The Effects of Quantitative Tightening on Financial Markets: A Comparison with Quantitative Easing*

Simon Lloyd,[a] Daniel Ostry,[b] and Filippo Busetto[c]

January 2025

1 INTRODUCTION

Balance-sheet policies are no longer 'new' tools in central banks' arsenals, but their effects are still debated despite a vast literature assessing the impact of Quantitative Easing (QE) policies (surveyed in Bhattarai and Neely, 2022). Early studies into QE focused on financial-market impacts,[1] while authors were able to analyse more QE's macroeconomic impacts as time wore on.[2] Event studies were typically used to analyse QE's financial-market impacts (Gürkaynak and Wright, 2013), assessing bond-yield moves around central-bank policy announcements and examining the factors explaining asset-prices moves – e.g., risk-neutral expectations of future short-term interest rates or term premia. Authors agreed that QE announcements – especially those around new asset-purchase programmes – reduced bond yields, but different studies ascribed varying degrees of importance to the different factors explaining these changes.

As central banks have sought to tighten policy after more than a decade at, or close to, the effective lower bound (ELB) for short-term interest rates, discussions around whether and how to go about

* The views expressed here are solely those of the authors and so cannot be taken to represent those of the Bank of England or any of its committees, or to state Bank of England policy.
[a] Bank of England and Centre for Macroeconomics. Email Address: simon.lloyd@bankofengland.co.uk.
[b] Bank of England and Centre for Macroeconomics. Email Address: daniel.ostry@bankofengland.co.uk.
[c] Bank of England. Email Address: filippo.busetto@bankofengland.co.uk.
[1] See, e.g., Gagnon, et al., 2011; Joyce, et al., 2011; Krishnamurthy and Vissing-Jorgensen, 2011; Breedon, et al., 2012; Christensen and Rudebusch, 2012; Bauer and Rudebusch, 2014.
[2] See, e.g., Gambacorta, et al., 2014; Haldane, et al., 2016; Weale and Wieladek, 2016; Lloyd, 2017, as well as JoyceChapter and WieladekChapter in this volume.

Quantitative Tightening (QT) have been brought to the fore (e.g., Jefferson, 2023; Ramsden, 2023; Schnabel, 2023; Tenreyro, 2023). However, unlike QE, the literature on QT is, necessarily, more nascent (some exceptions include, Bräuning, 2017; Kim, et al., 2020; Smith and Valcarcel, 2023; D'Amico and Seida, 2024; Du, et al., 2024; Lloyd and Ostry, 2024, as well as BoyarchenkoChapter in this volume). Therefore, understanding whether QT has equal and opposite effects to QE is a pressing question.

In this chapter, mirroring the approach in the early QE literature, we focus on the financial-market effects of QT. We first analyse how government bond yields changed on QE and QT announcement dates. This evidence allows us to compare the effects of QT announcements on the yield curve to the range of event studies into the yield effects of QE announcements.

The general picture from these event studies is that, compared to QE announcements, the magnitude of yield changes on QT announcement dates is muted. We reach this conclusion by analysing one-day changes in 2- and 10-year government bond yields on QE and QT announcement dates in the US and UK. In isolation, our evidence suggests that QT announcements were associated with more limited impacts on interest-rate expectations and term premia.

However, the information content in QE/QT announcements has changed over time and, as noted by Smith and Valcarcel (2023), the comparatively limited QT announcement effects are likely by design, a result of policymaker's objectives. In both the US and UK, the Federal Open Market Committee (FOMC) and Monetary Policy Committee (MPC) have sought to carry out QT in a gradual and predictable manner to limit the financial-market impact of such announcements. The event-study evidence we present suggests that, to date, this has indeed been the case; QT announcements have not come as a 'surprise', i.e., contained limited new information for market participants to react to.

However, even if these estimates reflect the ‘modal’ effects of QT announcements on financial markets, the past may not always be a good guide for the future. So, it is also important to understand the ‘risks’ associated with such policies. To address this, we analyse the sensitivity of government bond yields to ‘surprise’ moves in financial markets around QE and QT announcements, i.e., reactions to unforeseen information in central-bank announcements. These surprises are backed out from intra-day asset-price changes around policy announcements. While such announcements may contain information about a range of monetary policies, we apply the assumptions of Swanson (2021) to focus on US asset-price surprises that weigh on medium- and long-term expectations and, therefore, most closely reflect the maturities associated with QE and QT. Applying the empirical specification of Lloyd and Ostry (2024), we then document that these QT surprises post-2017 had larger and more persistent causal effects on US 2-year Treasury yields than equal-sized QE surprises. On the other hand, we do not find evidence of asymmetries at the 10-year horizon.

Finally, we seek to understand the mechanisms underpinning this, by using empirical decompositions of US Treasury yields into expectations of future short-term interest rates and term premia (Kim and Wright, 2005; Adrian, et al., 2013; Lloyd, 2020). Despite differences in these three decompositions, they all indicate that asymmetries at the 2-year horizon arise because QT surprises have larger and more persistent effects on expected future rates than equal-sized QE surprises. We then show that this is consistent with a simple equation characterising the term structure of interest rates, with an effective lower bound (ELB) on future short-term rate expectations.

While our analysis of the daily-frequency effects of QE and QT announcements of financial markets does not provide a complete picture into the possible similarities and differences between the two, it does provide an initial indication about the potentially asymmetric effects of QT (vs. QE) on the real economy. To the extent that policymakers wish to minimise the economic costs of QT, as our event-study evidence suggests, our yield-sensitivity analysis indicates that continued and concerted efforts to conduct QT "gradually" and "predictably" are likely to be important factors in limiting financial-market responses.

The remainder of the chapter has the following structure. Section 2 presents our event-study evidence, before Section 3 documents our yield-sensitivity analysis. Section 4 concludes.

2 Event-Study Evidence

To provide some initial indication as to whether QE and QT announcements had differential effects, we begin by assessing how bond yields responded to policy announcements. 'Event studies' of this form were common in the early QE literature (e.g., Gagnon, et al., 2011; Joyce, et al., 2011; Krishnamurthy and Vissing-Jorgensen, 2011; Breedon, et al., 2012; Christensen and Rudebusch, 2012; Bauer and Rudebusch, 2014).

Such event studies rely on the lumpy nature of monetary-policy announcements. As is the norm, we evaluate the change in interest rates within a narrow (one-day) event window on event dates where notable announcements pertaining to QE or QT occurred. To gauge the effects of policy announcements across the yield curve, we report one-day changes in the 2- and 10-year zero-coupon government bond yields.

Table 1 reports QE and QT event dates for the US. The 9 QE dates, presented in the left-hand columns, correspond with those studied in Krishnamurthy and Vissing-Jorgensen (2011, 2013). As is well-documented in the literature, the one-day changes in government bond yields demonstrate that QE announcements led to significant reductions in US Treasury yields. On average across the 9 announcement dates, 10-year yields fell by nearly 15bps, while 2-year yields declined by 6.5bps. The earliest announcements had some of the most pronounced effects on yields. However, even within this set of 9 events, the ‘surprise’ content of announcements varies; for instance, while early QE announcements resulted in sizeable declines in yields, event the fourth announcement on 28 January 2009 was met with a small increase in yields, as market participants anticipated more information about the possibility and timing of purchases of longer-dates US Treasuries.

In contrast, US yields did not *increase* in the same magnitude on QT announcement days. The right-hand columns in Table 1 report 11 US QT event dates, which correspond to those used by Smith and Valcarcel (2023). Of those dates, the first two events (22 May 2013 and 19 June 2013) were tapering announcements, where the FOMC revealed intentions to slow the pace of asset purchases. Compared to the subsequent nine dates – events where the FOMC communicated plans to reduce their balance-sheet size, either in statements, minutes or speeches – these tapering announcements stand out. On these two dates, 10-year yields rose by 10bps and 14bps, respectively – similar in magnitude to some QE dates. But on the nine balance-sheet reduction dates, US yields increased only marginally in comparison to the magnitude of changes seen on QE announcement dates. On average, 2-year yields increased by a little under 1.5bps, while 10-year yields rose by just over 2bps only.

<TABLE 1 HERE>

In isolation, this comparison of yield changes suggests that – except for tapering dates – announcements of balance-sheet reductions were associated with limited changes in US financial markets. However, these results could also reflect variation in the surprise-content of announcements, rather than a fundamental distinction between QE and QT. Indeed, as Smith and Valcarcel (2023) note, the comparatively small effects of QT announcements on US financial markets may have been by design. Indeed, Yellen (2017) emphasises that, in contrast to QE, a key aim of FOMC communications around QT was to mitigate market reaction:

“*…the plan is one that is consciously intended to avoid creating market strains and to allow the market to adjust to a very gradual and predictable plan. My hope and expectation is that when we decide to go forward with this plan, that there will be very little reaction to it, that it’s clear how we intend to proceed, and that this is something that will just run quietly in the background over a number of years, leading to a reduction in the size of our balance sheet and in the outstanding stock of reserves […] as one of my colleagues, President Harker, described it, it will be like watching paint dry, that this will just be something that runs quietly in the background.*” (Yellen, 2017)

The UK reactions display a similar picture, as Table 2 documents. QE announcements in the UK, listed in the left-hand columns, were associated with significant reductions in interest rates across the yield curve, albeit with variation across different rounds of QE (Busetto, et al., 2022). The largest reductions in yields were associated with the first £200bn QE programme. Joyce, et al. (2011) estimate that this led to a fall in medium to long-term gilts of around 100bps—starting with the near-32bp reduction in 10-year yields on the first announcement dates (5 March 2009).

Despite occuring during a period of short-term policy rate tightening, QT announcements – outside of the September 2022 ‘LDI crisis’ period, a time of marked financial-market volatility – have generally had limited effects on government bond yields. As the right-hand columns of Table 2 show, 2- and 10-year yields have, on average risen by less than 1bp and 2bps, respectively, on such dates.

<TABLE 2 HERE>

As in the US, these limited financial-market effects from QT announcements are largely by design, in line with the objectives set out by the MPC. Indeed, MPC minutes have explicitly noted that the impact of a reduction in the stock of purchased assets “*is likely to be smaller than that of asset purchases on* *average over the past*" provided that such a reduction takes place "*in a gradual and predictable manner and when markets are functioning normally*" (MPC, 2021).

3 THE SENSITIVITY OF YIELDS TO SURPRISES: ASYMMETRIES AND RISKS

Overall, the evidence from raw event studies suggests that announcement *effects* from QT have been less pronounced in magnitude relative to QE announcements, especially in the US. This is, to a large extent, by design; central banks have sought to clarify that QT is not an 'active' tool for policy in stabilising inflation. In this sense, past evidence suggests that future QT announcements could continue to have limited effects on financial markets.

However, the past may not always be a good guide to the future. So, to understand the *risks* around QT, it is insightful to analyse the sensitivities of bond yields to 'surprises'. Doing so can indicate how 'news' about QT transmits through financial markets. To do this, we draw on the empirical framework of Lloyd and Ostry (2024), who investigate the sensitivity of US yields to QE and QT surprises. We focus on the US, where QT initially occurred while short-term interest rates were at (or close to) their ELB – as the dates in the right-hand column of Table 1 evidence.[3]

3.1 EMPIRICAL SPECIFICATION

The setup of Lloyd and Ostry (2024) focuses on the effects of US QE and QT surprises on US Treasury yields at a daily frequency. Since changes in Treasury yields in turn drive the transmission of monetary policy to real activity, the response of these asset prices in the weeks following the FOMC

[3] By the same reasoning, we do not extend our analysis to cover UK QT, since that occurred during a short-rate tightening cycle, making it more challenging to disentangle the effects of multiple concurrent policies from asset-price surprises alone.

announcements provide an indication of the (potentially distinct) effects of QE and QT, albeit not a complete picture.

To identify QT and QE shocks, Lloyd and Ostry (2024) leverage the high-frequency LSAP surprises proposed and constructed by Swanson (2021). These shocks are estimated by decomposing monetary-policy surprises, extracted as common factors in asset-price movements in thirty-minute windows around FOMC announcements, into three distinct components: shocks to the level of the effective federal funds rate, forward-guidance shocks to its expected path, and LSAP shocks to the Fed's balance-sheet size. More specifically, Swanson (2021) constructs these shocks by rotating three factors that underlie a panel of asset-price movements, which together explain 94% of variation in asset-price changes around FOMC announcements from July 1991 to June 2019, using the following restrictions:

- both forward-guidance and LSAP shocks have no contemporaneous influence on the federal funds rate; and,
- the variance of LSAP shocks is minimised from 1991 to 2008.

A narrative check of the rotated factors supports the interpretation that they reflect surprises to the three types of interest-rate policies used by central banks. As such, the Swanson (2021) surprises – in particular the LSAP factor – are well suited for our investigation into the asymmetric effects of QE and QT.

Figure 1 plots the Federal Reserve LSAP surprises from December 2008 (when LSAPs began) to June 2019 (the end of the available sample) in units of standard deviations. The announcement of the Fed's first LSAP programme (QE1, which included the purchase of Treasuries and Mortgage-Backed Securities), on 18 March 2009, marks the largest surprise in the sample. On that date, the Fed announced the purchase of over $1.1 trillion of long-term bonds – around 16% of the outstanding US Treasury market at the time. This substantial easing is captured as a nearly-six standard-deviation expansionary (negative) surprise (policy looser than expected). Given the large size of this shock, alongside evidence in Swanson (2021) and Lloyd and Ostry (2024) who find that the effects of LSAP surprises on yields are even more persistent when excluding QE1, we henceforth omit the QE1 surprise from our baseline results – although our headline conclusions are robust to their inclusion.

<FIGURE 1 HERE>

The 'QE2' announcement surprise (focused solely on the purchase of US Treasuries) on 10 August 2010 and the MEP1 'Operation Twist' surprise on 21 September 2011 are also visible and, reassuringly, show up as negative shocks. The largest contractionary (positive) surprise (policy tighter than expected), of around two standard deviations, occurred on 5 May 2013 around the 'Taper Tantrum' – an event that was not associated with any actual tightening *ex post*. This policy reversal ('Taper pushed') shows up as the large expansionary (negative) surprise in the subsequent FOMC meeting on 19 June 2013.

Following Smith and Valcarcel (2023), as in Lloyd and Ostry (2024), we focus on two noteworthy periods of Fed QT policy, which we highlight in Figure 1 as well. First, an 'Asset-Runoff' phase from October 2017 to the end of our sample. In this period, the Fed actively purchased fewer assets than were maturing, such that bank reserves and Fed assets declined. Second, a 'Full-Reinvestment' phase from October 2014 to September 2017, when reserves passively declined, but the Fed reinvested proceeds of maturing securities to keep asset holdings constant. The surprises in Figure 1 during these periods are somewhat more muted—consistent with the fact that QT-related events generally lacked the large announcement effects that characterised QE. Nevertheless, over the two phases, there were some significant surprises, for instance, the 0.7 standard-deviation tightening on 19 June 2019.

Combining the LSAP surprises and the time-period classification, Lloyd and Ostry (2024) assess the distinct effects of QE, QT in the Asset-Runoff (AR) and QT in the Full-Reinvestment (FR) phases on financial markets using the following local-projection setup:

$$y_{M,t+h} - y_{M,t-1} = \alpha^h + \beta^h \varepsilon_t^{lsap} + \delta_{FR}^h \left(\varepsilon_t^{lsap} \times \mathbf{1}_t^{FR}\right) + \delta_{AR}^h \left(\varepsilon_t^{lsap} \times \mathbf{1}_t^{AR}\right)$$
$$+\theta_{FR}^h \mathbf{1}_t^{FR} + \theta_{AR}^h \mathbf{1}_t^{AR} + \boldsymbol{\gamma}^h \boldsymbol{x}_t + u_t^h \qquad (1)$$

where ε_t^{lsap} is the LSAP-surprise observed on the 85 FOMC announcement days between December 2008 and June 2019, and $h = 0,1, \dots ,50$ is the number of business days over which the dynamic response of the dependent variable $y_{M,t+h}$ is estimated. $\mathbf{1}_t^{FR}$ and $\mathbf{1}_t^{AR}$ are dummy variables which are set to 1 (0 otherwise) if the surprise occurred during the Full-Reinvestment (October 2014 to September 2017) or Asset-Runoff (October 2017 to June 2019) phases, respectively.

The dependent variables are the 10- or 2-year zero-coupon US Treasury yields (Gürkaynak, et al., 2007), such that $y_{M,t+h} - y_{M,t-1}$ for $M = 10,2$ measures the yield change, in basis points, from the day prior to the FOMC announcement ($t-1$) to the h-th day after ($t+h$). The 10-year yield provides a natural focus, having been a key object of interest in the literature studying the financial-market effects of QE. But the 2-year tenor is also of interest, having also been shown to move in response to QE announcements (Gagnon, et al., 2011; Christensen and Rudebusch, 2012; Lloyd, 2017; Lloyd, 2020) and capturing central banks' broad focus on managing expectations of the short-rate path roughly two years into the future (Bernanke, et al., 2004; Gürkaynak, et al., 2005; Swanson and Williams, 2014; Gertler and Karadi, 2015; Hanson and Stein, 2015).

In regression (1), the coefficient β^h captures the marginal effect of QE LSAP surprises, which are implicitly defined to occur during the period 2008:12-2014:09 when $\mathbf{1}_t^{FR} = \mathbf{1}_t^{AR} = 0$. $\beta^h + \delta_i^h$ captures the marginal effect of surprises in the Full-Reinvestment and Asset-Runoff phases of QT for

$i = FR, AR$, respectively. We focus on the magnitudes of overall marginal effects (β^h and $\beta^h + \delta_i^h$), which reflect the overall economic significance of our results (for a given sized surprise), but we also discuss the statistical significance of the difference in magnitudes (δ_i^h).

$\boldsymbol{x}_t$ denotes the set of controls, which include the level and forward-guidance surprises from Swanson (2021), along with their own interactions between the QT dummy-variable indicators, to account for other contemporaneous monetary-policy events. The controls also include five daily lags of the dependent variable to captures macroeconomic conditions prior to the announcement and five lags of the 1-year Treasury yield to capture the pre-announcement stance of monetary policy – where the lag choices are informed by information criterion.

3.2 ASYMMETRIC SENSITIVITIES

Figures 2(a) and 2(b) present results from regression (1) for the 10- and 2-year tenors, respectively. While the effects of LSAP surprises in the QE and Asset-Runoff-QT periods are not significantly different at the 10-year maturity, the most striking differences arise at the 2-year tenor. Here, QE surprises have no clear significant effect, while the results in Figure 2(b) highlight that surprises in the Asset-Runoff-QT period did move 2-year yields, with the effects statistically different to those in the QE period. Our findings suggest that, one month after the announcement, a one standard-deviation QT surprise in the Asset-Runoff period pushed 2-year yields up by around a 30bp. In contrast, a one standard-deviation QE surprise generated an insignificant response in the 2-year yield of around 5bp. These differences, however, are less economically meaningful when accounting for the fact that the surprises themselves were around 4 times more volatile in the QE period vs. QT, as highlighted in Figure 1.

<FIGURE 2 HERE>

In contrast, there are no significant differences between the effects of LSAP surprises in the Full-Reinvestment-QT and QE phases on yields at either tenor. This is in line with the findings of others who find that the majority of QT's effects occurred when the Fed actively reduced its asset holdings – i.e., in the Asset-Runoff phase (Smith and Valcarcel, 2023; D'Amico and Seida, 2024). Nevertheless, that our results indicate that QT surprises from late-2017 to mid-2019 had larger and more persistent effects on 2-year Treasury yields as compared to equal-sized QE shocks suggests that QT announcement surprises could potentially have stronger and more persistent effects on financial markets than previously envisioned.

3.3 Understanding Risks by Decomposing Drivers

To dig deeper into the economic mechanisms underpinning these differences, we consider a decomposition of M-period government bond yields $y_{M,t}$ into two components: (i) expectations of future short-term rates $exp_{M,t}$; and (ii) term premia $tp_{M,t}$:

$$y_{M,t} = \underbrace{\frac{1}{M}\sum_{m=0}^{M-1} y_{1,t+m}^{e}}_{\equiv exp_{M,t}} + tp_{M,t} \tag{2}$$

This decomposition has been widely used by academics and policymakers to ascertain the channels through which LSAPs can influence the real economy (Bernanke, 2010). Changes in the expectations component have been linked to a 'signalling channel', through which LSAP announcements influence expected future short-term rates, and changes in term premia have been linked to a 'portfolio rebalancing channel', whereby LSAPs influence the compensation investors require for holding Treasuries.

Although this decomposition is used widely, there exist a wide array of alternative empirical estimates of this decomposition from dynamic term-structure models (DTSM), which often yield different results

(Lloyd, 2017). Given this, we use three daily-frequency decomposition estimates: (i) Adrian, et al. (2013), which applies a linear-regression approach to decompose yields; (ii) Kim and Wright (2005), which augments a DTSM with survey expectations of interest rates to discipline the decomposition; and (iii) Lloyd (2020), which augments a similar DTSM with short-maturity overnight indexed swap rates. Using these estimated decompositions, we re-estimate regression (1) using changes in each component of the Treasury yield as the dependent variable. Based on the asymmetries documented in Section 3.1, we present results for the 2-year tenor only and focus on the Asset-Runoff phase.

While the term-premium responses are statistically indistinguishable for all three decompositions (Figures 3(b), 3(d), 3(f)), there are significant asymmetries in the response of expectations (Figures 3(a), 3(c), 3(e)). Like the 2-year yield itself, the response of the expectation component of 2-year Treasury yields is larger and more persistent to LSAP surprises during the Asset-Runoff phase of QT than equal-sized QE events. The differences are particularly striking when comparing QE and Asset-Runoff-phase QT estimates using the expectations components from the Adrian, et al. (2013) and Kim and Wright (2005) decompositions, but remain statistically significant at some horizons with the Lloyd (2020) decomposition as well.

<FIGURE 3 HERE>

We interpret this result through the lens of the term-structure equation (2). Given an ELB on short-term policy rates ($y_{1,t+m} \geq \underline{y}$ for all t, m), this implies an ELB on expected future short rates ($\exp_{\mathrm{M,t}} \geq \underline{\mathrm{y}}$ for all t, m) as well. To the extent that the ELB binds more at shorter maturities (for low M), it follows that, for a given maturity M, the ELB can limit the efficacy of the signalling channel in response to QE surprises, since policymakers are unable to signal a path for short term rates that goes below the ELB in any future period. So, although signalling can be an important channel through which QE announcements operate, the ELB constrains the relevance of changes in expectations at a given maturity by increasing the relevance of changes in longer-maturity expectations for the current stance of policy.

An implication of this result is that LSAP *surprises* during times of tightening can carry larger effects on expectations of future rates *at a given maturity* – as we document in Figure 3. As a result, policymakers seeking to limit the real economic costs of QT may wish to guard against the risk that communications about the central bank balance sheet normalisations are misinterpreted by, or surprise, market participants.

4 CONCLUSIONS

In this chapter, we have compared the high-frequency effects of QT announcements and surprises on financial markets to those of QE. Although our analysis provides an incomplete picture about the overall transmission of QT policies, it does offer some initial indication about possible asymmetries and risks at an early stage of the transmission mechanism.

Our results have confirmed that the impact of US and UK QT announcements on financial markets has, thus far, been small compared to QE. This has, in large part, been by design, part of a concerted effort to carry out QT in a "gradual and predictable" manner – in effect, limiting the extent to which QE 'surprises'.

Analysing the sensitivity of US bond yields to QT (vs. QE) surprises, suggests that this "gradual and predictable" approach may have been the right thing to do too. Near-to-medium-term yields, as well as short-term interest rate expectations over corresponding horizons, appear to have asymmetric sensitivity to QT 'surprises', vs. QE. For a given magnitude of surprise, the responsiveness of 2-year yields during the QT period is *larger* than the corresponding sensitivity during the QE period. Such asymmetry is also consistent with an ELB on short rates placing an ELB on expected future short rates. However, the volatility of QT surprises is smaller, rationalising the more limited impacts of QT announcements on financial markets to date.

Therefore, to limit the potential costs of QT, policymakers should continue to guard against the risk that communications of asset-purchase reversals are misinterpreted by, or 'surprise', financial markets.

5 References

Adrian, T., Crump, R. & Moench, E., 2013. Pricing the term structure with linear regression. *Journal of Financial Economics,* Volume 110, pp. 110-138.

Bauer, M. D. & Rudebusch, G. D., 2014. The Signaling Channel for Federal Reserve Bond Purchases. *International Journal of Central Banking,* Volume 10, pp. 233-289.

Bernanke, B. S., 2010. *Opening Remarks: The Economic Outlook and Monetary Policy.* Jackson Hole, Federal Reserve Bank of Kansas, pp. 1-16.

Bernanke, B. S., Reinhart, V. R. & Sack, B. P., 2004. Monetary Policy Alternatives at the Zero Bound: An Empirical Assessment. *Brookings Papers on Economic Activity,* Volume 35, pp. 1-100.

Bhattarai, S. & Neely, C. J., 2022. An Analysis of the Literature on International Unconventional Monetary Policy. *Journal of Economic Literature,* Volume 60, pp. 527-597.

Bräuning, F., 2017. *The Liquidity Effect of the Federal Reserve's Balance Sheet Reduction on Short-Term Interest Rates.* s.l.:Federal Reserve Bank of Boston.

Breedon, F., Chadha, J. S. & Waters, A., 2012. The financial market impact of UK quantitative easing. *Oxford Review of Economic Policy,* 28(4), pp. 702-729.

Busetto, F. et al., 2022. QE at the Bank of England: a perspective on its functioning and effectiveness. *Bank of England Quarterly Bulletin,* Volume Q1.

Christensen, J. H. E. & Rudebusch, G. D., 2012. The Response of Interest Rates to US and UK Quantitative Easing. *Economic Journal,* Volume 122, pp. 385-414.

D'Amico, S. & Seida, T., 2024. Unexpected Supply Effects of Quantitative Easing and Tightening. *Economic Journal,* Volume 134, pp. 579-613.

Du, W., Forbes, K. & Luzzetti, M. N., 2024. *Quantitative Tightening Around the Globe: What Have We Learned?,* s.l.: NBER Working Papers 32321.

Gagnon, J., Raskin, M., Remache, J. & Sack, B. P., 2011. The Financial Market Effects of the Federal Reserve's Large-Scale Asset Purchases. *International Journal of Central Banking,* Volume 7, pp. 3-43.

Gambacorta, L., Hofmann, B. & Peersman, G., 2014. The Effectiveness of Unconventional Monetary Policy at the Zero Lower Bound: A Cross-Country Analysis. *Journal of Money, Credit and Banking,* 46(4), pp. 615-642.

Gertler, M. & Karadi, P., 2015. Monetary Policy Surprises, Credit Costs, and Economic Activity. *American Economic Journal: Macroeconomics,* Volume 7, pp. 44-76.

Gürkaynak, R. S., Sack, B. P. & Swanson, E. T., 2005. Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements. *International Journal of Central Banking,* Volume 1, pp. 55-93.

Gürkaynak, R. S., Sack, B. P. & Wright, J. H., 2007. The US Treasury Yield Curve: 1961 to the Present. *Journal of Monetary Economics,* Volume 54, pp. 2291-2304.

Gürkaynak, R. S. & Wright, J. H., 2013. Identification and Inference Using Event Studies. *Manchester School,* Volume 81, pp. 48-65.

Haldane, A., Roberts-Sklar, M., Wieladek, M. & Young, C., 2016. *QE: The Story So Far,* s.l.: Bank of England Staff Working Paper 624.

Hanson, S. & Stein, J., 2015. Monetary Policy and Long-Term Real Rates. *Journal of Financial Economics,* Volume 115, pp. 429-448.

Jefferson, P. N., 2023. *Implementation and Transmission of Monetary Policy.* Washington and Less University, Lexington, Virginia , Speech at the H. Parker Willis Lecture.

Joyce, M. A. S., Lasaosa, A., Stevens, I. & Tong, M., 2011. The Financial Market Impact of Quantitative Easing in the United Kingdom. *International Journal of Central Banking,* Volume 7, pp. 113-161.

Kim, D. H. & Wright, J. H., 2005. *An Arbitrage-Free Three-Factor Term Structure Model and the Recent Behavior of Long-Term Yields and Distant-Horizon Forward Rates.* s.l.:Board of Governors of the Federal Reserve System (US).

Kim, K., Laubach, T. & Wei, M., 2020. *Macroeconomic Effects of Large-Scale Asset Purchases: New Evidence.* s.l.:Board of Governors of the Federal Reserve System (US).

Krishnamurthy, A. & Vissing-Jorgensen, A., 2011. The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy. *Brookings Papers on Economic Activity,* 43(2), pp. 215-287.

Krishnamurthy, A. & Vissing-Jorgensen, A., 2013. The Ins and Outs of LSAPs. In: *Proceedings: Economic Policy Symposium.* Jackson Hole: Federal Reserve Bank of Kansas City, pp. 57-111.

Lloyd, S. P., 2017. *Unconventional Monetary Policy and the Interest-Rate Channel: Signalling and Portfolio Rebalancing.* s.l.:Cambridge Working Papers in Economics 1735, University of Cambridge.

Lloyd, S. P., 2020. Estimating Nominal Interest Rate Expectations: Overnight Indexed Swaps and the Term Structure. *Journal of Banking and Finance,* Volume 119.

Lloyd, S. P. & Ostry, D. A., 2024. The Asymmetric Effects of Quantitative Tightening and Easing on Financial Markets. *Economics Letters,* Volume 238.

MPC, 2021. *Monetary Policy Committee Minutes - August 2021,* s.l.: Bank of England.

Newey, W. & West, K., 1987. A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix. *Econometrica,* Volume 55, pp. 703-708.

Ramsden, D., 2023. *Quantitative Tightening: The Story So Far.* London, Speech at the Money, Macro and Financial Society.

Schnabel, I., 2023. *Quantitative Tightening: Rationale and Market Impact.* Frankfurt am Main, Speech at the Money Market Contact Group Meeting.

Smith, A. L. & Valcarcel, V. V., 2023. The Financial Market Effects of Unwinding the Federal Reserve's Balance Sheet. *Journal of Economic Dynamics and Control,* Volume 146.

Swanson, E. T., 2021. Measing the Effects of Federal Reserve Forward Guidance and Asset Purchases on Financial Markets. *Journal of Monetary Economics,* Volume 118, pp. 32-53.

Swanson, E. T. & Williams, J., 2014. Measuring the Effect of the Zero Lower Bound on Medium- and Longer-Term Interest Rates. *American Economic Review,* Volume 104, pp. 3154-3185.

Tenreyro, S., 2023. *Quantitative Easing and Quantitative Tightening.* Glasgow, Speech at the Scottish Economic Society Annual Conference.

Weale, M. & Wieladek, T., 2016. What are the macroeconomic effects of asset purchases?. *Journal of Monetary Economics,* 79(C), pp. 81-93.

Yellen, J., 2017. *June 2017 Post-FOMC Press Conference,* s.l.: Federal Reserve.

TABLES AND FIGURES

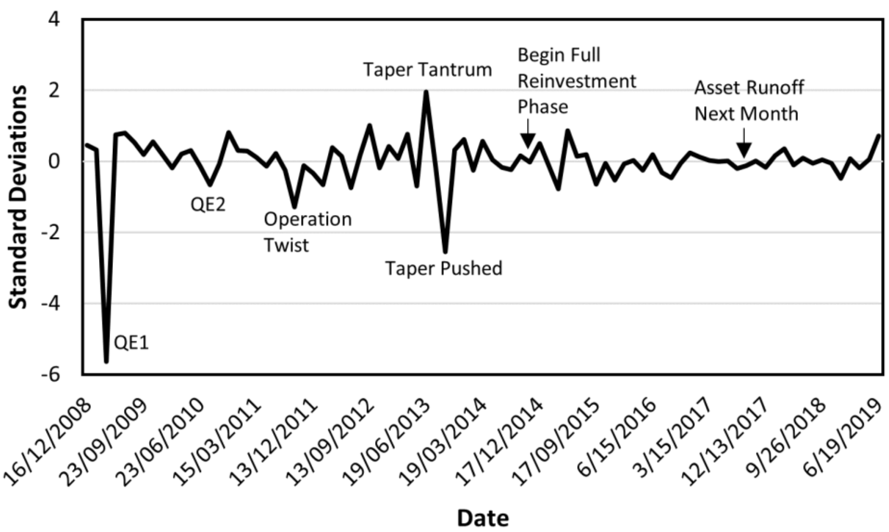
Table 1: US QE and QT Event-Study Evidence

QE Event Date, Description	Δ2Y Yield	Δ10Y Yield	QT Event Date, Description	Δ2Y Yield	Δ10Y Yield
25/11/08, QE1 Announced	-14.15	-21.91	22/05/13, Taper Announced	1.19	9.96
01/12/08, QE1 T-bill Announced in Fed Chair Speech	-11.64	-22.07	19/06/13, Taper Pushed Back	3.93	14.13
16/12/08, QE1 T-bill Announced	-10.58	-17.92	21/05/14, Normalisation Signal	1.44	3.11
28/01/09, QE1 LSAPs Continued	4.63	11.73	09/06/14, Gradualism Signal	2.24	1.25
18/03/09, QE1 LSAPs Continued	-25.76	-53.87	20/08/14, Unwind Planning	3.97	2.17
10/08/10, QE2 Reinvest Assets	-2.54	-7.28	17/09/14, Unwind Announced	3.20	1.88
21/09/10, QE2 Reinvest Assets	-3.58	-11.05	12/01/17, Speeches on Unwind	-0.84	-1.29
21/09/11, MEP 'Operation Twist'	6.58	-8.63	05/04/17, Reinvest.-End Signal	-1.68	-1.93
13/09/12, QE3 Announced	-0.68	-3.53	24/05/17, Reinvestment-End Plan	-1.56	-2.99
			14/06/17, Asset-Runoff Plan	-1.45	-6.61
			20/09/17, Runoff Next Month	4.87	3.69
QE Average	-6.41	-14.95	QT Average	1.39	2.12

Table 2: UK QE and QT Event-Study Evidence

QE Event Date, Description	Δ2Y Yield	Δ10Y Yield	QT Event Date, Description	Δ2Y Yield	Δ10Y Yield
05/03/09, QE1 Announced	-2.0	-31.7	05/08/21, QT Announced	0.8	-0.9
07/05/09, QE1 Extended	1.2	5.7	03/02/22, Passive QT Begins	12.8	12.3
06/08/09, QE1 Extended	-3.4	-7.3	19/07/22, QT Size Specified	1.6	-5.7
05/11/09, QE1 Extended	0.6	6.9	22/09/22, Active QT Begins	14.0	18.2
06/10/11, QE2 Announced	4.1	4.5	28/09/22, LDI crisis: QT Paused	-25.1	-38.2
09/02/12, QE2 Extended	0.9	5.4	19/10/22, QT skews short end	-2.7	-5.8
05/07/12, QE3 Announced	-7.1	-6.0	03/08/23, QT Assessment	-3.5	7.3
04/08/16, QE4 Announced	-8.3	-16.8	20/09/23, QT Pace Announced	-14.7	-10.4
19/03/20, QE5 Announced	-13.0	-30.5	01/08/24, QT Assessment	-2.8	-2.2
18/06/20, QE5 Extended	1.9	4.5			
05/11/20, QE5 Extended	2.3	3.0			
QE Average	-2.1	-5.7	QT Average (Ex. LDI crisis)	0.7	1.6

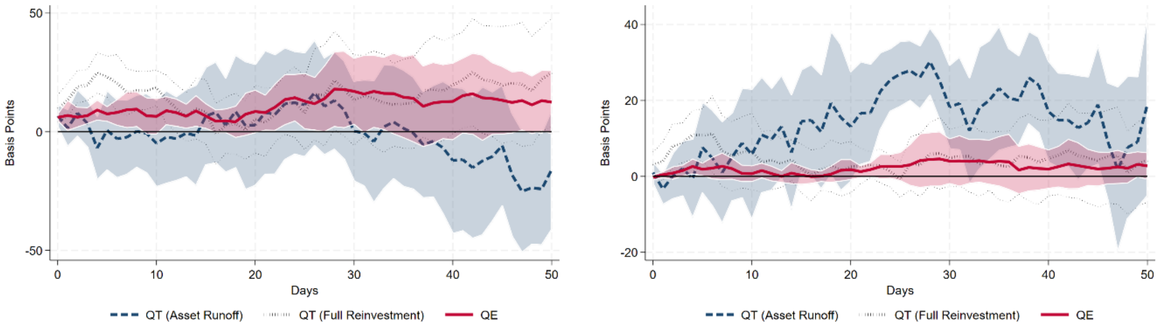
Figure 1: Federal Reserve LSAP Surprises



Notes: Annotated Federal Reserve LSAP surprises from Swanson (2021) over the period December 2008-June 2019. Shocks reported in units of standard deviations.

Figure 2: Asymmetric Response of 10- and 2-Year Treasury Yields to LSAP surprises in QE and QT Periods

(a) 10-Year Yield (b) 2-Year Yield

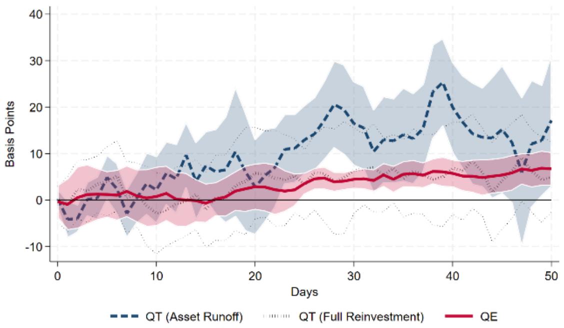


Source: Lloyd and Ostry (2024). Notes: Estimated average marginal effect of one-standard-deviation LSAP surprise on h-day-ahead US Treasury yields during QE (December 2008 to September 2014), QT Full-Reinvestment (October 2014 to September 2017) and QT Asset-Runoff (October 2017 to June 2019) periods from regression (1) (h=0,1,...,50). Sample: December 2008 to June 2019 (excl. QE1 announcement). Shadings/thin-dashed lines represent 95 per cent confidence bands, constructed from Newey-West standard errors with 12 lags.

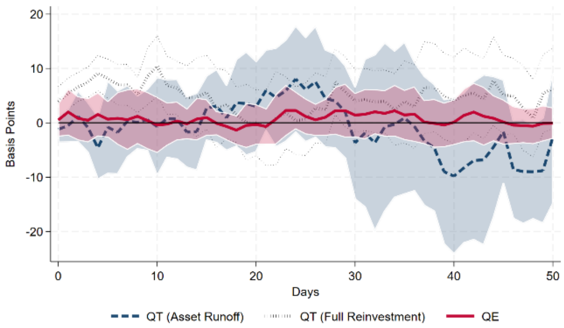
Figure 3: Asymmetric Response of 2-Year Treasury-Yield Components to LSAP surprises in QE and QT Periods

I. Adrian, Crump and Moench (2013) Decomposition

(a) Expected Future Short-Term Interest Rates

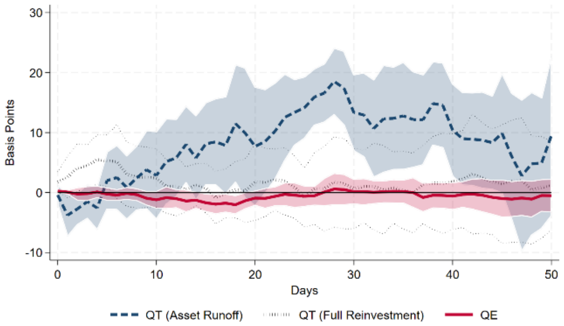


(b) Term Premium

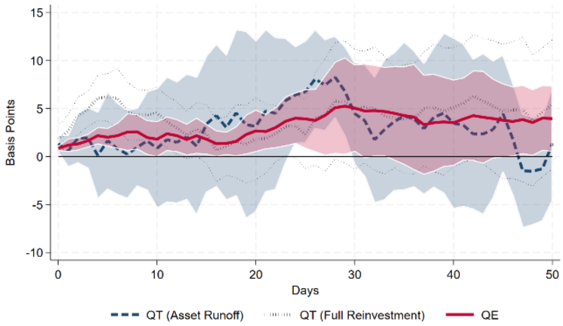


II. Kim and Wright (2005) Survey-Augmented Decomposition

(c) Expected Future Short-Term Interest Rates

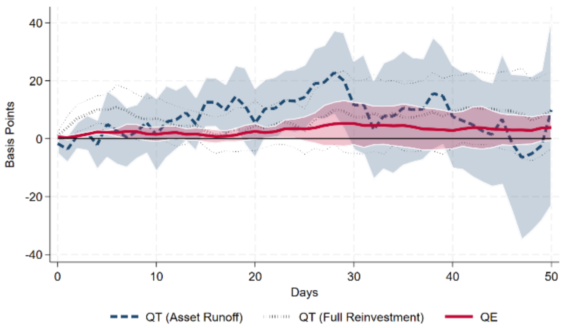


(d) Term Premium

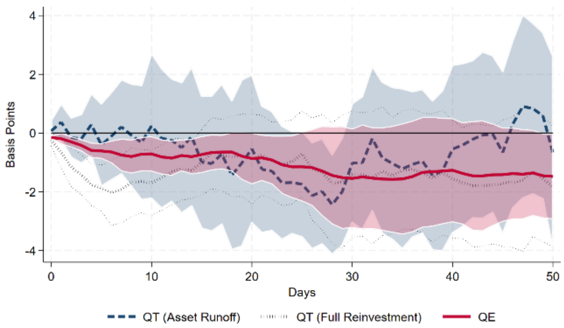


III. Lloyd (2020) OIS-Augmented Decomposition

(e) Expected Future Short-Term Interest Rates



(f) Term Premium



Source: Lloyd and Ostry (2024). Notes: Estimated average marginal effect of one-standard-deviation LSAP surprise on the h-day-ahead expectations and term-premium components of 2-year US Treasury yields during QE (December 2008 to October 2014), QT Full-Reinvestment (October 2014 to September 2017) and QT Asset-Runoff (October 2017 to June 2019) periods from regression (1) (h=0,1,...,50). Sample: December 2008 to June 2019 (excl. QE1 announcement). Shadings/thin-dashed lines represent 95 per cent confidence bands, constructed from Newey-West standard errors with 12 lags.

LIST OF FIGURES/TABLES

Table 1	US QE and QT Event-Study Evidence
Table 2	UK QE and QT Event-Study Evidence
Figure 1	Federal Reserve LSAP Surprises
Figure 2	Asymmetric Response of 10- and 2-Year Treasury Yields to LSAP surprises in QE and QT Periods
Figure 3	Asymmetric Response of 2-Year Treasury-Yield Components to LSAP surprises in QE and QT Periods