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**Research Report**

## Digital euro safeguards - Protecting financial stability and liquidity in the banking sector

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EUROPEAN CENTRAL BANK

EUROSYSTEM

## Occasional Paper Series

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Digital euro safeguards – protecting  
financial stability and liquidity in the  
banking sector

No 346

# Contents

<b>Abstract</b>	<b>2</b>
<b>1 Introduction</b>	<b>3</b>
<b>2 The added value of digital euro safeguards such as holding limits</b>	<b>5</b>
<b>Box 1</b> Description of the simulation model	7
<b>3 Estimated impact of different holding limits on the liquidity of euro area banks and on their reliance on central bank funding</b>	<b>9</b>
3.1 Simulated response of euro area banks to different holding limits in the second quarter of 2023	11
3.2 The role of excess reserves in a changing environment	12
3.3 Zooming in on significant institutions and less significant institutions: simulated impact on key liquidity metrics	13
3.4 The importance of effective regulation in addition to having an adequate holding limit	15
<b>4 Conclusion</b>	<b>17</b>
<b>5 References</b>	<b>18</b>

# Abstract

A digital euro would provide the general public with an additional means of payment in the form of risk-free central bank money in digital form that is universally accepted for digital payments across the euro area. A digital euro would offer a wide range of financial stability benefits, including safeguarding the role of public money and strengthening the strategic autonomy and monetary sovereignty of the euro area in the digital era. It would be designed to have no material impact on financial stability or the transmission of monetary policy. This paper shows the usefulness of digital euro safeguards, such as holding limits, that would limit the impact of the introduction of a digital euro on banks' liquidity and on their reliance on central bank funding. To this end, it assesses how banks might respond to the introduction of a digital euro while seeking to maximise profitability and manage their risks for a range of holding limit scenarios. The results of the simulated impact on key liquidity metrics show that, with safeguards in place and on aggregate, the liquidity metrics of euro area banks would decline but remain well above regulatory minimums. In addition, the central bank funding ratios of euro area banks would not increase materially on aggregate and would remain contained overall.

**JEL codes:** E42, E58, G21.

**Keywords:** CBDC, digital euro, bank intermediation, financial stability risks.

# 1 Introduction

## **Central banks around the world are investigating the benefits and risks of issuing central bank digital currencies (CBDCs) – an electronic equivalent to cash – in addition to banknotes and coins.**

The increased digitalisation of the economy and the steady decline in the use of cash for everyday payments have sparked interest among central banks across the globe in exploring retail CBDCs.<sup>1</sup> These would complement but not replace cash and existing digital means of payment. A retail CBDC is a digital form of central bank money widely accessible to the general public. In the euro area, the Eurosystem has been investigating possible design and distribution models for a digital euro over the past few years, and it recently decided to move to the preparation phase of the project.<sup>2</sup>

**A digital euro would be a digital form of cash fit for the digital world.** It would offer the general public a new risk-free means of payment alongside traditional cash. This would meet people's increasing preference for paying digitally, in a secure and efficient way while being free of charge for basic use. Just like physical cash, it would ensure a high degree of privacy and enhance inclusivity in the digital age.

**A digital euro has the potential to offer a wide range of financial stability benefits for the digital era.** By offering a digital alternative to cash, a digital euro would safeguard the role of public money, maintain trust in the euro, secure the monetary anchor role of the euro and provide a public alternative to private sector digital monies (e.g. stablecoins and tokenised deposits). A digital euro would stimulate financial innovation among private sector entities and enhance the efficiency and resilience of the financial system by supporting competition and diversity within it.<sup>3</sup> In addition, a digital euro would strengthen the strategic autonomy and monetary sovereignty of the euro area. Furthermore, it would ensure that central bank money continues to support the efficiency and proper functioning of payment systems.

**A digital euro would be designed to minimise risks to the financial system.** A CBDC issued by the central bank is a liquid and secure asset which could attract depositors looking for a safe haven, especially during periods of market uncertainty or volatility. Consequently, a CBDC could in theory crowd out bank deposits, adversely affecting the intermediation role of banks and their capacity to lend to the

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<sup>1</sup> ECB (2022).

<sup>2</sup> The preparation phase will pave the way for a future decision on whether or not to issue a digital euro. For more information, see the [digital euro page](#) on the ECB's website.

<sup>3</sup> For example, a CBDC could streamline payment processes, reduce transaction costs, support conditional payments through smart contracts and also serve new payment use cases.

real economy.<sup>4,5</sup> Thus, a CBDC without adequate safeguards could decrease demand for bank deposits, thereby impairing banks' liquidity, profitability and overall resilience.<sup>6</sup>

**A digital euro would include safeguards, such as holding limits, to limit its use as a store of value.**<sup>7,8</sup> The extent of the use of a CBDC as a store of value and thus of the potential deposit substitution depends on several factors, including its design, its take-up and the prevailing economic environment at the time of its issuance. When gauging the implications for the euro area banking sector of introducing a digital euro, take-up would be key, as it would determine the level of deposit outflows. The European Central Bank (ECB) would aim to minimise any potential threat a digital euro might pose to the financial system, and its design would therefore include safeguards, such as individual holding limits, to deter its possible use as a store of value so that large deposit outflows would not occur. Finally, if a digital euro is issued, the economic and financial environment prevailing at the time of the launch would be important, including the monetary policy environment and the potential availability of alternative private-sector digital monies .

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<sup>4</sup> Both commercial bank deposits and cash could be substituted by a digital euro. In the latter case, the issuance of a digital euro would not affect banks' balance sheets, since banks would return euro banknotes to the Eurosystem in exchange for digital euro. Banknotes and digital euro are two different types of central bank liability, so a swap between banknotes and digital euro would only affect the composition and not the size of the Eurosystem's balance sheet. In our analysis, we model only the substitution of commercial bank deposits with a possible future digital euro.

<sup>5</sup> The academic community's growing interest in the policy debate related to CBDC has led to a rapid increase in studies and publications on the financial stability implications of introducing a CBDC. See, for example, Ahnert et al. (2023), Hemingway (2023) and Li et al. (2023).

<sup>6</sup> Chen and Filippin (2023) and Lambert et al. (2023).

<sup>7</sup> At the same time, the safeguards would maintain the overall usefulness and attractiveness of a digital euro as a means of payment.

<sup>8</sup> The legislative proposal on a digital euro provides for the inclusion of such safeguards and establishes specific criteria for the limits, aiming to contain the use of a digital euro as a store of value. See ECB (2023).

## 2 The added value of digital euro safeguards such as holding limits

**To understand the benefits of digital euro safeguards, such as holding limits, it is useful to first consider the implications of introducing a CBDC without adequate safeguards.** Overnight household deposit funding is typically a relatively sticky and cheap source of funding for banks. A CBDC could lead to higher volatility or/and a structural reduction in overnight household deposits, which might induce banks to rely on alternative sources of funding. Depending on the take-up of CBDCs, this might potentially have an impact on the profitability and financial soundness of banks. Overnight household deposits make up over 20% of the liabilities of the euro area banking sector (Chart 1, panel a).

**Customer demand for such a CBDC would prompt banks to strike a balance between their profitability profile and liquidity risk.** Should depositors decide to convert their bank deposits into CBDC, banks would need to obtain CBDC on behalf of their clients from the central bank in exchange for reserves. Banks would then immediately pass on the CBDC to their customers, who would in turn reduce their bank deposits.<sup>9</sup> To obtain CBDC, banks could either use their own reserves or acquire new reserves in the interbank market or from the central bank (see Box 1 for a description of the simulation model).<sup>10,11</sup> All of these options come at a cost, which depends on the size of the CBDC take-up. Depleting their excess reserve holdings would reduce the reserve coverage of banks' other liabilities. Hence it would increase banks' liquidity risk. Likewise, obtaining funding secured by high-quality liquid assets (HQLA) would negatively impact banks' liquidity positions. The monetary policy stance prevailing at the time of the launch of a digital euro would further influence these trade-offs. In the euro area, excess reserve holdings have been quite ample in recent years (Chart 1, panel b). Moreover, in response to the introduction of a CBDC, banks would also be able to actively contain outflows by offering higher deposit rates.<sup>12</sup>

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<sup>9</sup> Every withdrawal of a bank deposit, whether transformed into CBDC or something else, has to be met by the bank by paying out central bank reserves. Banks could use banknotes instead of central bank reserves to meet the demand for CBDC. However, in this analysis, it is assumed that banks would keep hold of their banknotes to satisfy customer demand for cash.

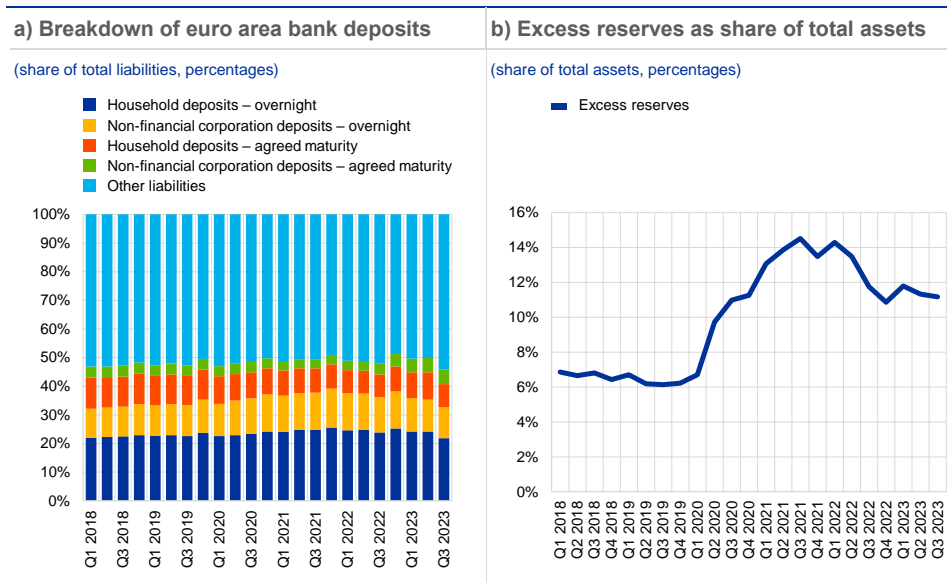
<sup>10</sup> Banks that cannot tap the interbank market would resort to central bank borrowing, which would lead to an increase in their reliance on the central bank. The analysis assumes that banks can borrow from the central bank by pledging either HQLA or other liquid assets.

<sup>11</sup> See also Adalid et al. (2022), "Central bank digital currency and bank intermediation: Exploring different approaches for assessing the effects of a digital euro on euro area banks", *Occasional Papers*, No 293, European Central Bank, Frankfurt am Main, May.

<sup>12</sup> For example, Li (2023), model banks' responses to CBDC by estimating a Cournot model and Li et al. (2023), by estimating a structural model.

## Chart 1

Euro area banks rely on household deposit funding and still hold high levels of excess reserves



Sources: ECB (Supervisory Banking Statistics – SUP) and ECB calculations.

Notes: Panel a: other liabilities include all other bank funding sources, such as central bank funding, bond funding, and short-term secured and unsecured funding. Panel b: excess reserves are defined as the reserves held at the central bank over and above the required minimum.

**The response of banks to the demand for CBDC is subject to a number of constraints, such as regulatory requirements, their liquidity risk appetite, the availability of collateral and excess reserves, and central bank policy.** First of all, banks are subject to liquidity requirements, including the net stable funding ratio (NSFR), which reduces banks' funding risks over a longer time horizon, and the liquidity coverage ratio (LCR), which is aimed at enhancing the short-term resilience of banks' liquidity risk profile. In principle, and depending on their risk appetite, banks may prefer to hold a voluntary buffer over and above the regulatory requirements.<sup>13</sup> Banks also need sufficient collateral to obtain secured funding from either the repo market or the central bank. In addition, banks face an individual reserve constraint, and the overall amount of reserves available in the system is limited. Without any constraints, banks might be expected to resort to the cheapest funding option. Hence, banks that are constrained by either liquidity or collateral would be expected to resort to unsecured funding. Finally, if the stock of reserves available in the system was insufficient to meet the demand for CBDC, or if banks were not able to obtain sufficient reserves in the interbank market, they could obtain additional reserves from the central bank.<sup>14</sup> It is important to recall that the central bank would

<sup>13</sup> The baseline analysis in this article assumes that banks are willing to reduce their voluntary liquidity buffers to the regulatory minimum. Footnote 23 also reflects how results would be affected in a scenario in which banks prefer to keep 50% of their voluntary buffers.

<sup>14</sup> The analysis assumes that banks that require reserves will obtain them either in the interbank market or from the central bank. Reserves are available in the interbank market as long as there are banks willing to lend part of their excess reserves, i.e. banks that still hold excess reserves above their liquidity risk preference. If banks are unwilling to provide reserves in the interbank market (at rates below the central bank rate), the central bank is assumed to provide the needed funding. In this regard, the analysis assumes an ECB policy of full allotment, meaning that the ECB would meet any funding demands that banks are not able or willing to meet via the interbank market, and sets out what such an assumption implies for the size of the central bank balance sheet.



still have an active role to play, including the deployment of appropriate tools and policy levers to preserve financial and financing conditions, promote stability and foster confidence in the financial system.

**The interaction between introducing a CBDC and banks' liquidity profile, funding costs and central bank reliance demonstrates the importance of safeguards such as holding limits.** Our analysis simulates how banks might respond to a loss of different levels of overnight household deposits while seeking to minimise funding costs and manage liquidity risks. Specifically, the analysis uses supervisory bank-level data to capture overnight household deposits, available collateral, reserves and liquidity buffers for over 2,000 euro area banks.<sup>15</sup> It also assumes that banks are willing to reduce their voluntary liquidity buffers to the regulatory minimum. This preference determines banks' willingness to use their own reserves and other HQLA to compensate for deposit outflows and their willingness to provide liquidity in the interbank market, as banks must maintain an NSFR and an LCR of at least 100% on an ongoing basis.

## Box 1

### Description of the simulation model

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The balance sheet optimisation model simulates the response of each bank – and the response of the euro area banking system as a whole – to a sudden loss of deposits following the introduction of a CBDC.<sup>16</sup> The model assumes that each bank seeks to optimise its balance sheet to maximise profitability, while also meeting the LCR and NSFR requirements and a collateral availability constraint. In addition, banks face two types of reserve constraint: each bank faces an individual reserve constraint and the banking sector as a whole is constrained by the amount of excess reserves in the system. Subject to these constraints, banks try to cover household overnight deposit outflows, first with their own excess reserves and then with the least expensive funding option.

More specifically, banks have three options for covering household overnight deposit outflows: their own excess reserves, interbank funding and central bank funding.<sup>17</sup> Drawing down their excess reserves will reduce the asset side of banks' balance sheets. As excess reserves qualify as HQLA, their reduction would lower banks' LCRs. Similarly, if banks borrow funds from the central bank, they must collateralise the loans received with eligible assets, which include HQLA. The impact on LCRs of this encumbrance of HQLA is similar to that of the winding down of excess reserves. Depending on the congruence between LCR haircuts and ECB collateral framework haircuts, the LCR may be lowered proportionally. In addition, the NSFR will also be reduced where banks make

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<sup>15</sup> The sample of banks includes euro area significant institutions (SIs) and less significant institutions (LSIs) that report the necessary data regarding their NSFR and LCR.

<sup>16</sup> For a more detailed overview of the balance sheet optimisation model, see Meller and Soons (2023).

<sup>17</sup> Nevertheless, there are certain limitations and caveats linked to the model. For example, instead of using their excess reserves, banks could rely on banknotes to meet deposit outflows. However, it is assumed that banks keep their banknotes to meet depositors' demand for cash. Moreover, the model assumes a constant order of precedence for pricing as well as a perfectly functioning interbank market which would otherwise imply an earlier supply of additional reserves by the central bank. In addition, for simplicity we do not model the possibility that banks could sell assets to the central bank to obtain additional liquidity. Finally, we assume that the central bank provides the demanded funding through its normal market operations.

use of standard central bank liquidity provision, as it has a maturity of up to one week. Importantly, banks are assumed to keep their lending to the real economy constant.

The impact of market-based funding on the liquidity ratios of banks depends on the duration of the loan and any collateral used. The LCR will be adversely affected whenever market borrowing with a maturity of less than 30 days takes place and/or HQLA are used as collateral. For example, a repo transaction with overnight maturity will have a double negative impact on the LCR – by reducing the stock of liquid assets (numerator) and by increasing expected outflows (denominator).

The NSFR, by contrast, would be adversely affected whenever banks substitute deposits with funding from less stable sources, such as those with a maturity below six months or one year depending on the exact source.

The relative attractiveness of the different funding sources is kept constant. For example, short-term funding is cheaper than long-term funding and collateralised borrowing is cheaper than unsecured borrowing. Long-term unsecured funding is the most expensive funding option, preceded by central bank funding.

### 3 Estimated impact of different holding limits on the liquidity of euro area banks and on their reliance on central bank funding

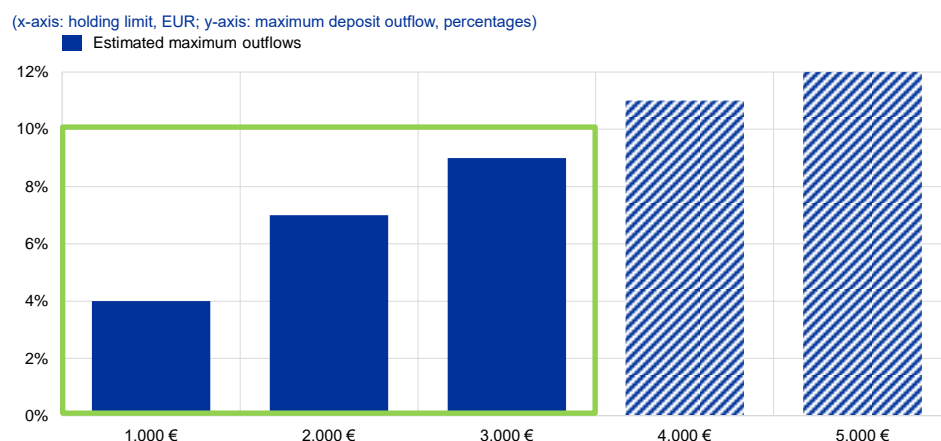
**The calibration of a digital euro holding limit would take into consideration the financial stability impact, and the limit would be set close enough to its possible introduction to reflect the economic conditions prevailing at that time.** Calibrating the holding limit to reflect the prevailing economic and financial environment would help minimise undesirable effects on the stability of the financial system, while promoting accessibility and convenience for users. Limits on individual holdings of digital euro would be aimed at preventing excessive use of the digital euro as a form of investment and thus unwarranted outflows of deposits.

**The design of a digital euro would ensure usability even with low holding limits.** The Eurosystem would ensure that users have a positive experience by incorporating features offering additional functionalities. One such feature would be the “waterfall” (and “reverse waterfall”) functionality. This would allow users to receive (and make) larger payments in digital euro by allowing funds to be redirected automatically. Funds in excess of the holding limit would be redirected to a commercial bank account or payment account linked to the digital euro account. Similarly, any shortfall in the digital euro account would be covered instantly from the linked account, provided that it contained sufficient funds.

**Our simulation analysis shows the impact of different levels of deposit outflows on euro area banks’ liquidity risk and central bank reliance.** From a methodological perspective, for each level of the holding limit, different deposit outflows can be inferred, depending on assumptions around (i) user behaviour, e.g. deciding to adopt the digital euro, and (ii) the average amount of digital euro in a wallet. This amount would also be influenced by users’ choices on when or whether to top up over a given cycle, i.e. the volatility of the digital euro wallet holdings. The impact would also depend on the speed at which the transition to a digital euro reaches a steady state. In an extreme scenario, all euro area citizens might adopt the digital euro simultaneously and shift bank overnight deposits to digital euro accounts up to the holding limit on a continuous basis. Based on this extreme assumption, and accounting for households with deposit holdings lower than the holding limit, Chart 2 displays a range of estimated maximum outflows of household

overnight deposits for various illustrative scenarios of holding limits.<sup>18</sup> The mapping of the illustrative holding limits to the corresponding estimated maximum outflows underpins the financial stability assessment presented in the next section. Importantly, less extreme assumptions regarding user behaviour would, all other things being equal, result in even lower levels of deposit outflows for the different scenarios represented in Chart 2. For example, continuous topping up of digital euro wallets by all users is highly unlikely, and it is likely that only households with commercial bank account balances above €100,000 – the amount covered by deposit guarantee schemes – would consider such a move to marginally increase their deposit protection.<sup>19</sup> In addition, and even more importantly, the above-mentioned reverse waterfall functionality would enable users to make digital euro payments even without holding any digital euro in their digital euro wallet. Finally, banks would also be able to respond to outflows by making deposits more attractive via higher deposit rates, which in turn would structurally lower the upper bound estimates.

**Chart 2**  
**Estimated maximum outflows of overnight household deposits in different holding limit scenarios**



Sources: ECB (SUP), HFCS and ECB calculations.

Notes: To estimate the maximum outflow of household overnight deposits for different holding limits, we estimate the share of depositors holding less than each holding limit by distributing household overnight deposits across economically active household members and using survey weights to extrapolate the data to the entire euro area population. We assume no portfolio reallocation between deposits with agreed maturity and overnight deposits. The green box indicates the range of holding limit scenarios considered in the analysis while the striped columns represent estimated alternative outflows for individual holding limits above €3,000. The estimated maximum outflow of overnight household deposits in the presence of a holding limit of maximum €3,000 per person would not be higher than 9% considering the share of household members that hold less than €3,000 in overnight deposits.

<sup>18</sup> The underlying analysis is based on data from the Household Finance and Consumption Survey (HFCS, 2023), a household-level survey providing detailed information on various dimensions of household balance sheets, such as income and consumption, as well as related economic and demographic variables for all euro area countries. To estimate the maximum outflow of household overnight deposits, we estimate the share of depositors holding less than each holding limit by distributing household overnight deposits across economically active household members and use survey weights to extrapolate data to the entire euro area population, assuming no portfolio reallocation between deposits with agreed maturity and overnight deposits.

<sup>19</sup> Under EU rules, deposit guarantee schemes protect depositors' savings by guaranteeing deposits up to a level of €100,000, thereby helping prevent a mass withdrawal of deposits in the case of a bank failure, which might otherwise create financial instability. See "[Deposit guarantee schemes](#)" on the European Commission's website.

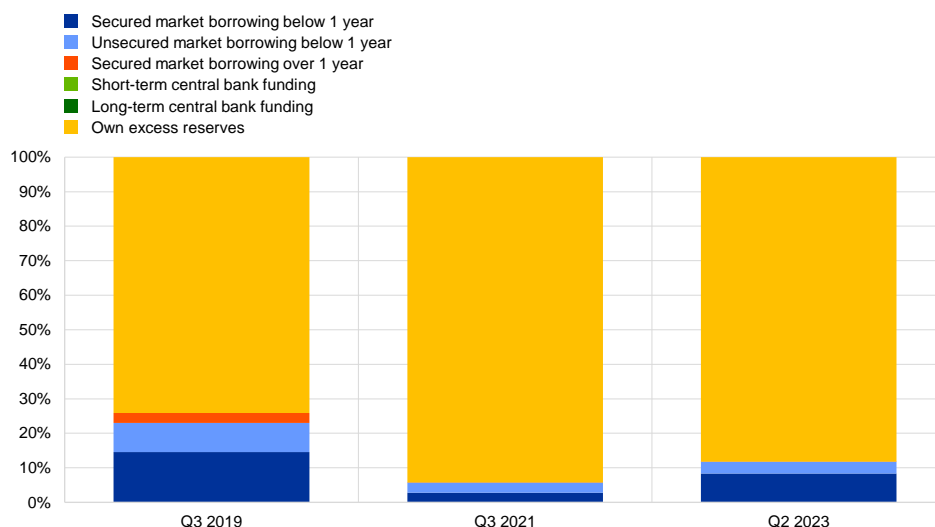
### 3.1 Simulated response of euro area banks to different holding limits in the second quarter of 2023

On aggregate and based on data for the second quarter of 2023, the impact that deposit outflows corresponding to the range of holding limit scenarios considered would have on banks' liquidity risks and funding structures would be contained. This result holds on aggregate, but the impact of the introduction of a digital euro on individual banks may be heterogeneous, depending on factors such as the bank's customer base, technological capabilities and potential to adapt to changes in the financial ecosystem. In a scenario in which banks would be willing to fully utilise the voluntary liquidity buffer held over and above the regulatory minimum, banks would on aggregate be able to cover deposit outflows for the range of holding limit scenarios considered. This would involve the use of their own reserves and, if necessary, the borrowing of additional reserves from other banks in the interbank market. All banks would thus have been able to meet digital euro demand without relying on additional central bank funding (Chart 3).<sup>20</sup>

**Chart 3**

On aggregate, euro area banks would be able to accommodate digital euro demand in the presence of individual holding limits

(share of deposit substitution by source, percentages)



Sources: ECB Supervisory data and ECB calculations.

Notes: Simulated impact on the balance sheet structure of SIs and LSIs for an outflow of 10% of overnight household deposits (the estimated maximum outflow of household overnight deposits in the presence of a holding limit of maximum €3,000 per person would not be higher than 9% considering the share of individual household members that hold less than €3,000 in overnight deposits) in a scenario in which banks are willing to draw down their entire voluntary liquidity buffer to the regulatory minimum (which is 100% for the LCR and the NSFR). Secured market borrowing includes repo transactions with overnight maturity and maturity beyond one month. Unsecured market borrowing refers to overnight borrowing in the interbank market and commercial paper issuance with three-month maturity. Long-term secured borrowing refers to the issuance of covered bonds. Short-term central bank funding refers to borrowing from the standing liquidity provision mechanism of the ECB. Long-term central bank borrowing refers to borrowing funds from a central bank with a maturity of beyond one year. The issuance of unsecured bank bonds is not considered as an available option in the model.

<sup>20</sup> Nonetheless, in a scenario in which banks would prefer to keep 50% of their voluntary liquidity buffers, funding constraints could emerge at lower levels of deposit outflows for individual banks. Specifically, a few banks might need to resort to central bank funding at lower levels of deposit outflows if they have low excess reserves and are unable to tap the interbank market. This would raise their funding costs and increase their central bank reliance while reducing their liquidity risks.

**Only deposit outflows beyond 15% could leave banks materially reliant on central bank funding.** In a scenario of very high digital euro demand and no or high individual holding limits, the interbank market would only be sufficient to redirect excess reserves up to a certain level, after which additional central bank funding would be needed to accommodate the residual digital euro demand. The liquidity provided by the central bank, if obtained against non-HQLA, would ease the liquidity risk in the system but leave euro area banks more dependent on central banks.<sup>21</sup>

## 3.2 The role of excess reserves in a changing environment

**In a scenario similar to the current economic environment, with lower excess reserves than in the third quarter of 2021, more interbank activity would be needed in order to meet the demand for digital euro, given the same holding limit.** A comparison of the third quarter of 2021 with the second quarter of 2023 suggests that, for equal holding limits, the decline in the volume of excess reserves as a result of the recent monetary policy tightening means that banks would have to rely more on interbank borrowing and less on their own reserves to meet the same maximum levels of deposit withdrawals (Chart 4, panels b and c).

**In an economic environment with even lower excess reserves, such as in the third quarter of 2019, liquidity pressures could start to rise at lower levels of deposit outflows.** If excess reserves in the banking system were lower, banks would need to rely on external and central bank funding at even lower levels of deposit outflows.<sup>22</sup> Importantly, in this scenario banks would also start off with lower central bank reliance than in the analysis presented above, given the lower level of excess reserves (Chart 4, panel a).

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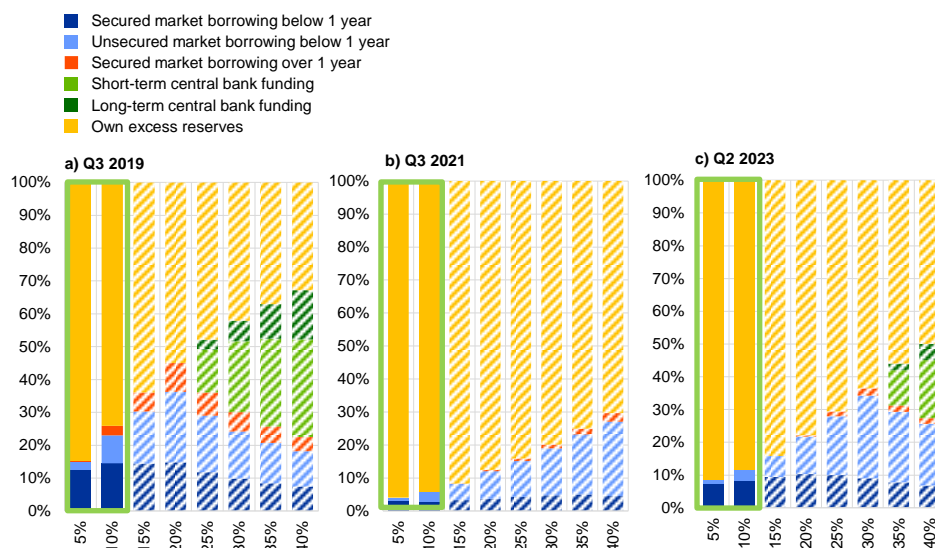
<sup>21</sup> In particular, central bank funding is considered more stable than overnight household deposits, which would reduce the LCR denominator (expected outflows) and would also count as stable funding for the NSFR.

<sup>22</sup> However, banks would turn to the central bank for funding only in a scenario of high deposit outflows, larger than the estimated maximum outflow of household overnight deposits implied by the various holding limit scenarios presented in Chart 2.

### Chart 4

On aggregate, euro area banks would be able to meet digital euro demand using their own excess reserves and interbank lending, while additional central bank funding would be demanded only if there were no or high holding limits

(x-axis: deposit outflows, percentages; y-axis: share of deposit substitution by source, percentages)



Sources: ECB (SUP) and ECB calculations.

Notes: Simulated impact on the balance sheet structure of SIs and LSIs of different levels of overnight household deposit outflows in a scenario in which banks are willing to draw down their entire voluntary liquidity buffer to the regulatory minimum (which is 100% for the NSFR and the LCR). Secured market borrowing includes repo transactions with overnight maturity and maturity beyond one month. Unsecured market borrowing refers to overnight borrowing in the interbank market and commercial paper issuance with three-month maturity. Long-term secured borrowing refers to the issuance of covered bonds. Short-term central bank funding refers to borrowing from the standing liquidity provision mechanism of the ECB. Long-term central bank borrowing refers to borrowing funds from a central bank with a maturity of beyond one year. The issuance of unsecured bank bonds is not considered as an available option in the model. The green box indicates the range and estimated maximum outflow of overnight household deposits in the presence of a holding limit of maximum €3,000 per person, which would not be higher than 9% considering the share of individual household members that hold less than €3,000 in overnight deposits.

## 3.3 Zooming in on significant institutions and less significant institutions: simulated impact on key liquidity metrics

**On aggregate, it is estimated that euro area banks' liquidity metrics would gradually decline while remaining well above the regulatory minimum.** In a

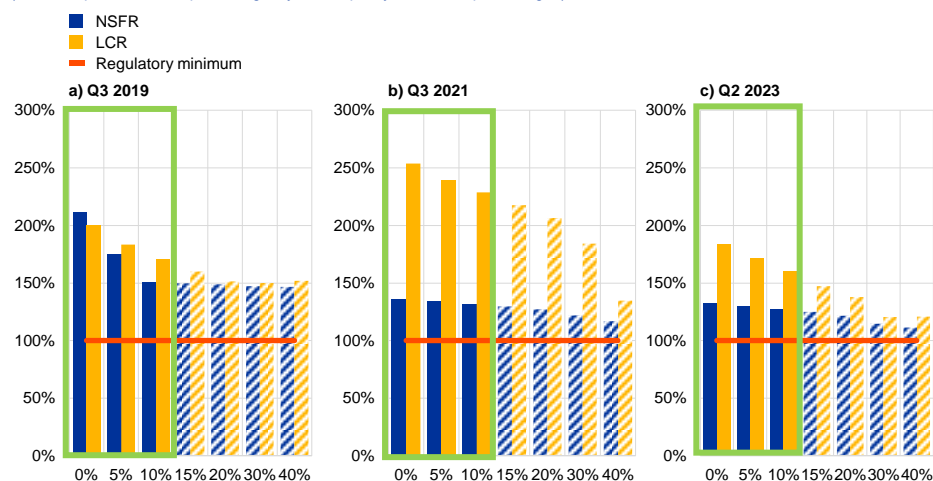
scenario in which banks are willing to exhaust their entire voluntary liquidity buffers to meet the demand for digital euro, banks' liquidity metrics would not deteriorate as a result of a flight of household deposits. A comparison of the third quarter of 2021 with the second quarter of 2023 indicates that the progressively reduced excess reserves in the banking system result in lower NSFRs and LCRs for euro area banks on aggregate, although these ratios remain well above the regulatory requirements (Chart 5, panels b and c).<sup>23</sup>

<sup>23</sup> For a liquidity tolerance scenario in which banks keep half of their current voluntary buffers, the results show only minor differences. Specifically, in such a scenario, banks' LCRs would increase slightly, while their NSFRs would decrease slightly.

## Chart 5

On aggregate, it is estimated that euro area banks' key liquidity metrics would remain well above the regulatory minimum

(x-axis: deposit outflows, percentages; y-axis: liquidity indicators, percentages)



Sources: ECB (SUP) and ECB calculations.

Notes: Simulated impact on euro area banks' key liquidity indicators over time in a scenario in which banks are willing to draw down their entire voluntary liquidity buffers to the regulatory minimum (which is 100% for the LCR and the NSFR) to meet the demand for digital euro. The liquidity indicators represent averages across all SIs and LSIs, weighted by total assets. The 0% deposit outflow scenario represents the liquidity metrics in the absence of a digital euro. The other outflows show how the conversion of overnight household deposits into digital euro, ranging between 5% and 40%, affects the liquidity metrics (the blue and yellow bars). The green box indicates the range and estimated maximum outflow of overnight household deposits in the presence of a holding limit of maximum €3,000 per person, which would not be higher than 9% considering the share of individual household members that hold less than €3,000 in overnight deposits.

**In particular, when zooming in by decomposing the results for SIs and LSIs, liquidity metrics decline but remain on aggregate well above the regulatory minimum for both SIs and LSIs.** In a scenario in which both SIs and LSIs are willing to draw down their entire voluntary liquidity buffer to the regulatory minimum, banks' LCRs and NSFRs remain on aggregate significantly above the regulatory minimums. However, on aggregate, LSIs exhibit higher LCRs and NSFRs across all outflow scenarios, though the effect is more significant for the LCR (Chart 6).

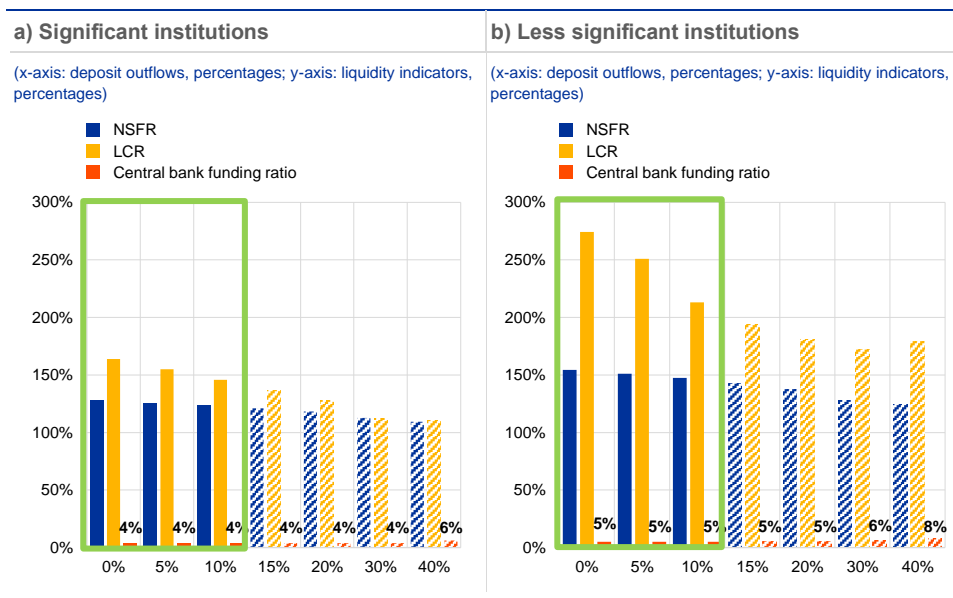
**In addition, central bank funding ratios for euro area banks do not increase materially on aggregate and remain contained overall if banks are willing to use their entire voluntary liquidity buffers to meet digital euro demand.** The results also suggest that, on aggregate, LSIs would be slightly more reliant on central bank funding than SIs (Chart 6).<sup>24</sup> However, some individual banks might rely more extensively on central bank funding if they face very high digital euro demand or do not have sufficient unencumbered HQLA.

<sup>24</sup> LSIs' higher reliance on central bank funding partially explains why their LCRs and NSFRs are higher than those of SIs.



**Chart 6**

Simulated impact of different levels of overnight household deposit outflows on key liquidity metrics of SIs and LSIs



Sources: ECB (SUP, Q2 2023) and ECB calculations.

Notes: Simulated impact on key liquidity metrics of SIs and LSIs for different levels of overnight household deposit outflows in a scenario in which banks are willing to draw down their entire voluntary liquidity buffer to the regulatory minimum (which is 100% for the LCR and the NSFR). In a highly unrealistic scenario involving a 40% deposit outflow, the LCR of LSIs would increase, since in such a scenario banks would resort to long-term central bank funding against non-HQLA, which would increase the indicator's numerator. The green box indicates the range and estimated maximum outflow of overnight household deposits in the presence of a holding limit of maximum €3,000 per person, which would not be higher than 9% considering the share of individual household members that hold less than €3,000 in overnight deposits.

### 3.4 The importance of effective regulation in addition to having an adequate holding limit

**Effective regulation is crucial for ensuring that euro area banks are liquid at all times and for financial stability.**<sup>25</sup> The NSFR and the LCR are two liquidity requirements intended to mitigate banks' liquidity risks during episodes of financial stress. In fact, additional simulations suggest that, in a hypothetical scenario without liquidity requirements, the LCRs of euro area banks could drop below 100% even at low levels of deposit outflows for several banks in the analysis. In the absence of liquidity requirements, banks might respond to digital euro demand by replacing stable and cheap retail funding with less stable and expensive wholesale funding, which could make them more vulnerable to episodes of financial turbulence. Thus, the liquidity requirements already in place ensure that banks maintain sufficient liquidity to meet withdrawals, even in a scenario in which citizens decide to shift bank deposits into digital euro.

**At the same time, as discussed in this paper, the design of a digital euro would include effective safeguards, such as individual holding limits, to mitigate potential financial stability risks.** Caps on individual holdings would effectively set

<sup>25</sup> Regulation offers many lines of defence, such as prudential requirements, supervision and oversight, market discipline, etc. Collectively they provide a framework that fosters the integrity, stability and proper functioning of the banking system.

an upper bound on the amount of digital euro in circulation, thereby addressing and limiting financial stability concerns associated with the introduction of a digital euro.

## 4 Conclusion

**A digital euro would have the potential to provide a wide range of benefits and its design would incorporate safeguards, such as holding limits, to minimise risks to banks' liquidity and to the financial system.** These safeguards have two aims: (i) to ensure that the digital euro would not unduly worsen the liquidity risk profile of banks and (ii) to avoid large deposit outflows.

**The calibration of a digital euro holding limit would take into account financial stability considerations, and the limit would be set closer to the potential launch so that the levels could be tailored to the prevailing economic and financial environment.** Our analysis shows that prudential liquidity requirements and individual holding limits calibrated taking financial stability considerations into account would, on aggregate and in the current environment, be effective in containing the amount of liquidity that could be withdrawn from the banking system. Thus, together, these safeguards would limit the impact on banks' liquidity risks and funding structures. At the same time, the design of the digital euro, including the option to draw liquidity from a linked payment account, would ensure usability and a smooth user experience.

## 5 References

- Adalid, R. et al. (2022), “[Central bank digital currency and bank intermediation: Exploring different approaches for assessing the effects of a digital euro on euro area banks](#)”, *Occasional Paper Series*, No 293, ECB, Frankfurt am Main, May.
- Ahnert, T., Hoffmann, P., Leonello, A., Monnet, C. and Porcellacchia, D. (2023), “[CBDC and Financial Stability](#)”, *Working Paper Series*, No 2783, ECB, February.
- BIS (2021), “[Central bank digital currencies: financial stability implications](#)”, Bank for International Settlements, Basel, September.
- Chen, H. and Filippin, M.E. (2023), “[Unveiling the Interplay between Central Bank Digital Currency and Bank Deposits](#)”, paper presented at the CEPR-ECB Conference 2023, November.
- ECB (2022), [Study on the payment attitudes of consumers in the euro area \(SPACE\) – 2022](#), Frankfurt am Main, December.
- ECB (2023), [A stocktake on the digital euro – Summary report on the investigation phase and outlook on the next phase](#), Frankfurt am Main, October.
- Gorelova, A., Lands, B. and teNyenhuis, M. (2022), “[Resilience of bank liquidity ratios in the presence of a central bank digital currency](#)”, *Staff Analytical Notes*, No 2022-5, Bank of Canada, May.
- Hemingway, B. (2023), “[The impact of central bank digital currency on bank deposits and the interbank market](#)”, paper presented at the CEPR-ECB Conference 2023, June.
- Household Finance and Consumption Network (HFCN) (2023), “[Household Finance and Consumption Survey: Results from the 2021 wave](#)”, *Statistics Paper Series*, No 46, ECB, July.
- Lagarde, C. and Panetta, F. (2022), “[Key objectives of the digital euro](#)”, *The ECB Blog*, 13 July 2022.
- Lambert, C., Pancaro, C. and Pellicani, A. (2023), “[A digital euro: gauging the financial stability implications](#)”, *Financial Stability Review*, ECB, November.
- Li, J. (2023), “Predicting the demand for central bank digital currency: A structural analysis with survey data”, *Journal of Monetary Economics*, Vol. 134, March, pp. 73-85.
- Li, J., Usher, A. and Zhu, Y. (2023), “[Central Bank Digital Currency and Banking Choices](#)”, paper presented at the CEPR-ECB Conference 2023, September.
- Meller, B. and Soons, O. (2023), “[Know your \(holding\) limits: CBDC, financial stability and central bank reliance](#)”, *Occasional Paper Series*, No 326, ECB, August.

Panetta, F. (2023), "[Shaping Europe's digital future: the path towards a digital euro](#)", introductory statement at the Committee on Economic and Monetary Affairs of the European Parliament, Brussels, 4 September.

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