UNCONVENTIONAL POLICY TOOLS AT THE FED: LESSONS FROM THEORY AND PRACTICE

Silvana Tenreyro*
London School of Economics

Mo Wazzi†
University of Oxford

May 10, 2025

Abstract

This paper assesses the Federal Reserve's use of forward guidance and large-scale asset purchases as part of its monetary policy toolkit, with a view toward informing its 2025 monetary policy strategy review. While drawing on the Fed's recent experience, the paper does not focus on the appropriateness of the policy stance, but on the tools themselves—their design, transmission mechanisms, and effectiveness under different economic conditions. It highlights crucial design trade-offs and examines lessons for the future. One key conclusion is that stress testing the tools before their implementation, for instance using scenario analysis, could help manage the trade-offs between commitment and flexibility inherent in these tools' design.

*Tenreyro: Department of Economics, London School of Economics, Houghton Street, London, WC2A 2AE, United Kingdom. S.Tenreyro@lse.ac.uk

†Wazzi: Department of Economics, University of Oxford, Manor Road, Oxford, OX1 3UQ, United Kingdom. Mohamad.wazzi@economics.ox.ac.uk

We would like to thank Philip Lane, Massimo Rostagno, Dimitri Vayanos, Annette Vissing-Jorgensen and Jan Vlieghe for insighful exchanges. Gabriel Leigh and Zuzanna Palion provided superb research assistance.

1 Introduction

As the Federal Reserve embarks on its 2025 monetary policy strategy review, it is both natural and timely to reassess the design, transmission, and effectiveness of the tools that have become central to its strategy. In particular, forward guidance (FG) and large-scale asset purchases (LSAPs), often referred to as quantitative easing (QE), have become standard elements of the policy toolkit, used extensively to overcome the limits imposed by the effective lower bound (ELB) on interest rates. In principle, these new, so-called unconventional tools enable the FOMC to change the policy stance at the constrained lower bound; above the effective lower bound, FG can also serve to communicate the Fed's reaction function, while LSAPs can aid in addressing financial market stress.[1]

These two tools were prominent parts of the Fed's response to the global financial crisis. In early 2020, the FOMC re-intensified its use of FG and LSAPs in response to the deep contraction and acute financial stress brought on by the Covid-19 pandemic. However, unlike the slow recovery that followed the global financial crisis, economic conditions evolved rapidly: inflation rose sharply, and employment rebounded at a fast pace. This prompted the FOMC to tighten monetary policy through a series of rapid increases in the policy rate beginning in March 2022.

There is a live debate, nourished by hindsight, on whether the stance of policy—for which FG and LSAPs were instrumental—should have shifted earlier in light of these developments. This paper does *not* take a view on that question. Instead, we ask whether the tools themselves—in particular the way FG and LSAPs were structured and communicated—were effective and whether they enhanced or limited the Fed's

[1] FG was hardly a new instrument for the Fed. As argued by Rudebusch and Williams (2008), the FOMC started doing a form of FG as early as 1983, but the guidance was only published after the following meeting. In February 1994, the FOMC began publishing a statement describing the current policy stance immediately after each meeting. In May 1999, the FOMC began communicating about the future policy stance in its published statements.

capacity to adapt to changing conditions, should that have been deemed appropriate.

To do so, we put the focus on the tools themselves—how they operate, what trade-offs they entail, and what lessons can be drawn for future use. We synthesise what is known about the theory and empirical performance of FG and LSAPs and highlight key reflections and questions raised from the recent policy experience using these tools. The aim is to inform how these tools might best be deployed in the future.

The main takeaways from our analysis are as follows.

1) **FG and LSAPs remain effective tools and should be part of the monetary policy toolbox.** Across a wide literature, both tools have been found to ease financial conditions and support economic activity. They should remain part of the Fed's ELB monetary policy toolkit. Above the ELB, (Delphic) guidance that clarifies the reaction function should be part of the FOMC's routine communications, and LSAPs may be needed to address periods of acute market dysfunction.

2) **Design and communication are critical to effectiveness.** Unlike the policy rate (which is a simple scalar), FG and LSAPs are multi-dimensional tools. They can be structured and communicated in various ways, which in turn will determine the balance of transmission channels through which they operate, as well as their effectiveness.

3) **There is an inherent trade-off between commitment and flexibility, which can be partly managed by stress-testing tools before their implementation.** Strong commitments can enhance credibility and initial effectiveness, but may limit the central bank's ability to adapt policy if conditions change rapidly. This was particularly evident in the 2020–2021 period. Scenario analysis and stress-testing policy design, including embedding clear, credible escape clauses, can help manage this trade-off.

4) **State-contingent FG is preferable, but must be forward-looking and robust.** Guidance tied to specific data outturns can anchor expectations, but risks creating rigidities if those thresholds are hit amid unexpected shocks. The Fed's 2020 guidance formulation arguably placed too much weight on realised outcomes (which might have limited preemptive action) and insufficiently accounted for potential trade-offs between its objectives.

5) **The cost-benefit trade-off between guidance that clarifies the reaction function (Delphic FG) and guidance that commits to a potentially time-inconsistent policy (Odyssean FG) is more nuanced under FAIT.** Under the Fed's flexible average inflation targeting regime, modest inflation overshoots are not deviations but features of the framework. As a result, clear reaction-function guidance alone can be sufficiently stimulative, reducing the need for explicit time-inconsistent commitments. This argues in favour of placing greater emphasis on reaction-function guidance rather than issuing strong forward commitments that may later constrain flexibility. Naturally, any future changes to the FAIT framework would require appropriate adjustments.

6) **LSAP transmission operates through multiple channels, and their strengths are state-dependent.** The strength of portfolio balance, signalling, and liquidity channels varies with program design and market conditions. There is no clear consensus on which transmission channels dominate. While portfolio-balance effects on targeted markets are widely documented, spillovers into other asset classes are more uncertain. The more segmented the markets, the more limited the scope for spillovers and broad effects.

7) **LSAPs' uneven effects have competing interpretations.** QE1 and QE4 rounds had larger measured market impacts than QE2 and QE3, but views diverge on why. One explanation is anticipation effects, which make it harder to precisely identify

the impact of QE2 and QE3. Another is that QE1 (and to some extent QE4) introduced a perceived Fed put, pricing in future interventions. A third view attributes the difference to financial market conditions, with asset purchases being more potent in periods of stress. While the first two views imply that the identification of subsequent rounds of LSAPs may be blurred by anticipation, they differ sharply in the assessment of LSAPs' effective multiplier: the Fed-put view attributes the large LSAP impact not just to the first intervention but also to the subsequent series of expected interventions. This difference in implied multipliers may alter LSAPs' cost-benefit calculation.

8) **Delineating asset purchase objectives could increase policy agility.** Asset purchases aimed at market functioning, such as during March 2020, are distinct from those aimed at providing macroeconomic stimulus. Blurring these roles may reduce agility, delay exit, and complicate communication. Clear separation, both in design and messaging, could enhance policy effectiveness and credibility. Where both types of purchases are needed simultaneously, careful consideration of operational and strategic trade-offs is essential and should be anticipated ex ante, before crisis conditions emerge. Should LSAPs remain a single, integrated tool, its design must be responsive to its evolving purpose.

9) **There remains substantial uncertainty about LSAPs' macroeconomic impact and persistence.** While asset price effects are well established, translating them into real outcomes remains contentious. Estimates vary widely, reflecting differences in identification and modelling assumptions. These approaches assume yield effects from LSAP announcements persist and map cleanly to the macroeconomy, but this assumption may not hold if markets are inefficient or segmented, where LSAPs are most often used. This uncertainty limits how precisely LSAPs' net benefits can be assessed.

10) **A more comprehensive framework is needed to assess costs and benefits.** While some research has begun to tackle this challenge, evaluations of LSAPs often focus narrowly on accounting losses to the central bank, ignoring broader macroeconomic benefits. A well-structured framework should incorporate expected effects under different states of the world, account for uncertainty, and weigh risks alongside the core policy objectives of output and inflation stabilisation.

We focus especially on the design and deployment of tools at the ELB, where the policy challenges and uncertainties are most pronounced. Above the ELB, we believe there is a continued case for Delphic guidance to communicate the reaction function, as well as asset purchases to address acute market dysfunction, as seen during the Bank of England's intervention in 2022 in response to fire sales of gilts by liability-driven investors.[2] Similarly, although the empirical literature on balance-sheet unwind remains in its infancy, current practice of running it in the background, rather than as an active policy tool, appears appropriate.

The rest of the paper is organised as follows. Section 2 reviews the theory and evidence on FG and LSAPs; it offers a characterisation based on some of the key dimensions of the two policies, and discusses the transmission channels and estimates of their effectiveness. Section 3 zooms in on the 2020-2024 experience, when the Federal Reserve turned from a loosening to a tightening cycle. The section reflects on the trade-offs posed by the constraining dimensions of the tools, which arguably detracted from the flexibility needed to change course, and suggests ways to enhance that flexibility in the future. Section 4 draws lessons from the use of the tools and poses some open questions for research. Section 5 presents concluding remarks. Additional information is collected in the Appendix.

[2] See Hauser (2022)

2 Unconventional Policy Tools: Theory and Evidence

This section reviews the theoretical arguments and empirical evidence on forward guidance and asset purchases, the two main unconventional monetary policy tools actively used by the Federal Reserve. Each subsection explains the tool, describes the theoretical mechanisms through which it is expected to operate, and summarises key findings from the empirical literature on its effectiveness.

2.1 Forward Guidance: Theory and Evidence

Forward guidance (FG) refers to the central bank's communication about the future path of monetary policy or the economy. It has become a core feature of monetary policy, particularly in, but not limited to, environments where interest rates are constrained by the ELB.

FG has often been classified into two conceptual forms: Delphic and Odyssean.[3] Delphic FG consists of forecasts about likely future policy actions conditional on the outlook, without any explicit commitment. Its primary role is to inform the public and financial markets about the central bank's outlook and reaction function. This can be especially valuable when the reaction function is unclear, such as during periods of economic uncertainty (when policymakers might be weighing new risks) or when policymakers face trade-off-inducing shocks, such as supply disturbances. In such circumstances, clear communication about the outlook and policy framework can align expectations by households, companies and financial markets with policymakers' views and reduce uncertainty.

Odyssean FG, on the other hand, entails a partial commitment to a future policy path that may be time inconsistent. If the central bank can credibly pre-commit to maintain a certain policy stance, it may influence expectations more forcefully and

[3] See Campbell *et al.*, (2012)

thereby impart more stimulus. For example, when at or close to the ELB, a commitment to retain looser financial conditions even after it is required by the mandate, can stimulate the economy and re-anchor expectations today. This approach comes with the cost of constraining policymakers in the future, and that cost might be especially large if economic conditions evolve in a rapid, unanticipated manner.

In practice, FG could be framed in a multitude of ways, with more or less precision and/or conditionality. A non-exhaustive list of examples for which economists have specific names are:

- **Open-ended guidance** provides a high degree of flexibility, but lacks precision, which in turn may not materially lower market uncertainty. For instance, in August 2003, the FOMC noted that policy accommodation could *'be maintained for a considerable period'* and in January 2004 that it could *'be patient in removing its policy accommodation'*. A similar formulation was used in December 2008, when it anticipated that weak economic conditions were *'likely to warrant exceptionally low levels of the federal funds rate for some time.'*

- Another format is **calendar-based guidance**, where policymakers tie the future path of interest rates to a specific date. This approach offers greater clarity and simplicity (Williams, 2016), though at the cost of reduced policy flexibility (Campbell *et al.*, 2012). In August 2011, the FOMC for the first time explicitly tied its guidance to a date, stating that it would maintain the federal funds rate near zero *'at least through mid-2013'*.

- Rather than tying the path of interest rates to a date, policymakers could tie it to certain economic conditions (such as data outturns or forecasts) using **state-contingent guidance**. This would allow market expectations to endogenously adjust to incoming data (Feroli *et al.*, 2017). However, its effectiveness hinges on the public's ability to interpret and monitor the relevant macroeconomic indi-

cators, potentially making it more impactful for financial markets than broader economic agents. The FOMC's December 2012 formulation is a prominent example: it stated it anticipated that the exceptionally low level of the federal funds rate would *'be appropriate at least as long as the unemployment rate remains above 6-1/2 percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored.'*

- While not a commitment, publishing projections using **explicit rate forecasts** (such as the FOMC dot plot) can help shape market expectations while preserving flexibility. Its drawback, as currently implemented, is that the dots are not tied to a particular forecast for the economy, and hence it is often difficult to infer whether changes in the dots reflect a change in members' forecast of future economic conditions or a change in members' reaction functions.

- FG frameworks can incorporate **explicit knockout clauses**, which serve to safeguard against undesirable outcomes or tail risks. This could be seen as a specific form of state-contingent guidance. While such clauses can improve robustness, they must be balanced against the risk of over-complicating the communication strategy.

While Delphic and Odyssean FG are often associated with particular formats—such as calendar-based vs state-contingent—the underlying distinction is arguably more conceptual. Delphic FG reflects the central bank's outlook and reaction functions, given its framework. It is an act of clarification, informing the public of the policymaker's likely actions under a given economic scenario given its reaction function and mandate. Odyssean FG, by contrast, involves a partial commitment to a path that may be time inconsistent. In this sense, the defining feature of Odyssean FG is not its format, but whether it implies a deviation from the central bank's standard policy rule

or reaction function. Such a deviation is typically justified when the central bank's ability to deliver stimulus is constrained, and when optimal policy requires making a commitment that extends beyond what the unconstrained reaction function would dictate. This logic, echoed in Campbell *et al.*, (2012) and Bernanke (2020), aligns with the classical rationale for Odyssean guidance as a device to enforce time-inconsistent promises, such as allowing inflation overshoots following a period below target.

However, this distinction has become more subtle in light of changes to policy frameworks. Under the Fed's flexible average inflation targeting (FAIT) regime, modest inflation overshoots are not a deviation but a feature of the reaction function. In such a framework, clear communication of the reaction function—even without explicit commitments—can be stimulative in principle. In that case, Delphic guidance may deliver effects previously thought to require Odyssean strategies (Evans, 2017). However, when guidance deviates from the implied trade-offs of the framework—for instance, by tolerating an overshoot without clearly defined limits—it begins to take on Odyssean characteristics.

From a theoretical perspective, FG works through two main mechanisms. First, it can reduce uncertainty by clarifying the central bank's reaction function, in turn lowering term premia and reducing risk premia in other asset markets (Bundick and Smith, 2017). This clarifying effect remains valuable above the ELB, and may in fact be more potent given the broader range of plausible paths for policy rates when unconstrained. Second, when guidance reflects or entails a commitment to maintain accommodative financial conditions beyond what would be implied by a standard policy rule, it can directly affect expectations of the future path of short-term interest rates, leading to declines in medium- and long-term yields (Bernanke, 2020). Moreover, if the commitment is viewed as credible, it can raise inflation and growth expectations, further stimulating current aggregate demand (Woodford, 2012). As discussed above, while these effects were historically linked to Odyssean guidance, recent shifts in the

monetary policy framework suggest that well-constructed Delphic guidance may now deliver similar outcomes without time-inconsistent commitments.

Empirical evidence is broadly supportive of these theoretical mechanisms. Several studies document that FG reduced market uncertainty about the path of short-term interest rates (Hattori, Schrimpf, and Sushko, 2016; Ehrmann *et al.*, 2019). FG announcements in the US have also been associated with significant movements in yields, equity prices and broader asset markets, with these market movements strongly related to shifts in expected policy rates (Campbell *et al.*, 2012; Femia and Sack, 2013; Del Negro, Giannoni, and Patterson, 2023; Raskin, 2013; Swanson, 2021).[4] The evidence on the macroeconomic effects of FG on inflation or activity is less conclusive, as typically the effects are estimated with low precision (Kim, Laubach, and Wei, 2023). That said, Swanson (2024) identifies FG shocks using high-frequency asset price movements around FOMC announcements and finds that they have significant effects on output and commodity prices.

While FG is commonly framed in terms of short-term interest rates, it also extends to central bank communication about future balance-sheet policies. Asset-purchase programs—particularly those with clearly articulated trajectories—implicitly provide guidance on the expected supply of bonds. Greenwood, Hanson, and Vayanos (2015) argue that such guidance influences the yield curve through changes in expected bond risk premia. Ray, Droste, and Gorodnichenko (2024) complement this perspective, noting that uncertainty around QE implementation—such as its duration and composition—can itself be a source of macroeconomic volatility, thereby underscoring the importance of clear communication. The benefits of such guidance are likely to be especially salient under flow-based programs, where the ultimate scale and persistence of purchases are not immediately known.

[4]There is also evidence from the euro area that FG announcements significantly reduced the upper tail of the distribution for expected future short-term rates, suggesting a compression of upside rate uncertainty (Rostagno *et al.*, 2025).

2.2 Asset Purchases: Theory and Evidence

Large-scale asset purchases (LSAPs) have become another key instrument in central banks' toolkits. These operations typically involve large-scale purchases of bonds from the private sector, financed by the creation of central bank reserves. Conceptually, these transactions are asset swaps: they change the composition of private sector portfolios but, subject to asset prices, they do not directly increase the net wealth of firms or banks.[5]

While asset purchases are often referred to as a single policy instrument, in practice its design can vary significantly across multiple dimensions: the type of assets purchased (e.g. government bonds, agency securities, corporate bonds); the stated objective (monetary stimulus vs liquidity provision); and the structure of implementation (e.g. flow-based vs fixed stock, quantity-based vs price-based). These distinctions matter because the underlying transmission mechanisms, and in turn the effects on financial markets and the broader economy, can differ markedly across programs.

LSAPs may affect financial and macroeconomic conditions through several distinct channels, shaped by different market structures and frictions. The magnitude and persistence of these effects are conditional on both program design and prevailing market conditions. At a first-order level, LSAPs aim to lower interest rates in targeted markets, which in turn lowers the cost of capital for households and firms, raises financial wealth and may depreciate the domestic currency. This section discusses the several ways in which this may happen and the empirical evidence for each.

[5]This is in contrast with some incorrect and popular interpretations of LSAPs as helicopter drops or bank bailouts. See Reis and Tenreyro (2022) for a discussion of helicopter drops and the distinction from LSAPs.

Portfolio balance channel

The portfolio-balance channel operates through the relative supply of assets available to private investors. By purchasing long-term securities, asset purchases reduce the net supply of duration risk ('duration channel') or bonds with specific characteristics ('local supply channel'). This in turn leads to a compression in risk premia, not only in the targeted securities but potentially in a broader set of markets that bond investors trade in, such as foreign exchange markets (Greenwood *et al.*, 2023).

The theoretical foundations for this channel are rooted in preferred-habitat models, in which some investors have strong preferences for specific maturities or securities that are not easily substituted away. These frictions underpin the enduring price effects from shifts in bond supply caused by LSAPs (Vayanos and Vila, 2021).

Based on this theoretical mechanism, the strength of the channel depends on several conditions. First, it is more effective when financial constraints and risk aversion are elevated, as these frictions limit arbitrage and increase the marginal impact of changes in bond supply. Conversely, under normal market conditions, arbitrageurs may smooth out relative price distortions, muting the effect.

Second, it relies on some degree of market segmentation, whereby investors are not fully indifferent across maturities or asset types. In such settings, a reduction in bond supply may have relatively narrow effects within the targeted market (Krishnamurthy, 2022). Conceptually, there seems to be some tension between intervening in a highly segmented market (with high, localised impact in that market) and having broad and impactful spillovers (and hence wider macroeconomic impacts from the intervention). In principle, the more segmented markets are, the lower the scope for broad effects (Woodford, 2012). It is possible, however, that localised effects may spill over to other asset classes more slowly, as capital reallocates across markets, as argued

by Greenwood, Hanson, and Liao (2018).[6]

There is robust empirical support for local supply and duration effects stemming from the early rounds of LSAPs. Studies such as Gagnon *et al.*, (2011), D'Amico and King (2013) and Cahill *et al.*, (2013) find that central bank purchases reduced yields on targeted securities, consistent with the predictions of the theory.

Estimating the effects of later LSAP programs is more challenging, however, as many were increasingly anticipated by financial markets. (This anticipation could potentially be part of the "put" idea in Haddad, Moreira, and Muir (2025) discussed below). Nevertheless, several studies have found that LSAP effects in the US and abroad remain significant when controlling for market expectations. For example, Cahill *et al.*, (2013) and Joyce, McLaren, and Young (2012) show that once the size of the monetary surprise is accounted for, local supply effects are consistent with earlier findings in the US and UK, respectively. Similarly, De Santis (2020) constructs a measure of ECB QE announcement surprises using Bloomberg references, and estimates that the ECB's Asset Purchase Program reduced yields by amounts comparable to early Fed and Bank of England purchases. Finally, recent work by Rostagno *et al.*, (2021) similarly finds that the impact of the ECB's purchases is braodly stable after controlling for QE expectations.

More recent work has highlighted that portfolio-balance effects are state contingent. Their strength may be attenuated in periods of normal market functioning, where arbitrage mechanisms are more effective and segmentation is less binding (Vlieghe, 2021; Bailey *et al.*, 2020; Tenreyro, 2023). Ray, Droste, and Gorodnichenko (2024) provide evidence of this asymmetry, finding that yield impacts are larger during periods of market stress.

[6]Consistent with this, Altavilla, Carboni, and Motto (2021) find that during periods of low financial distress, the local effects of ECB asset purchases on targeted assets are weaker, but spillovers to non-targeted assets are stronger, implying that the transmission of asset purchases varies systematically with financial conditions.

Liquidity channel

Asset purchases can also lower yields by reducing liquidity premia. Bond yields may include a premium compensating investors for the risk of not being able to sell the bond quickly without incurring a loss—particularly in times of stress. Central bank asset purchases can reduce this premium in two key ways. First, by injecting liquidity into the financial system and by signalling the presence of a large, willing buyer, such purchases reduce perceived illiquidity risk and encourage trading.[7] Second, by freeing up balance sheet capacity for constrained dealers, they can facilitate intermediation and improve overall market functioning (Duffie and Keane, 2023).[8] By limiting spikes in liquidity premia during stress episodes, asset purchases help preserve the transmission of monetary policy and offset the contractionary effects of financial shocks. These benefits were clearly illustrated by the Bank of England's gilt market intervention in 2022 in response to the fire sales of gilts by liability-driven investors triggered by a fiscal policy shock.

The strength of this liquidity channel depends on the extent of market dysfunction and the degree to which dealer intermediation is balance-sheet constrained. During periods of acute stress, when market-making capacity is impaired, large-scale purchases can play a critical role in restoring liquidity. In such instances, the effects may be predominantly 'flow based': it is the actual execution of purchases, rather than future changes in the central bank's stock of holdings, that stabilises markets. This was particularly evident in March 2020, when actual purchases were required to stabilise Treasury markets (Vissing-Jorgensen, 2021).

That said, credible announcements can sometimes achieve similar effects. Sim-

[7] This channel—lowering yields by increasing the supply of liquidity—can also be viewed through the lens of the portfolio balance channel, where investors exhibit preferences over assets with different liquidity characteristics.

[8] This mechanism by which asset purchases free up dealers' balance sheets is effective when dealers are net long bonds on average. However, that is not always the case; for instance, as discussed in Du, Hébert, and Li (2023), dealers were net short prior to the GFC.

ply signalling that the central bank stands ready to intervene or come in as a buyer in the future can improve confidence and reduce the liquidity premium. For example, Haddad, Moreira, and Muir (2021) find that the announcement of corporate bond purchases during the pandemic significantly lowered spreads, even before substantial purchases had taken place—reflecting a reduction in the liquidity premium as markets internalised the presence of a backstop.

Signalling channel

The signalling channel captures the idea that asset purchases can shape expectations about the future path of policy rates. By changing perceptions of the central bank's likely behaviour—through various possible mechanisms—asset purchases may lead investors to revise down their expectations for future rates and in turn lower medium- and long-term yields. In doing so, it may also reduce uncertainty about the policy outlook, compressing term premia.

There are several mechanisms through which signalling may operate. One is that LSAPs serve as a commitment device, increasing the perceived cost of raising rates. In this framework, explored by Bhattarai, Eggertsson, and Gafarov (2023), the initiation of LSAPs alters the maturity structure of government debt in a way that induces future policymakers to maintain low rates to reduce refinancing costs—a mechanism the authors term the 'rollover incentive.' While this channel operates through fiscal considerations, the authors show that under certain conditions, a similar logic applies to an independent central bank concerned with valuation losses on its own balance sheet. While theoretically appealing, it is unclear whether such costs meaningfully constrain policymakers in practice, or whether market participants perceive them as binding. To the extent that this mechanism is operative, its signalling power may fade over time as agents update beliefs through repeated experience.

Another possibility is that markets interpret LSAPs as a timing signal—that the

central bank will not raise rates until the program concludes. While this interpretation can anchor near-term rate expectations, it may simultaneously lead to expectations of sharper tightening once purchases end. This pattern was arguably observed (ex-post) during the Fed's recent tightening cycle.

A further mechanism is that LSAPs may reveal private information about the central bank's assessment of the natural interest rate or its reaction function at the ELB. The decision to launch or extend LSAPs might signal a commitment to stimulating demand when the policy rate is constrained. In this sense, LSAPs could reinforce or complement forward guidance, particularly when guidance alone is not seen as sufficiently credible.

The empirical evidence on signalling effects is less rich than portfolio-balance effects. Bauer and Rudebusch (2014) and Christensen and Rudebusch (2012) find that LSAP announcements have significant effects on interest rate expectations, suggesting a sizable signalling component. There is little systematic evidence on the signalling effects of LSAP programs implemented since 2010. While this may partly reflect the difficulty in identifying these effects when programs are increasingly anticipated, the gap leaves open the question of whether LSAP signalling continues to shape expectations at a time when forward guidance has become more explicit.

Backstop channel

A further mechanism, distinct but complementary to the channels above, is the perceived backstop effect. Announcing asset purchases can reduce tail risk by reassuring markets that the central bank stands ready to intervene in adverse states of the world. This perception may compress risk premia even in the absence of large-scale interventions.

Haddad, Moreira, and Muir (2025) formalise this view in a model where asset pur-

chases act as a conditional promise, with forward-looking markets internalising future central bank responses. In such frameworks, by shifting expectations about future interventions, the initial announcements of asset purchases have effects far beyond the immediate quantum of purchases. The mechanism at work is exactly the same as above, except that the intervention is interpreted as part of the reaction function of the central bank, and hence future expected interventions are priced in by financial markets.

Bank lending channel

Asset purchases may also operate through an increase in reserve holdings, but the direction of the effect is ambiguous. On the one hand, by increasing the supply of liquid reserves, LSAPs could relax liquidity constraints for banks and reduce their marginal funding costs. This could encourage greater credit supply, supporting economic activity. On the other hand, if banks face costs from a larger balance sheet —for instance due to more binding leverage constraints—greater reserves holdings could lead banks to curtail lending. [9]

Empirical evidence on the bank lending channel is mixed. Kandrac and Schlusche (2021) document a positive link between reserves and lending during LSAP episodes. Rodnyansky and Darmouni (2017) find that LSAPs boost bank lending when the Fed purchases MBS but not Treasuries alone. This suggests that the observed effects were driven more by a net worth channel—the rise in MBS prices strengthening banks' balance sheets—rather than by reserve accumulation itself. In contrast, Diamond, Jiang, and Ma (2024) find that increases in reserves crowded out lending, attributing the effect to balance sheet costs under leverage constraints that treat reserves similarly to other assets.

[9] Bank balance sheets mechanically expand during LSAPs when assets are purchased from non-bank investors.

Cross-country evidence provides a useful complement to the US studies above: Chavaz, Patozi, and Wazzi (forthcoming) study recent QE and Quantitative Tightening (QT) in the UK, during a period where reserves were exempt from leverage ratio requirements. In that setting, they find that increases in reserve holdings supported lending, in line with a liquidity self-insurance mechanism. Similarly, Altavilla, Rostagno, and Schumacher (2025) document a robust, positive connection between bank lending and reserves accumulated via QE-related operations in the euro area, particularly highlighting that these effects are stronger than those from conventional refinancing facilities.

Macroeconomic effects and persistence

There is wide dispersion in estimates of the macroeconomic effects of LSAPs, with no clear consensus in the literature. This reflects a combination of differing identification strategies, modelling assumptions, and views on the relevant transmission channels. Fabo *et al.*, (2021) document a strikingly wide dispersion in estimated effects across central banks, time periods and empirical strategies, highlighting the lack of consensus in the literature. That uncertainty is also echoed in the significantly wide swathes in Gulati and Smith (2022)'s meta-analysis of the Fed's balance sheet accomodation.

VAR-based studies—such as Baumeister and Benati (2013) and Walentin (2014)—typically combine large estimated declines in term or mortgage spreads from event studies with macroeconomic impulse responses. These often imply sizable output effects. For example, Baumeister and Benati (2013) estimate that QE1 prevented US output growth from falling to –10 percent and inflation from dropping to –1 percent. Kim, Laubach, and Wei (2023) use high-frequency asset price movements around FOMC announcements as external instruments and estimate a $500bn LSAP shock raises output and the price level by 1.2 percent and 0.8 percent, respectively. Swanson (2024) similarly utilises high-frequency asset price changes but follows a more flexible local

projections approach. By contrast, he finds persistent effects on long-term yields, but no statistically significant impact on output or inflation.

DSGE-based estimates are similarly varied, depending on which channels are featured and how frictions are calibrated. Chen, Cúrdia, and Ferrero (2012), using a model with limited market segmentation, find that the $600bn QE2 program raised GDP by just 0.13 percent. Gertler and Karadi (2013), who include binding leverage constraints, estimate a peak GDP effect closer to 1 percent. Ray, Droste, and Gorodnichenko (2024) calibrate a model with preferred habitat and segmentation to match macro and yield curve moments, and find that a QE1-style shock boosts output and inflation by an amount equivalent to a 50–75 basis point conventional rate cut.

Many of these papers rely on estimates of announcement effects on yields. There is, however, a limit to inference. These approaches rely on an implicit assumption that yield effects persist and translate cleanly into macro outcomes. Yet in practice, this assumption may not hold. In efficient financial markets, any revaluation following a LSAP announcement should be immediate and permanent. However, if LSAPs are used precisely because markets are dysfunctional or segmented, then post-announcement pricing may not cleanly reflect longer-run effects. This raises questions about the validity of using asset price responses—especially during stress episodes—to calibrate or infer macroeconomic outcomes. More broadly, it reinforces the substantial uncertainty that continues to surround the macroeconomic impact of LSAPs.

Overall, the evidence presented across the various channels supports the view that LSAPs have a meaningful impact on asset prices but that there is still significant uncertainty around the magnitude and persistence of such effects, and, in turn, their macroeconomic impact. In calculating LSAP multipliers, there is an additional complication: Haddad, Moreira, and Muir (2025)'s 'put' interpretation implies that the macroeconomic impact of LSAPs is not just the result of the initial intervention orig-

inating the put, but also of the subsequent series of expected interventions. Bridging the significant gaps in our understanding of macroeconomic effects of LSAPs and its persistence remains an important and pressing agenda for future research.

The evidence also suggests that the Federal Reserve's past asset purchase programs operated through multiple channels simultaneously, with the specific transmission mechanism depending on the design and composition of each program. Treasury purchases in particular probably worked through a broad mix of effects, including portfolio balance, signalling, and liquidity channels, though in all likelihood the relative importance of each channel varied over time.[10] MBS purchases operated through similar channels, but may have had more concentrated effects in the mortgage and housing markets. Meanwhile, the Fed's corporate bond purchases, which were implemented as part of its emergency credit facilities at the early stages of the pandemic and quickly unwound, primarily worked as a liquidity backstop. Their effects are best understood through the lens of the liquidity channel, stabilising financial conditions during stress but with limited direct, net stimulus to the macroeconomy relative to the pre-shock path. To be clear, liquidity interventions can have important macroeconomic effects, but primarily by preventing the transmission or amplification of adverse shocks, rather than by actively stimulating demand relative to the pre-shock trajectory. Therefore, the macroeconomic impact of liquidity interventions depends critically on the counterfactual: relative to a disorderly financial disruption, they support growth and financial conditions; but relative to the pre-shock path, they preserve rather than expand economic activity.

[10] Whereas we focus on how the impact of LSAPs may be dependent on market conditions, they may also be dependent on macroeconomic conditions, as illustrated in Adrian *et al.*, (2024).

3 The 2020-2024 Experience

This section considers the Fed's use of FG and asset purchases during the Covid-19 crisis and its aftermath. We begin by outlining the main features of the Fed's policies before reflecting on the challenges that emerged around them. In section 4, we use these reflections to draw broader lessons and pose open questions for research and future policy.

3.1 What did the Fed do?

In response to the economic and financial disruptions associated with the pandemic, the Fed implemented a range of unconventional policy measures, with FG and LSAPs playing central roles. Other policies were re-introduced and expanded at the time, including central banks' liquidity swaps, the Paycheck Protection Program Liquidity Facility, and several term-lending schemes. See the Appendix for a complete list.

Forward Guidance

The FOMC provided guidance covering both the future path of the federal funds rate and the trajectory of its LSAP program. The guidance on interest rates was state contingent, establishing three explicit conditions that had to be satisfied before policy rate increases would be considered appropriate. Specifically, in September 2020, the FOMC stated that it had:

> *"decided to keep the target range for the federal funds rate at 0 to 1/4 percent and expect[ed] it will be appropriate to maintain this target range until labor market conditions have reached levels consistent with the Committee's assessments of maximum employment and inflation has risen to 2 percent and is on track to moderately exceed 2 percent for some time."*

The formulation described above required that three conditions be met before a change in the policy rate could be deemed appropriate: (i) employment had reached the Committee's assessment of maximum employment; (ii) inflation had risen to 2 percent; and (iii) inflation was projected to moderately exceed 2 percent. This contrasted from earlier FOMC guidance, which was more explicitly designed to accommodate potential trade-offs between the employment and price stability objectives. For instance, the FOMC's December 2012 guidance stated how rates would need to remain low *'as long as the unemployment rate remains above 6-1/2 percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored.'*

In December 2020, shortly after the rate guidance was introduced, the FOMC provided open-ended guidance on its ongoing LSAP program. The Committee stated it would:

> *"continue to increase its holdings of Treasury securities by at least $80 billion per month and of agency mortgage-backed securities by at least $40 billion per month until substantial further progress has been made toward the Committee's maximum employment and price stability goals."*

Unlike the rate guidance, this statement did not specify quantitative thresholds, affording greater FOMC discretion while signalling a strong intention to maintain accommodation. Notably, the conditions implied by this formulation set a lower bar for ending purchases than those embedded in the rate guidance. This asymmetry was consistent with the FOMC's preference to conclude asset purchases before initiating rate hikes. For instance, Chairman Powell stated lift off would not occur until the FOMC stopped buying bonds at the December 2021 press conference.

In addition to this sequencing preference, the FOMC also emphasised its intention to provide "ample warning" before tapering asset purchases. As highlighted in Eg-

gertsson and Kohn (2023), both the Committee and Chairman Powell conveyed this communication strategy in several remarks, including at the June 2021 press conference. While this approach aimed to avoid market disruption, it also raised the threshold for responding quickly to evolving conditions.

Asset Purchases

The scale and structure of the Fed's asset purchase programs evolved during the initial stages of the pandemic. In March 2020, following the acute dysfunction in financial markets, the FOMC announced it would purchase at least $500bn in US Treasuries and $200bn in MBS. However, within days, the program was expanded to a potentially unlimited scale, with the Fed committing to purchase assets "in the amounts needed to support market functioning".

Additionally, the Fed launched corporate bond purchase facilities – the Primary Market Corporate Credit Facility (PMCCF) and the Secondary Market Corporate Credit Facility (SMCCF). Initially, these facilities were limited to investment-grade bonds, but eligibility criteria were later expanded in April to include certain high-yield ("fallen angel") debt.[11]

These interventions were liquidity-focused in their initial design and communication, aiming to stabilise disorderly market conditions. Although they indirectly supported monetary policy objectives by preventing an unwarranted tightening in financial conditions and facilitating an effective transmission of monetary policy, the Fed did not initially frame them as tools of monetary policy stimulus. It was not until September 2020 that the FOMC's official communication explicitly motivated asset purchases as easing the stance of policy, stating that the ongoing Treasury and MBS purchases would also serve to "foster accommodative financial conditions."

[11] See March 2020 and April 2020 FOMC announcements.

3.2 Takeaways and Reflections

These policies generated significant debate, particularly in light of the inflation surge that followed in 2021 and 2022. As said, much of the debate was on the policy stance. In what follows, we try to focus on the tools themselves—and the practical constraints they might impose at a time in which economic conditions could be rapidly changing.

Forward Guidance

One of the main concerns raised in retrospect is that the FOMC's FG may have constrained its ability or willingness to respond more rapidly to rising inflation. It is difficult to isolate FG's effect from the increased emphasis placed on the Fed's employment mandate relative to previous frameworks (Romer and Romer, 2024), but the guidance structure could have made it harder to shift course once inflation pressures emerged. To emphasise, this is not to argue that the stance of policy was necessarily inappropriate. Rather, the concern is that the design of the guidance may have tied the Committee's hands had it deemed a tighter stance of policy to be appropriate, or created the perception that doing otherwise would undermine credibility—or the future commitment value of FG.

Three features of the FG appear central to this perceived constraint. First, the guidance did not recognise that trade-offs between the Fed's dual mandate objectives may arise—for instance in the presence of supply shocks. This implied that the criteria effectively set a high bar for rate hikes—as illustrated by Figure 1 below from English and Sack (2024)—and was not sufficiently robust to face large shocks.

Second, there was a potential tension between (a) the differing thresholds communicated for tapering asset purchases and initiating rate hikes, and (b) the FOMC's preference to complete tapering before lift-off while providing enough lead time before starting to wind down purchases. As discussed above, the FOMC's guidance

required only "substantial further progress" to taper asset purchases, but full achievement of its two goals to raise rates. On its own, setting different bars for different tools is not a problem. However, combined with the long lead time needed to wind down purchases smoothly, it potentially created a constraint: if the gap between "substantial progress" and achieving the goals was shorter than the lead time needed to cease purchases, the Committee would either have to raise rates while tapering was still underway (which we discuss in further detail below), or delay lift-off beyond what macroeconomic conditions might warrant.

Finally, the FG formulation was highly conditional on realised data, requiring specific outturns to be observed before a change in the policy stance could be justified. This may have reduced the FOMC's ability to act pre-emptively based on forecasts or leading indicators, and may have fostered a bias towards inaction or delay.

These tensions relate back to the distinction between Odyssean and Delphic guid-

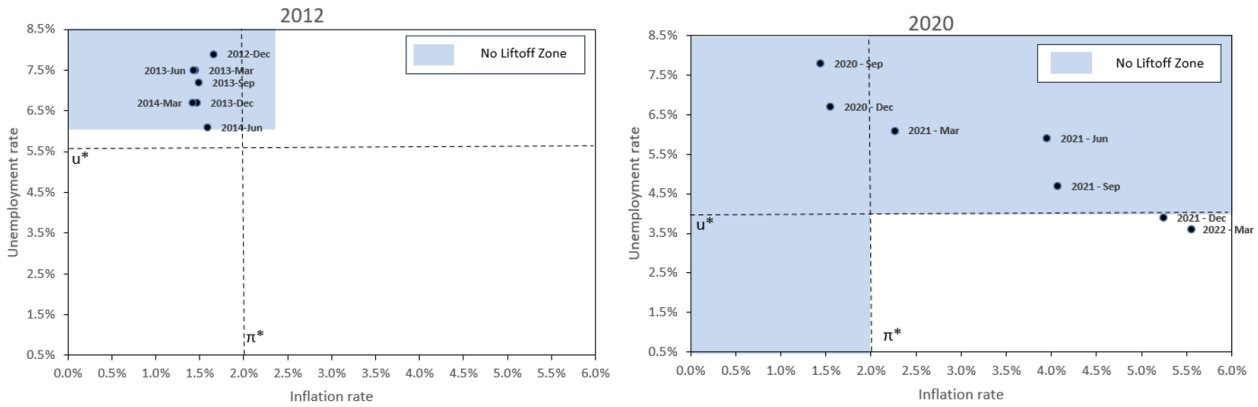

FIGURE 1:
Fed's Forward Guidance on Policy Rate Lift-off, English and Sack (2024).

Note: Authors' reproduction of English and Sack (2024). Notes: The charts show forward guidance conditionality in 2012 (left) and 2020 (right), plotted against year-on-year unemployment and inflation. Blue shaded areas mark the "No Liftoff Zones," where the federal funds rate was expected to remain at the ELB. In 2012, liftoff was tied to projected outcomes: it required either unemployment above 6.5% or inflation not projected to exceed 2.5% 1-2 years ahead. In 2020, it was based on realised data: both unemployment had to fall to its assessed natural rate and inflation had to reach 2% and be on track to moderately exceed it—a higher and more rigid bar.

ance: although the 2020 guidance was framed in state-contingent terms, it effectively represented an Odyssean commitment. First, the guidance established a sequencing in which rates would be raised only after purchases ceased. But because tapering required a lengthy lead time and was designed to proceed gradually, this sequencing could have constrained the timing of lift-off had the FOMC deemed a tighter stance to be appropriate, limiting its flexibility to respond to evolving conditions. Moreover, by tying lift-off to maximum employment and an inflation overshoot without an explicit upper bound on inflation, the FOMC may have departed from the flexible trade-off implied by its new FAIT framework; the formulation committed the Committee to a policy path that could plausibly have become suboptimal under certain shocks. A more symmetric or flexible formulation—such as embedding 'or' conditions or explicit inflation limits—may have kept the guidance closer to the Fed's stated framework, reducing the need for potentially time-inconsistent promises and aligning it more closely with a Delphic structure.

There is some empirical evidence suggesting that the structure of FG may have shaped market perceptions of the Fed's policy framework in unintended ways. For instance, Cieslak, McMahon, and Pang (2024) document a rise in perceived policy error during the post-pandemic period. Bocola *et al.*, (2024) argue that a shift in expectations about the Fed's reaction function—toward one with less emphasis on inflation stabilisation—may have contributed to inflation dynamics. These findings do not speak to the appropriateness of the Fed's stance per se, but rather to how FG can affect credibility and the interpretation of the central bank's objectives.

Although an escape clause was present in the FOMC's statement, it did not appear to play a meaningful role. Commentators largely viewed it as boilerplate, as it was not explicitly integrated into the FG, limiting its usefulness as a source of flexibility.[12]

[12]For instance, see Romer and Romer (2024) and Cieslak, McMahon, and Pang (2024).

Asset Purchases

In contrast to FG, the benefits of asset purchases—namely in restoring market functioning—during the early stages of the pandemic are widely acknowledged. For instance, Vissing-Jorgensen (2021) highlights the importance of purchases (flow effects) in resolving market stress, while Haddad, Moreira, and Muir (2021) show that credible announcements of corporate bond purchases alone were able to restore liquidity. Policymakers have also emphasised the success of asset purchases' role as a liquidity tool during that period in the US and abroad.[13]

However, despite the evolution of the economy and the motivation behind ongoing asset purchases, the structure of the purchase program remained relatively stable. While the share of longer-dated Treasury purchases did increase modestly over time, the overall composition and pace of UST and MBS purchases did not materially adjust in response to the stated rationale shifting from addressing market dysfunction towards fostering accommodative financial conditions. A valid question is whether the Fed's LSAP operations remained well targeted once financial market stress had abated. For instance, MBS purchases continued into 2021 even as mortgage markets appeared robust and housing activity surged (Krishnamurthy, 2022).

This limited degree of adaptation highlights a broader design consideration: when asset purchases are intended to serve multiple purposes—such as restoring market functioning and providing monetary accommodation—the structure of the program must evolve in line with its objectives. As we discuss further below, the absence of a clear delineation between liquidity-driven and demand stimulus-driven purchases may have constrained the Fed's agility in adjusting or exiting its asset purchase program, and may have blurred the communication of its policy intent.

This also highlights the importance of understanding the transmission channels at

[13]For example, see Logan (2020), Bailey *et al.*, (2020) and Schnabel (2021).

play. If, for example, MBS markets are highly segmented, as some theories suggest, then spillovers from MBS purchases to other asset classes may be more limited, implying the expansionary effects of those purchases through non-housing-based channels would be weak. Instead, under the framework of Greenwood, Hanson, and Liao (2018), where capital reallocates gradually across markets, those purchases may still operate with broader and more persistent effects—providing a more compelling rationale for continued MBS purchases even after financial market stress subsides.

4 Looking Forward: Lessons and Open Questions

The experience of 2020-2024 highlights a central challenge in the design and deployment of unconventional monetary policy: how to balance effectiveness at the point of deployment with the flexibility needed to adapt to evolving macroeconomic conditions. While the Fed's actions during the Covid crisis were forceful and timely, hindsight suggests that aspects of the policies adopted lacked the flexibility required to respond swiftly to unforeseen shocks—including the rapid rise in inflation. Through the lens of that challenge, this section sets out key lessons and unresolved questions concerning the use of FG, LSAPs and other unconventional policies.

Forward Guidance

One key lesson from the recent period is that FG frameworks—whether around rates or asset purchases—should be stress-tested for robustness under alternative states of the world. In designing guidance, policymakers must consider the possibility that FG conditions could later become constraints to the mandate's fulfillment, limiting their ability to adjust course, even if such consideration comes at the expense of some effectiveness in pinning down expectations. Any ancillary statements regarding sequencing or timing of policies should be consistent with the main guidance and take

part in the policy stress test.[14]

As part of this, there are several considerations that need to be taken into account:

i) State-contingent guidance offers the most effective balance between flexibility and effectiveness relative to calendar-based or open-ended approaches. However, the specific conditions chosen must be carefully constructed. Under the current Fed's FAIT framework, guidance should aim to clarify the objective of a moderate inflation overshoot while avoiding commitments that may conflict with the framework's underlying trade-offs. In other words, it should remain Delphic—informative, but not binding in a time-inconsistent way. Naturally, any future changes to the FAIT framework would require appropriate adjustments.

ii) Consistent with a Delphic character, the state-dependent nature of the guidance must be clearly communicated, including through well-integrated escape clauses that are easily interpretable by markets and the public. Policymakers should communicate ex ante that if economic conditions evolve materially differently to expectations, then the appropriate guidance may change. Incorporating greater flexibility in this way may require accepting some loss in effectiveness at pinning interest-rate expectations (Eggertsson and Kohn, 2023) .

iii) FG must remain adaptable over time. In extraordinary circumstances, policymakers should be willing to revisit and revise previously stated guidance, with clear communication for the rationale for doing so (Eggertsson and Kohn, 2023; Orphanides, 2023). Anticipating and communicating this adaptability in advance—as in the previous bullet—can ease the path for such revisions if needed.

iv) FG should avoid excessive reliance on realised data and be sufficiently forward looking. Given the lags inherent in the transmission of monetary policy, guid-

[14]One example is the ECB's approach during 2021-22, which adopted a hierarchical structure: the active policy tool (the policy rate) was explicitly tied to achieving the inflation target sustainably, while net asset purchases were positioned as derivative—ending shortly before lift-off.

ance that risks delaying action until thresholds on realised outcomes are met, may be misaligned with the goal of sustainably delivering the policymaker's objectives—even when those objectives include a temporary overshoot.

These features must be balanced against the need for simplicity and clarity. FG, particularly on interest rates, should be accessible to a broad audience, rather than being tailored exclusively to those in financial markets. Overly technical or conditional language risks diminishing its impact. Guidance on LSAPs by nature may be more technical, but communicating its implications for yields at least qualitatively should make it more accessible.

In hindsight, the FOMC may have been better served by FG language closer to its December 2012 formulation, which was conditioned on projections, rather than realised data outturns. Importantly, the design featured an integrated escape clause that preserved price stability while accommodating an inflation overshoot, allowing for conditional commitment without sacrificing flexibility.

More broadly, the experience also highlights that Delphic FG—clarifying the central bank's reaction function—should not be seen as a tool reserved for periods at the ELB. Even above the ELB, clear, state-contingent communication about the likely response of policy to evolving conditions can reduce uncertainty, anchor expectations and improve the transmission of monetary policy. Embedding this guidance as a routine part of the FOMC's communication strategy would strengthen credibility and reduce the risk of misinterpretations about the Fed's objectives, irrespective of the prevailing level of interest rates.

Asset Purchases

As with FG, a key lesson from the recent period is that LSAPs should be stress-tested under alternative scenarios before implementation. Doing so can enhance both the

design and communication of the policy.

As part of the stress testing, there are two main considerations:

i) Asset purchase programs should be separated into purchases aimed at liquidity support versus monetary accommodation, as emphasised in recent work (Kashyap *et al.*, (2025), English and Sack (2024), and Duffie and Keane (2023)).[15] As discussed in Section 3, during the Covid-19 crisis, asset purchases were rapidly deployed to address severe dysfunction in Treasury and MBS markets. However, as conditions stabilised, the same purchase program was repurposed for monetary policy, aiming to support accommodative financial conditions without material adjustments in its design. This lack of differentiation may have created challenges for policy exit. By not differentiating between monetary policy and financial stability asset purchases, the FOMC tied balance-sheet reductions for liquidity-driven interventions to changes in the stance of conventional monetary policy. In doing so, the Fed may have created a form of balance-sheet inertia, where delaying unwinding due to macroeconomic conditions discouraged normalisation even in the absence of financial market stress. If liquidity purchases were clearly identified and communicated as such, and kept distinct from monetary stimulus, their tapering or cessation would signal market health, reducing the risk of over-interpretation for the policy stance (Krishnamurthy, 2022). Moreover, clearly articulating a standing willingness to support liquidity could sustain smooth market functioning without requiring continuous, large-scale purchases. Last but not least, a clear distinction would also ensure the Fed is well-positioned to address market dysfunction above the ELB should such interventions be required.

[15] Kashyap *et al.*, (2025) also propose that, during periods of Treasury market dysfunction driven by leveraged basis trade unwinds, the Fed could ease dealers' balance-sheet stress more effectively by purchasing cash Treasuries while simultaneously selling Treasury futures.

In general, the benefit of delineating asset purchase objectives is that interventions targeting market dysfunction can be tailored to address specific dislocations more effectively. For example, the Bank of England's 2022 gilt market operation adopted a price-based approach, purchasing assets only below a reserve price (linked to prevailing market prices), in contrast to the quantity-based approach typically used for monetary policy operations.[16]

In practice, however, demarcating asset purchases may be more difficult when stress and stimulus needs coincide. While it is theoretically possible to operate two concurrent programs, doing so may raise practical challenges.[17] Therefore, in that scenario, policymakers may face a trade-off between launching a single intervention with blurred aims, or prioritising liquidity support while deferring stimulus-related purchases until market functioning is restored. There is unlikely to be a one-size-fits-all solution. These operational and strategic trade-offs should be assessed and stress tested during peacetime, before the next crisis hits.

Should LSAPs remain a single, integrated tool, its design must be responsive to its evolving purpose. The 2020-2021 program did not materially adjust despite a significant shift in rationale. For instance, MBS purchases continued even as the mortgage market showed signs of overheating (Krishnamurthy, 2022; Kohn, 2025), and the pace of purchases remained fixed at a relatively fast rate, despite the improvement in market conditions.

ii) Committing to a sequencing of tools and treating it as binding may reduce flexibility and detract from the advantage of having multiple tools. During the recent cycle, the FOMC committed to concluding purchases before initiating rate hikes

[16] See Hauser (2022)

[17] As an illustration, the central bank could, in principle, supplement its standard quantity-based auction structure with backstop price-based auctions—set with a larger maximum purchase size—to absorb excess selling pressure during market stress. However, this approach raises several operational challenges, including the risk of confusing market participants or creating incentives for strategic behaviour that could undermine the interventions.

and announced its intention to taper gradually, providing ample advance notice. This sequencing—while intended to ensure predictability—may have introduced additional policy inertia. As Orphanides (2023) and Eggertsson and Kohn (2023) have argued, pre-committing to a prolonged, full taper before lift-off can reduce the FOMC's flexibility, potentially creating a misalignment between policy settings and evolving macroeconomic conditions. Moreover, as we argued in the previous section, the sequencing may have also clashed with the FOMC's rate guidance, as conditions for rate lift-off could have been met before the lead time deemed necessary to halt purchases.

While there are arguments in favour of such sequencing, our view is that they are not sufficiently compelling to be a binding constraint. In principle, whether the sequencing is beneficial depends on the transmission channels policymakers believe are most operative. If portfolio-balance effects dominate, then expectations about the total stock of purchases matters most—and there is no reason to defer rate hikes (Eggertsson and Kohn, 2023). There may be optics challenges with policy tools moving in opposite directions. However, concerns about a perceived inconsistency between raising rates while still conducting purchases can be addressed through communication—for instance, by clarifying that the taper is being staggered to minimise market disruption, not to signal continued policy accommodation.

The strongest rationale for strictly delaying lift-off until after tapering concludes lies in the signalling channel. If LSAPs work in part by delaying expectations of rate increases until after purchases end, raising rates beforehand may dilute this signal in the future. However, as noted earlier, tying lift-off to the end of purchases may instead lead to a sharper expected rise in policy rates afterwards, potentially nullifying the effect on medium-term yields.

Even if sequencing may be desirable at times, it should not become a hard constraint. When delaying rate hikes threatens credibility, a temporary overlap between tapering and tightening—paired with clear communication—need not undermine policy effectiveness.

Beyond our main conclusions, some important questions remain unresolved. One unresolved question concerns the variation in the observed effects of different LSAP episodes on yields, particularly the relatively large impacts of QE1 and QE4 relative to the more muted effects from QE2 and QE3. As discussed in Section 2, several interpretations are plausible. One possibility is anticipation effects: once LSAP becomes a standard tool, its impact may have been increasingly priced in ahead of announcements (Bernanke, 2020; Cahill *et al.*, 2013). A complementary view is that QE1 established a new automatic stabiliser, altering expectations of future interventions and amplifying the initial announcement's effect (Haddad, Moreira, and Muir, 2025). Under this interpretation, subsequent rounds of LSAP may have had smaller marginal impacts because the stabilisation benefits had already been priced in. Finally, some have argued that the potency of LSAPs is state-dependent, operating more strongly during periods of acute financial stress when liquidity and segmentation frictions are elevated (Ray, Droste, and Gorodnichenko, 2024; Vayanos and Vila, 2021).

Each view has theoretical and empirical support, but the relative weight assigned to these explanations has important policy implications. Disentangling the relative importance of these factors remains an open question and is crucial for assessing LSAPs' effective multiplier and guiding the design of future interventions.

Another design question concerns whether purchases should be framed in terms of stock targets (as in QE1, QE2, and the initial Covid announcement) or monthly flow targets (as in QE3 and the expanded Covid program). Carlson *et al.*, (2020) argue that flow-based programs can, in theory, reap the benefits of state-contingent policy: they

allow policymakers to adjust purchases more flexibly in response to shocks, which may also strengthen investor confidence. By contrast, fixed-size programs commit to a pre-specified purchase amount, creating uncertainty about whether and when extensions will occur if conditions evolve.

However, flow-based programs may embed greater inertia. Because purchases continue until specific conditions are met, the burden of proof shifts towards continuation rather than cessation, raising the bar for halting purchases. This dynamic can extend the lead time required to prepare markets for an exit, given the benefits to giving investors ample advance notice to safeguard market functioning. Fixed-size programs, by contrast, terminate naturally without requiring as much justification or signalling, reducing exit frictions. Indeed, Carlson *et al.*, (2020) caution that flow-based programs are prone to a 'ratcheting-up' effect, leading to potentially larger balance-sheet expansions than originally intended.

In practice, the relative flexibility of stock versus flow programs may depend on the timing of shocks. If positive shocks arrive early—around when a fixed-size program might have been re-calibrated—flow-based programs can offer greater responsiveness. But if shocks occur midway through or late in a fixed-size program, flow-based structures may introduce undesirable inertia. Because the timing of shocks is inherently uncertain, policymakers should recognise that fixed-size and flow-based programs embed different forms of inertia at different stages. As such, the choice between a flow-based and stock-based design should be guided by an ex-ante assessment of which type of policy adjustment—early curtailment or late exit—is likely to be more critical given prevailing risks.

Other Tools

Finally, broader questions remain about the design and use of other unconventional tools. One is the role of negative interest rate policy. A growing literature, including

Balloch, Koby, and Ulate (2022), Rostagno *et al.*, (2025) and Mcleay, Tenreyro, and van de Berge (2025), suggests that if appropriately designed and implemented, negative rates can impart meaningful macroeconomic stimulus. Moreover, given the likely state dependence of LSAPs' effectiveness, there may be circumstances where negative rates serve as a more powerful or efficient substitute.

Another open question concerns the design of lending programs. Following the Covid-19 crisis, the Fed launched the Main Street Lending Program (MSLP) to ease banks' balance sheet constraints and encourage lending to small- and medium-sized enterprises (SMEs). However, take-up of the program was modest relative to its maximum announced size, raising questions about its effectiveness (see Appendix). English and Liang (2020) argue that MSLP loans largely displaced lending that banks would have undertaken anyway and that the program's structure may not have provided sufficient incentives to expand credit supply.

Alternative approaches may offer more effective designs. Funding-for-lending schemes—such as the ECB's Targeted Longer-Term Refinancing Operations (TLTROs) or the Bank of England's Term Funding Scheme with additional incentives for SMEs (TFSME)—offer banks low-cost funding, with incentives tied to actual lending behaviour. Empirical evidence, including that reviewed by Bernanke (2020), suggests that such schemes lowered bank funding costs, promoted lending and improved monetary policy pass-through to the real economy. While these programs are not without drawbacks, they may better align incentives and could be considered in future interventions, particularly when weakness in bank lending is a concern.

5 Concluding Remarks

In summary, our main conclusions are as follows. First, unconventional monetary policy tools—namely FG and LSAPs—should remain part of the Fed's toolkit, espe-

cially, but not limited to, the ELB. Second, the design of these tools should be routinely stress tested under alternative scenarios to better manage the trade-offs between flexibility and effectiveness. Third, LSAP programs must be clear about their primary purpose—whether to address market dysfunction or to provide macroeconomic stimulus—as blurred objectives risk constraining policy agility. Finally, separating goals and embedding flexibility into policy design can help central banks adapt more effectively to rapidly evolving conditions without undermining credibility.

Taken together, these lessons—and the broader reflections set out in Section 4—underscore that the choice and design of unconventional policy tools is far from straightforward. These decisions must weigh expected benefits against potential costs, both within individual tools and across the policy toolkit as a whole. As a baseline, we argue that Delphic FG should be a standard feature of the FOMC's communication strategy, both above and at the ELB. Its ability to clarify the outlook and align expectations with the central bank's reaction function makes it a valuable tool in a wide range of environments. Moreover, to the extent that the Fed's underlying framework encompasses inflation overshoots after periods of below-target inflation at the ELB, such overshoots should arise endogenously from adherence to the policy rule, without requiring additional Odyssean commitments.

Beyond that, the optimal deployment of unconventional policies—such as LSAPs, negative interest rates, or targeted lending schemes—depends critically on policymakers' views about transmission mechanisms and the state-dependence of their effects. For example, if LSAPs are thought to operate primarily through portfolio-balance channels, then their effectiveness may be materially lower during periods of smooth market functioning, when arbitrage frictions and segmentation are less binding. Under such a view, the case for LSAPs is strongest during times of stress but attenuates as markets normalise. Similarly, if long-term interest rates are already at very low levels, the marginal benefits from further compressing term premia may be limited, weaken-

ing the case for additional asset purchases and prompting consideration of alternative tools, including negative rates. In particular, if the banking sector is well capitalised and at least partly wholesale funded, negative interest rates should be beneficial, and their perceived downsides limited. Conversely, if the constraint lies in the supply of credit or if bank funding costs are relatively high, a targeted bank lending scheme may be more effective in easing financial and credit conditions. However, one concern is that such policies may be viewed as quasi-fiscal.

These examples are far from exhaustive, but they underscore the need for a structured cost-benefit framework to guide decision-making. Such a framework would account not only for the expected impact of each tool—taking into account their potential state dependency—but also for the degree of uncertainty surrounding those effects and the potential for adverse side effects, whether through financial stability risks, concerns with quasi-fiscal optics, or communication challenges. There is a vast literature on the potential costs associated with unconventional policy tools, but there is little evidence these risks have materialised (Rostagno *et al.*, 2019; Bernanke, 2020; Balloch, Koby, and Ulate, 2022; Bhattarai and Neely, 2022).[18] Importantly, tools should be assessed in relation to one another, with consideration of complementarities or interactions that may enhance or undermine their joint efficacy.

A final point concerns how the costs of LSAPs are measured. Too often, the debate is framed narrowly in terms of the central bank's accounting losses. This approach misses the broader macroeconomic benefits the policy may have delivered. Indeed, if LSAPs succeed in lifting output and inflation, the resulting increase in long-term yields will tend to generate capital losses on the central bank's asset portfolio. But this should be viewed as a feature, not a bug: the losses arise precisely because the policy

[18]One potential exception is the finding by Acharya *et al.*, (2023), who argue that LSAPs have increased liquidity risk at some banks. They document that reserve accumulation during QE led banks—particularly smaller ones—to issue more uninsured demand deposits and credit lines, increasing claims on liquidity that did not commensurately decline during QT, thereby raising vulnerability to liquidity shocks.

succeeded in stimulating the economy. Conversely, if LSAPs fail to raise inflation and growth, central banks may record no losses—but only because the economy remains stuck at the ELB. The true cost in that case is the foregone recovery, not the absence of an accounting loss. This logic emphasises that cost-benefit assessments of LSAPs must move beyond narrow fiscal metrics to incorporate the broader macroeconomic objectives central banks are mandated to pursue. In line with this, d'Avernas *et al.*, (2024) study the cost-benefit trade-off of LSAPs taking into account both fiscal costs and real-economy benefits, and conclude that LSAP programs in the United States made a positive net present contribution to welfare.

References

Acharya, Viral V, Chauhan, Rahul S, Rajan, Raghuram, and Steffen, Sascha (2023). "Liquidity Dependence and the Waxing and Waning of Central Bank Balance Sheets", *NBER Working Paper*,

Adrian, Tobias, Erceg, Christopher, Kolasa, Marcin, Lindé, Jesper, McLeod, Roger, Veyrune, Romain, and Zabczyk, Pawel (2024). "New Perspectives on Quantitative Easing and Central Bank Capital Policies", *IMF Working Papers*, p. 1.

Altavilla, Carlo, Carboni, Giacomo, and Motto, Roberto (2021). "Asset Purchase Programs and Financial Markets: Lessons from the Euro Area", *International Journal of Central Banking*, Vol. 17 No. 4, pp. 1–47.

Altavilla, Carlo, Rostagno, Massimo, and Schumacher, Julian (2025). *When Banks Hold Back: Credit and Liquidity Provision*, ECB Working Paper Series No. 3009. European Central Bank.

Bailey, Andrew John, Bridges, Jonathan, Harrison, Richard, Jones, Josh, and Mankodi, Aakash (2020). "The Central Bank Balance Sheet as a Policy Tool: Past, Present and Future", *Bank of England Staff Working Paper*,

Balloch, Cynthia, Koby, Yann, and Ulate, Mauricio (2022). "Making Sense of Negative Nominal Interest Rates", Unpublished manuscript. **available at**: https://www.frbsf.org/wp-content/uploads/sites/4/wp2022-16.pdf.

Bauer, Michael D. and Rudebusch, Glenn D. (2014). "The Signaling Channel for Federal Reserve Bond Purchases", *International Journal of Central Banking*, Vol. 10 No. 3, pp. 233–289.

Baumeister, Christiane and Benati, Luca (2013). "Unconventional Monetary Policy and the Great Recession: Estimating the Macroeconomic Effects of a Spread Compression at the Zero Lower Bound", *International Journal of Central Banking*, Vol. 9 No. 2, pp. 165–212.

Bernanke, Ben S. (2020). "The New Tools of Monetary Policy", *American Economic Review*, Vol. 110 No. 4, pp. 943–983.

Bhattarai, Saroj, Eggertsson, Gauti B., and Gafarov, Bulat (2023). "Time Consistency and Duration of Government Debt: A Model of Quantitative Easing", *The Review of Economic Studies*, Vol. 90 No. 4, pp. 1759–1799.

Bhattarai, Saroj and Neely, Christopher J. (2022). "An Analysis of the Literature on International Unconventional Monetary Policy", *Journal of Economic Literature*, Vol. 60 No. 2, pp. 527–597.

Bocola, Luigi, Dovis, Alessandro, Jørgensen, Kasper, and Kirpalani, Rishabh (2024). "Bond Market Views of the Fed", No. 32620.

Bundick, Brent, Herriford, Trenton, and Smith, Andrew Lee (2017). "Forward Guidance, Monetary Policy Uncertainty, and the Term Premium", *Federal Reserve Bank of Kansas City Working Paper*, No. 17-07.

Cahill, Michael E., D'Amico, Stefania, Li, Canlin, and Sears, John S. (2013). "Duration Risk Versus Local Supply Channel in Treasury Yields: Evidence from the Federal Reserve's Asset Purchase Announcements", *Board of Governors of the Federal Reserve System*, No. 2013-35.

Campbell, Jeffrey R., Evans, Charles L., Fisher, Jonas D. M., and Justiniano, Alejandro (2012). "Macroeconomic Effects of Federal Reserve Forward Guidance", *Brookings Papers on Economic Activity*, Vol. 2012 No. Spring, pp. 1–54.

Carlson, Mark, D'Amico, Stefania, Fuentes-Albero, Cristina, Schlusche, Bernd, and Wood, Paul (2020). "Issues in the Use of the Balance Sheet Tool", *Finance and Economics Discussion Series*, Vol. 2020.0 No. 70, pp. 1–38.

Chavaz, Matthieu, Patozi, Alba, and Wazzi, Mo (forthcoming). "Draining the Well: Bank Lending in the Era of Quantitative Tightening", *Bank of England Staff Working Paper*,

Chen, Han, Cúrdia, Vasco, and Ferrero, Andrea (2012). "The Macroeconomic Effects of Large-scale Asset Purchase Programmes", *The Economic Journal*, Vol. 122 No. 564, F289–F315.

Christensen, Jens H.E. and Rudebusch, Glenn D. (2012). "The Response of Interest Rates to US and UK Quantitative Easing", *Economic Journal*, Vol. 122 No. 564, F385–F414.

Cieslak, Anna, McMahon, Michael, and Pang, Hao (2024). "Did I Make Myself Clear? The Fed and the Market in the Post-2020 Framework Period", Brookings Conference Draft.

d'Avernas, Adrien, Fraisse, Antoine Hubert de, Ning, Liming, and Vandeweyer, Quentin (2024). "The Fiscal Cost of Quantitative Easing", manuscript. **available at**: https://adriendavernas.com/papers/durationrisk.pdf.

D'Amico, Stefania and King, Thomas B. (2013). "Flow and stock effects of large-scale treasury purchases: Evidence on the importance of local supply", *Journal of Financial Economics*, Vol. 108 No. 2, pp. 425–448. DOI: 10.1016/j.jfineco.2012.11.007.

De Santis, Roberto A. (2020). "Impact of the Asset Purchase Programme on euro area government bond yields using market news", *Economic Modelling*, Vol. 86, pp. 192–209. DOI: 10.1016/j.econmod.2019.06.011.

Del Negro, Marco, Giannoni, Marc P., and Patterson, Christina (2023). "The Forward Guidance Puzzle", *Journal of Political Economy Macroeconomics*, Vol. 1 No. 1, pp. 43–79.

Diamond, William, Jiang, Zhengyang, and Ma, Yiming (2024). "The reserve supply channel of unconventional monetary policy", *Journal of Financial Economics*, Vol. 159, p. 103887.

Du, Wenxin, Hébert, Benjamin, and Li, Wenhao (2023). "Intermediary balance sheets and the treasury yield curve", en. *Journal of Financial Economics*, Vol. 150 No. 3, p. 103722. DOI: 10.1016/j.jfineco.2023.103722.

Duffie, James Darrell and Keane, Frank M. (2023). "Market-Function Asset Purchases", *Federal Reserve Bank of New York Staff Report*,

Eggertsson, Gauti B. and Kohn, Donald (2023). "The Inflation Surge of the 2020s: The Role of Monetary Policy", *Hutchins Center Working Paper*,

Ehrmann, Michael, Gaballo, Gaetano, Hoffmann, Peter, and Strasser, Georg (2019). "Can more public information raise uncertainty? The international evidence on forward guidance", *Journal of Monetary Economics*, Vol. 108, pp. 93–112.

English, William and Sack, Brian (2024). "Challenges Around the Fed's Monetary Policy Framework and Its Implementation", *Brookings Papers on Economic Activity*,

English, William B and Liang, J Nellie (2020). "Designing the Main Street Lending Program: Challenges and Options",

Evans, Charles (2017). *The Future of Odyssean and Delphic Guidance - Federal Reserve Bank of Chicago*, **available at**: https://www.chicagofed.org/publications/speeches/2017/11-14-2017-future-odyssean-and-delphic-guidance-charles-evans-frankfurt-ecb#ftn1.

Fabo, Brian, Jančoková, Martina, Kempf, Elisabeth, and Pástor, Ľuboš (2021). "Fifty shades of QE: Comparing findings of central bankers and academics", *Journal of Monetary Economics*, Vol. 120, pp. 1–20.

Femia, Katherine, Friedman, Steven, and Sack, Brian P. (2013). "The Effects of Policy Guidance on Perceptions of the Fed's Reaction Function", *Federal Reserve Bank of New York Staff Report*,

Feroli, Michael, Greenlaw, David, Hooper, Peter, Mishkin, Frederic S., and Sufi, Amir (2017). "Language after liftoff: Fed communication away from the zero lower bound", *Research in Economics*, Vol. 71, pp. 452–490.

Gagnon, Joseph E., Raskin, Matthew, Remache, Julie, and Sack, Brian P. (2011). "The Financial Market Effects of the Federal Reserve's Large-Scale Asset Purchases", *International Journal of Central Banking*, Vol. 7 No. 1, pp. 3–43.

Gertler, Mark and Karadi, Peter (2013). "QE 1 vs. 2 vs. 3...: A Framework for Analyzing Large-Scale Asset Purchases as a Monetary Policy Tool", *International Journal of Central Banking*, Vol. 9 No. S1, pp. 5–53.

Greenwood, Robin, Hanson, Samuel, Stein, Jeremy C., and Sunderam, Adi (2023). "A Quantity-Driven Theory of Term Premia and Exchange Rates", *The Quarterly Journal of Economics*, Vol. 138 No. 4, pp. 2327–2389.

Greenwood, Robin, Hanson, Samuel, and Vayanos, Dimitri (2015). "Forward Guidance in the Yield Curve: Short Rates versus Bond Supply", *National Bureau of Economic Research Working Paper*,

Greenwood, Robin, Hanson, Samuel G, and Liao, Gordon Y (2018). "Asset Price Dynamics in Partially Segmented Markets", en. *The Review of Financial Studies*, Vol. 31 No. 9, pp. 3307–3343.

Gulati, Chaitri and Smith, Lee (2022). "The Evolving Role of the Fed's Balance Sheet: Effects and Challenges", *The Federal Reserve Bank of Kansas City Economic Review*, **available at**: https://www.kansascityfed.org/research/economic-review/the-evolving-role-of-the-feds-balance-sheet-effects-and-challenges/.

Haddad, Valentin, Moreira, Alan, and Muir, Tyler (2021). "When Selling Becomes Viral: Disruptions in Debt Markets in the COVID-19 Crisis and the Fed's Response", *Review of Financial Studies*, Vol. 34 No. 11, pp. 5309–5351.

– (2025). "Whatever It Takes? The Impact of Conditional Policy Promises", *American Economic Review*, Vol. 115 No. 1, pp. 295–329.

Hattori, Masazumi, Schrimpf, Andreas, and Sushko, Vladyslav (2016). "The Response of Tail Risk Perceptions to Unconventional Monetary Policy", *American Economic Journal: Macroeconomics*, Vol. 8 No. 2, pp. 111–136.

Hauser, Andrew (2022). "Thirteen days in October: how central bank balance sheets can support monetary and financial stability", **available at**: https://www.bankofengland.

co.uk/-/media/boe/files/speech/2022/november/thirteen-days-in-october-speech-by-andrew-hauser.pdf.

Joyce, M. A. S., McLaren, N., and Young, C. (2012). "Quantitative easing in the United Kingdom: evidence from financial markets on QE1 and QE2", *Oxford Review of Economic Policy*, Vol. 28 No. 4, pp. 671–701.

Kandrac, John and Schlusche, Bernd (2021). "Quantitative easing and bank risk taking: evidence from lending", *Journal of Money, Credit and Banking*, Vol. 53 No. 4, pp. 635–676.

Kashyap, Anil K., Stein, Jeremy C., Wallen, Jonathan L., and Younger, Joshua (2025). "Treasury Market Dysfunction and the Role of the Central Bank", Brookings Papers on Economic Activity, Draft, March 2025. **available at**: https://faculty.chicagobooth.edu/-/media/faculty/anil-kashyap/papers/kswy-brookings-conference-draft-exhibits-in-text.pdf.

Kim, Kyungmin, Laubach, Thomas, and Wei, Min (2023). "Macroeconomic Effects of Large-Scale Asset Purchases: New Evidence", *Finance and Economics Discussion Series*, No. 2020-047r1, pp. 1–89.

Kohn, Donald (2025). *Fed should be sure to include monetary policy tools in forthcoming framework review*, **available at**: https://www.brookings.edu/articles/fed-should-be-sure-to-include-monetary-policy-tools-in-forthcoming-framework-review/.

Krishnamurthy, Arvind (2022). "Lessons for Policy from Research", *Brookings Papers on Economic Activity*, Vol. 2022 No. 2, pp. 233–242.

Logan, Lorie K. (2020). *The Federal Reserve's Market Functioning Purchases*, https://www.newyorkfed.org/newsevents/speeches/2020/log200715. Remarks at SIFMA Webinar.

Mcleay, Michael, Tenreyro, Silvana, and van de Berge, Lukas (2025). "Negative Rates and the Effective Lower Bound: Theory and Evidence", LSE Manuscript.

Orphanides, Athanasios (2023). "Forward Guidance and the Price Stability Mandate", *IMFS Working Paper Series*, No. 190.

Raskin, Matthew (2013). *The Effects of the Federal Reserve's Date-Based Forward Guidance*, Finance and Economics Discussion Paper No. 2013-37. Federal Reserve Board.

Ray, Walker, Droste, Michael, and Gorodnichenko, Yuriy (2024). "Unbundling Quantitative Easing: Taking a Cue from Treasury Auctions", *Journal of Political Economy*, Vol. 132 No. 9.

Reis, Ricardo and Tenreyro, Silvana (2022). "Helicopter Money: What Is It and What Does It Do?", *Annual Review of Economics*, Vol. 14 No. 1, pp. 313–335. **available at**: https://ideas.repec.org/a/anr/reveco/v14y2022p313-335.html.

Rodnyansky, Alexander and Darmouni, Olivier M. (2017). "The Effects of Quantitative Easing on Bank Lending Behavior", *The Review of Financial Studies*, Vol. 30 No. 11, pp. 3858–3887. (accessed 22 Apr. 2024).

Romer, Christina D. and Romer, David H. (2024). "Did the Federal Reserve's 2020 Policy Framework Limit Its Response to Inflation? Evidence and Implications for the Framework Review", *Brookings Papers on Economic Activity*,

Rostagno, Massimo, Altavilla, Carlo, Carboni, Giacomo, Lemke, Wolfgang, Motto, Roberto, and Guilhem, Arthur Saint (2021). "Combining Negative Rates, Forward Guidance and Asset Purchases: Identification and Impacts of the ECB's Unconventional Policies", *Working Paper Series*,

Rostagno, Massimo, Altavilla, Carlo, Carboni, Giacomo, Lemke, Wolfgang, Motto, Roberto, Guilhem, Arthur Saint, and Yiangou, Jonathan (2019). "A Tale of Two Decades: The Ecb's Monetary Policy at 20", *ECB Working Paper Series*,

Rostagno, Massimo, Altavilla, Carlo, Carboni, Giacomo, Lemke, Wolfgang, Motto, Roberto, and Saint-Guilhem, Arthur (2025). "An options-based impact study of the negative interest rate policy and forward guidance", *Journal of Monetary Economics*, DOI:

10.1016/j.jmoneco.2025.103776. **available at**: https://doi.org/10.1016/j.jmoneco.2025.103776.

Rudebusch, Glenn D. and Williams, John C. (2008). "Revealing the Secrets of the Temple: The Value of Publishing Central Bank Interest Rate Projections", *Asset Prices and Monetary Policy*. Ed. by Campbell, John Y. University of Chicago Press, pp. 247–284.

Schnabel, Isabel (2021). *Asset purchases: from crisis to recovery*, https://www.ecb.europa.eu/press/key/date/2021/html/ecb.sp210920~ae2c7412dc.en.html. Speech at the Annual Conference of Latvijas Banka.

Swanson, Eric T. (2021). "Measuring the Effects of Federal Reserve Forward Guidance and Asset Purchases on Financial Markets", *Journal of Monetary Economics*, Vol. 118, pp. 32–53.

– (2024). "The Macroeconomic Effects of the Federal Reserve's Conventional and Unconventional Monetary Policies", *Unpublished Manuscript*, University of California, Irvine.

Tenreyro, Silvana (2023). *Quantitative Easing and Quantitative Tightening*, https://www.bankofengland.co.uk/speech/2023/april/quantitative-easing-quantitative-tightening-speech-silvana-tenreyro. Speech given at the Scottish Economic Society Annual Conference, Glasgow.

Vayanos, Dimitri and Vila, Jean-Luc (2021). "A Preferred-Habitat Model of the Term Structure of Interest Rates", *Econometrica*, Vol. 89 No. 1, pp. 77–112.

Vissing-Jorgensen, Annette (2021). "The Treasury Market in Spring 2020 and the Response of the Federal Reserve", *Journal of Monetary Economics*, Vol. 124, pp. 19–47.

Vlieghe, Gertjan (2021). *Running out of room: revisiting the 3D perspective on low interest rates*, https://www.bankofengland.co.uk/speech/2021/july/gertjan-vlieghe-speech-at-the-london-school-of-economics. Speech at the London School of Economics.

Walentin, Karl (2014). "Business Cycle Implications of Mortgage Spreads", *Journal of Monetary Economics*, Vol. 67, pp. 62–77.

Williams, John C. (2016). *Discussion of 'Language after Liftoff: Fed Communication Away from the Zero Lower Bound'*, Presentation at the US Monetary Policy Forum, New York, NY. February 26.

Woodford, Michael (2012). "Methods of Policy Accommodation at the Interest-Rate Lower Bound", Jackson Hole Symposium Paper.

Appendix

Besides FG and QE, several other measures were implemented after the onset of the Covid-19 pandemic. These facilities were designed to support a wide range of activities, including lending to state/local governments, small and medium-sized businesses, large corporations, and primary dealers. Other schemes targeted the stabilisation of money market funds, commercial paper markets, asset-backed securities, and central bank dollar liquidity swaps. They were either entirely new facilities—like the MLF, MSLP, PMCCF/SMCCF, PPPLF, FIMA outlined below—or expanded existing programs. Although some of the announced programs were large in scale, most were not used anywhere near their full capacity.

- **Municipal Liquidity Facility (MLF)**: Authorised up to $500 billion in state/local government loans. *Usage: $6.4bn.*
- **Main Street Lending Program (MSLP)**: Participations of up to $600 billion in loans for small and medium-sized businesses. *Usage: $16.6bn.*
- **Commercial Paper Funding Facility (CPFF):** Purchased commercial paper to support short-term funding markets. *Usage: $4.2bn.*
- **Primary Dealer Credit Facility (PDCF):** Provided collateralized loans to primary dealers. *Usage: $33.4bn.*
- **Money Market Mutual Fund Liquidity Facility (MMLF):** Offered loans to banks against collateral purchased from money market funds. *Usage: $53.2bn.*
- **Primary/Secondary Market Corporate Credit Facilities (PMCCF/SMCCF):** Authorized up to $750 billion in corporate bonds purchases - PMCCF for direct issuance, SMCCF for secondary market purchases. *Usage: $0bn (PMCCF), $14.3bn (SMCCF).*

- **Term Asset-Backed Securities Loan Facility (TALF):** Authorized up to $100bn of lending against asset-backed securities. *Usage: $4.1bn.*
- **Paycheck Protection Program Liquidity Facility (PPPLF):** Provided term funding to banks using PPP loans as collateral, with a theoretical cap linked to the total PPP volume, originally at $349 billion, then expanded to $953 billion. *Usage: $90.6bn.*
- **Foreign International Monetary Authorities Repo (FIMA):** Offered dollar liquidity to foreign central banks via repo transactions. *Usage: $1.4bn.*
- **CB Liquidity Swaps:** Expanded swap lines with major central banks (BoC, ECB, BoE, BoJ, SNB) and introduced new, temporary lines with others (e.g., Norges Bank, RBA, BCB, BoK, MAS). *Usage: $450bn.*