

## Conference Paper

# The Future is Near: On the Prospects of Central Bank Digital Currency Adoption in Central and Eastern European Countries

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**Abstract**

Central banks around the world have started exploring the possibility of issuing Central Bank Digital Currencies (CBDC). A CBDC would be similar to digital cash and could, in theory, substitute for commercial bank deposits as the money used by households and businesses. This paper explored the potential implications for financial stability and monetary policy stemming from potential CBDC adoption in Central and Eastern European countries (CEEs). We conducted an empirical analysis using publicly available data from the European Central Bank's database to assess how introducing a CBDC could impact the business models of the largest CEE banks. Our findings indicated that a CBDC could support financial stability by accelerating the adoption of digital payments in CEEs, improving anti-money laundering, and thus supporting banks' ability to finance the economy. We found that the impact of a CBDC on the profitability of commercial banks would be impacted more by any change in interest rates than by the quantity of CBDC replacing stable bank funding. Furthermore, a CBDC could be beneficial for monetary policy by improving the control over inflation and accelerating the implementation of countercyclical instruments when classical monetary policy instruments are no longer effective. Hence, non-Euro CEE countries would benefit the most from the introduction of a CBDC.

**Keywords:** central bank digital currencies; financial stability; monetary policy; financial institutions

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## 1. Introduction

Cash is a risk-free, instantaneous, and anonymous means of payment provided by central banks. However, the use of cash in Europe has been declining. Since the onset of the Covid-19 pandemic, Europe has seen an unprecedented surge in digital payments. At the same time, new technology has enabled new forms of money (e.g. cryptoassets) to emerge, as well as new ways to pay with it [1]. Central banks around the world have started exploring the possibility of issuing Central Bank Digital Currencies (CBDC).

Central banks are responsible for ensuring monetary policy and financial stability. This could be achieved by controlling inflation through setting interest rates, controlling the supply of money in the economy, and offering commercial banks access to reserves [2]. Cash and reserves are liabilities on the balance sheets of central banks. By issuing a retail CBDC, central banks would either need to expand their balance sheet or replace part of their liabilities with a new form of digital money. A retail CBDC would be similar to digital cash and could, in theory, substitute for commercial bank deposits and cash as the money used by households and businesses. Central banks are currently considering several design options for CBDC. For example, if customers have direct access to hold CBDC, central banks could, in theory, more easily transmit monetary policy. Indeed, changing interest rates could have a more immediate effect on consumption, spending and external balances. However, in the absence of any limits, a CBDC could increase the potential for bank runs, with potential implications for financial stability.

In this paper we analyze the implications on financial stability and monetary policy from a Euro-denominated CBDC in Central and Eastern European (CEE) countries. We define CEE countries as EU member states that were part of the former Eastern bloc, namely: Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia, Slovakia. We built an empirical model calibrated on European Central Bank (ECB) data and analyze the potential impact on CEE banks' profitability from introducing varying quantities of CBDC, under different scenarios. We find that the quantity of CBDC introduced has a lesser impact on banks' profitability than small fluctuations in interest rates because of banks' deposits needing to compete with CBDC. This is in line with analysis from [3], [4], [5]. Interestingly, corroborated with additional empirical evidence regarding the low levels of digitalisation and financial inclusion in CEE we find that benefits from a CBDC could outweigh the risks in these countries. To our knowledge, this is a pioneering analysis on the topic of CBDC implications for Central and Eastern Europe.

The paper is structured as follows. Section 2 provides an overview of the various forms of money that are in circulation in Europe today. It also explores the particularities of CEE economies, including their varying levels of digitalization, financial inclusion and overall state of the CEE banking sector. Section 3 presents the scenarios and methodology we used in our analysis and Section 4 shows and discusses our results. We used stylized balance sheets to explain the mechanism of introducing a retail CBDC and we used ECB data to calculate the potential impact on banks' profitability. Section 5 discusses the financial stability and monetary policy implications from introducing a retail CBDC. Finally, Section 6 presents our conclusions and flags possible future work.

## 2. Literature Review

This paper is, to the best of our knowledge, one of the first attempts to quantify the potential impact on European banks' profitability from introducing a Euro-denominated retail CBDC. Furthermore, we believe this to be the first discussion on the potential implications on financial stability and monetary policy of CEE countries from the introduction of a CBDC.

Banknotes — the most accessible form of money — are being used less frequently to make payments. Since the onset of the Covid-19 pandemic, Europe has seen an unprecedented surge in digital payments [6]. Today, people are able to hold money in two forms: physical cash (banknotes issued by central banks), or commercial bank deposits. During recent years, the use of physical cash decreased to less than 20% of the total money in circulation in the eurozone [7], while the use of bank deposits has steadily outgrown cash. However, bank deposits serve as a vital source of funding for the other important financial-economic function of banks (e.g. extending credit). Table 12 shows the breakdown of cash usage in CEE countries.

TABLE 1: Monetary policy & interest rates in CEE countries and Eurozone

Country/ zone	Monetary policy regime	Main interest rate (central bank) (2021)	Market rate (3M offer 2021)	Population million (2019)
Poland	<b>Inflation targeting</b>	0.10% (1w deposit)	0.20%	37.97
Hungary	<b>Inflation targeting</b>	0.60% (1w deposit)	0.90%	9.77
Czech Republic	<b>Inflation targeting</b>	0.25% (2w repo)	0.40%	10.71
Romania	<b>Inflation targeting</b>	1.25% (1w deposit/ repo)	1.70%	19.41
Eurozone	<b>Inflation targeting</b>	0% (1w repo)	0.55%	337.28

Source: ECB [8], IMF available at URL <https://www.imf.org/en/Research>

NPB available at URL [https://www.nbp.pl/homen.aspx?f=en/onbp/polityka\\_pieniezna.html](https://www.nbp.pl/homen.aspx?f=en/onbp/polityka_pieniezna.html) accessed in March 2021

MNB available at URL <https://www.mnb.hu/en/monetary-policy/monetary-policy-framework/inflation-targeting>, accessed in March 2021

CNB available at URL <https://www.cnb.cz/en>, accessed in March 2021

NBR available at URL <https://www.bnro.ro/Open-market-operations--3656.aspx>, accessed in March 2021

This shift away from cash has, in part, been due to advances in technology. Increased adoption of mobile phones and improved internet access pushed people away from cash, and towards digital payments (e.g., through cards and online banking) [9]. More recently, new technology has enabled new forms of money (e.g. cryptoassets) to emerge, as well as new ways to pay with it. Central banks have embraced payments innovation globally and started exploring the possibility of issuing Central Bank Digital Currencies (CBDC) [10] & [11].

We consulted the Digital Economy and Society Index (DESI, 2020), which is a composite index of Europe's digital performance also tracking the evolution of the digital competitiveness of EU Member States. The most significant progress was noted in Ireland, followed by the Netherlands, Malta, and Spain. These countries performed above the EU average, measured by the DESI score. Apart from Estonia and Lithuania,

TABLE 2: Level of cash in CEE countries (2019)

Country/ zone	M1 – EUR bn (2019)	Cash – EUR bn (2019)	Cash/ M1	Cash (EUR)/ Population
Poland	271.30	56.02	0.21	1475
Hungary	74.10	20.10	0.27	2057
Czech Republic	162.55	23.57	0.15	2201
Romania	57.89	15.49	0.27	798
Eurozone	8,975.33	1,293	0.14	3834

Source: ECB available at URL <https://www.ecb.europa.eu/home/html/index.en.html>, accessed in March 2021

NPB available at URL <https://www.nbp.pl/homen.aspx?f=/srodeken.htm>, accessed in March 2021

MNB available at URL <https://www.mnb.hu/web/en/the-central-bank>, accessed in March 2021

CNB available at URL <https://www.cnb.cz/en/>, accessed in March 2021

NBR available at URL <https://www.bnr.ro/Home.aspx>, accessed in March 2021

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most CEE countries scored well below average regarding the level of digitalization and have not made much progress over the past 5 years. Most notably, this was the case for Romania, Bulgaria, and Greece.

For a CBDC to be viable, reliable access to a good broadband connection is very important and overall, EU connectivity has improved in recent years. For example, according to DESI (2020) internet coverage increased to 86% of households in 2020 compared to 83% in 2019. Furthermore, nearly the entire EU population was covered by 4G networks in 2020, while progress regarding 5G readiness remained slow.

Another important aspect is represented by digital skills, which enable people to make full use of digital services as well as engage in basic activities online. The COVID-19 crisis has accelerated digitalization and has highlighted the importance of digital services for the wider economy. According to European Commission (2020), the percentage of people with at least basic digital skills in the EU reached 58% in 2019, up from 55% in 2015. However, a large part of EU's population still lacks basic digital skills, despite these being required in many jobs.

European Commission [12] also found that internet usage during the pandemic soared, with 85% of Europeans browsing at least once per week, up from 75% in 2014. These figures vary from 67% in Bulgaria to 95% in Denmark or the Netherlands. Internet banking and shopping were amongst the most popular activities (alongside video calls), and were used by 66% and 71% of internet users respectively.

A lack of reliable access to financial services could lead to inequality and poverty traps and there is a growing body of literature which documents the potential benefits of increased financial inclusion [13]and [14]. Indeed, owning a commercial bank account represents an important entry point into the formal economy. Having a bank account allows customers to transfer funds more easily and could potentially boost personal savings or credit. Bank accounts are therefore frequently used as an indication of the level of financial inclusion in an economy. A CBDC could allow unbanked or underbanked people to access traditional financial services without the need for a formal bank account, which could be a barrier for many. This could increase financial

inclusion and so it could be a compelling argument for launching a CBDC in countries with limited financial inclusion today.

According to the World Bank [15], account ownership varied widely by region (see Table 3) with CEE significantly lower than elsewhere in Europe. Despite the continued growth in what account ownership is concerned, inequality remains prevalent, particularly with regards to gender and income. World Bank [15] found that nearly half of all unbanked adults came from the poorest 40 percent of European households and 30 percent of unbanked adults reported a lack of trust in traditional financial institutions as their main reason for not opening a bank account. Other factors included cost, lack of formal documentation, and distance.

TABLE 3: Summary of key digitalization indicators in CEE countries

Country/ zone	% adult population with an account (2017)	% adult population with access to internet (2020)	Online banking penetration (2020)
Poland	87	79	49
Hungary	75	89	51
Czech Republic	81	87	70
Romania	58	75	12
Eurozone	95	92	60

Source: Global Findex 2017, available from URL <https://globalfindex.worldbank.org/> accessed in March 2021

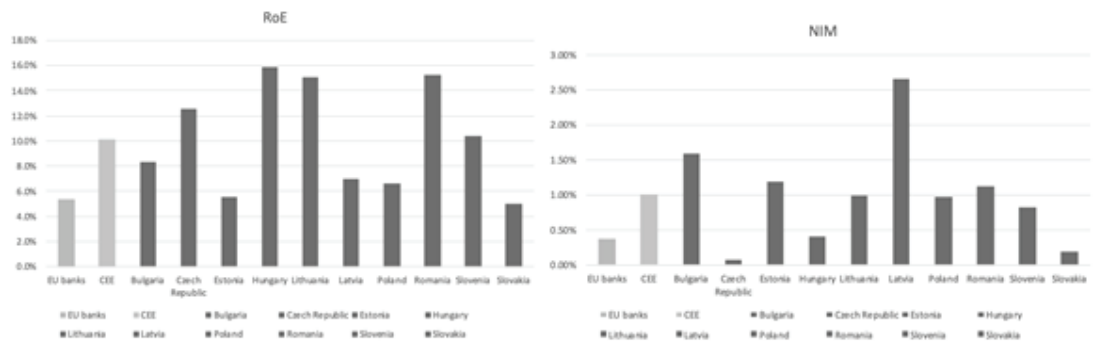
Statista available from URL <https://www.statista.com/> accessed in March 2021

While CBDC could become an alternative to cash, we believe it is unlikely a CBDC would fully replace cash in the medium term. Instead, we think it would be more likely for a CBDC to co-exist alongside other means of payment including cash, cards, bank transfers, etc. More broadly, a retail CBDC could compete with (or even replace) bank deposits, which may decrease and destabilize the funding capacity of banks. This would negatively influence the banks' ability to lend [16]. Nevertheless, providing a public sector cash-like payments alternative could strengthen the financial system by providing a contingent means for electronic payments. This could increase financial inclusion [17] and could reinforce the transmission of monetary policy [18].

Launching a CBDC could lead to a new view over the roles of money, central banks, and the financial sector. CBDC is still in its research phase and many design decisions are yet to be made. However, the narrative around CBDC has become more positive in recent years and research has accelerated globally. In Europe, the ECB recently published a comprehensive report on 'a digital euro' (European Central Bank, 2020) (7) and countries such as Estonia [19], Lithuania [20] or Greece [1] already expressed interest in exploring CBDC.

In general, all CEE countries have the same pattern of monetary policy, interest rates and regime (Table 1). The differences stem from the particularities of each country, deviations from budget deficits, external balance, and inflation. Table 12 shows that despite the decrease in usage over the last decade, cash still represents more than 20% of the M1 money supply and any significant changes will likely take time.

We can observe low to medium banking penetration (measured by the ratio of banking assets to GDP) in CEE countries, compared to other Euro countries, therefore there is still growth potential, especially in Romania and Bulgaria. Medium banking penetration is observed in Poland, Hungary, Latvia, Slovakia, Lithuania. Slovenia, Czech Republic and Estonia have the highest banking penetration [21]. Nonetheless, the profitability of the region is still relatively high compared to Eurosystem countries (see Figure 1). This has been supported by robust lending activity, high fees, improved asset quality and reversal of provisions in the region.



**Figure 1:** Profitability of European commercial banks (Source: ECB, available at URL <https://www.ecb.europa.eu/home/html/index.en.html> accessed in March 2021)

The Single European Payments Area (SEPA) aims to unify payment markets across Europe, being applied to all payment instruments: credit transfers, direct debits and payment card. Having the same standards and an unique legal basis, we expect payment costs to decrease significantly. Also, due to new and emerging fintech companies, we see lower spreads for foreign exchange rates to individuals and cheaper payment fees.

As far as we know, this is one of the first papers exploring potential implications for financial stability, and monetary policy, stemming from potential CBDC adoption in CEE countries. Our analysis has been influenced by the methodology presented in [22], [3] and [4].

### 3. Data and Methodology

Data is a major limitation because no large-scale retail CBDC project exists today. In order to understand the potential impact on European financial and monetary stability from the introduction of a retail CBDC, we opt for a double approach that combines empirical and scenario analysis (see Table 4).

For our analysis, we used European Central Bank’s CBD2 dataset of consolidated European banking data. This provides information on the aggregate consolidated profitability, balance sheets, asset quality, liquidity, funding, capital adequacy and solvency of EU banks. Data is published every quarter – we used the comprehensive end-year data for 2019, but more granular subsets subject to more frequent reporting were also available.

TABLE 4: Summary of CBDC adoption scenarios

Scenario	Scenario description	CBDC share of EU commercial bank assets	CBDC share of EU commercial bank deposits	Impact on overnight deposits interest rate
A1	CBDC equals cash outstanding and effective interest rates increase by 25bps	4%	6%	25 bps
A2	CBDC equals cash outstanding and effective interest rates increase by 50bps	4%	6%	50 bps
B1	CBDC equals overnight deposits and effective interest rates increase by 25bps	26%	40%	25 bps
B2	CBDC equals overnight deposits and effective interest rates increase by 50bps	26%	40%	50 bps

Source: Authors' analysis

We begin by building stylized commercial and central bank balance sheets [22] and model how the introduction of CBDC changes the structure of assets and liabilities. Since the rate of CBDC adoption determines how much deposit funding would be at risk, we examine the breakdown of EU money supply (M1) in order to devise severe, but plausible, CBDC adoption assumptions.

To reduce the outflow of deposits, banks could increase the interest paid to deposits that are most susceptible to flightiness [23]. Banks would also need to replace lost deposits with other, more expensive, sources of funding. This will reduce profitability of banks, all else being equal.

In order to plausibly gauge the extent of future CBDC uptake, we considered the euro area monetary aggregate M1 [8] see Table 2. The breakdown is not easily available for CEE countries, so we will use euro area M1 for the purpose of this paper and design 2 scenarios: **Scenario A** where the quantity of CBDC introduced equals that of all euro in circulation (in 2019) and **Scenario B** where the quantity of CBDC introduced equals the amount of all overnight deposits (in 2019). We further refine our scenarios, as follows:

- **Scenario A** assumes that the quantity of deposits that could be vulnerable to a CBDC is the same as the quantity of cash outstanding in 2019, of approximately €1.2tn, representing around 4% of aggregate EU commercial assets and 6% of deposits. To assess how sensitive net income and return on equity (RoE) would be to CBDC, we analyse an increase in the effective interest rate for overnight deposits by 25 bps (**Scenario A1**) and 50bps (**Scenario A2**)
- **Scenario B** assumes that the quantity of deposits that could be vulnerable to a CBDC is the same as the quantity of overnight deposits in 2019, of approximately €7.7tn, representing around 26% of aggregate EU commercial banks assets and 40% of deposits. Similar to scenarios A1 and A2, we analyse an increase in the effective interest rate for overnights deposits by 25 bps (**Scenario B1**) and 50bps (**Scenario B2**)



Finally, we use European Central Bank aggregated balance sheet data for 2019 to calculate the impact on EU commercial banks' profitability under the previously described scenarios through which CBDC might displace bank deposits, and in turn affect financial stability. We then calculate Net Interest Margin (NIM) and Return on Equity (RoE) to gauge the impact on profitability. The former is an indicator of profitability, which aims to approximate the likelihood of a commercial bank succeeding over the long term. In doing so, the net interest income a bank would generate from its credit products such as loans and mortgages is compared with the interest it pays its depositors. The latter measures a bank's profitability as it relates to the equity of its stockholders. It is difficult to disentangle interest rates, deposits, RoE and NIM as bank performance metrics. For each scenario we attempt to do this by amending the structure of the aggregated balance sheet by modifying, in turn, overnight deposits and the effective interest rate while keeping all other parts fixed.

We then discuss the results in the context of CEE countries. For the monetary policy, we focused our analysis on a smaller sample of CEE countries, namely Poland, Hungary, Czech Republic, Romania, in whose case we hypothesize that they will continue to have their own currencies and their own monetary policy in place and can implement local decisions.

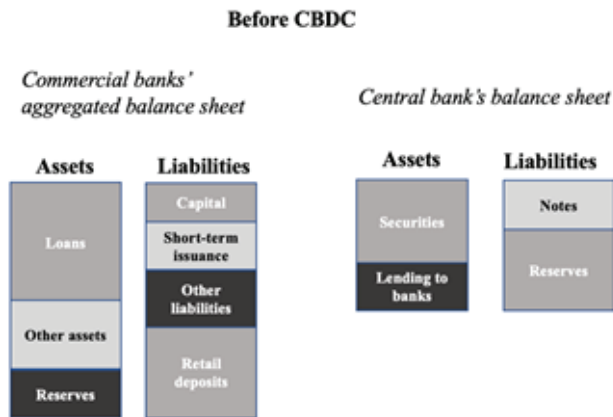
Our assumption is that if a retail CBDC were introduced, it would initially be used as a means of payment because it mostly resembles cash or overnight deposits. It could therefore act as a substitute for cash, or deposits, or both. If a CBDC would replace deposits, this could lead to a "run to the bank" with potentially severe implications for financial stability. Using our CBDC adoption-based scenarios, we analyse how increased funding costs and deposit outflows would affect commercial bank profitability.

Figure 2 shows the 2019 stylised at-scale balance sheets for EU commercial banks as well as the European Central Bank. We expect a retail CBDC would substitute for commercial bank deposits, given that CBDC and deposits would initially play similar roles. When households expand their CBDC holdings in a significant way (and thus lower their deposit holdings accordingly), the central bank's liabilities eventually expand (see Scenario B). We hypothesize that central banks would effectively intermediate between non-banks and banks by providing adequate and timely substitute funding for banks in exchange for CBDC.

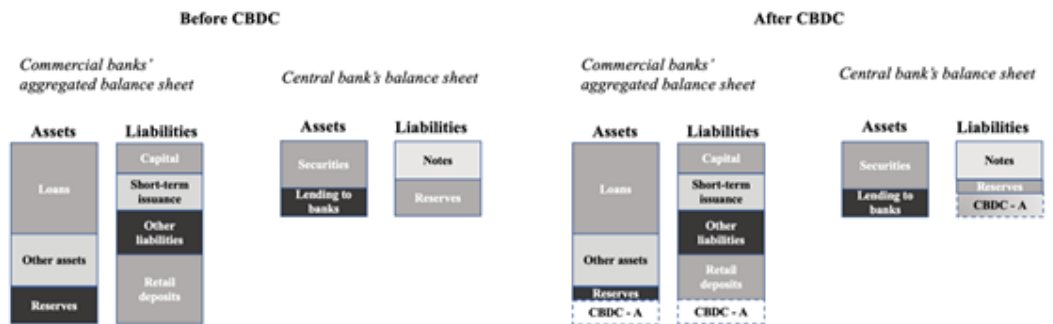
Under Scenario A commercial banks would exhaust most of their reserves on the assets side to buy CBDC. An equivalent quantity of deposits would disappear, as customers will use their deposits to buy CBDC. On the central bank liabilities side, the size of the balance sheet would remain unchanged, but the composition of liabilities would change as CBDC substitutes for a portion of reserves. Figure 3 shows what the before and after would look like under Scenario A.

**Scenario B** is more extreme than **Scenario A** and assumes that a higher proportion of overnight deposits would be displaced by CBDC, as shown in Figure 4. In this scenario, commercial banks would exhaust all their reserves when managing the outflow. They would therefore need to pledge liquid assets to borrow additional reserves from the central bank. The size of the commercial banks' balance sheet would not shrink further, but the outflow would change the banks' asset and funding structure. However, the



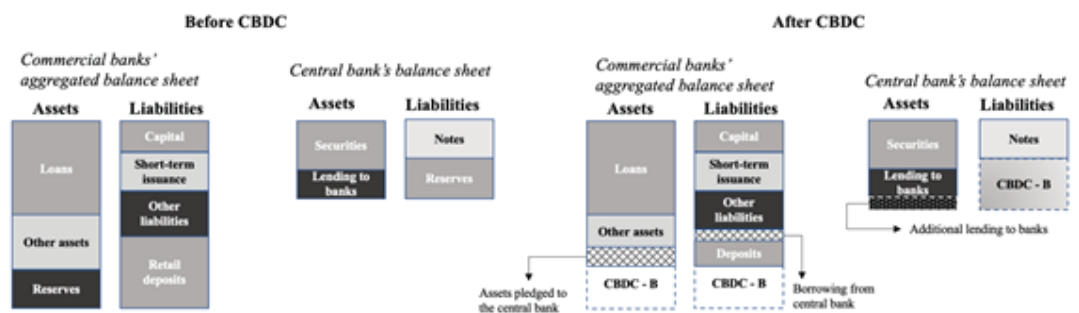


**Figure 2:** Stylized balance sheets before CBDC introduction *Source: Authors' analysis*



**Figure 3:** Stylized balance sheet - before and after CBDC introduction under Scenario A *Source: Authors' own analysis*

size of the central bank's balance sheet would grow under this scenario, as the quantity of CBDC exceeds that of reserves on the liabilities side, and on the assets side more lending to banks would be required.



**Figure 4:** Stylized balance sheet - before and after CBDC introduction under Scenario B *Source: Authors' analysis*

## 4. Results and Brief Discussion

Table 5 summarizes our key findings. Both Return on Equity (RoE) and Net Interest Margin (NIM) are significantly more impacted by the change in interest rates, than they are by the quantity of deposits being displaced by CBDC.

We find that in the worst-case scenario RoE would fall by 3.8 per cent (Scenario B2), and NIM by 0.25 per cent (Scenario A2). In the best-case scenario, RoE would fall by 1.8 per cent (Scenario A1), and NIM by 0.08 per cent (Scenario B1). Figure 5 shows a summary of the RoE impact and Figure 6 a summary of the NIM impact. These results suggest that the increase in the cost of deposits has a more significant impact on NIM than the level of CBDC adoption. Our results are in line with similar analysis undertaken by [3] and [4].

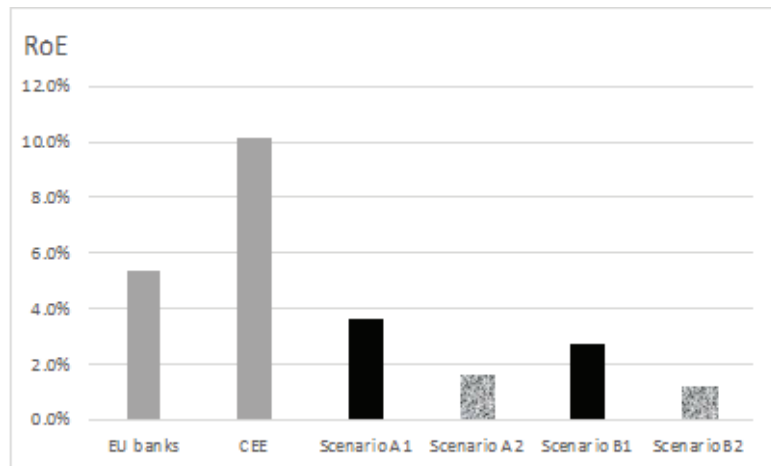
TABLE 5: Impact on aggregate RoE and NIM of EU banks from CBDC replacing deposits, and interest rates going down, under different scenarios

Scenario number	RoE impact (bps)	NIM impact (bps)
A1	-177	-9
A2	-376	-25
B1	-192	-8
B2	-383	-24

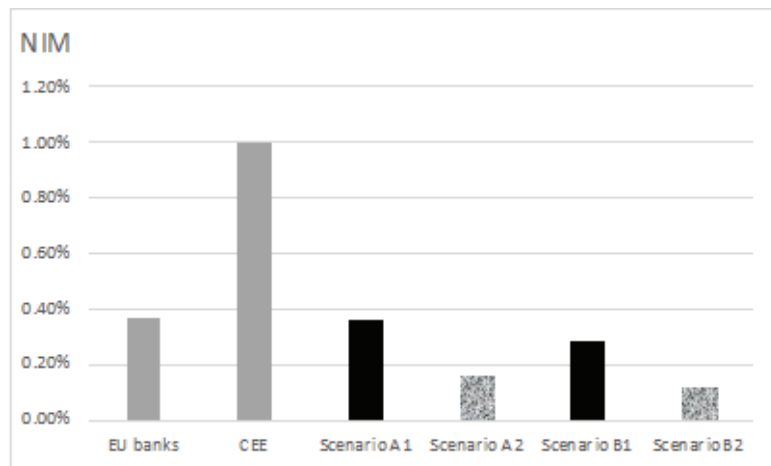
Source: Authors' analysis

While a fall in European commercial banks' RoE of 3.8 per cent is very significant, this is in part due to our initial assumptions. To isolate the potential impact on profitability, we assumed that banks maintain their business model, are able to replace deposits with other sources of funding, funding costs are not sensitive to deposit demand and banks maintain their fee income. However, it is unlikely that deposits would outflow without banks taking any measures to restore their liquidity and funding positions. It is possible that banks face extra costs to replace lost funding, either by acquiring new and more expensive deposits, either by issuing bonds or financing through interbank or capital markets.

Further, while the impact on both RoE and NIM in the worst-case scenario would be significant for EU banks, this would not be as daunting for CEE banks. Indeed, most CEE countries' banks have their RoE significantly higher than the EU aggregate [21], so the introduction of CBDC would not impact them to the same extent as their Western EU counterparts. Another relevant aspect is that in CEE countries a CBDC is more likely to replace cash, rather than deposits, limiting the overall impact of CBDC further. We would require more granular CEE data to customize our analysis, but this is an area of research we will explore in the future.



**Figure 5:** Impact on RoE from all scenarios *Source: Authors' own analysis*



**Figure 6:** Impact on NIM from all scenarios *Source: Authors' own analysis*

## 5. Financial Stability and Monetary Policy Implications

### 5.1. Financial stability implications

We have already shown that large scale CBDC adoption could increase the flightiness of EU commercial banks' overnight deposits, but it remains unclear why this should reduce credit or negatively impact financial stability. This would ultimately depend on the monetary policy that would accompany the issuance of CBDC, as well as on how strongly the central bank is committed to act as a lender of last resort [23].

Funds flowing out of commercial banks into CBDC would increase the automatic substitution of deposits by central bank funding, thus changing the overall composition of commercial bank funding [24]. This would therefore shift banks' funding mix towards more wholesale sources of funding and push up their funding costs [25]. In order to compete with CBDC, banks would need to increase the interest rates they pay on deposits, which could have a potentially severe impact on their profitability should banks be unable to rethink their business model.

In the extreme scenario where CBDC displaces a significant portion of deposits, the repercussions for lending could potentially be severe [26]. If lenders depend exclusively on wholesale sources for funding, there could be greater variations of funding costs across banks according to their credit worthiness. This could make the flow of lending more unstable, as lenders would have to rapidly switch between lenders, forcing them to adjust their volumes of credit provision.

However, our analysis confirms the findings of [3] and [4] by showing that the quantity of CBDC has a lesser impact on the profitability of banks than potential changes in interest rates. Therefore, a more moderate outflow (which is a more likely scenario) would have milder consequences. These could be further mitigated if the CBDC would be accompanied by limits on the quantity of CBDC that could be held, or on the value of CBDC transactions allowed.

However, the implications are not the same across the EU. Indeed, CEE banks are more profitable than the European average, and therefore more able to adapt to reductions in profitability. As discussed previously, CEE countries tend to be heavier cash users. This means that CBDC could at first replace cash and, to a lesser extent, overnight deposits. This would mean that the impact from a CBDC on the profitability of CEE banks would be more limited. This could accelerate digitalization, increase the overall resilience of payments infrastructure (by adding an additional redundancy) with positive implications for financial stability.

Cash is currently the only way for EU residents to access ECB money, but commercial deposits are increasingly becoming the principal form of money used for transactions in the economy. As CBDC payments would be processed near-instantaneously, there would be less settlement risk in the economy compared with current retail payments systems which can take days to clear. A CBDC would essentially be an alternative payments system, which would improve overall resilience of the system, including by reducing the economy's reliance for digital payments on the operational resilience of a very limited number of systems.

A CBDC could also lead to increasing competition in the CEE banking sector. CEE banks are more profitable than EU's average for several reasons. Most CEE countries have not adopted Euro, and their national central banks have been able to maintain different interest rates than the rest of Europe – indeed, no CEE countries have negative interest rates to date. We see that banks in CEE region still have higher NIM than their Eurozone peers. Loan spreads are higher than in developed countries due to more uncertain or more expensive funding than in developed countries. Liquidity and risk premiums are also higher as inflation evolution and money market interest rates are more volatile than in euro area.

Furthermore, CEE countries have some of the lowest levels of internet banking adoption, and least digital governments. Nearly 20% of CEE residents are unable to access bank accounts, which makes it impossible for them to access simple financial services, such as borrowing, saving, or investing. Instead, some are forced to turn to alternative financial institutions that demand higher fees and take advantage of financial exclusion. As a result, the underserved or unbanked tend to be “trapped in a cycle of poverty” [14] and increasing debt, without access to more affordable alternatives. A

CBDC could replace or could provide a viable alternative to cash and thus establish a more inclusive and potentially a more affordable digital payments ecosystem. It could thus help redesign the financial system into one that the underserved or underbanked could more easily access, as they no longer need to interact with incumbents to gain access to digital forms of money. A CBDC could also create financial data identities and help the unbanked or underserved to build a financial history, which is critical for credit checks.

However, this could increase privacy risks, particularly with regards to data collection and the potential of surveillance of individuals' transactions. These risks are even higher for the most vulnerable communities. GDPR goes some way in alleviating these concerns, but a CBDC could drive governments to create data standards for building a digital identity, one that could interoperate with other government services.

## 5.2. Monetary Policy

After the Global Financial Crisis (2007-2008) central banks have reduced interest rates significantly, even going negative. They also performed unconventional monetary policy (e.g. quantitative easing, buying long term bonds) with the purpose of generating inflation and support economic growth. However, because certain limitations remain, as presented below, interest rates could not be taken too much into negative territory.

While real interest rates could differ based on inflation, negative nominal interest rates could provide arbitrage opportunities: attract funds from a bank at the published negative rate and place the funds in zero-interest bearing cash. In this scenario, cash is preferable to deposit accounts. However, keeping physical cash generates storage costs that have to be considered in order to offset the arbitrage [27].

Central banks around the world are studying the format options of a CBDC. For example, a central bank digital currency would permit the central bank to reduce interest rates to negative numbers (even applied on CBDC) as a strategy to encourage spending and investment [28].

In the environment with negative interest rates, people that usually invest in fixed income instruments to obtain a minimum yield, would have to find alternative options. It could be argued that households with significant interest rate revenue have a lower propensity to spend to begin with, so that negative interest rates would have a smaller effect on consumption than on investment. The decision to apply negative interest rates on CBDC needs careful consideration, as households could be reluctant to use the new technology, and it could disproportionately affect poorer categories. This could be similar to the "bail-in" recapitalization of banks in Cyprus which became painful for customers, after the government suggested that banks increase their equity by using the balances of certain customer accounts. This specific case might be solved if a floor would be put on amounts charged with negative interest rates for lower income categories.

We believe that non-Euro CEE countries could more easily and efficiently implement a CBDC compared to Eurozone countries. A CBDC in a non-Euro CEE country could be more tailored for the specific economy and could generate significant effects. This

is because non-Euro CEE countries do not have to accommodate differences in fiscal policies and external balances of each euro country. We think that a non-Euro CEE CBDC would be of domestic use only. It would also have the characteristics of legal tender and be used as a means of payment, store of value and unit of account [29].

In countries with low banking penetration and unreliable settlement systems, CBDC may be more appealing to customers, especially in the absence of electronic storage facilities. Also, the demand for cash is likely to diminish as digitalization accelerates.

Some CEE countries have not yet adopted Euro and continue to maintain their own monetary policy, which includes setting positive interest rates. For this reason, we believe that in these countries the possibility for negative interest rates to be implemented is remote in the short to medium term, and therefore unlikely to affect the willingness of the population to use CBDC.

## 6. Conclusions

As discussed in this paper, a CBDC could support financial stability. This is because, amongst other factors, it could increase financial inclusion and help diversify payments architecture. It could also act as an alternative tool through which central banks could more efficiently transmit monetary policy. However, a CBDC could act as a replacement for stable deposits and cash, which could negatively impact the profitability of banks and potentially increase the risk of “bank runs”.

Our analysis shows that the quantity of CBDC to be introduced into the market would have a lesser effect on the profitability of banks than a change in interest rates. This is true even in the extreme scenario that a CBDC would replace all deposits. These findings are in line with research from Bank of Canada, the Riskbank and the ECB and show that the introduction of a CBDC might only have a limited impact on financial stability. The impact could be further mitigated through the policies accompanying a CBDC (e.g. limits).

Furthermore, we show that given the local economic and political circumstances, a CBDC could bring benefits, especially to non-Euro CEE countries (Romania, Hungary, Czech Republic, and Poland). This is in part because these countries are further behind in terms of digitalization, and financial inclusion, which a CBDC could help accelerate. Another reason why a CBDC would be more beneficial to CEE countries is because central banks in this region have more autonomy in setting monetary policy and could thus benefit the most from a CBDC used as a monetary transmission tool.

While encouraging, our analysis is limited by the lack of data available as, at the time of writing, no CBDC was implemented at scale. We thus had to rely on empirical and scenario analysis using aggregated European data. Further work could be done to expand our analysis on individual countries.

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