The impact of the digital euro on Austrian banks from a financial stability perspective

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We study the impact the introduction of the digital euro might have on Austrian banks from a financial stability perspective. The premise is that the digital euro will not bear interest and will be subject to a holding limit. More specifically, we analyze (1) the impact on Austrian banks' liquidity positions in a liquidity stress scenario and (2) long-run profitability effects on banks' net interest income and income from payment services. With respect to liquidity risk, we find substantial effects only for extreme scenarios and high holding limits. For instance, at a holding limit of 3,000, the most extreme stress scenario we consider results in outflows of 9.0% of total retail deposits into the digital euro. Besides, 7.4% of banks (accounting for 4.2% of the sample's total assets) would breach the regulatory liquidity coverage ratio (LCR) threshold of 100%. Smaller banks are disproportionately affected because they have a larger share of retail funding, which leads to higher outflows. The picture is similar with respect to the long-run effects on banks' net interest income. In a similarly extreme scenario as above, we estimate that the digital euro would cause interest income losses and a drop in the aggregate sample return on equity (RoE) of 51 basis points – the aggregate sample RoE is 14.9% – at a holding limit of 3,000. Smaller banks and less capitalized banks would be affected more strongly. In a more realistic scenario, the effects are substantially lower, with 1.0% of total retail deposits outflowing and the aggregate sample RoE dropping by 5 basis points. Lower holding limits effectively contain adverse outcomes both with respect to interest income losses and liquidity risk. As to the effect on payment services income, it is harder to arrive at reliable estimates given a lack of suitable bank-level data and high uncertainty about the digital euro's impact on transaction volumes and fees of retail current accounts and about how digital euro transactions and account management will be remunerated. In a tentative estimation, we find an aggregate sample RoE effect of around 26 basis points. By determining the remuneration of the digital euro, the central bank can effectively control the magnitude of this effect. Overall, we conclude that the introduction of a digital euro would not pose a threat to the stability of the Austrian banking system provided the digital euro is subject to a carefully designed holding limit and remuneration model. From a purely financial stability perspective, low holding limits would be preferable to higher ones.

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Central banks worldwide are investigating the issuance of central bank digital currencies (CBDCs). In October 2023, the Eurosystem finalized the two-year investigation phase for a euro area CBDC, i.e. the digital euro. We are now one year into the preparation phase scheduled to last until October 2025. After that, the Governing Council of the European Central Bank (ECB) will decide whether the digital euro project will progress toward potential development and rollout (ECB, 2024). With the digital euro, the Eurosystem aims for the euro to evolve alongside the general public's digital payment preferences and to facilitate electronic payments in the euro area. The digital euro is also meant to strengthen Europe's

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monetary infrastructure and sovereignty by reducing Europe's dependence on non-European private payment providers that currently dominate the European payments landscape. At the same time, a widely accepted CBDC might generate systemic repercussions for bank intermediation, which might have negative effects on financial stability. If households substitute CBDC for bank deposits, which are a relatively stable and cheap funding source for banks, this might have adverse consequences for banks' liquidity and profitability. Ultimately, this might also impact the overall resilience of the banking sector and its intermediation function for the real economy.

We study these concerns, using bank-level data from Austrian banks.[2] We first analyze the impact the digital euro would have on Austrian banks' liquidity risk in a stress scenario in section 1. Then, in section 2, we assess the long-run profitability effects of the digital euro, in particular on banks' net interest income and income from payment services, abstracting from initial implementation costs. A particular emphasis lies on bank heterogeneity because the impact of the digital euro most likely depends on a bank's business model, e.g. on its share of financing from retail deposits.

Consistent with the current proposals of the ECB,[3] we model the digital euro as a digital alternative to cash, which does not bear interest and can be held by households only. Households can hold digital euro up to a certain holding limit set by the ECB. Their digital euro accounts are directly linked with their other payment accounts to automatically top up the digital euro account up to the holding limit. This "(reverse) waterfall approach" allows households to transact any amount in digital euro, independent of the holding limit.

In the following sections, we focus on a baseline scenario characterizing the most likely outcome and a maximal scenario that captures the extreme but very unlikely upper bound for outcomes. The baseline scenario is mainly calibrated by using the Deutsche Bundesbank's Survey on Consumer Expectations of 6,000 households in Germany presented in Bidder et al. (2024). This survey contains information on how households plan to use the digital euro both in normal and in crisis times.

1 Liquidity effects

To assess the financial stability impact of the digital euro on Austrian banks' liquidity positions, we use a sample of 393 Austrian banks at the unconsolidated level, which reported household salary and pension accounts in the second quarter of 2023.[4] Table 1 presents some descriptive statistics of the sample.

Table 1

Descriptive sample statistics

Total assets, EUR billion	Household sight deposits, EUR billion	Salary/pension accounts, EUR million	Accounts per bank (median)	Account size (mean), EUR
727.3	191.9	5.75	5,200	33,400

Source: OeNB.

[2] *Similar papers include Auer et al. (2024), Bellina and Cales (2023), Bidder et al. (2024) and Meller and Soons (2023).*

[3] *See https://www.ecb.europa.eu/euro/digital_euro/html/index.en.html.*

[4] *The total bank sample at the unconsolidated level consists of 452 banks, of which 59 report no salary or pension accounts. As the reporting standards for 49 banks of the Sparkassen sector have changed, the most recent data for these banks are from the fourth quarter of 2022. The study sample covers 74% of the total sample in terms of total assets and 95% of household sight deposits.*

Table 2

Calibration of the baseline and the maximal scenario liquidity effects

	Baseline	Maximal	Description/Source
d€uptake_crisis	0.6	1	Bidder et al. (2024)
holding limit	(200, 5,000)	(200, 5,000)	
d€holdings	1,000	0	

Source: OeNB.

We consider a systemic liquidity stress scenario, where e.g. due to a sudden loss of confidence in the banking sector, Austrian salary and pension account holders abruptly transfer deposits up to the holding limit from their deposit accounts to a digital euro wallet. We model the deposit outflow for bank i in such a liquidity crisis as follows

$$out_{i,crisis} = d€uptake_{crisis} * \#accounts_i * (holding\ limit - d€holdings) \qquad (1)$$

where $d€uptake_{crisis}$ is the average ratio of account holders that adopt the digital euro in a liquidity crisis, $\#accounts_i$ is the number of salary and pension accounts of bank i, *holding limit* is the holding limit set by the central bank and *d€holdings* are the average intended digital euro holdings of a digital euro adopter before the crisis. If *d€holdings* > *holding limit*, digital euro adopters just hold the holding limit. Note that (1) assumes that the share of account holders that adopt the digital euro is uniformly distributed across banks and all digital euro adopters have enough deposits to withdraw up to the holding limit. We now calibrate the baseline and the maximal scenario as follows (table 2).

In the baseline scenario, $d€uptake_{crisis}$ is the upper bound of Bidder et al. (2024), who find that in a crisis event 56% of respondents would adopt the digital euro. In the maximal scenario, we assume that all account holders adopt the digital euro. We also assume that digital euro adopters intend to hold EUR 1,000 in digital euro in the baseline scenario before the crisis, while in the maximal scenario they hold no digital euro. We motivate the low intended digital euro holdings with the "reverse waterfall approach" explained above and the unremunerated nature of the digital euro. Note that the maximal scenario means that households hold no digital euro before the crisis but in the crisis they all transfer deposits up to the holding limit into the digital euro.

Table 3

Deposit outflows under liquidity stress: baseline vs. maximal scenario

	Baseline scenario			Maximal scenario		
Holding limit	Deposit outflow, EUR billion	% of total assets	% of deposits	Deposit outflow, EUR billion	% of total assets	% of deposits
200	0.0	0.0	0.0	1.1	0.2	0.6
1,000	0.0	0.0	0.0	5.7	0.8	3.0
3,000	6.9	0.9	3.6	17.2	2.4	9.0
5,000	13.8	1.9	7.2	28.7	4.0	15.0

Source: OeNB.

Table 3 shows deposit outflows in the two scenarios. In the baseline scenario, deposit outflows increase linearly from holding limits above 1,000 (since households already hold 1,000 digital euro before the crisis) to EUR 13.8 billion or 7.2% of total sight deposits at a 5,000 holding limit. In the maximal scenario, deposit outflows increase linearly to EUR 28.7 billion or 15% of total sight deposits at a holding limit of 5,000.

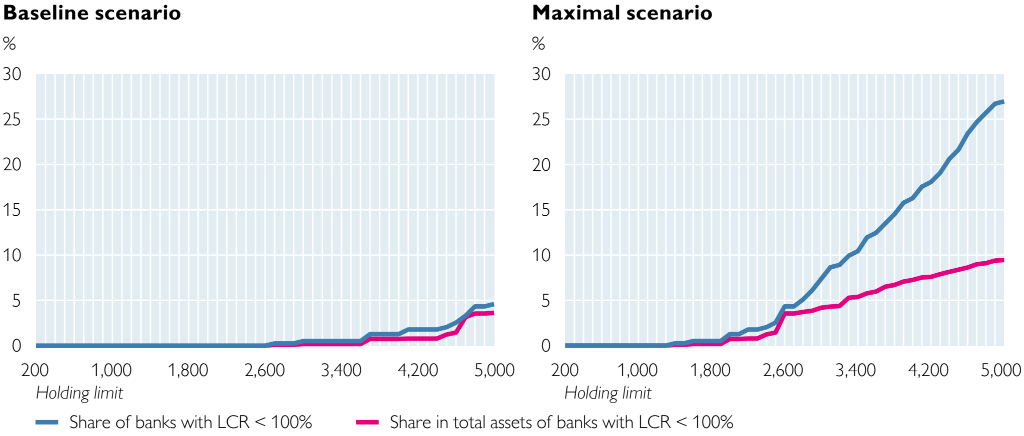
Do banks have enough liquid assets to withstand these outflows? To answer this question, we calculate banks' liquidity coverage ratios (LCR). In other words, we compare the high-quality liquid assets (HQLA) banks hold to their outflows due to the liquidity crisis $out_{i,crisis}$ plus their other net liquidity outflows (NLO).[5]

$$LCR_i = \frac{HQLA_i}{NLO_i + 0.95 * out_{i,crisis}} \tag{2}$$

Chart 1 shows how many banks have an LCR below 100% due to these outflows as well as their share in total assets. In the baseline scenario, we only see material effects for high holding limits. At a holding limit of 5,000, 4.6% of banks (3.6% of the sample's total assets) have an LCR below 100%. In the maximal scenario, the effects are more substantial. At a holding limit of 3,000, 7.4% of banks (4.2% of the sample's total assets) have an LCR below 100%; at a holding limit of 5,000, this is the case for 27% (9.5% of the sample's total assets). The divergence between the share of banks and their share of total assets indicates that it is mostly smaller banks that are affected. The reason is that, compared to large and medium-sized banks, smaller banks tend to have more accounts and more retail financing relative to their assets (see table A1 in the annex). Overall, the effects of the liquidity stress scenario are substantial only for high holding limits. Thus, a careful calibration of

Chart 1

Liquidity effects: baseline vs. maximal scenario



Source: OeNB.

[5] *We subtract 5% of outflows from the other liquidity outflows in the denominator because the outflows from these retail deposits are already contained in the outflows due to the crisis. 5% is the usual outflow rate applied to retail deposits in the calculation of the LCR. The HQLA and the liquidity outflows of the Raiffeisen banks in Lower Austria, Vienna, Upper Austria, Styria and Vorarlberg as well as the Volksbanken banks are aggregated to a sector level due to special liquidity reporting requirements that apply to these banks. In the baseline scenario, we also adjust* $HQLA_i$ *for pre-crisis outflows per bank into the digital euro* $out_{i,normal}$ *derived in section 2.1 on net interest rate income losses below.*

the holding limit can contain the adverse effects of such a scenario even in the extreme and very unlikely maximal scenario.

2 Profitability effects

To assess the financial stability impact of the digital euro on Austrian banks' solvency, this section first analyzes the effects on banks' net interest income (NII) and then the effects on banks' net payment services income (NPI). In contrast to the crisis focus in the liquidity part, we now concentrate on the digital euro's profitability effects in "normal times." This steady state perspective also abstracts from initial introduction costs.

2.1 Net interest income (NII)

Banks might suffer NII losses due to deposit outflows into the digital euro either because banks must replace deposits with more expensive funding or because they shrink their assets. As shown in (3) we model average deposit outflows of bank i $out_{i,normal}$ as a product of the average share of account holders that adopt the digital euro in normal times $d€uptake_{normal}$ and the number of accounts of bank i $\#accounts_i$, the average intended digital euro holdings of digital euro adopters and the fraction of digital euro holdings which digital euro adopters substitute for sight deposits (and not for cash) $deposit\_sub$:

$$out_{i,normal} = d€uptake_{normal} * \#accounts_i * d€holdings * deposit\_sub \qquad (3)$$

The NII loss is then the product of $out_{i,normal}$ and the funding advantage of sight deposits, $funding\_advantage$.

$$NII\_loss_i = out_{i,normal} * funding\_advantage \qquad (4)$$

We calibrate the baseline and the maximal scenario as shown in table 4.

In the digital euro survey of the Deutsche Bundesbank (Bidder et al., 2024), 46% of households responded they would adopt the digital euro in normal times. We take the upper bound of this and – similar to the liquidity part – assume 100% adoption in the maximal scenario. $d€holdings$ are calibrated as in the liquidity section. However, note that high digital euro holdings map into high outflows here, while in the liquidity section high digital euro holdings implied low outflows. Thus, we choose EUR 5,000 for the maximal scenario here (and as a robustness exercise we also consider 3,000 or 5,000 intended digital euro holdings in the

Table 4

Calibration of the baseline and the maximal scenario NII effects

	Baseline	Maximal	Description/Source
d€uptake_normal	0.5	1	Bidder et al. (2024)
d€holdings	1,000	5,000	
deposit_sub	0.64	1	Bidder et al. (2024)
funding_advantage	1.61%	1.61%	Average interest spread between new term deposits and household sight deposits in Austria 2003–2008

Source: OeNB.

baseline scenario). The substitution parameter is derived as follows: In Bidder et al. (2024), digital euro adopters project to hold 21.1% of their liquid portfolio in digital euro (a share similar to cash) while reducing their deposit share by 13.4 percentage points to this end. Thus, *deposit_sub* is 0.134/0.21=0.64. Note that NII losses are zero if digital euro holders completely substitute digital euro holdings for cash, i.e. *deposit_sub* is zero. Finally, the funding advantage banks lose with deposit outflows is calibrated to the period before the very low or negative interest rate period with deposit rates stuck at the zero lower bound. The value is close to Austrian banks' average net interest margin in 2023 (1.53%).

Table 5 shows the deposit outflows and NII losses in the two scenarios. We also express NII losses relative to tier 1 bank capital, thus capturing the effect on the return on equity (RoE). In the baseline scenario, the aggregate deposit outflows amount to EUR 1.8 billion, which results in an NII loss of EUR 29 million and an RoE effect of 5 basis points, which is very small compared to the aggregate RoE (14.9%) in the sample.[6] In the maximal scenario, the effects are more material. Deposit outflows here exactly correspond to the outflows in the maximal crisis scenario above. This is because, with intended digital euro holdings of 5,000, the holding limit always binds and deposit outflows equal the holding limit, as was the case in the liquidity crisis scenario. Also note that the holding limit effectively contains the more material effects in the maximal scenario. Choosing a 3,000 holding limit instead of a 5,000 holding limit reduces the RoE effect from 86 basis points to 51 basis points.

Chart 2 identifies banks that are particularly affected by NII losses. In the baseline scenario, no bank has an RoE effect above 100 basis points. We only have significant effects in the maximal scenario, where the share of banks with an RoE effect above 100 basis points increases approximately linearly from a holding limit around 1,500. At a 3,000 holding limit, 23.1% of banks (22.6% of the sample's total assets) have an RoE effect above 100 basis points, while at a 5,000 holding limit, 59.3% of banks (37.3% of the sample's total assets) have an RoE effect above 100 basis points. As in the liquidity section, the NII losses rather affect small banks but not as strongly as was the case with effects on the LCR above.

Table 5

Deposit outflows and NII losses: baseline vs. maximal scenario

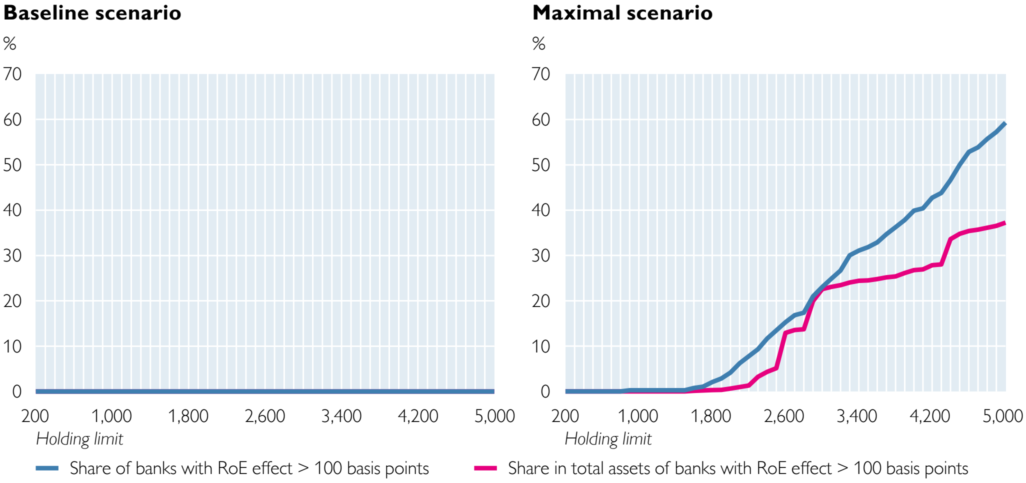
	Baseline scenario			Maximal scenario		
Holding limit, EUR	Deposit outflow, EUR billion	NII loss, EUR million	RoE effect, basis points	Deposit outflow, EUR billion	NII loss, EUR million	RoE effect, basis points
200	0.4	6	1	1.1	19	3
1,000	1.8	29	5	5.7	93	17
3,000	1.8	29	5	17.2	278	51
5,000	1.8	29	5	28.7	463	86

Source: OeNB.

[6] *For intended digital euro holdings of 3,000 (5,000), the RoE effects are only slightly higher at 16 (28) basis points.*

Chart 2

RoE effects from NII losses: baseline vs. maximal scenario



Source: OeNB.

2.2 Net payment services income (NPI)

Due to data limitations[7] and the high uncertainty about the digital euro's impact on banks' NPI, we restrict the analysis to the Austrian banking sector as a whole in this section. We model aggregate NPI as a linear function of the number of transactions T and the return per transaction with sight deposits R_D, i.e. $NPI=T*R_D$. After the introduction of the digital euro, NPI changes to $NPI'=(1-x)T*R_D'+xT*R_{d€}$ where x is the share of transactions transferred into the digital euro and $R_{d€}$ is the return per transaction with digital euro. Note that this NPI definition assumes that the income from digital euro transactions remains within the banking sector. Thus, the NPI loss is calculated as follows:

$$NPI_{loss} = NPI - NPI' = NPI * \left[1 - (1-x)\frac{R'_D}{R_D} - x\frac{R_{d€}}{R_D}\right] \quad (5)$$

where R_D'/R_D and $R_{d€}/R_D$ denote the change in the return of transactions with sight deposits and digital euro relative to the current return. $R_{d€}/R_D$ can thus be interpreted as a parameter measuring how the central bank remunerates digital euro transactions. We calibrate the baseline and the maximal scenario as shown in table 6.

Table 6

Calibration of the baseline and the maximal scenario NPI effects

	Baseline	Maximal	Description
NPI	1.1	1.1	Aggregate NPI of sample banks in EUR billion
x	0.16	0.32	16% (32%) of transactions move to the digital euro
R'_D/R_D	0.95	0.90	Profitability of transactions with sight deposits decreases by 5% (10%)

Source: OeNB.

[7] *NPI data for Austrian banks are only available for a different bank sample.*

To estimate the *NPI*, we proceed as follows: We use the average end-of-year 2020–2023 NPI of the banks for which NPI data are available (EUR 2.16 billion) and set this number in relation to the average end-of-year sum of sight deposits from households, nonfinancial firms and the government from 2020 to 2023.[8] This yields 0.57, which means that Austrian banks on average earn 0.57 cent per euro of (transactional) sight deposits. Assuming this also holds for the household deposits of the banks in our sample, we arrive at an aggregate NPI of EUR 1.1 billion. To define how many transactions move into the digital euro (x), we follow up on the reasoning in the NII section. There, we assumed in the baseline scenario that 50% of account holders adopt the digital euro. We further assume that the share of deposit substitutions we assumed there (64%) also holds for transactions and, finally, we assume that holders of a digital euro wallet split their transactions 50-50 between sight deposits and digital euro, which yields 0.16. For the maximal scenario, we double this to 32% outflows. Finally, the decrease in the profitability of transactions with sight deposits of 5% (10%) reflects the idea that the introduction of the digital euro also increases competition in the conventional NPI business with sight deposits and puts these margins under pressure.

Chart 3 shows the NPI losses for different digital euro remuneration levels $R_{d€}/R_D$. Values like 0.5 mean that transactions in digital euro are remunerated at 50% of the current return on sight deposits. In table 7 we provide reasonable parameters for the remuneration of digital euro transactions, following the idea that the remuneration of digital euro transactions should target the return of the most efficient providers of transactions.[9] This yields NPI losses ranging from EUR 140 to 173 million (EUR 262 to 329 million) and RoE effects of 26 to 32 basis points (49 to 61 basis points) in the baseline (maximal) scenario. As with holding limits, carefully calibrating the digital euro remuneration prevents extreme profitability effects for the banking sector.

Table 7

NPI losses: baseline vs. maximal scenario

	Baseline scenario		Maximal scenario	
Digital euro remuneration	NPI loss, EUR million	RoE effect, basis points	NPI loss, EUR million	RoE effect, basis points
0.47	140	26	262	49
0.28	173	32	329	61

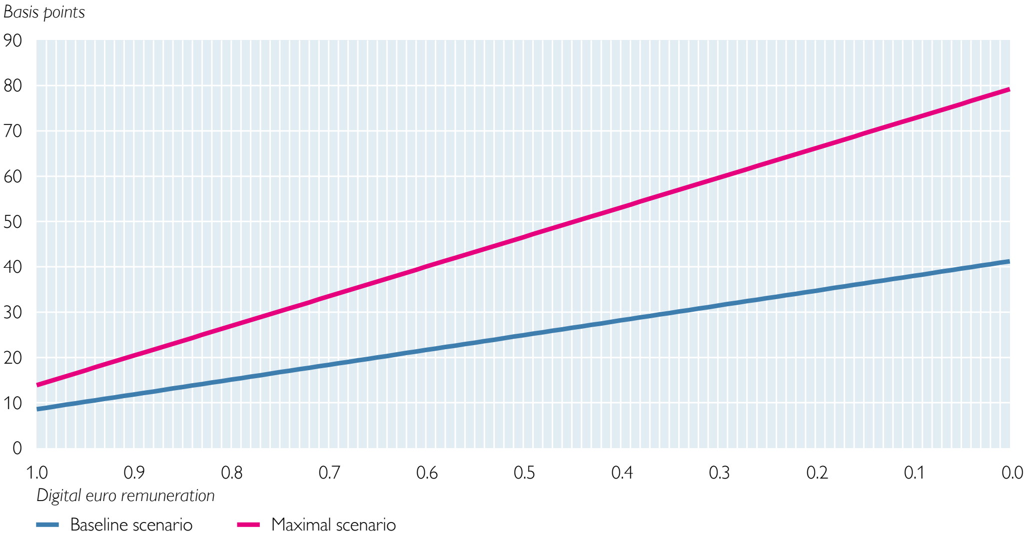
Source: OeNB.

[8] *The idea here is that sight deposits from these agents are mainly used for transactional purposes, while the sight deposits of financial firms and central banks do not serve this function.*

[9] *The first (second) value, 0.47 (0.28), relates the NPI return of Austrian banks from sight deposits derived above (0.57) to the 25th (10th) percentile of the same NPI return of a sample of European SSM banks, 0.27 (0.16). The 25th percentile corresponds to the NPI return of Dutch banks in the SSM sample (0.28), where the payment system is often considered one of the most efficient and innovative in Europe.*

Chart 3

RoE effect from NPI losses



Source: OeNB.

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Annex

Table A1

Sample statistics for small, medium-sized and large banks

	Small banks	Medium-sized banks	Large banks
Share of banks, %	79.9	16.5	3.6
Share of total assets, %	15.6	25.0	59.4
Share of accounts, %	27.6	27.4	45.0
Share of deposits, %	22.3	27.9	49.8
Accounts per total assets, EUR million	14.0	8.7	6.0
Share of household deposits in total assets, %	37.9	29.6	22.1

Source: OeNB.

Note: Small banks are defined as banks with total assets up to EUR 1 billion, medium-sized banks' total assets range from EUR 1 billion to EUR 10 billion, while large banks' total assets amount to more than EUR 10 billion.