



EUROPEAN CENTRAL BANK

EUROSYSTEM

Central bank digital currency and bank intermediation

Exploring different approaches for
assessing the effects of a digital euro
on euro area banks

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Based on ECB Occasional Paper N.293 by R. Adalid, A. Álvarez-Blázquez, K. Assenmacher, L. Burlon, M. Dimou, C. López-Quiles, N. Martin, B. Meller, M. A. Muñoz, P. Radulova, C. Rodriguez d'Acri, G. Šílová, T. Shakir, O. Soons, A. Ventula

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Introduction: Overview and main findings



Analysis

- 1. Illustrative scenarios to gauge potential demand for digital euro**
 1. Based on current data, analysis arrives at CBDC take-up between €500 bn and €7.5 tn
- 2. Potential changes to structural bank intermediation**
 1. Analyse balance sheets of central bank, banks and households
 2. Potential bank responses under liquidity regulation, collateral requirements and Eurosystem's credit operations
 3. Bank intermediation capacity: considerations based on bank-level data
- 3. Considerations on the severity of economy-wide bank runs**



Results

- 1. Due to the presence of market imperfections, policy & regulatory constraints, and bank-level specificities:**
 1. A digital euro may affect bank intermediation
 2. Certain restrictions could become binding (liquidity regulation, collateral requirements, etc), limiting the extent to which banks could adjust through certain channels
 3. The impact may vary across banks
- 2. Scale and speed of economy-wide bank runs**
 1. Under certain conditions the introduction of a digital euro could exacerbate the severity of runs
 2. An adequate calibration of CBDC safeguards (remuneration, holding limits) would neutralize such effects

1. CBDC demand and illustrative scenarios

CBDC demand and illustrative scenarios

- Use **illustrative** take-up scenarios based on **current** aggregate balance sheet data to inform the different analyses.
- Make assumptions on:
 - Use for retail payments vs. storage of value
 - Demand intensities for different use cases and sectors (households, firms, non-banks, external sector)
 - Degree of substitutability between different forms of money (deposits, cash, D€)
 - Quantity limits

Ad-hoc nature of these assumptions imply that calculations are subject to a lot of uncertainty

Three illustrative take-up scenarios

A. Moderate take-up:

- ☐ D€ only partially replaces other retail means of payment w/ unconstrained demand

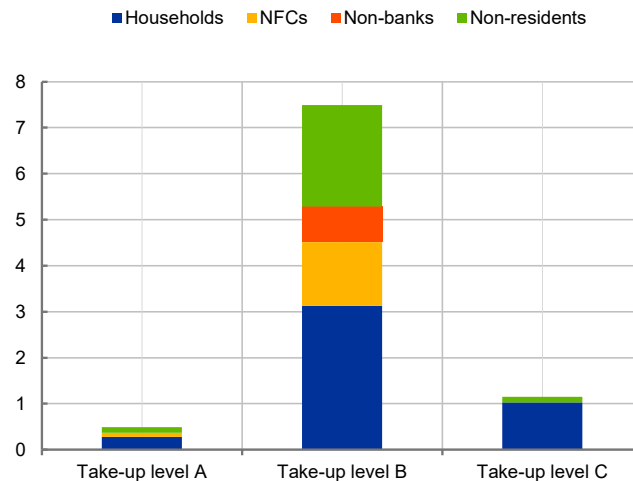
B. Large take-up:

- ☐ Intense use of D€ as a storage of value and increased use for retail payments w/ unlimited take-up

C. Capped take-up:

- ☐ All residents exhaust assumed limit of €3,000 & visiting non-residents hold D€ only for retail payment purposes

Digital euro take-ups by sector
(EUR trn)



Sources: ECB and ECB calculations.
Notes: Figures as of September 2021.

2. Considerations on changes to structural bank intermediation

2.1. Stylised balance sheet adjustment

Balance sheet mechanics: absorption limits

Any adjustment option must involve the Eurosystem's balance sheet

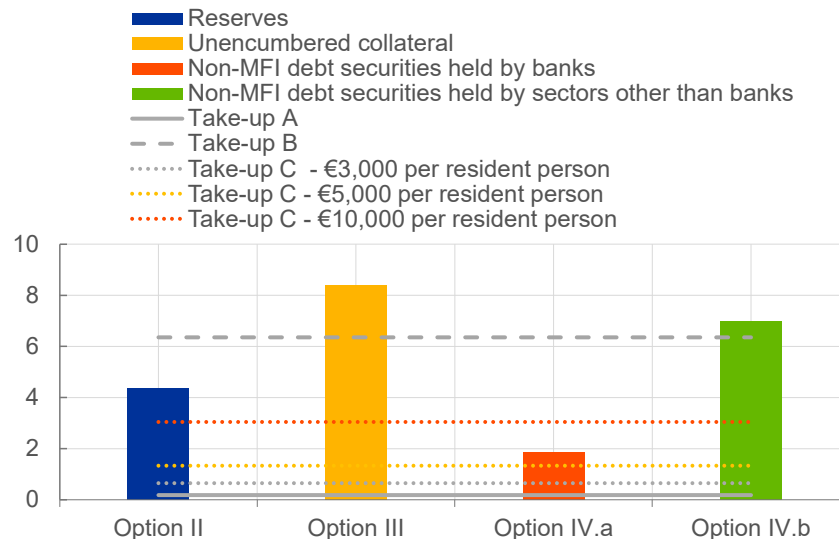
Re-arrangement of Eurosystem liabilities

- I. D€ substitutes for banknotes
- II. Banks draw down existing reserves

Expansion of Eurosystem assets

- III. Banks borrow from the Eurosystem
- IV. Banks sell assets to the Eurosystem
 - IV.a From their own portfolios
 - IV.b On behalf of other sectors

Absorption limits
(outstanding amounts in EUR trn in September 2021)



Sources: ECB and ECB calculations.

Notes: *Option II*: outstanding amount of bank reserves (see Annex B). *Option III*: A large, generic haircut (40%) is applied to the value of banks holdings of potentially eligible unencumbered securities and loans in order to account for their assumed uneven quality. *Option IV.a*: Banks' holdings securities issued by euro area governments and non-financial corporations (NFCs). *Option IV.b*: Holdings of euro area government and NFC securities by sectors other than euro area MFIs, including non-residents. *Options IV.a and IV.b* do not consider issuer limits.

Does it mean that lending won't be affected?

In theory (in a frictionless economy), CBDC has neutral impact on banks' intermediation capacity.

✓ Stylised balance sheet analysis in line with theoretical literature (e.g. Brunnermeier and Niepelt 2019)

BUT: frictions and constraints are pervasive in the financial system.

Existing constraints and frictions:

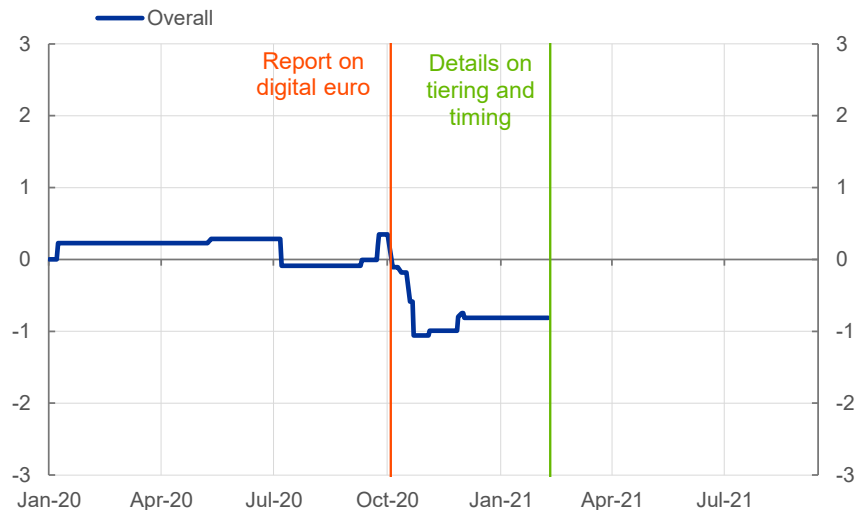
- Collateral requirements,
- Binding liquidity regulation,
- Money market imperfections,
- Perceived market stigma associated with excessive borrowing from the Eurosystem,
- Political economy considerations regarding the use of monetary policy instruments, etc.

➔ With binding and significant frictions, issuance of CBDC affect banks' intermediation capacity and thereby monetary policy transmission.

2.2. Bank intermediation capacity and lending conditions: insights from bank valuations

Reactions to digital euro news

Stock market reactions to CBDC news by euro area banks
(percentage points)



Sources: Burlon et al. (2022), CEPR Discussion Paper No. 16995.

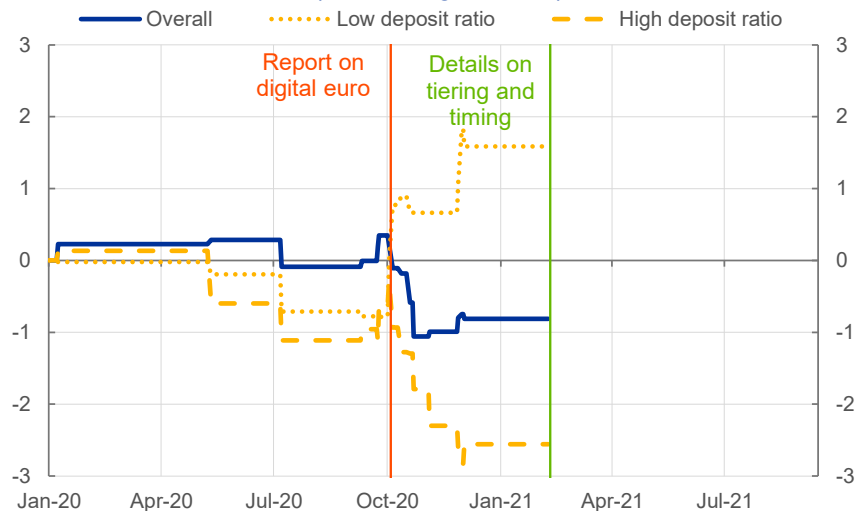
Notes: A 3-factor Fama-French model is fitted to two-day stock market returns of 134 euro area banks at a daily frequency, isolating abnormal returns occurred at key events. Blue line reports cumulated abnormal returns across key events.

Key messages

- Banks' stock market valuations barely dropped after publication of ECB report

Reactions to digital euro news

Stock market reactions to CBDC news by euro area banks (percentage points)



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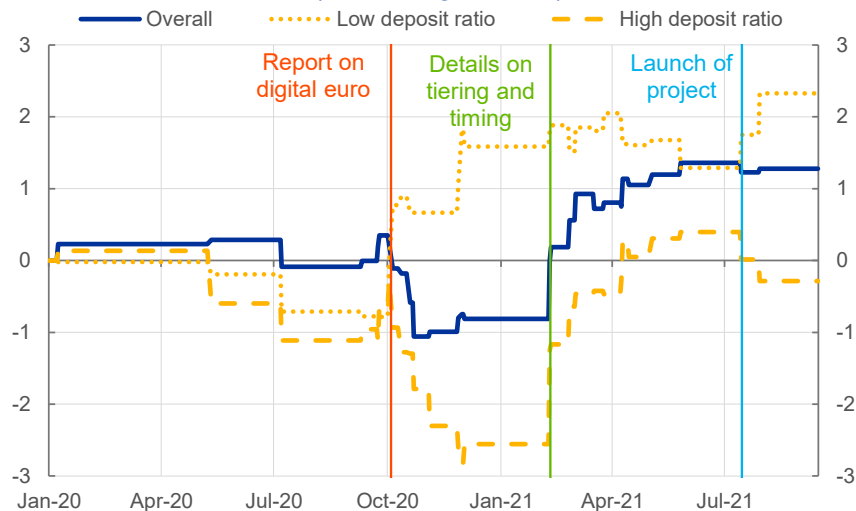
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Key messages

- Banks' stock market valuations barely dropped after publication of ECB report
- Banks relying more on deposit funding were the most affected...

Reactions to digital euro news

Stock market reactions to CBDC news by euro area banks (percentage points)



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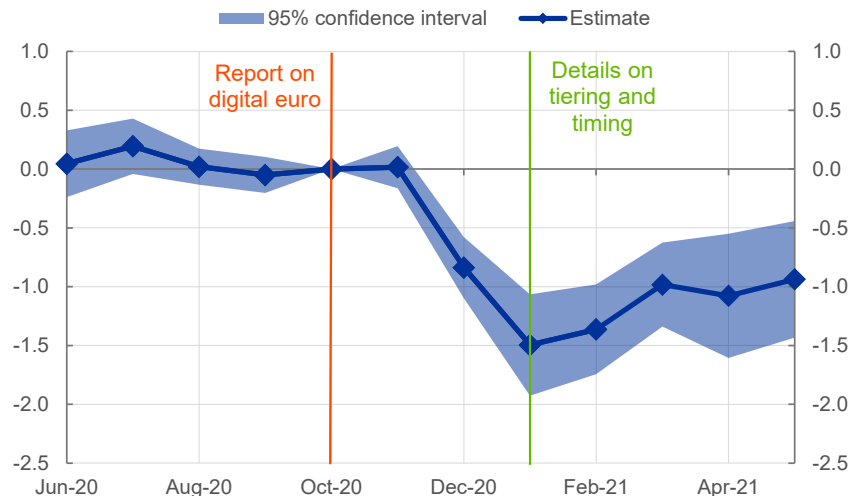
Latest observation: 10 September 2021.

Key messages

- Banks' stock market valuations barely dropped after publication of ECB report
- Banks relying more on deposit funding were the most affected...
- ... but valuations recovered, as the design and timing became clearer

Reactions to digital euro news

Change in loan volumes to firms associated with a 4% cumulated gap in bank stock prices (percentages of ex-ante volumes)



Sources: Burlon et al. (2022), CEPR Discussion Paper No. 16995. Notes: The solid line reports, for each monthly horizon from October 2020 indicated on the horizontal axis, the impact of a 4 pp decrease in (cumulated) abnormal returns in October 2020. Impacts are identified within a diff-in-diff set-up, where the growth rate of loan volume from October 2020 to January 2021 is regressed on the stock price reactions to digital euro events as of October 2020, obtained by fitting a 3-factor Fama-French model to daily data on stock market returns of euro area banks. The specification includes industry-location-size fixed effects à la Degryse et al. (2019) and (lagged) bank-level controls. Shaded areas represent confidence intervals based on standard errors clustered at the bank level.

Key messages

- Banks' stock market valuations barely dropped after publication of ECB report
- Banks relying more on deposit funding were the most affected...
- ... but valuations recovered, as the design and timing became clearer
- Albeit transitory, a re-allocation in lending markets was observed

2.3. Simulated bank responses to CBDC demand under liquidity risk preferences and regulation

Simulated bank responses to CBDC demand

- **Approach:** Bank-level cost minimization model with constraints and assumed deposit outflows
- **Banks minimize costs** when deciding on their:
 - *Excess reserves holdings*
 - *Funding sources – interbank market and central bank funding (both with different maturities, secured/unsecured)*
- **Subject to:**
 - *Liquidity regulations (LCR and NFSR)*
 - *Collateral requirements (by ECB or market participants)*
 - *Availability of unencumbered assets and excess reserves*
 - *Relative prices: rates on excess reserves and CB lending provides a floor and a ceiling (normally)*

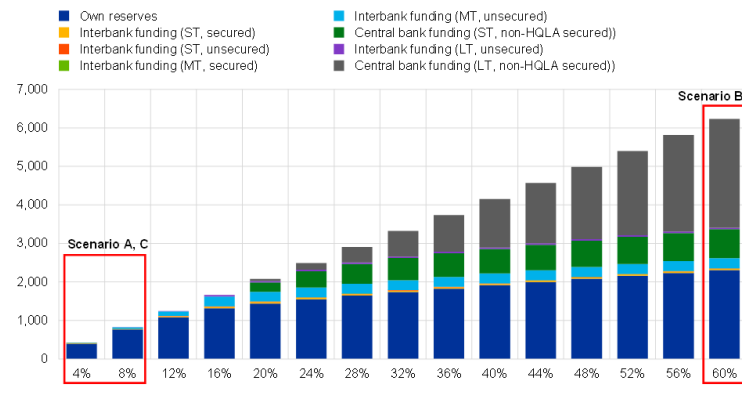
Simulated bank responses to CBDC demand: key messages

- **Assumption:** substituting excess reserves for CBDC is the most cost-efficient option
- **For low CBDC demand, most banks can accommodate** with their own reserves (scenario A, C)
- **For higher demand, more banks become constrained** by their reserves or LCR/NSFR
- Interbank borrowing could be used if there are excess reserves in the system, that is, if lending would not breach banks' LCR/NSFR constraint
- **To accommodate high CBDC demand, banks have to rely on L-T central bank funding** provided against non-HQLA collateral (scenario B)

Simulated balance sheet response (x-axis: deposit outflows in %; y-axis: response in € billion)

Bank balance sheet re-optimisation

(x-axis: share of deposit outflow covered by funding sources; y-axis: EUR billions)



3. Considerations on the severity of potential economy-wide bank runs

Considerations on the severity of economy-wide bank runs

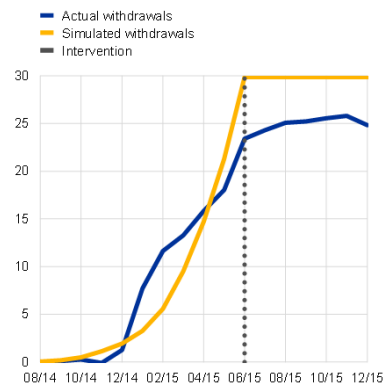
- Two models to discuss the possible **consequences a digital euro could have for the scale and speed of system-wide bank runs**
 - Model for simulated bank runs
 - Model of panic-based bank runs: Diamond and Dybvig type-model with cash and CBDC (Muñoz and Soons, 2022)
- **Common characteristics**
 - Individuals can convert their bank deposits into cash and/or CBDC
 - Technological superiority of CBDC
- **Key distinctive features**
 - Withdrawals decisions based on expected return maximization behaviour vs. due to a coordination problem
 - Model for simulated bank runs: based on data (past nation-wide bank runs)

Model for simulated bank runs

Deposit withdrawals in Greece and Cyprus

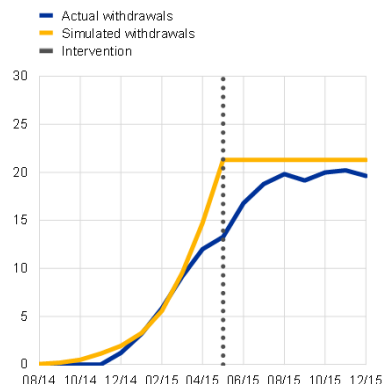
a) Cumulative actual and simulated deposit withdrawals in Greece

(Aug 2014 – Dec 2015, percentages of deposits in Aug 2014)



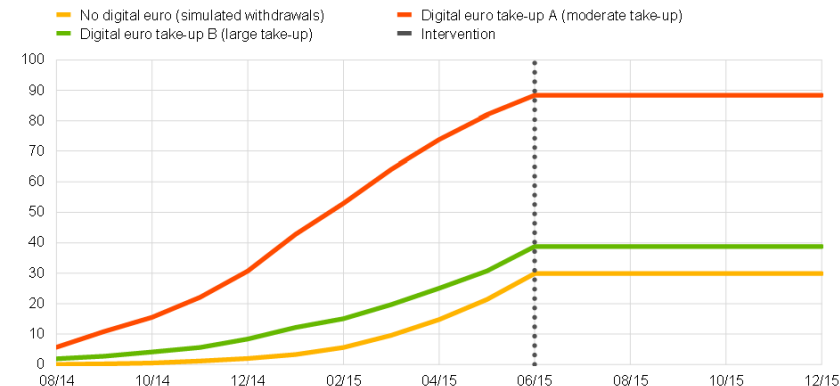
b) Cumulative actual and simulated deposit withdrawals in Cyprus

(Aug 2012 – Dec 2013, percentages of deposits in Aug 2012)



Simulated cumulative deposit withdrawals in Greece under illustrative digital euro take-up scenarios A and B

(Aug 2014 – Dec 2015, percentages of deposits in Aug 2014)



- Model calibrated such that simulated withdrawals match the deposit outflows registered during the recent economy-wide bank runs in Greece (2015) and Cyprus (2013).

- Unconstrained supply of a digital euro exacerbates the scale and speed of simulated economy-wide banks runs.

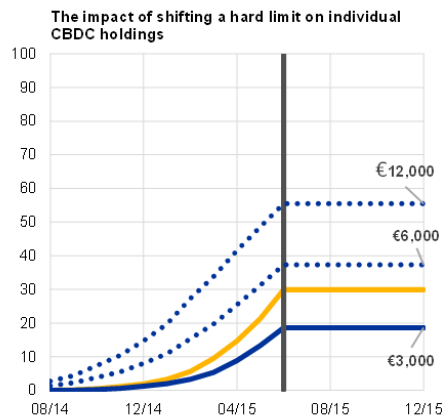
Model for simulated bank runs (Cont'd)

Simulated cumulative deposit withdrawals in Greece under illustrative digital euro take-up scenario C: Hard vs soft limits on individual digital euro holdings

a) Hard limit on individual CBDC holdings

(Aug 2014 – Dec 2015, percentages of deposits in Aug 2014)

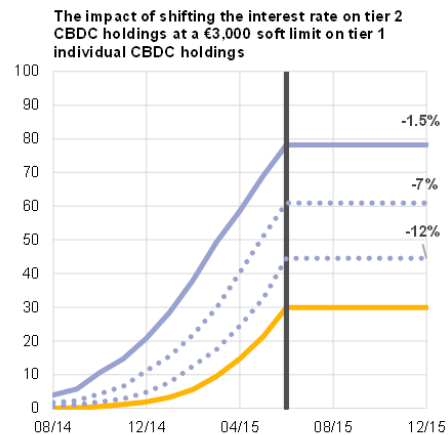
- No digital euro (simulated withdrawals)
- Take-up C with a €3,000 hard limit
- Intervention



b) Soft limit on individual CBDC holdings (I)

(Aug 2014 – Dec 2015, percentages of deposits in Aug 2014)

- No digital euro (simulated withdrawals)
- Take-up C with a €3,000 soft limit and -1.5% tier 2 rate
- Intervention



c) A soft limit on individual CBDC holdings (II)

d) A soft limit on individual CBDC holdings (III)

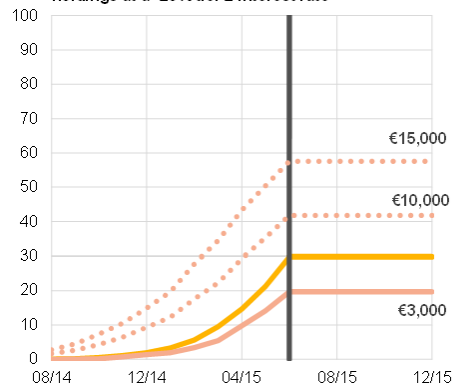
Model for simulated bank runs (Cont'd)

c) A soft limit on individual CBDC holdings (II)

(Aug 2014 – Dec 2015, percentages of deposits in Aug 2014)

- No digital euro (simulated withdrawals)
- Take-up C with a €3,000 soft limit and -20% tier 2 rate
- Intervention

The impact of shifting the soft limit on tier 1 holdings at a -20% tier 2 interest rate

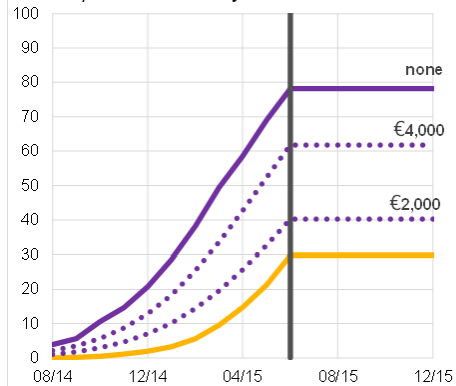


d) A soft limit on individual CBDC holdings (III)

(Aug 2014 – Dec 2015, percentages of deposits in Aug 2014)

- No digital euro (simulated withdrawals)
- Take-up C with a €3,000 soft limit and a convertibility limit
- Intervention

The impact of complementing a €3,000 soft limit on individual CBDC holdings (with a -1.5% tier 2 rate) with a convertibility limit



- Under an adequate design and calibration, individual CBDC limits offer a variety of options to neutralize potential effects on the severity of bank runs

Conclusions

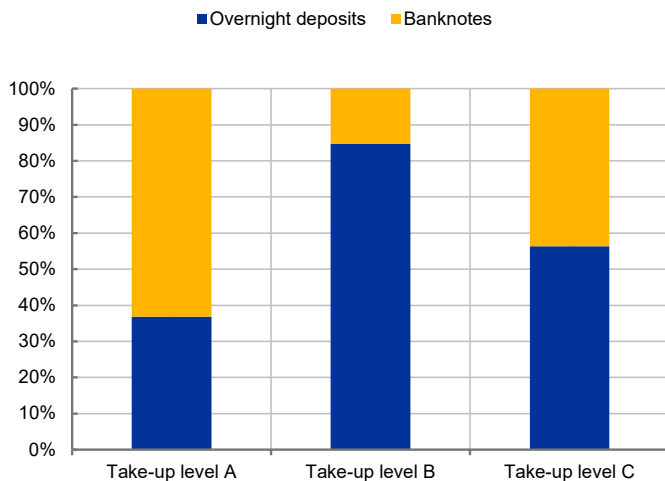
- 4 main adjustment channels
 - *CB balance sheet plays a crucial role in the adjustment process*
- When binding, frictions, constraints, and bank-level specificities in the financial system:
 - *May impose limitations on banks' adjustment options*
 - *May require additional central bank liquidity against non-HQLA collateral*
 - *Open-up the possibility for an impact of a digital euro on bank intermediation capacity...*
 - *...with the impact likely to notably vary across entities*
- Under certain conditions a digital euro could potentially amplify the scale and speed of system-wide bank runs
 - *Adequate design and calibration of CBDC safeguards could help neutralizing such adverse effects*
- Analysis to be updated and extended, once there is less uncertainty surrounding:
 - i. Digital euro design features
 - ii. Demand for a digital euro
 - iii. Prevailing environment under which a digital euro would be issued

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Background slides

Demand scenarios in terms of deposit substitution

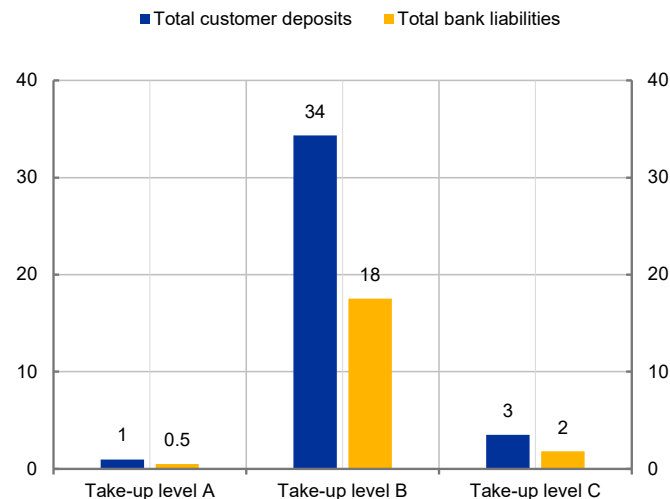
Digital euro substitution by instrument per hypothetical take-up (percent)



Sources: ECB calculations.

Notes: The chart shows what proportion of the total take-up in the left-hand side chart substitutes banknotes or overnight deposits.

Impact on bank liabilities across take-ups (percentages)



Sources: ECB calculations.

Notes: Total customer deposits include all deposit liabilities except those between euro area interbank. Figures as of September 2021.