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Central Bank Digital Currency in the European Union

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Abstract

The aim of conducted research was to analyze current use of cash and assess potential demand for digital currencies issued by central banks in the largest economies of the European Union. A logistic function was applied in order to estimate future use of cash in analyzed countries. The results provide evidence that the use of cash varies to a large extent across the largest economies in European Union. It was identified that introducing a central bank digital currency will be most beneficial for Germany, Austria and Italy. The second group of beneficiaries will be Sweden and United Kingdom. Introducing public digital currency will be least beneficial for France and Poland.

Keywords: CBDC, currency, currency in circulation, central bank digital currency

Introduction

Banknotes and coins are part of money supply available in the economy. Money is required to settle payments. The role of cash in total money supply has been decreasing for decades, although the process has not been homogenous across countries. Universally speaking, the ongoing cash displacement around the world has been driven by cost reductions, greater convenience and improved security. Khiaonarong & Humphrey (2019) identify 6 major factors supporting the declining use of cash, banknotes in particular:

- Introducing cheques and credit cards. Instead of cash, checks and giro payments have been utilized in employee disbursements as well as consumer bills payments. Later, credit cards were introduced for business travelers and the broader population of customers.
- Introduction of electronic payments and POS terminals. First credit cards were paper based, where retailers had to deposit paper slips at the bank in order to receive money. Introduction of payment terminals at point of sales (POS) increased the convenience and reduced processing costs.
- Paper giro payments were displaced by electronic transfers. Internet penetration and development of e-banking enabled banks to offer electronic transfers. Paper payment orders were replaced by electronic orders, which reduced the time of transaction processing, which enhanced convenience and also lowered costs.
- Rising mobile phone functionality. Most recently, the development of mobile phones has enabled phone payments. Transactions have become not only cashless but also contactless. This development improved convenience and, due to standard authorization by fingerprint, also improved security (Thirupathi, et al., 2019).
- In order to reduce costs, some countries decided to replace low denomination banknotes by coins, because the usual lifetime of banknotes had been significantly shorter than the lifetime of coins (US GAO, 2019). Replacing banknotes by coins did not influence the total amount of cash in use but has changed the proportion between banknotes and coins.

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- Introduction of internet-based instant payment system for retail customers. This improved cost efficiency and reduced the time required for ordinary money transfer between two different financial institutions (Greene, et al., 2014).

As a result of the decreasing importance of cash, households and companies increasingly depend on private payment solutions (European Central Bank, 2020). Lower use of cash in the economy also impacts the shadow economy, which helps in reducing tax evasion, since transactions are trackable, making it harder to hide shadow economy incomes (Immordino & Russo, 2018). However, consistent reducing use of cash may affect the sustainability of the cash infrastructure. It may increase provisions of cash services, i.e. cash deposits or withdrawals. Low use of cash infrastructure should result in its diminishment. If services become unprofitable, commercial banks will reduce infrastructure and force citizens to abandon cash, which may put some groups of citizens in a difficult situation where they lose access to the only mean of payment that is provided by the public sector (European Central Bank, 2020). This implies that, in cashless economies public digital currency may address some negative consequences of noncash means of payment. In addition, declining amount of cash leads to lower seignorage revenue for a government, which has negative implications for fiscal standing.

Lastly, it is possible that private digital currencies become much more popular. Private currencies may enable faster transactions, appear to be cheaper to use and may be safer than payments via the banking sector. There is a risk that cryptocurrencies displace money regardless of the form in which they exist, cash or commercial bank deposits (Cukierman, 2019). In that case, the central bank may lose control of monetary policy in the economy or its influence will be significantly limited. The same risk applies in the scenario where citizens move from using the national currency to a digital currency issued by another country.

In response to these challenges, many central banks have begun studies regarding the potential introduction of central bank digital currency, also known as CBDC, as a future cash replacement (Cukierman, 2019). According to the Bank for International Settlements survey, over 80% of participating central banks out of 66 surveyed in 2019, were engaged in some sort CBDC studies (Boar, et al., 2020).

Theoretical Background

The term "central bank digital currency" has been applied to a number of ideas and designs that refer to digital money issued by a central bank. There has not been a single definition that is broadly agreed on (Meaning, et al., 2018). The Bank for International Settlements, together with major central banks, developed a definition that CBDC is "*a digital payment instrument, denominated in the national unit of account, that is a direct liability of the central bank,*" (Bank for International Settlements, 2020). Developing a universal definition is challenging because the concept generates a number of parameters that vary across central banks around the world. One of them is accessibility - it has to be decided whether CBDC is universally accessible (Berentsen & Schar, 2018) or it is restricted to certain economic agents (Fung & Halaburda, 2016). Digital currency could bear interest (Berentsen & Schar, 2018), which could improve efficiency of monetary policy by eliminating the zero lower bound (Sun & He, 2018). Without interest bearing, a CBDC would look like cash currently issued. The new currency could be traded at par but it is possible that a CBDC could be exchanged with reserves at different rate (Agarwal, 2015). A very important distinction is technology – the digital currency may exist in token-based or account-based form. The former enables transactions without access to any payments network that can be critical advantage during natural disasters, while the latter works very similar to reserve accounts (Ward & Rochemont, 2019).

Meaning et al. (2018) compare various features between different money-like assets in Table 1. The comparison includes central bank reserves and notes, deposit in banking sector as well as a private cryptocurrency – Bitcoin. While most assets show clear distinctions between each other, features of a CBDC still remain undefined.

Table 1: Characteristics of CBDC and other money-like assets

	CBDC	RESERVES	CENTRAL BANK NOTES	DEPOSITS	BITCOIN
Liability of the central bank	✓	✓	✓	X	X
Electronic	✓	✓	X	✓	✓
Universally accessible	?	X	✓	✓	✓
Interest bearing	?	?	X	?	X
Trades at par	?	✓	✓	✓	X
Cryptocurrency	?	X	X	X	✓

Token or account based (T/A)	?	A	T	A	T

Source: *(Meaning, et al., 2018)*

According to the European Central Bank (2020), a digital currency should generate low costs for transaction participants. This is similar to the current physical cash feature. Digital currency should be secure, prevent fraud and provide protection. The new currency should not be exposed to any market risk or issuer default. Digital currency should be easy to use for every citizen without any digital skills requirements. It should permit fast payments and, if possible, it should enable payments offline –-without constant access to the internet or other networks.

A proposal of CBDC being available for all, as well as bearing interests, has some advantages. On the other hand, it brings meaningful risks for the banking system. Berentsen & Schar (2018) postulate universal access to central bank accounts that would allow households and entrepreneurs making payments with central bank money rather than deposits held at commercial banks. Introducing a retail form of CBDC, with deposits held at the central bank, is a reminder of the "narrow banking" concept (Quignon, 2020; Pennacchi, 2012; Cukierman, 2019). The idea of narrow banking weakens the intermediation role of the banking sector, because introducing narrow banks may provoke destabilization in deposit flows between narrow banks and commercial banks, for example during recession or financial turmoil (Sławiński, 2019). In that case, moving deposits from a commercial bank to a narrow bank would worsen the situation of the commercial banking sector and would pose a risk for financial system stability (Kim & Kwon, 2019).

From the perspective of theory, the economic impact of CBDC depends much on the design of the digital currency. The research presented herein was conducted under assumptions according to which the CBDC reflects current features of physical cash as much as possible. In consequence, the digital currency is assumed to be available for everyone, does not bear interest and is token-based, which can be distributed via intermediaries. Such a design restricts some potential advantages of the CBDC but retains a similar philosophy to current cash. This approach is aligned with BIS's foundation principles and core features (Bank for International Settlements, 2020) for the CBDC:

- Coexistence with cash and other types of money in a flexible and innovative payment system.
- Any introduction should support wider policy objectives and do no harm to monetary and financial stability.
- Features should promote innovation and efficiency.

As a consequence, the level of demand for cash can be also attributed to the potential demand for public digital currency. The CBDC would be a "virtual complement to cash" (Quignon, 2020) but more convenient and secure.

Research Objective, Methodology and Data

The aim of conducted research was to assess the potential demand for digital currencies issued by central banks in the largest economies of the European Union.

Countries may have different motivations for considering CBDC adoption. Countries with the highest use of cash may benefit the most from introducing CBDC due to lower costs of operations, security and convenience, Cashless economies will not benefit much from the same features as these challenges would have been already addressed by private electronic payments provided by the banking sector. It does not mean that cashless economies may not benefit from a CBDC at all. However, the motivation will most likely be different. In economies without cash, people are losing access to risk-free central bank money (European Central Bank, 2020). The CBDC in this case could play the role of digital banknote and ensure access to public money as an alternative to ubiquitous solutions from the banking sector.

The undertaken analysis resulted in the identification of countries among largest EU economies that stood to benefit the most, considering the two potentially different motivations explained above. The study consisted of 3 stages. The first stage was focused on the analysis of Eurozone currency in circulation in a global context. The Euro was confronted with other major reserve currencies in the world (International Monetary Fund, 2020). The second stage was devoted to cash usage in 10 largest economies of the European Union. The group comprised countries that had adopted Euro as official currency as well as countries still retaining their national currencies. The third stage was focused on projections for cash usage in 10 largest EU economies in the next decade, until 2030.

The analysis of currency in circulation was based on total value of currency issued by the central bank, reduced by the amount of currency that has been removed from the system. Following countries or economic blocks were used in this part of research: China, the Eurozone, Japan, United Kingdom and the United States. The analysis was based on data regarding money supply and gross domestic products provided by: People's Bank of China, China National Bureau of Statistics, European Central Bank, Eurostat, Bank of Japan, Cabinet Office of Japan, Bank of England, UK Office for National Statistics, US Federal Reserve Board and US Bureau of Economic Analysis. Time range of this part of research covered almost 3 decades – between 1990 and 2019. All data were annual observations and were expressed in official currency of each respective country or economic block.

In the second stage, the time range for the study of cash usage was 2010-2019. The time range was determined by data availability. The approach of the analysis was similar to what Khiaonarong and Humphrey (2019) proposed in their article devoted to CBDC demand around the world, while this study was focused on European countries and provided more up to date results. The source of the data for all analyzed countries was the database of Payments and Settlement Systems Statistics (PSS) provided by European Central Bank. Following categories of transactions have been used in the second stage of the analysis:

- Card payments with cards issued by resident payment service provider - except cards with an e-money function only,
- E-money purchase transactions,
- Automated teller machine (ATM) cash withdrawals,
- Over the counter (OTC) withdrawals.

Despite the time restrictions there were gaps identified in specific countries - particularly regarding over the counter (OTC) withdrawals. In case of missing time series for a particular country, only ATM withdrawals were considered as cash payment. All tables, charts and author's calculations were based on annual numbers.

The study was focused on the 10 largest economies among, what were then, 28 EU member states. The group of countries under investigation included United Kingdom as an EU member state, since the UK left the European Union only in January 2020. The described group represented 80% of the EU population and 86% of EU GDP. Out of 10 analyzed countries, seven belonged to the Eurozone while three of them held own national currencies: United Kingdom, Poland and Sweden. Time series represented various categories of analyzed countries and were expressed in the Euro currency, despite some of them referring to countries outside the Eurozone. This poised a potential risk that time series analysis for selected countries could be distorted by fluctuations of currency exchange rate. The risk was eliminated by the nature of variables used in the analysis - the research was focused on cash share in total payments where both numerator and denominator were expressed in Euro. If the time series required currency conversion, where the average ECB reference rate was applied, it affected both numerator and denominator. As a consequence, the final measure was immune to exchange rate fluctuation.

The third stage of this study aimed to estimate the future use of cash in analyzed economies. It was assumed that cash and electronic payments substituted each other, so the decrease in the use of cash resulted in the gain of electronic payments. Ongoing penetration of electronic payments on the market was considered as technological innovation and was unlikely to show a linear trend. Initially, electronic payments' share should increase, gather speed, pass an inflection point to start rising at decreasing rate, until they push out cash from payment system. At this point, currency would be withdrawn from circulation (Khiaonarong & Humphrey, 2019). In consequence, the path of falling cash share in total payments would look more like a reverse logistic S-shaped curve rather than linear trend (Jarne, et al., 2005). The curve has been successfully used in describing development of other technological innovations: mobile phones (Islam, et al., 2002); color TV-sets; mobile Internet services (Trappey & Wu, 2008); or in insurance industry (Melnikov & Romaniuk, 2006).

Khiaonarong & Humphrey (2019) used logistic curve to describe cash share in total payment by equation (1):

$$\ln\frac{1-S_t}{S_t} = \alpha + \beta \times t + \varepsilon_t \tag{1}$$

Where S_t was defined as the predicted cash share, α and β were estimated parameters and t was time.
Thus:

$$S_t = \frac{1}{e^{\alpha+\beta\times t}+1} \tag{2}$$

In the following empirical study, a similar approach was applied.

Empirical Results

In order to assess potential demand for CBDC, the critical factor should be the current usage of physical cash in an economy. Currency in circulation shows the value of notes and coins issued by the central bank that are currently in economic circulation (Laurent, 1974). The amount of cash issued is a function of gross domestic product - the larger the economy, the more money is required for transactions. In consequence, the most relevant measure of cash in an economy is the ratio of currency in circulation to gross domestic product (GDP). Another important factor for cash demand is the adoption of electronic payments as substitute for cash. Rising popularity of either bank transfers or card payments should decrease the demand for cash. The third factor is external demand for the national currency (Haasl, et al., 2018). If a currency is stable and perceived as good store of value, the demand rises but exported banknotes and coins are not used in payment settlements.

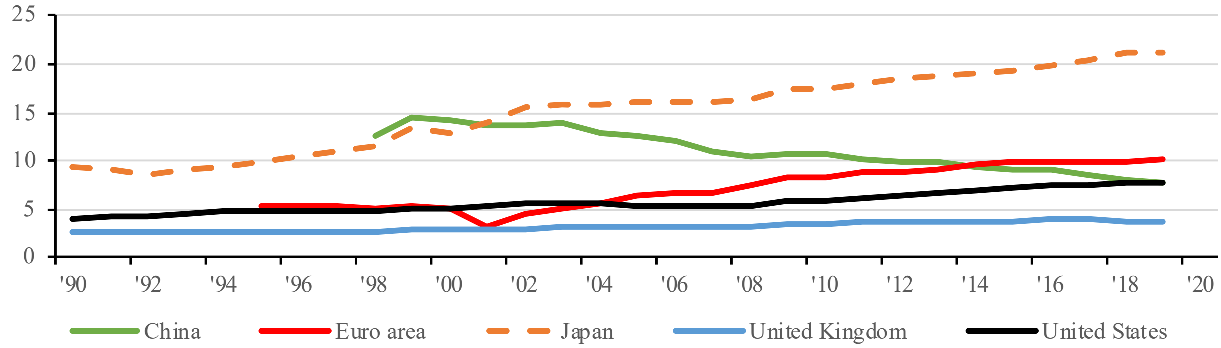

Fig 1. Currency in circulation to GDP ratio (%)

Source: People's Bank of China, China National Bureau of Statistics, European Central Bank, Eurostat; Bank of Japan, Cabinet Office of Japan, Bank of England, UK Office for National Statistics, US Federal Reserve Board, and US Bureau of Economic Analysis, own calculations

Figure 1 shows that currency in circulation has been rising in most countries. The trend was present particularly in countries whose currencies were considered as reserve currencies (Khiaonarong & Humphrey, 2019). This was in contradiction to what had been expected due to rising popularity of electronic payments. Cash in circulation did not rise in line with nominal GDP growth. Since the 1990s, the rise in cash usually exceeded economic growth. The British Pound was the only currency, out of five major currencies, that maintained its level of circulation – between 3% and 4% of GDP. The amount of US dollar, Euro and Japanese Yen have all increased, albeit at different paces. Japan consumers had always preferred cash over electronic payment (Humphrey , et al., 1996; Haasl, et al., 2018; Fujiki, 2020) but the ratio of currency in circulation to GDP almost doubled between 2000 and 2019. The second important finding from the analysis was that China's ratio equaled almost 15% in 2000. This was very similar level to Japan at that time. However, since then, the cash in circulation ratio in China has been consistently decreasing, most recently dropping below 8%. Discrepancies between currency in circulation and actual use of cash for payments may suggest that the ratio of currency in circulation to GDP is not the most accurate indicator of actual use of cash. Apart from settlement of payments, a currency also plays another role – store of value (Rochon & Rossi, 2013; Bordo & Levin, 2017). One of the reasons of rising demand for cash was expansionary monetary policy around the world for most of the 21st century. Funds held on bank deposits usually earn interest while physical currency is not interest-bearing. In consequence households usually have motivation to hold funds on bank deposits. If interest rates are very low, or even negative due to expansionary monetary policy, households have less motivation to keep funds in the banking system and start hoarding cash (Haasl, et al., 2018). The phenomenon was identified in the US, Switzerland, the Eurozone, or the UK following the global financial crisis when interest rates were set by central banks on zero lower bound. The rise of cash in circulation ratio was observed in Japan since the mid-1990s and it was accompanied by central bank action of lowering interest rate at that time (Haasl, et al., 2018). The rising importance of cash function as store of value, rather than means of payment, was confirmed by the fact that higher currency in circulation was usually driven by large-denomination notes (Bech & Boar, 2017). Another reason of rising currency in circulation was foreign demand for that currency. This applied the most to reserve currencies. The rising value of US dollars in circulation was driven by shipments abroad, while domestic demand was stable or decreasing over time (Judson, 2018). Also, the ECB study on trends and developments in the use of the Euro, found that most Euro banknotes in circulation were used as a store of value in the Eurozone or held abroad (Lalouette & Esselink, 2018). In conclusion, the general assumption that all banknotes and coins in circulation should reflect the amount of cash in use in economy, seemed reasonable although this category was usually distorted in most countries. In consequence, there emerged a need to implement an alternative way to reflect the use of currency for settlement of payments and future demand.

The solution proposed in this study was to use a share of cash in total payments to assess actual demand for cash in economy. Total payments were defined as "sum of cash and electronic payments, for example credit or debit cards as well as electronic money". Card payments and electronic money payments are the strongest substitutes for cash and are most usually provided by the private sector. It was assumed that all cash payments were settled using currency withdrawn from ATMs or withdrawn over the counter (OTC) at bank branches. Total amount of cash withdrawals from ATMs and OTC would roughly equal cash used for settlements of payments. Cash share analysis confirmed the trend of decreasing share of cash in all transactions. Among the 10 largest EU economies only Austria appeared to be an outlier. However, in this particular case the increase of cash was a result of large shift that took place in 2013, when the amount of cash withdrawn in Austria more than doubled and remained around this level to the end of the analyzed period. In consequence, it is recommended to analyze the case Austria with caution. The shift in reported cash withdrawal could be a result of data inconsistency rather than real economic change. Table 2 illustrates the cash use at the beginning and at the end of analyzed period, as well as the average pace of change over the last decade. The use of cash was not homogenous in the European Union. At the beginning of the analyzed period the cash share varied from 21% to 76% among top 10 EU member states and from 29% to 76% among states using the Euro as official currency. These differences remained large at the end of the period. The share of cash varied from 8% to 65% among all top 10 EU members and from 20% to 65% among Eurozone members in 2019. Italy, Germany and Poland were countries with the highest share of cash in transactions through the whole analyzed period. While the use of cash in the Eurozone, considered as a block of all Eurozone members, in 2010 was 46%. In Italy cash share was 76% while in Germany the share was marginally lower at 75%. In 2019 cash share dropped to 34% in the Eurozone, decreasing at a pace of 1.2% each year. Similar decrease was observed in Germany (-1.1%), while in Italy it was -1.9 %. Poland reported the fastest decrease among analyzed countries, as use of cash dropped in Poland from 74% in 2010 to 47% in 2019. On the other hand, the United Kingdom and Sweden were countries with the lowest share of cash in total transactions - both at the beginning and at the end of analyzed period. The use of cash in the United Kingdom halved over a decade, from 29% to 14%. Sweden was the only country in the sample, where cash share dropped below 10% in 2019. The decreasing role of cash in Sweden was confirmed both in cash share of payments and currency in circulation data. This lends support for the opinion that Sweden could become a cashless economy in coming years (Arvidsson, et al., 2016; Arvidsson, 2019).

Table 2: Share of cash use in total payments value between 2010 and 2019

	AT	BE	FR	DE	ES	IT	NL	UK	PL	SE	EA
2010	45%	44%	42%	75%	50%	76%	38%	29%	74%	21%	46%
2019	53%	25%	29%	65%	27%	56%	20%	14%	47%	8%	34%
Avg ann. change	0,7%	-1,9%	-1,3%	-1,1%	-2,2%	-1,9%	-1,8%	-1,5%	-2,7%	-1,3%	-1,2%

Source: ECB Payments Statistics Report, own calculations.

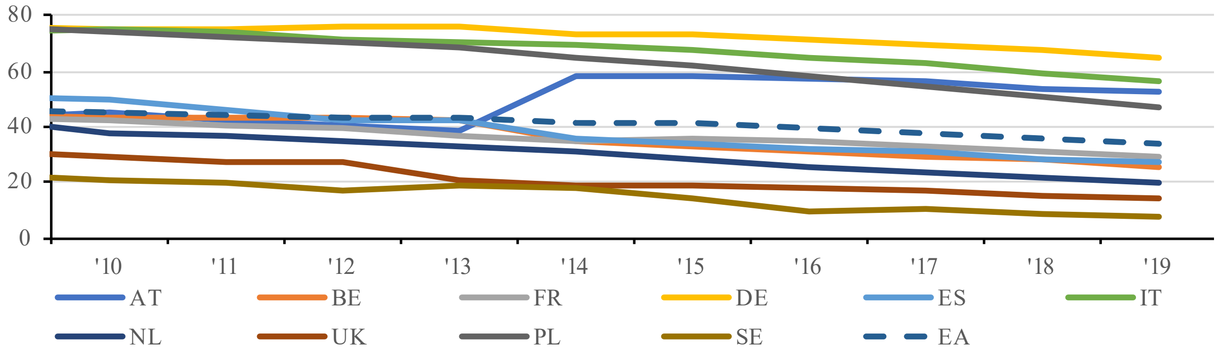

Fig 2. Value of cash payments as % of total payments in analyzed countries

Source: ECB Payments Statistics Report, own calculations

Projections

The third step of the study aimed at estimating future demand for cash in selected countries. The projection was based on a logistic function described in the Research Objective, Methodology and Data section. Regression for each country was estimated using annual observations from the 2010-2019 time period. The results of the estimation were used for projection of future cash share. In consequence, the estimates cash share level for 2030 were obtained. This helped in accessing, which countries appear to become cashless economies in the coming decade, as well as indicated countries with remaining high demand for cash in the same period. As specified in the Research Objective, Methodology and Data sections, countries with high demand for cash could also represent high potential demand for a central bank digital currency, given the similar nature of both means of payment and strong advantages of CBDC over physical cash: being more convenient, safer and reducing operating costs for central bank. Countries with cashless economies could also benefit from introducing a CBDC but for different reasons.

Table 3 illustrates the projected use of chase between 2019 and 2030. By the end of the evaluated period in Germany and Austria around half of all transactions should still be settled using cash. The third country with the highest estimated demand for cash is Italy. In consequence, introducing CBDC in these countries shows the biggest potential. In the Eurozone, comprising all monetary union members, the share of cash is estimated to drop from 34% to less than 25%.

Table 3: Share of cash use in total payments in 2019 and 2030 projection of future demand for cash

	AT	BE	FR	DE	ES	IT	NL	UK	PL	SE	EA
2019	53%	25%	29%	65%	27%	56%	20%	14%	47%	8%	34%
2030 est.	40%	11%	19%	52%	10%	35%	8%	5%	20%	2%	25%
Avg ann. change	-1,2%	-1,4%	-1,0%	-1,2%	-1,7%	-2,1%	-1,2%	-0,9%	-2,7%	-0,6%	-0,9%

Source: ECB Payments Statistics Report, Own calculations

Sweden appears to become the first cashless economy among the 10 analyzed countries. With cash share estimated at 2,3% Sweden is likely to experience a reduction in cash-required infrastructure given the rising operating cost per currency unit (cash withdrawals, maintenance of currency fitness, etc.). Without the infrastructure in place, it becomes impossible to use cash anymore. Other countries that are likely to become cashless economies in the near future: United Kingdom with 5,1% of cash share by 2030; Netherlands (8,3%); and Belgium (11,0%).

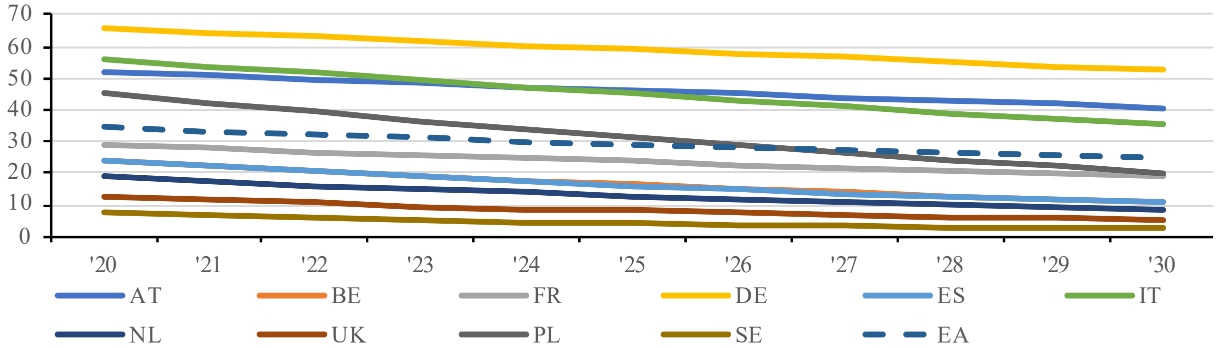

Fig 3. Projection of cash share in total payments (%) between 2020 and 2030 in analyzed countries
Source: ECB Payments Statistics Report, Own calculations

Figure 3 illustrates how the demand for cash is expected to evolve in each country during the third decade of the 21st century. The case of Poland is specific in this context - while the use of cash in 2010 in Poland was very similar to countries with the highest use of cash, like Germany or Italy, it consistently declined at a high pace. In 2019 it was still above the Eurozone average, but Poland is expected to maintain the strong pace of decline. As a result, in 2030 Poland is projected to use cash less than the Eurozone average and close to the level projected for France. The level of 20% share, is far from being a cashless economy but also much below countries associated with high cash usage: Germany, Austria or Italy. Between countries with projected high demand for cash and cashless countries, France and Poland are considered as benefitting the least from introducing central bank digital currency among the largest EU economies.

Conclusion

The demand for cash as means of payment has been falling for decades, a process driven by technology innovations in the banking sector. This process is expected to continue in the foreseeable future. The ongoing decline in cash use will eventually lead to cash withdrawal from the economy. Despite many positive consequences eliminating cash from circulations has also disadvantages and risks, such as having a negative impact on financial inclusion or the rising popularity of private digital currencies. If private currencies prove to be safer and more attractive than services provided by the banking sector, they may displace national currencies. This poses a risk for central banks and the efficacy of monetary policy. Central bank digital currency may be response to these challenges. CBDC is considered as future substitute to current physical cash.

The aim of this study was to assess the future demand for cash or its electronic substitute provided by the central bank. It has proved that the ratio of currency in circulation to GDP is not a good measure illustrating actual demand for cash used in payments. In consequence, an alternative method was proposed, comprising information of cash withdrawn from banking system as well as card and e-money payments. Cards and electronic money were considered as the best substitutes for cash. The proposed measure showed that there is a large dispersion among largest economies within the European Union. The research has identified Germany, Austria, Italy and Poland as countries with the largest share of cash in total payments. In 2019 half or more payments were settled by cash. At the same time the use of cash in Sweden and United Kingdom was 8% and 14% respectively. As a result of the projection made for 2030, the use of cash is expected to decline further. Germany, Austria and Italy are countries with the highest cash share, while Poland is expected to move from group of countries with high cash usage to countries with moderate cash usage. The level of cash share in Poland is expected to be similar to the level estimated for France. It was identified that by 2030 Sweden is expected to become cashless economy, with potential use of cash at 2%. The United Kingdom is expected to be the second largest European economy without use of cash in the near future.

It was argued that countries with the highest use of cash are likely the biggest beneficiaries of CBDC introduction, due to cost reduction, security improvement and higher convenience of payment. In consequence, the introduction of CBDCs appear to be most beneficial for Germany, Austria and Italy. The second group of beneficiaries should be countries without use of cash. The motivation of introducing CBDC in this case is financial inclusion of citizens who lose access to the only public mean of payment that is cash nowadays. It also mitigates the risk of increasing role of private digital currencies and, in consequence, reducing the effectiveness of monetary policy. It was assessed that Sweden and United Kingdom should belong to the second group of beneficiaries. It was assessed that introducing CBDC is the least beneficial for France and Poland. Their use of cash in the next decade is expected to decline below the level of the whole Eurozone but should remain far from the level considered to be cashless economies.

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