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From: The Secretary

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INTERNATIONAL MONETARY FUND

EURO AREA POLICIES

SELECTED ISSUES

June 29, 2023

Approved By
European Department

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QUANTITATIVE TIGHTENING BY THE ECB: WHY AND HOW?

The current tightening cycle provides an opportunity to revisit the ECB's balance sheet policy. With inflation running above target, the monetary accommodation provided by the ECB's bond holding is no longer necessary. This paper uses evidence from the literature on the impact of central bank bond purchases and sales on bond yields, and the monetary policy stance, to outline a roadmap for reducing the Eurosystem's bond holdings. The paper concludes that the ECB's short term policy rates should be the main choice for adapting the monetary policy stance to changing circumstances and QT should proceed in a gradual, predictable manner as outlined by the ECB.

Executive Summary

1. The ECB Governing Council (GC) initiated the process of reducing the Eurosystem stock of securities holdings, a process known as quantitative tightening (QT). The large Eurosystem holdings of assets, which has been accumulated since January 2015 through quantitative easing (QE), supported aggregate demand and the proper transmission of monetary policy by compressing bond yields. The ECB also introduced targeted longer-term refinancing operations (TLTROs). However, the large balance sheet expansion has depressed activity in the interbank market and reduced the availability of safe securities for collateralized lending (which was mitigated by the ECB's securities lending facility). With inflation running high, QT is meant to support the removal of monetary policy accommodation and, at the same time, alleviate QE side effects, reduce the Eurosystem's footprint in financial markets, and ensure that issuer limits do not hinder the ECB's ability to restart large scale asset purchases in the future.

2. QT should play a limited role in calibrating the monetary stance, with the policy rate remaining the primary policy instrument. First, there is considerable uncertainty about the effects of QT on yields and financial conditions. Second, QT could increase fragmentation in euro area debt markets and interfere with monetary transmission, which may present challenges for monetary policy in certain circumstances. Third, a relatively fast pace of QT would reduce the necessary conventional policy space from a monetary risk management perspective.

3. The recommended QT design involves the following features: 1) pre-announcing a QT pace and the dates at which the speed of QT is to be reassessed, so that market participants can adjust their expectations, thereby allowing a smooth market price adjustment of bonds; 2) allowing for deviation from the capital key over a reasonable time horizon as the result of passive QT; and 3) embedding an "escape clause" to be activated in case of severe market dysfunction creating a severe impediment to the smooth transmission of monetary policy.

A. Context

4. The return of inflation has ended a decade long period of accommodative monetary policy. After years of below target inflation and slow growth, the ECB initiated in January 2015 (APP) and in March 2020 (PEPP) two programs of asset purchases or quantitative easing (QE) which amounted to €4.9 trillion (60 percent of euro area GDP) by end 2022. QE implemented through June 2022 aimed at easing financial conditions to boost demand and supporting the transmission of the monetary stance to all euro area jurisdictions with the objective of lifting inflation back to target.

5. With inflation rising since 2021, the ECB halted QE in June 2022 and, in July 2022, raised rates for the first time since July 2011. After raising rates by a cumulative 300bps, the GC began normalizing the Eurosystem's monetary securities holdings through a measured and predictable pace starting in March 1, 2023, after almost all other major central bank in advanced economies (see Box 1). Between March and June 2023, the Eurosystem's securities holdings are being reduced by a monthly average of €15 billion. Starting July 2023, the GC plans to stop all APP reinvestments, increasing the pace of the APP portfolio reduction. By end 2023, it will also review its operational framework, which will provide information regarding the size of the ECB's balance sheet in a steady state.

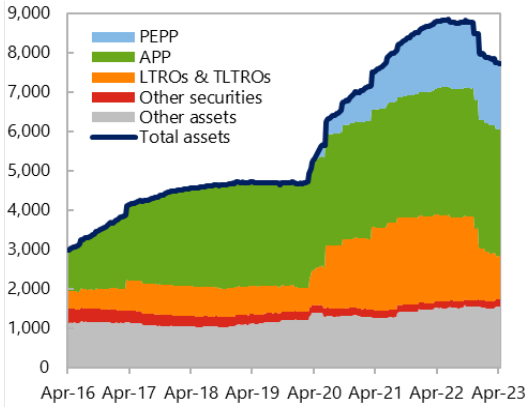
6. Unwinding the QE portfolio requires an understanding of its past impact and the risks associated with the process. The large holding of bonds has kept sovereign yields depressed, which was the aim of QE at a time when inflation remained stubbornly below target. With euro area inflation reaching all-time highs, this accommodation is no longer necessary. QE also came with the disappearance of the unsecured interbank market and, together with changes to bank liquidity regulations, contributed to a shortage of marketable assets. Nonetheless, unwinding the QE portfolio has uncertain impacts on yields and comes with risks.

7. Against this backdrop, this note elaborates on the case for QT, discusses the tradeoffs involved in its design, and proposes a roadmap for its implementation. First, the note discusses the consequences of the ECB's large bond holdings by asking how much monetary accommodation has been provided by the large asset holdings and how important the side-effects have been on the availability of safe securities, the activity in the interbank market, and the income of national central banks. Then, it discusses the justification for QT by examining the potential impact on the monetary stance, its interaction with policy rates, and the risks associated with unwinding the bond portfolio. Finally, it enquires about the design of QT, by discussing the considerations that should determine its main implementation features.

Box 1. Euro Area: ECB Balance Sheet and International QT Experiences

After lowering its main policy rate into negative territory in June 2014, the ECB's bond purchases and direct lending to banks led to a significant expansion of the Eurosystem's balance sheet. The various Eurosystem asset purchase programs amounted in total to €4.9 trillion between January 2015 and June 2022,[1] including €4.3 trillion in public sector bonds, corresponding to 60 percent of euro area GDP. The various programs aimed at easing financial conditions to boost demand and supporting the transmission of the monetary stance to all euro area jurisdictions with the goal of lifting inflation back to target. The balance sheet started shrinking at end 2022 as loans under the targeted long-term lending to banks were being repaid and the APP portfolio started shrinking in March 2023 through QT.

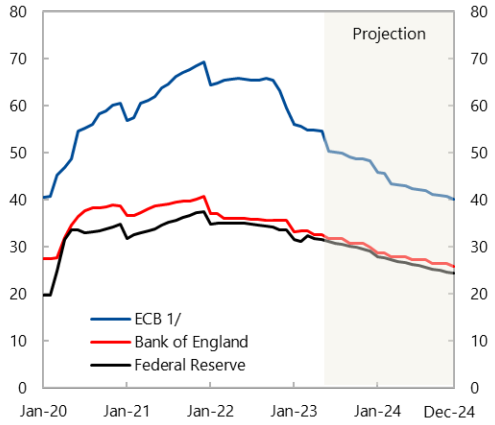
Eurosystem Funding to Banks and Securities Holdings (EUR Billion)



Sources: European Central Bank; and IMF staff calculations.

Other major central banks started QT earlier while the ECB balance sheet has shrunk by more Most major central banks have initiated QT by either partially or fully ceasing to reinvest the proceeds of maturing bonds—known as passive QT—or by selling securities ahead of their maturity date—known as active QT. The reduction of central bank balance sheets differs across countries, depending on the pace of QT, the type of QT implemented, and the maturity structure of the bond holdings. For instance, the Fed chose the passive QT route—first in October 2017 before interrupting it in September 2019—and restarting it in June 2022. On the other hand, the BoE resorted to active asset sales given the longer weighted average maturity of its portfolios. It ceased reinvesting maturing gilts in February 2022, through passive QT, while initiating the sale of non-financial investment-grade corporate bonds, with active QT starting in earnest on November 1, 2022. Annex 1 provides further details and experience of other major central banks.

Central Bank Balance Sheet Policy
(As percent of GDP)



Sources: Bank of England; European Central Bank; Federal Reserve System; Haver Analytics and IMF Staff Calculations.
1/ of EUR 15bn/month decline until June 2023 followed by no reinvestment of maturing redemptions averaging EUR 30bn month, TLTRO loans are assumed to be repaid at maturity.

[1] The Asset Purchase Program, initiated in 2015, consisted of the Public Securities Purchase Program (PSPP), purchases of corporate bonds, and asset- backed securities. The Pandemic Emergency Purchase Program (PEPP) was introduced at the start of the pandemic in March 2020 as a temporary asset purchase program to "counter serious risks to monetary policy transmission" with eligible securities broadly the same as for APP (except for Greece) but allowing for shorter maturities and with flexibility in purchases across jurisdictions. As such, PEPP was both a monetary policy easing and an anti- fragmentation tool.

B. Rationale for QT

Removing the Accommodation Provided by QE

8. QE affects long-term yields through the signaling and portfolio rebalancing channels. According to the former, the announcement acts as forward guidance on the expected path of the short-term interest rate, indicating that the latter would be kept at the effective lower bound for an extended period. Therefore, according to the expectations theory of the term structure of interest rate, a shallower expected path for the short-term rate helps to deliver a lower long-term bond yield. According to the 'portfolio rebalancing' channel, asset purchases compress the term premium (i.e., the required compensation to hold long-term debt securities) and therefore reduce long-term yields. This happens because QE reduces the net supply of long-term assets held by the private sector. Private sector agents, in turn, will accept to reduce their holdings of such assets if their prices go up (or yields go down). The channel predicates on the limited substitutability across assets and can work either through local supply effects (e.g., "preferred habitat theory") or duration risk extraction.[1]

9. Estimates of the magnitude of QE's effect on yields in the euro area suggest that the stock of assets currently held by the Eurosystem could be reducing long-term yields by up to 265 bps. The evidence on the magnitude of QE for the euro area is more limited than for the US as the ECB started its asset purchase programs only in 2015. Work by Eser and others (2019) and Altavilla and others (2021) for the euro area suggest yields fall, on average, 3.6 to 5.4bp per €100bn of asset purchases. There is large uncertainty with these estimates, which may be overestimated as debt management officers have been extending bond maturities, offsetting part of the duration extraction from the purchases (Kaufmann and others 2022). Applying these elasticities to the stock of QE purchases, which amounted to €4.9 trillion, the level of accommodation provided to the 10-year GDP-weighted zero-coupon yields of the four largest euro area jurisdictions is on average between 176 and 265bp. Such effects are, however, state contingent and can be much higher in periods of market stress than when markets are tranquil (D'Amico and others 2013, and Haldane and others 2016). They were also measured at the time of longer expected duration of these asset programs (until 2026 for APP and 2025 for PEPP). Downward revisions since could result in smaller actual effects (see ECB Economic Bulleting Box 2023/3 Box 6).

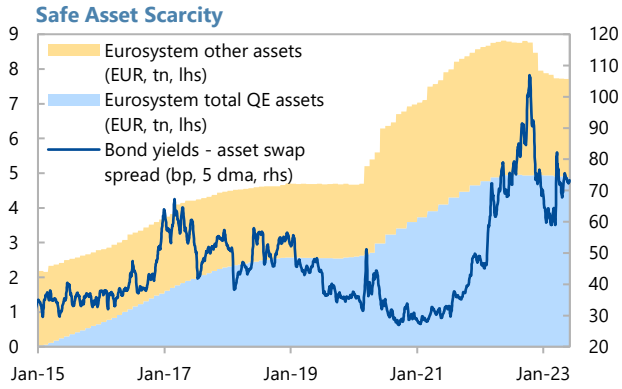
Reducing the ECB's Footprint in the Financial System

10. QE contributed to shortages of some safe securities, including for use as collateral. As a result of the €4.3 trillion in public sector bond purchases between June 2015 and June 2022, the share of sovereign free float—securities held by entities other than central banks, insurance, and pension funds—was cut in half, reaching 40 percent out of the €10.3 trillion in outstanding euro area sovereign bonds by end 2022. The fall in the Bunds' free float was even more dramatic, dropping threefold during

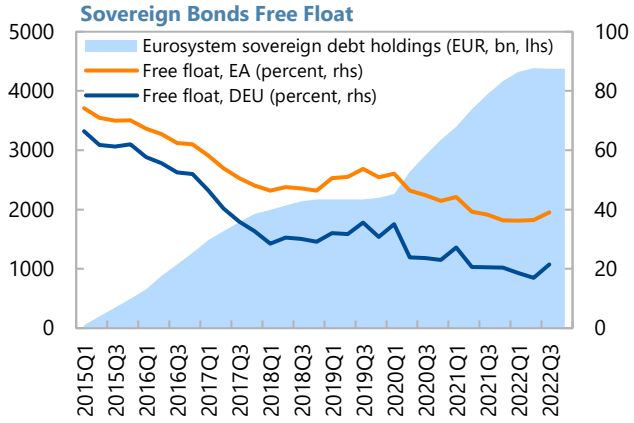
[1] As central banks buy long-term assets against the issuance of short-term assets like bank reserves, they reduce agents' exposure to duration risk which in turn reduces its required compensation. In addition, certain investors prefer a particular maturity length and would require compensation for holding securities outside of their "habitat" preference which implies that the transmission from short rates to the entire yield curve is not perfect making QE more effective in lowering long rates by removing longer-maturity bonds from the market.

the same period to 20 percent of the issued stock by end 2022,[2] in contrast to sovereign bonds for Italy, France, and Spain, for which the share fell to 56, 51, and 47 percent, respectively.[3] Eurosystem refinancing operations, which required pledging public sector securities among other eligible collateral, contributed to the pressure on the availability of public sector collateral, with locked up government securities peaking at €542 billion in Q3 2021. A measure of scarcity based on the difference between the yield of an asset and the similar asset swap rate—the compensation required by an investor to swap a security and earn interest on the swap instead of just holding on to it— confirms increased scarcity, particularly with the introduction of the PEPP during 2020-22. This measure often increases along with market volatility and risk aversion. Some of the scarcity has been mitigated through other ECB operations such as the securities lending operations, whose limits were raised in November 2022, and the TLTRO repayments—by which banks take back their pledged collateral. However, the average asset swap spread in recent months remains almost double the pre-QE average.[4]

Figure 1. Euro Area: Safe Asset Scarcity



Sources: Bloomberg Financial Markets L.P.; ECB; and IMF staff calculations.
Note: A positive difference between the area swap rate and the euro area government yields indicates that investors are prepared to pay a premium for government bonds, which signals scarcity.



Sources: ECB; Haver Analytics; and IMF staff calculations.
Note: Free float (broad measure) is defined as holdings of sovereign bonds by price sensitive investors, excluding insurance and pension funds.

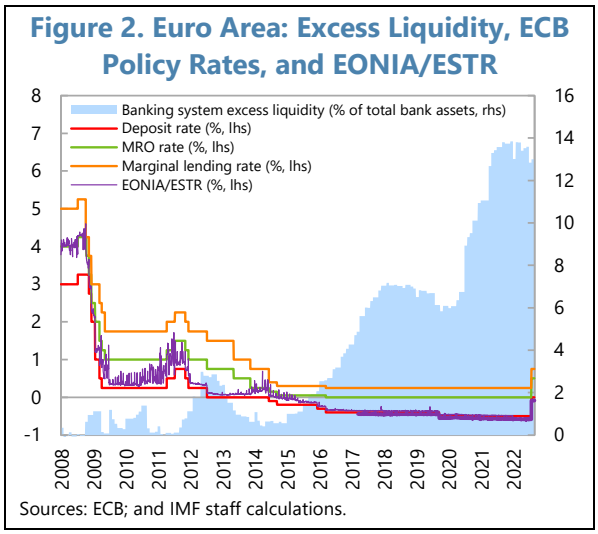
11. The asset purchase programs have also made the interbank market less relevant by creating an environment of abundant bank reserves with monetary operations driven by a de-facto floor system. The implementation of asset purchases led to the creation of reserve balances which over time shifted the unsecured overnight lending rate close to the Deposit Facility Rate (DFR), resulting in a shift from a corridor to a floor system. While there are merits to both a corridor and a floor system, the latter comes with a high level of excess reserves that eliminates the need for unsecured interbank transactions. As a result, banks have become less vigilant about their counterparty risk and

[2] Accounting for public sector agencies, the drop in German free float is less pronounced.

[3] Because nonbanks without access to ECB reserves demand safe assets, specific securities (e.g., German Bunds) are needed for market transactions, including repos. A lower free-float of these securities translates into a "convenience yield" or "specialness" which pushes down their yields relative to other securities (van den End, 2019). Scarcity of safe securities can often result in a spread between the repo rates and the DFR (Arrata and others 2021).

[4] Scarcity increased during the APP program in 2015-17 and declined afterwards as the ECB started lending PSPP securities against cash, as part of its securities lending facility in 2017.

over time, accustomed to the abundant liquidity, which might make it difficult to exit the system, should there be a desire to do so (see Maehle 2020; Acharya and others 2022).



Mitigating Political Risks for the ECB and the Eurosystem

12. The large asset holdings in the context of rising policy rates creates an interest rate mismatch resulting in profit losses in the Eurosystem. The Eurosystem remunerates bank reserves at the deposit facility rate which has increased by 400bps from July 2022 to June 2023. This expense is not matched by an equivalent increase in the income earned on the Eurosystem assets since these earn fixed-rate coupons with low interest rates. As a result, several national central banks are recording temporary losses, putting the spotlight on their performance. Losses accruing in 2022 were offset by a release from risk provisions and buffers accumulated from the substantial profits earned over the 2012-2021 period. Over time, these losses will decline as the income earned on the bonds and other assets held will also rise as they mature and get reinvested. Although losses do not matter for the conduct of monetary policy if the central bank's commitment to its inflation target remains credible, transfers to fiscal authorities are temporarily halted.[5]

C. Policy Considerations Associated with QT

QT's Effects on Financial Conditions Are Uncertain

13. Evidence on the impact of QT on yields is sparse. Studies have focused on the Federal Reserve (Fed) experience from October 2017 to August 2019, when holdings of assets were reduced by $640 billion, equivalent to about 2.8 percent of GDP, at a monthly average pace of $28 billion. The estimates of QT effects vary, with some studies finding no statistically significant impact on the 10-year Treasury yield (Smith and Valcarcel 2020), while others find that a reduction of the Fed's balance sheet by 1 percent of GDP being associated with an increase in 10-year yields equivalent to 6-10bp increase of the Fed Funds rate (Crawley and others 2022).

14. Like those of QE, the effects of QT are likely to be state contingent and could be large during periods of market dysfunction. If QT is implemented when markets are calm and when monetary policy is not constrained, then its impacts may be mild. Moreover, the signaling channel of QT is likely different from QE because there is no implied forward guidance on the duration of keeping interest rates close to the ELB, as it had been the case for QE. Instead, conceptually, QT could contain information on the pace of rate hikes and level of the terminal interest rate needed to achieve a similar

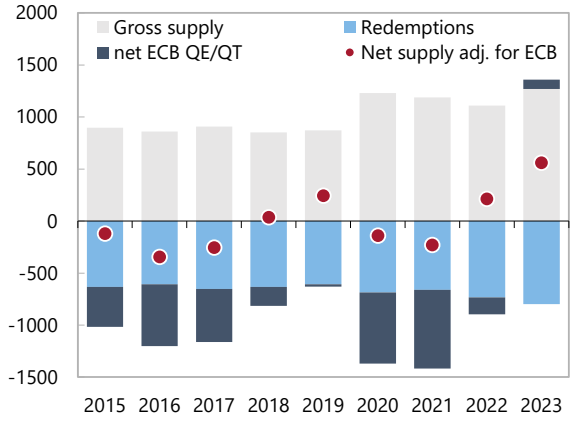
[5] See Stella and Lonnberg (2008), Perera and others (2013), Archer and Moser-Boehm (2013), Reis (2017), and Honohan (2023) for evidence, examples and discussion of central banks that have achieved their inflation mandate with negative equity and for the risks associated with a weak central bank balance sheet.

inflation target. Thus, although QT could be conceived as the reverse of QE, not all channels of transmission apply symmetrically. This could explain the lack of announcement effects associated with QT in 2017-19 (Smith and Valcarcel 2020). However, like for QE, QT 'surprises' have been documented to have stronger effects when markets are turbulent (D'Amico and Seida 2020). This suggests that yields could be more responsive to QT during periods of turbulence, a finding corroborated by Wei (2022), with the interest-rate equivalent of QT almost three times higher during crisis periods.

15. The impact on yields of the QT program announced by the ECB over the 12 months ahead is expected to be small. As an illustration, using the QE elasticity symmetrically for QT and assuming the absence of non-linearity, the ongoing monthly QT pace of €15 billion until the end of June and doubling thereafter would translate into an increase in the term premia of 12-18bp over the next 12 months.[6] Extrapolating the impacts on policy rates identified for the Fed translates into a substitution with the policy rate in the range of 15 to 22bp. This is a small fraction compared to the cumulative 400bps increase in the ECB's deposit facility rate between July 2022 and June 2023. In addition, much of the faster rundown of the balance sheet compared to market expectations in December 2021 has been gradually priced into the yield curve. Therefore, the marginal impact going forward is likely to be small.

16. QT may have larger impacts than currently predicted if marginal buyers are not forthcoming at a time of large sovereign financing needs. Some of the increases in bond yields may incorporate the expectations about the future bond net supply. For the first time in many years, euro area governments and bond markets will face lower ECB support in rolling-over maturing debt. The question arises as to which economic actors would step in and which spread levels would be required to attract demand. Euro area banks seem to be the natural candidate given their historical appetite for sovereign bonds with current holdings standing below historical highs in most countries.

Figure 3. Euro Area: Bond Supply Net of ECB Purchases (EUR bn)



Sources: UBS; and IMF staff calculations.

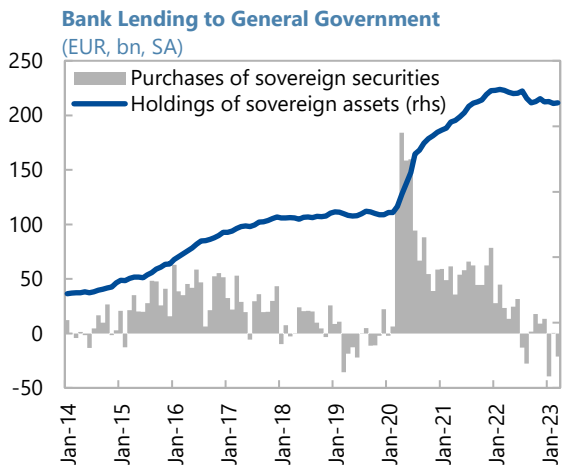
QT Could Amplify Fragmentation

17. QE helped reduce fragmentation by preserving the proper transmission of monetary policy to different euro area economies. During the euro area debt crisis, transmission was challenged because of market segmentation. Lending rates for sovereigns, corporates and households across the monetary union diverged sharply due to specific country risk premia, beyond the fundamental values of the assets, a phenomenon that the ECB defined as fragmentation (ECB 2022). The APP in 2015, followed by the PEPP in 2020—which offered flexibility over bond purchases and reinvestments to depart from the capital key—and then the announcement of the Transmission

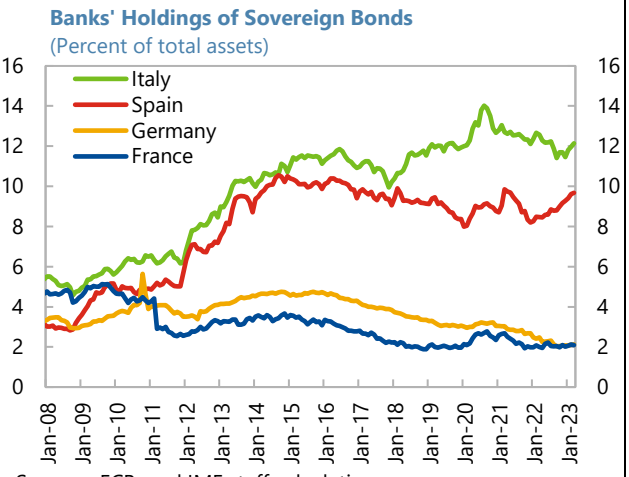
[6] The ECB study finds that changes in the expected path for APP and PEPP during 2022 contributed 55 bps to the increase in 10-year euro area bond yield (ECB Bulletin Box 2023/3, Box 6 "Model-based assessment of the macroeconomic impact of the ECB's policy tightening since December 2021").

Protection Instrument (TPI) in July 2022, have reduced the divergence in borrowing rates by compressing spreads.

Figure 4. Euro Area: Sovereign-Bank Nexus



Sources: ECB; and IMF staff calcuations.



Sources: ECB; and IMF staff calculations.

18. Although policy rate changes have overall been passed on smoothly and homogenously since the start of the tightening cycle in July 2022, fragmentation in euro area debt markets remains a concern. In principle, fragmentation should not originate from QT if it proceeds in a predictable and cautious way. The PEPP's flexible reinvestments would be a first line of defense against fragmentation. If an exogenous shock materializes and eligibility criteria are met, the ECB could consider activating the Transmission Protection Instrument (TPI). Sovereign solvency concerns should be addressed through the ECB's Outright Monetary Transactions and the ESM's macro-adjustment programs.

19. Tools designed to support market liquidity should be used to address severe financial market dysfunction. When facing severe and systemic financial market stress, the ECB should deploy liquidity support tools. The use of such tools should respect a separation principle between monetary policy tools geared toward attaining price stability (e.g., policy rates and QE/QT) and emergency support tools designed to address the specific market functioning or financial stability concerns (e.g., central bank lending facilities, reverse auctions, or outright asset purchases; see King and others 2017). At the same time, the pace of balance sheet reduction could be reassessed. Upholding this separation principle, however, can be challenging to communicate as the example of the Bank of England during the LDI crisis in September 2022 to proceed with passive QT along with targeted market interventions.

More Aggressive QT Implies a Shallower Path for the Policy Rate

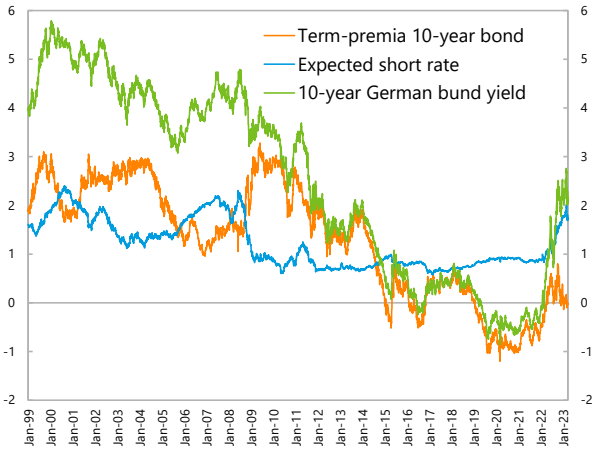
20. In principle, building back unconventional policy space is desirable but this needs to be balanced against the costs of giving up some conventional policy space. As long as the effect of QT on the monetary stance is small, there is no tradeoff between rebuilding conventional and unconventional space. Given the advantage that gaining conventional policy space has in terms of making a return to the ELB less likely, the rational of gaining unconventional policy space is less

convincing as a motivation for QT than if the tradeoff were pronounced (see Brandao-Marques, forthcoming).

21. The QT objective of supporting the monetary stance is of course state dependent. Since the large balance sheet provides monetary accommodation, it is desirable to implement QT when the aim is to tighten financial conditions. During a loosening cycle, unless policymakers put a premium on the benefits of a smaller central bank footprint, the case for QT weakens or disappears *ceteris paribus*.

22. The short-term policy rate should remain the primary tool used to fine tune the overall policy stance with changes in the inflation outlook. Policy rates have the advantage of being easier to understand and communicate to the public. Gaining more conventional space makes a return to the ELB and the constraints that come with it less likely, which has an advantage from a risk management perspective (see Brandao-Marques and others forthcoming). These arguments, in the context of ever-present fragmentation risks, suggest that short term policy rates should be the main choice for adapting the monetary policy stance to changing circumstances and QT should proceed in a gradual, predictable manner. In fact, since the beginning of the rate hikes, long- term yields have responded almost one-to-one with expected short rate hikes suggesting that the transmission of policy rate hikes to the whole curve is not being impaired by the large stock of Eurosystem securities holdings.

Figure 5. Euro Area: Germany Estimated Expected Rate and Term Premia
(Percent, January 1999 – March 2023)



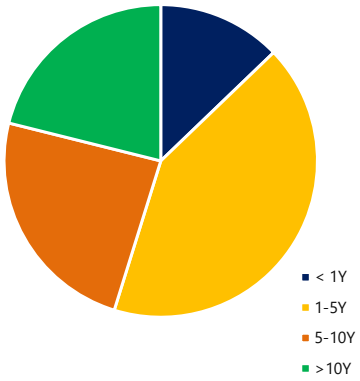
Sources: Haver Analytics; and IMF staff calculations.
Note: Estimates are based on ACM term structural model, see Adrian et al (2013).

Proposed QT Implementation

23. The current approach by the ECB to follow a gradual and predictable unwinding of the Eurosystem's balance sheet with a passive runoff of the APP portfolio is appropriate. This will allow the ECB to understand the impact on yields— expected to be small initially given the modest amount of roll-off—and to monitor the emergence of risks to the transmission of monetary policy. Since the ECB's asset portfolio is made up of generally somewhat shorter average maturity of assets than those of other central banks (which allows a relatively faster passive runoff in the coming years compared to a more market-neutral positioning), an active approach to QT with outright sales of assets is not warranted.

24. Over the medium term, the ECB can follow a decision-tree approach to QT implementation to navigate the tradeoffs which may arise until the balance sheet reaches its desired level. Pursuing QT and tailoring its pace will depend on how large the impact on yields turns out to be, the position in the monetary cycle, whether fragmentation risks resurface and the ECB's preference for its operational monetary framework. Past the learning phase, the different branches of the decision tree can be summarized as follows:

Figure 6. Euro Area: Maturity Profile of ECB's APP Portfolio



Source: ECB, IMF Staff Calculations

- **Tightening cycle—QT can serve all objectives.** If the impact of QT on yields continues to be assessed as small and the balance sheet is still far from a desirable endpoint, the ECB could increase its pace to reduce the CB footprint in financial markets. The pace could also accelerate if the pass-through from short-term to long-term rates is deemed insufficient (this has not been the case so far). As the ECB has stopped APP reinvestments all together, to accelerate QT, the ECB could reduce the reinvestment of the PEPP portfolio, and later, fully cease its reinvestment. Under such a scenario, assuming similar amounts of maturing assets under the APP and the PEPP, the roll-off would then attain €624 billion per year, with an expected impact on yields in the range of 22-33bp. Since the current expectations are in line with the GC's forward guidance on PEPP, the marginal impact from here on would be even smaller. Policymakers would have to judge whether these subsequent increases correspond to a tighter monetary stance than warranted by setting the pace accordingly. If the QT process proceeds ahead, the ECB can decide to stop QT once it has reached its desired balance sheet size (see discussion below).

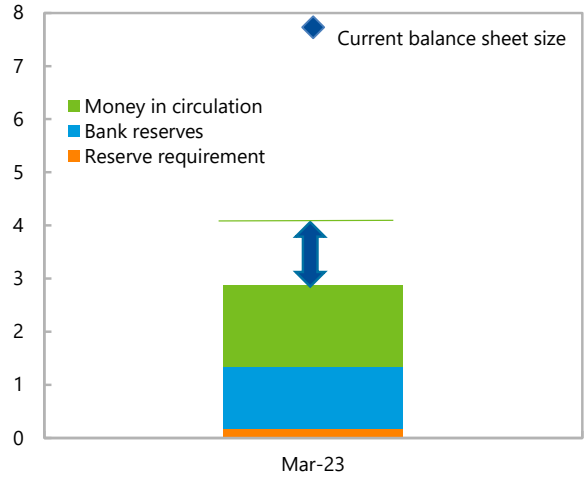
- **Loosening cycle—tradeoffs with some QT benefits.** The ECB could continue with QT in a rate loosening cycle if the balance sheet is still far above the desirable endpoint and the impact of QT is minimal. However, if QT is found to have a significant tightening impact on financial conditions, it should pause in a loosening cycle to not increase the risk of hitting the ELB.

25. A significant reduction of the ECB footprint would require an acceleration of the QT pace, all else the same. Beyond the minimum reserve requirements and currency in circulation (about 13 percent of 2022 GDP or €1.7 trillion), the demand for bank reserves has increased since 2009. This is due to precautionary motives, prudential considerations, and changing business models.[7] To determine a terminal balance sheet size requires knowing the steady state banks demand for reserves, which is an ongoing productive research area. For a back-of-the-envelope calculation, one can use the average excess reserves after the GFC and prior to the implementation of QT (2010-2022), amounting to €1.1

[7] For instance, ensuring a high level of liquidity coverage ratio (LCR) increases the attractiveness of holding excess reserves compared to holding other high-quality liquid assets (HQLA). In addition, some banks place their deposits at the central bank to accommodate the liquidity storage preferences of their customers rather than their own need for liquidity insurance.

trillion, an average throughout the QE period (2015-2022) of €1.7 trillion, or a more recent average (2017-2022) of €2.1 trillion which covers more firmly the floor system period. This would result in a total Eurosystem balance sheet of between €3 and 4 trillion or 20-30 percent of 2022 GDP. Reaching this level over the next 7 years would mean an annual reduction of €554-694 billion, which corresponds to at least three times the current monthly QT pace. If continued beyond June 2023, the current QT pace would keep the Eurosystem balance sheet twice as large as the Fed's or the Bank of England by end 2024 even though the Eurosystem's has historically been larger than that of its peers.

Figure 7. Euro Area: Minimum Eurosystem Balance Sheet (EUR, trillion, March 2023)



Sources: ECB; and IMF staff calculations.

26. Ultimately, the appropriate balance sheet size can only be ascertained along the way and will require a cautious approach. By observing the reserve satiation point, the ECB can eventually decide to slow down or stop QT to keep its current floor system.[8] This is also the strategy adopted by the Fed as it announced that it would slow and then stop the decline in the size of the balance sheet when reserve balances are somewhat above the level it judges to be consistent with ample reserves. The Fed's approach implicitly assumes that it will continue to operate under a floor system. By the end of 2023, the GC will review its operational framework for steering short-term interest rates, which will provide information regarding the endpoint of the balance sheet normalization process. Nevertheless, the view seems to be that the future level of reserves in the banking system would be appreciably below that seen in recent years but larger than before the financial crisis given the endogenous dynamics discussed above (ECB 2021). Indeed, it appears that financial institutions have increased their dependence on liquidity, which can only be substituted with other assets up to a point, before triggering volatility as experienced in the US repo market in 2019 (Nelson 2022, and Acharya and others 2022).

27. To address the multiple tradeoffs described above, the QT roadmap would continue benefiting from the following principles:

- Early on, communicate QT principles, making it predictable and eventually "invisible", even as market conditions change**.**

- Pre-announcing regular but infrequent dates at which the speed of QT is re-assessed. Pre-announcing any changes to the QT pace ahead of time so that market participants can adjust their expectations regarding the extra bonds' supply that need to be absorbed, seeking to facilitate a

[8] The ECB 2021 acknowledges the difficulty in determining the minimum level of reserves compatible with a floor system and, at that time, estimated that the floor required excess liquidity (FREL) could be somewhere between €400 billion and €1 trillion, which would suggest a lower bound of the terminal balance sheet size compatible with the floor system would be between €2.2 and €2.8 trillion.

smooth adjustment to their pricing.

- Embedding an "escape clause" in the QT setup should there be a severe and systemic shock which requires pausing the program – this escape clause would cover the case of severe impediment to the smooth transmission of monetary policy

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Annex I. International Experience with QT

1. Except for the Bank of Japan, other major central banks started QT earlier. Most major central banks have initiated QT by either partially or fully ceasing to reinvest the proceeds of maturing bonds—known as passive QT—or by selling securities ahead of their maturity date—known as active QT. The reduction of central bank balance sheets differs across countries, depending on the pace of QT, the type of QT implemented, and the maturity structure of the bond holdings. For instance, after issuing a set of QT principles, the Fed chose the passive QT route—first in October 2017 before interrupting it in September 2019—and restarting it in June 2022. On the other hand, the BoE ceased reinvesting maturing gilts in February 2022, through passive QT, while initiating the sale of non-financial investment-grade corporate bonds, with active QT starting in earnest on November 1, 2022.

2. The Fed's QT was implemented by putting a ceiling on the reinvestment of maturing securities. A month before initiating QT in May 2022, the Fed announced that it would only reinvest maturing principals above US$30 billion per month for treasuries and US$17.5 billion per month for MBS over the following three months, after which these caps would be doubled. The caps are expected to remain in place over the medium term, allowing for a gradual decline in the balance sheet, unless economic and financial developments call for an adjustment.

3. In contrast to the Fed, the BoE has chosen the active asset sales route. In February 2022, the BoE ceased reinvesting maturing gilt and initiated the sale of non-financial investment-grade corporate bonds. The BoE also communicated its intention to conduct QT in a gradual and predictable manner to prevent disruption in financial markets, while maintaining the discretion to alter its plans in response to economic circumstances and market conditions. For instance, QT was temporarily reversed when the gilt market faced severe dysfunctions in October 2022. In August 2022, the BoE announced the start of active gilt sales after the September meeting, in part because the maturity profile of its holdings is very long and lumpy at about 14 years. It also indicated that gilt sale operations would be distributed evenly across short and medium maturities, amounting to an overall reduction of £80 billion over a year. The starting date of the sell-off was eventually delayed to November 2022 after some market turmoil and short-term financial stability purchases.

4. The Reserve Bank of New Zealand (RBNZ) chose a similar approach to the BoE, although by selling treasury bonds directly to the treasury. In February 2022, the RBNZ announced it will start the gradual reduction of its bond holdings through both bond maturities and managed sales of government securities to New Zealand Debt Management, arguing that it will offer more scope to use quantitative easing again in the future. In July 2022, the RBNZ started selling its holdings of government securities, in order of maturity date, beginning with the longest duration, indicating that its sales will continue in a gradual and predictable manner until holdings have reduced to zero, which is expected to be in mid-2027. Meanwhile, short-dated securities won't be reinvested when they mature. It added that it reserves the right to change the rate of sales or halt sales should conditions change, but do not expect such changes to be common.

5. The Reserve Bank of Australia (RBA) offers yet another example of an approach based exclusively on stopping reinvestment of the proceeds of maturing securities. In May 2022, the RBA

announced that progress towards full employment and the evidence on prices and wages warrant withdrawal of the extraordinary monetary support by seizing to reinvest the proceeds of maturing government bonds highlighting that the RBA is not currently planning to sell the government bonds. The RBA indicated that outright sales would add volatility in bond markets and complicates the task of the Treasury Debt Management Office. It expects its balance sheet to remain substantial for some years to come.

6. Despite different approaches to QT, some similarities exist between the different central banks. All central banks had pre-announced months in advance of the QT start of QT. In the case of the BoE and the RBNZ, they also pre-announced when active sales will be taking place. All central banks emphasized that QT would be predictable, gradual, and orderly, although they kept discretion over adjusting their QT plans in relation to financial and economic conditions. All central banks do not view using their QT decisions to provide forward guidance about the future path of their policy rates but instead as a "sideshow", allowing them to focus on policy rates.

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