

INTRODUCTION

While financial markets and the financial press focus closely on where the Fed sets interest rates, there is also a consequential debate occurring within the Fed about how it goes about setting and maintaining its chosen rate. In particular, after it shrinks its securities holdings swollen by successive rounds of quantitative easing, will the Fed return to conducting monetary policy roughly in the manner that it did before the crisis, or will it stick to the implementation framework it has essentially followed for the past decade? The outcome of that debate will have important consequences for the Fed's future footprint within the financial system.

To better understand the debate, this note provides background on the mechanics of monetary policy; how Fed policy implementation evolved over the past decade, as it fought the financial crisis and the sharp contraction and extended period of weakness that followed; important ways that the Fed's own post-crisis bank liquidity regulations have constrained its monetary policy choices; and the pros and cons of two different implementation frameworks. It concludes with a discussion of how current market conditions suggest that the Fed may be forced to decide on a framework much earlier than it had expected.

BACKGROUND ON THE FED

At its most general, monetary policy entails adjusting a central bank balance sheet (its assets and liabilities) to achieve macroeconomic objectives by influencing financial market conditions. The Fed has traditionally operated by manipulating overnight interest rates, in particular the overnight federal funds rate, which is the on-shore, uncollateralized rate at which banks lend to each other. That rate, in turn, has a strong influence on longer-term rates, and also on the stock market and the exchange value of the dollar. The tighter financial conditions associated with higher interest rates slow economic activity, raising the unemployment rate and lowering inflation. The looser financial conditions associated with lower interest rates do the opposite.

Although the FOMC (Federal Open Market Committee) makes monetary policy decisions, the Board of Governors sets two key policy rates: the primary credit rate (commonly called the "discount rate"), which is the rate Reserve Banks charge on collateralized loans to depository institutions in sound financial condition; and the Interest on Excess Reserves (IOER) rate, which is the rate Reserve Banks pay on reserves balances (essentially deposits) they receive from depository institutions, in excess of required reserve balances.¹ Even though the Board sets these rates, it does so in a manner designed to support the monetary policy set by the FOMC.

In a 1977 amendment to the Federal Reserve Act, Congress instructed the Fed to adopt "maximum employment" and "stable prices" as its macroeconomic objectives for monetary policy. These objectives are referred to as "the dual mandate."² Because it is impossible to achieve zero unemployment and attempting to do so would lead to accelerating inflation, and because an inflation rate of zero would increase the risk of deflationary spirals that would cause high unemployment, the Fed has interpreted its mandate to be low and stable inflation and low unemployment. In January 2012, the Fed indicated that it would specifically seek to achieve inflation of 2 percent over the longer run. It also noted

1 The Board also sets the seasonal credit rate, the secondary credit rate, and the interest rate on required reserves, but those rates are less relevant for monetary policy implementation. The FOMC sets the interest rate on its standing overnight reverse repurchase facility, discussed below.

2 Congress also instructed the Fed to achieve "moderate long-term interest rates," but that third objective is redundant to the objective of achieving price stability and so is rarely mentioned.

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that the minimum non-accelerating inflation rate of unemployment (NAIRU) is outside its control and varies over time. The Fed currently estimates the NAIRU to be about 4½ percent.

Economic activity depends on the real interest rate (the nominal rate (the actual rate) minus the expected inflation rate) not the nominal rate. The real interest rate that is neither stimulative nor contractionary is referred to as the “neutral federal funds rate” or “r-star.” The Fed currently judges r-star to be about 1 percent. The Fed estimates that inflation will be 2 percent in the longer-run (its target). Consequently, the Fed estimates that the longer-run neutral nominal federal funds rate is about 3 percent. So, when the Fed says it is moving the fed funds rate target toward neutral, it means toward about 3 percent.

MONETARY POLICY BEFORE THE CRISIS

To understand monetary policy, it is necessary to understand a central bank’s balance sheet. In the case of the Fed, its balance sheet is relatively simple. As depicted below, prior to the crisis, assets consisted primarily of Treasury securities owned outright. Another important asset was Treasury securities purchased under an arrangement for the counterparty to repurchase the security in the near future, usually the next day. Such “repurchase agreements” or “repos” are a common type of short-term collateralized transaction. A repo is a sale with an agreement to repurchase, so it is a borrowing. A reverse repo is a purchase with an agreement to resell, so it is a loan. (Confusingly, the Fed refers to the transactions from the perspective of its counterparties – it calls its reverse repos, “repos”, and repos “reverse repos”.) The Fed also extends collateralized loans to depository institutions (henceforth, “banks”) called “discount window” loans, not because they are provided at a discount (they aren’t), but because they used to take the form of a “discount” of a bank asset (loans are now extended as “advances” against a pool of collateral).³ Fed liabilities consist mostly of currency and deposits of banks institutions (either required reserves or excess reserves); another important liability is the deposit of Treasury. Pre-crisis, the Fed generally kept the amount of Treasury securities owned outright about equal to the amount of currency, though as described below, that has changed dramatically. Apart from during the crisis, discount window loans are on most days close to zero.



Because currency and equity were essentially fixed, and the Treasury deposit known, the FOMC could determine exactly the amount of reserve balances by adjusting the amount of securities it owned; pre-crisis, those adjustments typically occurring in the repo portfolio. Since the Fed then paid banks zero interest on excess reserves, banks generally sought to keep excess reserves as low as possible. (Banks did maintain a small amount of excess reserves necessary to avoid overdrafts in their accounts at the Fed.) This motivation for banks, and the resulting low level of excess reserves, was critical to the pre-crisis implementation framework.

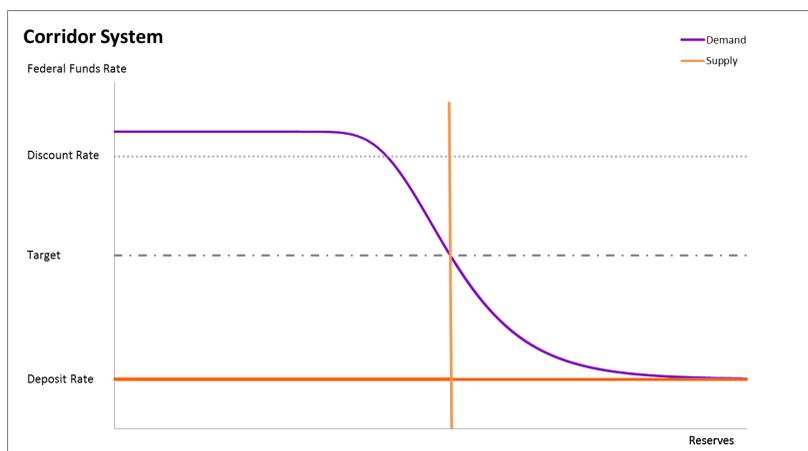
Banks traded reserve balances on an overnight basis, often to avoid overdrafts in their accounts at the Fed. The rate banks charged each other for these unsecured overnight transactions—the federal funds rate—is the rate the Federal

³ For example, the Fed would give a bank \$99 for a bank’s trade receivable that would pay \$100 in a month, with the “discount” reflecting the interest rate.

Reserve targets for monetary policy purposes. Thus, pre-crisis, monetary policy consisted of adjusting central bank assets so that the right supply of reserves was created to meet bank demand at the targeted interest rate.

The FOMC conducted monetary policy essentially using what is called a “corridor system.” At least in theory, banks would not borrow reserves in the marketplace for much more than they could borrow them at the discount window, so, as depicted by the blue line in the exhibit below, the demand for reserves had a ceiling at the discount rate (or a bit above). Similarly, banks would not lend reserves in the marketplace for less than they could lend to the Fed in the form of a reserve balance. Pre-crisis, the Fed did not pay interest on reserve balances, so the floor of the system was zero (the deposit rate).

Thus, in pre-crisis practice, the FOMC established a target for the overnight federal funds rate, and the Fed set the discount rate 100 basis points (1 percentage point) above that target and the floor for its corridor was zero.⁴



As noted, with the IOER rate at zero, banks only wished to hold a small amount of excess reserves. In aggregate, banks held about \$10-15 billion in reserve balances including \$1-2 billion in excess reserves, on average, prior to the crisis. The FOMC would keep the federal funds rate near its target by adjusting the size of the Fed balance sheet so that it was supplying only that small quantity of reserves. As depicted in the exhibit above, the Fed would supply reserves, the orange line, that just met the demand for reserves, the blue line, at the target federal funds rate, the dashed line.

A corridor system is characterized by reserve scarcity. By keeping reserves scarce, banks are willing to pay somewhat more to borrow reserve in the market than the earn on the reserves on deposit at the central bank. If the central bank mistakenly provides too large a quantity of reserves on a particular day, interest rates fall below the target. If the central bank provides insufficient reserves, the interest rate rises up to the discount rate.

MONETARY POLICY DURING THE GREAT RECESSION

The financial turmoil that began in August 2007 and the resulting severe contraction that began in the Fall of 2008 required the Fed to conduct monetary policy differently than it had in the past.

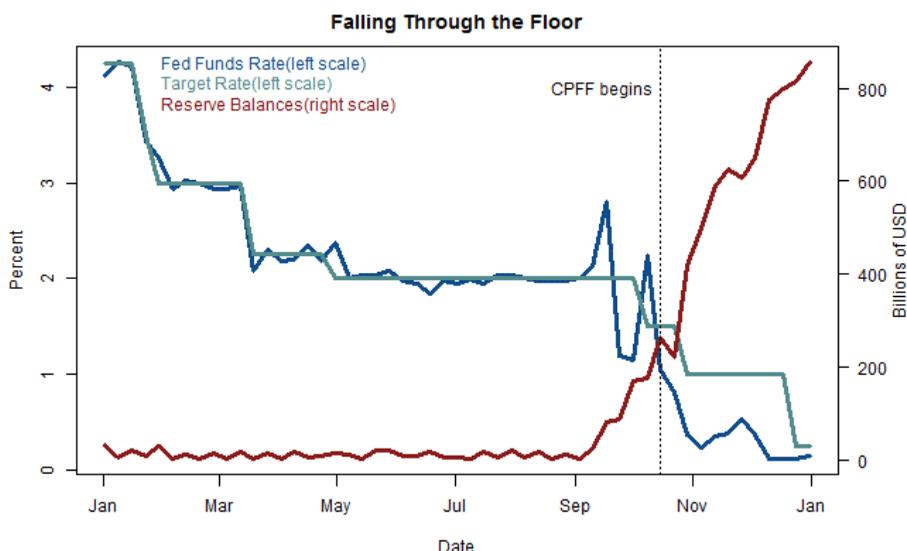
The Fed responded to the financial crisis by lending. Initially, the Fed increased its discount window lending to depository institutions by lowering the discount rate and extending the term of the loans. But, in an effort to reduce the severe stigma associated with discount window borrowing, beginning in December 2007, the Fed conducted regular auctions of one and three-month discount window loans. At that time the Fed also began swapping dollars for foreign currency with other central banks to assist them in meeting the dollar funding needs of banks in their jurisdictions. Beginning in March 2008, with the near-failure of Bear Stearns, the Fed began extending loans to non-banks using its emergency authority, provided in section 13(3) of the Federal Reserve Act. That second wave of lending included loans to support the JPMorgan acquisition of Bear Stearns, and loans to primary dealers to support the repo market. Lastly, beginning in

⁴ The European Central Bank, which was also conducting policy using a corridor system and also set its discount rate 100 basis points above its target for overnight rates, paid interest on excess reserves equal to 100 basis points below its target.

October 2008, again using its emergency authority, the Fed lent to AIG directly and opened several lending or guarantee facilities to support the commercial paper and asset-backed securities markets.⁵

Loans are assets and so expand the Fed's balance sheet. If the Fed hadn't taken actions to offset the increased assets, the supply of reserves would have risen above the relatively small amount demanded by commercial banks. In that case, because banks at that time earned no interest on their reserve balances, they would have been willing to lend the reserves out at very low rates. As banks scrambled to shed the reserves, the federal funds rate would have fallen toward zero. But the FOMC's target for the federal funds rate was above zero until December 2008. So, to prevent an unwanted increase in reserve balances and concomitant, undesired decline in the fed funds rate, the Fed reduced its holdings of Treasury bills to offset the increased lending. In central-bank terminology, it "sterilized" the lending.

However, in October 2008, the Fed ran down its Treasury holdings to the point that it was unable to sterilize lending. (Such lending had by then increased markedly under the Commercial Paper Funding Facility (CPFF) that had been opened to support the commercial paper market in the wake of the Lehman default.) Fortunately, Congress had just granted the Fed authority to pay interest on reserves balances. The Fed anticipated that paying interest on excess reserve balances would allow it to control the federal funds rate without regard to the supply of excess reserves. As discussed above, IOER was supposed to put a floor on rates if the level of excess reserves exceeded demand. To everyone's surprise and dismay, however, when the CPFF opened and excess reserves rose far above the level demanded by banks, the federal funds rate dropped through the IOER rate of 1 percent to near 0. The fed funds rate generally remained well below the FOMC's target until mid-December 2008, when the FOMC dropped its target for the federal funds rate to a range of 0 to .25 percent.



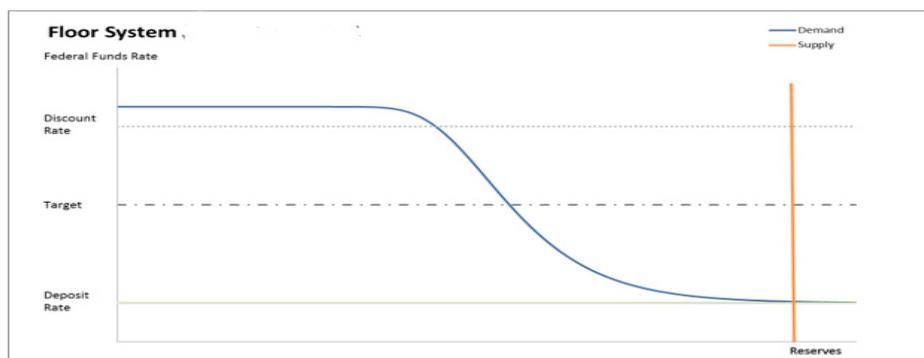
The primary reason why IOER failed to work as a floor was that Fannie Mae, Freddie Mac, and the Federal Home Loan Banks maintain accounts at the Fed but do not receive interest. That is, for the GSEs, IOER was still zero. As a result, when the GSEs ended up with unwanted reserves, they would lend the funds out at any rate above zero. As described below, fixing that problem was a big part of how the Fed was later able to raise the federal funds rate even with a huge balance sheet.

While the Fed responded to the financial crisis by lending, it responded to the Great Recession and anemic recovery by easing monetary policy. Initially, the FOMC eased policy in the traditional way, by reducing its target for the federal funds rate. In August 2007, the FOMC's target stood at 5¼ percent. As noted, by December 2008, the FOMC had lowered its target to a range of 0 to 0.25 percent, where it stayed throughout the crisis. That low range is often described as the

⁵ For a summary of Fed lending in the crisis see Domanski, Dietrich, Richhild Moessner, and William Nelson, 2014, Central banks as lender of last resort: experiences during the 2007-2010 crisis and lessons for the future, <https://www.federalreserve.gov/econresdata/feds/2014/files/2014110pap.pdf>

effective lower bound or the zero lower bound (ZLB).⁶ To achieve that target range, the Fed set IOER to 0.25 percent, and the effective federal funds rate generally traded in the middle of the 0 to 0.25 percent range.

Once the Fed began providing more reserves than were demanded it could no longer conduct policy using a corridor system, which requires that reserves be scarce. Instead, it was implementing policy in a “floor system.” In a floor system, depicted in the exhibit below, the Fed oversupplies reserves, and market rates drop to the floor because each bank must be freely willing to hold the quantity of excess reserves supplied in aggregate; if market rates were above IOER, banks would prefer to lend out the reserves rather than keep them on deposit at the Fed. If market rates were (much) below the floor, banks would prefer to borrow in the overnight market and hold the borrowed funds on deposit at the Fed, earning a spread.



Once the target range was set at the ZLB, however, the Fed could not provide additional stimulus using traditional means. If the Fed could not have provided enough stimulus, inflation would have fallen. Monetary stimulus depends on the real interest rate, and the nominal interest rate can't go much below zero; thus, if inflation falls, real interest rates rise and the Fed is passively tightening policy. That tightening can lead to further, and accelerating, reductions in inflation, with inflation turning to deflation (negative inflation). The result could have been a devastating deflationary spiral.

Fear of a deflationary spiral was a driving motivation behind all the subsequent policy actions of the Fed. When Fed communications over the period described asymmetric risks for monetary policy, they were referring to the fact that the Fed could raise rates to fight inflation but could not lower them below zero to fight deflation.⁷

Nor was this just an abstract fear. When the Fed lowered its target range to the ZLB in December 2008, staff estimated the resulting real federal funds rate to be $-1\frac{3}{4}$ percent. At the same time, staff's best estimate of the short-run neutral federal funds rate at that time was -3 percent.⁸ By this measure, even after dropping its target for the federal funds rate to the ZLB, the Fed was restraining, not supporting, the economy. Indeed, as shown below, in March 2009 the staff's estimate of optimal policy called for the Fed to lower the federal funds rate, if possible, to -7 percent.⁹

To provide at least some of the additional needed stimulus, the Fed eased its monetary policy stance using two nontraditional tools: forward guidance and large-scale asset purchases (a/k/a quantitative easing (QE)).

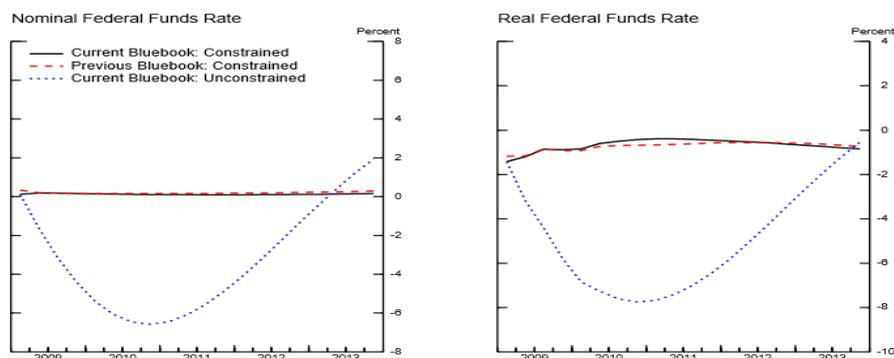
6 Nominal interest rates can't go much below zero in part because currency provides a zero return. If interest rates fall much below zero, investors will simply hold currency. However, because it is costly to hold a large amount of currency, interest rates can move a bit below zero. For example, for the past several years the ECB has paid a negative interest rate on deposits and the interest rate that banks charge on an interbank loan has also been negative. When the interest rate is negative, lenders must pay borrowers to engage in the transaction.

7 This asymmetry is also why some economists think the Fed should raise its inflation target to 3 percent. The higher the normal level of inflation, the higher the normal level of nominal interest rates, and the more room the FOMC has to lower interest rates before hitting the ZLB.

8 December 2008 bluebook, p. 26, adjusted for the 75 bp decline in the target taken at the meeting.

9 The optimal policy calculation places a penalty on moving the target federal funds rate too quickly and it was constrained by the fact that the funds rate was starting at zero; the level of -7 percent wasn't reached for over a year and a half. The optimal contemporaneous setting for the funds rate would have been much lower than -7 percent.

Constrained vs. Unconstrained Monetary Policy (2 Percent Inflation Goal)



FORWARD GUIDANCE

Forward guidance entails the FOMC announcing not just where it is currently setting its target for the federal funds rate but providing information about where it intends to set it in the future. Beginning in December 2013, the FOMC used three types of guidance (qualitative, date-based, and inflation- and unemployment-threshold based). Guidance continued until April 2015, when the Fed merely indicated that rates would change as appropriate to meet its statutory objectives.

LARGE-SCALE ASSET PURCHASES

The Fed's QE programs were intended to provide additional stimulus by putting downward pressure on longer-term interest rates. The stimulus channel was the same as for ordinary policy – lower interest rates boost economic activity – but the means by which interest rates were lowered was different. In the case of QE, by buying long-term Treasury securities, agency debt, and agency MBS, the Fed reduced the supply of longer-term securities in public hands. When supply goes down, prices go up which, in the case of a debt security, means interest rates go down.

QE occurred in four waves.¹⁰ Under QE1, begun in November 2008, the FOMC bought \$1.75 trillion in Treasury securities, agency securities, and agency MBS. QE1 is judged to have stimulated the economy not just by taking duration out of private hands but also by calming MBS markets. Under QE2, which began in November 2010, the FOMC purchased \$600 billion in Treasury securities. In September 2011, the Fed began the Maturity Extension Program ("MEP," aka "Operation Twist"). Under the MEP, the Fed purchased longer-term Treasury securities while simultaneously selling short-term securities. Under the MEP, the Fed purchased about

\$700 billion in securities while not expanding its balance sheet.¹¹ Unlike the earlier programs, QE3 was a flow-based program under which the Fed indicated how much it would buy each month until economic conditions improved. QE3 (also called "the flow-based asset purchase program" or "QE-infinity") began in September 2012 and ended in October 2014. In total, under QE3, the Fed bought \$1.5 trillion in Treasury securities and agency MBS.

Combined, the QE programs purchased securities equal to about 23 percent of GDP. The Fed reinvested principle on maturing securities, thereby keeping its holdings constant over time. Gagnon (2016) estimates that the purchases reduced the longer-term interest rates by 1.2 percentage points thus providing a considerable amount of stimulus.¹²

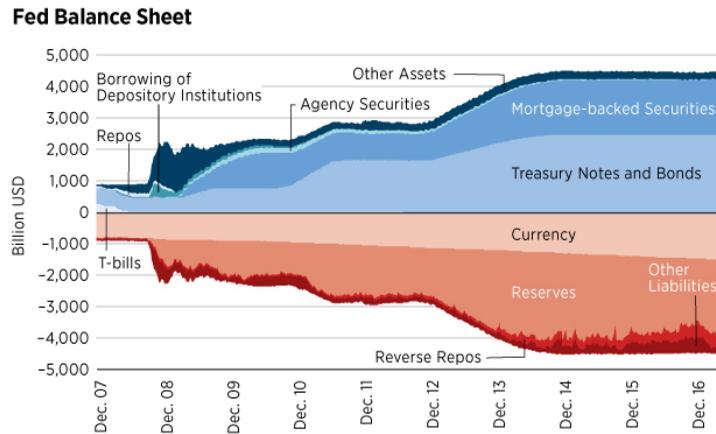
10 See QE: A User's Guide, Joseph Gagnon and Brian Sack, October 2018. <https://piie.com/system/files/documents/pb18-19.pdf>

11 The MEP illustrates why "QE" is a misnomer. Quantitative easing is intended to provide stimulus by increasing the quantity of reserves. The Fed did not judge that increasing reserves by itself provided any stimulus; the stimulus was provided by taking duration out of private hands.

12 Quantitative Easing: An Underappreciated Success, Joseph Gagnon, April 2016. <https://piie.com/system/files/documents/pb16-4.pdf>

POLICY NORMALIZATION

As discussed below, even before it was done with QE, the FOMC began to worry about how it would tighten policy when it became appropriate to do so. Just prior to the plummeting of the fed funds rate through the IOER rate in the Fall of 2008, excess reserves averaged about \$2 billion. When QE ended in October 2014, excess reserves exceeded \$2 trillion. The combined effect on the Fed's balance sheet of crisis lending and QE is illustrated by the exhibit below. The ineffectiveness of IOER to serve as a floor on the funds rate in Fall 2008, combined with the very high level of excess reserves, raised concerns that when the time came, the Committee would be unable to increase the funds rate.



To resolve those concerns, the FOMC developed plans to normalize its balance sheet and tighten policy when it became appropriate to do so. Those plans changed over time. In June 2011, the FOMC indicated that when it decided to tighten policy, it would do so by first allowing its securities to roll off, second by raising its target for the fed funds rate, and finally by selling off its holdings of agency MBS and agency debt. Regarding the post-normalization framework, the Committee stated that

...the size of the securities portfolio and the associated quantity of bank reserves are expected to be reduced to the smallest levels that would be consistent with the efficient implementation of monetary policy. (Minutes to the FOMC meeting of June 21-22, 2011)

For reasons discussed in Nelson (2018)¹³, as the balance sheet continued to swell under QE3, the Committee changed its normalization plans in September 2014. At that point, the Committee indicated that it would start normalization by raising its target for the federal funds rate. Rather than sell MBS, the Committee indicated that it intended to allow the MBS to simply mature. The Committee again stated that it intended to hold no more securities than necessary

...to implement monetary policy efficiently and effectively, and that it will hold primarily Treasury securities, thereby minimizing the effect of Federal Reserve holdings on the allocation of credit across sectors of the economy. (Minutes of the FOMC meeting of September 16-17, 2014)

The Committee also indicated that it would use an “overnight reverse repurchase agreement facility” (RRP facility) to help control the federal funds rate, but that it would “phase it out when it is no longer needed to help control the federal funds rate.”¹⁴ Because an RRP is essentially a deposit with the Fed, by creating the RRP facility, the Fed effectively began paying interest on deposits to financial institutions other than commercial banks, repairing the hole that had made the IOER rate an ineffective floor. That is, the RRP facility enabled Fannie, Freddie, and the FHLBs (as well as other investors, including money funds) to engage in overnight RRP with the Fed at a predetermined rate (the “ON RRP rate”), which was set 25 basis points below IOER.

13 Nelson, Bill (2018) “A former Fed insider explains the internal debate over QE3,” Financial Times, February 16, 2018. <https://ftalphaville.ft.com/2018/02/16/2198845/guest-post-a-former-fed-insider-explains-the-internal-debate-over-qe3/>.

14 As noted above, an overnight reverse repurchase agreement is effectively a form of collateralized lending in which the lender buys a security from the borrower with an agreement for the borrower to buy it back the next day. Consequently, at the RRP facility, institutions are effectively lending money to the Fed overnight.

On December 15, 2015, the FOMC raised its target range to between 25 and 50 basis points, up from 0 to 25 basis points, where it had been since December 2008. To encourage federal funds trading in that range, the Fed raised the IOER rate to 50 basis points and the RRP rate to 25 basis points. As intended, and to great relief, the fed funds rate traded in the middle of the new range.

Confusingly, while the rates were intended to combine to provide a floor on rates, the IOER rate and the RRP rate were set at the top and the bottom of the target range, respectively. Think of the IOER rate as the top of the shag carpet and the RRP rate as the plywood below the carpet padding; the weight of the massive amount of excess reserves pushes the fed funds rate somewhere in between.

In June 2017, the Committee provided details on how, exactly, it intended to reduce its securities holdings and thereby excess reserves. Specifically, the Committee intended to allow securities to roll off its portfolio as they matured up to established gradually increasing caps above which it would reinvest principal from maturing Treasury and agency securities. In the case of Treasury securities, the cap started at \$6 billion per month and increased by \$6 billion at 3-month increments until it reached \$30 billion. In the case of agency debt and agency MBS, the corresponding figures were \$4 billion and \$20 billion. For example, if the cap for Treasuries was currently \$18 billion, and less \$18 billion in Treasury securities matured in a month, none the principal received would be reinvested. If \$27 billion matured, \$9 billion would be reinvested.

The Committee began its gradual winddown in October 2017. Despite fears that it would result in another taper-tantrum (the outsized market reaction when the Fed publicly discussed the possible future start of a wind-down of QE3), market reaction was negligible.

Subsequently, the FOMC has raised its target range for the target federal funds rate 8 times—it's currently 2 to 2½ percent—and is widely expected to tighten again in December. The caps for redemptions of Treasury and agency securities have reached their maximum levels. The FOMC's securities holdings have fallen from \$4¼ trillion to \$4 trillion, and the level of excess reserves equals \$1¼ trillion. As discussed below, the Committee hasn't yet decided on the ultimate size of the balance sheet or the longer-run policy implementation framework, but the meeting minutes indicate that these topics are under active discussion.

THE IMPACT OF LIQUIDITY REQUIREMENTS

While the Fed had been changing the supply of reserves and US Government securities to implement monetary policy during the crisis, it had also been acting in its role as bank supervisor to implement new liquidity requirements on banking organizations. The various liquidity requirements that have been put in place since the crisis have changed banks' demand for excess reserves and so must be considered when designing a monetary policy implementation framework. The Basel III financial reforms include two new liquidity requirements: the liquidity coverage ratio (LCR) requirement, which focuses on a 30-day horizon, and the net stable funding ratio (NSFR) requirement, which focuses on a one-year horizon. (Only the LCR has been implemented in the United States to date.) In addition, large banks are required to conduct liquidity stress tests monthly, hold sufficient liquidity to fund their own resolution should they fail, and are subject an annual horizontal (that is, it is conducted simultaneously across banks) liquidity review.

The LCR is a good proxy for all the requirements, and its implications for monetary policy have been the most studied (though still not sufficiently studied). The LCR is defined as the ratio of a bank's high-quality liquid assets (HQLA) to its projected net cash outflows over a 30-day period under severe liquidity stress. HQLA consists of excess reserves, Treasury securities, and, to a more limited extent, agency mortgage-backed securities, agency debt, and certain other securities. Banks are required to maintain an LCR above 1.

If a bank is out of compliance, it can raise its LCR in three ways. It can hold more HQLA, it can increase its projected cash inflow over 30 days, or it can reduce its projected cash outflow over 30 days. Banks will, over time, choose to comply in the least costly means possible. As described in Nelson (2016 and 2018), banks' efforts to satisfy the LCR requirement in the least costly manner will drive some foreseeable relationships among money market interest rates.¹⁵

¹⁵ For example, the term premium associated with borrowing beyond 30 days should roughly equal the amount by which the yields on HQLA fall below those on otherwise similar assets that aren't HQLA, because terming out a bank's borrowing or holding more HQLA are two equivalent ways to raise the bank's LCR. If one way costs a lot less than the other, banks would switch to the cheaper alternative.

Importantly for monetary policy implementation, scarcity of excess reserves caused by banks' need to satisfy the LCR ("LCR scarcity") has different implications for money market rates than the normal pre-crisis scarcity caused by banks' needs to avoid overdrafts in their accounts ("account maintenance scarcity"). If a bank is hit with an unexpected large late-day debit and is concerned it will have an overdraft in its Fed account, it can borrow in the overnight fed funds market to replenish its account. As a result, if excess reserves are scarce, banks will end up bidding aggressively in the fed funds market, driving up the fed funds rate. By contrast, borrowing from another bank in the overnight in the federal funds market does not increase the LCR, because the added HQLA is matched by an increased projected cash outflow.¹⁶ As a result, LCR scarcity should not, by itself, push up the fed funds rate relative to IOER; account maintenance scarcity is required.

As a result, if the Fed wanted to reduce the quantity of excess reserves sufficiently to increase the intra-bank fed funds rate above IOER, it would have to shrink its balance sheet to the point where account maintenance scarcity kicks in. But if that level is significantly lower than where LCR scarcity begins to materialize, then reducing reserves sufficiently to lift the fed funds rate above IOER will leave banks scrambling to satisfy their LCR. One way they will seek to do so is to borrow more beyond 30 days, driving up money market term premiums sharply. It is precisely such a conflict between the LCR and monetary policy implementation that Morten Bech of the BIS and Todd Keister of Rutgers have highlighted for several years (for a high-level explanation of their work, go here).

In principle, in such circumstances, rather than terming out their borrowing, banks could hold Treasury securities rather than excess reserves to satisfy their LCR. However, while the LCR regulation treats excess reserves and Treasury securities the same, Fed supervisors have reportedly instructed banks through the examination process that they must hold a certain, not publicly known, fraction of their HQLA as excess reserves. The Fed's "LCR reserve requirement" creates an added function that only excess reserves will be able to satisfy.¹⁷

Even with an LCR reserve requirement, however, scarcity caused by the LCR cannot drive IOER permanently below other money market rates, including the fed funds rate, in the steady state.¹⁸ If IOER is below other interest rates, and HQLA must include excess reserves, then the average return on HQLA must be below the fed funds rate. But, if that were true, a bank could always satisfy its LCR more cheaply by replacing HQLA with a fed funds loan (and the associated cash inflow), so IOER must not be below the fed funds rate in equilibrium.

All that said, to paraphrase Keynes, in equilibrium we are all dead. Banks are large, complex institutions, and it will no doubt take time for the price signals from funding markets to influence target HQLA composition or vice versa. At any given point in time, each bank will likely have established a specific amount of excess reserves that it desires to satisfy the LCR reserve requirement as well as its own account management needs. As the Fed shrinks its portfolio of securities and the quantity of excess reserves declines, banks may find themselves consistently falling short of their desired levels, temporarily driving up market interest rates, including the fed funds rate, relative to IOER.

THE MONETARY POLICY IMPLEMENTATION FRAMEWORK DEBATE

At the same time that the Committee was debating how to normalize its balance sheet, it was also debating how it would implement monetary policy after normalization. That debate continues. When staff analysis on the post-crisis implementation framework began in 2008, the focus was on ways to return to a framework like that used before the

¹⁶ An important exception is overnight fed funds borrowing from a GSE, which has an LCR outflow rate of 50 percent. As a result, such borrowing does increase a bank's LCR, an option that banks have reportedly been taking recently. In equilibrium, assuming there are limits on the ability of GSEs to provide such funds, the amount they charge should rise until it is about equally costly for a bank to boost its LCR by borrowing from GSEs or terming out their borrowing beyond 30 days. In that case, because of the 50 percent cash outflow assumption, the fed funds rate from a GSE should exceed the fed funds rate from a commercial bank by about half the money market term premium.

¹⁷ Vice Chairman Randal Quarles acknowledged that supervisors have indicated to banks that there is an expectation that some HQLA be held in the form of excess reserves in response to a question at a conference at the Hoover Institution on May 4, 2018. Such expectation would not be a "requirement" in the legal sense. <https://www.wsj.com/articles/transcript-panel-discussion-with-feds-quarles-at-hoover-institution-conference-1525724119?mod=searchresults&page=1&pos=2>

¹⁸ While there may be a spread between the fed funds rate and IOER in equilibrium because IOER is risk free and more liquid, LCR scarcity cannot cause a permanent increase in the spread.

crisis but with the benefit of IOER (that is, a corridor system).¹⁹ But the minutes of the November 2016 FOMC meeting suggest that the Committee currently leans toward maintaining a floor system. At the press conference following the June 2018 FOMC meeting, Chairman Powell indicated that the Committee would reengage the framework debate this Fall, although evidently (based on the minutes) they did not do so at the September meeting.

There are advantages and disadvantages of both a floor and a corridor system. An advantage of the floor system is that the FOMC could continue to use that framework even if it were necessary for the Fed to expand its balance sheet massively again, either through lending or QE. A second advantage is that, at least in theory, no day-to-day open market operations would be required – high-frequency variations in the supply and demand for reserves should not move market rates because reserves are so far out on the flat part of the demand curve.²⁰ Third, the low opportunity cost of holding excess reserves would make it less costly for banks to maintain a liquid balance sheet, enhancing the liquidity of the financial system. Lastly, if banks hold high levels of excess reserves, they will be less concerned about daylight or overnight overdrafts and so less likely to throttle their payments until late in the day, avoiding the associated systemic risk.

Disadvantages of the floor system focus on the role of Fed in the financial system. In response to a question following his first policy speech as President of the New York Fed, John Williams indicated that the pitfalls were essentially political concerns about the larger “footprint” of the Fed in the financial system under the floor system.²¹ In particular, by using the IOER rather than scarcity to set interest rates, the Fed will be counterparty to a much larger set of transactions each day. The thousands of depository institutions that have accounts at their Federal Reserve Bank will see those deposits as a critical source of liquidity. Moreover, contrary to the Fed’s stated plans, it may need to keep the ON RRP facility as a permanent fixture with the result that, in addition to banks, the Fed would be a regular counterparty to GSEs and money funds it allows to have access to the facility.²² In addition, a high level of excess reserves requires large and probably politically unpopular interest payments to banks, as well as IOER-like payments to ON RRP facility counterparties, especially if the Fed has to increase the fed funds rate well above neutral to slow the economy and prevent an unwanted rise in inflation.²³

An advantage of a corridor system is that it provides an effective way for the FOMC to control interest rates with a smaller financial footprint. To manage day-to-day variations in the demand for, and supply of, excess reserves the Fed needs only to engage in relatively small repo transactions with broker-dealers—transactions that are not important to the dealers at a rate that is not important to the Fed (the Fed targeted the fed funds rate and was largely indifferent to the precise repo rate at which it conducted its daily transactions). Those transactions determine conditions in the federal funds market, a small market that the Fed only participates in when it makes the rare discount window loan. Moreover, because excess reserves are kept to a minimum in a corridor system, so too are interest payments to banks, reducing the scope for associated political interference.

A serious challenge for a corridor framework is that the discount window is likely to be an ineffective ceiling. Because of the perception during the crisis that Fed lending was a “bail out” and the associate public opprobrium, stigma associated

19 See “Interest on Reserves: A Preliminary Analysis of Basic Options,” staff memo for the FOMC, April 2008. <https://www.federalreserve.gov/monetarypolicy/files/FOMC20080411memo01.pdf>

20 As discussed below, the level of reserves may already have reached the upward sloping part of the demand curve, so higher-frequency operations to manage the level of reserves may become necessary.

21 “‘Normal’ monetary policy in words and deeds,” John C. Williams, Q&A at Columbia University, September 28, 2018. <https://sipa.columbia.edu/ideas-lab/central-banking-and-financial-policy-sipa/reserve-reductions-money-markets-and-future>

22 In a speech on “Operational perspectives on Monetary Policy,” Lorie Logan, Senior Vice President at the New York Fed, described the ON RRP facility as integral to the implementation of policy using a floor system. “Even with near-zero usage, as has been seen in recent months, the ON RRP facility supports market rates by ensuring that counterparties demand rates on other investments at least as attractive as the rate offered on the Federal Reserve’s ON RRP’s.” Consequently, it is unclear that the FOMC’s criteria for phasing out the RRP facility of no longer being needed to implement monetary policy will ever be met. “Operational Perspectives on Monetary Policy Implementation: Panel Remarks on The Future of the Central Bank Balance Sheet,” Remarks at the policy conference at Hoover Institution, Stanford University, May 4, 2018. <https://www.newyorkfed.org/newsevents/speeches/2018/log180504>. A list of counterparties to the ON RRP facility is available here: https://www.newyorkfed.org/markets/rrp_counterparties.

23 While the interest payments may be politically unpopular, because the IOER rate is set at or below market rates, they are neither a handout to the banks nor a net expense for the Fed.

with the discount window is at an all-time high. Banks are unwilling to borrow from the Fed even if interbank interest rates rise well above the discount rate. While a corridor framework requires a ceiling, a floor-system does not because interest rates are squished down against the floor.

From an economics perspective, neither approach is clearly superior. First and foremost, an implementation framework needs to provide good interest rate control so that the Committee can guide the macro economy, and both approaches seem likely to perform that function well. While it is true that the Fed could stick with a floor system in a crisis when it needed to expand excess reserves, it could equally well switch from a corridor system to a floor system in such circumstances. The decision may come down to second-order considerations: The Fed is now used to a floor-based system and may simply not want to change without a compelling reason to the contrary. Moreover, markets and market participant behavior has adjusted to a high-volume of excess reserves, and there are costs associated with adjusting. On the other hand, it may be difficult for the Fed to continue paying billions of dollars of interest to large banks in the form of IOER (even though those payments are largely offset by higher interest earnings on the Fed's securities portfolio), and to also extend those payments to GSEs and other money funds – something not clearly contemplated in any governing law.

IS IT DECISION TIME?

The FOMC has deferred for a decade a decision about how it will conduct monetary policy after its balance sheet normalizes. Typically, the stated reason to demur has been that it didn't need to decide yet, and it was gaining valuable information. That was the reason given by Bill Dudley, President of the New York Fed at the June 2011 FOMC meeting:

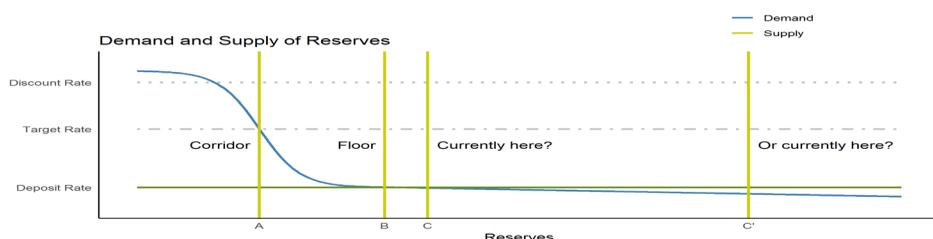
Now, in all of this, I'm not saying I favor a floor system. I'm not arguing for a floor system over a corridor system. All I am arguing is that it is bad policy to rule out a floor system at the current time given the chance to learn a lot about how a floor system operates in practice.²⁴

And six years later that was the explanation given by Janet Yellen, Chair of the FOMC, for why they had not picked a destination for normalization even when beginning to shrink the balance sheet in June 2017:

I can't tell you what the longer-run normal level of reserve balances will be because that will depend on the Committee's eventual decisions about how to implement monetary policy most efficiently and effectively in the longer run, as well as a number of as-yet unknown elements, including the banking system's future demand for reserves and various factors that may affect the daily supply of reserves...Decisions about the appropriate long-run framework do not need to be made for quite some time, and our future deliberations will benefit from the experience we will gain during the normalization process.²⁵

The critical piece of missing information is the shape of the demand curve for reserves. As shown in the exhibit below, we are currently probably at point C', with the supply of reserves far to the right. As the balance sheet declines, supply is creeping to the left. Ultimately, we will get to point B, where reserves begin to be scarce (as discussed below, reserve supply may be closer to B than had been thought). Any lower, and banks will only be willing to hold the available supply of excess reserves if market interest rates are above IOER.

That point where scarcity begins is important for making the decision about whether to operate policy with a corridor or floor framework because it is the smallest quantity of excess reserves consistent with a floor-based system. If it takes



24 Transcript of the June 21-22, 2011 FOMC meeting, p. 37. <https://www.federalreserve.gov/monetarypolicy/files/FOMC20110622meeting.pdf>

25 Janet Yellen, Post-FOMC Press Conference, June 14, 2017.

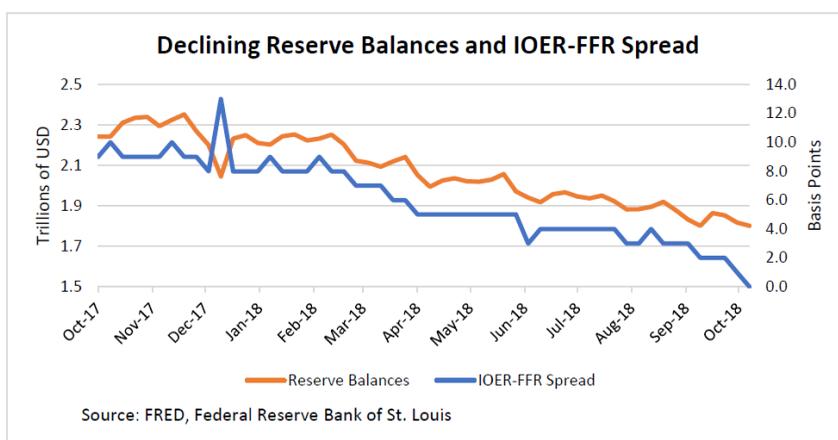
a huge balance sheet to push interest rates down to the floor, then the Fed will also have to be making huge interest payments to large and foreign banks and invite political inference. However, if B is relatively small, the political costs of a floor framework might be low.

There were good reasons to think that the minimum level of excess reserves consistent with a floor system would be low. As noted earlier, pre-crisis, banks in aggregate typically only demanded about \$2 billion in excess reserves, and when the supply of excess reserves exceeded demand by even a modest amount, interest rates would fall sharply.

On the other hand, there are now reasons to think that the level could be fairly high. As discussed above, banks now have to meet several new, stringent liquidity requirements. Moreover, banks' experiences during the financial crisis have likely led them to revise sharply upward their assessments of both the likelihood and costs of illiquidity episodes. As a combined result, banks are holding much larger stocks of liquid assets. For example, at the end of 2006, only ½ percent of bank assets were Treasury securities and virtually zero percent were excess reserves.

While no one knows the minimum amount of excess reserves that is sufficient to keep the fed funds rate at or below IOER, most market participants put the number significantly lower than \$1.8 trillion, where we are now. For example, in July of 2017, based on a survey of market participants, the New York Fed projected the Fed's balance sheet using a baseline assumption that excess reserves would settle at \$500 billion, with a range of \$100 billion to \$1 trillion. Using that range, the Fed expected to continue to reduce its holdings of securities until sometime in 2020 to 2023.

Consequently, the fact that the fed funds rate has risen up to IOER this year, suggesting that reserves are beginning to get scarce, has been surprising and likely unsettling for the Fed. While the funds rate had been about 9 bps below the IOER rate in the recent past, this year it has risen and now equals the IOER rate. Indeed, at the June meeting, the FOMC raised IOER only 20 bps while raising its target range 25 bps in order to keep the fed funds rate away from the upper end of the range, and it is expected to do so again at the December meeting. That behavior of the fed funds rate raises the possibility that we are really at point C, not C', raising the possibility that the Fed may have to stop shrinking its balance sheet much sooner than it had anticipated.



It is possible, however, that the decrease in the fed funds – IOER spread reflects only a transitory squeeze, and that excess reserves can fall considerably further and remain consistent with a floor system. The banking system had to absorb a large decline in excess reserves in a short period earlier this year. In addition to the decline in excess reserves resulting from the shrinking of the Fed's securities holdings, the Treasury has increased its deposits at the Fed, with the combined result that excess reserves have fallen by \$350 billion so this year.²⁶ It may simply take some time for the relatively greater expense of excess reserves to lead to an adjustment in bank behavior, either substituting toward other forms of HQLA, increasing projected cash inflows by lending more overnight, or reducing projected cash outflows by terming out their borrowing beyond thirty days. Of particular importance is the willingness of banks to substitute Treasury reverse repos or treasury securities for excess reserves. If they are willing to do so for a small spread, then excess reserves can fall considerably further without pushing the fed funds rate above IOER.

²⁶ Because Treasury deposits are also a liability of the Fed, when they go up, commercial bank deposits (reserves) go down.

Adjustments on all those margins should allow banks to reduce their holdings of excess reserves without a permanent increase in the fed funds rate above IOER. That said, if the fed funds rate is edging up because banks simply have vastly higher precautionary demands for excess reserves now, then the Fed may, in fact, be approaching its minimum size consistent with a floor-based monetary policy implementation framework. Moreover, if the Fed continues to require banks to hold a fraction of their HQLA as excess reserves, then it will need to maintain a balance sheet that is large enough to provide the excess reserves it is requiring banks to hold, or LCR scarcity will drive money market term premiums up sharply.

NEXT STEPS

Because Chairman Powell indicated that the FOMC would be discussing its implementation framework this Fall, and the Committee did not do so in September (according to the minutes) it likely did so at its meeting on 7-8 November.²⁷

If so, the staff provided an extensive briefing with a variety of options and the Committee had a robust discussion. A summary of both will be included in the minutes of the meeting released on 29 November. In preparation for the meeting, Board staff conducted a survey of bank senior financial officers, the first since 1998, likely to gather information on banks' demand for excess reserves. Results of that survey will probably be released shortly after the minutes.

Even if the Committee concluded that the recent signs of tightness in money markets are not being caused by reserve scarcity, it may still have concluded that the possibility that they are near the inflection point in reserve demand is sufficiently serious that they must finally decide how they intend to implement monetary policy going forward. If so, they may have conducted a straw poll on a possible strategy and would vote on the final version in at the meeting on 18-19 December. That plan would be released immediately following the December meeting and discussed by Chairman Powell at the press conference.

If the Committee settled on a new implementation framework at its November meeting, it would necessarily be a floor framework because the Committee doesn't yet have the information needed to conclude that it would pursue a corridor system. In addition to oversupplying reserves, the plan could include changes to the Fed's target rate, such as opting for the New York Fed's new "overnight bank funding rate" or OBFR, which is broader than the FOMC's current target, the effective fed funds rate. The plan could also include changes to the discount window intended to reduce stigma or changes to reserve requirements.

Rather than make a final decision, however, the FOMC could indicate that it would, or would soon, pause the runoff of its portfolio so that it could gather further information on the demand for reserves. Such a determination could still be accompanied by changes to target rate, the discount window, or reserve requirements.

In any case, the Committee will very likely raise its target range for the fed funds rate 25 basis points, to 2.25-2.50 percent, but again only raise IOER by 20 bp, to 2.40 percent. As a result, the fed funds rate could rise as much as 10 bp above IOER but still be in the target range.

The Committee could also have decided in November that the Desk would conduct term repos over year-end to add additional reserves. Conditions in the market for reserves will become particularly tight around year-end because mid-December tax payments will drive the Treasury's deposit at the Fed up and reserves down. Such operations would call into questions the idea that a floor-based system can be implemented in a set-it-and-forget-it manner.

An interesting wrinkle is that a decision by the Committee to pause, or end, the runoff in its portfolio would decrease longer-term interest rates and so ease monetary policy. To offset that easing, it would need to tighten the federal funds rate a bit faster than otherwise, a prospect that it might not relish in the current political environment.

²⁷ Alternatively, the FOMC could discuss the framework at the meeting on 18-10 December, which is also in the Fall. However, past practice suggests that they would have a comprehensive discussion in November around a tentative proposal, and that they would vote on the proposal in December when it could be explained to the public at the press conference.