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Research Report

Two-tier system for remunerating excess reserve holdings

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Abstract

This paper reviews the experience of the ECB with the two-tier system for excess reserve remuneration that exempted a portion of banks' excess liquidity (EL) holdings from the negative interest rate of the ECB's deposit facility.

The two-tier system aimed to support the bank-based transmission of monetary policy, while preserving the positive effect of the ECB's negative interest rate policy on the accommodative stance of monetary policy. By signalling that the side effects of the negative interest rate policy could be mitigated, the two-tier system supported the ECB's forward guidance on key policy rates. Banks made swift use of the system by filling their allowances through money market transactions, reserves reallocation within their banking groups or by reducing security holdings. Although introducing the system increased turnover of reserves between banks, money market rates remained fully anchored to the deposit facility rate. The system effectively safeguarded the pass-through of monetary policy by providing significant relief to banks from their cost of holding EL and supporting banks' net interest rate margins and net worth. Factoring in the rates at which banks obtain EL shows that the net cost of holding EL for banks in 2021 remained substantially below the levels seen before the exemption was introduced. Ultimately, the system supported the transmission of monetary policy to the real economy, in particular the transmission of negative interest rates to lower lending rates.

JEL: E41, E43, E52, E58, G11, G12.

Keywords: exemption scheme, two-tier system, excess liquidity, monetary policy transmission, negative interest rates.

Non-technical summary

This paper reviews the rationale behind the two-tier system (TTS) for remunerating excess reserve holdings introduced by the ECB, and assesses its impact on market conditions and bank-based transmission of monetary policy. It thereby contributes to the growing literature on tiered central bank reserve systems and side effects of negative interest rate policies.

Between June 2014 and July 2022, the ECB implemented a negative interest rate policy by maintaining the deposit facility rate in negative territory. The negative deposit facility rate determined the remuneration on banks' EL holdings, i.e. the sum of banks' holdings in the ECB deposit facility and of their reserve holdings in excess of the reserve requirement. In addition, over recent years, the aggregate amount of EL has grown to unprecedented levels owing to various accommodative monetary policy measures implemented by the ECB in the pursuit of its price stability mandate.

In order to support the bank-based transmission of monetary policy, while preserving the favourable effects of negative rates for the economy, the ECB decided to exempt part of banks' EL holdings from remuneration at the negative deposit facility rate in September 2019. The ECB's TTS remunerates the exempted EL holdings at zero percent. Following its implementation, the TTS effectively reduced banks' cost of holding EL and thus mitigated the risk of impairments in the transmission of monetary policy through banks. Banks are reluctant to charge negative rates on retail deposits, especially for households, and in some cases face legal constraints that prevent this from happening. This can weigh on banks' net interest rate margins when deposit rates approach zero, and ultimately has the potential to impair the transmission of policy accommodation to lending rates in a negative rate environment. Given that banks' TTS allowance is linked to their reserve requirements, which are, in turn, determined mainly by the deposit base, banks that were more reliant on deposit funding benefited more. Thus, the relief targeted those banks that were the most likely to experience downward rigidities in the pass-through of negative interest rates to funding costs.

Following implementation of the TTS, banks made swift use of the system. Initially, some banks had fewer reserve holdings than required to make full use of their allowance. With the start of the TTS, these unused exemption allowances declined swiftly to low levels as banks attracted sufficient reserves from banks over-fulfilling the allowance. The fact that such redistribution of reserves took place and included cross-border flows pointed to a reduction in market segmentation compared with what had been observed since the sovereign debt crisis.

A key objective of the calibration of the TTS was to avoid upward pressure on money market interest rates that could have interfered with the accommodative monetary policy stance. Given that the TTS creates incentives for banks to borrow reserves to fill their allowance, calibration of the system needs to ensure that sufficient EL remains subject to the deposit facility rate to ensure its continued anchoring function for short-term interest rates. The design and calibration of the system, as decided by

the Governing Council, were effective in avoiding such risks. Money market rates remained broadly stable, and limited temporary upward pressure was observed only in individual market segments after the start of the TTS. The euro short-term rate (€STR) barely reacted to the introduction of the TTS, and the repo market proved an important channel for the redistribution of reserves. Banks made use of a variety of sources of reserves, including net money market borrowing, net intragroup borrowing, and reducing security holdings. This meant that banks could spread their demand for reserves across market segments, and this may also have reduced the potential upward pressure on rates.

Market reactions suggest that the TTS supported the ECB's forward guidance on its key policy rates. Introducing the TTS meant that the potential side effects of the negative interest rate policy could be mitigated, making it possible for interest rates to stay low(er) for longer as needed to support the accommodative monetary policy stance. Therefore, when this system was first mentioned as a potential policy measure in March 2019, the market pricing of the future path of ECB policy rates declined noticeably.

The TTS provided significant relief to banks' financial position during the period of negative interest rates. The exemption meant annual gross relief in excess of € 4 billion for the banking sector, corresponding to around 20 basis points in return on equity (ROE). These savings led to the direct cost of holding EL showing just a mild increase in 2020, despite the significant increase in EL. While this cost continued to increase in 2021, it is important to note that it is just one of the channels through which negative interest rates affect bank profitability. EL is often obtained at negative rates and therefore, despite its substantial increase since the introduction of the TTS in 2019, the net cost of holding EL is estimated to have remained substantially lower than before the introduction of the system. Moreover, negative rates also affected bank profits through their impact on lending rates, asset valuations, lending volumes and borrower creditworthiness. Overall, across all these channels, the negative interest rate policy is found to have had a neutral impact on bank profitability between 2014 and 2021, in part thanks to the TTS.

Surveys and empirical evidence suggest that the benefits of TTS were transmitted to the real economy. By shielding banks from some of the side effects associated with negative interest rates and by fostering the reintegration of banks into the money market, the measure enabled banks to pass on the benefits to the real economy. Specifically, the measure led to lower lending rates and had a sizeable positive impact on lending volumes. Moreover, banks benefiting the most from the TTS raised their deposit rates, in particular on household deposits, as compared with banks less able to exploit the TTS.

1 Introduction

In September 2019 the Governing Council of the ECB decided to introduce a TTS for the remuneration of holdings by credit institutions of central bank reserves in excess of their minimum reserve requirement.¹ Prior to that, all euro area credit institutions' EL holdings had been remunerated at the prevailing interest rate on the ECB's deposit facility, which was negative between June 2014 and July 2022. The TTS exempts a portion of credit institutions' excess reserve holdings from this negative rate.² The exemption has been operationalised by introducing a remuneration structure with two distinct rates applicable to different parts of credit institutions' excess reserve holdings: the exempt tier is remunerated at zero percent, whereas the remainder continues to be remunerated at the deposit facility rate (DFR). The measure aims to “support the bank-based transmission of monetary policy, while preserving the positive effect that negative rates can have on the accommodative stance of monetary policy, and towards the sustained convergence of inflation to the ECB's aim”.³

This paper reviews the rationale behind the TTS and assesses its impact on market conditions and bank-based transmission of monetary policy. Section 2 recalls the reasons for introducing the TTS and the motivation behind the design choices, as well as providing a comparison with similar systems used by other central banks. In Section 3 the paper assesses the extent to which banks have made use of the system, as well as how reserves are distributed across the euro area banking system. Section 4 reviews how banks fulfilled their exempt tier and whether the system had any undue impact on short-term money market rates. Finally, in Section 5 the paper turns to the impact on the transmission of monetary policy through the banking sector by considering the impact of the system on bank profitability, bank equity prices and the net cost of holding EL for banks. It also discusses the impact of the TTS on bank lending and deposit rates.

By explaining the ECB's TTS and assessing its impact, the paper contributes to the growing literature on tiered central bank reserve systems and the mitigation of the side effects of negative interest rate policies (NIRPs). For example, while Fuster et al. (2021) find that the exempt tier created by the Swiss National Bank was funded through more interbank borrowing and customer deposits,

¹ Euro area credit institutions are required to hold a minimum amount of reserves in their current account at their national central bank. These so-called minimum reserve requirements are remunerated at the rate applicable to the main refinancing operation. Current account holdings in excess of that amount are called excess reserves and until the TTS were remunerated at the rate of the deposit facility or zero percent, whichever is lower. Excess reserves in turn are a part of banks' EL, which equals the sum of banks' recourse to the deposit facility and banks' excess reserves, with deposit facility holdings being remunerated at the rate of the deposit facility. EL is thus the appropriate concept when the focus is on the total amount of central bank reserves in excess of reserve requirements held by the euro area banking system, whereas excess reserves is the correct term in the context of the TTS given that a bank's recourse to the deposit facility is not exempt under the TTS. However, banks can freely transfer any deposit facility holdings to their current account to benefit from the TTS. And, when the rate on the deposit facility is positive, banks can transfer current account holdings to the deposit facility to benefit from the positive remuneration.

² For simplicity, the paper will refer to credit institutions as banks.

³ Updates on the two-tier system can be found on the [ECB website](#).

and that the effects on bank lending were moderate, Baldo et al. (2022) show, that euro area banks were able to maximise the benefits of the ECB TTS by increasing net borrowing in the money market, increasing net borrowing from their banking group, and reducing holdings of marketable securities. Altavilla et al. (2022), using micro-level data for banks' money market activity and lending behaviour, show that euro area banks that re-entered the money market following the introduction of the TTS extended more credit to the real economy after the system was implemented. Finally, Eisenschmidt et al. (2022) show that banks benefiting the most from the TTS raised household deposit rates in contrast to banks less able to exploit the TTS, indicating that the former banks passed on a proportion of their savings to their clients.

2 Rationale and design of the two-tier system

The TTS supports the transmission of monetary easing, in particular the transmission of negative interest rates. With NIRP, banks bear the cost of holding EL and face constraints in passing this cost on to bank customers. That cost depends on how much EL a bank holds, its remuneration (at the DFR), and the cost at which a bank obtained the EL, which is determined by its ability to pass that cost on to its customers. In this regard, it should be noted that there is no way for the banking system as a whole to avoid holding the aggregate amount of EL given that these reserves may only be held by banks and circulate in a closed system, i.e. all central bank reserves that are created must be held by banks. The ECB introduced the TTS in September 2019, alongside a ten basis points cut in the DFR that would, in the absence of the TTS, have raised the aggregate cost of holding EL. Moreover, the rate cut was part of a comprehensive monetary policy easing package, including measures that had the potential to further increase the amount of EL in the banking system.⁴

If negative policy rates are not fully passed on to banks' funding costs owing to frictions that emerge when bank deposit rates approach zero, then NIRP can reduce banks' net interest rate margins, thereby hampering bank-based transmission of monetary easing. This may be the case, notably, when the returns on banks' assets (e.g. on loans and other investments) fall in response to lower and more negative policy rates, while deposit rates lag or do not move into negative territory. Consequently, the lack of a full pass-through of central bank interest rate cuts, looked at in isolation, could have a negative effect on bank profitability. In theory, these constraints could therefore limit the bank-based transmission of NIRP, particularly if banks were to try to compensate for the lost earnings by raising lending rates since this might hamper bank lending to the real economy. In such a situation, the central bank is said to have reached the reversal interest rate, at which point the accommodative effect of monetary policy reverses and becomes contractionary.⁵

The euro area has not experienced such a scenario so severe that bank-based transmission has been impaired. In addition to the contribution made by the TTS, certain other developments have contributed to this outcome. In particular, in implementing NIRP, the ECB cut the DFR gradually and in small steps of 10 basis points, which dampened any issues with delayed transmission. In addition, over time, it became clear that banks passed negative rates onto corporate deposits progressively and significantly, and that this did not need to lead to outflows (Altavilla et al. (2021a)). Moreover, a small but growing share of household deposits saw negative rates above certain exemption thresholds. This pass-through of negative

⁴ The ECB announced the restart of net purchases under the asset purchase programme (APP) and more favourable terms applicable to the TLTRO III. These did not immediately have a material impact on EL. Only from March 2020 did additional crisis measures boost EL levels.

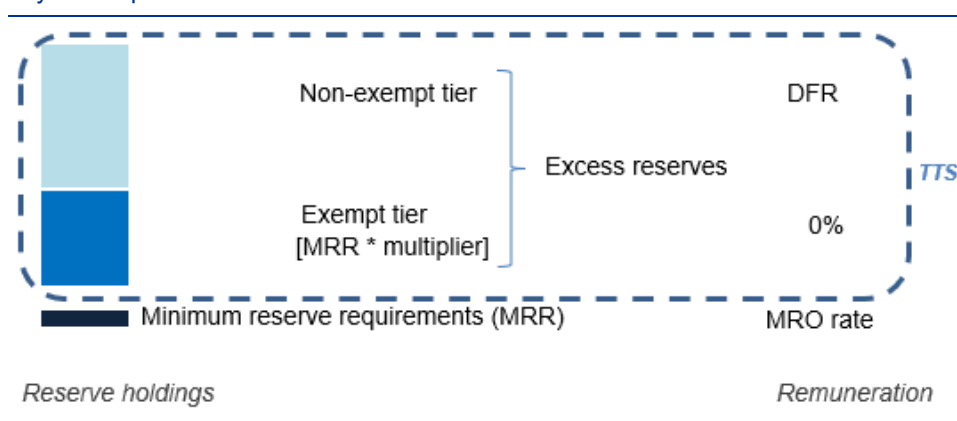
⁵ The argument received greater attention in the literature in response to Brunnermeier and Koby (2019).

rates meant that the pressure on bank net interest rate margins was reduced. More broadly, empirical analysis shows that while NIRP compressed banks' net interest margins, this was offset by the positive impact on other components of bank profitability, most notably intermediation volumes and loan loss provisions, and that the reversal rate was not reached (Boucinha and Burlon (2020), and Altavilla et al. (2021b)). This positive impact reflects the fact that NIRP provided additional monetary policy accommodation (see Section 5).

The TTS was introduced to lower the risk of impairments in the transmission of monetary policy through banks in a negative interest rate environment. The TTS aims to shield segments of the banking sector that are particularly vulnerable to the side effects of NIRP and to safeguard against the possibility that the side effects of NIRP on bank-based transmission would increase over time. Box 1 sheds light on the alternative purposes of tiering systems used by other central banks.

The ECB's TTS was designed to provide banks with relief from the costs of holding EL. Under the TTS, banks' excess reserves are subject to two distinct remuneration rates: the exempt tier is remunerated at 0%, whereas the non-exempt tier continues to be remunerated at the DFR, which at its minimum reached -0.5% (Figure 1).⁶ The size of the exempt tier has been set at six times banks' minimum reserve requirement (MRR). The exemption rate and the multiplier have remained unchanged since the introduction of the TTS, whereas the DFR has been raised out of negative territory in July 2022.⁷

Figure 1
Stylised representation of the ECB's TTS



Source: ECB.
Note: MRO is the rate of main refinancing operations.

The exemption allowance has been defined as a multiple of MRR because the frictions in the pass-through of policy rates to bank funding rates originate from a bank deposit base, which in large part is remunerated at, or above, zero. The MRR is calculated as a percentage (i.e. the reserve ratio – currently 1%) of the reserve base (mostly composed of short-term deposits, but also debt securities with a notice period or maturity of less than two years). Therefore, banks

⁶ The terms 'exempt tier' and 'allowance' are used interchangeably throughout the paper.
⁷ The Governing Council can change the multiplier and the remuneration rate.

that rely to a greater extent on deposits as a funding source have a higher MRR and, consequently, relatively higher exemption allowances (see Section 5). Furthermore, banks highly reliant on deposits for their funding typically also have a higher propensity to lend. For example, on average, banks with deposits over assets above the median value of the bank sample have loan books that account for 50% of their assets, as opposed to banks below the median with 30%. Box 1 provides further details of the design choices of other central banks (often modelled on the basis of bank MRRs).

The initial calibration of the exemption allowance was chosen so that a sufficiently large share of banks' EL holdings continued to be remunerated at the DFR, thereby keeping market rates aligned with the ECB's policy rates (see Section 4). The multiplier of six meant that around € 800 billion in EL was exempt from the DFR upon the introduction of TTS and that a significant volume of non-exempt reserves, required to anchor short-term rates, continued to be remunerated at the DFR⁸. Given the uneven distribution of EL holdings across banks and jurisdictions in the euro area, the application of a common multiplier across all banks when the TTS was introduced meant some banks had an allowance that was greater than the amount of EL they held, while other banks held more EL than needed to fill their allowance. This created an incentive for the latter banks to trade reserves (see Section 3). The calibration also sought to avoid banks holding fewer excess reserves needing to borrow significantly in the market in order to fill their allowance given that such borrowing could also have led to an upward pressure on rates in specific market segments. In addition, the ECB dampened the need for trading by applying the TTS to average end-of-calendar-day excess reserves over the maintenance period (MP) in reserve accounts, which meant that banks did not need to fill the exempt tier every day.⁹ Instead, banks had the flexibility to let reserve holdings fluctuate over the MP, diminishing the need to borrow at short notice and bid up market rates.

The TTS also served to reinforce the ECB's forward guidance on key interest rates. When the TTS was launched, the ECB's forward guidance stated that the Governing Council expected key ECB interest rates to remain at their current or lower levels until the inflation outlook robustly converged to a level sufficiently close to, but below, 2% within the Governing Council's projection horizon, and that

⁸ On the introduction of the TTS, around € 1 trillion was not exempted, which was assessed to be sufficient to anchor short-term rates. Estimates of the amount needed to anchor short-term rates are subject to high uncertainty, depend on market conditions, and vary across time.

⁹ A MP roughly covers the weeks between two subsequent Governing Council monetary policy meeting dates. Any changes to the parameters of the TTS will normally apply from the start of a subsequent MP rather than during a MP.

convergence had been consistently reflected in underlying inflation dynamics.¹⁰ By mitigating the possible side effects of NIRP on the monetary policy transmission mechanism, the TTS increases the credibility that, if needed, NIRP could be maintained in place for longer, or that policy rates could be cut more deeply into the negative territory. In other words, it defers the point in time when the negative impact on bank margins would start to impair bank intermediation, i.e. to the extent that it would outweigh the positive effect of lower interest rates on the economy. The TTS thereby bolstered the ECB's forward guidance on policy rates, as evident by the decline in the expected level of future short-term rates priced into the market (see Section 4).

Box 1

Tiering systems applied by other central banks

The ECB's TTS has neither been the only, nor the first, tiering system adopted by central banks for the remuneration of excess reserves. Conceptually, a tiering system simply means that the central bank applies different remuneration rates to different parts of banks' current account balances. Annex 1 summarises the experience of other central banks that have implemented this type of reserve remuneration policy. From their experience, at least four conclusions can be drawn.

First, tiering systems can be deployed to serve different purposes and therefore its aim needs to be clearly defined and communicated. The ECB's system, like many of the systems recently implemented around the world, is aimed at supporting the bank-based transmission of monetary policy, while preserving the positive effect that negative rates can have on the accommodative stance of monetary policy. However, as in the cases of New Zealand and Norway, a tiering system can aim to encourage money market activity that is otherwise typically subdued in a floor system, i.e. a set-up in which the central bank engineers sufficient EL to steer short-term market rates near the rate at which excess liquidity is remunerated (King and Mancini-Griffoli (2018)). In a floor system, most banks hold significantly more reserves than the minimum required by the central bank and what banks themselves demand for precautionary purposes. They therefore have no incentive to borrow reserves short-term in the market from other banks at a rate above the floor, and other banks have no incentive to lend reserves short-term below the floor rate. In this scenario, a tiered remuneration can, however, encourage reserve redistribution through the interbank market from banks with relatively larger excess reserves to banks with smaller excess reserves. In addition, tiered remuneration of bank reserves may be conceived to serve other purposes by penalising excessive and disproportionate reserve accumulation and encouraging a more even reserve distribution.

¹⁰ The Governing Council's forward guidance was subsequently adjusted several times. Following the conclusion of the ECB's Strategy Review in 2021, it suggested, in support of its symmetric two per cent inflation target and in line with its monetary policy strategy, that the Governing Council expected the key ECB interest rates to remain at their present or lower levels until it sees inflation reaching two per cent well ahead of its projection horizon and durably for the rest of the projection horizon, and it judges that the progress realised in underlying inflation is sufficiently advanced to be consistent with inflation stabilising at two per cent over the medium term. This may also involve a transitory period in which inflation is moderately above target. In March 2022, the forward guidance was adjusted further with a reference to the possible lower levels for key ECB interest rates being dropped. In June 2022, the Governing Council concluded that the conditions for raising interest rates had been satisfied, and signalled its intention to raise the key ECB interest rates at its July monetary policy meeting. In July 2022, the Governing Council decided to raise the three key ECB interest rates by 50 basis point, and judged that at its upcoming meetings, further normalisation of interest rates will be appropriate.

Second, a tiering system could be calibrated based on a number of criteria other than MRR.

Tiering systems have been effectively deployed in countries without an MRR framework by using alternative criteria to calibrate the allowances. This is the case, for instance, in Denmark, New Zealand and Norway, as set out in Annex 1. However, when tiering is aimed at mitigating the effects of negative rates on net interest margins in the presence of nominal rigidity of deposit rates at the zero lower bound, the use of MRR or a proxy of bank deposits ensures better alignment between the purpose pursued and the allocation of allowances. Indeed, some central banks that initially used different calibration mechanisms, such as Danmarks Nationalbank, switched either to an MRR-based design or to another gauge of bank deposits. Furthermore, other central banks, such as the Swiss National Bank, which used MRR for the initial calibration but had fixed it in time, ultimately switched to a calibration mechanism that enabled a dynamic adjustment of the allowance as banks liabilities evolved over time.

Third, a tiering system, like any monetary policy instrument, requires regular monitoring and review of its impact and parameters within the context of its overall monetary policy toolkit.

To preserve its effect over time, the values of the parameters on the basis of which the allowances are calculated may need to be reviewed depending on how the banking system's liquidity position evolves, the purpose of the scheme and the constraints it faces. This entails both the calibration of the total allowance and its allocation to individual banks, as was the case with Bank of Japan, Swiss National Bank and Danmarks Nationalbank. The frequency of the recalibration, however, varied among central banks. Furthermore, the need for such recalibration must be assessed holistically within the overall monetary policy toolkit. Additional instruments may be adjusted or recalibrated to achieve the same purposes as an adjustment of the tiering system parameters.

Fourth, tiering systems can be exited when they have served their purposes or when they cease to fulfil the conditions that warranted them.

So far, two central banks have exited their tiered reserve remuneration frameworks. In Denmark, excess reserves shrank, and their volatility increased, making the level of excess reserves more difficult to forecast, with short-term market rates becoming increasingly volatile within the rates at which the two tiers were remunerated. In New Zealand, the system introduced to limit reserve hoarding by banks and preserve the functioning of the interbank market was jettisoned when larger reserve balances made the system unsustainable. The termination of the both these programmes was smooth, without leading to disturbances in market functioning. The side effects of such exits need, however, to be carefully assessed. This is the case, for instance, for the effects on money market activity and its ability to support transaction-based reference rates if that activity was, to a large extent, driven by reserve redistribution within the banking system to fill up the exempt tier.

3 Usage of the system

3.1 Fulfilment of allowances and interest on reserves

At the start of the TTS, some banks had reserve holdings lower than needed to make full use of their allowance, i.e. they had unused exemption allowances.

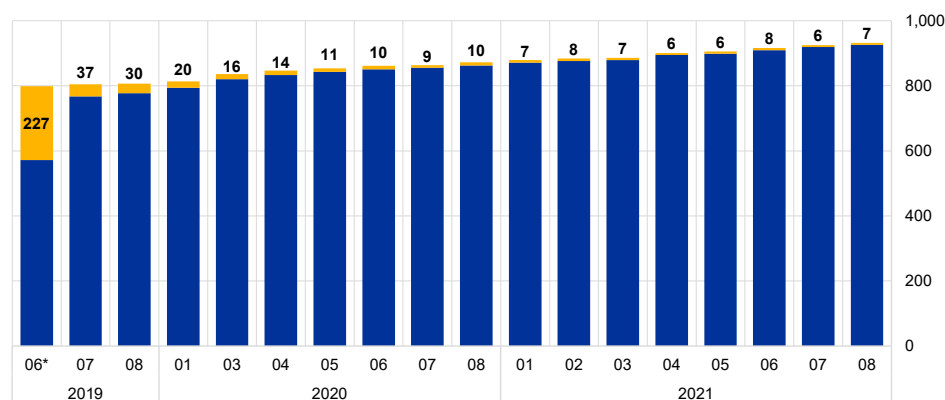
As EL holdings were unequally distributed across banks (Baldo et al. (2017)), their starting position differed significantly, with some banks holding less and others more than their allowance under the TTS. On aggregate, before the TTS became active, i.e. in the sixth MP of 2019, the sum of euro area banks' individual EL holdings falling short of their allowance was € 227 billion, or 28.5% of the total exemption allowance of € 799 billion (Chart 1). From 30 October 2019, when the TTS became active, banks with unused allowance had an incentive to fill it, either by substituting negative yielding assets or by borrowing at negative rates to increase their reserve holdings up to the allowance as that they would be remunerated at the higher rate of zero percent.

Chart 1

Exempted excess reserves and unused allowances under the TTS

(EUR billion)

■ Exempted excess reserves
■ Unused allowances



Source: ECB.

Notes: Although the TTS was only implemented from the seventh MP of 2019 (201907), the statistics for 201906 were also calculated for analytical purposes (and include the deposit facility holdings).

With the start of the TTS, unused exemption allowances declined immediately to low levels, gradually decreasing further in the following months. The level of unused allowances in the first MP with the TTS, i.e. seventh MP in 2019, was € 37 billion (4.6% of the total exemption allowance). The immediate high degree of utilisation of allowances under the TTS highlights banks' ability to make effective use of the TTS. The fulfilment of the exemption allowance gradually rose further in subsequent MPs as banks became more familiar with the system and optimised their reserve management. After more than a year in operation, banks' unused allowances stabilised at a very low level: slightly below € 10 billion, and accounting for less than 1% of the aggregate exemption allowance.

The pandemic did not have any significant impact on usage of the TTS, but, at the margin, it may have altered allowance fulfilment strategies. By the time the COVID-19 crisis started in spring 2020, utilisation of TTS allowances was already high. The non-standard measures employed by the ECB in response to the COVID-19 crisis led to a further increase in EL. However, due to the already high utilisation ratio at that time, the additional EL did not have any noticeable effect on the utilisation ratio. Unused allowances gradually declined further, to stabilise below € 10 billion, into 2021. The non-standard measures offered additional means of attracting reserves, and banks may have relied on these to substitute for strategies applied up to then. In particular, a handful of banks that had unused allowances before the start of the TTS reduced their reliance on the money market to fulfil exempt allowances when additional Longer-term Refinancing Operations (LTROs) and Targeted Longer-term Refinancing Operations (TLTRO) III.4 funds were allotted in early 2020. However, this played no major role at aggregate level, and central bank borrowing continued playing only a marginal role in allowance fulfilment.

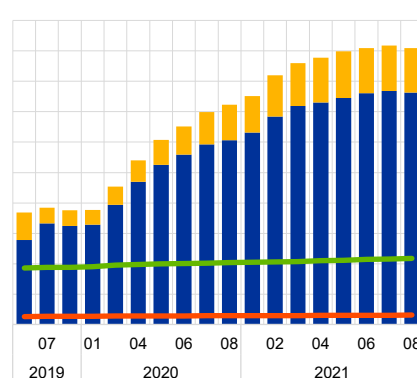
Chart 2

Increasing EL and average remuneration of reserves

a) Excess liquidity

(EUR trillion)

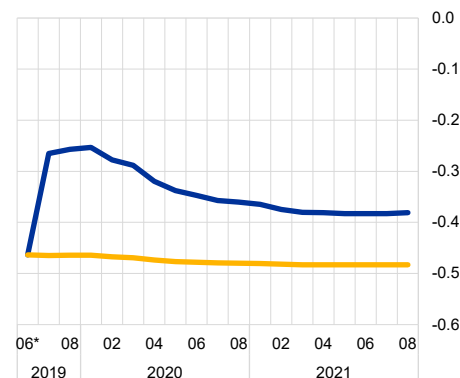
- Current accounts
- Deposit facility
- MRR
- Exemption allowance



b) Average remuneration of reserves

(percentages per annum)

- Average remuneration
- Average remuneration without TTS



Source: ECB.

Notes: Although the TTS was only implemented from the seventh MP of 2019 (201907), the statistics for 201906 were also calculated for analytical purposes (and include deposit facility holdings). The average remuneration calculation includes reserves required, excess reserves, and the deposit facility.

The average remuneration of banks' EL holdings gradually declined as aggregate EL increased to a level above € 4 trillion. In the last MP of 2021 non-exempted reserves stood at € 2.7 trillion, significantly above the level of € 1 trillion at the start of the TTS. As a result, the average remuneration of banks' EL drifted downwards from -0.27% during the first MP after the start of the TTS to -0.38% during the last MP of 2021.¹¹ However, the remuneration of aggregate EL still remained more than 10 basis points higher than it would have been without the TTS (Chart 2).

3.2 Why did banks not fully fill their allowances?

Banks' unused allowances remained at a low level without converging to zero as long as negative rates were applied, with two main groups of banks not making full use of their allowances under TTS. Banks that held unused allowances can be divided into i) those that are branches and subsidiaries of foreign banks, and ii) those that are very small or very specialised and that do not actively manage their liquidity position.

Some international banking groups did not optimise their liquidity across branches and subsidiaries and were therefore not able to fully benefit from their allowances under the TTS. The TTS applies at the level of individual entities and not at the banking group level. Consequently, a banking group may only fully benefit from the TTS if it effectively distributes its reserves among members of its group to collectively fill the sum of their individual allowances.¹² Current account data show that many foreign branches and subsidiaries hold just the minimal of reserves (i.e. just enough to fulfil their MRR), and that their strategy changed little when the TTS was put in place. A potential reason for this could be that the benefit of intra-group liquidity transfers to small branches and subsidiaries with unused allowances might be outweighed by potential operational and regulatory costs or constraints. In any event, the amounts in question show that this only affects small branches and subsidiaries.

Some small banks reportedly did not have a treasury function, which constrained their access to the money market to borrow the amount of reserves needed to fill their unused allowance. In addition, due to operational costs, those banks found it undesirable to participate in the TLTRO III programme in order to fulfil their unused allowance, even if they were eligible for TLTRO participation. Some other smaller banks had a strong preference for not exceeding their exemption allowance, and they rather had unused allowance than reserves exceeding their allowance. As a consequence, and due to the difficulties of precisely

¹¹ The non-standard measures deployed by the ECB in response to the COVID-19 crisis lowered, however, the cost at which excess reserves are generated. Targeted longer-term refinancing operations (TLTRO III) offered a borrowing rate that could be as low as -1% for banks meeting the lending benchmarks for the special interest rate period and the additional special interest rate period. In addition, TLTROs and the higher level of broad-based EL contributed to a further decline of wholesale funding costs.

¹² This may either take place through intragroup transfer, to let each member of the group fulfil its TTS allowance, or through own funding of the branches and subsidiaries to fill unused allowance.

forecasting reserve inflows and outflows, these banks had reserves somewhat below their exemption allowance in each MP.

3.3 Impact on EL distribution across jurisdictions

Introducing the TTS led to cross-border flows of liquidity within the euro area.

At the start of the TTS, banks in Italy, Greece, Portugal and Slovakia held less EL than the allowances, and these allowances could not be fully utilised merely by redistributing EL among banks within the country. Consequently, the distribution of EL at the start of the TTS resulted in cross-border flows of central bank liquidity given that this was the only way for the banking sector in each of these countries to make full use of its allocation of allowances under the TTS.¹³

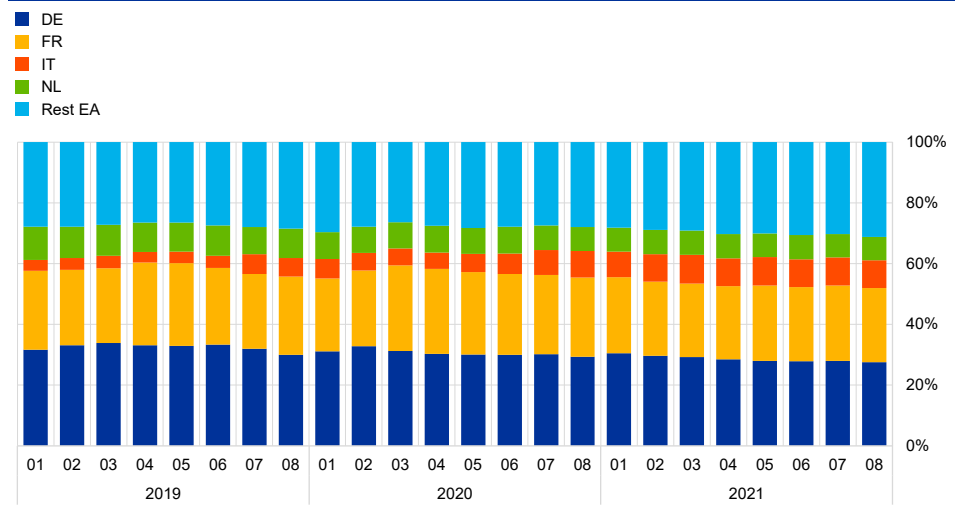
The cross-border flows induced by the TTS are also evident from developments in terms of the balances in the TARGET2 real-time gross settlement system. Except for Greece, many national central banks with a TARGET2 liability position saw a reduction in these liabilities immediately after the TTS was introduced, indicating inflows of central banks reserves into these countries. Banks in Italy, Portugal and Slovakia also managed to optimise their utilisation of the TTS through cross-border borrowing from non-residents or through sales of assets to non-residents. For example, in the first few weeks of the TTS, liquidity flowed into the Italian banking system, as evidenced by a € 48 billion decline in Italian TARGET2 liabilities and a considerable rise in EL held in the Italian banking system from € 69 billion in the sixth MP of 2019 to € 115 billion in the seventh MP of that year.

Many countries with a TARGET2 claims position saw a corresponding decline in these claims. The TARGET2 claims of Germany, France, the Netherlands and Belgium declined during the first weeks of the TTS, indicating outflows from these countries that most likely included net transfers of reserves in the context of tiering. Accordingly, these countries' share of total EL holdings declined in the wake of the introduction of the TTS. The TTS therefore led to a redistribution of EL across countries, giving rise to a slightly more equal distribution. The share of EL held by banks in Germany, France and the Netherlands (i.e. the three largest countries in terms of EL holdings) decreased by close to 3 percentage points in the first MP, when the TTS was implemented (Chart 3). The biggest drop occurred in Germany (-1.5 percentage points), while the biggest increase was observed in Italy (+2.5 percentage points).

¹³ In principle, changes in autonomous factors or intervention by the ECB could also change the EL available to banks, but these were not a dominant factor at that moment in time.

Chart 3

EL – share of selected individual countries



Source: ECB.

The speedy redistribution of EL following the introduction of the TTS hints at lower levels of segmentation across borders in euro area money markets. It also supports the notion that the skewed distribution of EL in the euro area is largely due to the financial structure of the euro area in conjunction with the ECB's asset purchases given that large cross-border flows were taking place as soon as even very limited financial incentives were present (Eisenschmidt et al.(2017)). At the same time, the flows associated with the TTS were limited in relation to both the overall reserves in the system and the amount of cross-border TARGET2 flows. Therefore, the TTS effect became more difficult to discern the more time had elapsed since the launch of the TTS.

4 Market impact

The fact that banks swiftly filled unused allowances shows that they must have relied on the markets to attract sufficient reserves. In this section we explain why this demand for reserves carries the risk of creating upward pressure on money market rates and how the design and calibration of the TTS already sought to take this into account. Next, we verify the actual impact on various market rates and the strategies banks used to fill allowances. Finally, we discuss the announcement effect of the TTS on policy rate expectations.

4.1 Potential upward pressure on market rates

The borrowing of reserves by banks to fill their allowances came with the risk of creating upward pressure on money market rates. Banks that received an allowance that was higher than their EL holdings had an incentive to borrow in the market at interest rates below zero to fill their unused allowances. Banks with liquidity holdings that exceeded their allowances had an incentive to lend at rates above the DFR. Therefore, both groups of banks might have found it financially attractive to trade at interest rates somewhere between the DFR and zero, potentially increasing money rates from their initial position at the DFR at the start of the TTS.

Significant upward pressure on money market rates could have interfered with the accommodative monetary policy stance. And this risk was taken into account in the design and calibration of the TTS. Rising money market rates after the start of the TTS would have undone part of the existing monetary policy accommodation, conflicting with the principal aim of the TTS, which is to safeguard transmission while maintaining the level of monetary policy accommodation. The design and calibration of the TTS avoided such effects along four dimensions.

First, the exemption allowance was defined as a fixed amount and not a function of EL. What matters for anchoring short-term market rates is the marginal rate, i.e. the remuneration that applies to every additional unit of EL assuming it was added to the system.¹⁴ For example, if the ECB were to exempt a certain percentage of each bank's EL holdings, the remuneration on an additional unit of EL would be $DFR + (1-x)*(0\%-DFR)$, with x being the exempted share. For any exempted share greater than zero and a negative DFR, the marginal rate would therefore be above the DFR. Consequently, money market rates would rise to that level to exclude any arbitrage opportunities in relation to the option of depositing with the ECB. Instead, by exempting a multiple of banks' required reserve holdings, while guaranteeing that the total exemption allowance would stay well below the total

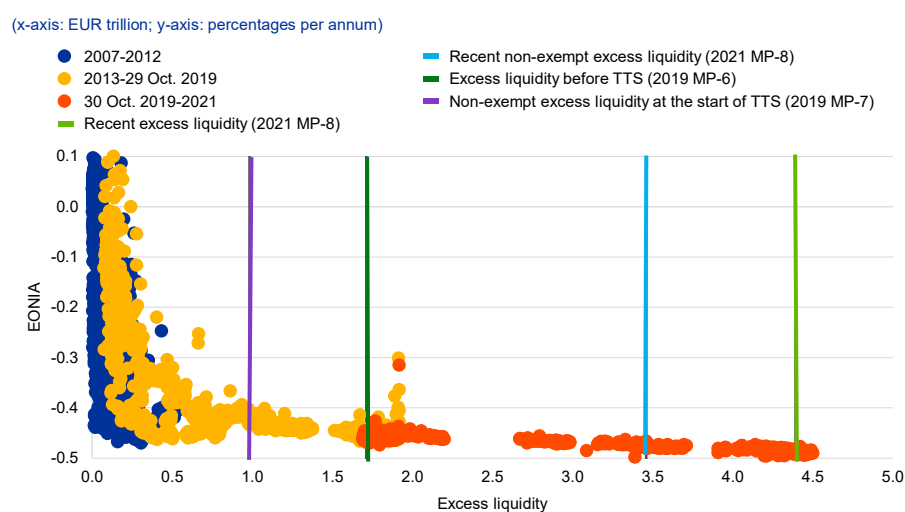
¹⁴ In contrast, the average rate determines how much banks earn on their total EL holdings.

reserve holdings of the banking sector, the marginal remuneration of an additional unit of EL is the DFR.

Second, the initial calibration of the TTS kept significant reserves remunerated at the DFR. At the start of the system about € 1 trillion of reserves remained non-exempted from remuneration at the DFR, and this amount rose thereafter as the aggregate level of EL continued to rise. Historically, short-term interest rates have stood close to the DFR for that level of EL and only at significantly lower levels of EL have rates started to drift up towards the rate for MROs (Chart 4).¹⁵

Chart 4

Euro OverNight Index Average (EONIA) as a function of EL



Source: EMMI, ECB.
Notes: Y-axis shows the normalised EONIA = EONIA to DFR spread/MRO rate to DFR spread, which is subsequently projected into the MRO rate to DFR spread of 50 basis points and DFR of -0.5%.

Third, the multiplier was set at a conservative level to limit banks' need for borrowing in the market to fill unused allowances. Trading by banks may be accompanied by upward pressure on money market rates in the event of market frictions. Significant market frictions could not be excluded ex ante given that a degree of market segmentation was likely to persist, even in the wake of the global financial and sovereign debt crises, and due to new regulations. The larger the borrowing needs created by the TTS, the higher the likelihood of upward pressure on money market rates. The latter was deemed to be particularly relevant to potential cross-border borrowing.

Fourth, the TTS was announced well before its actual start date, thereby giving banks sufficient time to consider their fulfilment strategies and avoiding a rush to the money market that could have exacerbated the potential market impact.

¹⁵ Fuhrer et al. (2021) study the relationship of rates and market activity to the level of excess reserves in the Swiss case. They find that the market interest rate becomes insensitive to changes in the aggregate level of reserves at high levels of aggregate reserves.

Even with advance communication of the TTS, the potential market impact was seen as uncertain by market participants. About one-third of the total exemption allowance (around € 227 billion) was unfilled at the start of the TTS and could thus be traded among banks. Under the assumption that banks would see cross-border borrowing as their last resort – in view of existing market segmentation – and first rely on other liquidity sources, about 4% of allowances (€ 32 billion) needed to be traded across borders to make full use of the TTS. These are sizeable amounts compared with the daily turnover in money markets. Market analysts were broadly aware of the trading needs at country level based on the large concentration of EL holdings in the euro area, and deduced that particularly Italian banks might need to attract reserves from abroad.¹⁶ However, whether these flows would take place and at what rates remained uncertain before the start of the TTS.

Uncertainty about the impact of the TTS on money market rates was reflected in market rates ahead of the start of the TTS. While market analysts broadly expected the €STR to remain unchanged, short-term Overnight Index Swap (OIS) rates traded almost 3 basis points higher just before the start of TTS, suggesting a premium was priced in for uncertainty about the ultimate impact of the TTS on euro area money markets. Italy was also in market participants' focus due to the importance of its repo market for cash funding and a risk of drying up was identified if domestic lenders were to halt their activity. Market participants also expected the reduction in the amount of liquidity remunerated at the DFR to have led to more pronounced spikes in money market rates at quarter-ends.

Finally, the TTS could also have exercised upward pressure on longer-term rates if the incentive for banks to invest reserves was reduced. The introduction of negative rates had created an incentive for banks to rebalance their portfolios away from EL holdings and into riskier longer-term assets, such as bonds that carry higher and positive yields. Even though EL always remains in the banking sector, this so-called hot-potato effect was expected to have reduced longer-term yields (see Ryan and Whelan (2021), Rostagno et al. (2019) and Demiralp et al. (2021)). The TTS may have partially offset this effect by providing relief to banks which then saw less need to invest their reserve holdings.

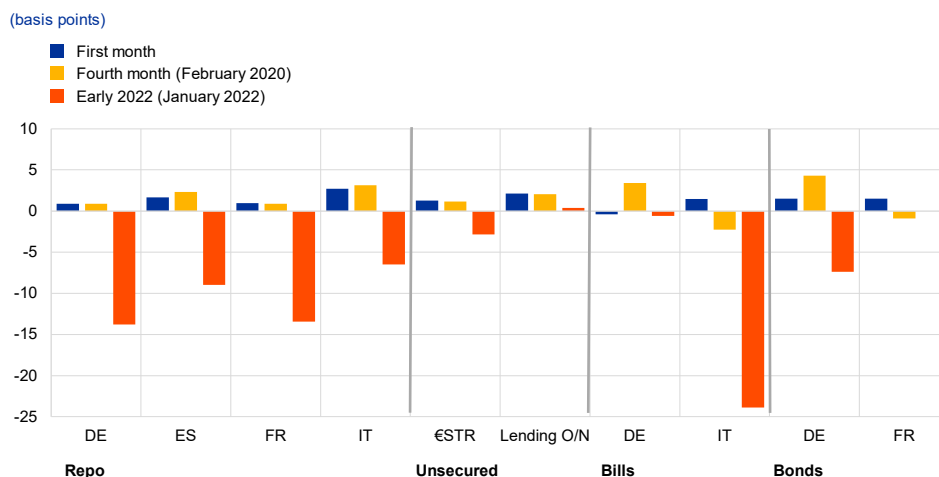
¹⁶ There were concerns that, for example, Italian short-term government paper might be sold. Market participants reported that price action related to that concern had emerged shortly after the TTS press release because details of the TTS design showed that the exemption was based on allowances that needed to be filled. However, any price pressure was very short lived that afternoon, as the information quickly sank in that the TTS would only become active after a few weeks and banks had various fulfilment strategies available.

4.2 Impact on money markets

Since the start of the TTS, money market rates have remained broadly stable and temporary upward pressure was observed only in specific market segments. Repo rates against Italian and Spanish general collateral increased slightly (by 2-3 basis points) during the first few months of the TTS (Chart 5). The €STR stood about 1 basis point higher, and banks' overnight unsecured lending rates increased by around 2 basis points. Other repo rates for euro area jurisdictions' collateral and sovereign bill spreads did not show any change outside their normal fluctuations. The financial turmoil at the start of the COVID-19 crisis in spring 2020 initially led to upward pressure on certain rates, but afterwards money market rates gradually declined to levels well below those at the start of the TTS (Chart 5, orange bars).

Chart 5

Change in market rates since the start of the TTS



Source: Brokertec, MTS, money market statistical reporting (MMSR), Bloomberg.

Notes: changes in the average interest rate level for the respective month compared with the average interest rate level for the month before activation of the TTS. The focus is on overnight rates, except for bills (bonds) which relate to the three-month (10-year) sovereign bill (bond) spread to OIS. Repo refers to rates on repos against general collateral per country of the collateral. Unsecured refers to banks' overnight borrowing and lending conditions.

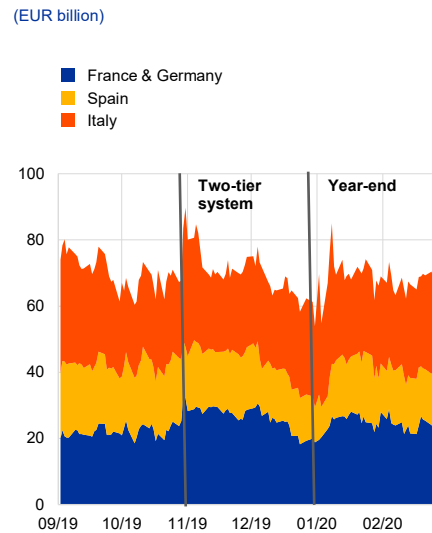
4.2.1 Repo market

The repo market was an important channel for redistributing reserves within the context of the TTS, and this role was confirmed by occasional spells in turnover and pressure on rates at the start of the scheme. Transaction data confirm that banks with unused allowances increased their repo borrowing through central clearing counterparties in the short-term repo market against Italian and Spanish collateral (Chart 6a). During this episode, repo rates against Italian and Spanish collateral increased by an average of 6-8 basis points before normalising shortly thereafter (Chart 6b).

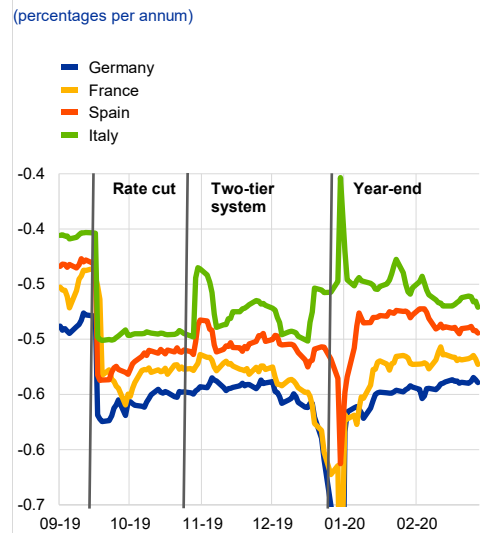
The TTS affected repo rates when liquidity conditions tightened towards end-2019, but trading of reserves alleviated the pressure. While pressure on repo rates was a common phenomenon at year-ends, it appeared particularly protracted at the end of 2019.¹⁷ However, trading of reserves with new counterparties appears to have limited the impact on repo rates. In particular, Italian banks reduced their lending in the repo market towards the year-end, and non-Italian banks are seen to have stepped in with larger lending volumes at the start of 2020 (Chart 7).

Chart 6
Repo market developments

a) Secured cash borrowing by banks with unused exemption allowance at the start of the TTS in the sixth MP of 2019, per country of the collateral issuer



b) Repo rates per country of the collateral issuer



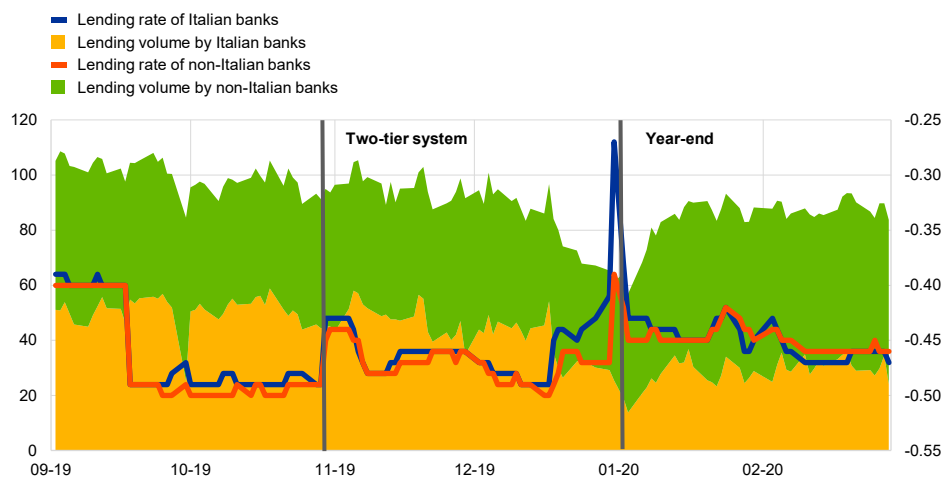
Sources: ECB, MMSR, Brokertec, MTS.
Notes: Overnight, tomorrow next (tomnext) and spot next (spotnext) trades at settlement date.

¹⁷ One element that contributed to the developments was the decline in the outstanding amount of TLTROs by € 49 billion in December 2019, combined with a rise in autonomous factors, meaning a reduction in excess liquidity available to fill unused exemption allowances.

Chart 7

Secured cash lending by banks against Italian collateral

(left-hand scale: EUR billion; right-hand scale: percentages per annum)



Source: ECB MMSR.

Notes: Overnight, tomnext and spotnext trades at settlement date.

Overall, the repo market kept functioning in the presence of the TTS and provided banks with a channel to borrow reserves at broadly unchanged rates. Banks from all euro area countries were able to rely on the repo market to fill their allowance, further illustrating the importance of the secured market segment to overcome market segmentation.

4.2.2 Unsecured money market

The €STR was not significantly affected by the introduction of the TTS, suggesting that reporting banks did not borrow significantly more funds overnight owing to the TTS (Chart 8a). A breakdown of the change in the €STR per counterparty sector suggests that most trades were unaffected, but a minority showed upward pressure of between 1 and 2 basis points at the start of the TTS (Chart 8b). This effect also persisted in subsequent months. Overall, the impact of the TTS on the €STR was limited.

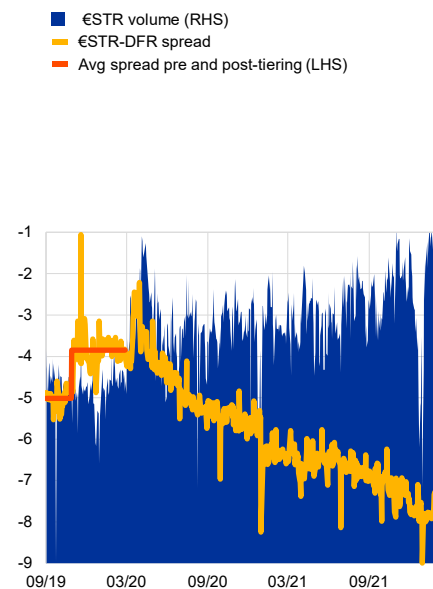
The prevailing market structure was likely to have been a dampening factor given that the overnight unsecured segment largely reflects deposits by non-bank financial institutions with banks that have access to the ECB's deposit facility. Given that banks have a certain degree of market power over the vast majority of depositors, they are able to avoid paying higher rates in that market segment.

Chart 8

Impact on the euro short-term rate

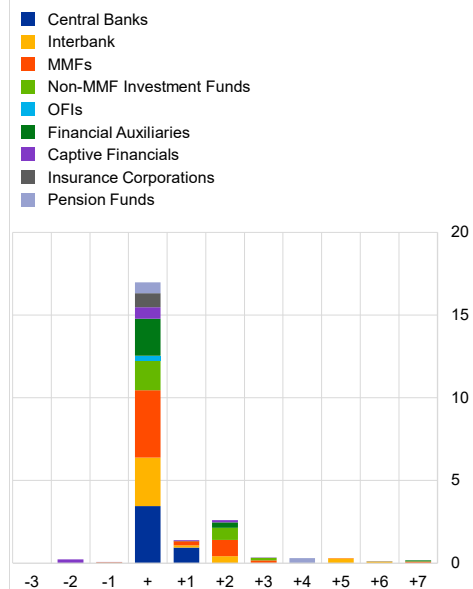
a) Euro short-term rate (€STR)

(left-hand scale: basis points, right-hand scale: EUR billion)



b) Change in the transaction rates eligible for the €STR and the associated trading volume per counterparty sector

(x-axis: basis points; y-axis: EUR billion)



Source: ECB, MMSR.

Notes: In chart a, DFR stands for deposit facility rate, with data until January 2022 and the average spread post-tiering shown until end-February 2020. LHS stands for left-hand scale and RHS stands for right-hand scale. Chart b presents the change in rates of trades conducted between the same counterparties before and after the launch of the TTS, broken down by counterparty sector of the reporting banks. The change is taken between end-October and end-November 2019.

With the exception of certain German banks, the unsecured interbank market was rarely used to fill allowances, confirming the strong notion of relationship-driven lending in the remaining unsecured interbank activity.¹⁸ Interbank

unsecured lending had already reached historically low levels in the euro area and could hardly be reduced further by banks with unused allowances (ECB (2021)). At the same time, banks over-fulfilling their allowance were not easily tempted to lend more on an unsecured basis, given that the regulatory cost of such activity is high and internal risk limits apply. Nevertheless, the unsecured segment became more active, but as Deutsche Bundesbank (2021) explains, the impact on the euro area unsecured money market segment largely related to banks from the cooperative and savings bank sectors. The central institutions of those associations lent significantly more to affiliated institutions on an unsecured basis and at rates that were, on average, 4 basis points higher. As those institutions were not reporting agents for the purposes of calculating the €STR, the benchmark rate was unaffected.

4.2.3 Other market segments

Apart from the euro money market, other market segments were entirely unaffected by the start of the TTS. Even though the evidence in Section 4.3 suggests that some banks also reduced their holdings in bonds and bills to fill their allowances, short-term government bond yield to OIS rate spreads were very stable after the launch, suggesting that any TTS-related activities were not disruptive (Chart 5).

There is also little indication that the TTS led to material upward pressure on longer-term yields by dampening the ‘hot-potato’ effect. As explained above, the relief provided to banks reduced their incentive to invest reserves in longer-dated bonds with higher and positive yields. Government bond spreads did not change, however, even for countries where banks hold relatively high levels of EL (Chart 5).

Overall, the muted market impact of the introduction of the TTS shows that segmentation in the euro money market is contained and money markets can efficiently redistribute large amounts of reserves across borders. This conclusion is supported by the fact that the TTS triggered significant cross-border flows, mainly in secured money markets, leading to only very limited pressure on money market rates. Euro money markets kept functioning smoothly, with good liquidity conditions and rate resilience.

The negligible and only temporary impact of the TTS on short-term interest rates implies that the risk of an unintended effect on the monetary policy stance associated with the introduction of TTS did not materialise. Calibration of the TTS multiplier involves an important trade-off between the amount of support required for bank-based transmission of monetary policy and the risk of creating upward pressure on money market rates and hence unintended effect on the monetary policy stance. A larger multiplier provides greater relief to banks, but increases the risk of rising money market rates. Section 5 discusses the cost relief

¹⁸ See Chiu et al. (2020).

brought by the TTS as a result of the calibration chosen to preserve the positive contribution of negative rates to the accommodative stance of monetary policy.

4.3 Banks' fulfilment strategies

Banks had various options for obtaining the reserves required to fulfil their unused allowances. Banks could substitute assets with reserves to fill their unused exempt tier. For instance, they could substitute government bond holdings through sales or decide not to roll over their holdings when they matured. Likewise, they could reduce their interbank lending. Banks could also obtain reserves through changes in their liabilities. For example, they could borrow in the repo or unsecured money market. Members of a banking group could optimise their joint reserve holdings through intragroup transfers given that the exemptions are allocated at individual bank level.

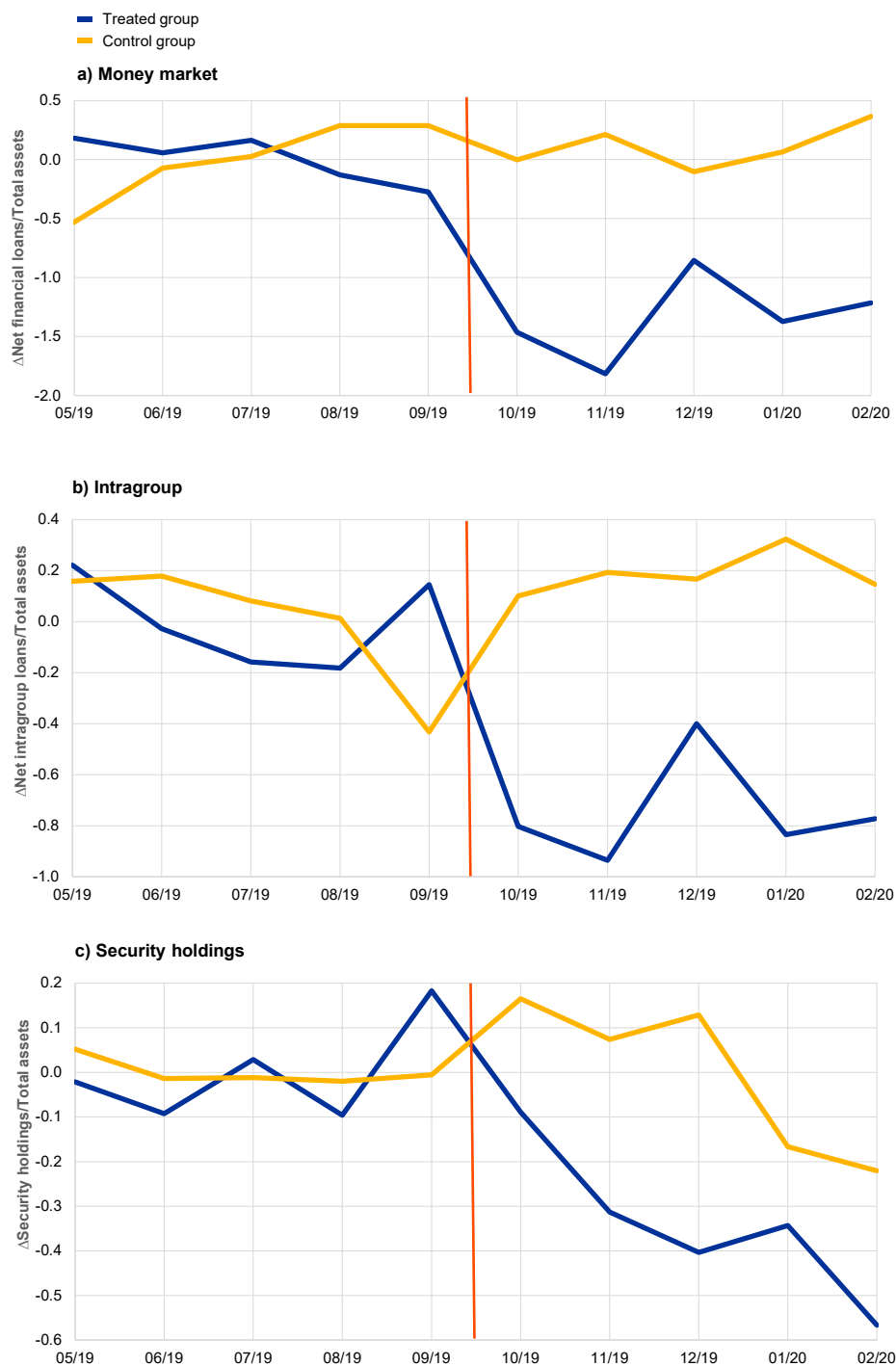
The evidence suggests that banks made use of a large variety of sources for reserves, dampening the impact of the TTS on money market rates. Baldo et al. (2022) find that banks increased their net money market and net intragroup borrowing and reduced their security holdings to fill their unused exempt tier. These sources of reserves are the most liquid items on bank balance sheets, form part of their liquidity management tools and may have negative yields, serving as an incentive for substitution. Banks that had unused exemption allowances at the start of the scheme relied on each of those sources significantly more than banks that closely fulfilled their allowance and had no borrowing needs. Chart 9 shows how banks with unused allowances lent or invested significantly less reserves in net terms than other banks ("control group of banks") after the launch of the TTS in October 2019. The results indicate that potential price pressures due to market frictions may have been dampened given that banks did not depend on a single channel, but relied on all liquid sources of reserves available to them. Using different sourcing strategies in combination tends to spread the demand for reserves across market segments, thereby reducing the potential upward pressure on rates.

Banks spread their efforts to fill their allowances under the TTS proportionally across the available liquidity sources. Baldo et al. (2022) show that banks did not have a 'pecking order' in their sources of liquidity but relied on all sources proportionally so that the relative allocation among the sources of liquidity remained unchanged after the start of the TTS compared with the prior period. This suggests that banks aim to keep the composition of their liquid portfolio constant. For example, banks' reliance on money market loans as a share of the sum of intragroup loans, security sales and money market loans was statistically the same as before the start of the TTS (Chart 10). The same was true for money market deposits. These findings are based on the period between September 2019 and February 2020 for the 142 banks that are part of the ECB's dataset on banks' individual balance sheet items (IBSI).

Chart 9

Strategies used to fill exemption allowances

(change in banks' (net) position to total bank assets, percentage points)



Source: Baldo et al. (2022).

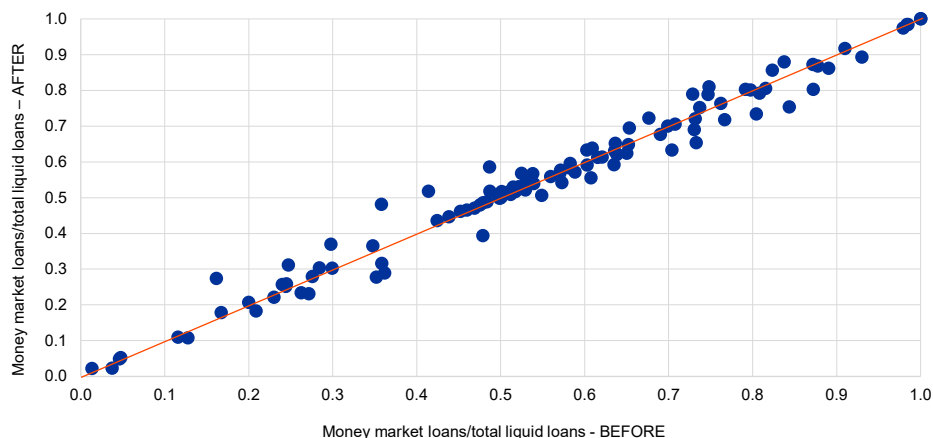
Notes: Comparison of banks' fulfilment strategy: 1) between banks that started with unused allowance and banks that were close to the fulfilment threshold, 2) before and after tiering, and 3) across market segments. Shown are changes compared with the average pre-tiering level. The changes are statistically significant in diff-in-diff regressions. Red vertical lines indicate the start of the TTS.

Chart 10

Reliance on the money market at bank level

Before versus after tiering

(ratio of money market loans to total liquid loans)



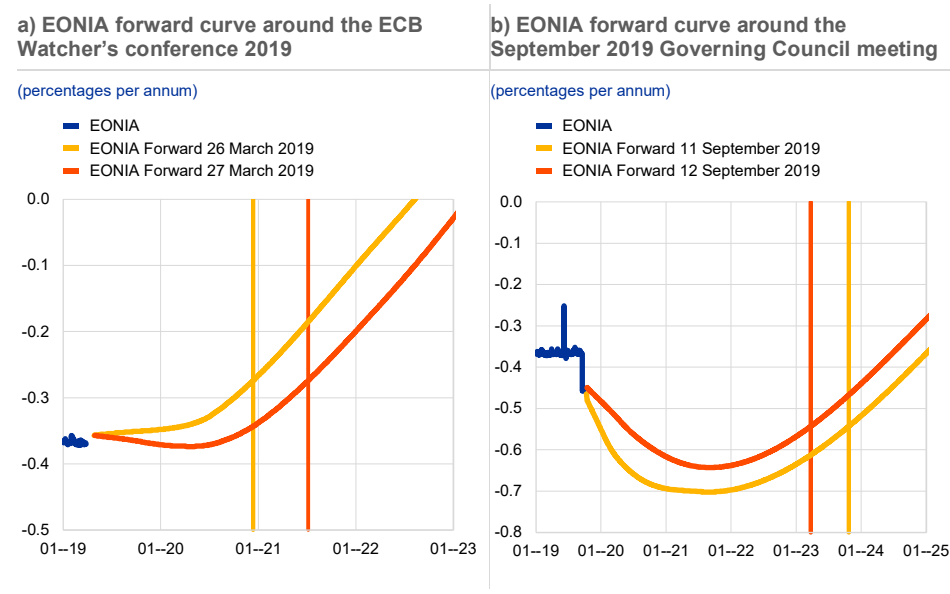
Source: Baldo et al. (2022).

Notes: The variables refer to liquid bank assets. Total liquid loans is the sum of money market loans, intragroup loans and government bond holdings. The orange line is the 45 degree line.

4.4 Signalling effect

The initial market reaction to the ECB communication on a potential introduction of a TTS suggests that the news was perceived as a signal of the future path of short-term interest rates. Market speculation that the ECB was considering the introduction of a TTS gained traction following a speech by former President Mario Draghi on 27 March 2019, in which he said that the Governing Council would contemplate policies aimed at mitigating the potential side effects of negative interest rates, if necessary (see also Box 2 or Altavilla et al. (2022)). These remarks had a profound impact on the forward OIS curve: instantaneous forward OIS rates fell by up to 10 basis points in quarter 1 of 2022 (Chart 11a). While forward rates also contain term premia and therefore do not represent a clean measure of interest rate expectations, the direction of the market reaction implied that investors perceived the information as a signal that the ECB's policy rates would remain low, or fall even lower, for a longer period. As a result, the forward-implied "lift-off" date – the date on which the forward curve exceeds the prevailing short-term rates by 10 basis points¹⁹ – shifted from the end of 2020 to mid-2021 as market participants internalised the potential prospects of the TTS and its possible implications for the future path of ECB policy rates.

¹⁹ Market expectations as expressed in the ECB's Survey of Monetary Analysts suggested that the size of the first increase of the DFR was expected to be 10 basis points until early 2022.

Chart 11**EONIA forward curves around key event dates**

Source: ECB.

Notes: Vertical lines indicate the date at which the forward curve exceeds $\min(\text{EONIA}, \text{trough of forward curve}) + 10$ basis points.

The signalling property of the TTS is related to the notion that potential side effects of a NIRP are likely to increase over time and a TTS may act as a mitigant, prolonging the period over which a NIRP can remain in place with the same degree of effectiveness.²⁰ A TTS effectively allows a NIRP to remain in place for longer, reach deeper into the negative territory, or both, before the negative impact on bank intermediation begins to outweigh the positive effect of lower interest rates on the economy. The signalling property of the ECB TTS for the future path of interest rates was therefore linked to the effect of the announcement on expected bank profitability, the latter having occurred mainly at the end of March 2019 (see also Section 5.1 and Box 2). Indeed, the actual announcement of the TTS on 12 September 2019, jointly with the decision to cut the DFR by 10 basis points and to restart net asset purchases, was not met with an additional downward adjustment of forward rates (Chart 11b). In actual fact, forward rates actually increased by up to 10 basis points in the second quarter of 2020, the option of an even larger reduction in the DFR being priced out when the market recognised that the ECB's focus had shifted to new net asset purchases that would impact longer-term yields. If the TTS press release had any additional downward impact on forward rates, then it was more than offset by the pricing out of the likelihood of additional rate cuts.

²⁰ See, for example, Schnabel (2020) or Altavilla et al. (2021a).

5 Impact on the transmission of monetary policy through the banking sector

The impact of the TTS on the transmission of monetary policy through banks can be measured by its impact on bank profitability and on bank lending conditions and deposit rates. The TTS was adopted to support the bank-based transmission of monetary policy while preserving the positive contribution of negative rates to the accommodative stance of monetary policy (see Section 2).²¹ Evaluating the TTS' contribution to the cost of holding EL, and to bank profitability more broadly, helps to gauge its impact on the transmission of monetary policy, which was further complemented by the reaction of money markets and the signalling effect over the future course of that monetary policy. Each of these channels contributed differently to the footprint left by the TTS on lending conditions and deposit rates, as summarised in Table 1.

Table 1
Impact of TTS on the transmission of monetary policy through banks

Channels of transmission	Measurement	Impact on lending conditions	Impact on deposit rates
Bank profitability	EL charge (Section 5.1), Reaction of stock prices to announcements (Box 2), net cost (Box 3), overall impact of the NIRP on bank profitability (Section 5.1)	More easing due to stronger balance sheets Less easing due to the lower "hot-potato effect" (Section 5.2)	Increase (Less need to prop up margins)
Money market access	Money market volumes and interest rates (Section 4.1 and 4.2)	More easing (Altavilla et al. (2022))	Decrease (Easier funding)
Signalling	EONIA forward curve (Section 4.4)	More easing (standard transmission of risk-free rates)	Decrease (standard transmission of risk-free rates)

5.1 Impact on bank profitability

Low profitability affects banks' ability to generate capital through retained earnings and to attract fresh capital from investors, thus potentially limiting bank loan creation. Since providing loans consumes capital, this means that low profitability has the potential to hamper banks' role in the transmission of monetary policy.²² Policy easing, and in particular negative interest rates, contribute to a reduction in banks' net interest margins for three main reasons. First, the NIRP translates into a direct cost for banks of holding EL. Second, banks are reluctant to charge negative rates on retail deposits, especially for households, and in some cases face legal constraints preventing them from doing so. This downward rigidity in deposits rates creates an asymmetry between the transmission of negative rates to

²¹ See "ECB introduces two-tier system for remunerating excess liquidity holdings", ECB press release, 12 September 2019.

²² See, for example, Brunnermeier and Koby (2019) and Ulate (2021).

banks' assets and liabilities, leading to pressure on bank net interest margins. Third, the flattening of the term structure induced by the deployment of the NIRP²³ reduces the return on banks' maturity transformation.

Box 2

Impact of the TTS on bank equity prices

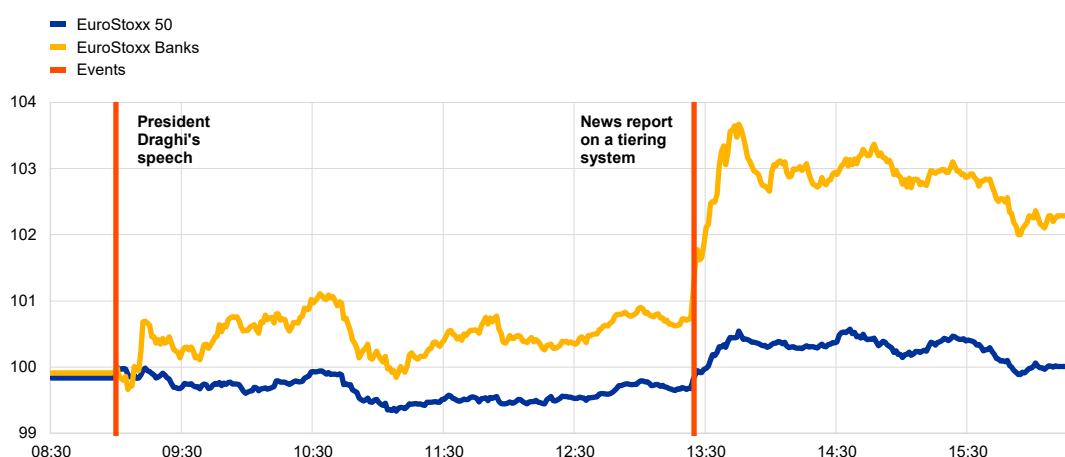
This box discusses the support provided by the TTS for remunerating excess reserve holdings by investigating the response of banks' market valuations to the announcement of the policy measure. Stock prices serve as a forward-looking measure of net worth, representing the discounted sum of future cash flows. The real time availability and forward-looking nature of stock prices, and their reflection of all the information available to market participants at a certain point in time, make them a useful indicator for assessing the impact of the introduction of the TTS.

Developments in equity prices observed following the emergence of rumours about the implementation of the TTS show that the markets saw the policy as supportive of banks. On 27 March 2019, in a speech at the ECB Watchers Conference, Mario Draghi – then ECB President – mentioned the “need to reflect on possible measures that can preserve the favourable implications of negative rates for the economy, while mitigating the side effects”. This was interpreted by news outlets and market analysts as pointing to the introduction of a TTS for the remuneration of EL. Based on high frequency data, Chart A shows that euro area bank stock prices showed a significant increase following the speech and ensuing media reports raising expectations about the introduction of a TTS.

Chart A

Bank stock prices following news of the introduction of a tiering system

(index: 9 a.m. = 100)



Source: Altavilla et al. (2022).

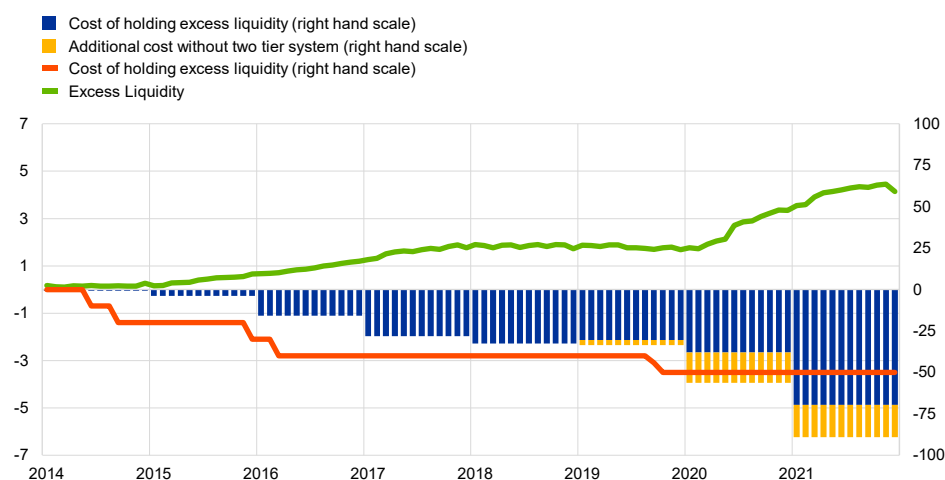
A more formal analysis of bank level data confirms these results, suggesting that the TTS was effective in supporting banks' net worth. The analysis is based on an event study of the market response to the three main events providing markets with information on the TTS. The first event was 27 March 2019, the date of the first news of the TTS referred to above. The second

²³ See Lemke and Vladu (2017).

event was 12 September 2019, when the system was officially announced together with the details of its design. The third event was 30 October 2019, when the system was implemented. The first step in the analysis was to estimate, using a Fama-French three-factor model, banks' abnormal returns in a two-day window around the discussion, announcement and implementation of tiering. Individual bank stocks' abnormal returns were then related to each bank's tiering benefit, i.e. the savings each bank was expected to benefit from. The results showed that banks with tiering savings of 30 basis points of ROE (the variable's standard deviation in the sample) benefited from abnormal stock returns of close to 70 basis points following the tiering events (Altavilla et al. (2022)).

The TTS offset part of the direct cost for banks of negative remuneration at the DFR of their EL holdings. This direct cost of the NIRP was initially negligible, owing to the fact that the DFR was only slightly negative and the volume of EL was limited (Chart 12). Banks' cost of holding EL increased over time, due to the two cuts in the DFR in late 2015 and early 2016 and to the additional EL injected by asset purchases and TLTROs, stabilising at close to 30 basis points of euro area banks' ROE between 2017 and 2019. Following to the introduction of the TTS in September 2019, banks' cost of holding EL showed only a mild increase in 2020, despite the significant increase in EL, the introduction of the TTS having enabled savings of close to 20 basis points of ROE. Box 2 documents the fact that the rise in bank equity prices following news on the introduction of the TTS reflected an anticipation of the boost to banks' net worth. EL continued to increase in 2021, bringing the cost after savings attributable to the TTS to around 70 basis points of ROE. For reference, euro area banks' ROE hovered around 6% before the pandemic and, after virtually nil profits in 2020, banks' income in 2021 recovered close to pre-pandemic levels.

Chart 12
Direct cost of holding excess reserves for euro area banks



Source: ECB, S&P Market Intelligence (SNL Financial) and ECB calculations.

The net cost to banks of holding EL was likely lower than the rate of the ECB deposit facility applied to the excess reserves and is only one of the many channels through which the NIRP affects bank profitability. Taking a closer look at the direct cost to banks of holding EL in the NIRP environment, it becomes clear that banks' EL holdings were often obtained at rates below zero (and even below the DFR). Indeed, assets purchased by the Eurosystem often carried negative interest rates, as did TLTRO borrowing and, in many cases, money market borrowing by banks. An estimate of the resulting net cost is discussed in Box 3 as a potentially better gauge of the cost to banks of holding EL. However, although this is likely to be a more accurate representation of the costs to banks of holding EL, it still does not enable a comprehensive assessment to be made of the impact of NIRP on bank profitability, which requires a holistic approach encompassing all the channels through which the NIRP affects bank profitability. These channels include the NIRP impact on lending rates, lending volumes, asset valuations, and borrower creditworthiness, which translate into costs associated with credit impairment.

Box 3

The net cost of holding EL

Additional net asset purchases under the asset purchase programme (APP) and pandemic emergency purchase programme (PEPP), as well as the high take-up under TLTRO III, have led to a sharp rise in EL since the start of the TTS and, concomitantly, an increase in the cost of holding EL. However, to assess the impact of these increases on bank profitability, it is important to factor in the price at which banks obtain their (additional) EL.

The net EL charge takes into account the price at which banks take EL onto their balance sheet and is defined as the difference between the rate at which EL is held in Eurosystem accounts and the average rate of obtaining it. EL can be obtained by a bank directly from the Eurosystem, through refinancing operations or asset sales, or indirectly, through other banks and their clients when it is redistributed through the banking system. Consequently, the cost of holding EL – and its cross-sectional distribution – depends not only on the price at which it is injected into the banking system (for instance, the TLTRO borrowing rate or the price at which an asset is sold to the Eurosystem), but also on the price at which it is subsequently redistributed (for instance, the interest rate at which a bank borrows EL from another bank).

Setting aside any subsequent transaction that affects the distribution of EL after its creation, the price at which EL is created, through banks' recourse to Eurosystem refinancing operations or through the Eurosystem's outright purchases, affects the net cost of holding EL. When a bank borrows from the Eurosystem, the Eurosystem reports a refinancing operation with this bank on the asset side of its balance sheet and credits that same amount to the current account of the bank at its national central bank (NCB), leading to a corresponding entry on the liability side of the Eurosystem balance sheet. Alternatively, the Eurosystem could purchase an asset outright from a bank. The Eurosystem acquires these assets by increasing the amount of reserves in the bank's account at its NCB.²⁴ All else being equal, the net charge is positive when banks borrow funds from the Eurosystem in refinancing operations conducted at a rate above the

²⁴ Notably, the Eurosystem mostly purchases securities from non-banks, which then deposit the proceeds with banks. Where this is the, an increase in the bank's reserve holdings at its NCB is balanced by an increase in the bank's liabilities to its client.

DFR. By the same logic, if banks obtain Eurosystem funding at a rate at, or even below, the DFR (as is the case under the more favourable conditions of TLTRO III), this would either result in a zero net charge or even a negative net charge, and thus a net benefit. The impact of asset purchases on the net charge is harder to ascertain given that it depends on the price at which the sale of the asset occurs and whether the bank is selling its own assets or assets on behalf of clients. For instance, when the Eurosystem buys assets that have a risk-adjusted rate of return that is very similar to the DFR, a zero net charge results if a bank has sold its own securities to the Eurosystem. However, if the Eurosystem purchases securities from non-banks or from the non-financial private sector which then deposit the proceeds with banks, the net charge will depend on the difference between the interest rate banks pay for the newly generated deposits (or other liabilities) and the DFR.²⁵

The process of redistributing EL after its creation affects the net cost of holding EL. EL is redistributed among banks for three reasons: (i) a bank could buy a security from another bank, (ii) depositors could redistribute deposits to another bank, for instance when conducting payment transactions, and (iii) a bank could settle an interbank loan.²⁶ All these transactions affect the redistribution of EL within the banking system. The evolution of the net charge will depend on the price at which EL is redistributed across banks. When interbank transactions or the purchase of securities are settled using EL, the bank that receives the EL swaps an existing asset (the interbank loan or the security) for the EL it receives. The net charge would be affected if the rate on the interbank loan or the return on the security differs from the return on EL. However, the remuneration rate on large parts of a bank's retail deposit base is subject to the zero lower bound. As a consequence, a bank that receives a (retail) deposit inflow that is settled through a transfer of EL receives the EL inflow at a rate above the DFR. A statistical approach is used to determine the relative and absolute importance of all these factors in the redistribution of EL in the euro area in the months after it has been created.²⁷

²⁵ Demand for central bank reserves may also reflect other benefits banks derive from holding central bank reserves, such as, for instance, complying with bank liquidity regulations by converting non-high quality liquid assets (HQLAs) into central bank reserves - which count as HQLAs. These benefits are not included in the methodology outlined in Box 3, which focuses solely on the net cost of holding EL.

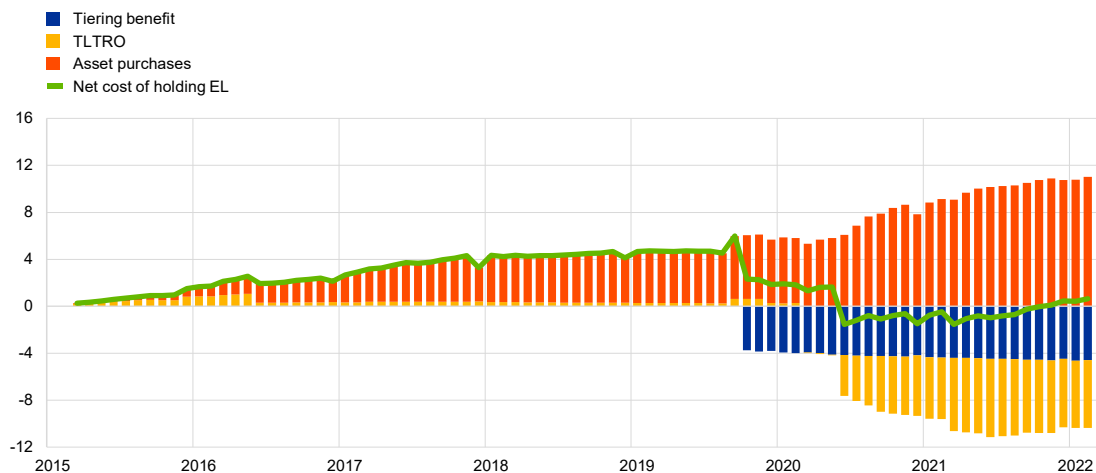
²⁶ Bank to non-bank transactions can be ignored because they have a similar outcome to the three reasons mentioned since reserves are held by banks in a closed system.

²⁷ See Eisenschmidt et al. (2022a) for a more detailed specification of the empirical approach.

Chart A

Net cost of holding EL

(EUR billion)



Factoring in the price at which EL is obtained leads to the conclusion that the average net cost of holding a unit of EL stood substantially below the gross costs. The gross cost concept is the simplest form of measurement of banks' cost of holding a unit of excess liquidity by using the DFR and implicitly assuming that banks obtain their EL at a rate of zero. The net charge concept systematically takes into account the price at which banks obtain their EL and therefore, in a situation in which money market rates are closely aligned with the DFR and the pass-through of negative rates to significant parts of banks' deposit base is increasing, points to significantly lower costs for banks to hold a unit of EL than indicated by the gross charge.

Computing the net cost of holding EL and factoring in the additional benefit banks achieve through the introduction of the TTS shows that the net cost of holding EL remained substantially below the levels before the system was introduced (Chart A). While the surge in net asset purchases under the PEPP caused an increase in the net cost of holding EL, the introduction of the TTS, and more recently the recalibration of the TLTRO III in conjunction with high take-up, have markedly reduced the net cost. Taken together, the net cost was substantially below levels observed shortly before the introduction of the TTS in September 2019.

Overall, the adverse effect of the NIRP on banks' net interest income was offset by a positive effect on borrower creditworthiness.

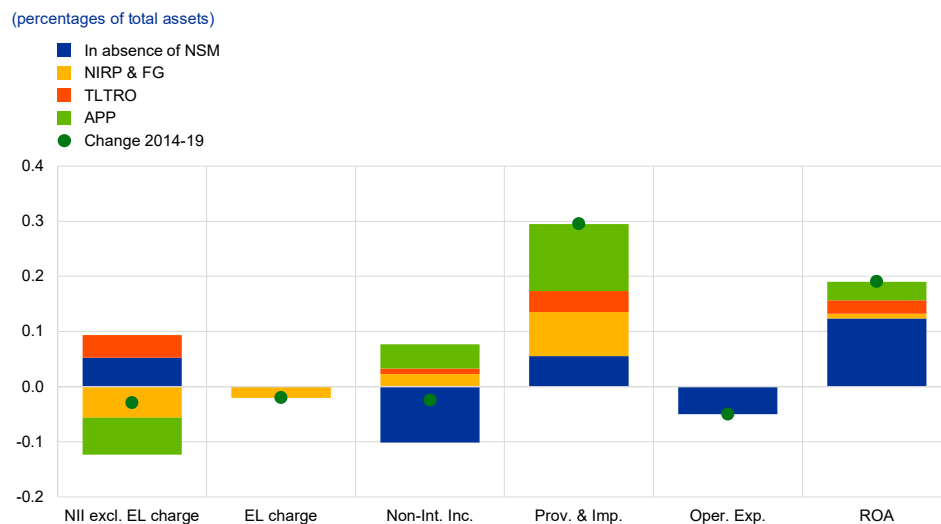
The results of a comprehensive assessment of the impact of negative rates on bank profitability between 2014 and the start of the pandemic are reported in Chart 13. The exercise, which also identifies the impact of other non-standard measures, was conducted using a dynamic Bayesian Vector Autoregressive (BVAR) model to compare actual developments in the main components of bank profitability with those under a counterfactual scenario in which non-standard monetary policy measures had not been implemented.²⁸ Actual developments in bank profitability components (green dots) can be broken down into the estimated impact of negative interest rates (yellow bars), that of other non-standard measures (green and orange bars) and the developments that would have been observed under the counterfactual scenario (blue bars). The first main message from the analysis is that the overall impact of the NIRP (indicated by NIRP and forward guidance (FG) in Chart 13) on bank profitability, measured as return on assets (ROA), is estimated to be broadly neutral.²⁹ Overall, the direct cost of remunerating banks' holdings of excess liquidity at the negative DFR (indicated by the EL charge) is limited in the presence of the TTS. This negative effect is compounded by a drag on net interest income (indicated by net interest income (NII) excluding the EL charge) through the channels discussed above. In parallel, NII is supported by TLTROs offering funding at attractive rates. Decreases in interest rates lead to an increase in the value of the securities held by banks, although this positive impact on non-interest income is relatively small and short-lived (non-interest income). Crucially, the NIRP, like other non-standard measures, is estimated to account for a significant share of the decline in loan loss provisions observed (provisions and Impairments) by supporting borrower creditworthiness directly, through lower interest payments, and indirectly, as the macroeconomic effect of the policy supports borrowers' income. The overall impact of the NIRP on bank profitability is therefore estimated as being broadly neutral, reflecting these offsetting effects.

²⁸ This scenario is obtained from the simulation of a BVAR model based a counterfactual path for the term structure without policy easing and under the assumption that the zero lower bound would always be enforced. The role of different policy measures is identified using the options-based methodology described in Rostagno et al. (2019) for negative rates and forward guidance and on the Eser et al. (2019) methodology for the APP. The model includes information on return on assets, net interest income, non-interest income, loan loss provisions, lending rates to NFCs, loan volumes to NFCs, real GDP, harmonised index of consumer prices (HICP) inflation and interest rates with a remaining maturity of one day, five years and ten years over the period from the first quarter of 1999 to the fourth quarter of 2019. For technical details of the model, see Altavilla et al. (2018).

²⁹ For reference, euro area banks' ROA in 2019 stood slightly below 0.4%, corresponding to a 5.2% ROE.

Chart 13

Changes in bank profitability between 2014 and 2019 and the impact of non-standard measures (NSM)



Sources: ECB and ECB calculations.

Notes: NII excl. EL charge refers to net interest income excluding the excess liquidity charge. Non-Int. Inc. denotes non interest income. Prov. & Imp. are provisions and impairments. Oper. Exp. are operating expenses. The sample is balanced (covering 194 euro area banks) and adjusted for major mergers and acquisitions. The NSM impact is obtained using a dynamic BVAR model, in line with Rostagno et al. (2019). For technical details of the model, see Altavilla et al. (2018).

5.2 Impact on bank lending and deposit rates

The impact of the TTS on bank intermediation depends on the degree to which banks benefit from the TTS and the incentives it creates. The MRR-based design of the system means that the benefits are more significant for banks that are more reliant on deposit funding (Chart 14), i.e. those banks for which the downward rigidity of deposit rates matters most. As illustrated in Section 5.1, the profitability of banks with higher EL holdings is supported directly by the TTS. The profitability of banks that initially held lower reserves is also supported indirectly due to the reallocation of EL in the banking system as banks access money markets and reorganise their overall asset and liability management to fill up their exemption allowances.³⁰ On the one hand, the support offered by the TTS ensures that banks are able to ease bank lending conditions even in a more prolonged low interest rate environment, safeguarding the transmission of monetary policy. On the other hand, the lower pressure on intermediation margins may translate into a lesser incentive for banks to try to avoid the EL charge by extending more loans or purchasing more

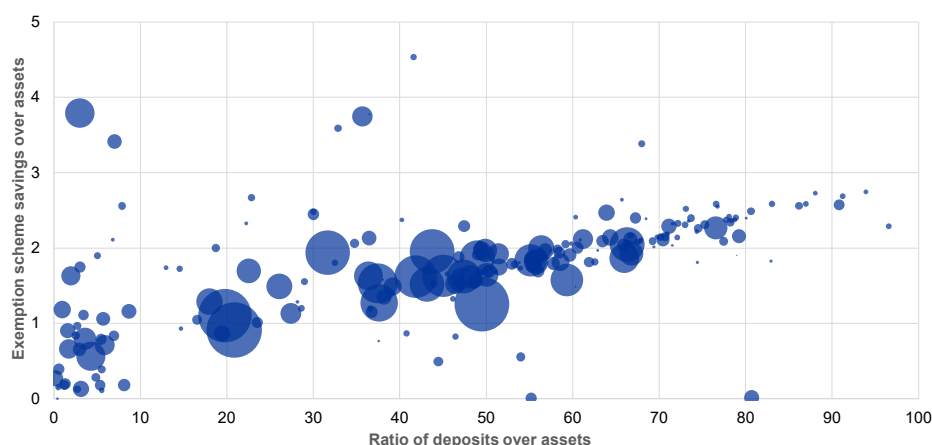
³⁰ Tapping the money markets following implementation of the two-tier system might have also removed the potential stigma that resorting to these markets might have been subject to in some jurisdictions under different circumstances. As the requested liquidity was squarely dedicated to mechanically fill up unused allowances under the TTS, there was presumably no inference on the borrower banks' liquidity situation from those transactions.

higher yielding assets (the so-called hot-potato effect).³¹ This could potentially result in a muted response of bank lending to the TTS and therefore higher lending rates. Therefore, in theory, identifying ex ante the response of bank lending to the introduction of the TTS is not straightforward.

Chart 14

Exemption scheme savings and reliance on deposit funding

(exemption scheme savings in basis points of assets, ratio of deposits as a percentage of assets)



Sources: ECB and ECB calculations.

Notes: Based on December 2020 data for a sample of 206 banks. Bubble sizes determined on the basis of banks' main assets.

The transmission of the TTS to bank intermediation extends beyond loan markets, potentially affecting deposit pricing. The positive effect of the TTS on banks' net interest margins may also translate into a lesser incentive for banks to pass on the NIRP through to bank deposit rates (see Box 4). The TTS affords banks a sustainable way to shield their deposit base from negative remuneration. Pass-through of the policy rate to bank deposit rates can then be smaller than it might otherwise have been. In parallel, the profitability of banks that are particularly benefited by the TTS may increase to an extent that improves their perceived exposure to the consequences of a prolonged period of margin compression, as was evident from banks' market valuations after the announcement of the TTS (see Box 2). This reflects positively on their ability to tap market financing, affording them a lesser need to rely on deposit funding, and thus potentially translating into lower deposit rates. Hence, identifying ex ante the response of bank deposit rates to the introduction of the TTS is likewise not straightforward.

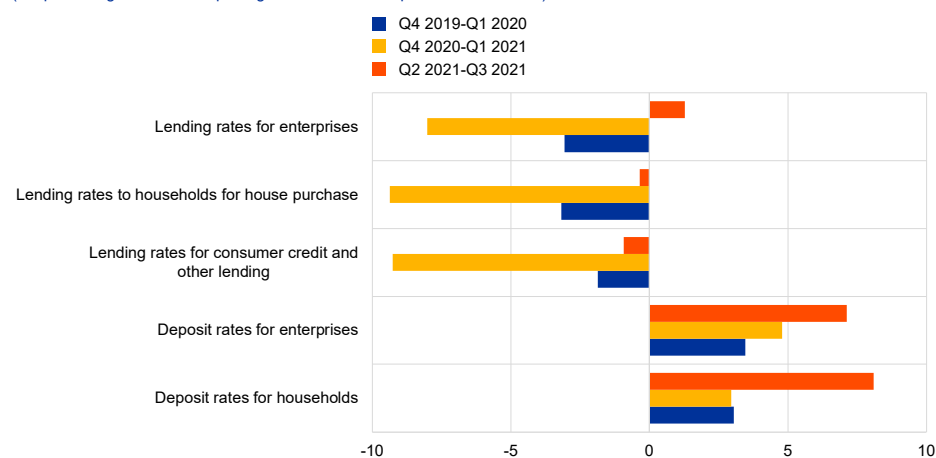
³¹ See Demiralp et al. (2021). Note that the hot-potato effect does not result in an elimination of the EL charge at aggregate level given that central bank reserves circulate in a closed system. For the same reason, it does not even necessarily result in a permanent elimination of the charge at individual bank level given that the liquidity might quickly find its way back to the bank that got rid of it through, for example, higher deposits, which would flow back to the same institution for the same reasons as why that very same institution was in a position of high liquidity to begin with (e.g., higher safety or better servicing of depositors).

Evidence from the ECB Bank Lending Survey suggests that the TTS supports banks' intermediation even in a prolonged low interest rate environment, affording lower lending rates and higher deposit rates (Chart 15). Isolating the impact of the TTS is not straightforward given the multitude of possible confounding factors, highlighting the value of soft information where banks themselves report on the effect of the policy. Banks reported some transmission to lending rates in the first year after the introduction of the TTS, and this seems to have stabilised by the third quarter of 2021. Banks also increasingly reported higher deposit rates as a result of the TTS, with around 8% of banks reporting an impact on deposit rates by the beginning of 2021.

Chart 15

Impact of the TTS on bank lending and deposit rates

(net percentages of banks reporting an increase in the previous six months)



Source: ECB Bank Lending Survey.

Notes: The net percentages are defined as the difference between the sum of the percentages for "increased considerably" and "increased somewhat" and the sum of the percentages for "decreased somewhat" and "decreased considerably". The periods in the legend refer to the respective bank lending survey (BLS) rounds.

The cross-sectional differences in exposure to the TTS determine the type of channel through which banks' intermediation capacity is supported. The benefits of the TTS that accrue to banks depend on two key coordinates in the space of potential bank balance sheets' configurations: EL holdings and exemption allowance. The direct benefits come from the level of EL that is exempted, and the indirect benefits from the level of EL that can be accumulated to fill up unused allowances.³² At the start of the TTS, most banks were set to benefit directly via the exemption of outstanding liquidity, but a by no means negligible segment was also bound to benefit indirectly by filling unused allowances (see Chart 1 in Section 3.1).

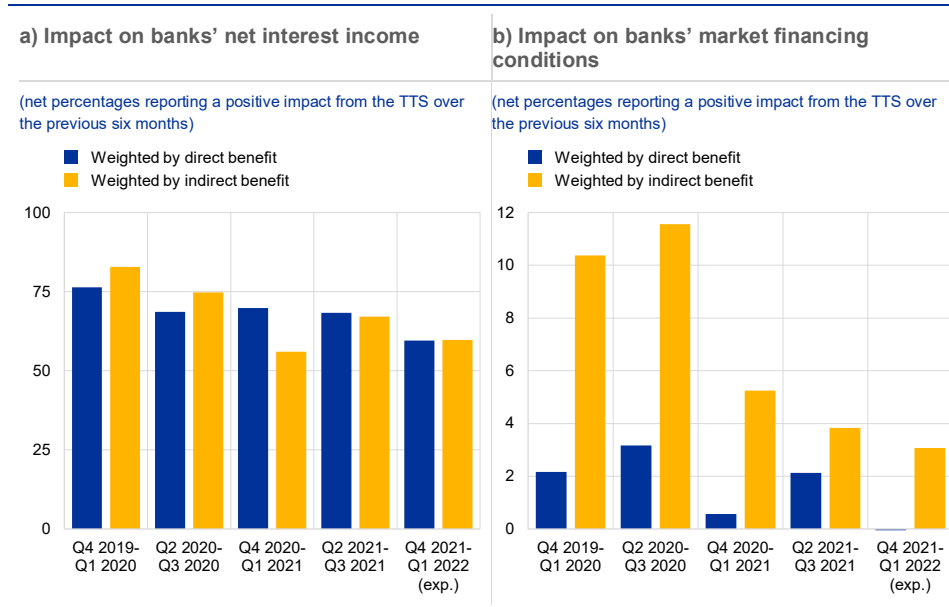
Differences in exposure to these two types of benefits translate into a different prominence of a specific type of impact from the TTS on bank profitability, as reported in the ECB Bank Lending Survey (Chart 16). Banks exposed to both types of benefits reported similar impacts on their net interest margins following the implementation of the TTS (Panel a below). The impact reported for market financing

³² Central bank reserves qualify as HQLAs under the Liquidity Coverage ratio Regulation. In a low interest rate environment HQLAs typically have a negative yield, while the TTS remunerates a proportion of HQLAs at 0%, making it naturally attractive to hold.

conditions was instead driven almost exclusively by exposure to the indirect benefits, that is, the leeway to tap into the money markets and other sources of funding to fill up unused allowances (Panel b). The improvement reported in access to market financing decreased over time, reflecting the lower scope for filling up unused allowances through trading.

Chart 16

Type of exposure to the TTS and banks' market financing conditions



Source: ECB individual Bank Lending Survey, ECB calculations.

Notes: For the impact on overall profitability and its components, the net percentages are defined as the difference between the sum of the percentages for "improved considerably" and "improved somewhat" and the sum of the percentages for "deteriorated somewhat" and "deteriorated considerably". Individual responses are weighted by exposure to the indirect benefits (unused allowance over main assets, in yellow) and to the direct benefits (minimum between EL and exemption allowance over main assets, in blue) as measured in February 202019, before the ECB Watchers Conference. The periods in the horizontal axis refer to the respective BLS survey rounds. "(exp.)" denotes expectations indicated by banks in the latest available round.

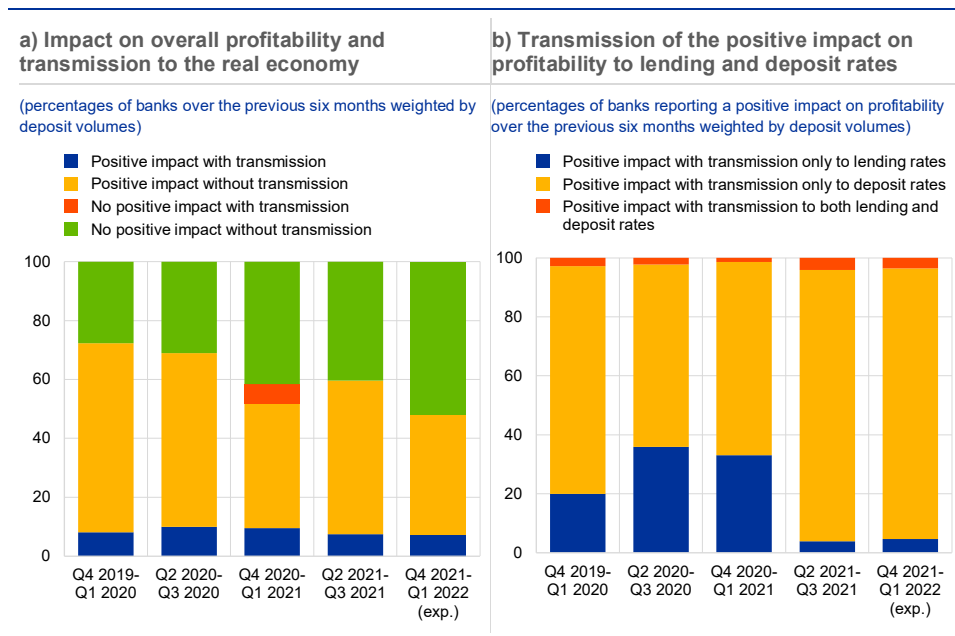
The TTS afforded lower lending rates by supporting bank profitability

(Chart 17, Panel a). From the outset, the TTS was associated with widespread increases in bank profitability (blue and yellow areas in Panel a).³³ Not all the support for profitability translated into increased lending rate accommodation (blue areas in Panel a), with a significant portion of banks reporting a positive impact on profitability without associating to it a decrease in lending rates or an increase in deposit rates (yellow areas in Panel a). Yet, there were also instances when enhanced transmission to lending rates was reported in the absence of a concomitant increase in profitability (red areas in Panel a). This could be due to full pass-through of the relief to lending margins, resulting in a nil impact on profitability. There are also signs of a diminishing impact of the system on banks' profitability and transmission, with banks increasingly reporting nil impact on profitability from the TTS (green areas). The increase in EL translated into a growing share of non-exempted holdings with the Eurosystem and respondents may have considered the support of the TTS relative to the (direct) cost of holding EL.

³³ The shares of each category of responses are based on deposit volumes given that the bank balance sheet items are the most exposed to the potential side effects deriving from the negative interest rate environment that the TTS is aimed at mitigating.

Chart 17

Impact on banks' intermediation capacity, transmission to the real economy and their qualitative composition



Source: ECB individual Bank Lending Survey, ECB calculations.
 Notes: In Panel a, banks are sorted into four categories depending on whether they reported that their overall profitability had “improved considerably” or “improved somewhat” (labelled “positive impact” in the legend) and on whether they reported that their lending rates “decreased considerably” or “decreased somewhat” in any of the three customer segments (NFCs, HHs for house purchases, households for consumer credit) or that their deposit rates “increased considerably” or “increased somewhat” in any of the two institutional sectors (NFCs or HHs) as a result of the TTS (labelled “with transmission”). The weight of each category in the chart is proportional to the share of deposits from the non-financial private sector that the category concerned accounts for in the overall sample. In Panel b, banks that reported a positive impact on profitability are further divided into three categories: banks that reported a transmission to lending rates only, to deposit rates only, or to both. The weight of each category in the chart is proportional to the share of deposits from the non-financial private sector that the category concerned accounts for in the sample of banks reporting a positive impact on overall profitability. The periods in the horizontal axis refer to the respective BLS survey rounds. “(exp.)” denotes expectations indicated by banks in the latest available round.

The transmission to the real economy occurred either through accommodation of lending rates, higher lending volumes or moderation of the pass-through of negative rates to deposit rates (Chart 17, Panel b). Banks that reported a positive impact on profitability and some form of transmission to lending and deposit rates fall into three categories. First, banks used the profitability leeway to shield their depositors from a further decrease in deposit rates, especially in the latest survey round (yellow areas in Panel b). Second, a number of banks used the benefit to lower lending rates (blue areas in Panel b). Third, a few banks report transmitting the improved profitability through both lower lending rates and higher deposit rates. Recent empirical evidence confirms that the TTS contributed to containing the decline in deposit rates, especially for household deposits (Eisenschmidt et al. (2022b)). Finally, while not covered by the ECB BLS questionnaire, preliminary evidence suggests that there was a sizeable positive impact also on lending volumes, especially after the implementation of the measure (Altavilla et al. (2022)). At the same time, when the DFR was raised out of negative territory in July 2022 it was still early to see the full effects of the TTS unfold onto the euro area banking system, mainly due to the length of time this measure needs to be fully reflected in bank lending and to the major confounding factors created by the pandemic and the associated policy response.

Box 4

Do bank depositors benefit from tiering?

The ultimate incidence of banks' savings from the impact of the TTS is likely to depend on bank-specific conditions. In general, banks can internalise the financial benefits from the TTS, for example through rising bank valuations (see Box 2), passing on the savings to customers by accepting (more) deposits at higher deposit rates, or by lending (more) at lower rates (see, for example, Ulate (2021) for a simple model of the implications of the proximity to the reversal rate for banks' lending and deposit business). In principle, there could also be interaction effects between these options, e.g. banks' rising market valuations could improve their access to market funding, which could potentially reduce the need to attract deposits, translating into lower deposit rates. Ultimately, the incidence of banks' savings from the TTS is thus an empirical question, with the expected impact of the TTS most pronounced for banks receiving the largest savings. In view of heightened attention to the implications of NIRP for savers, this box focuses on the potential impact of the TTS on depositors.

A continuous difference-in-difference (DiD) approach makes it possible to identify whether banks that benefited more from the TTS passed on parts of the benefits to depositors.

Empirically, the approach taken in Fuster et al. (2021), Baldo et al. (2022) or Altavilla et al. (2022) can be applied to this question. To study the potential impact of the TTS on bank behaviour, banks' total allowances are broken down into "used" and "unused" allowances" (see also Section 3.2). Used allowances are defined as allowances that banks could fill immediately on introduction of the system without sourcing any additional EL. Banks with allowances almost fully used therefore represent banks that had high EL holdings before the introduction of the TTS. By contrast, banks with unused allowances had low EL holdings before the introduction of the TTS and thus needed to acquire additional EL to benefit fully from the TTS. In order to estimate the potential effect of the TTS on bank depositors, banks' deposit volumes and rates are regressed for the measures of total, used and unused allowances.³⁴

³⁴ Specifically, the following regressions are estimated $Y_{i,t} = \beta_0^1 + \beta_1^1(T_i \times D_{i,t}^A) + \beta_2^1(T_i \times D_{i,t}^U) + \theta_i^1 + \gamma_t^1 + \epsilon_{i,t}^1$ and: $Y_{i,t} = \beta_0^2 + \beta_1^2(T_i^{used} \times D_{i,t}^A) + \beta_2^2(T_i^{unused} \times D_{i,t}^A) + \beta_3^2(T_i^{used} \times D_{i,t}^U) + \beta_4^2(T_i^{unused} \times D_{i,t}^U) + \theta_i^2 + \gamma_t^2 + \epsilon_{i,t}^2$, where $Y_{i,t}$ denotes either HH or NFC deposits over total assets or the HH or NFC deposit interest rate of bank i in month t , T_i , T_i^{used} and T_i^{unused} refer to a bank's total, used and unused TTS allowances, i.e. the treatment variable computed as a bank's TTS allowance over its total assets as determined by its MRR and EL holdings in the 5th MP of 2019 as a share of its total assets, $D_{i,t}^A$ and $D_{i,t}^U$ denote dummy variables, with $D_{i,t}^U$ equal to 1 after the implementation of the TTS in October 2019 and 0 otherwise, while $D_{i,t}^A$ equals 1 in September 2019 – the month of the announcement of the TTS – and 0 otherwise, and θ_i and γ_t denote bank and time-fixed effects. Total assets are fixed at August 2019 (the last full month before the announcement) to ensure that the variation across banks is fully driven by the numerator. Notably, as used and unused allowances are positively correlated, both variables need to be included in the regression given that analysing their impact separately would result in an omitted variable bias. By contrast, including non-exempt EL as a third control variable to condition the control group for not having high EL holdings pre-TTS implementation does not affect the results. The estimation sample runs from January 2019 to February 2020, ensuring sufficient cross-sectional data availability while preventing the large build-up in bank and firm liquidity holdings at the outbreak of the coronavirus pandemic in Spring 2020 interfering with the results. The results are sufficiently robust to extend the sample from January 2018 to February 2020. Results are also sufficiently robust to include a dummy to control for anticipation effects triggered by Draghi's speech at the conference, "The ECB and Its Watchers XX".

The results show that banks with a larger allowance and high ex ante EL holdings passed on part of the savings to household depositors through higher deposit rates (left-hand scale of Chart A). A one percentage point larger TTS allowance (as a percentage of total assets) is associated with higher HH deposit rates (around two basis points) following the introduction of the TTS. On closer inspection, this result is entirely driven by banks that had high EL holdings ex ante, i.e. before the introduction of the TTS, and thus had already fully filled their allowance: for this group of banks, a one percentage point higher TTS allowance translates into a three basis points higher HH deposit rate, on average.³⁵ By contrast, no significant impact on deposit rates is found for banks that had unused allowances before the introduction of the TTS, suggesting that this group of banks did not pass on the savings to HH savers. Moreover, in general, no significant effect is estimated from TTS exemption allowances on NFC deposit rates.

At the same time, the estimates suggest that the deposit volumes of banks with large allowances and ex ante high EL holdings declined as compared with banks that first needed to attract additional liquidity to realise the possible benefits of the TTS (right-hand scale of Chart A). A one percentage point larger exemption allowance relative to total assets is associated with a 0.2 percentage points stronger decline in HH deposits as compared with total assets. The breakdown of allowances into used and unused exemptions suggests that the decline is driven mostly by banks that had already fully used their allowances before the introduction of the TTS. Splitting total deposits into HH and NFC deposits shows that the results for deposit volumes are also mainly driven by HH deposits.³⁶

In conclusion, it appears that the TTS has, at least to some degree, also mitigated the costs associated with the NIRP for HH depositors. Banks that were more affected by the introduction of the TTS offered higher HH deposit rates relative to banks that were less affected. The impact appears to be particularly strong for banks that also had high excess liquidity holdings ex ante.

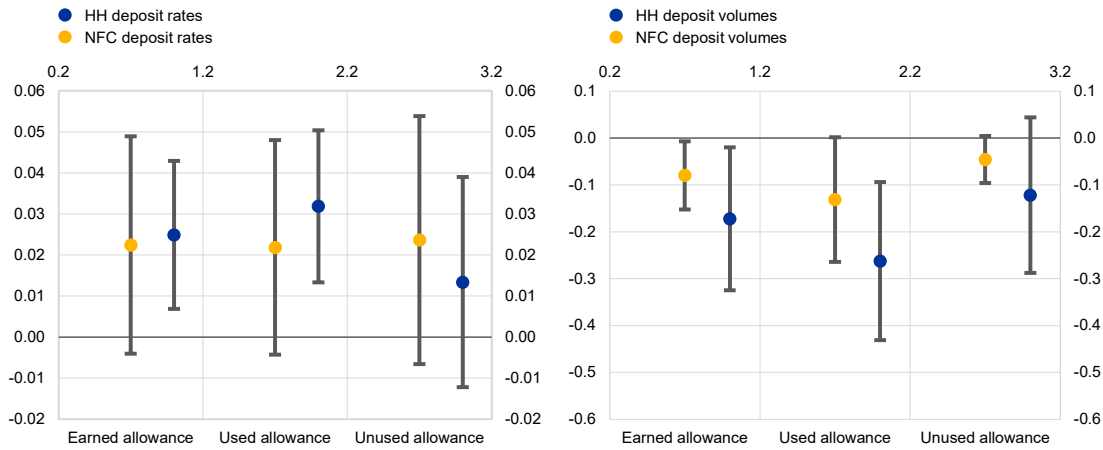
³⁵ In principle, higher deposit rates for banks more exposed to the benefit of the two-tier system could suggest a lower pass-through of the ECB's negative interest rate policy. However, in the context of the introduction of the TTS, this phenomenon is likely to reflect lower pressure on banks to prop up their margins (see, for example, Chart 17, Panel a). The empirical strategy adopted in the box does not make it possible to study these so-called general equilibrium effects of the two-tier system on the bank-based transmission of monetary policy.

³⁶ The results are robust to transforming all ratio variables by taking their natural log (which is useful as all volume variables appear to be log-normally distributed), and indicate even more clearly that the decline in deposit volumes was driven by banks with high levels of used exemption allowances. The results are also robust to dropping banks with large swings in their asset holdings compared with August 2019.

Chart A

Impact of a 1 percentage point increase in TTS allowances (and used/unused allowances) on deposit rates and volumes

(percentage points)



Notes: Point estimates and 95 percent confidence bounds of the coefficients on the interaction term between total, used and unused TTS allowances and a post-implementation indicator (i.e. $\beta_2^1, \beta_3^2, \beta_4^3$) in the regressions specified in footnote 34 for $Y_{i,t}$ denoting NFC and HH deposit rates (LHS) and NFC and HH deposit volumes (RHS). All regressions include bank and time-fixed effects. Deposit volumes, as well as TTS allowances (and used/unused allowances), are scaled by total assets as at August 2019. Banks' TTS allowances are equal to their minimum reserve requirements multiplied by the TTS multiplier.

6 Conclusion

In September 2019 the ECB introduced the TTS for remunerating excess reserves aimed at safeguarding the transmission of the ECB's monetary policy during the period of negative policy rates. The TTS changed the remuneration of banks' excess liquidity holdings up to an allowance ceiling, thereby impacting banks' incentives to hold EL and the distribution of excess liquidity within the euro area more broadly. In so doing, the TTS provided significant relief to banks from their cost of holding EL during the period of negative interest rates. Although turnover of reserves between banks increased to make use of the allowances, the TTS calibration avoided an adverse impact on prevailing money market rates and the overall monetary policy stance.

Banks used the system as intended, reducing segmentation in the money market with a limited impact on money market rates. These rates increased only slightly, and the increases did not persist. Banks' unused allowances under the TTS were filled relatively quickly, including through cross-border flows of central bank liquidity, indicating a swift adoption of the system by banks and pointing to an environment of lower market segmentation.

Data on bank lending conditions and the remuneration offered by banks for retail deposits suggest that the TTS worked as intended, shielding banks from part of the costs of negative interest rates. As a result, bank lending in the euro area has been sustained or even increased, and banks have been able to offer higher deposit rates to their clients than would have been possible without the system. Seven years after the introduction of the negative interest rate policy in the euro area, the overall impact of this policy on euro area banks' profits has been largely neutral, in part due to the introduction of the TTS.

Annexes

Annex 1: Tiering frameworks of other central banks

The **Reserve Bank of New Zealand** (RBNZ) was the first central bank to introduce a tiering framework, and did so in a positive rate environment (Bowman, Gagnon and Leahy (2010)). It implemented it in 2007 to encourage interbank trading and prevent the hoarding of reserves and the drying up of market activity experienced in the traditional floor system until then. RBNZ's policy rate is the Official Cash Rate (OCR), and the central bank uses its policy tools to keep overnight interbank interest rates close to the OCR. Institutions hold balances at the RBNZ to meet settlement needs, which must be met without resort to intraday credit from the central bank. There are no required reserves. Overnight holdings were remunerated at the OCR up to a fixed limit, or "tier," which the central bank determined for each individual bank, primarily based on likely tail-event settlement needs. Balances held in excess of the limit earned interest at a rate equal to the OCR less 100 basis points. The relatively low return on excess balances discouraged holdings of central bank balances beyond what was needed for settlement purposes, thereby encouraging banks with excess balances to lend in the interbank cash market and invest in liquid instruments other than central bank balances.

The tiering system was kept in New Zealand until March 2020, when it was suspended in a context of larger reserve balances that made it increasingly difficult to keep short-term rates close to the OCR. Consequently, the RBNZ decided to remunerate all credit balances at the OCR and remove all tiering limits beyond which a lower remuneration rate was applied (Reserve Bank of New Zealand (2020)).

Norges Bank introduced a tiering framework in October 2011. While banks previously received interest on all deposits at the key policy rate (the sight deposit rate), quotas were introduced in October 2011 to limit the level of a bank's reserves that would be remunerated at the key policy rate. The interest rate on deposits in excess of the quota is called the reserve rate, which is lower than the key policy rate.

The purpose of changing to a quota-based system was to limit bank demand for central bank reserves, thereby limiting Norges Bank's intermediation, and to provide a stronger incentive for banks to redistribute liquidity in the interbank market relative to the more traditional floor system that had been Norges Bank's operational framework since the mid-1990s. The purposes and the design were therefore similar to those of the RBNZ, and the framework was active in a positive rate environment.

Quotas are determined via a top-down approach (Norges Bank (2021)). First, Norges Bank determines the total quota of bank reserves remunerated at the policy rate. Second, banks are divided into three groups based on Norges Bank's settlement system (NBO) data. The aggregate quota of each group is set by that respective group's share of total assets. All the banks in a group are assigned the same quota. Settlement banks are assigned an additional quota determined by the

size of the settlement bank relative to the size of the banks for which it performs settlements. Norges Bank normally reviews the quotas twice a year.

Danmarks Nationalbank (DN) introduced a tiering framework in 2012, when it lowered the interest rate on its certificates of deposit into negative territory in response to the ECB's decision to cut its monetary policy rates by 0.25 percentage points (Danmarks Nationalbank (2012)). The remuneration of current accounts held by banks and mortgage institutions (monetary policy counterparties) with DN were likewise lowered by 0.25 percentage points to 0%, and the maximum limit per counterparty of the current account balances was revised. Under this tiering system, DN regularly set a total limit on the current account balances that monetary policy counterparties could hold with DN, and broke the total limit down into individual limits per counterparty. The individual limits were calibrated on the basis of the money market turnover of the individual counterparties until 2015, and on the basis of their deposit base from 2015 onwards. All overnight balances of individual counterparties held in excess of the limit were automatically converted into seven-day certificates of deposit remunerated at the negative rate. DN's counterparties therefore had a financial incentive to redeploy overnight liquidity in excess of the limit to prevent automatic investment of the surplus in the lower yielding certificates of deposit. As long as the monetary policy counterparties' aggregate reserves were large enough relative to the total limit, short-term interest rates remained anchored to the remuneration of the DN's certificates of deposit, representing the marginal opportunity cost of EL. The overall current account limit and its breakdown per counterparty were frequently revised, among others to take into account liquidity forecasts.

The objective of the framework was to preserve the effectiveness of the monetary policy transmission mechanism, and to prevent perverse effects under which banks could react to lower interest rates through higher lending rates to preserve their net interest rate margins in a context in which deposit rates exhibited nominal rigidity at the zero lower bound.

DN terminated the tiered remuneration in 2021, by harmonising the remuneration of current accounts and certificates of deposit at -0.5%, to reduce fluctuations in Danish money market rates. These fluctuations resulted from changes in the size and composition of banks' deposits at and lending from DN (Danmarks Nationalbank (2021)). Two factors contributed to this adjustment. First, banks' balances in excess of the exempted allowance had shrunk below the level necessary to anchor short-term rates to the rate on certificates of deposit. Second, as a result of the COVID-19 pandemic induced uncertainty, autonomous factors and total bank current account balances had become more difficult to forecast and, as a consequence, the calibration of the overall current account limit had also become more complex. In addition, the initial rationale for the tiering system was also no longer fully relevant. With negative interest rates applying in Denmark since 2012, banks have increasingly passed on the negative rates to the current account balances of their retail and wholesale clients in excess of a minimum threshold considered to fulfil transactional purposes. Hence, the need to minimise the negative spread between bank deposit rates and excess reserve remuneration rates because of the effects it

may have on monetary policy transmission and financial stability did not feature as prominently as it did in 2012.

The **Swiss National Bank** (SNB) introduced a tiering system in 2015, when it discontinued the minimum exchange rate of CHF 1.20 per euro and lowered the remuneration on sight accounts held with SNB to -0.75% (Swiss National Bank (2015)). In its initial formulation, the exempt tier was calculated for institutions subject to reserve requirements as a multiple of the MRR held prior to implementation of the framework in October 2014 (a static component) minus/plus any increase/decrease in the amount of cash held (a dynamic component). In 2019, the framework was revised (Swiss National Bank (2019)). Based on the revised formulation, the static component was replaced by a “basis component” corresponding to the moving average of the MRR over the preceding 36 reserve maintenance periods (RPs), multiplied by the applicable threshold factor. This made it possible for the exemption threshold to reflect developments in banks’ balance sheets over time. The dynamic component continued to apply.

The threshold factor, i.e. the multiplier initially applied to the static component and later to the basis component, has been adjusted as excess reserves continued increasing. It was lifted from 20 to 25 in 2019 and to 30 in April 2020. These exemption thresholds are deliberately chosen by SNB to be fairly generous, so as to limit the burden on the banking system to the minimum deemed necessary for the implementation of monetary policy (Maechler and Moser (2020)) on the premise that what matters, from a monetary policy implementation perspective, is the marginal cost of funding and the marginal cost of holding excess reserves. For money market interest rates to stay close to the SNB’s negative interest rate on sight deposits, the supply of non-exempted liquidity must exceed the demand for liquidity by a sufficient amount (Fuhrer et al. (2021)).

The special feature of the SNB tiering framework is the adjustment of the exemption threshold based on the dynamic component. The dynamic component aims to prevent account holders from substituting cash for sight deposits. Such a dynamic component, as evidenced by Boutros and Witmer (2020), makes it possible to push the effective lower bound (ELB), the remuneration of excess reserves, and the interbank rate below the return on cash. Intuitively, in such a setting, converting negatively remunerated excess reserves into cash provides a benefit, but also a cost in terms of a smaller allowance. The ELB is pushed below the yield of cash to the level determined by the cost of the smaller allowance. Not surprisingly, such a dynamic component has been introduced in jurisdictions where interest rates were cut further into negative territory, and, therefore, where the risk of cash hoarding is the highest.

The **Bank of Japan’s** (BoJ) tiering system was introduced in January 2016, when BoJ introduced a negative interest rate policy to prevent “an adverse impact on the functions of financial intermediation” in case negative rates applying to all reserve balances had exerted “excessive burdens on financial institutions” (Kuroda (2016)). The balances with BoJ were, in relative terms, far larger than those in Europe and were increasing rapidly under the BoJ’s large-scale asset purchases.

The special feature of the BoJ tiering framework is that it has multiple tiers. There are three basic tiers, to which positive, zero, and negative interest rates apply respectively. The first tier, the basic balance, is fixed and is based on the average current account balances of each credit institution at the BoJ in 2015 minus the reserve requirement. The first tier is remunerated at 0.1%. The second tier, the macro add-on balance, comprises minimum reserve holdings plus the basic balance multiplied by a benchmark ratio (expressed as a percentage). It also contains other components, such as the amount outstanding of the BoJ's provision of credit through the loan support programme and its operation to supply funds to support financial institutions in disaster areas. The macro add-on balance is regularly adjusted by changing the benchmark ratio to take into account autonomous factors forecast and targets for the different purchase programmes and liquidity-providing facilities. This second tier is remunerated at 0%. The third tier, the policy-rate balance, is the residual amount of the difference between total current account holdings and the allowances under the first two tiers. The third tier is remunerated at -0.1%. Money market rates and the yields of other financial assets are steered by the third-tier remuneration rate.

Complementing its three-tier system, the BoJ introduced, in November 2020, a temporary, three-year special deposit facility to enhance the resilience of the regional financial system. The special deposit facility is an incentive mechanism for regional banks to promote consolidation in the fragmented regional banking sector. Regional banks that meet certain requirements, relating to support for regional economies and to strengthen bank business models, will benefit from an extra remuneration of 0.1% on each of the three tiers.

Since 1994 **Sveriges Riksbank** has used weekly liquidity providing and liquidity-absorbing market operations with a one-week maturity at the policy rate combined with standing overnight lending- and borrowing facilities at rates well above and below the policy rate. Until October 2019 the Riksbank also conducted daily fine-tuning transactions overnight to stabilise the overnight rate in the market at $\pm 0.10\%$ of the policy rate. In October 2019 the Riksbank ceased to conduct these daily fine-tuning transactions and raised the deposit rate from 0.75% below the policy rate to 0.10% below the policy rate. A narrow symmetric interest rate corridor (0.10% below and above the policy rate) was finally introduced in June 2020. This framework cannot therefore be considered a TTS per se, at least, not in a narrow sense. However, some publications (e.g. Bundesbank (2021)) have included it in the list of two-tier systems (in the wider sense) given that the Riksbank absorbed a certain amount of excess liquidity by issuing certificates of deposits on a weekly basis.

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