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How to conduct monetary policies. The ECB in the past, present and future

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A B S T R A C T

We study the evolving operating procedures used by the ECB since its creation. During the period up to 2015, bank reserves were scarce and the ECB, like other central banks, used a corridor system in which the money market rate could fluctuate within the bounds set by the lending and the deposit rates. With the start of Quantitative Easing (QE) the operating procedure evolved into a regime of reserve abundance. This regime has become problematic since the inflation surge forced the central banks to raise the policy rate. The result has been a massive transfer of central banks' profits (and more) to the banks. We propose a two-tier system of reserve requirements that would only remunerate the reserves in excess of the minimum required. This would drastically reduce the giveaways to banks, allow the central banks to maintain their current operating procedures and make monetary policies more effective in fighting inflation.

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1. Introduction

During the 25 years of its existence, the way the European Central Bank (ECB) conducted its monetary policies has changed dramatically. Before the sovereign debt crisis, the ECB would typically provide liquidity to financial institutions and determine the interest rate at which it was willing to do so. When the ECB wished to follow contractionary monetary policies, it would raise the interest rate at which it provided this liquidity; when wishing to follow an expansionary monetary policy the ECB would do the opposite. This operating procedure was implemented in an environment in which financial institutions held a relatively small amount of bank reserves (liquidity).

This operating procedure changed fundamentally after the sovereign debt crisis, when in 2015 the ECB started its programme of bond buying in the open market (often referred to as Quantitative Easing, QE). This led to a large build-up of liquidity (bank reserves) in the balance sheets of commercial banks. As long as inflation and the interest rate were low this did not create particular problems for the central banks. However, when as a result of the surge in inflation in 2021, the ECB (and other central banks) had to raise the interest rate in an attempt to lower inflation, this operating procedure created large "collateral damages" in that it necessitated transfers by central banks to the banking system that exceeded central banks' profits.

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In this paper, we first provide a short historical analysis of how the operating procedures of the ECB changed over time, and what factors drove these changes (in Section 2). This will lead us to study the transition of a scarce reserve system into the present reserve abundant regime. We analyze the problems that have arisen in the present regime when the central bank was forced to fight inflation by raising the interest rate (in Section 3). We will argue that the present operating procedures lead to a loss of effectiveness of monetary policies (in Section 4). At the same time, they lead to fairness issues related to the fact that the ECB (and the national central banks of the Eurosystem) now transfer large amounts of money to banks. It might be more socially acceptable for this money to be transferred to taxpayers. In Section 5, we propose an alternative operating procedure that reduces the size of these transfers and then enhances the effectiveness of monetary policies in the fight against inflation. In Section 6, we advocate rethinking the role of minimum reserves and we conclude in Section 7.

2. Operating procedures of the ECB from 1999 to 2023

In this section, we discuss the evolving nature of the operating procedures of the ECB. We distinguish three periods: the period before 2015, the period between 2015 and 2021, and the period from 2022 to 2024 (for background information, see ECB (2021)).

2.1. ECB's operating procedure before 2015: The corridor system

The main techniques that the ECB used up to 2015 (when it introduced quantitative easing) were transactions using tenders. The ECB calls these its *main refinancing operations*. In this technique, the ECB provided liquidity to financial institutions in exchange for collateral. The latter also consists of marketable securities. The Governing Council sets the interest rate (the *repo rate*) that is applied to the main refinancing operations. One can also call the repo rate the *policy rate*.

The ECB then announced a tender procedure. This could be a fixed-rate or a variable-rate tender. In the case of a fixed-rate tender, the interest rate chosen by the Governing Council was the fixed rate at which financial institutions could make their bids. Private financial institutions were invited to make a bid to obtain a certain amount of liquidity in exchange for delivering collateral (called eligible assets). These bids were collected by the national central banks (NCBs) and centralized by the ECB. The ECB decided the total amount to be allotted and distributed this to the bidding parties pro rata to the size of the bids.[1]

By increasing or reducing the interest rate on its main financing operations, the ECB affected market interest rates. In addition, by changing the size of the allotments, the ECB affected the amount of liquidity directly.

The ECB supplemented the system of *main refinancing operations* with so-called *standing facilities* which aimed to provide and absorb overnight liquidity. Banks can use the *marginal lending facility* to obtain overnight liquidity from the NCBs. The Governing Council fixes the marginal lending rate. During the pre-financial crisis period, it was typically 1 per cent above the interest rate used in the main refinancing facility. Banks can borrow from this facility without limit provided they present adequate collateral. The marginal lending rate acts as a ceiling for the overnight market interest rate.

Similarly, banks can use the *deposit facility* to make overnight deposits. The Governing Council fixes the interest rate on the deposit facility. During the pre-financial crisis period, it was typically 1 per cent below the interest rate used in the main refinancing facility. This interest rate acts as a floor for the overnight market interest rate (interbank rate).

In Fig. 1 we present the repo rate, the deposit rate and the lending rate applied by the ECB between 1999 and 2024. This figure nicely illustrates the existence of three periods. The first one is from 1999 to 2015, the second period from 2015 until the end of 2021, and the third period from 2022 to 2024.

The nature of the operating system that was used up to 2015 can be represented graphically in Fig. 2. This shows the banks' demand for liquidity (bank reserves) and the supply (by the central bank). The demand is negatively related to the interbank interest rate (the money market rate). The supply is determined by the central bank. The Governing Council sets the repo rate (policy rate, r_P) together with the lending rate r_L and the deposit rate r_D. To ensure that the policy rate coincides with the money market rate, the ECB can vary the supply. This is done by changing the total allotment of liquidity in the main refinancing operations. In Fig. 2 we have represented the case where the central bank has manipulated the supply in such a way that the policy rate coincides with the money market rate. This operating regime is called the "corridor system" because the central bank can guide the money market rate towards the policy rate within the corridor given by the deposit and loan rates. It was in existence until the financial crisis of 2008. It was also used by other major central banks, such as the Federal Reserve and the Bank of England (see Ihrig and Wolla (2020)).

In this corridor system, the lending and deposit rates act, respectively, as upper and lower limits for the money market rates. The lending rate is an upper limit because if the money market rate were to exceed it, banks would turn to the central bank to borrow, and none would borrow in the interbank market. Similarly, the deposit rate is the lower limit because if the money market rate were to drop below it, banks would invest all their excess funds at the central bank, and none in the interbank market.

The corridor system implies that the money market rate can vary freely within the bounds set by the lending and deposit rates. Before 2015 the corridor was 2 percentage points. This is quite large and allowed for potentially wide short swings in the money market rate. That is why the ECB (and other central banks) actively intervened to smooth the money market rate by varying the supply of bank reserves. Some variability, however, was difficult to avoid as the demand for reserves itself is stochastic.

[1] The variable-rate tender system, which was used between 2000 and 2008, implied that banks bid for the amounts of liquidity they wanted to buy at successive interest rates. The interest rate decided by the Governing Council (the repo rate) acted as a minimum bid rate, below which the ECB did not accept bids from the financial institutions.

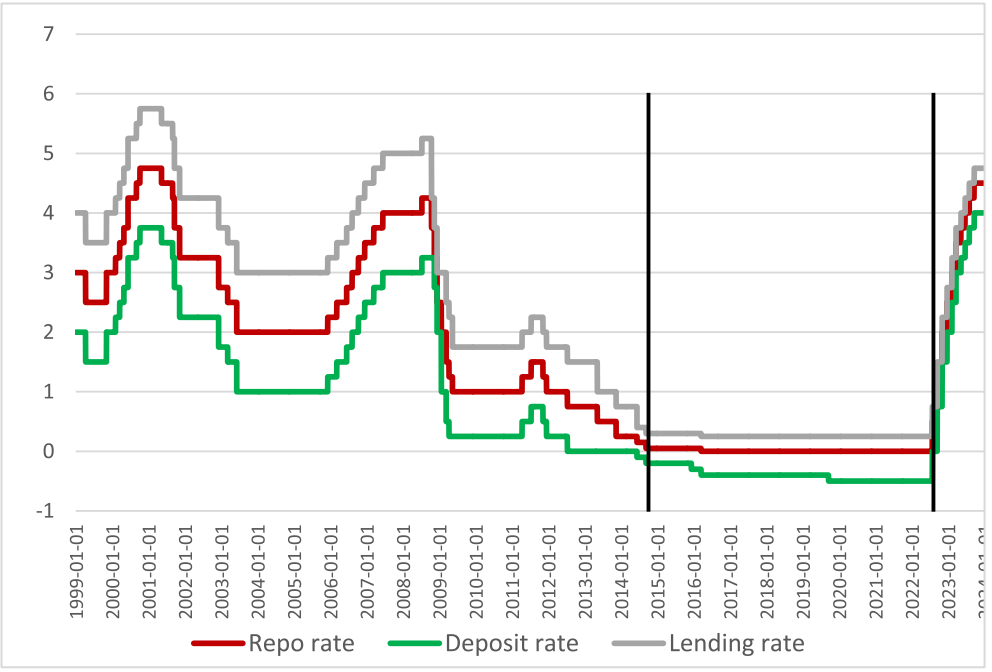

Fig. 1. ECB policy rates.
Source: European Central Bank.

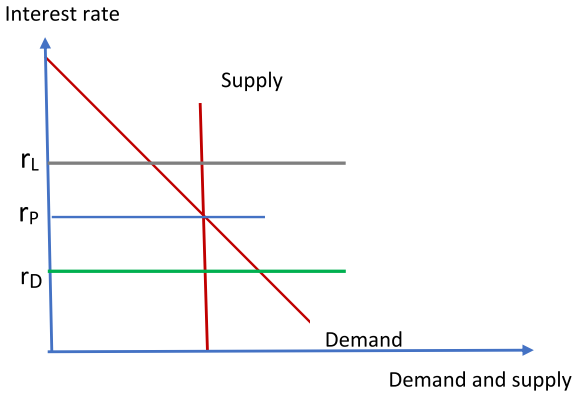

Fig. 2. Demand and supply of reserves in reserve scarce regime (corridor system).

2.2. The operating regime since 2015: Reserve abundance regime

The biggest change in the operating procedure occurred in 2015 when the ECB started its QE programme. When the ECB bought government bonds from financial institutions, it credited the deposit accounts these institutions held at the central bank (typically the NCBs of the Eurosystem). These deposits constitute the bank reserves. As these bond purchases became very large (see Fig. 3), the supply of bank reserves increased dramatically.

The corridor system could not be maintained, and the operating regime switched to a reserve abundance regime. We show the implications for the central bank's operating procedure in Fig. 4. As a result of QE operations (purchases of government bonds by the NCBs of the Eurosystem), the supply of bank reserves shifts to the right. Given the large size of these operations, the supply curve has shifted so much to the right that the intersection of the demand and supply curves is located in the negative y-axis. This has the effect of making the deposit rate the lower bound for the money market rate. Another way to put this is that when the demand curve intersects with the deposit rate line, it becomes infinitely elastic. The reason is that if the money market rate were to drop below the deposit rate banks would have an incentive to shift all their holdings of interbank deposits into deposits at the central bank. The equilibrium in the market for bank reserves is now obtained in point E where demand equals supply of bank reserves.

In Fig. 4, we have assumed that the deposit rate is zero. This does not have to be the case. In fact, from 2015 until 2022 the deposit

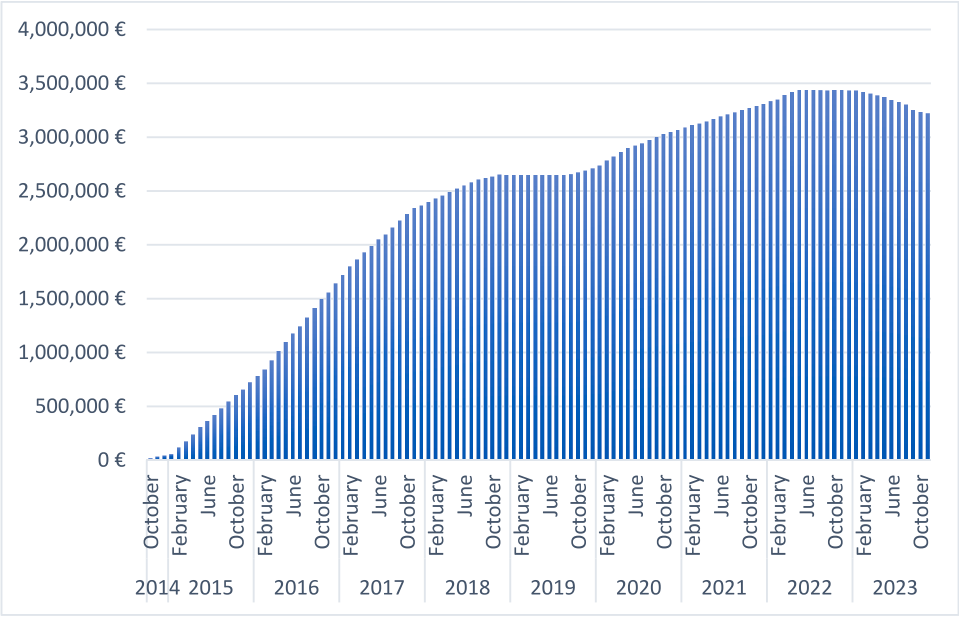

Fig. 3. Cumulative bond purchases under APP (million euros). Note: APP stands for Asset Purchase Programme (commonly called QE). It does not include the pandemic Emergency purchase programme (PEPP) programme which was initiated in 2020 and led to an additional purchase of bonds of more than €1 trillion.
Source: European Central Bank.

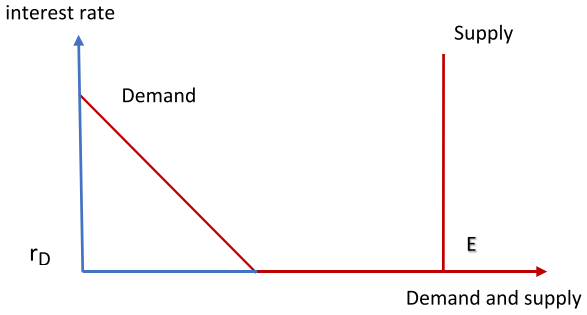

Fig. 4. Demand and supply of reserves in reserve abundance regime. Note: We do not show the lending rate which acts as an upper limit because in this regime the upper limit becomes redundant.

rate was negative. It was set successively at −0.2, −0.4 and −0.5 by the ECB (see Fig. 1). This implied that the banks paid the ECB (actually the NCBs of the Eurosystem) for holding bank reserves.[2]

It should be noted that in this system the money market rate tends to be less volatile than in the corridor system that, without the intervention of the central bank, allows the money market rate to fluctuate freely within the corridor. In the reserve abundance regime, there is no corridor. Only the lower limit of the deposit rate is in effect, working as a point of attraction. The money market rate becomes much less volatile without the active intervention of the central bank (see Ihrig and Wolla (2020)).

2.3. The operating regime since 2022: The surge in inflation

The surge in inflation in 2022 had a major effect on the operating procedure of the ECB. To fight inflation, the ECB and the other central banks had to raise the interest rate. How to do this in a reserve abundance regime?

One way would have been to sell government bonds (in today's parlor: Quantitative Tightening, QT). This would have shifted the supply curve in Fig. 4 back to the left. By selling enough government bonds the supply of reserves could then have shifted sufficiently to

[2] It was a little more complicated. The ECB introduced a two-tier system so that the banks would pay interest on only part of their bank reserves. We discuss this feature in Appendix 1.

the left to recreate the regime of reserve scarcity that existed prior to QE, as described earlier.

The problem with this approach was that the central banks would have to sell large amounts of government bonds. For example, in June 2023 the ECB was holding €4.9 trillion of bonds (mostly government bonds).[3] This led to reserve balances of the banking system of €4.3 trillion, 99 % of which are reserves in excess of minimum reserve requirements (of 1 %). To bring back the supply curve in the range given by the downward-sloping part of the demand curve, the ECB would have to sell almost all the government bonds it holds. An operation that would have created havoc in government bond markets.[4]

In a monetary union such as the Eurozone, such a large sale of government bonds risked leading to large increases of the spreads in the national government bond markets, (see Pieterse-Bloem and Eijffinger(2023) who showed that the bond buying programme in the context of QE led to a severe tightening of the spreads). In fact, at the start of the inflationary surge when the ECB started to raise the interest rates, this led to a surge in the spreads in the government bond markets (see Fig. 5). As a result, the ECB announced yet another bond purchase programme, the so-called Transmission Protection Instrument (TPI), which pacified the markets.

Under those restrictions, the only way to raise the interest rate was to remunerate the deposits held by the banks at the central banks (bank reserves). By raising the deposit rate, the lower bound in the market for bank reserves would shift up so that also the money market rate could increase. We show this in Fig. 6 by an upward shift in the deposit rate. This positive deposit rate becomes the new lower bound. The equilibrium is obtained in point F. (Note that the demand curve becomes infinitely elastic at the point G where the demand curve intersects the horizontal lower bound provided by the deposit rate).

Thus, the fight against inflation has required the central banks to make large interest payments to commercial banks. Taking the example of the Eurosystem: bank reserves held by credit institutions at the national central banks and the ECB amounted to €3.6 trillion in August 2023.[5] In September 2023 the remuneration rate on these bank reserves held by commercial banks was raised to 4 % (see Fig. 1 and Table 1). This means that the Eurosystem is paying out €140 billion in interest to credit institutions as of September 2023, on a yearly basis.

Other central banks, in particular the Federal Reserve and the Bank of England follow the same procedure of raising the interest rate by increasing the rate of remuneration on bank reserves. In Table 1, we compare the interest transfers for these three central banks. We find that these transfers to commercial banks have become substantial. The last column of the table shows these interest payments as a percent of GDP. One observes that in relative terms the transfers made by the Bank of England are the highest followed by the ECB and the US Fed.

To give an idea of the size of these transfers in the Eurozone consider the following. With a yearly transfer of €140 billion by the Eurosystem towards the Eurozone banks we are approaching the yearly total spending of the EU which amounts to €168 billion.[6] This is a remarkable situation which is even more remarkable when considering that the transfers by a European institution towards the banks are decided without any political discussion and are granted without attaching any condition. This contrasts with the EU spending which is the result of an elaborate political decision-making process and is usually accompanied by tight conditions.

Many economists and central bankers today take it for granted that to conduct an anti-inflation policy, bank reserves should be remunerated. Yet this remuneration is a recent phenomenon. Before the start of the Eurozone in 1999, most European central banks did not remunerate banks' reserve balances. During the 1970s and 1980s, for example, the Bundesbank used very high unremunerated minimum reserve requirements to siphon off large inflows of money into the country (see Schobert and Yu (2014)). The ECB started the practice of remunerating bank reserves in 1999. The Federal Reserve introduced the remuneration of banks' reserve balances only in 2008. Thus before 2000, the general practice was *not* to remunerate banks' reserve balances. This made good sense: commercial banks themselves do not remunerate demand deposits held by their customers. These demand deposits have the same function as bank reserves at the central bank: they provide liquidity for the non-bank sector. These are not remunerated. It is not easy to justify why bankers should be paid when they hold liquidity while everybody else should accept not to be remunerated.

3. Problems with the remuneration of bank reserves in the current operating regime

The large remuneration of bank reserves creates several problems that we discuss in this section. Some of these problems may have political economy implications in the Eurozone.

[3] See ECB, Consolidated Financial Statement of the Eurosystem, https://www.ecb.europa.eu/press/pr/wfs/2023/html/ecb.fst230613.en.html.

[4] A similar problem arose in the US and the UK. These central banks made it clear that they wished to maintain the reserve abundance regime and that they do not wish to return to the previous reserve scarcity regime. In March 2023 the US Federal Reserve was holding government securities and government backed securities amounting to $7.9 trillion, which, as in the Eurozone, has created a huge oversupply of bank reserves. The Bank of England was in a similar position. The Bank of England has announced a gradual depletion of its holdings of UK government bonds. To maintain the abundant reserve regime the Bank of England offers reserves through short-term repo operations at the same rate of remuneration of bank deposits at the central bank. This will keep the supply of bank reserves sufficiently high so that the regime of reserve abundance can be maintained while allowing the Bank of England to unwind its stock of government bonds (see Schnabel (2023)).

[5] https://www.ecb.europa.eu/press/pr/wfs/2023/html/ecb.fst230613.en.html.

[6] Some economists have argued that this is compensation for the the period of 2015–2022, when banks paid to the Eurosystem when the deposit rate was negative. We calculated that the cumulative payments by banks over this whole period was €61 billion (see Appendix 1). This compares with €146 billion that is being paid out today on an annual basis.

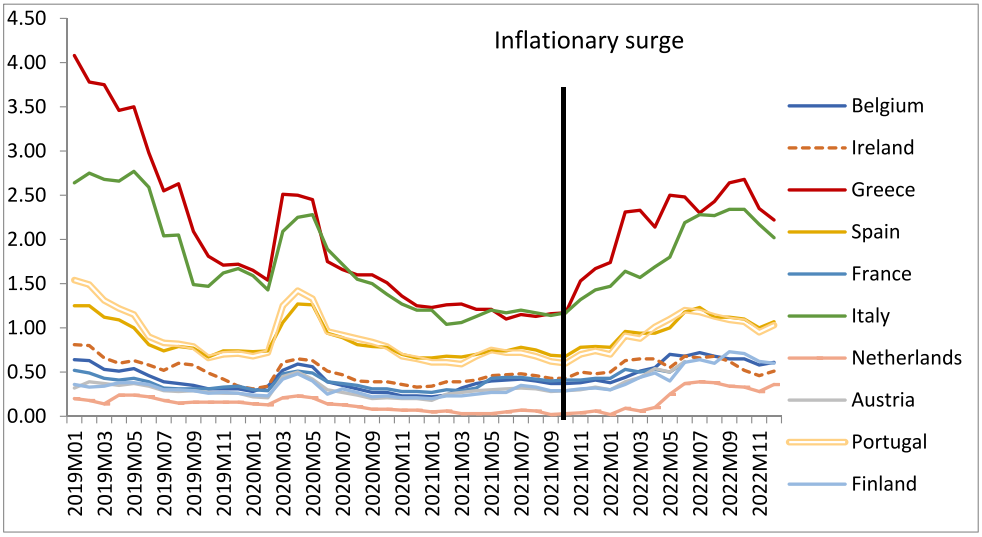

Fig. 5. 10-year government bond spreads in the Eurozone Note: The spread measures the difference in the yield with the 10-year German government bond.
Source: European Central Bank.

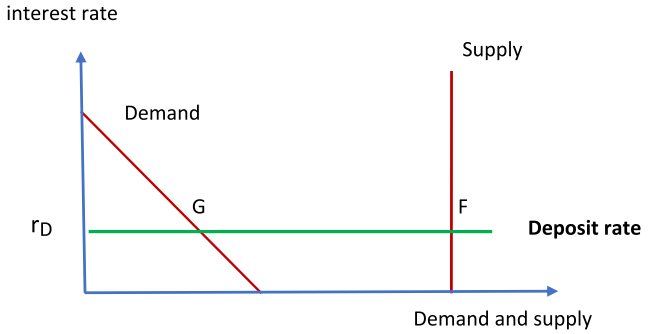

Fig. 6. Demand and supply of reserves in reserve abundance regime.

Table 1
Bank reserves and interest payments to banks (Jan 2024), billions.

	Bank reserves	*Interest rate*	*Interest payments*	*percent GDP*
ECB	*€ 3.504*	*4,00 %*	*€ 140*	*1.10 %*
Fed	*$3.066*	*5,15 %*	*$158*	*0.64 %*
BoE	*£800*	*5,25 %*	*£42*	*1.75 %*

Sources: Bank of England, Board of Governors Federal Reserve and European Central Bank.
See list of references for more detail on the sources.

3.1. Large transfers and fiscal implications

First, when the central bank makes interest payments to commercial banks it transfers part of its profits to the banking sector. Central banks make profit (seigniorage) because they have obtained a monopoly from the state to create money. The practice of paying interest to commercial banks thus amounts to transferring this monopoly profit to private institutions. This monopoly profit should be returned to the government that has granted the monopoly rights. It should not be appropriated by the private sector, which has done nothing to earn this profit. The present situation of paying out interest on banks' reserve balances amounts to a subsidy to banks paid out by the central banks at the expense of taxpayers. In Table 2, we show the size of the potential annual interest payments of central banks of the Eurosystem. We observe large differences in these transfers by these central banks, varying from 0.43 % to 9.15 % of GDP.

The paying of interest on banks' reserve accounts has an unfortunate fiscal consequence. It transforms long-term government debt into short-term debt. Most of the government bonds held by the central banks have been issued at very low interest rates, often even

Table 2
Remuneration of bank reserves in the Eurosystem (Aug 2023).

Country	Remuneration (million Euro)	% of GDP
Luxembourg	7095	9.15
Cyprus	920	3.31
Finland	5285	1.97
Belgium	10,326	1.88
Netherlands	13,918	1.45
Malta	241	1.40
France	35,925	1.36
Germany	49,107	1.27
Austria	4108	0.92
Croatia	593	0.87
Estonia	302	0.84
Slovenia	426	0.75
Spain	9170	0.68
Ireland	3277	0.65
Portugal	1434	0.59
Greece	1201	0.58
Latvia	215	0.55
Lithuania	360	0.53
Slovakia	484	0.44
Italy	8347	0.43

Source: European Central Bank.

zero or negative. This implies that governments are immune for some time from the interest rate rises. By paying an interest rate of 4 % (Eurozone) to 5.15 % (US) on bank reserves and thus reducing government revenues by the same amount, the central banks transform this long-term debt into highly liquid debt forcing an immediate increase in interest payments on the consolidated debt of the government and the central bank. This may contribute to higher budget deficit and increasing government debt, leading to fiscal austerity in some countries. Paradoxically, central banks contribute to a worsening outlook for the government.

3.2. Large losses of central banks

The large central banks' transfers to banks have important implications for the profit and losses of central banks. These transfers are so high that not only do they wipe out central banks' profits, but they also push many of them into loss-making territory (see Wellink (2003)). This is well-illustrated by a recent study by researchers at the International Monetary Fund that analyzes the profit and loss accounts of five major Eurozone central banks (Belhocine,et al., 2023). We use the data on profits and losses obtained in this study. We provide the assumptions made by the IMF team in computing these numbers in the note of Fig. 7. One assumption stands out here: the IMF team assumes that the deposit rate will peak at 3.5 %. In September 2023 it reached 4 %, which implies that the losses estimated by the IMF are probably underestimated.

We show the results in Fig. 7. This presents the profits and losses of the four largest central banks and of the Eurosystem as a whole (expressed as a percent of respective GDPs).[7] We also present the cumulative profits and losses starting in 2022. Two observations can be made. First, the Bundesbank makes the largest losses. It is estimated that it will take until 2027 for the Banks to make profits again. The Banque de France is the second in the row of central banks with losses. Profit-making is estimated to start again in 2025. Surprisingly, the Banca d'Italia is the only one among the larger central banks not to make losses (although its profits decline during 2022-23). The Bank of Spain makes some small losses during 2023-24.

The cause of this divergence is the following. The Bundesbank, and to a lesser degree the Banque de France, hold a portfolio of low-yielding long-term government bonds. As a result, interest revenues are very low, and given the long duration of these bonds, it will take time before they start earning interest. This is not the case for the Banca d'Italia and to a lesser degree the Bank of Spain which hold relatively high-yielding government bonds. It follows that the Bundesbank and the Banque de France have transformed low-yielding long-term government bonds into short-term liabilities (bank reserves) on which they pay high interest rates. This transformation is much less costly in the case of the Banca d'Italia and the Bank of Spain.

Source: Belhocine, et al. (2023), IMF, and own calculations. The assumptions made by the IMF team to estimate the profit and losses of the Eurozone central banks are: (1) The deposit rate will peak at 3.5 % in 2024 and then decline to 2.3 %; (2) The yields on QE-portfolios held by central banks will increase until 2024–25 and then gradually decline to 2 %; (3) The APP-programme of the ECB

[7] Note that these profits and losses do not include the valuation losses of the government bonds held by the central banks. If marked to market, these bonds show a loss. However, these losses are exactly equal to the gain of the Treasury which has issued bonds at very low interest rates in the past, and now enjoys a gain arising from the fact that it will pay very low interest rates until these bonds mature, while market interest rates have increased significantly. If we consolidate the balance sheets of the central bank and the treasury these gains and losses disappear. Therefore, these valuation losses should not be counted as the losses of the central bank. If we did this, we would count these losses twice: once because of the transfers of interest to the banks and a second time as valuation losses.

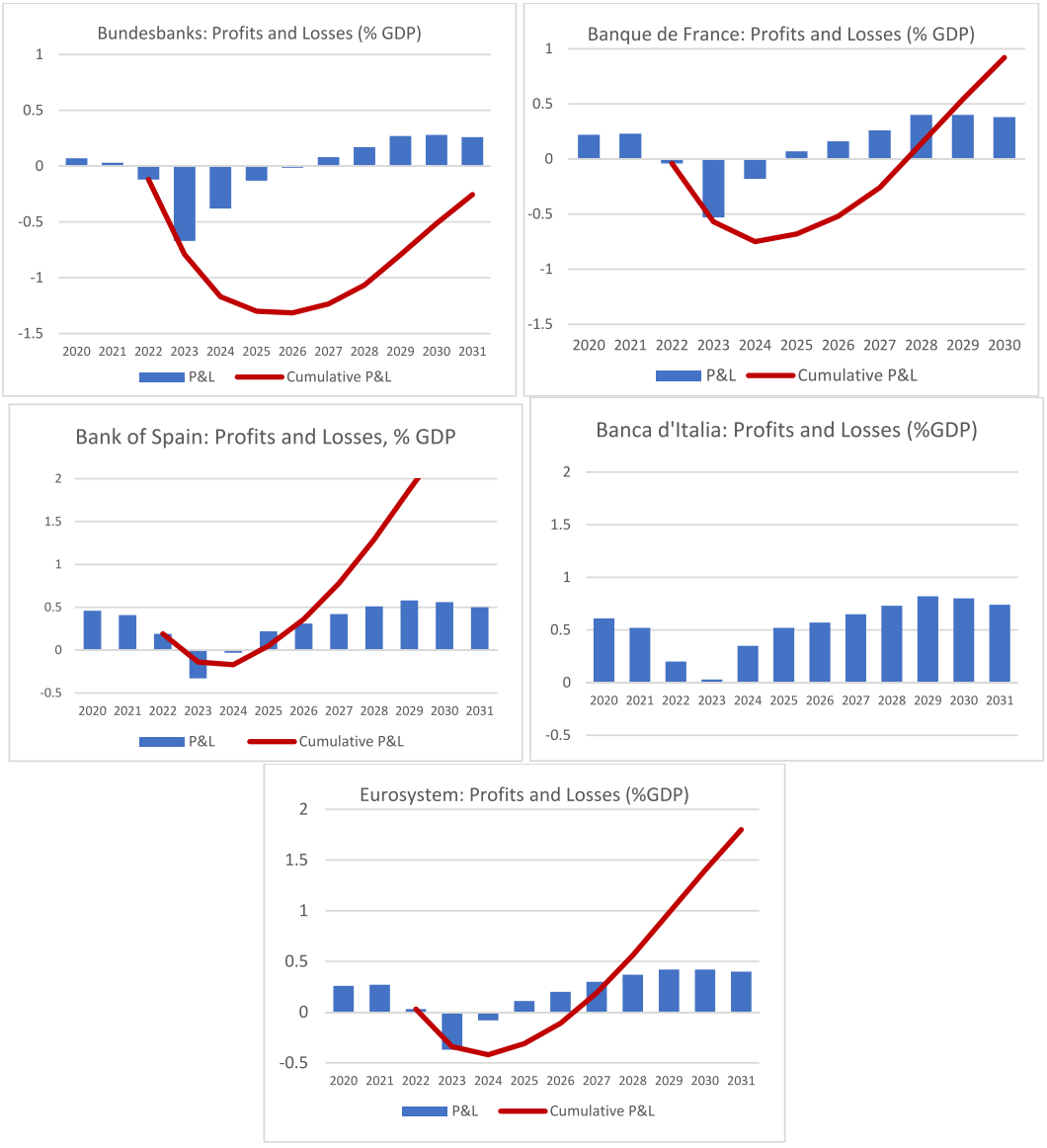

Fig. 7. Profit and losses Eurozone central banks.
Source: Belhocine et al. (2023), IMF, and own calculations. The assumptions made by the IMF team to estimate the profit and losses of the Eurozone central banks are: (1) The deposit rate will peak at 3.5 % in 2024 and then decline to 2.3 %; (2) The yields on QE-portfolios held by central banks will increase until 2024–25 and then gradually decline to 2 %; (3) The APP-programme of the ECB will be brought down gradually by not reinvesting the bonds coming to maturity; (4) The PEPP will be maintained at the same level as today by reinvestments.

will be brought down gradually by not reinvesting the bonds coming to maturity; (4) The PEPP will be maintained at the same level as today by reinvestments.

In Fig. 7, we also show the cumulative profits and losses profile. These are important because large cumulative losses can lead to a point where the equity of the central banks turns negative. This is likely to occur in the case of the Bundesbank and possibly the Banque de France. Should one worry about the negative equity of central banks? Not really. Central banks, in contrast to commercial banks, do not need to have positive equity to conduct credible monetary policies. In addition, a more relevant concept of the net worth of central banks is the net present value of future seigniorage gains and losses (see Buiter, (2008)). The cumulative profit and loss profiles shown in Fig. 7 indicate that the losses are likely to be temporary. As a result, the net present value of future gains and losses is most likely to be positive.

While technically, negative equity does not pose problems for a central bank, the political economy of this issue is very different (see Wellink and Marsh (2023)). The negative equity of the central banks expresses the fact that these are transferring large amounts of money to private agents and in doing so make large losses. These will have to be borne by governments and taxpayers. Negative equity

reveals this underlying problem. When this appears in the open, citizens, in particular in countries where their central bank make larger losses, will ask the question of why it was necessary to enrich the bankers to fight inflation. They will also insist on knowing why the central banks did not look for other operating procedures that were equally effective to combat inflation and that avoided making transfers to banks at the expense of taxpayers.

The ECB has announced that it will gradually reduce its holdings of government bonds by not reinvesting in new bonds when old bonds come to maturity. This will lead to a gradual decline in the amount of government bonds on its balance sheet. It will take many years, however, to reach the point where the excess supply of reserves has been eliminated. Thus, it appears that the Eurozone will remain in a reserve abundance regime for many years to come. This implies that the operating procedure of the ECB (and the other central banks of advanced countries) will continue to be based on manipulating the rate of remuneration of banks' reserves as their central policy tool, which in turn also implies that these central banks intend to continue to make large transfers of their profits to commercial banks for many years to come.

3.3. Central banks have solved the biggest risk of banks

Related to commercial banks, the problematic nature of remunerating bank reserves appears from the following. Banks are "borrowing short and lending long". In other words, banks have long assets (with fixed interest rates) and short liabilities. As a result, an interest rate increase typically leads to losses and reduces banks' profits because the interest cost of their liabilities increases fast, while the interest revenues are slow to pick up. Banks are supposed to hedge this interest rate risk. But this is costly, and as a result, they are often reluctant to buy such an insurance. By remunerating bank reserves, the central banks are providing free interest hedging to banks. The latter obtain immediate compensation from the central banks when interest rates rise.

The profit and loss profile of the central banks mimics the profit and loss profile of commercial banks during periods of interest increases. Paradoxically, this time banks are escaping the burdensome loss profile as they are making large profits during the spell of interest rate increases of 2022–23. This appears to be possible because central banks have taken over this burden from the commercial banks. It is difficult to see the economic rationale of a system where public authorities provide free insurance of the banks' interest rate risks at the expense of taxpayers. It is also worth mentioning that during the 1970s and 1980s when central banks raised the interest rates to fight inflation, they did not make losses (Humann et al., 2023). They increased their profits. One of the main reasons was that they did not remunerate bank reserves.

Such a free provision of interest hedging to banks is likely to intensify moral hazard risks. First, the remuneration of reserves reduces the banks' incentives to hedge their interest rate risk. The ECB as the single supervisor in the Eurozone requires that banks manage their interest rate risk appropriately. However, when at the same time the ECB remunerates commercial banks' reserves, it undermines its own micro- and macro-prudential supervision objectives. In addition, because the remuneration of reserves will lead to a lower degree of interest rate risk hedging by banks, the central bank will find it increasingly difficult to stop remunerating reserves, as it might fear that the interest rate risk of some banks could materialise triggering banking crises. Second, as will be shown in Section 4, the remuneration of bank reserves strengthens the equity position of reserve-rich banks, thereby giving them incentives to increase the loan supply and weakening the transmission of monetary policy.

4. The transmission of monetary policies in the current regime

An important issue is how the existence of remunerated bank reserves affects the transmission of monetary policies. Does this remuneration make the transmission of monetary policies effective? In today's context of central banks' anti-inflationary policies this question can be reformulated as follows: Does the remuneration of bank reserves enhance or reduce the effectiveness of the interest rate hikes to fight inflation?

To answer this question, we first turn to the theory. There is a large economic literature on the equity channel of bank lending which is relevant here. This channel can be described as follows. When the bank's capital (equity) declines banks will have an incentive to reduce lending. There are essentially two reasons for this. One is a balance sheet effect. A lower equity means that the bank may not satisfy the capital requirements imposed by regulators. The bank will then have to reduce the supply of loans. The second reason is that with lower equity, the cost of funding bank loans will tend to increase, thereby leading to fewer incentives for banks to lend. Thus, a decline in the value of banks' equity leads to less bank lending. Conversely, an increase in the value of equity stimulates banks to lend more (see Shin (2015), Gambacorta and Shin (2016), Van den Heuvel (2002), Diamond and Rajan (2000)). This theory has been subjected to many empirical tests confirming its importance (see Boucinha, et al. (2017), Girotti and Horny (2020)).

This equity effect is also important for the transmission of monetary policies. When the central bank raises the interest rate this will have a direct negative effect on bank loans that have become more expensive. It will also have an indirect effect through the equity channel: the higher interest rate tends to reduce the value of the banks' equity (because it lowers the collateral value of the banks' loans). In addition, a rate hike typically leads to a recession which tends to increase the size of non-performing loans. This also has a negative effect on the value of equity of banks. This equity effect in turn will induce the banks to lower the supply of loans. Thus, the equity channel tends to amplify the direct effect of the increased interest rate on bank loans.

This equity channel of bank lending is important to understand how the remuneration of reserves may affect bank lending. By increasing the profit margins of banks, the use of remunerated minimum reserve requirements tends to increase the net worth (equity) of banks. With a higher equity ratio, banks will be more willing to supply loans to households and firms. Thus, when today the central banks raise the interest rate and as a result increase the remuneration of reserves, they give incentives to banks to extend more loans (ceteris paribus). Put differently, the expected negative effect of a rate hike on loans is (partly) offset by the positive equity effect on

bank loans when bank reserves are remunerated. The transmission mechanism is made less effective, i.e., increases in the policy rate have a lower effect on the loan supply and ultimately on inflation.

We test this hypothesis by estimating the following econometric Equation (1) with fixed effects, using monthly country-level data of the current 20 Eurozone countries:

$$y_{it} = \alpha + \beta_1 * Reserve_{it-1} + \beta_2 * \Delta Rm_{it} + \beta_3 * r_t + \beta_4 * Con_{it} + \alpha_i + \varepsilon_{it} \quad (1)$$

where y_{it} is the percentage change in the aggregate credit institutions' loans to households or non-financial corporations in country i in month t (where t goes from September 2022 until August 2023), $Reserve_{it-1}$ is the aggregate level of reserves in country i in the previous month as a percent of GDP of country i, r_t is the policy rate in month t, ΔRm_{it} is the change in the (annual) remuneration of bank reserves in month t as a percent of GDP of country i, Con_{it} represents the control variables and α_i is the countries' fixed effects. ε_{it} is the error term.

We focus on the variables $Reserve_{it-1}$ and ΔRm_{it}. The former measures the level of reserves in country i (as a percent of GDP) in the previous month. Note that we use the previous month observation as the stock of bank reserves is typically recorded at the end of the month. We expect that the higher this level (and given that it is remunerated) the stronger are the funding possibilities for banks wishing to extend loans. We expect its coefficient β_1 to be positive. We interpret the second variable ΔRm_{it} to measure the equity effect, i.e., its coefficient β_2 measures how changes in the policy rate change the net worth of the banks in country i in month t relative to month/t. An increase in the policy rate raises the cashflow from the central bank to the banks and in doing so increases the net worth of the banks, ceteris paribus. We expect a positive sign of this variable, i.e., as the cashflow to banks increases due to an increase in the policy rate, banks have an incentive to increase the supply of loans. In doing so, the transmission of an increase in the policy rate is made less effective in reducing inflation by lowering the growth of aggregate loans.

We expect the policy rate r_t to have a negative effect on the supply of loans, i.e., β_3 is negative. Finally, we use as control variables including the crude oil price (in natural logarithm form) and consumer and business confidence indices. In Table A1 of Appendix 2, we show the definition, descriptive statistics, and source of all the variables.

The results based on the fixed effect model (Eq. (1)) regarding loans to households and non-financial corporations are shown in Tables 3a and 3b, respectively. The first columns of Tables 3a and 3b show the results for the full sample of 20 Eurozone countries. We find that all the independent variables have the correct sign and are significant. The policy rate and the oil prices have the expected negative effects on the growth of loans to households and non-financial corporations. The level of reserves has a positive and significant effect on the growth of bank loans. An increase in the remuneration of bank reserves leads to a positive and significant effect on bank loans both to households and non-financial corporations. Thus, when bank reserves are high in a country, bank loans in that country will increase faster and when the remuneration increases (due to a higher policy rate) banks tend to increase their lending. All this weakens the transmission of monetary policies in the fight against inflation.

We have done several robustness checks. We have split the sample into different groups. Top-50 % refers to the subsample containing the observations of countries during the months with levels of reserves belonging to the top 50 % of the distribution. In Table A2 of Appendix 2, we show a list of countries that belong to this group. They are mostly countries from the Northern Eurozone. Bottom-50 % refers to the bottom 50 % of the distribution. In addition, we have done regressions excluding two outlying countries, i.e., Cyprus and Luxembourg which have extremely high levels of bank reserves (probably because they are important tax havens) which could affect our results. We show the results in the columns (2)–(5).

We find that the equity effect measured by "change in remuneration" remains significant in all cases, except in the case of the bottom 50 % subsample for their bank loan to non-financial corporations. Thus, it appears that the equity effect is important for countries with high levels of bank reserves. This is less the case in the subsample of countries with relatively low levels of reserves (at

Table 3a
The transmission of monetary policies: Loans to households (growth rate, in yearly percent changes), twenty Eurozone countries, 2022 M9-2023 M8.

	(1)	(2)	(3)	(4)	(5)
	All sample	Top 50 %	Top 50 % exclude	Top 50 % exclude	Bottom 50 %
Lag reserve	6.11***	7.45***	2.92	1.79	−0.82
	[1.51]	[0.81]	[2.32]	[1.97]	[4.66]
Policy rate	−1.05***	−0.98***	−1.10***	−1.30***	−1.90***
	[0.21]	[0.22]	[0.22]	[0.39]	[0.12]
Ln (oil price)	−2.44***	−3.04***	−3.19***	−3.67***	−3.02**
	[0.84]	[0.76]	[0.68]	[0.44]	[1.06]
Change in remuneration	1.08***	1.00***	1.38***	1.44***	2.76**
	[0.24]	[0.22]	[0.24]	[0.31]	[0.88]
Consumer confidence				0.04	0.29**
				[0.32]	[0.11]
Constant term	Yes	Yes	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	216	106	84	72	97
R^2	0.658	0.778	0.749	0.828	0.866

Clustered at the country level, the results display robust standard errors in brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Note: we use adjusted loans to households which measures the lending to the real economy (households). "Exclude" means that Cyprus and Luxembourg are excluded from the sample.

Table 3b
The transmission of monetary policies: Loans to non-financial corporations (growth rate, in yearly percent changes), twenty Eurozone countries, 2022 M9-2023 M8.

	(1)	(2)	(3)	(4)	(5)
	All sample	Top 50 %	Top 50 % exclude	Top 50 % exclude	Bottom 50 %
Lag reserve	7.05***	12.42***	16.29***	13.92***	−7.23
	[2.43]	[1.58]	[4.28]	[3.57]	[20.24]
Policy rate	−3.00***	−1.46**	−1.64**	−1.42***	−3.75***
	[0.54]	[0.54]	[0.59]	[0.18]	[0.65]
Ln (oil price)	−8.11***	−1.59	−3.57*	1.13	−10.26**
	[2.03]	[2.13]	[1.80]	[1.71]	[3.42]
Change in remuneration	2.13***	1.98***	2.71***	1.16**	7.84
	[0.24]	[0.09]	[0.37]	[0.51]	[4.66]
Business confidence				1.32***	0.35
				[0.41]	[0.59]
Constant term	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	216	106	84	72	97
R^2	0.627	0.711	0.583	0.882	0.746

Clustered at the country level, the results display robust standard errors in brackets. * p < 0.1, ** p < 0.05, *** p < 0.01. Note: we use adjusted loans to non-financial corporations which measures lending to the real economy (non-financial corporations). "Exclude" means that Cyprus and Luxembourg are excluded from the sample.

least for loans to non-financial corporations). This is in a way not surprising. In countries with low levels of reserves, the equity effect on loans is weak as bank reserves (and their remuneration changes) have a weak impact on the net worth of the banks. In the subsample of countries with high levels of reserves, the link between these reserves and the banks' net worth is strong.

Our results make clear how the current regime of remuneration of bank reserves may reduce the effectiveness of the transmission of monetary policies. From Tables 3a and 3b, we observe that an increase in the policy rate of one percentage point is associated with a decline in loans to households of 0.98–1.9 % and non-financial corporations of 1.42–3.75 %. However, this effect is counteracted by the fact that the same increase in the policy rate increases transfers to banks leading these to partially offset the negative effect of the policy rate hike on bank loans.

We want to know how strong this compensation is. To find out we add the coefficient of the "change in remuneration variable" to the coefficient of the "policy rate" variable. In doing so we have to consider that the change in remuneration variable ΔRm is defined as $\Delta Rm = \Delta(r^*Reserves)$, where r is the policy rate and *Reserves* is the level of bank reserves. Since we are interested in how the increases in the policy rate affect the remuneration, we single out $Reserves^*\Delta r$ from ΔRm. This means that the equity effect measured by the change in remuneration variable depends on the size of the reserves.

We concentrate on the top-50 % of observations in the sample (high-reserve sample) and compute the equity effects for different levels of remuneration in the sample. We then add these to the policy rate coefficient and obtain the total effects of an interest rate hike of 1 percentage point on the loan supplies. We show the results in Figs. 8 and 9. Fig. 8 shows the total effects on the supply of loans to households for different levels of reserves. We can compare these with the direct interest rate effect measured by the policy rate coefficient and represented by the vertical red line (-0.98 %). We find that the total effects of a rate hike remain negative for most observations but that they are significantly reduced (in absolute value) compared to the effect coming from the estimated coefficient of the policy rate. The results obtained for the supply of loans to non-financial corporations (Fig. 9) lead to the same conclusions.

In terms of the causal relationship between loan growth and bank remuneration, we recognize that potential endogeneity issues

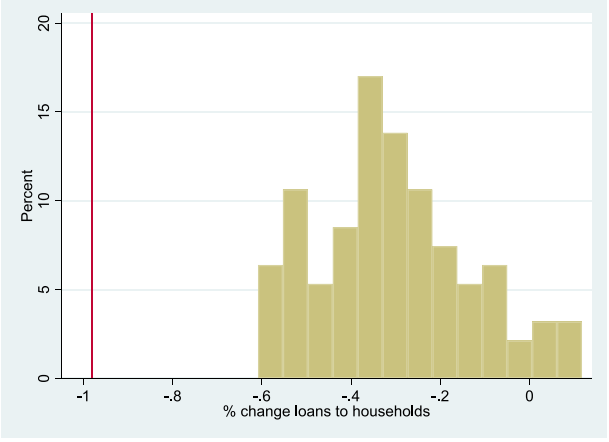

Fig. 8. Total effects of a one percent rate hike on the % change loans to households (Top 50% sample excluding Luxembourg and Cyprus).

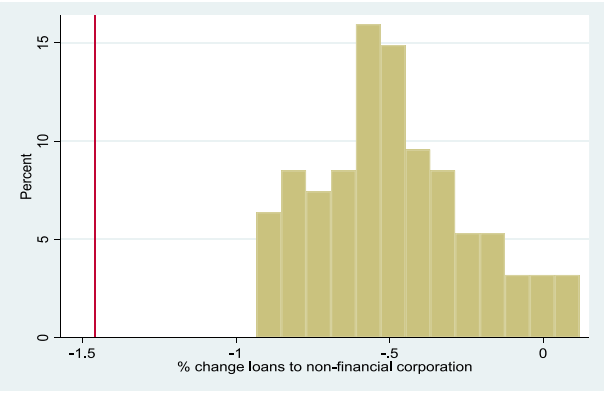

Fig. 9. Total effect of a one percent rate hike on % change loans to non-financial corporations (Top 50% sample excluding Luxembourg and Cyprus).

may result in biased coefficient estimates and impact the robustness of our empirical findings. Therefore, our results should be interpreted with some caution. Despite this concern, the results obtained above are in line with the recent findings of Fricke et al. (2023), who employ a robust methodology with very detailed bank-level data for the Eurozone. They conclude from their empirical analysis of these micro-data that "banks with larger excess reserves display a relative increase in their credit supply to non-financial companies following the rate hike", thereby confirming that the remuneration of bank reserves tends to weaken the transmission mechanism of monetary policies aimed at reducing inflation.

5. A two-tier system of minimum reserve requirements

The major central banks now embrace their new operating procedure (arising from the abundant reserve regime) which consists in raising the rate of remuneration on bank reserves as an instrument to increase the market interest rate in their fight against inflation. This has also led to a surprising but widespread conviction among central bankers and economists that this is the only reasonable operating procedure.

Can one design a system that will avoid having to make substantial transfers to banks while maintaining the current operating procedure used by the central banks, and in doing so (hopefully) gaining their backing? We believe it is possible to design such a system. It is a two-tier system.

5.1. The proposal

The two-tier system consists in imposing non-interest-bearing minimum reserve requirements on *part* of the bank reserves. The bank reserves exceeding the minimum requirement (excess reserves) would then be remunerated as they are today (for similar proposals for a two-tier system, see Whelan (2021), van Lerven and Caddick (2022), and Tucker (2023)); see also Angeloni (2023) for a proposal not to remunerate bank reserves).

The imposition of minimum reserve requirements leads to a horizontal displacement of the demand curve for bank reserves to the right (see Fig. 10). The minimum reserve requirement would apply only to part of the total bank reserves. As a result of this partial displacement of the demand curve, we remain in the abundant reserve regime. The central bank then remunerates the excess reserves with the rate r_D (the horizontal green line). As before, this rate of remuneration acts as a floor for the market rate, and the central bank can raise the market rate by increasing the interest rate on (excess) bank reserves.

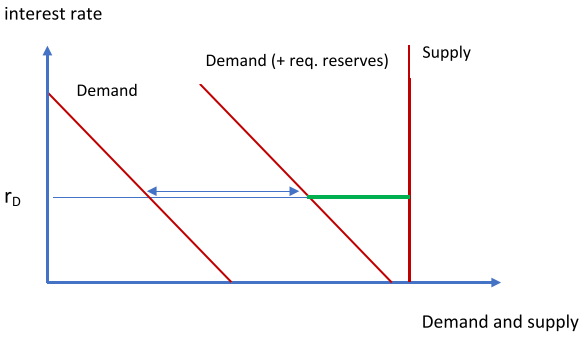

Fig. 10. Demand and supply of reserves: two-tier system.

A combination of sustained sales of government bonds and minimum reserve requirements would probably be the best policy option. Thus, the central bank would raise minimum reserve requirements as in Fig. 10. It would then gradually start reducing its bond holdings allowing the supply curve to shift to the left. This also would make it possible for the minimum reserve requirements to be relaxed gradually. In such a strategy, both the supply and the demand curves in Fig. 10 would then shift to the left, maintaining a regime of reserve abundance and allowing the central bank to use its monetary policy tools while reducing the subsidies to banks.

The advantage of this two-tier system is that the operating procedure so cherished by central bankers can be kept unchanged. The central bank continues to use the interest rate on bank reserves as its monetary policy instrument. The banks continue to have the same incentive to hold recess reserves, as these continue to be remunerated as today. However, the transfer of central banks' profits to commercial banks can be reduced significantly. We show this in Table 4, where we assume that the central banks would block 50 % of the existing bank reserves in the form of non-remunerated minimum reserves. The remuneration would then be on the excess reserves using the same interest rates as shown in Table 1. We observe that in our proposed system there would be a significant reduction of interest transfers to banks. In our two-tier system, the banks would continue to profit. They would continue to receive relatively large transfers on what is essentially a risk-free asset. This would be much less than today in 2024, however, and surely less "exorbitant".

There is a window of opportunities today as the ECB decided in July 2023 to stop remunerating required reserves (1 percent). This implies that the ECB could increase required reserves and reduce its losses, without having to change its operating procedures. We made some calculations illustrating the range of choices the ECB has. In Table 5, we show the total reserves as of July 2023 (column 1). We then apply different minimum reserve requirements (column 2). Column 3 then shows the size of the minimum required reserves on which no remuneration is paid. This leads to column 4 showing the reduction of transfers to banks resulting from these different minimum reserve requirements. Finally, the last column presents the level of excess reserves that are remunerated. At the end of 2023, with a minimum (unremunerated) reserve requirement of 1 % the transfers of the Eurozone's central banks to the banks were reduced by €6 billion. Clearly, the ECB could gradually increase minimum reserve requirements and it would achieve two things. The profit transfers to banks could be reduced, the ECB could maintain its operating procedure consisting of changing the deposit rate and as we showed in the previous section, the fight against inflation could be made more effective.

5.2. Possible objections

Several objections have been raised against our proposal for a two-tier system of reserve requirements. We discuss these objections in this subsection, and we find them wanting.

5.2.1. Imposing minimum reserve requirements is a tax on banks

Several observers have argued that imposing minimum reserve requirements is a tax on banks. In addition, it is unfair (McCauley and Pinter, 2024a) and introduces distortions (Kwapil(2023)). Let us first concentrate on the use of the word "tax". Is the fact that bank reserves would be (partially) unremunerated a tax? Traditionally, money base (bank reserves and banknotes) has not been remunerated. The money base is the ultimate liquidity provided by the monetary authorities and creates important benefits for the holder of this liquidity. Only recently bank reserves have been remunerated under the pressure of the banking system. This has led since 2022 to significant transfers of the profits of central banks to the banking sector. To call a reduction of the transfers of the profits of the central banks to the banking sector a tax is far-fetched. Words matter. The use of the word "tax" creates the perception that a (partial) non-remuneration of bank reserves is bad.

Banks routinely do not remunerate the demand deposits held by their customers (except for big holders of these demand deposits). If the non-remuneration of the deposits held by commercial banks at the central bank is a tax, then the non-remuneration of demand deposits issued by banks and held by the non-banking sector is also a tax. And a larger tax because the size of these demand deposits is large than the bank reserves. Why is it unacceptable that central banks "tax" the banks by not remunerating their deposits and is it acceptable that banks "tax" their customers? In both cases, the services provided are the same. The central banks provide a highly liquid asset to the banks, and the latter provide a highly liquid asset to the non-banking sector. There is a difference. The liquid asset provided by the central bank is not only the ultimate liquid asset but also the only safest possible asset; safer than the demand deposits provided by the banks to the non-banking sector. If anything, the latter should be remunerated more than the bank reserves because they are riskier than bank reserves.

McCauley and Pinter (2024a) use an elaborate argument to show how unfair the non-remuneration of bank reserves would be. In their view, when in the context of QE, banks sold government bonds to the central banks, they did this because they expected future increases in the interest rate on bank reserves that they accepted to hold in exchange for the bonds. It would therefore be unfair to reduce the rate of remuneration (to tax them in their parlance).

There is very little evidence that during the period of quantitative easing (2015–2019) and (2020–2021) bankers, or anybody else, were expecting the dramatic increases in the interest rate that we have seen since 2022. In Table 6, We notice that, from 2015 to 2021, yields of the long-term government bonds for most Eurozone countries were very low. For example, the average German government bond yield was 0.03 %. This implies that the then prevailing expectations of financial markets of the short-term interest rates for the next ten years were close to zero. Bankers sold the bonds to central banks freely because the central banks offered a high price for these bonds, making these transactions profitable for the banks under the prevailing expectations that the interest rates would remain low during the duration of these bonds. The unexpected increase in the interest rate since 2022, therefore, created a large windfall profit for banks, at the expense of the taxpayers. It is therefore quite natural to limit the size of these windfall profits that explain why during 2023 banks in the Eurozone made record profits.

The imposition of minimum reserve requirements, of course, introduces distortions. To evaluate these distortions and the welfare

Table 4
Interest transfers in Jan 2024 (billions).

	Present system	Two-tier system
ECB	€ 140	€ 70
Fed	€ 158	€ 79
BoE	€ 42	€ 21

Sources: Own calculations based on data from Bank of England, Board of Governors Federal Reserve and European Central Bank.

Table 5
Total reserves (Aug 2023), minimum reserves and transfers (billion euros).

Total reserves	Percent min res	Min reserves	Reduction transfer	Excess reserves
€ 3.818	1 %	€ 168	€ 7	€ 3.650
€ 3.818	5 %	€ 840	€ 34	€ 2.978
€ 3.818	10 %	€ 1.680	€ 67	€ 2.138
€ 3.818	15 %	€ 2.520	€ 101	€ 1.298

Note: total reserves = deposit facility + current accounts (min reserves).

Table 6
10-year government bond yields 2015–2021 (%).

Country	2015	2016	2017	2018	2019	2020	2021	Average
Belgium	0.84	0.48	0.72	0.79	0.19	−0.15	−0.01	0.41
Germany	0.5	0.09	0.32	0.4	−0.25	−0.51	−0.37	0.03
Ireland	1.18	0.74	0.8	0.95	0.33	−0.06	0.06	0.57
Spain	1.73	1.39	1.56	1.42	0.66	0.38	0.35	1.07
France	0.84	0.47	0.81	0.78	0.13	−0.15	0.01	0.41
Italy	1.71	1.49	2.11	2.61	1.95	1.17	0.81	1.69
Netherlands	0.69	0.29	0.52	0.58	−0.07	−0.38	−0.33	0.19
Austria	0.75	0.38	0.58	0.69	0.06	−0.22	−0.09	0.31
Portugal	2.42	3.17	3.05	1.84	0.76	0.41	0.3	1.71
Finland	0.72	0.37	0.55	0.66	0.07	−0.22	−0.09	0.29

Source: Eurostat.
Note: Greece is not included here as it was not qualified for the QE programme (2015–2019).

costs they generate, one has to compare these with the benefits of having an additional instrument of stabilization. We pursue this issue in the next section.

5.2.2. Minimum reserve requirements and the heterogeneity in the banking sector

It has been noted by some observers (Kwapil, 2023 and S&P Global, 2023) that the use of a two-tier system of reserve requirements in an environment of heterogeneity for the banking sector would create problems. Some banks have relatively few bank reserves. They would be forced to borrow funds in the interbank market to satisfy the minimum reserves. In this connection, these observers have pointed at Italian banks that would face difficulties.

We do not think there is a systemic problem in the Italian bank sector. We show the evidence in Table 7. This presents the minimum required reserves (MRR), (that today are 1 % of outstanding deposits) as a percent of the total reserves of the banks. We observe indeed heterogeneity in the distribution of bank reserves across countries in the Eurozone. If the MRR is raised from 1 % to 10 % all Eurozone countries (except Malta) should have enough reserves to satisfy the MRR while maintaining some excess reserves.

Take the case of Italy. In 2022, these minimum reserves represented 9.2 % of total bank reserves of Italian banks. If the MRRs of outstanding deposits were raised to, say 5 %, this would imply that these minimum reserves would represent 46 % of the total reserves of Italian banks. The Italian banks would still have 54 % of their reserve as excess reserves. Hence, we can conclude that as long as the MRRs remain below 10 % of outstanding deposits Italian banks would have enough reserves to satisfy these minimum requirements, without having to borrow liquidity from the interbank market. This still leaves open the possibility that some Italian banks may have a shortage of reserve to satisfy a higher minimum reserve requirement. In that case, they can borrow from the interbank market.

5.2.3. Minimum reserve requirements and footloose banks

Some observers have argued that the imposition of unremunerated minimum reserve requirements would lead to large-scale displacements of banking activities. In particular, Eurozone banks that would face larger unremunerated minimum requirements would move the deposits held by their customers to countries with no or lower minimum reserve requirements (MRRs) and perform their lending activities from these countries. This would have dramatic effects on the banking sectors in the Eurozone (McCauley and Pinter, 2024b).

Table 7
Minimum required reserves (MRR) as percent of total reserves (at 2022 level).

Country	(MRR = 1 %)	(MRR = 5 %)	(MRR = 10 %)
Austria	5.6 %	28.0 %	56.0 %
Belgium	3.3 %	16.5 %	33.0 %
Cyprus	2.9 %	14.5 %	29.0 %
Germany	5.6 %	28.0 %	56.0 %
Estonia	6.6 %	33.0 %	66.0 %
Spain	7.5 %	37.5 %	75.0 %
Finland	3.4 %	17.0 %	34.0 %
France	4.7 %	23.5 %	47.0 %
Greece	5.7 %	28.5 %	57.0 %
Ireland	5.5 %	27.5 %	55.0 %
Italy	9.20 %	46.0 %	92.0 %
Lithuania	8.8 %	44.0 %	88.0 %
Luxembourg	6.1 %	30.5 %	61.0 %
Latvia	6.6 %	33.0 %	66.0 %
Malta	14.9 %	74.5 %	149.0 %
Netherlands	5.0 %	25.0 %	50.0 %
Portugal	7.4 %	37.0 %	74.0 %
Slovenia	5.3 %	26.5 %	53.0 %
Slovakia	4.8 %	24.0 %	48.0 %

Source: ECB, Disaggregated financial statement of the Eurosystem. We use the reserve level of each national banking system in 2022 as the total reserve base.
Note: MRR is defined as the percent of deposits issued by banks that have to be held as required reserves at the respective central banks.

First, some empirical perspectives. There is a long tradition of the use of MRRs in Europe. Prior to the creation of the Eurozone, several countries like Germany, France and Italy used MRRs, sometimes exceeding 10 % of deposits. No such terrible displacements of banking activities took place. Today, Switzerland uses a 2.5 % MRR (in contrast to the 1 % used in the Eurozone) and one is still waiting for the large displacement effects.

If these displacement effects were to occur, the ECB could easily counter these by using an asset-based system of reserve requirements (Schobert and Yu (2014)). This would consist in computing minimum reserves as a percent of total bank reserves. Thus, if bank A has total bank reserves of 100 and bank B of 200, the ECB could tell these banks that, say, 20 percent of these bank reserves are unremunerated MRRs. For bank A this would mean that 20 of their 100 of bank reserves would be MRR and unremunerated, and for bank B this would be 40. No amount of displacement of deposits to London would help these banks in reducing their unremunerated MRRs.

6. Rethinking the role of minimum reserves

As argued earlier, minimum reserve requirements were a standard tool of monetary policy in the past in many industrialized countries. This monetary policy tool is still being used in many emerging countries. Its use as an active tool of monetary policy has been discontinued, however, in most industrialized countries. In this section, we review the bank regulations in the banking system after the global financial crisis of 2008 and find that the current regulations have prioritized bank profitability and efficiency. We argue that there is a need to rethink the role of minimum reserve to better serve the purpose of ensuring sufficient liquidity and financial stability.

6.1. Tradeoff between liquidity and profitability

One would have expected that after the banking crisis of 2008 monetary authorities would have taken recourse to minimum reserve requirements as an instrument to stabilize the banking system. They did not. Instead under Basle III they introduced a new instrument of liquidity control. Banks of a certain size were subjected to a "Liquidity Coverage Ratio" (LCR) (see Bank for International Settlement (BIS) (2013)). The Basle III agreement defines the assets that qualify as liquid assets to be included in the LCR and calls them "High Quality Liquid Assets" (HQLA). The problem is that there are just too many HQLAs eligible for liquidity purposes. Not only do bank reserves at the central bank qualify,[8] but also government bonds and even certain types of corporate bonds. In Appendix 3, we show a table with the different types of assets and the percentages of their permitted use. It strikes the reader that many of these assets, even with much imagination, do not qualify as liquidity because their prices in times of crises become extremely uncertain.

It is difficult to understand how regulators designed such a system of liquidity management. The common sense dictated that they would reactivate the only sound instrument of liquidity control, i.e., reserve requirements at the central bank. They did not do so. This

[8] There is some discussion about whether required reserves qualify for inclusion in the LCR. The BIS qualifies central bank reserves (including required reserves) as belonging to the level 1 assets in the stock of HQLA's "to the extent that the central bank policies allow them to be drawn down in times of stress", BIS (2013). The experience of the post-financial crisis shows that central banks typically allow these reserves to be drawn down. Required reserves should be included in the LCR calculations.

seems to be an example of capturing the regulators by banks that want to have liquidity and make profits. There is a tradeoff between liquidity and profitability. Assets that are very liquid are not profitable; assets that generate profits are not very liquid.

By remunerating bank reserves the central banks have made it possible for banks to have their cake and eat it: banks can hold highly liquid assets and make profit while holding these. Central banks have eliminated the tradeoff between liquidity and profitability for the banks. In the Eurozone (October 2023), banks can earn more on their bank reserves (4 %) than on 10-year German government bonds (2.75 %). An extraordinary act of generosity towards bankers, at the expense of taxpayers.

6.2. *Tradeoff between efficiency and stability*

The decline in the use of minimum reserve requirements by central bankers was very much the result of a paradigm shift from the 1980s on; a shift that stressed the use of market forces and that frowned upon policy-induced distortions. Minimum reserve requirements were seen as introducing important inefficiencies in the financial markets that had negative effects on the optimal allocation of capital. It was often seen as a form of financial repression that led to wasteful investment with a negative effect on economic growth (see McKinnon (1972) for an early and influential analysis of this view). The corollary of this view was that in truly free markets (provided that the monetary authorities maintained price stability) the risk of financial crises would be minimal.

How large the cost of the inefficiencies, induced by minimum reserve requirements, is an empirical matter. The jury is still out on this.[9] But clearly, there is a tradeoff between efficiency and stability of financial markets. The existence of such a tradeoff has now been firmly established both theoretically and empirically (see Campos et al. (Forthcoming)). On the one hand, there is a large literature documenting how financial liberalization spurs efficiency and growth (see Levine (1997), Beck and Levine (2004), Bekaert et al. (2005) for both theory and empirical validation). On the other hand, there is an equally large literature showing that financial liberalizations tend to lead to excessive risk-taking activities in financial markets increasing the risk of crises (Stiglitz (2000)). As a result, most banking crises in the postwar period occurred after financial liberalizations (see Demirgüç-Kunt and Detragiache (1999), Kroszner et al. (2007) and Arregui et al. (2013)). The fact that financial liberalization leads to more efficiency and more instability leads to the conclusion that financial liberalization leads to a tradeoff between efficiency and stability.

By abandoning the use of minimum reserve requirements, central banks also abandoned the use of an instrument of monetary policy whose primary aim is stabilization of the banking sector and, more generally, the business cycle. Thus, one can also conclude that in the choice between efficiency and stability, central banks chose for efficiency at the detriment of stability.

In an important paper, Kashyap and Stein (2012) show that the use of minimum reserve requirements together with the interest rate makes it possible for the central bank to pursue the two objectives of price stability and financial stability. The interest rate can be geared towards achieving the goal of price stability, while the minimum reserve requirement can be used to achieve financial stability. When banks engage in maturity transformation (borrowing short and lending long) they take risks on their own balance sheets. There is also an externality involved in that bankruptcies of one bank can lead to bank runs and systemic risks. Individual banks typically do not take these externalities into account. By using reserve requirements, the central bank can force the banks to internalize these externalities.

If we enlarge the concept of efficiency to include risk externalities, dealing with these externalities (e.g. with the use of minimum reserves) and thereby reducing instability, can also be interpreted as policies that increase the efficiency of the financial system. This also leads to the view that the tradeoff between efficiency and stability can be overcome.

7. Conclusion

The government bond-buying programmes in the framework of QE have led to a fundamental change in the operating procedure of the European Central Bank (and other major central banks) which now operate in a regime of abundance of bank reserves. This requires raising the money market interest rate by increasing the rate of remuneration of bank reserves. This, in turn, leads to a large transfer of the central banks' profits (and more) to commercial banks. We have argued that this is unsustainable, not only because of the sheer size of these transfers, but also because central banks' profits belong to governments that have granted the monopoly power to create money base, and the accompanying profits, to central banks. We have also argued that there is no serious economic argument to justify why banks should receive an interest rate that in 2023 and 2024 varies between 4 % (Eurozone) and 5.25 % (US) on liquid deposits that carry no risk.

We showed empirically that the present system of remunerated bank reserves strengthens banks' equity position and thereby giving them incentives to increase the supply of bank loans. This has the effect of reducing the effectiveness of the transmission of monetary policies which today is focused on reducing inflation.

We argued that the remuneration of bank reserves is not inevitable and that there is an alternative to the current central banks' operating procedure. This alternative reduces the profit transfers to private agents and makes monetary policies more effective in addressing inflation. We proposed to use a system of two-tier minimum reserve requirements. This consists of freezing part of the existing bank reserves in non-interest-bearing deposits while remunerating the reserves in excess of these minimum requirements. This achieves two things. It allows for a drastic reduction in the transfer of central banks' profits to private agents, and it makes it possible for the central banks to maintain their current operating procedures.

[9] See, for example, Cuaresma, von Schweinitz and Wendt (2019) who find medium levels of reserve requirements may be optimal for medium- to long-run growth.

We have argued that there are arguments of fairness to reject the present operating procedure that transfers the profits of central banks (and more) to the commercial banks. There is also an argument based on the effectiveness of monetary policies. We have provided some empirical evidence that the present operating procedures reduce the effectiveness of monetary policy in combatting inflation and that the use of minimum (unremunerated) reserves enhances this effectiveness. Finally, we have argued that there is a need to rethink the role of minimum reserve to better serve the purpose of ensuring sufficient liquidity and financial stability.

CRediT authorship contribution statement

Paul De Grauwe: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Yuemei Ji:** Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix 1. . Interest banks paid to the Eurosystem

During the period 2015–22, the deposit rate was negative (see Fig. 1). The result was that the banks paid interest to the Eurosystem during that period. The question that arises here is how much interest on their deposit accounts the banks paid out to the Eurosystem during that period. The question is relevant because today banks often object to the imposition of unremunerated minimum reserves, arguing that the transfers they obtain today is a compensation for the interest payments they made during 2015–22.

We compute these interest payments made by banks taking into account the fact that, from September 2019 until July 2022, the ECB operated a two-tier reserve system (for more detail on this system see Boucinha, et al. (2022)). The origin of this two-tier system was the fact that in September 2019 the deposit rate (which had been negative since 2014) was lowered to the record low level of −0.5 % (see Fig. 1). The ECB had ears for the complaints of the banks that found the paying of 0.5 % on their deposit accounts at the central banks too onerous. Therefore, the ECB agreed to exempt part of the bank reserves from the payment of this interest charge. The total exemption was put at a constant €950 billion (see Figure A1), until July 2022 when the deposit rate became zero and the two-tier system was discontinued.

We calculated the total amount of interest payments made by banks on their deposit accounts from 2015 until 2022 (when the deposit rate turned positive), taking into account the two-tier system that was in operation during 2019–22. We obtain a total payment by banks over the period 2015–22 of €61 billion. This compares with €140 billion that is being paid out today on an annual basis. In one year, banks will receive compensation which is more than double the interest payments they made over seven years.

What is striking from this short historical analysis is that the ECB was willing to exempt part of the banks' deposits from the negative interest rate, in response to the banks' complaints of having to make these payments. Now that the banks receive significant transfers that dwarf what they had to pay in the past, the ECB has been unwilling to impose a similar two-tier system that would exempt part of the banks' deposits from receiving interest transfers. It would be incomprehensible if the ECB were to continue its opposition to the introduction of a two-tier system that would alleviate the burden on taxpayers, in the same way as it was willing to alleviate the burden on banks when they were hit by a negative interest rate.

Illustrative Summary of the LCR

(percentages are factors to be multiplied by the total amount of each item)

Item	Factor
Stock of HQLA	
A. Level 1 assets:	
• Coins and bank notes • Qualifying marketable securities from sovereigns, central banks, PSEs, and multilateral development banks • Qualifying central bank reserves • Domestic sovereign or central bank debt for non-0% risk-weighted sovereigns	100%
B. Level 2 assets (maximum of 40% of HQLA):	
Level 2A assets	
• Sovereign, central bank, multilateral development banks, and PSE assets qualifying for 20% risk weighting • Qualifying corporate debt securities rated AA- or higher • Qualifying covered bonds rated AA- or higher	85%
Level 2B assets (maximum of 15% of HQLA)	
• Qualifying RMBS • Qualifying corporate debt securities rated between A+ and BBB- • Qualifying common equity shares	75% 50% 50%
Total value of stock of HQLA	

Figure A1. Bank reserves and exempted reserves 201922

Source: European Central Bank.

Appendix 2

Table A1
Summary statistics, definition, and data source.

Variables	Obs	Mean	Std. Dev.	Min	Max	Definition and Data source
Loans to non-financial corporations	216	5.44	5.45	−9.68	21.03	monthly adjusted loans to non-financial corporations, annual growth rate (%), from ECB
Loans to households	216	3.98	3.90	−3.40	13.05	monthly adjusted loans to households, annual growth rate (%), from ECB
Lag reserve	216	0.41	0.57	0.09	3.23	lagged monthly reserve, divided by nominal GDP (in 2022), from ECB and Eurostat
Policy rate	216	2.63	0.90	0.75	3.75	Deposit facility rate (%), monthly, from ECB
Ln (oil price)	216	4.41	0.07	4.32	4.54	crude oil prices in natural logarithm (ln) form: Brent - Europe, Dollars per Barrel, monthly, https://fred.stlouisfed.org
Change in remuneration	216	0.09	0.24	−0.73	2.22	change in remuneration based on reserve and deposit facility rate, divided by nominal GDP (in 2022), from ECB, Eurostat, authors' own calculation
Business confidence	180	99.04	1.86	92.53	102.31	business confidence indicator, from OECD
Consumer confidence	180	97.34	2.05	91.14	101.87	consumer confidence indicator, from OECD

Table A2
High reserve sample (countries and month).

Country	Month
Ireland	Oct-22
Estonia	Jun-23
Cyprus	June-August 2023
Greece	September-November 2022
Portugal	September-November 2022
Spain	September-November 2022
Austria	September 2022-August 2023
Belgium	September 2022-August 2024
Finland	September 2022-August 2025
France	September 2022-August 2026

(*continued on next page*)

Table A2 (*continued*)

Country	Month
Germany	September 2022-August 2027
Luxembourg	September 2022-August 2028
Malta	September 2022-August 2029
Netherlands	September 2022-August 2030

Source: ECB.

Appendix 3. High Quality liquid assets (HQLA)

Illustrative Summary of the LCR

(percentages are factors to be multiplied by the total amount of each item)

Item	Factor
Stock of HQLA	
A. Level 1 assets:	
• Coins and bank notes • Qualifying marketable securities from sovereigns, central banks, PSEs, and multilateral development banks • Qualifying central bank reserves • Domestic sovereign or central bank debt for non-0% risk-weighted sovereigns	100%
B. Level 2 assets (maximum of 40% of HQLA):	
Level 2A assets	
• Sovereign, central bank, multilateral development banks, and PSE assets qualifying for 20% risk weighting • Qualifying corporate debt securities rated AA- or higher • Qualifying covered bonds rated AA- or higher	85%
Level 2B assets (maximum of 15% of HQLA)	
• Qualifying RMBS • Qualifying corporate debt securities rated between A+ and BBB- • Qualifying common equity shares	75% 50% 50%
Total value of stock of HQLA	

Source: Bank for International Settlement (BIS) (2013), Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools, Basle, https://www.bis.org/publ/bcbs238.pdf.

Note: the percentages in the last column represent the percent of the value of the assets that can be counted as liquidity in the LCR.

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