of Means of Payment by Transaction Amount**



SOURCE: Bank of Israel.

## 3. What distinguishes cash from digital currency

Central bank digital currency is similar to cash in several respects. Both constitute a central bank liability, and are therefore credible and secure means of payment. Both are not only a means of payment, but also a means of holding monetary value. From this standpoint, they are similar to electronic deposits that the commercial banks currently hold at the Bank of

Israel, and they differ from existing digital means of payment such as debit cards, since the latter cannot be used to hold monetary value.

Cash has a number of unique qualities (some of which can also be ascribed, wholly or partially, to digital currency).

**- Payment by cash does not depend on technological factors:** The banknote or coin contains all of the information necessary to verify its authenticity for the purpose of settlement. In other words, the moment the payment is received and we have verified that the banknote or coin is authentic, the transaction is completed—without any dependence on technology. The lack of dependence on technology is important in a case where technological systems fail (for instance due to a cyber attack) or for instance if there is no cellular reception in the area.

**- Cash payment is immediate and final:** As stated, the moment payment is received and it is verified that the banknote or coin is authentic, the transaction is completed and final. Since a CBDC can be settled within seconds, it can mimic cash in terms of immediacy. The importance of the finality of the transaction is that it minimizes risk to the parties.

**- Users of cash do not need to meet minimum requirements:** Cash can be used by anyone, of any age (including children), and there is no need for a bank account or citizenship. (Cash is available to tourists and foreign workers as well.)

**- The use of cash is anonymous:** In many cases, it is neither necessary nor important to identify the parties to the transaction. This quality has significant advantages. It enables users to maintain full privacy; and since personal details or the details of the means of payment are not provided, such information cannot be exploited for fraudulent purposes. In contrast, anonymity can have disadvantages having to do with illegal or unreported activity.

**- Cash has emotional benefit:** A focus group consisting of people aged 20–24 generated a number of emotional benefits to cash: (1) In contrast with digital means of payment, cash is tangible, which gives rise to a sense that its value is higher; (2) Cash provides a sense of economic security both in general and because it makes it possible to deal with unexpected situations; (3) When cash income of higher-than-normal amounts is received, it creates a sense of pride in accomplishment.

**- Cash provides advantages in managing expenses:** Surveys conducted among the public show that cash helps in controlling expenses. The surveys show that this is a main factor in the public's preference of cash as well as its main advantage in the public's view.

**- A sense of convenience in the use of cash:** In a survey on habits of the use of cash, the public rated cash in third place in terms of convenience of use, and gave it a high mark on that index, which shows a positive attitude toward it. The survey showed that convenience/speed of payment and availability were considered particular advantages of cash.

**Tables 3a and 3b in Chapter 8 summarize the characteristics of cash compared with other means of payment.**

#### *4. Cost: Cash and digital currency*

The following are the main costs to the Bank of Israel, the commercial banks, businesses and households of using cash:

### **The Bank of Israel**

- Cost of issuing banknotes and coins in response to wear-and-tear and increased demand;
- Cost of storing inventory in vaults;
- Operating costs—receiving the cash and issuing it to the banks and the public, the counting and sorting process, and shipment.
- The costs of public information regarding security features.

The main cost involved in the use of cash is due to printing it. An estimate for 2018 shows that the annual cost is NIS 81.4 million—about 0.0065 percent of GDP in 2017. This does not take into account the cost of replacing the series of banknotes, since Israel replaced its series just recently, so the need for further replacement will come up only many years from now. In this context, it is worth noting that as long as cash is not completely cancelled, banknotes should be replaced every so often in order to upgrade the security features with the aim of making sure that the banknotes are a secure means of payment. This involves additional cost.

### **The commercial banks**

- Cost of shipment—shipment of cash from and to the Bank of Israel, cash centers, bank branches, and ATMs.
- Operating costs—counting and sorting, equipment (counting and sorting machines), insurance and securing of inventory, and distribution of cash to the public.

### **Businesses**

Storage of cash in vaults (including the cost of security and insurance), and shipment to and from the banks.

### **Households**

The cost to households is mainly “shoe leather cost”—the time and bother involved in going to a withdrawal point (an action that wears out shoes-hence the name of the cost).

Digital currency will save some of these costs, but some of them will remain in place since it is reasonable to assume that cash will continue to exist alongside digital currency. Moreover, the issuing of digital currency also involves costs—for establishing the system (a major but one-time cost), maintenance, supply of the necessary technological services, protection against cyber attacks, and so forth. While the operating costs involved in the supply of central bank money are not the main consideration in deciding on how to issue it, if it is decided to issue digital currency, the costs must be examined in depth.

## **b. The payment and settlement system and means of payment<sup>24</sup>**

### *1. Background: The payment and settlement systems in Israel*

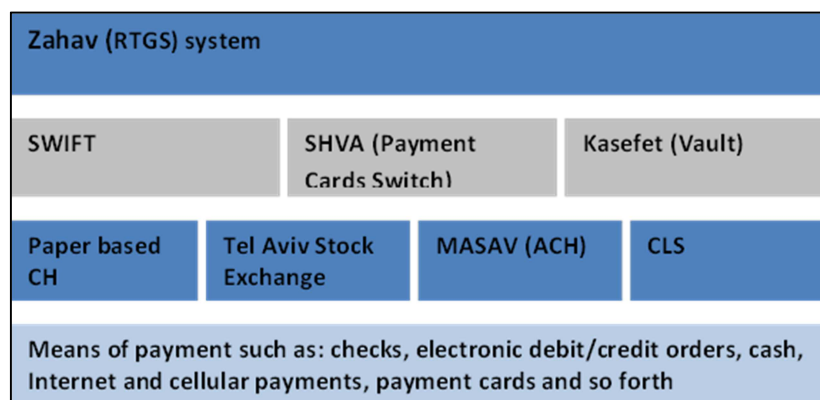
There are a number of payment and settlement systems operating within the payment array in Israel: (a) **Zahav** (an RTGS-type system), is operated by the Bank of Israel. This system serves as final settlement for all payment and settlement systems in Israel. (b) **Paper-based clearing house** (check clearing house), which is also operated by the Bank of Israel. This

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<sup>24</sup> An up-to-date and comprehensive review of the payment and settlement system in Israel appears at: <https://www.boi.org.il/en/NewsAndPublications/PressReleases/Pages/22-1-17.aspx>

system settles checks and collection vouchers. (c) **Credits, debits and payment transfers system**, operated by Masav (bank settlement system). This is an electronic system that transfers interbank shekel transactions that are not final, such as standing bank orders, salary payments, tax payments, and so forth. (d) **Payment card services**, which is operated by Shva (automatic bank services). This system deals with the approval, gathering and processing of transactions made in Israel by payments cards. (e) **Automatic bank machines system**, which is also operated by Shva. This system deals with the network switching of cash withdrawal ATMs. (f) **Stock Exchange clearing house** (securities clearing house and Maof clearing house). These systems settle the results of trading on the stock exchange. (g) **Continuous Linked Settlement (CLS)**, an international clearing house for currency conversion transactions. This system provides multicurrency settlement service through a mechanism that ensures payment in one currency against payment in another. The shekel joined this system in 2008, and the system currently settles 18 currencies.

**Figure 5: The Payment and Settlement System**



SOURCE: Bank of Israel.

	Payment System
	Communication infrastructure
	Means of payment

## 2. Other means of payment

Discussion of an e-shekel must include discussion of all existing and planned means of payment, examining whether any of them have characteristics that would make the e-shekel redundant.

Consumers and merchants differ as to what characteristics are important to them in a means of payment. It is important for merchants that the means of payment ensure them secure payment, be held by as many consumers as possible, enable immediate crediting, and provide the business with a high level of liquidity and proper recording in the books. For households, it is important that the means of payment enable easy and convenient use, with accessibility, low transaction cost, and low risk of loss, among other things.

**Tables 3a and 3b in Chapter 8 summarize the advantages of the various means of payment**—cash, CBDC, immediate payment, checks and various kinds of payment cards—from the points of view of consumers and merchants.



### 3. *Issuing digital currency given the infrastructure for settling immediate payments*

As stated, a few countries operate faster payments infrastructure, and the Bank of Israel has begun examining and advancing the establishment of such infrastructure in Israel. In November 2017, the Bank of Israel published a call for public consultation on the subject<sup>25</sup>, and established an internal interdepartmental team to examine the positions of various entities on the matter.

Faster payments is a relatively new means of payment. The payer is debited immediately, and the payee is credited immediately, such that he can use the money immediately. From this standpoint, faster payments is similar to cash, and different from most other common means of payment, since with those, the credit is not immediate.

Faster payments can provide a response to a significant portion of the existing needs in the Israeli payments market, and has many advantages:

1. It is similar to cash:
  - a. Rapid
  - b. Available 24/7
  - c. Easy and convenient. It is based on an advanced payment application, and enables, for instance, the use of telephone numbers from a contacts list instead of keying in the beneficiary's bank account details.
2. It increases liquidity and lowers credit costs for merchants.
3. The payments infrastructure can be used by all payment applications—a kind of “freeway” that all payment applications can use together securely. Thus, we will be able to transfer payments among the various applications while having only one application on the phone.
4. It will enable the existing payment applications to upgrade their activity, since the beneficiary will be credited with the transfer amount immediately, and not the following day.
5. It will lower transaction costs.
6. Competition in the payment system is expected to increase because new actors will enter and offer solutions to carry out immediate transactions along the entire transaction execution chain.
7. The redundancy in the payment system in Israel will increase, since a switch for transactions through advanced means of payment (those not based on payment cards) will be advanced.

The implementation of faster payments in Israel is expected to affect the volumes and trends of the use of all means of payment common in Israel, paper-based and otherwise. Such a trend has been observed in countries that have implemented it. There were marked increases in the rate of transactions executed through digital means of payment, and declines in the volume of transactions executed through paper-based means of payment, particularly small transactions. We expect to see a more moderate effect on the means of payment geared mainly to large transactions or pre-arranged (and periodically repeating) transactions—such as electronic credit orders, electronic debit orders, and Zahav (RTGS) transfers.

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<sup>25</sup> <https://www.boi.org.il/en/NewsAndPublications/PressReleases/Pages/15-11-17.aspx>

### c. The effect on the central bank's balance sheet

The issuing of digital currency may also have an effect on the central bank's balance sheet. The central bank does not operate on a for-profit basis, but rather aims to achieve the economic objectives for which it is responsible. However, if there are significant changes to its balance sheet, they may have an effect on its ability to fulfill its functions. The cash issued by the bank appears on the liabilities side of the bank's balance sheet. If the issuance of digital currency increases total demand for central bank money, it will be reflected in an increase in its liabilities and a matching increase on the assets side—in foreign exchange or domestic currency.<sup>26</sup>

It is reasonable to assume that if the Bank of Israel decides to issue digital currency, it will continue to manage monetary policy similar to the way it manages it today, and will continue to absorb excess liquidity in the banking system through monetary tools. Therefore, in this context, the issuance of an e-shekel is not expected to significantly affect the Bank's balance sheet.

In a less-likely scenario, where the Bank of Israel decides to manage an e-shekel account for any interested resident, there may be significant changes to the Bank's balance sheet. Residents' accounts will in practice constitute an alternative—at least partially—to current accounts at banks, since the difference between central bank money and a current account will narrow considerably, which will apparently lower demand for maintaining current accounts at commercial banks. The effect on demand for current accounts at commercial banks depends particularly on the decision of whether the digital currency will bear interest and under what terms.

The issuance of an e-shekel is also expected to have an effect on the central bank's income and expenses, as well as on its profit and loss statement, which will be affected through a number of items:

The cost of managing banknotes and coins: Cost savings include expenses involved in physical money—issuance, holding, security and shipping (expenses that will only decline, but will not be eliminated entirely if physical money continues to exist alongside digital currency). Costs include the price of establishing the new computer system (one-time cost) and regular maintenance.

On the Bank of Israel's 2017 balance sheet, expenses for printing banknotes and minting coins reached about NIS 200 million (including expenses on the new series of banknotes), while in previous years these expenses were lower than NIS 100 million. Therefore, if we completely abolish cash, we would save less than NIS 100 million per year, and if we partly abolish it, we would save even less. These are not significant amounts relative to the Bank of Israel's total expenses or from the viewpoint of the economy.

The cost of establishing and maintaining the digital currency system: A distinction must be made between two situations: (1) Digital currency will be managed through accounts in the commercial banks or other financial institutions. In such a situation, the Bank of Israel will act vis-à-vis the banking system similar to the way it does so today, and the only cost will be in establishing the system and regular maintenance. (2) Each citizen will maintain an account at the central bank. In this case, the establishment and management of the system will be complex, and it is difficult to estimate the expected costs.

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<sup>26</sup> See also Section 6, which discusses the effects on monetary policy.

Seigniorage profits: The Bank of Israel's total balance sheet in 2017 was about NIS 400 billion. The "banknotes and coins in circulation" item was about NIS 80 billion, about 20 percent of the balance sheet. Money in circulation is basically a kind of bond that the central bank issues that bears no interest. We can say that the seigniorage profits are equal to the interest that the bank would have to pay to absorb this amount. Under current interest rates (0.1 percent), this amounts to just NIS 80 million a year, but the amount will increase with higher interest rate environments. If the digital currency does not change the total demand for central bank money—whether in the form of cash or digital currency—there would also be no change in the seigniorage profits. If it increases demand, the seigniorage profits can be expected to increase. Implementing advanced means of payment that will lower demand for central bank money is expected to lower the seigniorage profits.

#### **d. The effect on the banking system**

One of the main issues in the discussion of digital currency focuses on its possible impact on the financial system, and particularly on the banking system. Since no one has any experience in this area, it is very hard to assess the scope of the impact or its macroeconomic or prudential significance.

In this discussion, we assume that all individuals will be able to make retail use of the e-shekel.<sup>27</sup> A digital currency accessible to all is expected to have a significant impact on the banking system, with the impact depending to a large extent on the particular specifications of the currency, and particularly on whether it will bear interest and whether it will be anonymous.

From the standpoint of the users, CBDC is closer to bank deposits than to cash, so issuing it will increase competition between the central bank and the commercial banks. If it does not bear interest, it will be more a means of payment, and can therefore be expected to serve as an alternative to the payment service provided by the banks. If it does bear interest, it would constitute a closer alternative to interest-bearing deposits, and can therefore be expected to have a greater impact on the supply of deposits to banks. Such a currency will increase the cost of sources for the banks, since they will need to raise deposits at a higher interest rate or hold other, more expensive, assets as a source of credit, and therefore may increase the interest rate on credit.<sup>28</sup> The banks will not be able to offer a lower interest rate on deposits than the rate they receive on digital currency, and they may need to offer higher interest because the bank deposit involves a higher risk than CBDC. If the currency bears interest, it will increase the central bank's involvement in financial intermediation, and may reduce the commercial banks' involvement.

If the currency does not bear interest but is anonymous, even if only in limited form, it will also be a partial alternative to a bank deposit and may lower the supply of deposits to banks, and thereby lower their sources of financing.

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<sup>27</sup> A wholesale currency that is accessible only to financial institutions is expected to have a moderate impact on the banking system, since the banks already have digital access to the central bank. It is expected that such a currency will improve the efficiency of the payment system and perhaps also increase competition with nonbank financial institutions to which the currency will be made accessible.

<sup>28</sup> Koomhof and Noon (2018) show that digital currency will not harm the banks' ability to provide credit if it has certain characteristics, such as variable interest payments, an inability to convert it to reserves, and a lack of obligation to convert bank deposits to it.

Digital currency will therefore have an impact on the banks' operations during routine times, but it will also have an impact on the dynamic during crises. It will enable a more rapid "run on the banks" in order to convert deposits to central bank money, and may therefore increase the intensity of the crisis.<sup>29</sup>

It is worth mentioning that issuing digital currency will require an amendment to legislation with the aim of adapting the financial system to its unique characteristics.

#### **e. The effect on the foreign exchange market and capital movements**

According to the prevalent assessment, the use of DLT technology, including for CBDC, is expected to make cross-border capital movements more efficient. The improvement is expected to be reflected in both the duration and the costs of transferring money. It seems that the business sector believes that CBDC will serve to a large extent as an intermediate means, a kind of token that will make it possible to carry out transactions with distributed technology, and will serve as a risk-free tool for converting various national currencies. While it seems that the ability to streamline transactions does not have a central place in the overall considerations in favor of investing in a particular currency, if some CBDC serves as a token in many international transactions, it could affect its value.

The transition from cash to digital currency is not expected to have a significant impact on the foreign exchange market, since most of the (legal) activity is in any case already done through digital means and not cash. However, issuing CBDC alongside the use of new technologies may significantly shorten the time necessary to confirm and settle inter-currency transactions, and thereby lower their cost significantly. A separate examination should be made of how CBDC may impact illegal cross-border transactions.

All in all, it seems that issuing digital currency is not expected to significantly impact the exchange rate and/or the openness of the foreign exchange market. We heard similar assessments in discussions we held with other central banks and market players.

#### **f. The effect on monetary policy**

The Bank of Israel conducts monetary policy in the framework of an inflation target. The Bank uses the tools available to it, mainly the interest rate, in order to achieve the inflation target. In order to maintain the interest rate that it sets, the Bank adjusts the supply of liquidity by injecting (absorbing) liquidity to (from) the banking system, and through activity in the open market (issuing *makam*).

The monetary base is comprised of cash held by the public and the banks, and deposits that the banks hold in order to meet their liquidity requirements. Even now, the central bank allows the banks to hold these deposits with it digitally (as it does for interest-bearing deposits). Therefore, issuing an e-shekel would mean that another part of the monetary base would become digital. Since it is reasonable to assume that cash in its current form will not completely disappear in the coming years, it will also continue to be part of the monetary base.

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<sup>29</sup> In order to lower this risk, the withdrawal of digital cash can be limited, for instance.

In general, we can say that the change in the composition or volume of the monetary base as a result of issuing an e-shekel is not expected to have a significant impact on the transmission mechanisms of monetary policy, since the Bank of Israel would issue it by demand, as it currently issues cash. In other words, the central bank will provide any requested quantity of digital currency or of cash. Moreover, the monetary base is not a significant indicator of how policy is conducted. Policy is set according to an assessment regarding the central bank interest rate's effect on demand, inflation expectations, and the exchange rate, and as a result on the possibility of achieving and maintaining the inflation target.

However, if the share of bank intermediation declines and the public increases its holds of means of payment that constitute the central bank's direct liability, it may strengthen the transmission of monetary policy. It will have a direct and independent (or less dependent) effect on the banks' responses to policy.

**The effect on demand for money:** Digital currency will enable electronic payments, similar to other advanced electronic means of payment such as debit cards or payment applications that require a current account at a commercial bank. In contrast with a bank account, CBDC involves no risk—the central bank's liability will always be honored—giving the digital currency an advantage over a demand deposit at a commercial bank. In contrast, digital currency will provide less anonymity than cash—if any, depending on the particular specification—which will contribute to lower than current demand. Over all, it is unclear what the net impact will be on demand for central bank money—cash or digital currency.

**Implications of interest payment:** One of the main questions concerning the characteristics of digital currency is whether it will bear interest. Since digital currency would be a good alternative to deposits in banks, the banks would need to pay interest on deposits (including demand deposits) at the same level as for digital currency, even though they need to hold liquidity against deposits, which increases their costs (See Section 3.3 in Dyson and Hodgson, 2016). An interest-bearing digital currency will change the interest rate structure in the market, and may strengthen the transmission from policy to retail interest rates, since it may also improve the ability of nonbank institutions to offer credit.<sup>30</sup>

There are those who argue that digital currency will make it possible to solve the Effective Lower Bound (ELB) problem, since the central bank will be able to set a negative interest rate for it, thereby enabling a more accommodative monetary policy when necessary. However, since it is reasonable to assume that cash will continue to exist alongside the digital currency, those holding digital currency will be able to convert it to cash in the event of a negative interest rate on digital currency, and the ELB problem will remain. If the digital currency does not bear interest, the ELB problem would actually become worse, since holders of digital currency would find it much easier, and at a lower “storage” cost, to avoid the negative interest rate by moving from bank deposits that are assigned a negative interest rate to the digital currency.

**“Helicopter money”:** The theoretical monetary literature discusses the possibility of quantitative easing through “helicopter money”. In such a situation, the central bank increases the supply of money directly to the public without the intermediation of financial institutions. Current monetary accommodation operates through the financial institutions, so in a crisis, such

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<sup>30</sup> See also Meaning, Dyson, Barker and Clayton (2018).

as the beginning of the Global Financial Crisis, the monetary accommodation does not reach the public, and the transmission of policy is impaired.

Digital currency will improve the applicability of “helicopter money”—the distribution of liquidity directly to households—although it will of course be necessary to deal beforehand with many operational problems. Dyson and Hodgson (2016) discuss the possibility of distributing digital money to the public, thereby incentivizing the public to use the innovative means of payment. This possibility gives rise to a series of further questions, such as whom to distribute the money to and how much of it, and whether it can be done before all citizens have a digital wallet. However, it is still too early to discuss these questions.

**Table 4 in Chapter 8 summarizes the possible effects of digital currency—advantages and disadvantages/difficulties.**

## 7. Technology

In order to operate a digital currency, the Bank of Israel will need technologies that make it possible to issue the currency, trade in it, maintain its data in a secure database, manage a secured communications network, and ensure connectivity between the network and the various financial entities.

The digital currency would be issued through a mechanism that only the central bank would operate. This mechanism would make use of means of encryption that would create a unique code for each coin. Each coin would initially be ascribed to the cryptowallet of the coin’s holder, in order to prevent duplication or counterfeiting of the coins.

The technology that would enable trading may be derived from alternative architectures that would differ in terms of the extent of distribution of the database, the anonymity that they provide, and the number of transactions that can be made at a given time.

Trading in the digital currency can be enabled on a nondistributed (central) platform: The central bank would operate a central database, and grant access to it to the various financial entities in order to verify and document transactions. This alternative is simple to manage and implement, but it creates a failure point in a platform that must be active at all times, without any downtime.

Alternatively, the data can be distributed between the Bank of Israel and various entities in the financial system over a private network, meaning a network with a limited number of participants whose identity is restricted. This structure is referred to as a “federation of participants”, and is basically a closed group of participants. The distribution of data will inoculate the system against counterfeiting by verifying each transaction, downtime would be close to zero, and the level of security would be high thanks to the use of encryption keys. Various levels of anonymity can be chosen and defined for activity on the network.

Alternatively, the use of an open distributed platform can be considered, although this possibility is less reasonable in the context of CBDC. An example of such a platform is the blockchain network used for trading in bitcoin. The blockchain underpinning the bitcoin is a public network with no unique access mechanism: Anyone can participate in it and verify transactions.

There are distributed platforms that are able to run “smart” contracts, meaning virtual agreements that define the business logic that would run on the distributed network, the officers, and the functions they are allowed. For instance, on the network on which the CBDC would trade, it would be defined that only the central bank is permitted to create more coins, and the actors that could trade in them, as well as all the rules that the central bank wants to enforce, would be defined.

There are various distributed platform types, which differ from each other in their technological readiness, their ability to work on a private network (some of them work only on the Internet), the number of transactions they can process at a given time, how the data is kept, their ability to run smart contracts, the algorithm for approving and verifying transactions (consensus), and their development language.

The technological solution for the digital currency will need to enable trading in two states: (1) online—meaning when a connection to the Internet is possible and when trading between various entities and verification of transactions is enabled; and (2) offline—meaning when it is not possible to connect to the network for various reasons (such as a network failure). In order to enable this, a mechanism can be built to manage identities, for instance, which would ensure the fulfillment of the transactions.

## 8. Tables

**Table 1: Possible objectives of Central Bank Digital Currency**

Objective	Explanation	Comments
Main objectives		
Maintaining access to the central bank's liability	This objective is based on the principle that citizens should be allowed direct access, without intermediaries, to risk-free means of payment that constitute a central bank liability. Reduction in the use of cash may have a negative impact on this principle.	In Israel, the use of cash is not declining to the extent that it creates difficulties.
Maintaining the stability and efficiency of the payments system	The issuance of a digital currency means an additional, efficient and convenient advanced means of payment, increased competition in the payments system, and increased redundancy in the payments system by establishing an additional payments system.	Israel has begun examining and advancing the establishment of a faster payments system. This system will be able to generate a platform for additional uses, such as digital currency.
Additional monetary tool	Central bank digital currency will improve the transmission between monetary policy and the financial markets.	As long as cash also exists, it will be hard for the central bank to set a negative interest rate, since the public will be able to move easily to cash.
Adaptation to the advanced technological environment and reducing the costs of issuing money	Technological advances allow the central bank to issue its money in the most advanced and efficient manner.	There is tremendous uncertainty regarding the costs of establishing, securing, backing up, and maintaining a digital currency system. In the foreseeable future, the central bank will need to continue issuing cash as well at some volume. The cyber risks that will be created with the transition to digital currency must also be taken into account.
Additional benefits		
The financial system	Digital currency can contribute to increased competition in the financial system.	Alongside the benefits of increased competition, the risk to the stability of the system must also be taken into account.
Support and advancement of fintech	Israel excels with an active and advanced fintech sector, and a digital currency could support and advance that field.	This is not the central bank's main function.
War on the shadow economy	Transitioning from cash to electronic means of payment will reduce the ability to hide income, and will support the struggle against the shadow economy.	It can be argued that other advanced infrastructures, such as the faster payments system, can achieve the same objective. In this context, we can derive an advantage from digital currency only if we decide that it will not have complete anonymity. In this case as well, it is possible that the benefit derived will be insignificant, since the entities interested in anonymous and illegal payments will continue to use cash, which will continue to exist alongside the digital currency.
Adaptation to advances in other advanced economies	If other countries decide to issue digital currency, it may have an impact on the global financial system, and on Israel as well.	It is important to follow the discussions being held by other central banks. The team found that when a country activates a faster payments system, it is a consideration against digital currency.



**Table 2: Possible characteristics—advantages and disadvantages**

	Advantages	Disadvantages
<b>Extent of anonymity</b> (Partial is also possible)	<u>Full anonymity</u>	
	Maintains privacy, similar to cash. Enables issuance without keeping detailed information at the central bank	Presents technological and legal challenges, since it is not consistent with the effort to reduce illegal money and money laundering.
	<u>No anonymity</u>	
	Helps in reducing the shadow economy. Enables the collection of statistical information for decisions made by the central bank and various government agencies.	Negative impact on privacy. Requires the keeping of detailed information by the central bank or an agency on its behalf.
<b>Does it bear interest?</b>	<u>Not interest bearing</u>	
	Similar to cash. Used as a means of payment and maintains the ability to be used as a unit of account.	Will make it hard to set a negative interest rate on deposits since it would be easier to move to it than to cash. Its risk is lower than the risk of an interest-free deposit at commercial banks, so it creates some competition with them.
	<u>Interest bearing</u>	
	Can be an additional tool for monetary policy makers, particularly in setting a negative interest rate (on condition that there is no cash alongside it in the economy).	Creates more significant competition for the banks in the area of deposits, so it may have a negative impact on the stability of the financial system. The central bank becomes an intermediary. It should be examined whether it would also offer credit. If yes, it would need to build complex mechanisms to assess and monitor risk. Loses the basic quality of cash – fixed (nominal) value. As long as cash exists, a negative interest rate for the digital currency cannot be set.
<b>Method of issuance</b>	<u>Balance-based</u>	
	Enables full identification of holders and transactions.	Requires that the central bank keep detailed information. This can be done through agents or intermediaries. It will be necessary to examine who the agents would be—the public sector or the private sector, the banks, or other entities.
	<u>Value-based</u>	
	Enables a greater extent of anonymity to be set	Does not enable the payment of interest, and cannot be used as a monetary tool. May be less secure in maintaining value.
<b>Technology</b>	<u>Distributed DLT system (closed network with a role for the central bank)</u>	
	A more resilient system against attack. Makes it easier to coordinate between various entities.	The technology is still not sufficiently mature and stable. The technology may change in the future, which would require significant adaptation of the systems.
	<u>Central Ledger</u>	
	Known technology. May have a current advantage in making transactions and transfers.	The technology may become outdated. Makes it difficult to coordinate between various entities. Easy to attack the system since just one failure point is sufficient.

**Table 3a: Characteristics of means of payment from the consumer's standpoint**

Characteristic	e-Shekel	Cash	Immediate payment	Immediate/deferred debit card	Prepaid card	Negotiable check
State liability	Yes	Yes	No	No	No	No
Means of holding monetary value	Yes	Yes	No	No	Yes	Yes
Means of increasing the quantity of money during emergencies or financial crisis	Yes But not when there is a technological/energy failure	Yes There may be operational restrictions during a crisis	No	No	No	No
Dependent on technology to increase the quantity of money	Dependent on the model – can use technology that also enables offline activity	No  Can be distributed without depending on technology	--	--	--	--
Means of distribution	Digital	Physical	Digital	--	--	--
Dependent on the banking system	Dependent on the model	Distribution – Yes; Making transactions – No	Yes	Yes	Depends on the type of card	Yes
Dependent on technology	Yes	No	Yes	Yes	Yes	No
Easy to use	Yes  For the digitally literate	Yes	Yes	Yes	Yes	Yes
Accessible	Yes  To those with access to supporting technological means	Yes	Yes	Partial  To those with a bank account. Deferred debit is not accessible to all.	Yes	Partial  To those with a bank account.
Anonymous	Possibly partial	Yes	No	No	Depends on the type of card and the amount	Partial – depends on the amount
Immediate and final	Yes	Yes	Yes	Immediate debit card – Yes  Deferred debit card – No.	No	No
Dependent on a bank account?	No	No	Yes	Yes	Depends on the amount	Yes

**Table 3b: Characteristics of means of payment from the merchant's standpoint**

Characteristic	e-Shekel	Cash	Immediate payment	Immediate/deferred debit card	Prepaid card	Negotiable check
Easy to implement	?	Yes	Partial	Yes	Yes	Yes
Redemption is safe	Yes	Yes	Yes	Yes	Yes	No
Payment is immediate and final	Yes	Yes	Yes	No	No	No
Requires physical storage	No	Yes	No	No	No	Yes
Requires shipment	No	Yes	No	No	No	No
Enables use during emergencies	Depends on the technology	Yes	Possibly	Possibly	Possibly	Yes

**Table 4: e-Shekel – advantages and disadvantages**

Aspect	Advantages	Disadvantages / Difficulties
<b>Payment systems</b>	<p>Implementing digital currency in the payments system is among the functions of the Bank of Israel, since the Bank is tasked with streamlining the payments systems and advancing effective and reliable means of payment, including alternatives to cash.</p> <p>Establishing a dedicated payments system for settling digital currency would add to redundancy in the payments system in Israel.</p> <p>Establishing the system would reduce concentration in the payments system and make it possible to streamline it and increase competition in it.</p>	<p>Involves cost—whether due to the establishment of dedicated settlement infrastructure or due to the conversion of an existing system. There would also be costs due to the application of the system with intermediaries and merchants.</p> <p>Digital currency may not be necessary if there is an immediate payment system in the economy.</p> <p>There would be costs to the banking system and the business sector, and at this stage it is difficult to estimate what those costs would be.</p>
<b>Effect on the central bank</b>	<p>Digital currency may reduce the costs associated with the issuance of central bank money.</p> <p>Issuing digital currency would reduce the risk to the ability to manage monetary policy as a result of reduced use of cash (less relevant to Israel).</p> <p>Digital currency would reduce the negative impact to seigniorage as a result of reduced use of cash (less relevant to Israel).</p> <p>Digital currency may serve as an additional monetary tool (depending on how it is defined, particularly regarding whether it will bear interest). CBDC creates the theoretical possibility of implementing a “helicopter money”.</p>	<p>There would be costs (unknown at this stage) for establishing and maintaining the system, protection against cyber attacks, and adopting and upgrading technology.</p> <p>There may also be costs if another country decides to issue digital currency that is legal tender.</p> <p>If demand for currency increases, it would increase the central bank’s balance sheet.</p> <p>A failure of digital currency may have a negative impact on the central bank.</p>
<b>Access to central bank money</b>	<p>Digital currency would maintain the public’s access to risk-free money that is a central bank liability, if demand for cash declines or disappears.</p>	<p>Digital currency requires technological intervention.</p> <p>Such currency may create difficulty for certain groups or even exclude them from the general public that would use CBDC.</p> <p>Digital currency is not immediately necessary, since it appears that cash will not disappear in the foreseeable future.</p>
<b>Effect on the economy – in general and during emergencies</b>	<p>Digital currency can help in reducing the shadow economy.</p> <p>The currency may help in the development of fintech in Israel.</p> <p>Making means of payment more efficient is expected to contribute to an increase in GDP and in well-being.</p> <p>Digital currency can serve as a backup to cash if cash cannot be distributed due to emergency (technologies enabling offline transactions are possible).</p>	<p>Digital currency cannot serve as a backup when the economy experience a broad communication failure (during a disaster).</p>
<b>Effect on the banking system and the financial system</b>	<p>Competition in the financial system would increase as a result of the entry of new actors.</p> <p>An opportunity would be created to assimilate advanced technologies.</p>	<p>Digital currency may make it difficult for banks to raise sources, thereby making them more expensive.</p> <p>Issuing digital currency would increase the possibility of a run on the banks, and of withdrawing cash rapidly. However, this can be overcome by limiting the amount of a withdrawal.</p> <p>Digital currency may have a negative impact on the stability of the banking system.</p> <p>Issuing digital currency would create the need to adjust financial legislation to it.</p>
<b>Effect on households and businesses</b>	<p>Growth and the well-being of individuals would increase because this would be an immediate, convenient, available and rapid means of payment, and because the costs involved in executing a transaction would be lower for both households and businesses.</p>	<p>Digital currency may lead to undesirable effects in some parts of the public (concern of a “Big Brother”, fear of technology, concern over the theft of money and cyber incidents, and so forth).</p> <p>The ability to make transactions would be negatively impacted among population groups that do not adopt the technology.</p>

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## Appendix: Broad survey of global developments in the CBDC field

Country	Stage in reference to digital currency	Date information obtained	Reference
Australia	The central bank does not intend to issue digital currency in the foreseeable future, but it has begun research to examine the advantages and disadvantages of doing so.	January 2018	<a href="#">Reference 1</a> <a href="#">Reference 2</a>
Canada	Canada is examining the implications of issuing CBDC, as well as the feasibility of a DLT-based wholesale payments system (Project Jasper). The Bank of Canada believes that it must continue to study the implications of issuance and the various alternatives to CBDC, and that DLT is not sufficiently ready for use as infrastructure for the payments system.	April 2018	<a href="#">Reference 1</a> <a href="#">Reference 2</a> <a href="#">Reference 3</a>
China	China has successfully completed a simulation examining the use of DLT-based digital currency in transfers between the central bank and commercial banks. The Chinese deputy governor's assessment was that his country would issue CBDC, it would be concentrated and not distributed, and would therefore not be based on DLT.	January 25, 2018	Reference 1: The People's Bank of China, "Annual Report, 2016", p.77. <a href="#">Reference 2</a> <a href="#">Reference 3</a> <sup>32</sup>
Denmark	The central bank analyzed the Danish economy and concluded that there is no need for digital currency. First and foremost, Denmark has an immediate payment system from demand deposits, which enables fast and convenient transactions. Second, each Danish citizen has access to a payments account. Last, the central bank is not interested in competing with the commercial banks.	December 15, 2017	<a href="#">Reference 1</a>
Ecuador	In 2015, the country issued digital currency that is not DLT-based, and linked it to the official currency—the dollar. The main motivation was the desire to save operating costs of the physical dollar. However, the public did not trust the currency, and preferred to continue using the dollar, leading to the failure of the project.	March 13, 2018	<a href="#">Reference 1</a> <a href="#">Reference 2</a> <a href="#">Reference 3</a>
Eurozone	Officials in the eurozone currently see no need for issuing CBDC, since the use of cash is not declining, and because a faster payments system is coming online this year. Moreover, they do not view DLT technology as a reliable alternative for maintaining records. However, the ECB is studying a number of alternatives to CBDC and examining their implications. The study is focusing on the specifications of the currency and on testing the need for issuing it, and is not focusing at this stage on the technological-implementation aspect.	September 12, 2018	<a href="#">Reference 1</a> <a href="#">Reference 2</a>
Finland	Finland is at the initial research stages. They see the need to examine how digital currency will affect the private market, financial stability, and so forth. The central bank assumes that they will not use DLT, and they argue that it is reasonable to assume that it is currently more efficient to manage records through a central body.	May 2017	<a href="#">Reference 1</a>
Hong Kong	Officials in Hong Kong believe that the market has an efficient payments system and that CBDC will not significantly improve that efficiency. However, they have announced that they intend to continue studying the matter.	May 30, 2018	<a href="#">Reference 1</a>
India	The central bank established a team to study and provide direction concerning the feasibility of CBDC. The bank intends to participate in the international forums organized by the BIS in this area.	April 5, 2018	<a href="#">Reference 1</a>
Iran	Iran has declared that it will begin research and development with the aim of issuing state-backed digital currency. The motivation is in their desire to bypass future financial sanctions.	February 21, 2018	<a href="#">Reference 1</a>

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<sup>32</sup> The link is to an interview in Chinese.

Country	Stage in reference to digital currency	Date information obtained	Reference
Italy	Italian officials view CBDC as an important topic for study, but currently believe that moving to CBDC will make only a negligible improvement to efficiency in the economy. They further argue that issuing CBDC will bring the economy closer to “narrow banking”. It should be noted that it is reasonable to assume that within the eurozone, the ECB would be the one to issue the currency, and not the central bank of a particular country.	June 7, 2018	<a href="#">Reference 1</a>
Japan	The central bank is studying digital currency, but does not currently view a need for it, since there is no demand in the country for currency that is not physical. Private banks are initiating a currency to create competition with the currency issued by online shopping giant Alibaba.	October 4, 2017	<a href="#">Reference 1</a> <a href="#">Reference 2</a>
Lithuania	The Bank of Lithuania announced that it would issue a digital currency based on blockchain or a similar technology this year, but it has not yet done so.	March 6, 2018	<a href="#">Reference 1</a>
Marshall Islands	The Marshall Islands is very close to issuing a digital currency that would be legal tender, alongside the US dollar, and the value of which would be pegged to the dollar. The currency would not be anonymous, so that the Marshall Islands does not become a tax shelter. The country is interested in monetary independence, but the IMF has recommended that it not issue its own currency, since such a step could actually have a negative impact on financial stability.	September 16, 2018	<a href="#">Reference 1</a> <a href="#">Reference 2</a> <a href="#">Reference 3</a>
New Zealand	Similar to most advanced economies, officials in New Zealand argue that more research is required in order to properly assess the advantages and disadvantages of issuing CBDC.	June 2018	<a href="#">Reference 1</a>
Norway	Research has begun to assess the ideal form of future money. The Norwegians expect that cash will not disappear in coming years, and assume that the public’s deposits with commercial banks will remain the most common means of payment in the country.	January 2018	<a href="#">Reference 1</a> <a href="#">Reference 2</a>
Russia	Russia is interested in issuing electronic currency in parallel with the ruble. Exchange for rubles will be of free and unlimited through the Russian authorities. If a citizen cannot explain the source of the money for a transaction, he will be required to pay a 13 percent tax.	March 13, 2018	<a href="#">Reference 1</a>
Singapore	A project has begun to examine the feasibility of CBDC and to assess the implications of DLT-based CBDC. At this stage, the project is focusing on the specification of blockchain-based infrastructure in the banking system. Officials do not currently see a need for issuing CBDC.	January 17, 2018	<a href="#">Reference 1</a> <a href="#">Reference 2</a> <a href="#">Reference 3</a>
South Africa	The Khokha project to examine a DLT-based wholesale payments system was completed successfully. During the simulation, the system successfully managed a daily transaction volume on a DLT infrastructure. South Africa is showing willingness to continue examining the issue.	June 5, 2018	<a href="#">Reference 1</a>
South Korea	South Korea established a team to examine CBDC.	January 10, 2018	<a href="#">Reference 1</a>
Sweden	Sweden is considered the pioneer in research in the field, but has not yet reached the stage of implementation. The Swedish e-Krona project was divided into three stages: At the end of the first stage, a general proposal was formulated for the structure of the currency and the entire system. In October 2018, the Riksbank published a second report, which recommended examining technological solutions for implementing the e-Krona.	October 26, 2018	<a href="#">Reference 1</a> <a href="#">Reference 2</a> <a href="#">Reference 3</a>

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Country	Stage in reference to digital currency	Date information obtained	Reference
Switzerland	The central bank believes that CBDC is not essential to the Swiss economy. CBDC “is not necessary to ensure an efficient system for cashless payments”, and the private sector may be able to supply demand.	April 5, 2018	<a href="#">Reference 1</a>
Thailand	The governor of the central bank of Thailand announced Project Inthanon—a future project in conjunction with the commercial banks that aims to examine interbank transfers through a wholesale CBDC.	June 5, 2018	<a href="#">Reference 1</a>
UK	The Bank of England began a multiyear study intended to examine the implications of issuing digital currency, and established a team for the purpose. The main motivation is in the need to provide the public with a risk-free asset like cash but convenient and rapid like electronic means of payment. In view of the complexity of the issue, the central bank’s assessment is that it will not issue CBDC in the coming years, but they are continuing with the in-depth and comprehensive study.	February 25, 2018	<a href="#">Reference 1</a> <a href="#">Reference 2</a> <a href="#">Reference 3</a>
US	The Federal Reserve is interested in the possibility of implementing blockchain technology in various markets more than it is in issuing digital currency (FedCoin) to complement or replace the dollar. The Fed does not currently see a need for issuing digital currency, since its assessment is that the banking system is sufficiently efficient and innovative, and that demand for cash is not declining, in contrast with the situation in Sweden.	May 15, 2018	<a href="#">Reference 1</a> <a href="#">Reference 2</a> <a href="#">Reference 3</a>
Uruguay	Uruguay successfully completed a pilot study of digital currency. The study included 10,000 citizens, and 20 million pesos (about \$700,000) were converted into digital currency.	September 16, 2018	<a href="#">Reference 1</a> <sup>33</sup> <a href="#">Reference 2</a> <sup>34</sup>
Venezuela	Venezuela has become the first country to issue government-backed distributed digital currency. The president announced that every coin is backed by one barrel of oil from the country’s oil reserves. The digital currency will be complementary with the bolivar, the country’s official currency, and will even serve as legal tender in the country. The main motivation for issuing it is in the desire to struggle against the financial sanctions that the US is imposing on Venezuela.	February 20, 2018	<a href="#">Reference 1</a> <a href="#">Reference 2</a> <a href="#">Reference 3</a>
BIS	A BIS report presented a cautious position concerning CBDC. Despite their caution, the authors call on central banks to study CBDC in depth and to discuss its implications for financial stability and monetary policy	March 12, 2018	<a href="#">Reference 1</a>
IMF	The topic of CBDC came up for discussion at the organization’s annual conference in October 2018. In addition, a potential research program was formulated, including discussion of CBDC.	October 11, 2018	<a href="#">Reference 1</a>

<sup>33</sup> This link leads to a notice in Spanish.

<sup>34</sup> This link leads to a presentation in Spanish.