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More Stories of Unconventional Monetary Policy

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This article extends the work of Fawley and Neely (2013) to describe how major central banks have evolved unconventional monetary policies to encourage real activity and maintain stable inflation rates from 2013 through 2019. By 2013, central banks were moving from lump-sum asset purchase programs to continuing asset purchase programs, which are conditioned on economic conditions, careful communication strategies, bank lending programs with incentives and negative interest rates. This article reviews how central banks tailored their unconventional monetary methods to their various challenges and the structures of their respective economies.

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1. Introduction

Central banks worldwide responded to the financial crisis of 2007-2009 with a variety of emergency lending, conventional interest rate reductions and eventually unconventional monetary policy (UMP) measures. There is no hard and fast distinction between emergency lending, conventional monetary policy and UMP, but emergency lending is narrowly focused and temporary, while monetary policy broadly and persistently changes interest rates and the availability of credit. Similarly, conventional monetary policy works through positive short-term interest rates while UMPs influence medium- and long-term rates, or facilitate credit in specific markets, or — most broadly — use monetary policy in unusual ways to influence prices and economic activity.

Initial lending and monetary policy actions aimed to stabilize the financial sector, but central banks soon turned to stimulating growth with UMPs, which can be grouped into communication (i.e., “forward guidance” (FG)), asset purchases, conditional bank lending programs and negative interest rates. Asset purchases and FG affect long term interest rates and other asset prices. Conditional bank lending programs create incentives for banks to lend to the nonfinancial sector. Negative interest rates on deposits broadly affect asset prices in a manner similar to that of conventional declines in short-term interest rates. Foreign exchange management —i.e., pegs, and sterilized and unsterilized intervention — are not uncommon, even for developed economies, but might be considered as UMPs.

UMPs are usually implemented because short-term interest rates have reached the “zero lower bound” and central banks have little or no scope to lower them further.¹ In such a low interest rate environment, central banks can still use UMPs, such as FG and asset purchases, to reduce long yields, raise stock prices, increase employment, and promote price stability.

Short-term interest rates have rarely reached the zero lower bound in post-war history, but such events may be common in the future. Many observers believe the global economy faces a long-term, low

¹ In practice, several central banks have pushed short-term interest rates below zero. While this strategy has potential benefits, it also has potential costs, and so the use of negative interest rates has been limited.

interest rate environment in which conventional short-term interest rate tools may have limited scope to stimulate the economy (Summers (2016)). For example, the Bank of Canada's policy report forecasts that short-term rates will peak at only 2.5-3.5 percent after normalization is completed (Bank of Canada (2018)). In contrast, the Bank of Canada's overnight rate averaged 7 percent from 1960 through 2007.

Unconventional policies can be implemented quickly and flexibly, rendering them important contingency tools of stabilization policy, alongside conventional interest rate policy. In contrast, economists and policy makers widely perceive fiscal policy to be unwieldy and slow in practice.

"[F]or several years, the Fed has been close to being 'the only game in town,' as Mohamed El-Erian described it in his recent book." — Stanley Fischer, Nov. 21, 2016.

<https://www.federalreserve.gov/newsevents/speech/fischer20161121a.htm>

A great deal of research has examined the UMP effects on financial markets and the macro economy. The backbone of such research is a set of theoretical models that suggest how such policies might affect real activity and prices through asset prices. Several types of studies indicate that UMP announcements strongly influenced domestic and international asset prices, including sovereign and corporate bonds, exchange rates and stock prices. These price effects changed lending and portfolio behavior of individuals and financial institutions. There is greater uncertainty about how UMP affects the real economy, but both calibrated dynamic stochastic general equilibrium (DSGE) models and structural vector autoregressions (VARs) studies imply that UMP significantly stimulated output and prices. Bhattarai and Neely (forthcoming) survey the literature on the theory of UMP and its effects on financial markets and the macro economy.

Researchers have paid much less attention to the motivations, methods and institutional details of the internationally varied unconventional programs than they have to the impact of such policies. Fawley and Neely (2013) describe and compare the quantitative easing (QE) and related maturity extension programs of the Federal Reserve (Fed), the Bank of England (BOE), the European Central Bank (ECB), and the

Bank of Japan (BOJ) from 2008-2012. During this period, all four major central banks provided unconventional monetary accommodation, although their efforts differed in extent and design.

This article complements Fawley and Neely (2013) by describing the unconventional policies of major central banks both prior to the crisis and from 2013 through 2019, during which time the four major central banks faced different challenges. With a recovering economy, the Fed first reduced, then removed additional unusual monetary accommodation before moving to normalize monetary conditions in 2014-2018. Having pursued a milder easing campaign in 2008-2012, the BOJ substantially increased accommodation in 2013, aggressively purchasing assets, lending to banks, and imposing negative deposit rates before eventually explicitly targeting long yields. The ECB used more aggressive measures, including negative deposit rates, conditional bank lending programs and asset purchases in 2014-2016 to counter undesired disinflation. Having aggressively eased in 2009-2012, the BOE maintained steady but accommodative policies from 2013-2016, and did not resume easing in earnest until after the 2016 Brexit vote. The coverage of this article ends at the end of 2019 because central banks shifted policies radically again in 2020Q1 to respond to economic conditions associated with the unprecedented COVID-19 crisis. Haas, Emmons and Neely (2020) cover those central bank reactions.

To provide the reader with an understanding of the states of their respective economies and the stances of their monetary policies at the start of 2013, we briefly review the non-standard policy measures of the Fed, the BOE, the ECB, and the BOJ from 2000 through 2012. The article will then review the policies of the major central banks from 2013 through 2019.

2. Types of Unconventional Monetary Policies

Conventional monetary policy acts upon current and near-term-expected short-term interest rates to influence prices and economic activity through a variety of potential channels that mostly function through asset prices. Although the line between conventional and unconventional policy is often blurry, unconventional policies typically are defined as those that directly influence long yields and exchange

rates, push short rates below zero, explicitly create incentives for lending and/or confront financial frictions by purchasing particular types of assets.

To broadly influence long yields, central banks purchase quantities of long-term bonds and provide expansionary FG. The purchase of long-term bonds may reduce long yields through one or more of three channels: “duration risk” or “local supply” or “signaling.” Duration risk is the sensitivity of bond prices to changes in the level of the yield curve, and long-term bonds have more duration risk. By buying long-term bonds, central banks remove the amount of duration risk in the hands of the public, which might reduce the risk premium that market participants demand to hold long bonds and thus reduce the yields they must pay. Similarly, if some agents have strong preferences for bonds of particular maturities, then reducing the supply of such bonds (i.e., the local supply) in the hands of the public might make market participants more willing to hold the remaining supply even at lower yields. In addition, asset purchases can signal to the public that a central bank will keep interest rates low for a long time, as rapid increases in short rates could subject the central bank to embarrassing capital losses on its portfolio (Bhattarai, Eggertsson, and Gafarov 2015). Finally, central bank FG can influence current long yields by changing expectations of future short rates. If an announcement leads market participants to expect lower short rates in the future, then —other things equal—bond holders will tend to switch from rolling over short-term positions into holding long bonds. Such rebalancing will also tend to reduce long-term yields.

Central banks have also purchased assets in specific markets to ease credit conditions or reduce particular risk premia in those markets. For example, the first large U.S. asset purchases, announced in November 2008, were of mortgage-backed securities (MBS) to specifically reduce yields in the MBS market by reducing the quantities of specific risks associated with MBS, such as pre-payment risk, and by providing a source of regular liquidity for the market.

Some central banks have extended the bounds of conventional monetary policy by setting negative interest rates on deposits with the central bank (i.e., reserves) or even a negative interest rate on

borrowing, that is, they have paid banks to borrow.² Pushing short-term rates below zero has many of the same effects as conventional short-term rates reductions: they both tend to lower yields at all horizons, raise equity and real estate values through discounting, and strengthen balance sheets. Similarly, negative interest rates on excess reserves encourage banks with excess reserves to make loans.

Central banks typically tailor their UMP to the types of intermediation in their economies. In areas where bank intermediation dominates, such as Europe and Japan, central banks have created or altered bank lending programs to support banking markets. For example, after the worst of the 2008 financial crisis, the BOJ and the ECB supplied liquidity elastically to banks instead of making banks bid for fixed quantities. Since 2012, central banks have developed and expanded conditional bank lending programs that use price or quantity incentives to encourage bank loans to the nonfinancial sector.

Central banks of small, open economies face a different set of challenges than do the major central banks. The former have no control over international monetary conditions, have smaller, more fragmented domestic bond markets, and are more sensitive to international conditions. Therefore, smaller central banks frequently seek to stabilize their exchange rates to facilitate international trade and finance or reset those pegs to influence economic activity. Although commonly used, pegs and foreign exchange intervention might also be considered UMP in the context of developed countries. A boxed insert describes the challenges and unconventional monetary policies of smaller central banks.

3. A First Pass at Unconventional Monetary Policies: The Bank of Japan: 2000-2006

The BOJ's 2001-2006 response to the severe and prolonged economic downturn known as "the Lost

² Many central banks influence general short-term interest rates by setting the interest rate that the central bank pays on reserves (IOR) and interest rate that the central bank charges borrowers, i.e., the lending rate. The IOR functions as a floor for interest rates because banks would not lend to private parties at a rate lower than they could lend to the central bank. Similarly, commercial banks would not borrow at a rate greater than the rate at which they could borrow from the central bank. Such a system is called a "corridor" system (Keister (2012)), and moving it influences all short-term interest rates.

In practice, this argument does not always hold. For example, in the United States there are institutions that cannot deposit money with the Federal Reserve and so they are willing to lend at rates below the IOR rate. Similarly, banks may be reluctant to borrow from a central bank for regulatory reasons under some systems.

Decade” serves as a recent antecedent to the UMP that followed the financial crisis. Japanese asset prices soared to historic highs in the late 1980s as the Japanese economy hummed and the relatively huge cohort of postwar Japanese baby boomers invested for their retirements. The Shiller cyclically adjusted price-to-earnings (CAPE) ratio for the Japanese market topped 90 in January 1990. For comparison, the CAPE ratio for the S&P 500 has varied from about 5 to 45 from 1880 to 2020 (Siblis Research (2017), Mizrach and Neely (2020)). Japanese equity and real estate prices had become unsustainable and then plunged in the early 1990s, sending the Japanese economy into prolonged stagnation and deflation (Figure 1).

From 1991 to 2000, the BOJ responded to this stagnation by repeatedly lowering its conventional policy rate. The Japanese authority also employed some FG on April 13, 1999, promising essentially zero interbank interest rates until deflationary concerns are dispelled.³ Dissatisfied with the results of this zero interest rate policy (ZIRP), the BOJ turned to UMP on March 19, 2001, switching its main policy instrument from the uncollateralized overnight call rate to the quantity of reserves held by financial institutions with the central bank.⁴ The BOJ initially targeted bank reserves at ¥5 trillion (\$41 billion), an increase of roughly ¥1 trillion (\$7 billion) from previous levels and stated that it would maintain its accommodative policy until inflation—which had been significantly negative—firmly reached 0 percent.⁵ The BOJ purchased long-term Japanese government bonds (JGBs) and asset backed securities (ABS) to reach its reserves target, which increased nine times over the next four years, ultimately reaching a target range of ¥30 to ¥35 trillion (\$247 to \$288 billion). The expansion of BOJ’s balance sheet reflects the progressive increases in reserve targets over this span (see Figure 2).⁶ Bank reserves were a very small part of the Japanese monetary base, which consisted largely of currency, so this policy produced only a

³ Governor Hayami originally committed to a ZIRP until deflationary concerns are dispelled at a press conference on April 13, 1999 and reiterated that commitment in a speech on June 22, 1999 (Hayami (1999)).

⁴ The term for Japanese bank reserves is often translated as “current accounts,” a term that is more commonly used for international trade. In this article, we will refer to the quantity of bank reserves to avoid confusion.

⁵ In this paper, we often approximate foreign currency amounts in dollars using an exchange rate from the year of the announcement or program discussed. Therefore, the conversion rate will change with the period discussed. Such inexact calculations are only intended to provide gross perspective of the amounts in dollars.

⁶ See Spiegel (2006) and Shiratsuka (2009).

small percentage increase in that base.⁷ The BOJ supplemented these asset purchases with another promise, on October 10, 2003, to maintain quantitative easing until inflation was “stably” non-negative (Bank of Japan (2003)). On March 9, 2006, the BOJ ended this UMP by announcing a return to using the uncollateralized overnight interest rate as its main monetary policy tool, but it continued purchasing JGBs at a pace of ¥1.2 trillion (\$10 billion) per month.

With the benefit of hindsight, the promise to maintain UMP until inflation was positive for a few consecutive months appears to have been much too unambitious. Malmendier and Nagel (2016) argue that people overweight inflation experienced during their lifetimes when forming expectations. Thus, the long period of Japanese deflation would produce persistently low inflation expectations. In later years, the BOJ would adopt progressively more ambitious inflation targets to attempt to break such beliefs.

4. Responses to the Global Financial Crisis: 2008-2012.

The collapse of the housing bubble in 2006-7 sparked a financial crisis and a global contraction in real activity, “the Great Recession.” Monetary authorities initially focused on emergency lending to restore financial market function but quickly shifted to staving off deflation and stimulating economic activity by cutting policy rates (see Figure 3), later supplementing those conventional cuts with large-scale asset purchases and long-term lending programs (see Figure 4).

4.1 The Federal Reserve: 2008-2012.

In 2008, the Federal Open Market Committee (FOMC) became increasingly concerned about the functioning of credit markets and the danger of systemic risk to the economy (Bullard, Neely and Wheelock (2009)). In response, the Fed created several facilities to support credit markets.⁸ Some of these

⁷ A country’s monetary base is made up of reserves held with the central bank and currency in circulation. The monetary base is a liability of the central bank. The accounting counterpart of the monetary base is the total assets of the central bank, that is, the assets that the central bank has purchased to create the monetary base.

⁸ These measures included currency swap lines with foreign central banks, the Term Auction Facility (TAF) in December 2007 to get liquidity directly to banks, the Term Securities Lending Facility (TSLF) to provide Treasuries as collateral for financial markets in March 2008, the Primary Dealer Credit Facility (PDCF) in March 2008, Maiden Lane LLC I, II and III to hold risky assets from Bear Sterns and AIG, the Asset Backed-Commercial Paper Money

programs directly lent to banks or purchased private assets (e.g. commercial paper) to provide liquidity to targeted markets. These programs included both Fed discount window loans and also special loans, such as the \$85 billion loan to American International Group (AIG).⁹ These unsterilized policy measures constituted the first unusual expansion of the Fed's balance sheet in September 2008, which can be seen as the first steep rise in Fed assets shown in Figure 5.

On the heels of this emergency lending, the Fed began the first of four large-scale asset purchase (LSAP) programs to stimulate U.S. economic activity and promote price stability. The FOMC announced the two components of this first round of Quantitative Easing (QE1), on November 25, 2008 and March 18, 2009, respectively. QE1 eventually purchased \$1.725 trillion in federal housing agency debt, private mortgage-backed securities (MBS) and Treasuries. The Fed designed QE1 to support housing sales and construction, which had been hit hard by the 2006-2008 fall in real estate prices and the subsequent financial crisis. Housing GSE debt and MBS accounted for more than 80 percent of the \$1.725 trillion in purchased assets. The FOMC paired QE1 with several versions of guidance suggesting that it would keep the federal funds rate lower “for some time” (12/16/2008) and “for an extended period” (3/18/2008).¹⁰ The Fed then purchased \$600 billion worth of longer-term Treasuries under QE2 during 2010-11. In late 2011, the Fed introduced the Maturity Extension Program (MEP) — nicknamed “Operation Twist” —

Market Mutual Fund Lending Facility (AMLF) in September 2008, the Commercial Paper Funding Facility (CPFF) and Money Market Investor Funding Facility (MMIFF) in October 2008, and the Term Asset-Backed Securities Loan Facility (TALF) in November 2008.

In addition to these Federal Reserve actions, other regulatory and governmental authorities took action to relieve financial market distress. On September 7, 2008, the Federal Housing Finance Agency (FHFA), placed Fannie Mae and Freddie Mac into conservatorship. In October 2008, the FDIC established the Temporary Liquidity Guarantee Program (TLGP) to facilitate interbank lending. In early 2009, The U.S. Treasury, created the “Making Home Affordable” support program to help homeowners avoid foreclosure.

⁹ The Dodd-Frank Act (2010) now prohibits the Fed from making special loans to just one firm. Instead, any loan facility must be available to a class of borrowers and the loan facilities must not extend credit to insolvent firms.

¹⁰ The FOMC regularly used FG long before other “unconventional” policy tools. In 1994-1995, the FOMC began to announce funds rate target changes and issue statements immediately after FOMC meetings and it almost eliminated intermeeting target changes, which had previously been common. The FOMC took further steps in the following years: It added a statement of “bias” — the likely direction of its next move — in May 1999 and then replaced that with a “balance of risks” statement, characterizing likely risks to growth or inflation, in January 2000. From August 2003 to December 2005, the FOMC often offered FG about the future path of the funds target in statements. The Board of Governors provides a timeline of FG at: <https://www.federalreserve.gov/monetarypolicy/timeline-forward-guidance-about-the-federal-funds-rate.htm>

which funded purchases of long-term Treasury notes through equal sales of short-term Treasury bills. In June 2012, the FOMC responded to stubbornly weak labor market conditions by extending the MEP to December 2012. In September 2012, the FOMC announced a third round of outright asset purchases (QE3), under which it purchased \$40 billion in MBSs each month, indefinitely, again with housing markets in mind. In December 2012, the Fed announced it would add \$45 billion per month in Treasury purchases to the existing QE3 MBS purchases. Bond purchases comprised a very important part of the Fed's UMP, reflecting the importance of bond markets in the U.S. economy (Bini Smaghi (2009)).

4.2 The Bank of England: 2008-2012.

Facing financial and economic circumstances like those in the U.S., the BOE began its unconventional policies on January 19, 2009 by announcing an asset purchase facility (APF) that would buy £50 billion (\$78 billion) in commercial paper and corporate bonds. The BOE soon increased APF purchases to £200 billion (\$314 billion), targeting medium and long-term gilts to drive down those yields and to provide broad monetary stimulus. The BOE's APF initially financed these purchases by issuing short-term gilts, which did not change the monetary base, but switched to issuing reserves to fund purchases in March 2009, which more than doubled the U.K. monetary base by the end of 2009. Like the Fed, the BOE conditioned its asset purchases on economic circumstances. In response to the worsening European sovereign debt crisis, the BOE started a second round of asset purchases in late-2011 and raised its APF ceiling to £275 billion (\$436 billion). The APF held £375 billion (\$594 billion) in assets at the end of 2012, mostly in U.K. government bonds. Although the BOE authorized up to £10 billion (\$15.9 billion) in private asset purchases, the APF didn't hold more than £3 billion (\$4.8 billion) of that class at the end of 2012.

4.3 European Central Bank: 2008-2012.

Prior to 2013, the ECB implemented a comparatively modest UMP program that focused on providing liquidity to banks and supporting sovereign bond markets in the face of default fears. The ECB did not ease policy as quickly or drastically as the Fed and BOE because it was more concerned about the

upside risks to inflation — which had climbed to 4 percent — and more skeptical of the risks to financial stability. Indeed, when the financial crisis came to a head in September 2008, the ECB had been raising short-term interest rates for several years and it waited until October 8, 2008, almost a month after the Lehman Brothers’ bankruptcy filing, to make its initial interest rate reduction in response to the crisis. One week after that initial cut, on October 15, 2008, the ECB pledged to make unlimited fixed-rate loans to banks to ensure “continued access to liquidity” (González-Páramo (2011)), a policy known as “fixed-rate full allotment” (FRFA). This policy naturally increased reserves during periods of illiquidity, but only banks with adequate collateral could bid for loans, which controlled the expansion.

The ECB employed a second, complementary strategy to support the covered bond market, an important funding source for banks. The ECB announced its first program to purchases assets on May 7, 2009, the covered bond purchase program (CBPP), which acquired €60 billion (\$83.4 billion) in covered bonds. The bank followed this with an additional €40 billion (\$55.6 billion) in purchases in 2011 (CBPP2). Buying covered bonds allowed the ECB to indirectly lend to banks, ensuring funding for them.

In contrast to the Fed’s and BOE’s emphasis on bond purchases, the ECB focused on supporting the banking system, because of the relative importance of banking credit in the euro area, compared to the U.S. or U.K. where bond markets are relatively more important. In 2016, for example, the U.S. bond market grew to \$36 trillion in outstanding debt securities, compared to \$18 trillion for the euro-area bond market.¹¹ That is, outstanding U.S. debt securities expanded to 193 percent of U.S. GDP, while the euro-area debt securities only reached 153 percent of euro-area GDP.

European governments generally responded to the financial crisis with bank recapitalization programs and fiscal stimulus. Some countries, such as Portugal, Ireland, Italy Greece and Spain, carried preexisting, large sovereign debts that became very difficult to sustain due to the deficit spending demanded by the crisis. In 2009–2010, ratings agencies downgraded the credit ratings of the sovereign bonds of those

¹¹ The Bank for International Settlements reports statistics on debt securities outstanding. One can access these data at <https://stats.bis.org/>.

stressed nations, which helped erode already sinking investor confidence. The bond yields of these euro-area nations soared as creditors feared that a single sovereign default could force a costly bailout from the European Union, a financial crisis, and a domino-effect on other euro-area nations.

The escalating European sovereign debt crisis prompted the ECB to introduce the Securities Markets Program (SMP) in May 2010 to purchase government debt and thereby promote depth and liquidity in the troubled sovereign-debt markets. The ECB funded SMP purchases with sales of other assets to prevent those transactions from increasing the money supply. That is, the ECB *sterilized* its SMP purchases. The SMP accumulated €220 billion (\$293 billion) in euro-area sovereign debt at its peak.

In September 2012, the ECB replaced the SMP with Outright Monetary Transactions (OMTs). In contrast to the SMP, a government wishing to have its bonds purchased under the OMT program must submit a plan for fiscal consolidation and financial reforms subject to the European Stability Mechanism (ESM). While the ECB has not exercised OMTs, policymakers argued that the OMT announcement quelled fears of a euro-area dissolution, shrank distortions in sovereign debt markets, and ultimately reduced the risk that an OMT intervention would be necessary (Cœuré (2013)). Altavilla, Giannone, and Lenza (2016) find that OMT announcements cumulatively reduced 2-year yields by 200 basis points (b.p.) for the most stressed nations, such as Italy and Spain.

4.4 The Bank of Japan: 2008-2012.

Like other major central banks, the BOJ acted as a lender of last resort during the extreme financial market turmoil of the latter half of 2008. Specifically, on December 2, 2008, the BOJ announced that it would begin special funds-supplying operations (SFSOs) that — like the ECB’s FRFA operations — offered unlimited, low-interest loans to banks in exchange for collateral. As in the ECB’s case, the BOJ’s policies reflected the central role that banks play in the Japanese economy.

The BOJ complemented its lending operations by purchasing public and private assets. From December 2008 through February 2009, the BOJ raised its monthly JGB purchases from ¥1.2 to ¥1.4 trillion (i.e., from \$12.8 billion to \$14.9 billion) and announced plans to purchase ¥4 trillion (i.e., \$42.7

billion) in private assets, such as high-quality commercial paper and corporate bonds, to lower the premium on private borrowing costs. These amounts were quite modest in comparison to Fed asset purchases, even when adjusted for the relative sizes of the economies.

As with other central banks, the BOJ soon broadened its focus from supporting financial markets to promoting growth and price stability. On May 21, 2010, the BOJ introduced the Growth-Supporting Funding Facility (GSFF), a lending program that offered up to ¥3 trillion (\$34.2 billion) in low-cost loans to support new businesses, technological research, and social infrastructure such as medical facilities, universities and housing. In October 2010, the BOJ again promised zero interest rates until “price stability is in sight” and it established an Asset Purchase Program (APP) to buy a range of public and private assets to ease monetary policy further (Bank of Japan (2010)).¹² The APP had accumulated ¥40 trillion (\$501 billion) in public and private assets by the end of 2012 (see Table 1 for breakdown by asset class) and planned to purchase another ¥36 trillion (\$369 billion) in assets throughout 2013. These plans would soon be revised, however.

In 2011, the Bank of Japan provided emergency liquidity in response to a new crisis: the Tōhoku earthquake of March 11, 2011, which killed over 15,000 people and caused nearly a billion dollars in property damage (Kazama and Noda (2012)). The disaster also sparked widespread volatility in financial markets. The BOJ responded by lending through its program: Funds-Supplying Operations to Support Financial Institutions in Disaster Areas. This emergency lending facility offered ¥1 trillion (\$12.5 billion) worth of low-interest rate loans to banks with business operations in affected areas.

The yen appreciated sharply in the wake of the earthquake as “carry trade” investors closed borrowing positions in the yen and market participants anticipated that insurance companies would repatriate reserves from abroad. To counter this yen appreciation, the G-7 authorities jointly intervened to sell yen, which weakened the currency as much as 4 percent (see Neely (2011)).

¹² On February 14, 2012, the BOJ again promised zero interest rates until “1 percent inflation is in sight.”

Although Japan adopted UMP early, its efforts in 2001-2006 and 2008-2012 seem cautious by some metrics in comparison to those of its peer institutions. The BOJ brought about the smallest percentage increase in its assets among the four major central banks during 2008-2012. Over those four years, the BOJ's holdings grew by 40 percent, in contrast to the larger increases engineered by Fed (223 percent), the BOE (317 percent) and ECB (123 percent). However, this comparison is sensitive to the metric. If one considers the change in central bank holdings as a fraction of GDP— rather than as a fraction of central bank assets — the BOJ expanded its balance sheet from 21 percent to 32 percent of GDP, an 11 percentage point increase, which is similar to the Fed's increase (12 percentage points) and modestly smaller than the increases of the BOE (18 percentage points) and the ECB (16 percentage points). This latter comparison is probably more appropriate as the initial central bank asset holdings depend on factors such as the proportion of currency held in the economy.

An additional complication in drawing such comparisons is that financial and economic conditions differed among the major economies. For example, the financial crisis was less severe in Japan than in the U.S., but the decline in Japanese GDP was more severe and unwelcome deflation more persistent. Thus, it is not easy to judge definitively, even in hindsight, whether the BOJ expanded more or less than other central banks or whether it should have.

5. Unconventional Monetary Policies Evolve: 2012-2015

During 2008-2012, central banks used a variety of UMPs to stimulate economic activity and achieve price stability. Research and experience with these policies led policymakers to modify such policies and introduce new variations. In particular, central banks began conditioning asset purchases explicitly on incoming data —making the purchases contingent and open-ended—and modifying bank lending programs to provide incentives for banks to expand their lending to the nonfinancial economy.

Because the international business cycle and movements in international commodity prices tend to influence major countries in a similar manner, major central banks generally face similar risks to their goals and similar pressures and so tend to move their policy rates in the same direction. For example, in

2008-2009, all the major central banks tried to ease monetary and financial conditions. The 2012-2015 period was different, however, in that the major central banks saw very different risks to their objectives and acted quite differently. While the Fed moved to remove some of the unusual monetary accommodation that it had provided, the ECB was initially concerned with excessive inflation and then persistent deflation, the BOE focused on creating incentives for more efficient use of the reserves that it provided, and the BOJ moved toward much more aggressive stimulatory policies.

5.1 Bank of England Funding for Lending Scheme (FLS): July 2012.

In the latter half of 2012, the BOE faced several challenges, many of which related to the euro-area debt crisis of the previous year. Although the U.K. was not a member of the eurozone — maintaining an independent monetary policy with an independent currency, the pound — the debt crisis affected the U.K. through its extensive trade and financial links with the eurozone. The U.K. banking system was vulnerable. Many U.K. banks had lent to French banks, which held a lot of debt from fiscally troubled Italy and Spain. A debt default by those countries could easily impair the balance sheets of U.K. banks.

In 2012, the European macroeconomy had weakened. Eurozone growth had been very low from 2011:Q3 through 2012:Q2, and U.K. output growth had been only modestly better at 1.0-1.5 percent. U.K. inflation had been above the BOE Monetary Policy Committee's (MPC) 2 percent target.

Despite substantial monetary easing by the BOE, credit was not flowing freely in the U.K. financial system. Hoping to remedy this, on July 13, 2012, the U.K. Treasury and BOE jointly announced the new Funding for Lending Scheme (FLS), which would lend U.K. Treasury bills to banks for use as collateral in money markets. The FLS loans would be collateralized by lower quality assets. The asset swap allowed the BOE to accept the credit risk associated with lower quality, heterogeneous assets. The MPC supplemented the FLS announcement with FG on August 7, 2013, when it pledged to keep rates low while unemployment remained above 7%.

The FLS was the first of the *conditional credit programs* that used incentives for banks to increase lending to households and businesses. These programs conditioned either borrowing quantities or

borrowing prices (interest rates on borrowing) on each bank's loan growth. They often also offered cheap loans at 3-4-year terms, which are unusually long maturities for obligations to central banks. The use of long maturity loans reduces rollover risk for commercial banks as only a small portion of their funding must be rolled over in any given period. In addition, long-term funding reduces maturity transformation risk as the yields on funding more closely match yields on loans. By making more loans, banks would take advantage of the excess reserves that QE policies had created. The BOJ and ECB would later adopt their versions of conditional credit programs and the BOE would later introduce a second variant.

The U.K. Treasury/BOE designed the FLS to encourage broad participation and conditioned borrowing quantities on bank loans to the nonfinancial sector. A bank could initially borrow U.K. Treasury bills worth up to 5 percent of its outstanding loans to U.K. businesses and households. The FLS rewarded banks for increased lending and penalized banks that cut back.¹³ Each bank's borrowing allowance would increase 1-for-1 with net new loans to the nonfinancial sector. Banks with declining lending would pay a higher interest rate on borrowed funds, 25bp higher interest for every 1 percent decline in lending. The BOE capped FLS interest rates at 1.5 percent.

In its first year, the FLS disbursed the modest amount of £17 billion (\$26.6 billion) in U.K. Treasury Bills: less than a quarter of the facility's total lending capacity. Still the program reduced borrowing costs. The FLS announcement prompted a number of banks to announce, "reductions in the rates on certain mortgage and small-business loans" and LIBOR rates fell further in the weeks following the announcement (Bank of England (2012)). By directly targeting bank lending, the FLS complements QE policies that target asset prices (Churm et al. (forthcoming)). At its peak effects, the FLS reduced banks' funding costs, i.e., unsecured bond spreads declined by 75 bps, increased GDP by 0.8 percent and boosted the annual inflation rate by 0.6 percentage points (Churm et al. (forthcoming)).

In April 2013, the BOE extended the FLS by 12 months and expanded borrowing quantities. That is, to increase incentives for SME lending, the BOE would add £10 to banks' borrowing allowances for

¹³ See 7/13/2012 BOE press release. See Table 2C.

every £1 net increase in SME lending; the BOE decreased that ratio to £5:1 in 2014.¹⁴ In the 12 months following the April 2013 extension, the FLS more than doubled in size as banks borrowed an additional £27 billion (\$42.2 billion) in U.K. Treasury Bills.

The FLS grew to a moderate size compared to other conditional credit facilities (see Figure 6), peaking in size in 2015Q4 at £70 billion (\$107 billion), equal to 3.7 percent of U.K. GDP. The BOE twice postponed the expiration of the FLS before officially ending new drawdowns on January 31, 2018.¹⁵

Aside from expanding the FLS, the BOE maintained steady policies from 2012 until 2016 (see Figures 3 and 4). Kristin Forbes, a member of the BOE MPC in 2014-2017, attributed the MPC's reluctance to make major policy changes to economic and financial shocks that increased volatility and risk, which she described as "a series of unfortunate events." Forbes (2017) specifically cited the Scottish independence referendum in 2014, deflationary declines in oil prices in 2014, Greek debt restructuring in 2015, and capital outflows from China in late 2015. Forbes described her reasoning as follows: "[W]hen the case for raising interest rates is not urgent, there is little cost to delay a decision for a few weeks until a major result is known – especially if it could provide more certainty on key economic variables."

5.2 The Fed's Taper Tantrum and Tapering: June 2013-December 2013

In September 2012, in response to continued weakness in the U.S. labor market and subdued inflation, the Fed embarked on QE3, an open-ended asset purchase program that would be conditioned on incoming economic data.¹⁶ Likewise, in December 2012, the Fed announced that it would switch to funding MEP purchases by issuing reserves, rather than selling short-term assets.¹⁷ Both policies were intended to further ease monetary conditions. The FOMC supplemented these asset purchase measures with the December 12, 2012 contingent guidance that "the Committee ... currently anticipates that this exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment

¹⁴ See the 4/24/2013 BOE press release. See Table 2C.

¹⁵ On 12/2/2014, the BOE extended the FLS to January 2016 and, on 11/30/2015, it extended it to January 2018.

¹⁶ See Federal Reserve (2012a).

¹⁷ See Federal Reserve (2012b).

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.”¹⁸

QE3 marked a major turning point for international UMPs in that it was the first major open-ended asset purchase program. Prior to QE3, programs committed to making purchases indefinitely but on a regular basis, accounted for roughly 23 percent of Fed, ECB, BOE and BOJ asset purchases. But, from the beginning of QE3 purchases in October 2012 until December 2019, open-ended strategies accounted for more than 95 percent of all asset purchases by the four major monetary authorities.

Together with other factors, QE3 and the MEP improved the U.S. economic picture. A series of positive economic reports and nonfarm payroll gains in the winter and spring of 2013 caused the FOMC to consider withdrawing some of the unusual monetary ease by scaling back QE3. On June 19, 2013, Chairman Bernanke stated “the Committee [FOMC] currently anticipates that it would be appropriate to moderate the monthly pace of purchases later this year” – conditional on a continuation of strong economic data (Federal Reserve (2013)). Markets interpreted this remark to indicate that the Fed would soon begin reducing, i.e., “tapering,” QE3. The anticipation of tighter-than-expected monetary policy roiled financial markets, boosting long Treasury yields and the foreign exchange value of the dollar (see Figure 7).¹⁹ These sharp co-movements in asset prices, which became known as the “Taper Tantrum,” illustrated the powerful effect of central bank communication on financial markets (Neely (2014)). The FOMC ultimately chose not to reduce the unusual monetary ease in the summer or autumn of 2013 but the episode did shape anticipation of such actions.

On December 18th, 2013, with PCE inflation hovering near 1.5 percent, below the 2 percent target, and U.S. jobs multiplying briskly, the FOMC announced that it would begin tapering QE3 asset purchases. Starting in January 2014, the Fed would reduce its monthly Treasury and MBS purchases by

¹⁸ See the 12/12/2012 Federal Reserve press release. See Table 2A.

¹⁹ Tighter-than-expected monetary policy causes domestic currency to appreciate.

\$5 billion each, to \$40 and \$35 billion, respectively. Chairman Bernanke emphasized that all future reductions would be gradual and contingent on incoming economic data, and the meeting statement reassured markets that the FOMC expected low rates to persist “well past the time that the unemployment rate declines below 6.5 percent.” Stock markets rallied in response with the S&P 500 gaining about 1.5-2 percent on the signal from the Fed that the economy was on track for recovery.²⁰ The FOMC continued to taper by reducing its Treasury and MBS purchases by \$5 billion each at each of its next seven meetings.

QE3 officially ended on October 29, 2014, but the Fed continued reinvesting principal and coupon payments from maturing securities to maintain its \$4.5 trillion balance sheet. The Fed bought roughly \$1.6 trillion in Treasuries securities and MBS over the course of QE3 (see Figure 5), increasing the U.S. monetary base by about 50 percent.

5.3 The Bank of Japan Hits the Accelerator: 2012-2014

The BOJ’s lender-of-last resort and banking support actions during and immediately after the financial crisis of 2008-2009 did not much change the Japanese monetary base. That is, while it pursued other supportive measures, the BOJ engaged in no significant QE in 2008-2012. The upper panel of Figure 4 shows this distinguished it from the other major central banks. Perhaps as a result, Japan experienced consistent deflation and very slow growth during 2008-2012. This outcome motivated changes in 2013. While the Fed was considering removing some of the extraordinary accommodation that it had provided in the spring and summer of 2013, the BOJ was moving in exactly the opposite direction, to stimulate the economy in earnest.

Following his landslide victory in December 2012, newly-elected Japanese Prime Minister Shinzo Abe pressured the BOJ to ramp up stimulatory measures after two decades of sluggish economic activity including several years of deflation (see Figure 8), stating that “daring monetary policy” would be essential to curbing deflation (Riley (2013)).²¹ On January 22, 2013, as part of a joint statement with the

²⁰ See the 12/18/2013 Federal Reserve press release. See Table 2A.

²¹ Neely (2013) discusses why central banks in developed nations are generally given operational independence to achieve goals set by political leaders and are accountable for their performance.

Japanese government, BOJ Governor Masaaki Shirakawa stated that the BOJ would introduce open-ended asset purchases (Bank of Japan (2013a), see Appendix A). Specifically, the Japanese authorities would purchase ¥13 trillion (\$163 billion) in short- and long-dated JGB each month, starting in January 2014 at the conclusion of the then-ongoing asset purchases of ¥36 trillion over the course of 2013 (Bank of Japan (2013b)). The BOJ also doubled its inflation target from 1 to 2 percent to bolster inflation expectations. Many observers viewed the joint announcement as a watershed linking the efforts of the central bank and national government (Irwin (2013)). The large asset purchase policy constituted both expansive easing and another step by major central bankers toward open-ended QE, but the delayed implementation indicated a lack of urgency that confounded market participants (Kihara and Kajimoto (2013)).²²

To achieve its ever-elusive inflation goal, the also BOJ planned to provide accommodation through two programs collectively dubbed the Loan Support Program (LSP): 1) the GSFF, which had been introduced in 2010 and grew to ¥3.4 trillion (\$34.8 billion) in 2013:Q1, and 2) the Stimulating Bank Lending Facility (SBLF), which had been announced in October 2012 and began allocating funds in 2013:Q2.

Like the BOE's FLS, the SBLF conditioned a bank's access to cheap credit on its loan growth, although, unlike the FLS, the SBLF lent money, not bonds, and did not penalize banks for scaling back loans. Through the SBLF, the BOJ pledged to fund up to 100 percent of banks' increases in net lending relative to 2012:Q4. These loans carried maturities of 1-3 years, though they could be rolled over for a fourth year, at the uncollateralized overnight call rate, which was only 0.1 percent in June 2013.

Despite these nascent stimulatory measures, Japanese inflation slipped further into negative territory during the spring of 2013, increasing pressure on the BOJ to act (see the lower panel of Figure 8). On April 4, 2013, the BOJ took dramatic action when newly appointed Governor Kuroda announced the BOJ's decision to officially change its main policy instrument again, from the uncollateralized overnight call rate to "QQ targeting." That is, the BOJ began "Quantitative and Qualitative Easing" (QQE), which involved

²² Andolfatto and Li (2014) briefly document and evaluate the history of Japanese QE.

both the traditional UMP strategy of increasing the maturity of asset holdings and the evolution toward state-contingent, open-ended programs, an approach that the Fed first turned to in September 2012. The BOJ again supplemented the QQE announcement with a promise to continue QQE until inflation stably reaches 2 percent.

Adopting the QQE strategy made the BOJ the second major central bank, after the Fed, to eschew lump sum asset purchases in favor of continuous and contingent purchases. Such a strategy is consistent with the advice in Bullard (2010) and Waller and Ricketts (2014), who argue for flexible policy frameworks to respond to incoming information, as in conventional interest rate policy.

The QQE strategy committed the BOJ to purchase assets at a pace of ¥50 to 55 trillion (\$512 to \$563 billion) per year, consisting of ¥50 trillion (\$512 billion) in Japanese Government Bonds (JGBs), ¥1 trillion (\$10 billion) in ETFs and ¥30 billion (\$307 million) in J-REITs. These purchases focused on longer-dated JGBs to raise the average maturity of the BOJ's JGBs holdings from 3 to 7 years. The QQE policy also called for very modest purchases of private assets to maintain holdings of ¥2.2 trillion (\$22.5 billion) in commercial paper and ¥3.2 trillion (\$32.8 billion) in corporate bonds.²³

The scale of the April 2013 QQE announcement exceeded expectations: anticipated QQE purchases would outstrip the Fed's QE3 in size relative-to-GDP, boosting the BOJ balance sheet by about 0.9 percent of GDP per month compared with the Fed's QE3, which increased the Fed's balance sheet by only 0.5 percent of U.S. GDP each month.²⁴ QQE also targeted both public and private assets. These asset purchases, along with the LSP, would double Japan's monetary base within 2 years and the BOJ hoped that they would achieve its two percent inflation target within that time horizon. Markets rallied on the news of greater-than-expected monetary easing, driving the Nikkei 225 — the primary Japanese stock index — up 2.2 percent by the end of the day, while the 10-year yield plunged almost 20 b.p. to match a record low (McLannahan and Soble (2013)).

²³ See the 4/4/2013 BOJ press release. See Table 2D.

²⁴ QE1 increased the Fed's balance sheet by about 12 percent of GDP over a period of 18 months.

5.4 The BOJ Extends and Expands Lending and QQE: 2014-2015.

The adoption of QQE in April 2013 was only the beginning of expansionary monetary policy measures. At its February 2014 policy meeting, the Policy Board of the BOJ announced a series of enhancements to the LSP, including one-year extensions to the GSFF and the SBLF. The BOJ also doubled the GSFF's and SBLF's lending capacity and increased the maturity limit of GSFF loans from three to four years. These modifications rapidly expanded SBLF drawdowns (see Figure 9), but some market participants doubted that these changes would significantly affect demand for credit (McLannahan (2014)).

Figure 6 illustrates that, relative to nominal GDP, the SBLF has been the largest conditional lending program among those administered by the four major central banks. As of December 2019, the GSFF and SBLF had lent out a combined ¥48 trillion (\$440 billion), equivalent to about 8.6 percent of Japanese GDP. As of December 2019, the GSFF and SBLF loan disbursements are set to finish in June 2021. The BOJ's reliance on the GSFF and the SBLF reflect the essential role that banks play in Japan and the importance of long-term lending as a means of unconventional monetary easing for the central bank.

A series of shocks in 2014 produced further deflationary pressures in Japan. Specifically, rapidly declining oil prices restrained global inflation, including inflation in Japan and the euro area (see the lower panel of Figures 8 and Figure 10). In Japan itself, a tax hike that raised the price level on a one-time basis also slowed household spending, which fed deflation concerns. To preempt these downside risks to price stability, the Japanese monetary authority expanded QQE on October 31, 2014, raising its annual asset purchases from ¥50 trillion to ¥80 trillion (\$473 billion to \$757 billion) in JGBs, from ¥1 trillion to ¥3 trillion (\$9.5 billion to \$28.4 billion) in ETFs, and from ¥30 billion to ¥90 billion (\$284 million to \$852 million) in J-REITs, which was a 63 percent increase in the pace of asset purchases. The BOJ further extended the average remaining maturity of its JGB portfolio from 7 years to a target range of 7-10 years.²⁵ This monetary expansion reduced both Japanese yields and the foreign exchange value of the yen. The BOJ

²⁵ See the 10/31/2014 BOJ press release. See Table 2D.

Policy Board approved the measures in an unusually tight 5-4 vote, demonstrating serious division over the measures (Kihara and Kajimoto (2014)).

Downward price pressures continued. On January 21, 2015, the BOJ downgraded its year-ahead inflation forecast to 1 percent. To help achieve its 2 percent inflation target, the BOJ extended its LSP for another year and raised the GSFF's total funding cap from ¥7 to ¥10 trillion (\$57.9 billion to \$82.6 billion).²⁶ A year later, at its December 2015 meeting, the BOJ approved an increase in the target range for the average maturity of its JGB holdings and extended the LSP for another year.

5.5 Deflation Fears in the Euro Area: 2012-2014

While the Fed was receiving positive macroeconomic news in early- to mid-2013, the ECB—like the BOJ—faced tepid growth and deflation fears. Despite a global recovery, euro-area growth in 2012-2013 was sluggish, below 2 percent on an annual basis in every quarter. At the same time, euro-area headline inflation receded well below the levels of 2011-2012, when it exceeded the ECB's goal, which was to keep inflation close to, but below 2 percent. Figure 10 shows that euro-area headline inflation declined from 2.5 percent in 2012 to 1.4 percent in 2013, as energy and food prices eased.²⁷ By the end of 2013, euro-area inflation fell to only 0.9 percent, while unemployment remained high, near 12 percent.²⁸ The lackluster euro-area growth in 2012-2013, along with weak commodity and energy prices, stoked fears of deflation (Kang, Ligthart and Mody (2015)). ECB communications frequently referenced concerns about expected inflation, including market-based measures, such as those from yield spreads.²⁹

The ECB Governing Council lowered policy rates in May 2013 and again in November 2013, reducing the MRO rate to just 0.25 percent, although it judged policy to be already accommodative. The Governing Council also employed expansionary FG in July 2013, stating that it expected key ECB interest rates to

²⁶ See the 1/21/2015 BOJ press release. See Table 2D.

²⁷ See European Central Bank (2014).

²⁸ In 1998, the ECB Governing Council quantified its definition of price stability as “a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%.” In 2003, the Governing Council clarified that “it aims to maintain inflation rates below, but close to, 2% over the medium term.” <https://www.ecb.europa.eu/mopo/strategy/pricestab/html/index.en.html>

²⁹ See, for example, the 1/22/2015 ECB press conference. See Table 2B.

remain at or below then-current levels for an extended period. The Governing Council confirmed this statement in August 2013 and reiterated it in January 2014. Despite these measures, the monetary base—and particularly longer-term refinancing operations (LTROs)—shrank as banks repaid loans early. Figure 11 illustrates the declines in these quantities from 2012 through most of 2014.

5.6 The ECB Goes Negative: June 2014.

Headline inflation in the euro area dipped still lower and undershot expectations, registering at only 0.5 percent in the 12 months to May 2014 (Figure 10). On June 5, 2014, ECB President Mario Draghi announced two stimulatory measures: negative deposit rates and a conditional credit program known as Targeted Longer-term Refinancing Operations (TLTROs). President Draghi also hinted at further asset purchases. The ECB applied its new deposit rate of -0.1 percent only to banks' excess reserves; it applied the higher MRO rate to required reserves. Because retail bank depositors strongly resist negative interest rates for their deposits, negative interest rates may tend to favor banks with market funding over those with deposit funding (Bernanke (2016), Schepens (2018)).³⁰ This move to negative interest rates made the ECB the first of the four major central banks to set a negative deposit rate.³¹ The ECB aimed to encourage banks to make additional loans rather than holding excess reserves with the central bank.³²

The ECB complemented its negative interest rate policy by introducing TLTRO at its June 5, 2014 meeting, hoping to boost lending to the real economy, which had been shrinking in 2013 (see Figure 12, Praet (2014)). TLTRO's features resembled those of the BOE's FLS and the BOJ's SBLF, including

³⁰ Bhattarai and Neely (forthcoming) detail the literature on negative interest rates.

³¹ See the 6/5/2014 ECB press release. See Table 2B.

³² Conventional wisdom is that interest rates cannot become (very) negative because people and banks would just hold cash rather than pay to hold bank deposits. Garbade and McAndrews (2012) and Anderson and Liu (2013) discuss problems related to imposing negative interest rates. The August 2010 FOMC meeting transcript very briefly mentioned a 2010 Federal Reserve Board memo, Burke, Hilton, Judson, Lewis, and Skeie (2010), that considered the implications of negative short rates for the U.S. economy. In its September 2011 meeting, the FOMC briefly considered the possibility that lowering the IOER would produce slightly negative rates in some money market rates. Neely (2020) discusses the issues surrounding the use of negative interest rates in the United States.

The banking system as a whole cannot “lend out” reserves because the total quantity of reserves is determined by decisions of the central bank and the cash/deposit preference of individuals, but banks with excess reserves—reserves in excess of legal requirements—can make loans and thereby convert excess reserves to required reserves.

provisions for 4-year loans to banks and low interest payments, only 10 bp above the MRO rate. The TLTRO program followed the SBLF in conditioning banks' borrowing allowances, but not borrowing rates, on increases in net loans, excluding mortgages, to the nonfinancial sector (see Table 3).

The ECB provided €80 billion (\$89 billion) in loans during its first TLTRO allotment on September 18, 2014 and had disbursed loans worth €425 billion (\$472 billion) by its final major allotment on March 24, 2016 (see Figure 12). As of March 2016, the TLTRO program was the largest of the three major conditional credit programs — SBLF and FLS — in absolute terms, but the SBLF remained the largest relative to GDP (see Figure 6). The TLTRO was about 4.0 percent as large as the euro-area GDP while the SBLF was about 4.6 percent as large as Japan's GDP.

The ECB's use of TLTROs reflected central bankers' growing emphasis on ensuring that credit expansions would fund real activity and signaled central bankers' acceptance of conditional credit programs as important tools. By 2014:Q4, the BOE, BOJ and ECB all operated conditional credit programs with a combined total of about \$555 billion of outstanding loans to banks.

In addition to announcing TLTROs and negative interest rates on June 5, 2014, President Draghi foreshadowed additional asset purchases, stating that the ECB would “intensify preparatory work” related to purchases of asset-backed securities. The ECB's unexpected stimulus prompted an equity rally; the Euro Stoxx 50 Index rose to a six-year high on June 5, 2014. According to Trevor Greetham, a director at Fidelity Worldwide Investment, “Draghi handsomely beat expectations by adopting all of the measures under discussion and leaving the door open to future QE” (Monaghan and Inman (2014)). Following the June 2014 announcement, Figure 13 shows that borrowing costs for non-financial corporations declined persistently for the first time in over a year. In addition, European Central Bank (2015) argues that the TLTROs appear to have particularly reduced rates in financially vulnerable countries.

5.7 The ECB's Covered Bond and Asset-Backed Securities Purchase Programmes

Following the ECB's June 5, 2014 announcement of negative interest rates and TLTROs, euro-area inflation continued to be undesirably low. The core harmonized CPI (HCPI)—all items less food, energy,

tobacco and alcohol—had grown only 0.7 percent over the 12 months to May while lending to euro-area businesses reached a seven-year low. At the Fed’s Jackson Hole Conference in August 2014, President Draghi reassured a concerned audience that the ECB “will use all the available instruments needed to ensure price stability in the medium-term” (Jones (2014)). On September 4th, 2014, the ECB Governing Council lowered its MRO rate to nearly zero (0.05 percent), its deposit rate further into negative territory (–0.2 percent), and announced two new asset purchase programs: an Asset-Backed Securities Purchase Program (ABSPP)³³ and a third Covered Bond Purchase Program (CBPP3).

The ABSPP and CBPP3 aimed to facilitate “new credit flows to the economy” by lowering borrowing costs in targeted asset markets. Both programs would begin in 2014:Q4, run for at least two years, and purchase assets with at least a BBB- credit rating. Notably, the ECB initially declined to set either a lump-sum target (like QE2) or a pace of continuing monthly asset purchases (like QE3). Two months after the initial announcement, on November 6, 2014, Draghi clarified that the new asset purchase programs and TLTROs would increase the ECB’s assets by roughly €750 billion to €1 trillion (i.e., by \$1 trillion to \$1.33 trillion) by June 2016, restoring the monetary base to its early-2012 size.

Despite the fact that money creation would fund these asset purchases, President Draghi described the CBPP3 and ABSPP as credit easing, rather than QE, because these programs specifically supported covered bond and ABS markets rather than providing broad monetary stimulus.³⁴ Markets welcomed the additional monetary easing, but some analysts doubted that the relatively narrow asset purchases would be sufficient to combat deflationary pressures (Kang, Ligthart and Mody (2015) and Ewing and Irwin (2014)).

5.8 The ECB Expands the APP: January 2015

Despite the negative interest rates and asset purchase programs announced at the June 2014 meeting, the ECB remained concerned about undesirably low inflation at the beginning of 2015. President Draghi

³³ ABSPP would also include purchases of mortgage-backed securities. See the 9/4/2014 ECB press release. See Table 2B.

³⁴ QE consists of asset purchase and lending programs that unusually increase bank reserves, which are liabilities of the central bank. Credit easing programs can also increase bank reserves but focus on altering the composition of central bank assets to affect credit market conditions (Bernanke (2009)).

stated on January 2, 2015 that “the risk that we [the ECB] do not fulfill our mandate of price stability is higher” and that the ECB stood ready to deliver additional monetary easing (Rankin (2015)). Five days later, an official data release from the European Commission showed that the 12-month headline inflation rate dropped to –0.2 percent, rekindling deflation fears (Petroff (2015)). On January 22, 2015, the ECB responded by expanding its asset purchase program (APP) to include a Public Sector Purchase Program (PSPP) to buy medium- and long-term bonds issued by euro-area governments, agencies and European institutions. The ECB would purchase €60 billion (\$67 billion) per month under the APP — the PSPP, the CBPP3 and ABSPP — and such transactions would continue at least through September 2016 and would persist until the euro area experienced a “sustained adjustment” in inflation and real activity.³⁵ Markets welcomed the expanded stimulus. The Euro Stoxx 50 Index had jumped 1.6 percent, while some euro-area yields declined to new lows (Jolly and Ewing (2015)).³⁶

Figures 4 and 11 show that the ECB purchase programs expanded its balance sheet from 22 to 26 percent of euro-area GDP, or slightly more than €570 billion (\$627 billion) over 2015. This aggressive, state-contingent, open-ended monetary policy mirrored the BOJ’s ongoing QQE and the Fed’s QE3, which had concluded in October 2014. While the relative size of the ECB’s expanded APP did not match that of the BOJ, it marked a radical step for the ECB, a relative latecomer to quantitative easing through asset purchases.

6. Normalization and Brexit: 2015-2019

6.1 The Fed begins to Normalize: 2015-2018

In 2014 and 2015 U.S. employment continued to grow and inflation remained at acceptable levels. Under these conditions, the FOMC began considering ways to reduce the extraordinary accommodation that it had provided and normalize U.S. monetary conditions. There would be two components to this

³⁵ See the 1/22/2015 ECB Press Release. See Table 2B. The ECB’s APP-related announcements cumulatively lowered 10-year euro-area yields by 30-50 b.p. and that the announcements had larger effects on Italian and Spanish yields than on German yields (Altavilla, Carboni, and Motto (2015)).

³⁶ Looser-than-expected monetary policy causes the domestic currency to depreciate.

normalization: a return to the use of short-term interest rates — the federal funds rate — as a policy tool and the gradual reduction of the huge quantity of assets held on the balance sheet.

The FOMC reassured markets that monetary policy would not tighten suddenly, carefully avoiding spooking financial markets, as it had inadvertently done during the “taper tantrum.” On March 19, 2014, the FOMC stated that it expected low rates “for a considerable time after the asset purchase program ends.” On December 17, 2014, the committee said that it “judges that it can be patient in beginning to normalize the stance of monetary policy.” Still, as the economy improved, normalization looked more likely.

On December 16, 2015, with U.S. unemployment having fallen to 5 percent, the FOMC raised the target range for the federal funds rate by $\frac{1}{4}$ percentage point to the 25 to 50 b.p. range.³⁷ In the following years, the FOMC followed this action with eight more quarter point increases that brought the upper limit of the federal funds target range to 2.5 percent by December 2018.³⁸ As it removed accommodation, on June 13, 2018, the FOMC changed its FG to remove expectations that the federal fund rate will remain below its long-run rate, and then, on September 26, 2018, dropped the claim that policy remains accommodative, which had been in place since December 2015.

On June 14, 2017, nearly three years after QE3’s conclusion, the Fed released a plan to reduce its asset holdings and unwind its \$4.5 trillion balance sheet. Starting in October 2017, the Fed would allow a maximum of \$6 billion in Treasuries, \$4 billion in agency debt plus MBS to roll off its balance sheet each month. That is, the Fed retired coupon and principal payments, rather than reinvesting them, thereby reducing the monetary base. During the first year of the normalization strategy, the Fed would increase those roll-off caps each quarter by \$6 billion and \$4 billion, respectively.

This gradual schedule provided time for markets to adjust to changes in excess reserves. Notably, Chair Yellen did not specify an ultimate goal for the size of the balance sheet, only stating that the Fed’s asset

³⁷ See Federal Reserve (2015).

³⁸ In the face of incipient weakness in the summer of 2019, the FOMC began to lower the target rate/IOR again, reaching 1.75 percent in November 2019. The other central banks had not gone nearly so far as the Federal Reserve toward “normal” monetary policy and so did not have scope for conventional easing in 2019.

holdings would be “appreciably below that seen in recent years but larger than before the financial crisis” (Federal Reserve (2017)). In contrast to the Taper Tantrum, the Fed’s balance sheet normalization announcement did not seriously influence asset prices, probably because the unwinding was long-expected and the Fed provided a detailed schedule for the process (Appelbaum (2017) and Timiraos (2017)).

By 2019, however, the FOMC moved away from the idea of a relatively small balance sheet and had decided to maintain a system of “ample reserves,” using the interest rate paid on reserves to influence other short-term interest rates (Federal Reserve (2019)).

6.2 The Bank of Japan Goes Negative: January 2016.

On January 29, 2016, the BOJ continued the easing actions that it had been pursuing since 2013. The Japanese monetary authority followed the Danish National Bank, the ECB and the Swiss National Bank (SNB) in announcing a negative deposit rates— −10 b.p. for the BOJ—on certain reserves held with the central bank. The BOJ Policy Board described the action as a response to global economic risks, including declining oil prices, slowing Chinese growth, and global financial instability (Bank of Japan (2016a)).

The BOJ’s system of deposit rates differed slightly from the existing negative interest rate policies of the ECB and the SNB.³⁹ BOJ adopted a layered deposit rate structure to protect banks’ profitability because it feared that banks would not be able to easily pass on negative rates to depositors. The BOJ adopted “a three-tier system... in order to make sure that financial institutions’ functions as financial intermediaries would not be impaired due to undue decreases in financial institutions’ earnings” (Bank of Japan (2016b)).⁴⁰ Notably, the BOJ stated that it would lower interest rates even further if economic conditions worsened.

The surprise with which markets greeted the BOJ negative-interest rate announcement highlighted a major difference between the communication strategies of the Fed and the BOJ. Excepting the first QE1

³⁹ A bank’s deposits with the BOJ would be organized into three categories: 1) Macro Add-on Balance, 2) Basic Balance and 3) Policy Rate Balance, which would entail interest rates of 0.0, 0.1 and -0.1 percent, respectively. The Macro Add-on Balance would include required reserves along with any amounts borrowed through the SBLF or the GSFF. The Basic Balance would contain reserves up to a bank’s average reserves held in 2015 minus its Macro Add-on Balance. And lastly, the Policy Rate Balance would comprise any reserves in excess of the Macro Add-on and Basic Balances (See Bank of Japan (2016b)).

⁴⁰ See the 1/29/2016 BOJ press release. See Table 2D and Bank of Japan (2016b).

announcements, which surprised markets, the Fed has generally tried hard to be transparent and to avoid startling financial markets.⁴¹ Of course, the Taper Tantrum episode of June 2013 illustrated the practical difficulties in communicating with markets. In contrast to the Fed's efforts, market observers thought that the BOJ and President Kuroda often seemed to go out of their way to surprise markets. For example, just three days prior to the negative interest rate announcement, *The Financial Times* reported, "Mr. Kuroda likes to surprise markets, but he has been emphatic in ruling out negative interest rates" (Harding (2016)).

6.3 The ECB Doubles Down in March 2016.

Despite a year of uninterrupted asset purchases in 2015 and a modest drop in borrowing costs, euro-area inflation remained subdued (Figure 10) and banks' nonfinancial loan volumes grew only marginally throughout 2015 (Figure 12). With these conditions in mind, in December 2015, the ECB extended the APP until at least March 2017 and expanded the PSPP to buy regional and local euro-area government debt. The ECB also began reinvesting payments from maturing securities to sustain its balance sheet.⁴²

Deflation continued to concern ECB policymakers, however. On February 29, 2016, preliminary estimates of euro-area inflation dipped unexpectedly (Jones and McGee (2016)). The ECB Governing Council responded at its March 10, 2016 meeting by 1) cutting its deposit rate deeper into negative territory, 2) implementing a new series of Targeted Longer-Term Refinancing Operations, i.e., TLTRO II and 3) expanding its APP.⁴³

Like its predecessor, the TLTRO-II program offered four-year loans to banks at minimal cost. The interest rate on TLTRO-II drawings started at the MRO rate (0 percent) and could be reduced as low as the deposit rate (−0.4 percent) if a bank expanded its lending by 2.5 percent or more. Such incentives were designed to stimulate new credit flows to the nonfinancial sector.

⁴¹Just one example would be the Federal Reserve's Policy Normalization Principles, which have been modified multiple times since it was initially released after its September 2014 meeting (Federal Reserve (2019)).

⁴² See the 12/3/2015 ECB press release. See Table 2B.

⁴³ See the 3/10/2016 ECB press release See Table 2B.

While the TLTRO-II program is superficially very similar to earlier conditional credit programs, i.e., TLTRO-I, the BOJ's SBLF and the BOE's FLS, its incentives differed in important ways (see Table 3). Specifically, the TLTRO-II's price incentives contrast with the BOJ's SBLF and first TLTRO program, both of which offered borrowing quantity incentives instead. Although the ECB's new long-term lending program and the BOE's FLS both used interest rate incentives, the TLTRO-II program differed from the FLS in three ways. First, unlike the FLS, TLTRO-II contained no provision for raising banks' borrowing allowances. Second, the FLS' incentives raised interest payments for banks that reduced lending, but the TLTRO-II program rewarded banks (i.e., charging a lower rate) for boosting loan volumes. Third, the TLTRO-II program offered euro-area banks the chance to borrow for longer terms at negative interest rates, which is a powerful incentive. While the BOJ did lower its benchmark interest rate into negative territory, it did not offer negative rates in its Loan Support Program until 2020 (Haas, Neely and Emmons (2020)).

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The March 10, 2016 ECB press conference that announced deeper negative rates, the TLTRO-II and expanded asset purchases also illustrated the difficulty of communicating clearly without roiling markets. Although the expansionary announcements and an "easing bias" in the introductory statement initially boosted European equities, President Draghi concurrently cautioned that "[W]e don't anticipate that it will be necessary to reduce rates further." This statement whipsawed stock indices.⁴⁵ The euro first depreciated sharply by about 1.2 percent on the news of additional stimulus, then jumped skyward on President Draghi's press conference comments, gaining back about 3 percent of its value by the end of trading. For comparison, the "Taper Tantrum" on June 19, 2013, which is often viewed as an example of the power of central bank (mis)communication, engendered an approximately 1.0-1.5 percent appreciation in the foreign exchange value of the dollar (see Figure 7).

⁴⁴ In April 2020, the BOJ would decide to offer to pay 0.1% to banks that participate in its new Special Funds-Supplying Operations (Kihara, Canepa, and Schneider (2020)).

⁴⁵ See the 3/10/2016 ECB press release. See Table 2B.

In addition to announcing negative rates and the TLTRO-II in March 2016, the ECB also expanded its APP by establishing the Corporate Sector Purchase Programme (CSPP) to specifically lower funding costs for euro-area businesses. The CSPP purchased investment-grade corporate bonds (BBB- or higher) with 6 months to 30 years remaining maturity that had been issued by non-financial corporations within the euro area (European Central Bank (2016)). The enhanced APP acquired €80 billion (\$88.6 billion) worth of bonds per month — a 33 percent increase from the previous monthly pace of €60 billion (\$66.4 billion). The ECB maintained this rate until March 2017, at which point the APP returned to its previous pace of €60 billion per month. Most of the APP expansion came from an uptick in sovereign bond purchases, while corporate bond purchases averaged €7.5 billion (\$8.3 billion) per month from June 2016 until March 2017. Nonetheless, the CSPP had acquired over 11 percent of the “CSPP-eligible bond universe” as of June 7, 2017 (European Central Bank (2017b)).

6.4 Bank of Japan Responds to Brexit: June 2016.

On Thursday June 23, 2016, the citizens of the United Kingdom voted to leave the European Union. This decision, commonly called Brexit, produced widespread uncertainty, financial market volatility and a flight to safe assets. As the yen is considered to be a very safe asset, Brexit caused it to appreciate substantially, which made Japanese exports relatively more expensive. The BOJ announced on July 29, 2016, that it planned to double its pace of ETF purchases and the size of its U.S. dollar (USD) lending operations to enhance business confidence and ensure access to funding in foreign currencies.⁴⁶ The BOJ lends in USD to support the overseas operations of Japanese firms through Japanese financial institutions. The BOJ’s policy actions failed to match market expectations of stronger stimulus (CNBC (2016)).

⁴⁶ See 7/29/2016 BOJ press release. See Table 2D.

6.5 Bank of England Responds to Brexit in August 2016

Journalist: "What do you fear most?"

Harold MacMillan, former U.K. Prime Minister: "Events, dear boy, events."

— Probably an apocryphal quote

Knowles, Elizabeth M. (2006). What they didn't say: a book of misquotations. Oxford University Press. pp. vi, 33.

The Brexit vote produced great economic uncertainty and caused many analysts to revise down their forecasts for U.K. growth. The pound depreciated sharply after the referendum as the U.K. business activity index dropped from 52.3 to 47.4 in July, the largest drop in the index's history (Cunningham (2016)).

Facing threats to growth and price stability, on August 4, 2016, the BOE cut its policy rate from 0.5 percent to 0.25 percent, expanded its APF and introduced the Term Funding Scheme (TFS), a conditional credit program that lent directly to banks against collateral. The BOE expanded its APF by £10 billion (\$13 billion) in U.K. corporate bonds and £60 billion (\$78 billion) in U.K. government bonds, raising the facility's total holdings from £375 billion in July 2016 to £445 billion (\$488 billion to \$566 billion) in May 2017, when purchases concluded. The BOE funded both the TFS and the expanded APF by money creation.

The TFS — like its companion, the FLS, which would operate until January 2018 — used both quantity and price incentives to encourage banks to lend to the U.K. nonfinancial sector. Unlike the FLS, the TFS directly lent money rather than government securities.⁴⁷ The BOE designed the TFS to reduce long-term borrowing costs and to insure banks "against the risk that conditions tighten in bank funding markets."⁴⁸ The TFS initially limited borrowing to 5 percent of banks' outstanding loans to the U.K. nonfinancial sector. Increases in lending would raise banks' borrowing limits on a 1-for-1 basis. The TFS' interest rate incentive structure mirrored that of the FLS, with higher borrowing rates for banks with declining loan volumes.⁴⁹

⁴⁷ The BOE had greatly modified the FLS between July 2012 and the last drawdown in January 2018. Specifically, the BOE had stripped out most of the incentives in the FLS.

⁴⁸ See the 8/4/2016 BOE press release. See Table 2C.

⁴⁹ Participants would pay a baseline fee of 25 bp as well as a 'scheme fee,' i.e., an additional 5 bp for every 1 percent its outstanding loans declined over the course of the program. The BOE set a 25 bp maximum for the scheme fee, but would be zero if a bank exhibited neutral or positive net lending.

As of January 2018, the TFS had lent U.K. banks over £100 billion (\$130 billion), about 5 percent of U.K. GDP, making it larger than the FLS at its peak. Figure 6 shows the value of TFS peaked at over 6 percent of U.K. GDP in early 2018. The post-Brexit easing — i.e., new asset purchases, along with TFS loans — expanded the BOE’s balance sheet from around £400 billion in June 2016 to £590 billion in August 2018 (\$544 billion to \$791 billion) (see Figure 14).

6.6 The BOJ Targets the Yield Curve: September 2016.

Despite the BOJ’s introduction of negative deposit rates in January 2016 and the modest stimulus following Brexit, expectations of Japanese inflation continued to be undesirably low. Meanwhile, long-term interest rates in Japan fell markedly below short-term rates in the months following the BOJ’s announcement of negative interest rates. In July 2016, for example, the yield on 10-year JGBs averaged around 22 b.p. below the uncollateralized overnight rate. This yield curve inversion threatened the profitability of Japanese banks, which make loans at long-term rates and borrow at short-term rates.

The BOJ announced on September 22, 2016 that it would target the uncollateralized overnight rate and the 10-year JGB yield at –0.1 percent and 0.0 percent, respectively, to avoid “destabilizing the financial system through downward pressure on financial institutions’ profits” and to further guide the economy towards price stability (Nakaso (2017)). This new policy, which the BOJ termed “QQE with Yield Curve Control (YCC),” was unprecedented in recent history.⁵⁰ While the Fed, ECB and BOE had all attempted to influence long-term yields through unconventional policies, the BOJ became the first to explicitly target longer-dated yields. To stoke inflation expectations, Governor Kuroda also announced an “inflation-overshooting commitment,” stating that the BOJ would maintain its asset purchase pace until year-over-year inflation “exceeds the price stability target of 2 percent and stays above the target in a stable manner.”⁵¹

⁵⁰ Prior to the U.S. Treasury-Fed accord of 1951, the U.S. Treasury and Fed had cooperated to effectively fix long-term interest rates to hold down the costs of financing World War 2 (Romero (2013)).

⁵¹ See the 9/21/2016 BOJ press release. See Table 2D.

Figure 15 illustrates that the JGB 10-year yield remained consistently above the overnight rate in the two years following the announcement of YCC, averaging 4 b.p. and ranging from – 10 b.p. to 15 b.p. QQE with YCC marked another policy shift for the BOJ, moving from “QQ targeting” back to interest rate targeting. But yield curve targeting required continued purchase of large amounts of JGBs, although at a slower pace. BOJ holdings of JGBs increased by roughly ¥63 trillion (\$562 billion) in the 12 months following the YCC announcement, compared with ¥78 trillion (\$718 billion) over the prior year.

The BOJ’s ability to successfully control long yields may depend on its ownership of a large fraction of the stock of JGBs and purchases of an even larger portion of issuance. For example, in December 2016, the BOJ owned ¥350 trillion JGB or 39.1% of the ¥895 trillion JGB market. Over the next year, the JGB market grew to ¥928 trillion, while BOJ holdings grew to ¥407 trillion or 43.9% of the market. That is, the BOJ’s holdings increased by ¥57 trillion, while the stock of JGBs only increased by ¥33 trillion over the course of 2017. The BOJ bought almost twice the net issuance of JGBs.

The BOJ added several minor measures in 2018 and 2019, such as extending deadlines for new applications to lending programs and modifying its interest rate policy and FG. While the BOJ reaffirmed its FG on July 31, 2018, stating “The Bank intends to maintain the current extremely low levels of short- and long-term interest rates for an extended period of time”, the central bank also loosened its control on the 10-year yield, indicating that yields “may move upward or downward to some extent” depending on economic conditions. From that BOJ announcement to December 2019, the 10-year JGB yield ranged between -30 b.p and 15 b.p. On July 30, 2019, the authority assured the public that, “the Bank will not hesitate to take additional easing measures if there is a greater possibility that the momentum toward achieving the price stability target will be lost” (see Appendix B).

6.7 The ECB and BOE Announce Removal of Accommodation in 2017-2018

While the Fed announced plans for to normalize its balance sheet in June 2017, improving economic conditions caused the BOE and ECB to similarly consider trimming back their stimulatory policies. By 2017, the unexpectedly solid performance of the U.K. economy in the wake of Brexit seemed to reassure

the BOE that it need not maintain unusual stimulus. On September 14, 2017, the MPC warned that “Some withdrawal of monetary stimulus is likely to be appropriate over the coming months.” On November 2, 2017, with inflation reaching 3 percent and unemployment having fallen to 4.2 percent, the MPC raised its policy rate by 25 b.p. to 50 b.p., the first MPC rate hike in more than a decade. A few months later, on February 8, 2018, the MPC warned that monetary policy may need to be “tightened somewhat earlier and by a somewhat greater extent.” The bank rate reached 0.75% on August 2, 2018 as the MPC cautioned that “future increases in Bank Rate are likely to be at a gradual pace and to a limited extent.” In keeping with this caution, the MPC kept the size of its balance sheet stable and maintained the Bank Rate at 0.75 percent until the Covid-19 crisis in 2020.

In April 2017, core, euro-area HCPI inflation —all items less food, energy, tobacco, and alcohol — climbed above 1 percent for the first time in more than a year, while real GDP growth registered above 2 percent for two straight quarters (2017:Q1-2).⁵² On October 26, 2017, the ECB announced it would “*downsize*” its long QE program.⁵³ Starting in January 2018, monthly APP bond purchases would shrink by half, down to €30 billion (\$35.4 billion) “until the end of September 2018, or beyond... if the outlook becomes less favorable.”⁵⁴ In June 2018, the ECB Governing Council took another step toward normalization by clarifying that, so long as the medium-term inflation outlook remained favorable, it would reduce monthly asset purchases to €15 billion from September to December 2018, at which point it would end net purchases (see Figure 11). But the ECB also stated that it would continue to reinvest principal payments from maturing securities for “an extended period” to maintain liquidity and monetary accommodation. The Governing Council maintained policy rates but reiterated that its policy was

⁵² While the ECB has a single mandate — price stability — unlike the Fed’s dual mandate of price stability and maximal sustainable employment, it seems very unlikely that real activity plays no role at all in the thinking of the members of the ECB Governing Council.

⁵³ President Draghi was emphatic in October that the policy change be termed “downsizing” rather than “tapering” (European Central Bank (2017a)).

⁵⁴ See the 10/26/2017 ECB press release. See Table 2B.

contingent on a path for inflation close to but below 2 percent. Table 4 summarizes and compares the UMPs of the ECB and its counterparts.

Responding to downside economics risks related to the U.S.-China trade war and Brexit, the ECB announced TLTRO-III in March 2019 to maintain favorable credit conditions. The incentives of the third iteration of the ECB's conditional credit program resembled those of the second. The ECB extended the maturity of TLTRO-III operations from two years to three years at its September 2019 meeting.

Facing a slow economy and undesirably low inflation in the fall of 2019, the Governing Council of the ECB acted to boost growth and price increases at its September 12, 2019 meeting. It introduced a two-tier system for the deposit facility, reduced the deposit rate to -0.5 percent, and added FG that the deposit, MRO and lending rates would be low until projected inflation is close to but below 2 percent within its projection horizon. It also announced the November 1, 2019 restart of the asset purchase programme (APP) at a monthly pace of €20 billion and added FG that it would be continued as long as necessary “to reinforce the accommodative impact of its policy rates.”⁵⁵

7. Conclusion

Fawley and Neely (2013) described the practice of UMP by major central banks from 2008-2012. This article has extended that work by investigating how major central banks have developed and implemented such policies from 2012 through 2019 to facilitate credit transactions, encourage real activity and maintain low and stable inflation rates.

Conventional monetary policy uses purchases of short-term assets to target short-term interest rates and influence credit conditions and real activity. This article defines UMPs to be those that seek to influence medium-and long-term interest rates, drive short-rates to negative levels, or influence credit conditions in particular markets. Central banks use broad purchases of long-term bonds and FG to influence medium and

⁵⁵ See the 9/12/2019 ECB press release. See Table 2B.

long rates, narrow asset purchases and/or conditional bank lending programs to influence conditions in particular markets, and negative deposit and/or lending rates to drive general short rates negative.

Central bankers developed UMPs to stimulate the economy, ease credit conditions, and respond to other economic problems when short rates were at or near the zero bound. Central banks have tailored these policies to the nature of their economies and their specific problems. For example, with a financial system that is centered on bond markets, the Fed emphasized reducing bond yields—both public and private—while the BOJ and ECB initially focused on banking credit with their bank-centric economies. The BOJ has gone further than other central banks in explicitly targeting long yields, rather than merely purchasing a pre-scheduled quantity of assets or keep a purchase pace over time. The BOE has been an early adopter of both broad asset purchases and bank lending incentive programs. The ECB used narrow bond purchases and long-term loans to banks at negative rates to support sovereign bond markets.

The earliest UMPs closely followed lender-of-last resort actions in short-term markets, as central banks saw the need to lower borrowing costs and increase the availability of longer-term credit. In 2008-2009, the Fed and BOE created large asset purchase programs and drove down medium- to long-term yields with FG in their bond-centric economies, while the ECB and BOJ pursued largely sterilized smaller asset purchase programs and elastic lending to support banks.

From 2008 through 2012, all four major central banks provided unconventional monetary accommodation to varying degrees, with an assortment of programs. In contrast, from 2012 through 2019, the four major central banks faced different challenges and responded to those challenges in different ways.

In 2013-2014, the Fed first reduced, then removed additional monetary accommodation before gradually raising the federal funds rate in 2015-2018. The BOJ went in the other direction. Following the election of Prime Minister Abe in late 2012, the BOJ substantially stepped up the aggressiveness of its monetary policies, adopting a much more determined QQE policy of asset purchases, conditional lending

to banks, and a tiered system of negative deposit rates before becoming the first major central bank in modern history to explicitly target long yields.⁵⁶

The ECB was initially preoccupied with threats to price stability in both directions before moving in 2014-2016 to counter undesired disinflation with more aggressive stimulatory measures, such as negative deposit rates, conditional bank lending programs and asset purchases.

As a result of “a series of unfortunate events”— i.e., the Scottish independence referendum, oil price declines, a U.K. general election and the Brexit vote — the BOE maintained fairly steady policies from 2012 - 2016, when it resumed substantial easing in the wake of Brexit.⁵⁷

Although the BOE and BOJ both responded to the Brexit vote in 2016 with additional easing, central banks moved toward normalizing monetary conditions in 2017-2018. In June 2017, the Fed published plans for normalizing its huge balance sheet and the ECB soon followed with normalization plans of its own in October 2017. Likewise, in February 2018, the BOE warned that it too may soon withdraw some unusual accommodation.

From 2012 through 2019, central banks learned from their earlier experiences and adapted old methods to tackle new problems. An important development was the move toward contingent asset purchases. Early asset purchase programs had been either very small and limited or announced as a lump sum, but central banks eventually moved to open-ended asset purchases whose sizes and durations depended on incoming economic data. The Fed’s QE3 was the first major asset program to be continuous, open-ended and explicitly contingent on incoming data.⁵⁸

Bank lending programs evolved too, as central banks moved from conventional lending operations to fully elastic supply to conditional programs that offer price and/or quantity incentives for greater bank

⁵⁶ Central banks sometimes targeted long yields in previous eras. During and shortly after WW2, for example, the U.S. Treasury and Federal Reserve cooperated to maintain low interest rates to reduce the costs of financing the war.

⁵⁷ We borrow the phrase “a series of unfortunate events” to describe the reasons for the Bank of England’s inactivity in 2012-2016, from Forbes (2017). Forbes was a member of the Bank’s Monetary Policy Committee in 2014-2017.

⁵⁸ The ECB’s earlier and much smaller SMP did not specify an amount or a pace of purchases but was conducted in an ad hoc fashion, conditional on market developments.

lending to the nonfinancial public. The BOE created the FLS and TFS; the BOJ created the SBLF and the ECB created the TLTROs.

In short, the 2012-2019 period was a period in which central banks further developed their UMP tools to cope with heterogeneous challenges. The preparation would prove useful for the central bank responses to the 2020 COVID-19 crisis, which are described in Haas, Neely, and Emmons (2020).

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Glossary

Asset-Backed Security (ABS) pays its holder the cash flows from a pool of financial assets (excluding mortgages), such as auto loans, credit card receivables, home equity loans, or student loans.⁵⁹

Asset Purchase Facility (APF) [Bank of England] a BOE facility to purchase large quantities of both public and private debt, thereby reducing borrowing costs and stimulating new credit flows.

Asset Purchase Program (APP) [Bank of Japan] a BOJ program to buy public and private assets to reduce long-term interest rates and risk premia. The APP also conducted 3- and 6-months fixed rate operations (FROs): collateralized loans to banks that were disbursed in fixed, pre-determined quantities.

Asset Purchase Program (APP) [European Central Bank] an ECB program to buy a wide range of assets, such as government bonds, asset-backed securities and corporate bonds, to reduce funding costs in those markets.

Commercial Paper is an unsecured, short-term debt instrument issued by corporations. Most commercial paper issued by U.S. corporates in 2016 had 1- to 4-day maturities, although commercial paper may have a maturity as long as 270 days.⁶⁰

Corporate Bonds are debt instruments used to finance business operations. They have maturities greater than 270 days and are sometimes backed by collateral such as a company's physical assets.⁶¹

Counterparty Risk (a.k.a., default risk) is the danger that a party to a financial agreement (loan, interest rate swap, etc.) will fail to meet its obligations. During banking panics and financial crises, perceived counterparty risk typically rises, raising interest rates and lowering trading volumes.

Covered Bonds permit bond-holders recourse to both the collateral and the bond issuer in the event of default. Banks must hold the underlying collateral on their balance sheets, which reduces incentive to make and securitize low-quality loans. Issuing longer-maturity covered bonds helps banks mitigate the maturity mismatch that they typically face between short-term deposits and long-term loans.

Credit Easing policies are central bank policies that aim to lower interest rates or provide liquidity to specific credit and asset markets. Credit easing can involve asset purchases that change the composition but perhaps not the size of the central bank balance sheet.

Deposit Rate is the interest rate that a central bank pays on some classes of reserves — often excess reserves — that financial institutions deposit with the central bank. A deposit rate typically establishes a floor for interest rates.

Exchange-Traded Funds (ETFs) are securities that trade on an exchange that track the value of a pool of stocks, bonds or commodities. For example, ETFs that track a stock market index enable investors to diversify their portfolio with a single tradable security.

Funding for Lending Scheme (FLS) is a Bank of England bank-loan program designed to stimulate lending and reduce borrowing rates for U.K. households and businesses. The FLS is an early example of a conditional credit program in that it used price and quantity incentives to encourage bank lending.

Growth-Supporting Funding Facility (GSFF) is a Bank of Japan program established to finance investments with special economic value. Banks could borrow from the GSFF for up to three years (four years

⁵⁹ For information on Asset-Backed Securities outstanding, see Federal Reserve (2020b).

⁶⁰ For information on commercial paper issuance, see Federal Reserve (2020a).

⁶¹ For information on new U.S. corporate bond issues, see Federal Reserve (2020d).

starting in June 2014) and at low interest rates to invest in specified types of projects, including research and development, startups, healthcare, workforce development, etc.

Inflation refers to a sustained increase in the general price level of goods and services over time. Central banks consider a low and stable rate of inflation to be price stability. A similarly persistent decline in the overall price level is called “deflation.”

Liquidity Risk is the chance that an asset cannot be liquidated quickly at a price close to its fundamental value. Heterogeneous assets, such as real estate, tend to be illiquid while homogeneous assets, such as government bonds, tend to be liquid.

Loan Support Program (LSP) is a Bank of Japan program to provide long-term credit to banks to lower borrowing costs and growth. The LSP comprises the Growth-Supporting Funding Facility (established 2010) and the Stimulating Bank Lending Facility (established 2012).

Main Refinancing Operations (MRO) are seven-day ECB bank loans that control liquidity to the banking system. The MRO rate is one of the main policy tools of the ECB; it benchmarks interest rates on other euro-denominated financial investments.

Monetary Base is the sum of currency in circulation, plus commercial bank reserves held with the central bank. It is the narrowest measure of the money supply and is frequently used to gauge the stance of monetary policy. A central bank security purchase expands the monetary base. Conversely, selling securities to tighten policy shrinks the monetary base.

Mortgage-backed Securities (MBS) pay the holder using cash flows from a pool of mortgage loans. Agency-MBS, are guaranteed by U.S. government-sponsored enterprises (e.g. Fannie Mae, Freddie Mac).⁶²

Outright Monetary Transactions (OMTs) is a program that replaced the ECB’s Securities Markets Program (SMP) on September 6, 2012. The OMT program provides a framework for the ECB to conduct sterilized government bond purchases in secondary markets on an as-needed basis. In contrast to the SMP, the OMTs require that countries receiving support implement fiscal reforms. The ECB has not executed any OMTs as of April 2018.

Quantitative Easing (QE) is monetary policy that expands the central bank balance sheet, which are typically asset purchases. Central banks typically implement QE by purchasing long-term bonds to lower long-term interest rates when short-term interest rates approach the zero-lower bound. Any policy that substantially raises central bank assets can be considered QE, however.

Risk Premium is the return on an asset that exceeds the risk-free rate of return, often measured as the interest rate on three-month U.S. Treasury bills. Risk premia compensate investors for holding many kinds of risk, e.g., default risk, duration risk, liquidity risk, prepayment risk.

Securities Markets Program (SMP) was an ECB program to support the debt of fiscally stressed countries by buying their sovereign debt in secondary markets. The ECB conducted fully sterilized SMP purchases on an ad hoc basis. On September 6, 2012, the ECB replaced the SMP with Outright Monetary Transactions (OMTs).

⁶² For information on Agency- and Government Sponsored Enterprise-backed Securities outstanding, see Federal Reserve (2020c).

Special Funds-Supplying Operations (SFSOs) The Bank of Japan's SFSOs offered unlimited three-month, collateralized loans to banks at the uncollateralized overnight call rate. The BOJ replaced SFSOs with Fixed-Rate Operations (FRO) on December 1, 2009.

Sterilization is the process by which a central bank prevents monetary policy actions (e.g., asset purchases) from affecting the monetary base by conducting countervailing operations. For example, the Federal Reserve's early long-term asset purchases through its Maturity Extension Program were offset by sales of short-term assets. *Unsterilized* asset purchases are funded by issuing central bank reserves, i.e., money creation.

Stimulating Bank Lending Facility (SBLF) was an early BOJ conditional credit program that offered banks the incentive of greater loans from the central bank in exchange for raising their loans to the nonfinancial sector. The BOJ made SBLF loans available at 1- to 4-year periods at the uncollateralized overnight call rate.

Targeted Longer-Term Refinancing Operations (TLTRO) are ECB low-interest loans to banks at maturities of up to four years. The TLTRO rewarded banks for increasing their loan activity by raising borrowing limits 3 percent for every 1 percent increase in nonfinancial lending. The ECB introduced the TLTRO program — its first conditional credit program — on June 5, 2014, and then replaced them with TLTRO-II on March 10, 2016.

Targeted Longer-Term Refinancing Operations II (TLTRO-II) replaced the ECB's TLTRO on March 10, 2016. The new facility aimed to stimulate new credit flows to the economy by linking interest payments on borrowed funds to increases in lending activity. Interest rates on TLTRO II loans started at the MRO rate (0 percent) and declined as low as the ECB deposit rate (-0.4 percent) if a bank increased its lending activity by 2.5 percent. The TLTRO II program concluded in March 2017.

Targeted Longer-Term Refinancing Operations III (TLTRO-III) were introduced by the ECB in March 2019 and were similar to TLTRO-II. At first, banks could borrow funds for up to two years, but in September 2019, the ECB increased the maximum maturity to three years. The interest rate on TLTRO-III funds for a bank would begin at the MRO rate (0 percent) and could decline as low as the deposit rate (-0.5 percent) if the participating bank increased its lending activity by 2.5 percent.

Term Funding Scheme (TFS) was the BOE's second conditional credit program. The BOE established the TFS program to ease conditions following the Brexit referendum in June 2016. The TFS functioned similarly to the FLS: The BOE would fund 100 percent of any net increases in banks' lending to U.K. households and businesses, and any banks that reduced loan activity would pay a higher interest rate on borrowed funds.

Boxed Insert: The Central Banks of Smaller Economies

Some central banks of smaller economies, such as the Swiss National Bank (SNB), the Danish National Bank (DNB), and Swedish Riksbank (“the Riksbank”), also implemented UMPs in response to the global financial crisis. Consistent with the actions of the Fed, the BOE, the ECB and the BOJ, these smaller central banks initially expanded their balance sheets by providing emergency liquidity but eventually began large-scale purchases of foreign exchange —not domestic bonds — to weaken their currencies and support real activity.

Central banks of smaller economies are generally much more concerned with exchange rates than are major central banks because foreign trade is usually much more important for smaller economies. In addition, foreign exchange markets are typically the deepest and most sophisticated financial markets in small economies, because a small economy would typically have small domestic bond and equity markets. There are exceptions to the focus on exchange rates, however. For example, the Riksbank and the SNB purchased government bonds in a manner like that of the major central banks; that is, it engaged in pure quantitative easing. Diez de los Rios and Shamloo (2017), who compare the purchases of the Bank of England, the Riksbank, and the SNB with those of the Federal Reserve, find that the purchases of the three smaller central banks have “limited but significant” effects in lowering bond yields.

Lender of last resort responses to the Financial Crisis

The collapse of the housing bubble in 2006-2007 intensely disrupted financial markets and caused the global economy to contract. Concerns about counterparty risk led to funding shortages as banks became reluctant to lend to one another. In December 2007, the SNB made emergency loans to banks in Swiss francs (CHF) and in U.S. dollars (USD) to restore market function with USD obtained through currency swap agreements with the Federal Reserve. These lending programs dramatically increased the SNB’s balance sheet, which doubled in size by January 2009 (Figure A).

In the wake of the March 2008 Bear Stearns bankruptcy in May 2008, the DNB also acted as a lender of last resort by providing emergency liquidity through a new short-term liquidity facility. In September

2008, the DNB began providing liquidity in USD through a currency swap agreement with the Federal Reserve. These emergency measures increased the size of the DNB's balance sheet by 50 percent, but it would not rise further over the next few years (see Figure A).

The Swedish Riksbank implemented its own emergency lending programs in September 2008 to counter the severe credit market disturbances that followed the bankruptcy of Lehman Brothers. In addition to supplying liquidity in Swedish krona (SEK), the Riksbank joined other central banks in establishing a currency swap agreement with the Federal Reserve to provide USD funding to domestic banks (Anderson, Gascon, and Yang (2010)). The Riksbank also became one of the first monetary authorities to respond to the financial crisis with negative deposit rates (–0.25 percent) and with longer-term loans to banks.⁶³ These longer-term lending facilities increased the size of the Riksbank balance sheet by more than 250 percent at peak, most of which occurred in October 2008. Access to market funding improved in 2010 as indicators of financial stress fell below pre-crisis levels, which prompted the Riksbank to unwind some accommodative policies in the summer of 2010, normalizing its balance sheet.

The CHF, the DKK and the European Sovereign Debt Crisis

The SNB was also concerned with international developments, specifically with a flight-to-safety by international investors that undesirably raised the value of the Swiss franc (CHF), which is perceived as exceptionally safe. Fearing that an overvalued CHF would hamper economic activity, beginning in March 2009, the SNB prevented appreciation of its own currency by buying foreign exchange. Such large-scale purchases expanded the SNB's balance sheet by 50 percent by May 2010.

In 2011, the worsening European sovereign debt crisis disrupted financial markets, producing another flight to safety and more upward pressure on the CHF. In August of 2011, the SNB responded by purchasing its own bills, expanding sight deposits (i.e., central bank reserves) from CHF 30 billion to CHF 200 billion. Despite this, the CHF continued rising in value. To arrest this rise, on September 6th 2011, the SNB established a currency peg of 1.2 CHF/EUR, which it enforced by first buying foreign exchange and,

⁶³ See Molin (2010).

eventually, by establishing negative interest rates on CHF deposits, which reduced demand for CHF. The SNB maintained this currency peg until the beginning of 2015, at which point it had bought foreign currency worth nearly CHF 250 billion (\$260 billion), equivalent to 40 percent of Switzerland's nominal GDP. As a percentage of GDP, the SNB asset purchases were roughly comparable to the value of all new Federal Reserve asset purchases. Since abandoning its fixed-exchange rate policy in 2015, the SNB has continued to actively weaken the Swiss franc, purchasing CHF 280 billion (\$291 billion) worth of foreign currency between January 2015 and April 2018, expanding its balance sheet by a further 50 percent (Figure A).

The SNB's retreat from its currency peg in January 2015 encouraged "massive inflow[s] of speculative money" to Denmark as speculators bet that the ECB would ease further, which would cause the Danish Krone (DKK) to appreciate against the EUR.⁶⁴ To defend its own peg to the euro, the DNB lowered its deposit rate well into negative territory, to – 0.75 percent, and began aggressively purchasing euros.⁶⁵ Significant currency appreciation would tighten Danish monetary conditions to an unwelcome extent. The DNB purchased DKK 300 billion (\$45 billion) worth of foreign currency by March 2015, equal to 15 percent of Danish GDP. After market pressures on the DKK subsided by November of 2015, the DNB sold nearly all its recently purchased foreign exchange, returning its balance sheet to pre-crisis levels by 2016.

Sweden Implements QE

Further north, Swedish inflation drifted below the Riksbank's target throughout the second half of 2014 and prompted the central bank to reduce its deposit rate to negative levels, i.e., – 0.5 percent. On February 12, 2015, the Riksbank announced a negative repo rate, initially – 0.1 percent, and begin buying Swedish government bonds — increasing the monetary base — to promote inflation. The Riksbank exclusively purchased bonds with 1-25 years of maturity remaining. QE purchases amounted to SEK 340 billion (\$39.8 billion) by the end of 2017, nearly doubling the size of the Riksbank's balance sheet. The Riskbank kept

⁶⁴ See Milne (2015).

⁶⁵ The DNB first set its deposit rate below zero on July 6, 2012 in response to the ECB's decision to lower its deposit rate to the zero lower bound (ZLB) earlier that month.

its policy rate anchored at – 0.5 percent until December 2018, when rosier economic conditions motivated the central bank to raise the repo rate to – 0.25 percent.

Tables

Table 1: Bank of Japan holdings as of December 2012

Asset Type	BOJ APP Holdings (trillion yen)	BOJ APP Holdings (percent of holdings)
JGBs	24.0	60.0
T-Bills	9.5	23.8
Commercial Paper	2.1	5.3
Corporate Bonds	2.9	7.3
ETFs	1.6	4.0
J-REITS	0.1	0.3
Total	40.0	100

SOURCE: Bank of Japan.

NOTE: This table details the distribution of BOJ APP holdings by asset class as of December 2012. Percent figures may not sum to 100% due to rounding.

Table 2: URLs for Relevant Policy Statements

A. Federal Reserve

Federal Reserve				
Date	Program	Event (link)	Brief Description	Interest Rate News
11/25/2008	QE1	FOMC statement	LSAPs announced: Fed will purchase \$100 billion in GSE debt and \$500 billion in MBS.	
12/1/2008	QE1	Bernanke speech	First suggestion of extending QE to Treasuries.	
12/16/2008	QE1	FOMC statement	First suggestion of extending QE to Treasuries by FOMC.	Fed cuts federal funds rate from 1% to 0.00-0.25%; expects low rates “for some time.”
1/28/2009	QE1	FOMC statement	Fed stands ready to expand QE and buy Treasuries.	
3/18/2009	QE1	FOMC statement	LSAPs expanded: Fed to purchase \$300 billion in long-term Treasuries and another \$750 billion and \$100 billion in MBS and GSE debt, respectively.	Fed expects low rates for “an extended period.”
8/12/2009	QE1	FOMC statement	LSAPs slowed: All purchases will finish by the end of October, not mid-September.	
9/23/2009	QE1	FOMC statement	LSAPs slowed: Agency debt and MBS purchases will finish at the end of 2010:Q1.	
11/4/2009	QE1	FOMC statement	LSAPs downsized: Agency debt purchases will finish at \$175 billion.	
8/10/2010	QE1	FOMC statement	Balance sheet maintained: The Fed will reinvest principal payments from LSAPs in Treasuries.	
8/27/2010	QE2	Bernanke speech	Bernanke suggests role for additional QE “should further action prove necessary.”	
9/21/2010	QE2	FOMC statement	FOMC emphasizes low inflation, which “is likely to remain subdued for some time...”	
10/12/2010	QE2	FOMC minutes released	FOMC members’ “sense” is that “[additional] accommodation may be appropriate before long.”	

10/15/2010	QE2	Bernanke speech	Bernanke reiterates that Fed stands ready to further ease policy.	
11/3/2010	QE2	FOMC statement	QE2 announced: Fed will purchase \$600 billion in Treasuries.	
6/22/2011	QE2	FOMC statement	QE2 finishes: Treasury purchases will wrap up at the end of month, as scheduled; principal payments will continue to be reinvested.	
9/21/2011	MEP	FOMC statement	Maturity Extension Program (“MEP”) announced: Fed to purchase \$400 billion of Treasuries with remaining maturities of 6-30 years and sell an equal amount of short-term Treasuries; MBS and agency debt principal payments will no longer be reinvested in Treasuries, but instead in MBS.	
6/20/2012	MEP	FOMC statement	MEP extended: The Fed to continue purchasing long-term securities and selling short-term securities through end-2012. Purchases/sales will continue at the current pace, about \$45 billion/month.	
8/22/2012	QE3	FOMC minutes released	FOMC members “judged that additional monetary accommodation would likely be warranted fairly soon.”	
9/13/2012	QE3	FOMC statement	QE3 announced: The Fed will purchase \$40 billion of MBS per month as long as “the outlook for the labor market does not improve substantially...in a context of price stability.”	Fed expects low rates “at least through mid-2015.”
12/12/2012	QE3	FOMC statement	QE3 expanded: The Fed will continue to purchase \$45 billion of long-term Treasuries per month but will no longer sterilize purchases through the sale of short-term Treasuries.	Fed expects low rates to be appropriate while unemployment is above 6.5 percent and inflation is forecasted below 2.5 percent.
6/19/2013	QE3	FOMC Statement	The FOMC "currently anticipates that it would be appropriate to moderate the monthly pace of purchases later this year" according to Chairman Bernanke's press conference.	
12/18/2013	QE3	FOMC Statement	QE3 downsized: Beginning in January, Fed will make monthly purchases of \$35 billion in MBS and \$40 billion in Treasuries, down from \$40 billion and \$45 billion, respectively.	Fed expects low rates “well past the time that the unemployment rate declines below 6.5 percent.”
1/29/2014	QE3	FOMC Statement	QE3 downsized: Fed reduces monthly asset purchases to \$30 billion in MBS and \$35 billion in Treasuries.	
3/19/2014	QE3	FOMC Statement	QE3 downsized: Fed reduces monthly asset purchases to \$25 billion in MBS and \$30 billion in Treasuries.	Fed expects low rates “for a considerable time after the asset purchase program ends.”
4/30/2014	QE3	FOMC Statement	QE3 downsized: Fed reduces monthly asset purchases to \$20 billion in MBS and \$25 billion in Treasuries.	

6/18/2014	QE3	FOMC Statement	QE3 downsized: Fed reduces monthly asset purchases to \$15 billion in MBS and \$20 billion in Treasuries.	
7/30/2014	QE3	FOMC Statement	QE3 downsized: Fed reduces monthly asset purchases to \$10 billion in MBS and \$15 billion in Treasuries.	
9/17/2014	QE3	FOMC Statement	QE3 downsized: Fed reduces monthly asset purchases to \$5 billion in MBS and \$10 billion in Treasuries. FOMC releases initial normalization principles.	
10/29/2014	QE3	FOMC Statement	QE3 finishes: Fed officially concludes QE3 and will continue to re-invest principal payments from its LSAPs in Treasuries.	
6/14/2017	Balance Sheet Normalization	Addendum to Policy Normalization Plan	FOMC announces normalization plans: Fed to allow assets to mature without re-investing principal payments and, instead, will retire those monies. The Fed will first retire a maximum of \$6 billion (\$4 billion) from principal payments of Treasuries (MBS and Agency debt) each month, and will raise cap by \$6 billion (\$4 billion) every quarter for a year.	The Fed raises the federal funds rate from 0.75-1.00% to 1.00-1.25%.
9/20/2017	Balance Sheet Normalization	FOMC Statement	Starting in October 2017, Fed will initiate the balance sheet normalization program described at its meeting in June 2017.	
3/21/2018	#N/A	FOMC Statement	#N/A	The Fed raises the federal funds range to 1.5-1.75%.
6/13/2018	#N/A	FOMC Statement	#N/A	The Fed raises the federal funds range to 1.75-2%.
9/26/2018	#N/A	FOMC Statement	#N/A	The Fed raises the federal funds range to 2-2.25%.
12/19/2018	#N/A	FOMC Statement	#N/A	The Fed raises the federal funds range to 2.25-2.5%.
1/30/2019	Balance Sheet Normalization	FOMC (Supplemental) Statement	FOMC specifies its intention to operate in a regime with an ample supply of reserves that does not require active management; says it is prepared to adjust details of balance sheet normalization in light of changes to economic conditions.	

3/20/2019	Balance Sheet Normalization	FOMC (Supplemental) Statement	FOMC intends to slow pace of decline in reserves over coming quarters: Will slow reduction of Treasuries by reducing cap on monthly redemptions from \$30 billion to \$15 billion in May 2019; Will conclude reduction of aggregate securities holdings in SOMA at end of Sep. 2019; Will continue to allow agency and MBS security holdings to decline, reinvesting principal payments from such securities in Treasuries up to \$20 billion per month starting in Oct. 2019.	
7/31/2019	Balance Sheet Normalization	FOMC Statement	FOMC announced conclusion of balance sheet shrinking program (two months earlier than anticipated).	The Fed lowers the federal funds target range to 2-2.25%
9/18/2019	#N/A	FOMC Statement	#N/A	The Fed lowers the federal funds range to 1.75-2%.
10/11/2019	Balance Sheet Normalization, Repos	FOMC Supplemental Statement	FOMC announces they will purchase Treasury bills at least into Q2 2020 to maintain ample reserve balances; will conduct term and overnight repo agreement operations at least through Jan. 2020 to ensure ample reserve supply and to mitigate risk of money market pressures.	

B. European Central Bank

European Central Bank				
Date	Program	Event (link)	Brief Description	Interest Rate News
3/28/2008	LTRO	Governing Council press release	LTRO expanded: 6-month LTROs announced.	
10/15/2008	FRFA	Governing Council press release	Refinancing operations expanded: All refinancing operations will be conducted with fixed-rate tenders and full allotment; the list of assets eligible as collateral in credit operations with the Bank is expanded to include lower-rated (with the exception of asset-backed securities) and non-euro-denominated assets.	
3/5/2009	#N/A	Governing Council press release	#N/A	Main refinancing rate lowered to 1.5%; marginal lending facility rate lowered to 2.5%; deposit facility rate lowered to 0.5%.
4/2/2009	#N/A	Governing Council press release	#N/A	Main refinancing rate lowered to 1.25%; marginal lending facility rate lowered to 2.25%; deposit facility rate lowered to 0.25%.
5/7/2009	CBPP, LTRO	Governing Council press release	CBPP announced/LTRO expanded: ECB to purchase €60 billion in euro-denominated covered bonds; 12-month LTROs announced.	ECB lowers the main refinancing rate by 0.25% to 1% and the rate on the marginal lending facility by 0.50% to 1.75%.
5/10/2010	SMP	Governing Council press release	SMP announced: The ECB will conduct interventions in the euro area public and private debt securities markets; purchases will be sterilized.	
6/30/2010	CBPP	Governing Council press release	CBPP finished: Purchases finish on schedule; bonds purchased will be held through maturity.	
10/6/2011	CBPP2	Governing Council press release	CBPP2 announced: ECB to purchase €40 billion in euro-denominated covered bonds.	
12/8/2011	LTRO	Governing Council press release	LTRO expanded: 36-month LTROs are announced; eligible collateral is expanded.	ECB lowers the MRO rate by 0.25% to 1%, the rate on the MLF by 0.25% to 1.75%, and the deposit facility rate by 0.25% to 0%.
8/2/2012	OMT	ECB press conference	ECB President Mario Draghi indicates that the ECB will expand sovereign debt purchases. He proclaims that “the euro is irreversible.”	

9/6/2012	OMT	Governing Council press release	OMTs announced: Countries that apply to the European Stabilization Mechanism for aid and abide by the ESM's terms will be eligible to have their debt purchased in unlimited amounts on the secondary market by the ECB.	
10/31/2012	CBPP2	Governing Council Press Release	As scheduled, asset purchases under CBPP2 conclude.	
5/2/2013	#N/A	Governing Council Press Release	#N/A	MRO rate lowered to 0.5%; MLF rate lowered to 1.0%; deposit facility rate unchanged.
11/7/2013	#N/A	Governing Council Press Release	#N/A	MRO rate lowered to 0.25%; MLF rate lowered to 0.75%; deposit rate unchanged.
6/5/2014	TLTRO	Governing Council Press Release	Targeted Longer-term Refinancing Operations (TLTRO) announced: ECB to provide low-interest loans at four year maturities. TLTROs will incorporate incentives to encourage banks to lend to the real economy. ECB accelerating preparations for outright purchases of ABS.	MRO rate lowered to 0.15%; MLF rate lowered to 0.4%; deposit rate down to -0.1%. Interest rates "will remain at present levels for an extended period."
9/4/2014	ABSPP, CBPP3	Governing Council Press Release	ECB's APP will purchase "simple and transparent" asset-backed securities and covered bonds through the ABSPP and CBPP3.	MRO rate lowered to 0.05%; MLF rate lowered to 0.3%; deposit rate down to -0.2%.
9/18/2014	TLTRO	Governing Council Press Release	ECB allots €82.6 billion in first round of TLTROs	
10/2/2014	ABSPP, CBPP3	Governing Council Press Release	ABSPP and CBPP3 will begin purchases in 2014:Q4 and run for 2+ years. Programs will have a "sizeable impact" on the balance sheet.	
11/6/2014	ABSPP, CBPP3	Governing Council Press Release	Draghi states that ABSPP and CBPP3 will grow the balance sheet "towards the dimensions it had at the beginning of 2012."	
1/22/2015	APP, TLTRO	Governing Council Press Release	ECB announces the Public Sector Purchase Program (PSPP) which will purchase bonds from euro area central governments. APP to buy €60 billion worth of assets per month until at least September 2016. ECB eliminates the 10bp spread on TLTROs above the MRO rate.	
12/3/2015	APP	Governing Council Press Release	APP extended until March 2017, or beyond, and will also purchase debt of regional and local euro-area governments. ECB to reinvest principal payments from holdings.	Deposit rate lowered to -0.3%.

3/10/2016	TLTRO II, APP	Governing Council Press Release	APP expanded: ECB announces the Corporate Sector Purchase Program, which will purchase corporate bonds. APP will purchase €80 billion worth of assets per month until at least March 2017. TLTRO-II announced: new long-term lending program offering lower interest rates to banks that increase lending activity.	MRO rate lowered to 0%; MLF rate lowered to 0.25%; deposit rate down to -0.4%. ECB expects rates at current or lower levels "well past the horizon of net asset purchases."
4/21/2016	APP	Governing Council Press Release	Announces that corporate bond purchases must 1) be rated BBB- or higher, 2) have between 6 months and 30 years of maturity remaining, 3) issued by a corporation incorporated in the euro-area.	
6/8/2016	APP	Governing Council Press Release	CSPP purchases commence.	
12/8/2016	APP	Governing Council Press Release	APP downsized: ECB will reduce monthly asset purchases from €80 billion to €60 billion starting in April 2017 until December 2017, or beyond, if necessary.	
4/27/2017	APP	Governing Council Press Release	ECB confirms that APP monthly asset purchases will proceed at €60 billion.	
10/26/2017	APP	Governing Council Press Release	APP downsized: ECB to purchase €30 billion in assets each month starting January 2018 until September 2018, or beyond if necessary. The ECB will also continue its FRFA policy until 2019, at least.	
6/14/2018	APP	Governing Council Press Release	APP downsized: ECB to purchase €15 billion in assets each month starting in September 2018 until December 2018, at which point it will end net purchases. ECB to continue reinvesting principal payments. Policies conditional on a "sustained convergence of inflation."	ECB expects rates to be at "present levels at least through the summer of 2019" and as long as necessary to ensure inflation remains aligned with a sustained adjustment path.
12/13/2018	APP	Governing Council Press Release	ECB intends to continue reinvesting principal from securities purchased under the APP for an extended period of time past the date when it starts raising key ECB interest rates.	
3/7/2019	TLTRO III	Governing Council Press Release	TLTRO-III announced, starting in September 2019 and ending in March 2021, each with a maturity of two years. Counterparties can borrow up to 30% of the stock of eligible loans.	

9/12/2019	APP, TLTRO III	Governing Council Press Release	<p>ECB announces changes to TLTRO-III: Interest rate will be reduced, will be equal to the MRO, and can be lower depending on net lending. Maturity of operations extended to three years.</p> <p>ECB restarts net purchases under APP at a €20 billion monthly pace; expects them to run for as long as necessary to reinforce the accommodative impact of its policy rates, and to end shortly before it starts raising the key ECB interest rates.</p>	ECB lowers deposit rate to -0.5%.
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C. Bank of England

Bank of England				
Date	Program	Event (link)	Brief Description	Interest Rate News
1/19/2009	APF	HM Treasury statement	APF established: The BOE to purchase up to £50 billion of “high quality private sector assets” financed by Treasury issuance.	
2/11/2009	APF	BOE Inflation Report released	The BOE views a slight downside risk to meeting the inflation target, reiterates use of APF as a potential policy instrument.	
3/5/2009	APF	MPC statement	QE announced: The BOE will purchase up to £75 billion in assets, now financed by reserve issuance; medium- and long-term gilts will comprise the "majority" of new purchases.	The BOE cuts policy rate from 1% to 0.5%.
5/7/2009	APF	MPC statement	QE expanded: BOE to purchase up to £125 billion in assets.	
8/6/2009	APF	MPC statement	QE expanded: BOE to purchase up to £175 billion in assets; to accommodate increased size, BOE will expand purchases into gilts with remaining maturity of 3 years or more.	
11/5/2009	APF	MPC statement	QE expanded: BOE to purchase up to £200 billion in assets.	
2/4/2010	APF	MPC statement	QE maintained: BOE to maintain the stock of asset purchases financed by the issuance of reserves at £200 billion; new purchases of private assets will be financed by Treasury issuance.	
10/6/2011	APF	MPC statement	QE expanded: BOE to purchase up to £275 billion in assets financed by reserve issuance; the ceiling on private assets held remains £50 billion.	
11/29/2011	APF	HM Treasury decision	Maximum private asset purchases reduced: HM Treasury lowers the ceiling on APF private asset holdings from £50 billion to £10 billion.	
2/9/2012	APF	MPC statement	QE expanded: BOE to purchase up to £325 billion in assets.	
7/5/2012	APF	MPC statement	QE expanded: BOE to purchase up to £375 billion in assets.	

7/13/2012	FLS	News Release	FLS announced: Program will lend Treasury bills to banks for up to four years to use as collateral in money markets. Lending program includes interest rate and borrowing quantity incentives to encourage banks to increase lending activity. Program will expire in January 2014.	
4/24/2013	FLS	News Release	FLS modified: BOE extends FLS until January 2015 and increases incentives for lending to small- and medium-sized businesses.	
11/28/2013	FLS	News Release	FLS modified: Following January 2014, BOE will remove special incentives for lending to households. BOE will also eliminate variable interest rate on FLS drawings and banks will pay 25 bp flat fee on funds borrowed.	
12/2/2014	FLS	News Release	FLS modified: BOE extends FLS until January 2016 and removes special incentives for lending to large corporations.	
11/30/2015	FLS	News Release	FLS extended: Starting in August 2016, banks' borrowing allowances will be reduced by 25% every six months until the end of January 2018 when the FLS will close.	
8/4/2016	APF	MP Statement	QE expanded: BOE announces purchases of £10 billion in UK corporate bonds and £60 in UK government bonds, raising the total stock of APF assets to £445 billion.	Bank Rate reduces to 0.25% from 0.5%
8/4/2016	TFS	MP Statement	Term Funding Scheme announced: BOE announces new long-term lending facility with £100 billion available in four-year loans to banks. TFS will include incentives for banks to increase lending activity. Banks can make drawdowns until February 28, 2018.	Bank Rate reduces to 0.25% from 0.5%
8/3/2017	TFS	MP Statement	MPC confirms that final day for TFS drawdowns will be February 28, 2018.	
11/2/2017	#N/A	MP Statement	#N/A	MPC raises the policy rate from 0.25% to 0.50%
6/21/2018	APF	MP Statement	MPC intends not to reduce the stock of purchased assets until Bank Rate reaches around 1.5%, compared to the previous guidance of around 2%. Any reductions will be at a gradual and predictable pace.	
8/2/2018	#N/A	MP Statement	#N/A	MPC raises the policy rate from 0.50% to 0.75%.

D. Bank of Japan

Bank of Japan				
Date	Program	Event (link)	Brief Description	Interest Rate News
12/2/2008	SFSO	Unscheduled Monetary Policy Meeting	The BOJ to operate a facility through the end of April to lend an unlimited amount to banks at the uncollateralized overnight call rate and collateralized by corporate debt.	
12/19/2008	Outright JGB, Corporate Finance Instrument (CFI) Purchases	Statement on Monetary Policy	Outright Purchases Expanded: BOJ increases monthly JGB purchases (last increased October 2002) from ¥1.2 trillion to ¥1.4 trillion; they will also look into purchasing CP.	The BoJ lowers the target for the uncollateralized overnight call rate from 0.3% to 0.1%
1/22/2009	Outright CFI Purchases	Statement on Monetary Policy	Outright Purchases Announced: BOJ to purchase up to ¥3 trillion in CP and ABCP and is investigating outright purchases of corporate bonds.	
2/19/2009	Outright CFI Purchases	Statement on Monetary Policy	Outright Purchases Expanded: BOJ to extend CP purchases and the SFSO through end of September (previously end of March) and will purchase up to ¥1 trillion in corporate bonds.	
3/18/2009	Outright JGB Purchases	Statement on Monetary Policy	Outright Purchases Expanded: BOJ increases monthly JGB purchases from ¥1.4 trillion to ¥1.8 trillion.	
7/15/2009	Outright CFI Purchases, SFSO	Statement on Monetary Policy	Programs Extended: BOJ extends the SFSO and outright purchases of corporate paper and bonds throughout the end of the year.	
10/30/2009	Outright CFI Purchases, SFSO	Statement on Monetary Policy	Status of Programs: Outright purchases of corporate finance instruments to expire at the end of 2009 as expected, but SFSO will be extended through 2010Q1; ample liquidity provision past 2010Q1 will occur through funds-supplying operations against pooled collateral, which will accept a larger range of collateral.	
12/1/2009	Fixed-Rate Operations (FRO)	Statement on Monetary Policy	Facility Announcement: BOJ to offer ¥10 trillion in 3-month loans against the full menu of eligible collateral at the uncollateralized overnight call rate.	

3/17/2010	FRO	Statement on Monetary Policy	Facility Expansion: BOJ expands the size of the FRO to ¥20 trillion.	
5/21/2010	GSFF	Statement on Monetary Policy	GSFF Announcement: BOJ to offer 1-year loans to private financial institutions with project proposals for "strengthening the foundations for economic growth."	
8/30/2010	FRO	Unscheduled Monetary Policy Meeting	Facility Expansion: BOJ adds ¥10 trillion in 6-month loans to the FRO.	
10/5/2010	Comprehensive Monetary Easing (CME)	Statement on Monetary Policy	APP Established: The BOJ will purchase ¥5 trillion in assets (¥3.5 trillion in JGBs and treasury discount bills, ¥1 trillion in commercial paper and corporate bonds and ¥0.5 trillion in ETFs and J-REITs).	BOJ targets the uncollateralized overnight call rate at around 0 to 0.1 %. BOJ will maintain virtually zero interest rates until "price stability is in sight."
3/14/2011	CME	Statement on Monetary Policy	APP Expanded: BOJ to purchase an additional ¥5 trillion in assets (¥0.5 trillion in JGBs, ¥1 trillion in Treasury discount bills, ¥1.5 trillion in CP, ¥1.5 trillion in corporate bonds, ¥0.45 trillion in ETFs, and ¥0.05 trillion J-REITs).	
6/14/2011	GSFF	Statement on Monetary Policy	GSFF Expanded: BOJ makes available another ¥0.5 trillion in loans to private financial institutions for investing in equity and extending asset-based loans.	
8/4/2011	CME	Statement on Monetary Policy	Programs Expanded: BOJ to purchase an additional ¥5 trillion in assets (¥2 trillion in JGBs, ¥1.5 trillion in Treasury discount bills, ¥0.1 trillion in CP, ¥0.9 trillion in corporate bonds, ¥0.5 trillion in ETFs, and ¥0.01 trillion J-REITs); 6-month collateralized loans through the FRO are expanded by ¥5 trillion.	
10/27/2011	CME	Statement on Monetary Policy	APP Expanded: BOJ to purchase an additional ¥5 trillion in JGBs.	
2/14/2012	CME	Statement on Monetary Policy	APP Expanded: BOJ to purchase an additional ¥10 trillion in JGBs.	BOJ will maintain virtually zero interest rates until 1% inflation "is in sight."

3/13/2012	GSFF	Statement on Monetary Policy	GSFF Expanded: BOJ to make available another ¥2 trillion in loans to private financial institutions, including ¥1 trillion in US dollar denominated loans and ¥0.5 trillion in smaller sized (¥1-10 million) loans.	
4/27/2012	CME	Statement on Monetary Policy	APP Expanded/FRO Reduced: BOJ to purchase an additional ¥10 trillion in JGBs, ¥0.2 trillion in ETFs and ¥0.01 in J-REITS. BOJ also reduces the availability of 6-month FRO loans by ¥5 trillion.	
7/12/2012	CME	Statement on Monetary Policy	APP Expanded/FRO Reduced: BOJ to purchase an additional ¥5 trillion in Treasury discount bills and reduces the availability of FRO loans by ¥5 trillion.	
9/19/2012	CME	Statement on Monetary Policy	APP Expanded: BOJ to purchase an additional ¥5 trillion in JGBs and ¥5 trillion in Treasury discount bills.	
10/30/2012	CME, SBLF	Statement on Monetary Policy	APP expanded/SBLF announced: The BOJ will purchase an additional ¥5 trillion in JGBs, ¥5 trillion in Treasury discount bills, ¥0.1 trillion in commercial paper, ¥0.3 trillion in corporate bonds, ¥0.5 trillion in ETFs, and ¥0.01 trillion in J-REITS. Through the SBLF it will fund up to 100 percent of depository institutions' net increase in lending to the nonfinancial sector.	
12/20/2012	CME	Statement on Monetary Policy	APP expanded: The BOJ will purchase an additional ¥5 trillion JGBs and ¥5 trillion in Treasury discount bills.	
1/22/2013	APP, Price Stability Target	Monetary Policy Release	APP expanded: beginning in January 2014, the BOJ will purchase about ¥10 trillion in T-bills and ¥2 trillion in JGBs each month. BOJ also announces inflation target of 2 percent.	BOJ will maintain virtually zero interest rates as long as the Bank judges it appropriate.
4/4/2013	QQE	Monetary Policy Release	QQE announced: BOJ to make annual purchases of ¥50 trillion in JGBs, ¥1 trillion in ETFs and ¥30 billion in J-REITS. Purchases will extend average maturity of JGB holdings from 3 to 7 years. BOJ to make purchases to maintain holdings of ¥2.2 trillion worth of commercial paper and ¥3.2 trillion worth of corporate bonds.	

2/18/2014	SBLF, GSFF	Monetary Policy Release	GSFF/SBLF expanded: GSFF lending limit increased from ¥3.5 to ¥7 trillion. Under SBLF, banks can borrow up to double their net increases in lending. Both programs extended until April 30, 2015.	
10/31/2014	QQE	Monetary Policy Release	QQE expanded: BOJ to make annual purchases of ¥80 trillion in JGBs, ¥3 trillion in ETFs, and ¥90 billion in J-REITs. BOJ will also set a target range for the average maturity of JGB holdings of 7-10 years.	
1/21/2015	SBLF, GSFF	Monetary Policy Release	GSFF/SBLF expanded: GSFF lending limit increased from ¥7 trillion to ¥10 trillion. BOJ extends both lending programs by one year.	
12/18/2015	SBLF, GSFF, QQE	Monetary Policy Release	GSFF, SBLF extended: BOJ extends both lending programs by one year. QQE Enhanced: BOJ to expand target range for the average maturity of JGB holdings to 7-12 years.	
1/29/2016	QQE with a Negative Interest Rate	Monetary Policy Release	#N/A	BOJ to apply -0.1% interest rate on excess reserves held with the central bank.
7/29/2016	QQE, US Dollar Lending Program	Monetary Policy Release	QQE expanded: BOJ to increase purchases of ETFs to ¥6 trillion per year. BOJ will also increase the size of its US Dollar Funds-Supplying Operations from \$12 billion to \$24 billion.	
9/21/2016	QQE with Yield Curve Control	Monetary Policy Release	BOJ to institute "inflation overshooting commitment," stating that it will pursue monetary easing until year-over-year inflation exceeds 2% and "stays above the target in a stable manner."	BOJ to target 0% for the 10-year JGB yield and maintain a -0.1% interest rate on excess reserves.
1/31/2017	SBLF, GSFF	Monetary Policy Release	GSFF, SBLF extended: BOJ extends both lending programs until July 1, 2018.	

1/23/2018	SBLF, GSFF	Monetary Policy Release	GSFF, SBLF extended: BOJ extends both lending programs until June 30, 2019.	
7/31/2018	QQE with Yield Curve Control	Monetary Policy Release	BOJ will reduce the size of the Policy-Rate Balance (balance of reserves for which negative policy rate applies) from around ¥10 trillion to ¥5 trillion.	BOJ will maintain "extremely low levels of short- and long-term interest rates for an extended period of time."
1/23/2019	SBLF, GSFF	Monetary Policy Release	GSFF, SBLF extended: BOJ extends both lending programs by a year.	
4/25/2019	SBLF, GSFF	Monetary Policy Release	GSFF, SBLF extended to June 30, 2021.	BOJ will maintain the current low interest rates "at least through around spring 2020."
12/19/2019	SBLF, ETFs	News Release	BOJ introduced the ETF Lending Facility, through which it can lend its ETF holdings to market participants to improve market liquidity. BOJ also will allow counterparties to roll over SBLF loans under certain conditions.	

Table 3: Conditional Credit Programs

Central Bank	Title	Peak Size (Millions, Local Currency)	Peak Size (Millions of Dollars)	Borrowing Allowance Linked to Net Lending?	Increase to Borrowing Allowance for Each Increase in Net Lending of 1 unit of local currency	Interest Rate Linked to Net Lending?
BOE	FLS	£69,500	\$105,500	Yes	£1 *	Yes
BOE	TFS	£127,000	\$176,800	Yes	£1	Yes
BOJ	GSFF	¥7,034,800	\$64,500	No	N/A	No
BOJ	SBLF	¥41,036,900	\$377,500	Yes	¥2, starting February 2014 (previously ¥1)	No
ECB	TLTRO-I	€425,300	\$470,500	Yes	€3	No
ECB	TLTRO-II	€740,200	\$912,700	No	N/A	Yes
ECB	TLTRO-III	€101,100	\$112,500	No	N/A	Yes

*Under the FLS, a £1 increase in net lending to small- and medium-sized enterprises between Apr. and Dec. 2013 (Jan. and Dec. 2014) raised a bank's borrowing allowance by £10 (£5).

SOURCES: Haver Analytics, Organisation for Economic Co-operation and Development, Federal Reserve, Bank of England, Bank of Japan, European Central Bank

Table 4: Asset Purchase Program Size

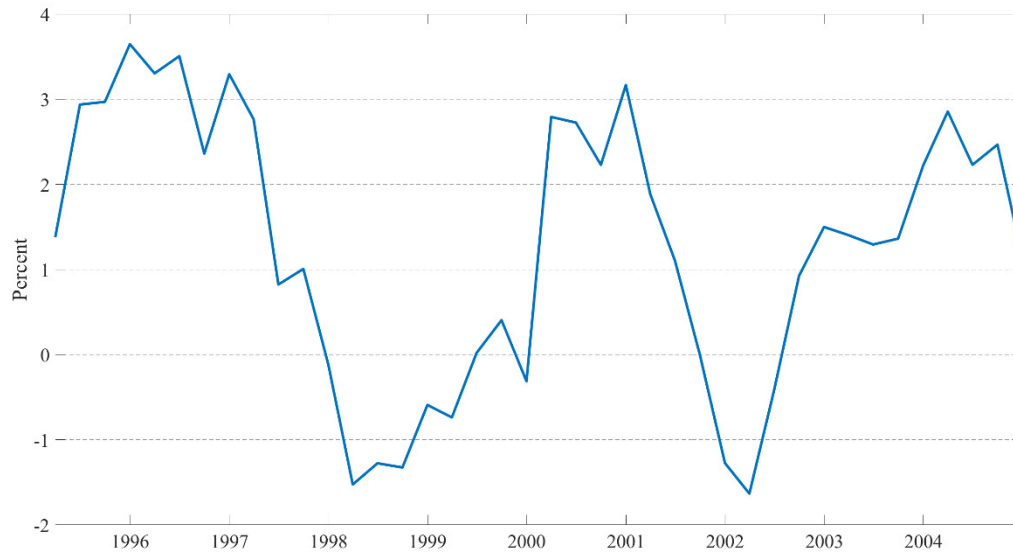
	Program	Initial Announcement Date	Peak Size (billion NC)	Peak Size (billions of USD using average FX rate, 2008-2019)	2008 GDP (billion NC)	Share of Economy
Federal Reserve	QE1 Agency Debt	11/25/2008	\$175	\$175	\$14,292	1.22%
	QE1 MBS	11/25/2008	\$1,250	\$1,250		8.75%
	QE1 Treasuries	3/18/2009	\$300	\$300		2.10%
	QE2	11/3/2010	\$600	\$600		4.20%
	MEP	9/21/2011	\$667	\$667		4.67%
	QE3 MBS	9/13/2012	\$883	\$883		6.18%
	QE3 Treasuries	12/12/2012	\$775	\$775		5.42%
Bank of England	APF Gilts	3/5/2009	£435	\$658	£1,441	30.19%
	APF Commercial Paper	1/19/2009	£1.97	\$3		0.14%
	APF Corporate Bonds	1/19/2009	£10	\$15		0.69%
European Central Bank	CBPP	5/7/2009	€ 60	\$76	€ 9,219	0.65%
	CBPP2	10/6/2011	€ 40	\$51		0.43%
	CBPP3	9/4/2014	€ 264	\$334		2.86%
	SMP	5/10/2010	€ 220	\$278		2.39%
	OMT	9/6/2012	€ -	\$-		0.00%
	ABSPP	9/4/2014	€ 29	\$37		0.31%
	PSPP	1/22/2015	€ 2,109	\$2,668		22.88%
	CSPP	3/10/2016	€ 185	\$234		2.01%
Bank of Japan	Outright Purchases JGBs	12/19/2008	¥106,800	\$1,079	¥501,209	21.31%
	Outright Purchases Commercial Paper	1/22/2009	¥3,000	\$30		0.60%
	Outright Purchases Corporate Bonds	2/19/2009	¥1,000	\$10		0.20%
	APP JGBs	10/5/2010	¥44,000	\$445		8.78%
	APP Treasury Discount Bills	10/5/2010	¥24,500	\$248		4.89%
	APP Commercial Paper	10/5/2010	¥2,200	\$22		0.44%
	APP Corporate Bonds	10/5/2010	¥3,200	\$32		0.64%
	APP ETFs	10/5/2010	¥2,100	\$21		0.42%
	APP J-REITs	10/5/2010	¥130	\$1		0.03%
	QQE JGBs	4/4/2013	¥387,168	\$3,912		77.25%
	QQE ETFs	4/4/2013	¥26,707	\$270		5.33%
	QQE J-REITs	4/4/2013	¥434	\$4		0.09%

SOURCES: Haver Analytics, Organisation for Economic Co-operation and Development, Federal Reserve, Bank of England, Bank of Japan, European Central Bank

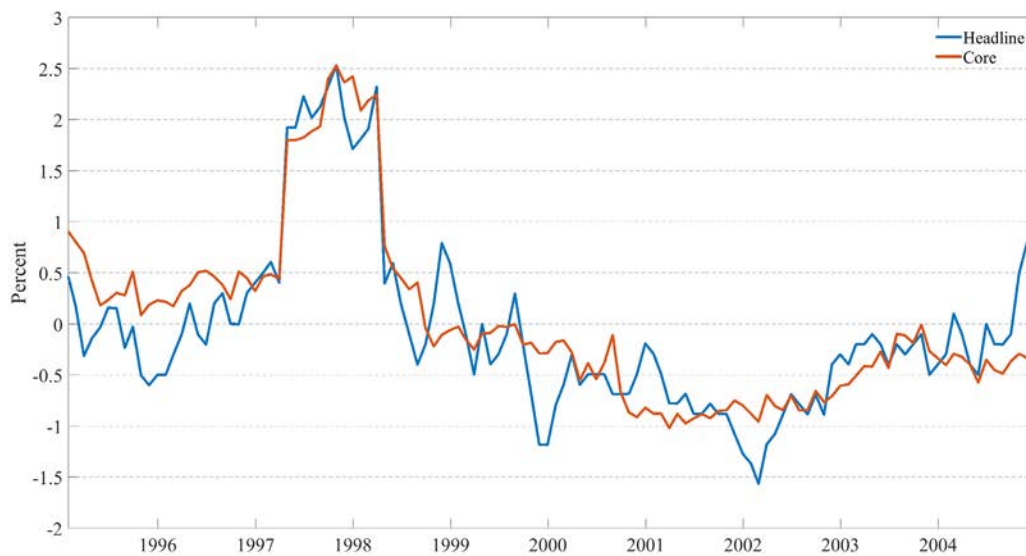
Figures

Figure 1: Japanese economic performance, 1995-2004.

Japanese Real GDP Growth

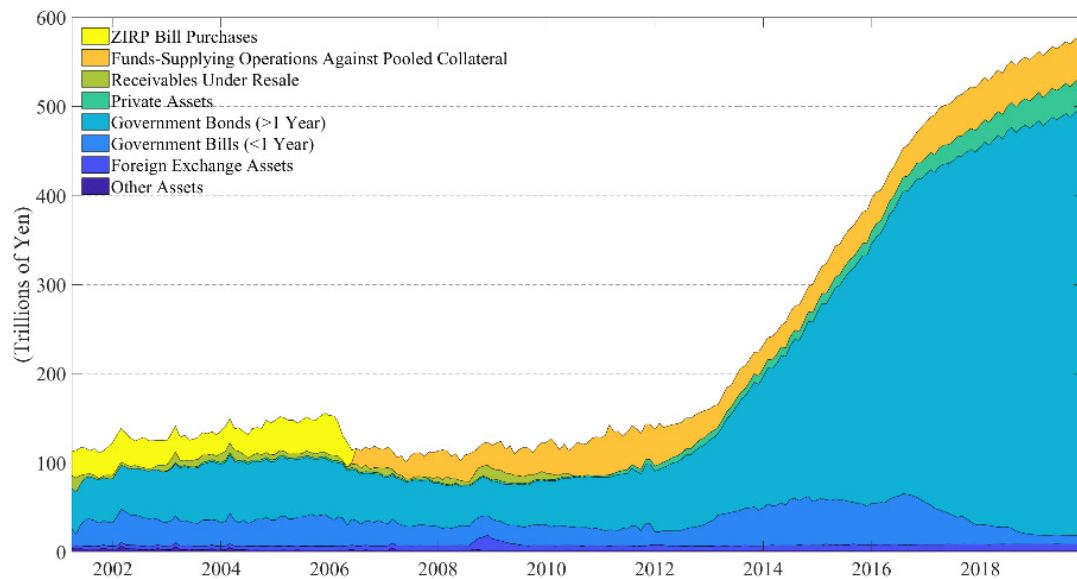


Year-over-Year Japanese Inflation



SOURCES: Haver Analytics, Organisation for Economic Co-operation and Development.

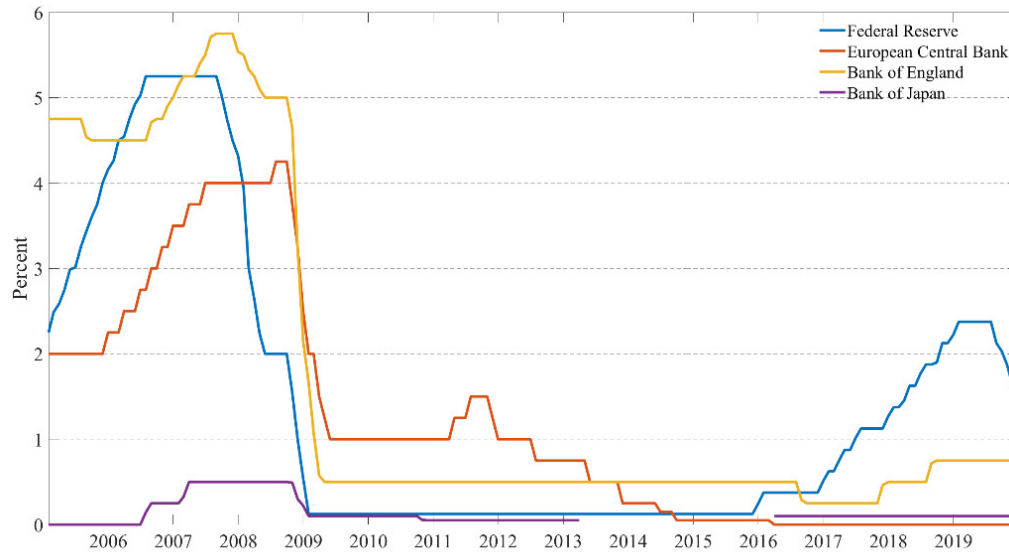
Figure 2: Bank of Japan Assets, 2001-2019



SOURCE: Bank of Japan.

NOTE: “Government Bonds” includes monthly JGB purchases. “ZIRP Bill Purchases” includes public debt purchases made under Japan’s ZIRP as part of its QE program in the early 2000s but excludes monthly JGB purchases. “Private Assets” includes all purchases of commercial paper, commercial bonds, ETFs, J-REITs, stocks, and MBS. On June 26, 2006, the BOJ introduced new electronic operations (“Funds-Supplying Operations against Pooled Collateral”) to replace conventional paper-based bill purchasing operations. Holdings of the GSFF and SBLF are included in “Funds-Supplying Operations against Pooled Collateral.”

Figure 3: Central Bank Policy Rates

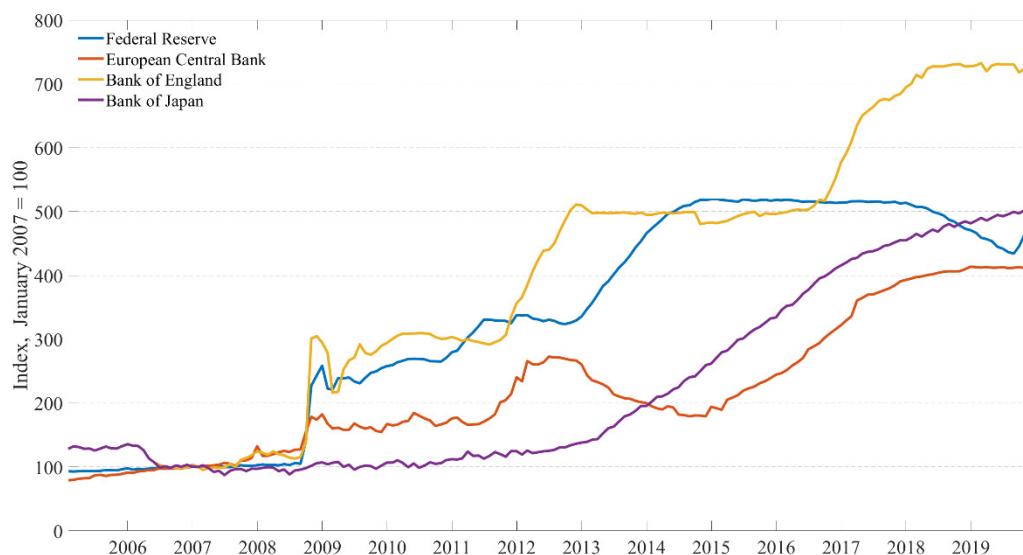


SOURCES: Bank of England, Bank of Japan, European Central Bank, Federal Reserve.

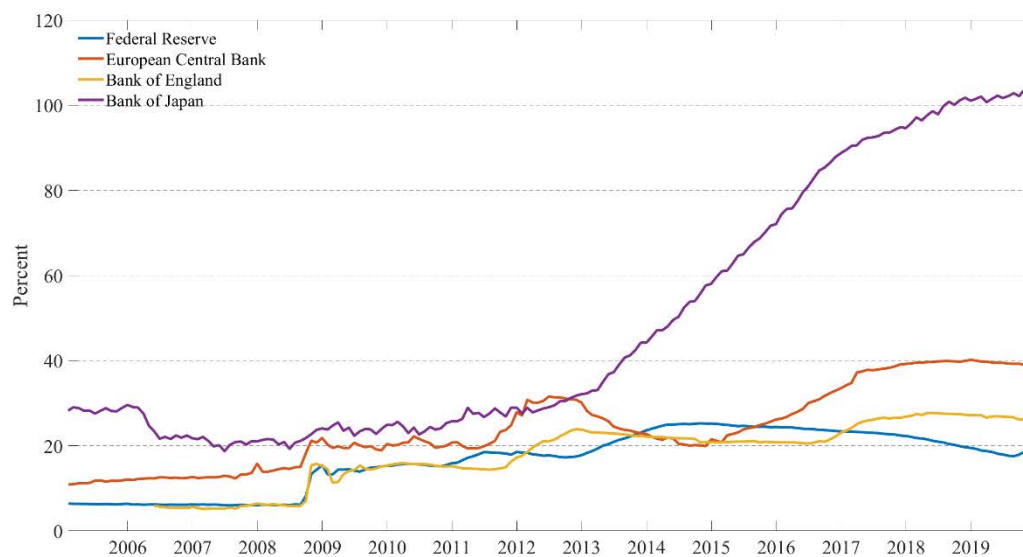
NOTE: The key policy rates for the BOE, Fed, ECB, and BOJ are, respectively, the Official Bank Rate, the Federal Funds Target Rate, the Main Refinancing Operations Rate, and the Uncollateralized Overnight Call Rate. Between April 2013 and February 2016, the BOJ did not set a target for the uncollateralized overnight call rate. Starting in March 2016, the BOJ resumed targeting a short-term interest rate, for which we report the BOJ's basic balance rate.

Figure 4: Central Bank Assets

Normalized Central bank assets



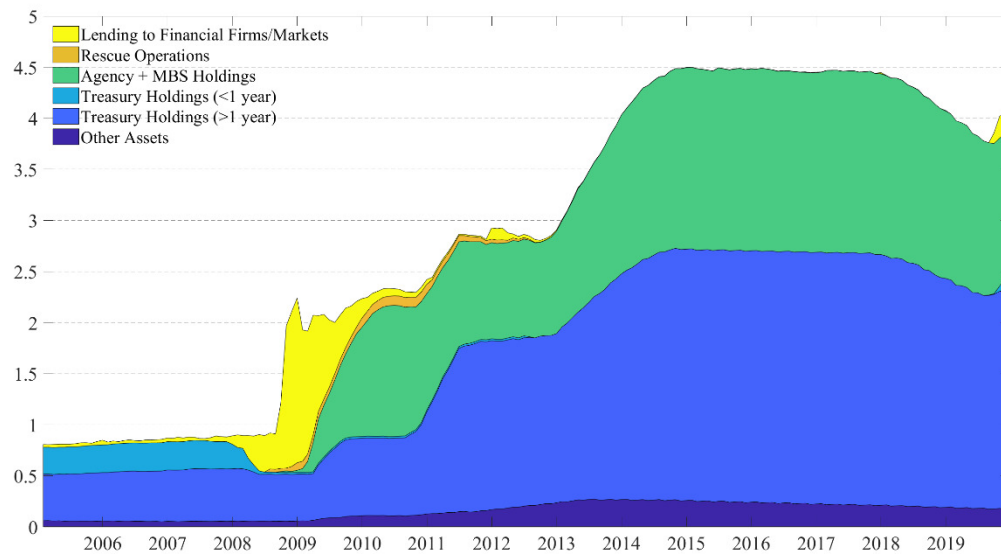
Central bank assets as a percentage of GDP



SOURCES: Bank of England, Bank of Japan, European Central Bank, Federal Reserve.

NOTE: The upper panel of the figure shows the monetary bases of the United States, European Monetary System, United Kingdom and Japan, normalized to equal 100 in January 2007. The lower figure shows the monetary bases of the United States, European Monetary System, United Kingdom and Japan, as a percentage of the respective nominal GDPs.

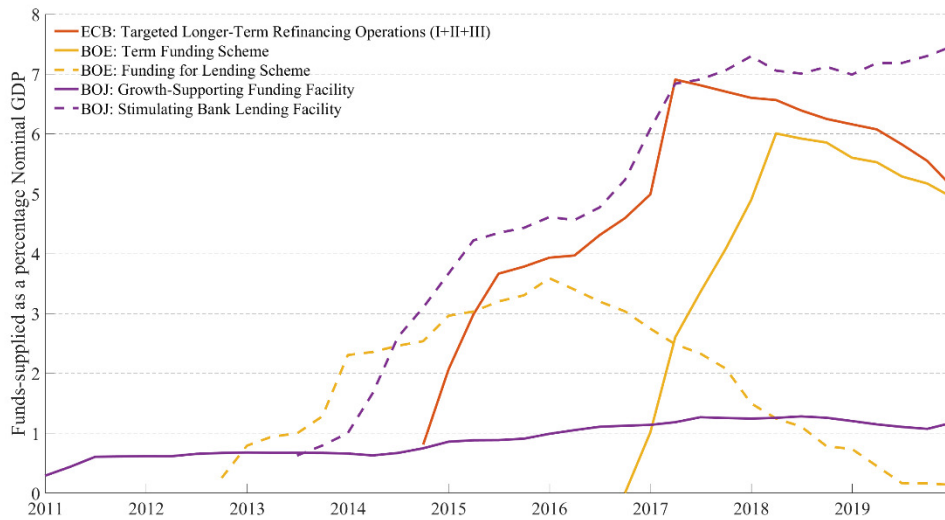
Figure 5: Federal Reserve Assets (Trillions of USD)



SOURCES: Federal Reserve, Haver Analytics.

NOTE: “Lending to Financial Firms and Markets” includes repurchase agreements, term auction credit, the CPFF, central bank liquidity swaps, the money market investor funding facility, other loans, and the Term Asset-Backed Securities Loan Facility (TALF). “Rescue Operations” includes net portfolio holdings of Maiden Lanes I, II, and III and preferred interests in AIA Aurora and ALICO Holdings. The figure shows the accumulation of agency and MBS holdings on the Fed balance sheet beginning in November 2008 and long-term Treasury securities beginning in March 2009. Fed balance sheet holdings begin declining in late-2017 as a result of the Fed’s Policy Normalization Plan. The increase in asset holdings in late-2019 reflects technical measures implemented by the Fed in money markets to ensure effective policy implementation and do not indicate a change in the stance of monetary policy.

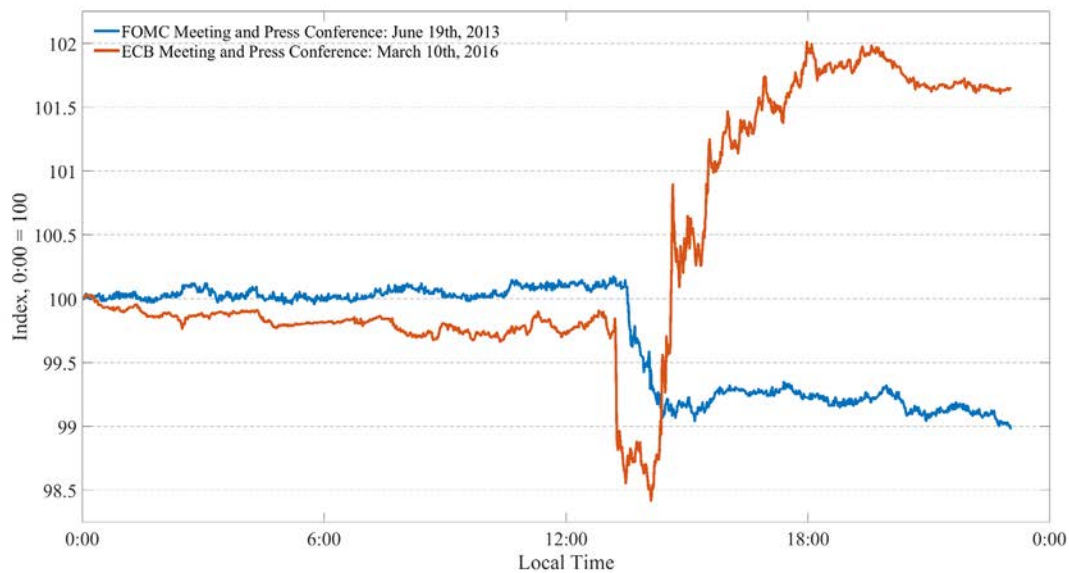
Figure 6: Conditional Credit Programs



SOURCES: Bank of England, Bank of Japan, European Central Bank, Haver Analytics.

NOTE: The figure depicts outstanding loan balances as a share of nominal GDP for each conditional credit program. “ECB: Targeted Longer-Term Refinancing Operations” includes outstanding loans provided through TLTRO I, TLTRO II, and TLTRO III.

Figure 7: EUR/USD Exchange Rate on Key Monetary Policy Announcement Days

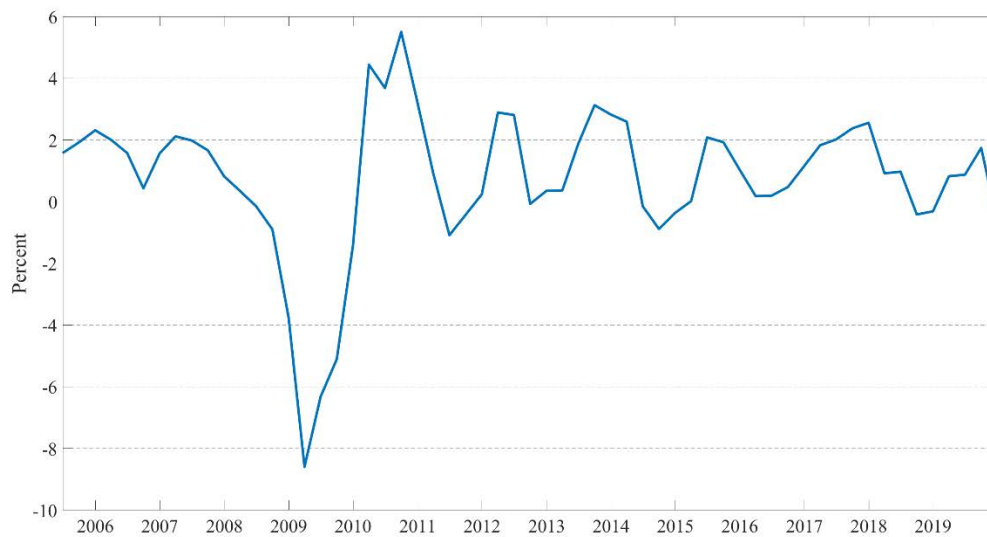


SOURCE: Tickwrite and the authors' calculations.

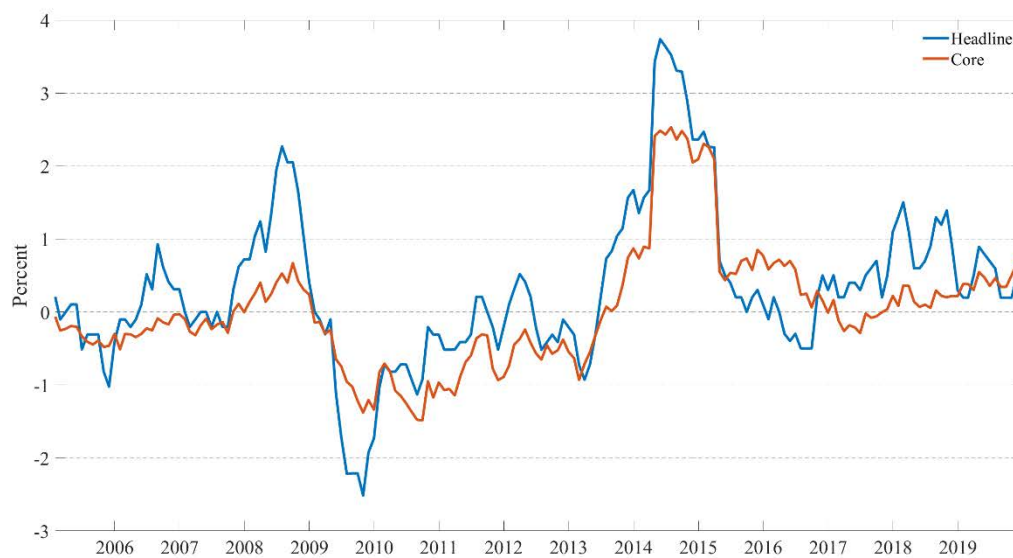
NOTE: The blue line reflects the EUR depreciation (USD appreciation) following Chairman Bernanke's remarks on June 19, 2013 that "the Committee [FOMC] currently anticipates that it would be appropriate to moderate the monthly pace of purchases later this year" (Federal Reserve (2013)). The red line reflects the gyratory response of the EUR/USD exchange rate to the ECB statement on March 10, 2016 of additional easing and President Draghi's subsequent remarks that the ECB would likely not ease further. See the 3/10/2016 ECB press release in Table 2B. Chairman Bernanke gave his remarks in Washington, DC; President Draghi gave his remarks in Frankfurt, Germany.

Figure 8: Japanese economic performance, 2005-2019

Year-over-Year Japanese Real GDP Growth

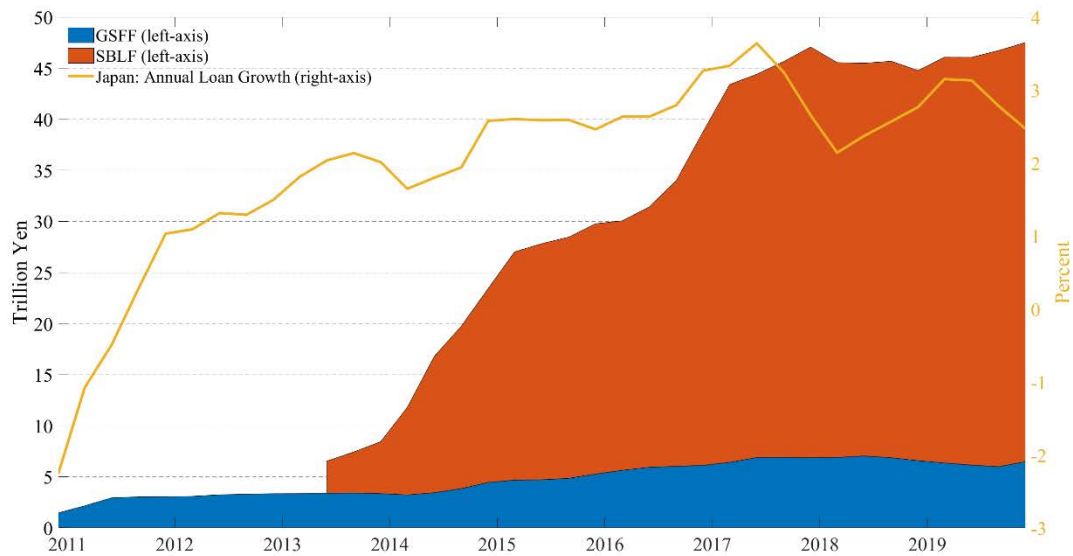


Year-over-Year Japanese Inflation



SOURCES: Haver Analytics, Organisation for Economic Co-operation and Development.

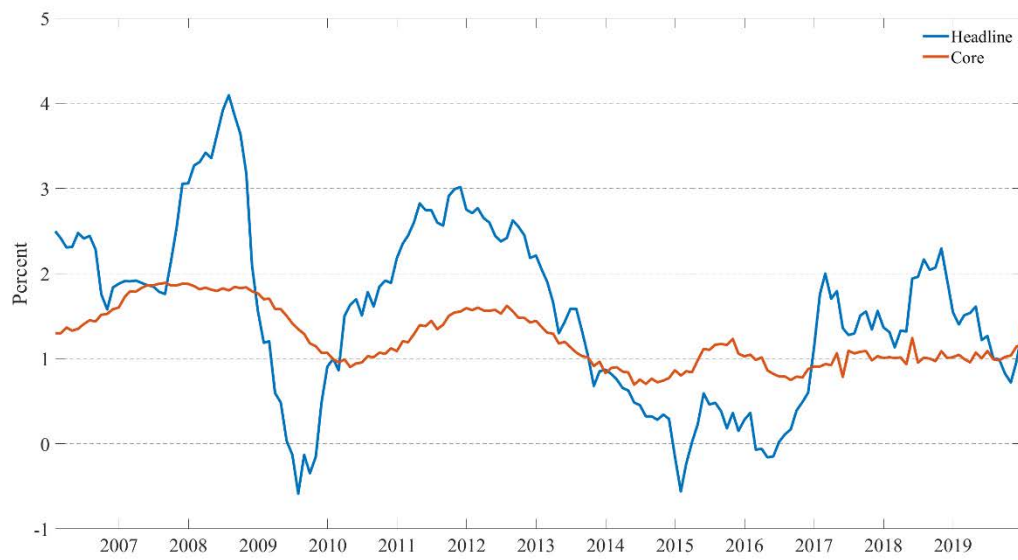
Figure 9: BOJ Loan Support Program, Amounts Outstanding (Trillions of Yen)



SOURCE: Bank of Japan.

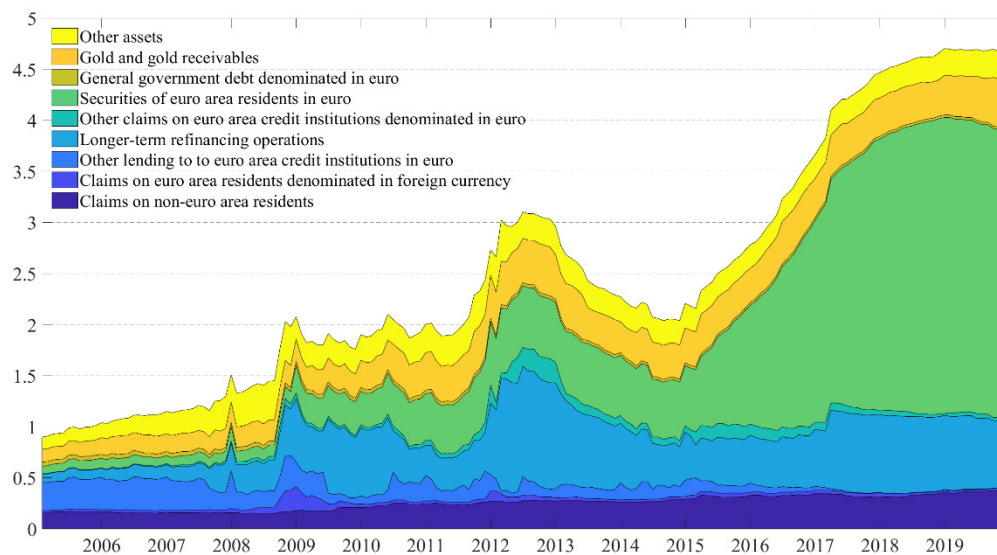
NOTE: Annual loan growth is measured as the year-over-year change in the amount of outstanding loans by Japanese banks to the nonfinancial sector.

Figure 10: Year-over-year euro-area inflation



SOURCES: European Central Bank, Haver Analytics.

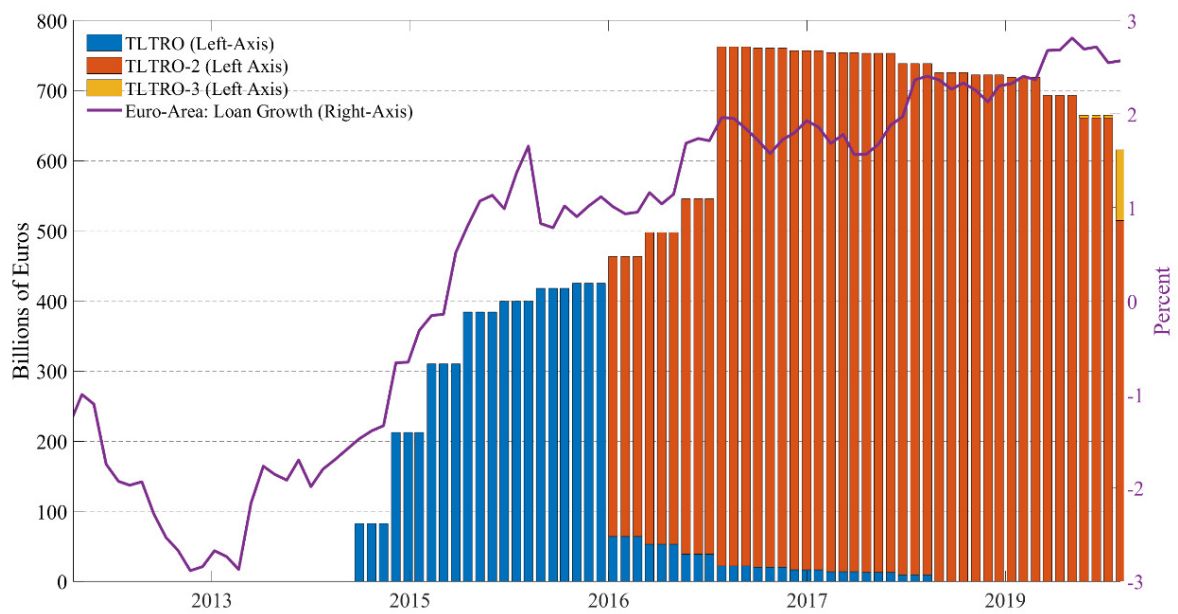
Figure 11: European Central Bank Assets (Trillions of EUR)



SOURCES: European Central Bank, Haver Analytics.

NOTE: “Securities of euro area residents in euro” includes bonds acquired under the ECB’s asset purchase programme. The figure shows a sustained increased in this category following the adoption of open-ended QE in January 2015. Holdings from all TLTROs are included in "Longer-term refinancing operations." Main refinancing operations are included in “Other lending to euro area credit institutions in euro.”

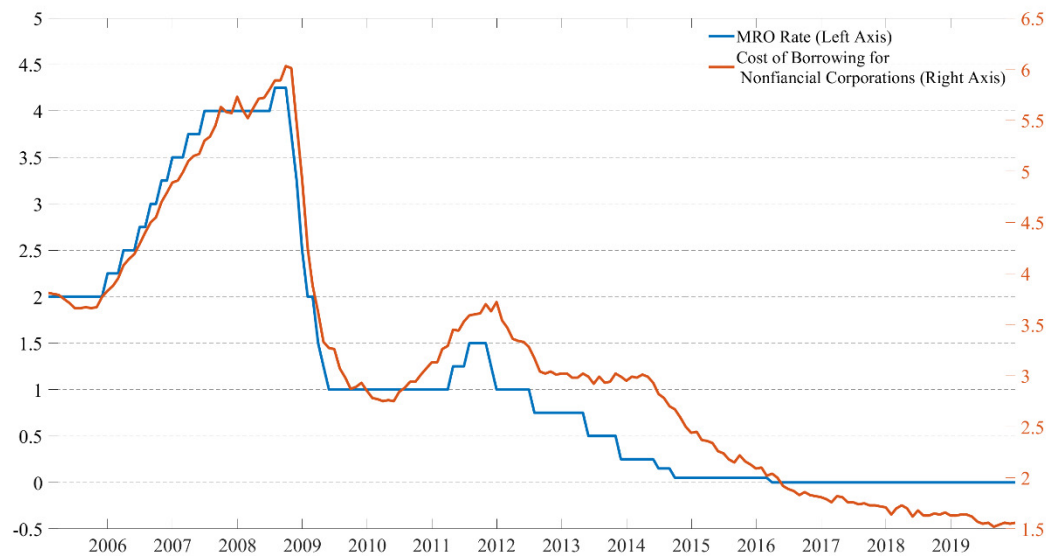
Figure 12: Targeted Longer-Term Refinancing Operations, Outstanding Balances



SOURCES: European Central Bank, Haver Analytics.

NOTE: “Euro area: Loan Growth” is measured as the year-over-year change in the amount of outstanding loans by euro-area banks to the nonfinancial sector.

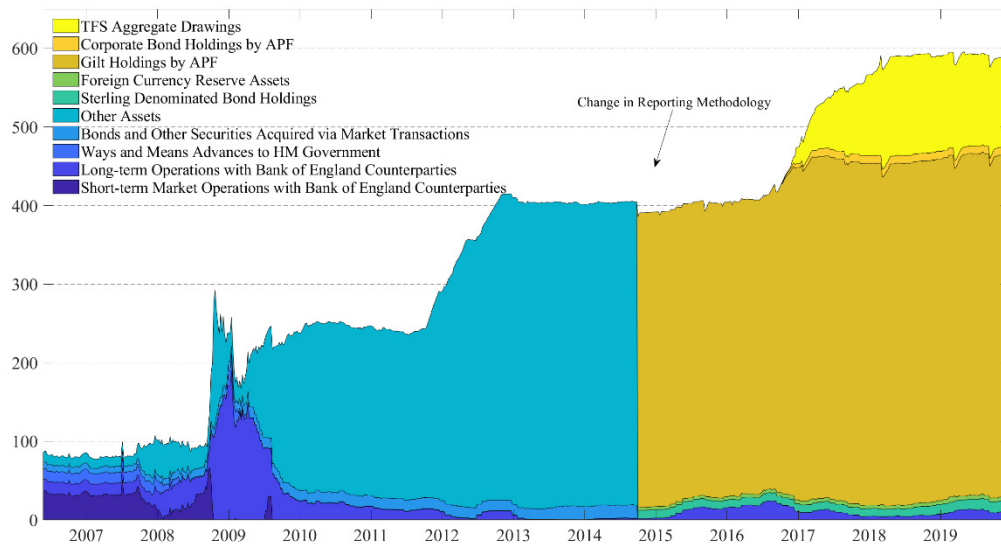
Figure 13: Euro-area Borrowing Costs (Percent)



SOURCES: European Central Bank, Haver Analytics.

NOTE: “Cost of Borrowing for Nonfinancial Corporations” is calculated as the weighted-average of interest rates on new loans made by euro-area banks to nonfinancial corporations.

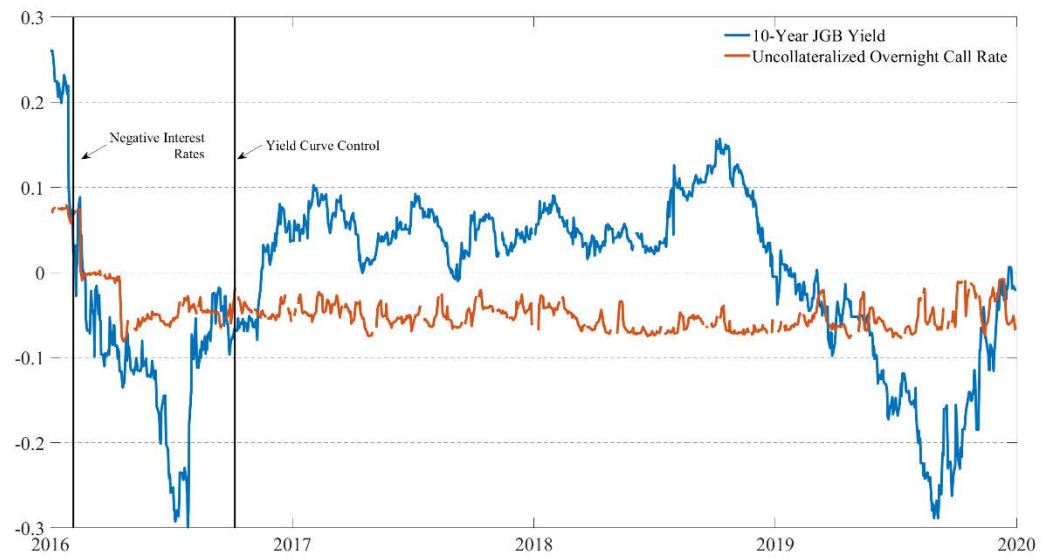
Figure 14: Bank of England Assets (Billions of GBP)



SOURCE: Bank of England.

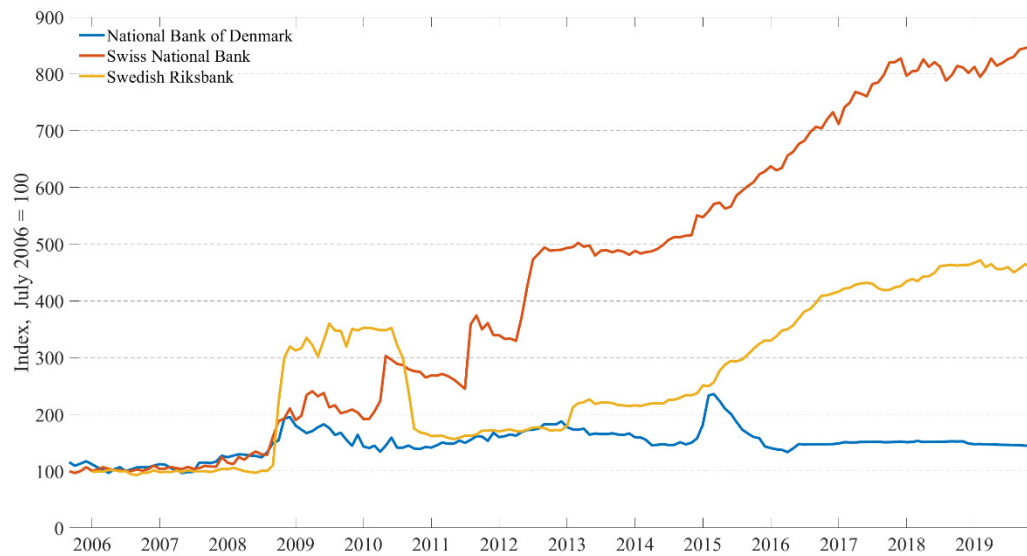
NOTE: In October 2014, the BOE replaced the “Bank Return” with the “Weekly Report” as its report of weekly balance sheet statistics. The new form still contains “balance sheet items that affect monetary conditions,” but it omits items “which have the scope to inadvertently reveal the provision of covert liquidity support.” Prior to the reporting methodology switch, Asset Purchase Facility holdings are included in “Other Assets.” (<https://www.bankofengland.co.uk/-/media/boe/files/quarterly-bulletin/2014/changes-the-banks-weekly-reporting-regime.pdf?la=en&hash=1BF2501F9A4B7DBF269C4E538BD3E5592A6CD563>).

Figure 15: Japanese 10-year bond yields before and after YCC (Percent)



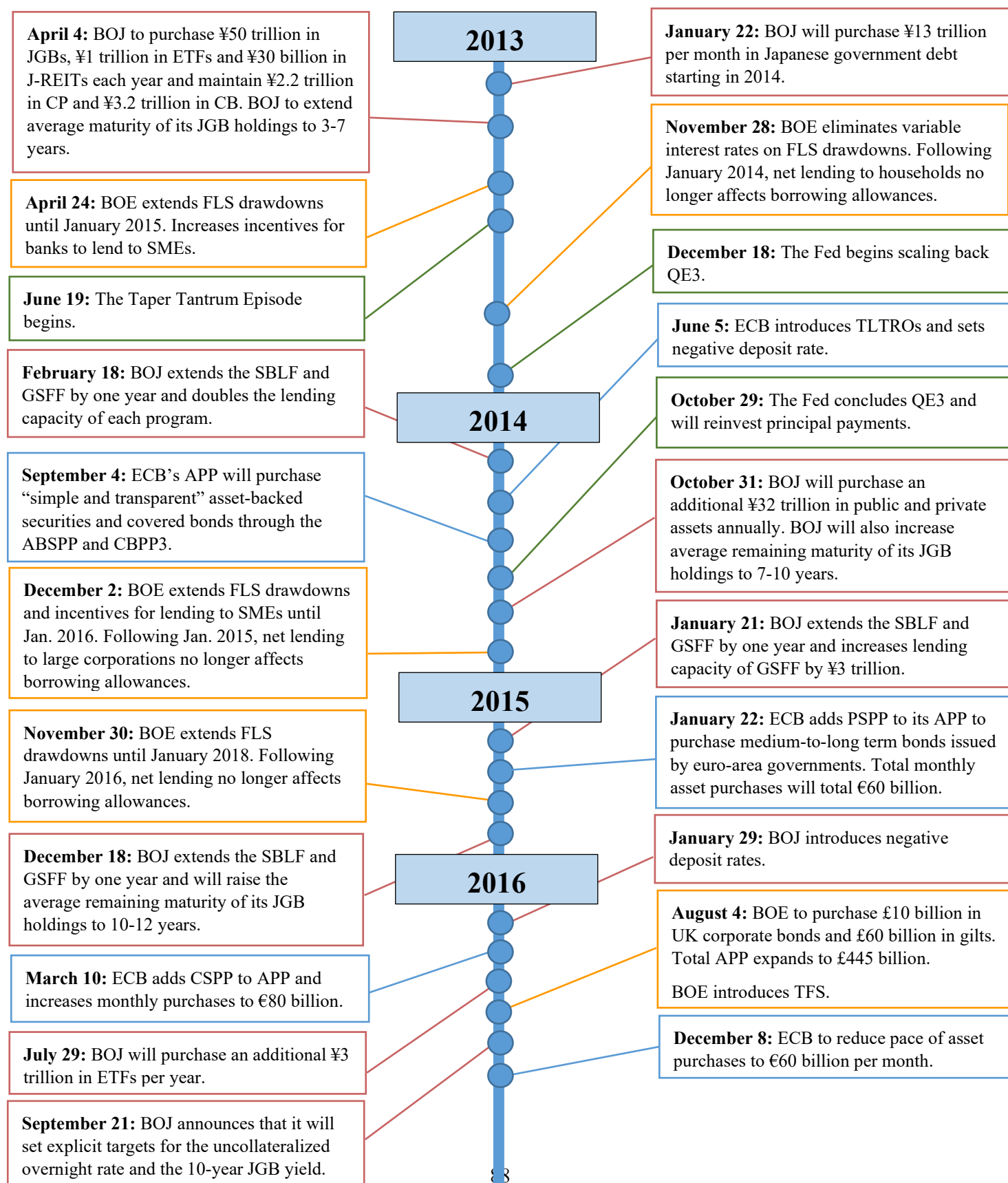
SOURCES: Bank of Japan, Haver Analytics.

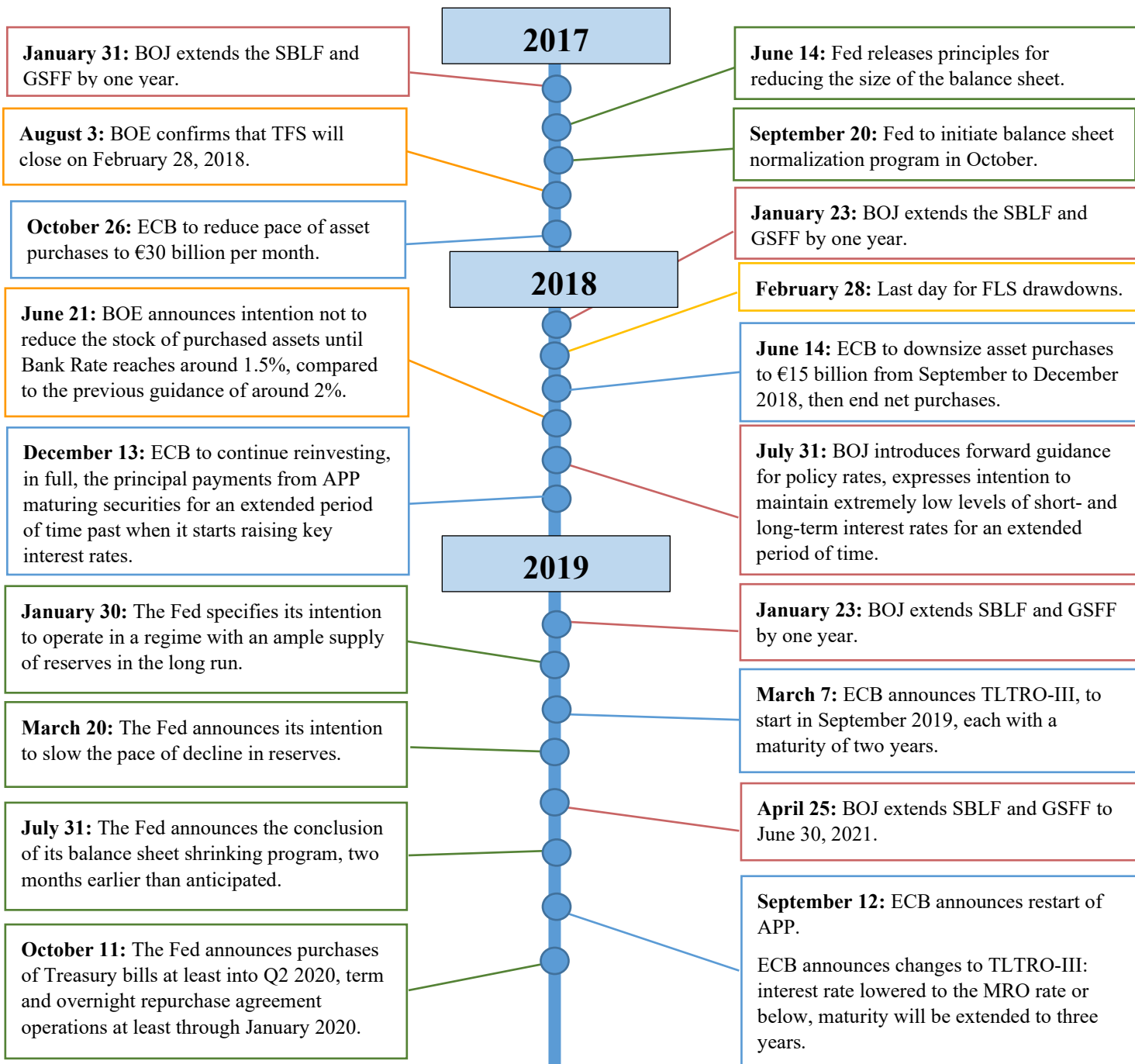
Figure A for boxed insert: Assets of Smaller Central Banks



SOURCES: Swedish Riksbank, Swiss National Bank, National Bank of Denmark.

Appendix A: Timeline





Appendix B: Forward Guidance Tables

Date	Federal Reserve statement on forward guidance
12/16/2008	Expects low rates “for some time.”
3/18/2009	Expects low rates “for an extended period.”
9/13/2012	Expects low rates “at least through mid-2015.”
12/12/2012	Expects low rates to be appropriate while unemployment is above 6.5 percent and inflation is forecasted below 2.5 percent.
12/18/2013	Expects low rates “well past the time that the unemployment rate declines below 6.5 percent.”
3/19/2014	Expects low rates “for a considerable time after the asset purchase program ends.”
10/17/2014	The committee “judges that in can be patient in beginning to normalize the stance of monetary policy.”
10/29/2014	Expects "to maintain the 0 to 1/4 percent target range for the federal funds rate for a considerable time following the end of its asset purchase program"
12/17/2014	The committee “judges that in can be patient in beginning to normalize the stance of monetary policy.”
3/18/2015	The committee expects an increase in the target range will be appropriate when it has "seen further improvement in the labor market and is reasonably confident that inflation will move back to its 2 percent objective"
7/29/2015	The committee changes that it expects an increase in the federal funds rate when it sees "further improvement" in the labor market to when it sees "some further improvement"
10/28/2015	The committee notes that it will be "determining whether it will be appropriate to raise the target range at its next meeting"
12/16/2015	The committee expects that economic conditions will "warrant only gradual increases in the federal funds rate; the federal funds rate is likely to remain, for some time, below levels that are expected to prevail in the longer run"
3/15/2017	The committee changes that economic conditions will "warrant only gradual increases" in the federal funds rate to that they will "warrant gradual increases"
1/31/2018	The committee changes that economic conditions will "warrant gradual increases" in the federal funds rate to that they will "warrant further gradual increases"
6/13/2018	The committee no longer states that the federal funds rate is "likely to remain, for some time, below levels that are expected to prevail in the longer run."
9/26/2018	The committee drops a sentence indicating that "the stance of monetary policy remains accommodative"
1/30/2019	The committee no longer indicates that some further gradual increases will be warranted, instead stating that it "will be patient as it determines what future adjustments to the target range" are appropriate
6/19/2019	The committee will “closely monitor the implications of incoming information for the economic outlook and will act as appropriate to sustain the expansion”

Date	ECB Statement on Forward Guidance
7/4/2013	Expects rates at current or lower levels for "an extended period of time."
8/1/2013	"Confirms that it expects" current or lower rates for an extended period.
1/9/2014	"Firmly reiterates" expectations of current or lower rates for an extended period.
3/10/2016	Expects rates at current or lower levels well past the horizon of net asset purchases.
6/8/2017	Expects rates at current levels well past the horizon of net asset purchases.
6/14/2018	Expects rates to remain at their present levels at least through the summer of 2019 or "for as long as necessary to ensure that the evolution of inflation remains aligned with the current expectations of a sustained adjustment path."
7/26/2018	Expects rates to remain at their present levels at least through the summer of 2019 or "for as long as necessary to ensure the continued sustained convergence of inflation to levels that are below, but close to, 2% over the medium term."
3/7/2019	Expects rates to remain at their present levels at least through the end of 2019 or "for as long as necessary to ensure the continued sustained convergence of inflation to levels that are below, but close to, 2% over the medium term."
6/6/2019	Expects rates to remain at their present levels at least through the first half of 2020 or "for as long as necessary to ensure the continued sustained convergence of inflation to levels that are below, but close to, 2% over the medium term."
7/25/2019	Expects rates to remain at their present or lower levels at least through the first half of 2020 or "for as long as necessary to ensure the continued sustained convergence of inflation to its aim over the medium term."
9/12/2019	Expects rates to remain at present or lower levels "until it has seen the inflation outlook robustly converge to a level sufficiently close to, but below, 2% within its projection horizon"

Date	BOE Statement on Forward Guidance
8/7/2013	MPC to keep rates low until unemployment falls to 7%.
2/12/2014	MPC will consider multiple factors before raising rates. Expects Bank Rate to rise ultimately to a level "appreciably below" pre-recession average.
9/14/2017	"Some withdrawal of monetary stimulus is likely to be appropriate over the coming months"
2/8/2018	Expects monetary policy may need to be tightened quicker and to a greater extent than previously expected.
3/22/2018	MPC states that "an ongoing tightening of monetary policy over the forecast period will be appropriate" to return inflation to its target.
12/20/2018	MPC adds that "the monetary policy response to Brexit, whatever form it takes, will not be automatic and could be in either direction"
6/20/2019	MPC adds that an ongoing tightening of monetary policy would be appropriate if the economy developed in line with inflation projections that "included an assumption of a smooth Brexit"
8/1/2019	MPC adds that an increase in interest rates would be appropriate "assuming a smooth Brexit and some recovery in global growth"
9/19/2019	MPC states that in the event of a no-deal Brexit, "the monetary policy response would not be automatic and could be in either direction", while in the event of a smooth Brexit and some global growth recovery, limited increases in interest rates at a gradual pace would be appropriate

Date	BOJ Statement on Forward Guidance
4/13/1999	Zero interest rates until "deflationary concerns are dispelled"
10/10/2003	Will maintain QE policy until inflation is positive for a few consecutive months.
10/5/2010	Zero interest rates until "price stability is in sight"
2/14/2012	Zero interest rates until "1 percent inflation is in sight"
1/22/2013	Open-ended purchasing with a 2 percent price stability target.
4/4/2013	Will continue QQE until inflation stably reaches 2 percent, time horizon of about two years.
9/22/2016	Will continue QQE w/ Yield Curve Control until inflation reaches and stays above 2 percent.
7/31/2018	Will maintain the current extremely low levels of short- and long-term interest rates for an extended period of time.
4/25/2019	Will maintain the current extremely low levels of short- and long-term interest rates for an extended period of time, at least through around spring 2020.
7/30/2019	The Bank states that they "will not hesitate to take additional easing measures if there is a greater possibility that the momentum toward achieving the price stability target will be lost."
9/19/2019	The Bank states that "it is becoming necessary to pay closer attention to the possibility that the momentum toward achieving the price stability target will be lost."
10/31/2019	The Bank expects rates to remain at present or lower levels "as long as it is necessary to pay close attention to the possibility that the momentum toward achieving the price stability target will be lost."