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The Federal Reserve's Long-Run Operating Regime¹

An essential policy choice in establishing a long-run operating regime is whether to *limit the supply of excess reserves* and operate on a steeper part of the demand curve for reserves, or to *supply a relatively larger quantity of excess reserves* and operate on a flat part of the curve. If the Federal Reserve supplies abundant excess reserves, it will – as it does today – primarily influence market interest rates by adjusting the administered rates on its liabilities, including the interest rate on excess reserves (IOER) and the overnight reverse repo (ON RRP) rate. In this regime, money market rates would generally remain close to IOER. By contrast, if the Federal Reserve supplies a limited quantity of excess reserves, it will primarily influence market interest rates by frequently adjusting the supply of reserves, and money market rates would be expected to trade significantly above IOER at a level determined by the FOMC.²

Whether excess reserves are abundant or limited, total reserves will be substantially higher than before the financial crisis. The largest banks now maintain substantial buffers of reserves and other liquid assets to satisfy internal liquidity needs and regulatory ratios.³ As a result, banks' demand for reserves now reflects, in part, internal assessments of their need for liquidity to meet stress outflows.⁴

Obtaining estimates of how high the level of reserves needs to be to satisfy bank demand is very difficult given structural changes in the financial system since the crisis and the likelihood that financial markets will continue to evolve. An approach that staff have used to establish an initial estimate of reserve demand is to directly ask a sample of banks for their individual minimum reserve levels, conditioned on different

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² In either case, the FOMC also influences market rates by communicating a policy target. This memo focuses on the influence of the Federal Reserve's implementation tools.

³ Among others, the liquidity coverage ratio (LCR) requires large banks to hold an amount of high-quality liquid assets (HQLA) sufficient to cover outflows in a 30-day stress scenario.

⁴ Internal liquidity stress tests include assessments of banks' ability to monetize non-reserve forms of liquid securities to meet stressed outflows. Constraints on this ability could come from credit limits for repo or limits to market size and depth for sales. Banks' reserve demand would be more sensitive to relative returns if they considered reserves and highly liquid securities as close substitutes than if they thought it could be difficult to rapidly monetize large quantities of liquid securities.

configurations of market rates⁵ Starting with the current configuration, where market rates are very near IOER, adding up the individual responses, and scaling the sample to represent the banking system as a whole gives an estimate of around \$800 billion. When the question is asked with a configuration of market rates roughly 50 basis points above IOER – a configuration that might prevail in a regime of limited excess reserves – the estimate is around \$700 billion. As a reference, in the last Desk surveys to ask dealers and market participants about estimates of longer-run aggregate reserve demand, the median response was \$750 billion. By contrast, total reserve balances averaged approximately \$10 billion in 2006.

Staff strongly caution against putting too much faith in these numbers. To start with, there is the usual sampling error in any survey. In addition, particularly with estimates for a regime of limited excess reserves, there is tremendous uncertainty as to how banks' business models would change in response to a remuneration rate on excess reserves far below market rates. In the staff's view, it is likely that business models would adjust over time in such a way as to lower the demand for reserves substantially below \$700 billion. Further, details of an operating regime that would produce interest rate control with IOER 50 basis points below market rates would still need to be determined. Such a regime would likely require more regularized, larger operations conducted with a wider range of counterparties than has been the Desk's past practice. We do not know how such an operating regime would affect banks' business models and their demand for reserves.

In a system with abundant excess reserves, monetary policy would be conducted on the flat part of the demand curve, with IOER set close to the policy target rate as it is now. In this regime, the level of reserves would depend on the demand for reserves and on the additional buffer of reserves supplied to limit the potential for volatility in money market rates. This buffer would accommodate both variation in the Federal Reserve's non-reserve liabilities, which could otherwise reduce reserve supply to a point of scarcity, and an allowance for the possibility that some banks might accumulate more than their minimum reserve demands. One initial staff estimate of the size of this buffer is \$200 billion, though it could be reduced by changing policies for the Federal Reserve's non-bank account holders.^{6,7}

⁵ These estimates are based on the Senior Financial Officer Survey (SFOS) conducted in August 2018. Please see the Appendix for a summary of the calculations.

⁶ These non-reserve liabilities primarily consist of currency and accounts held by the Treasury and foreign official institutions. Movements in these liabilities are typically referred to as "autonomous factors," as they affect the supply of reserves to the banking system. More information is available in the Appendix.

⁷ In a limited excess reserves regime, the Desk would conduct open market operations (OMOs) to offset changes in other non-reserve liabilities rather than providing a standing buffer. These OMOs would result

Both for a regime of abundant excess reserves and for one of limited excess reserves, there is considerable uncertainty about how efficiently the wholesale money markets will be able to distribute reserves to the banks that value them most, given the impact of new regulations and the experience of the financial crisis on banks' appetite and incentives to engage in interbank borrowing and lending. In an abundant excess reserves regime, less efficiency would require a higher buffer of additional reserves, perhaps an additional \$100 billion; in a limited excess reserves regime, it would lead to larger operations for any given desired degree of interest rate control.

On net, staff estimates based on the bank survey responses and buffers for variability and redistribution add up to about \$1 trillion in reserves in a system of abundant excess reserves, or about \$300 billion higher than the estimate of reserve demand with limited excess reserves and IOER 50 basis points below market rates. However, as noted earlier, the survey responses need to be treated with caution. Banks' reserve demand might turn out to be more sensitive to interest rate differentials than suggested by the survey, and it is possible that redistribution of reserves through the banking system will not be much reduced by the structural changes since 2007, in which case the banking system might need substantially smaller levels of reserves. Conversely, lower interest rate sensitivity or reduced willingness to engage in interbank transactions would raise the level of reserves needed.⁸

The evolution of money markets as the Federal Reserve's balance sheet continues to shrink will provide signals about the location of the demand curve and help to reduce the uncertainty about reserve needs in different operating regimes.⁹ However, sustained changes in the levels of money market rates would be necessary to reveal how many reserves banks would demand in the long run in an environment with market rates above IOER.

The remainder of the memo reviews the risks and rewards associated with supplying limited or abundant excess reserves, focusing in each case on the implications for interest rate control and the target interest rate; policy space; money market activity; the Federal Reserve's interest expense; and liquidity provision for the financial system.¹⁰

in an increase in non-currency liabilities, and, at times, aggregate liabilities could be similar to those in a regime with abundant excess reserves.

⁸ The Appendix uses the individual responses to the SFOS to give some possible ranges for how big this variation might be.

⁹ Please see the memo titled "Recent Developments in Reserve Markets and Understanding Reserve Demand" for details on these signals.

¹⁰ We assume that the counterparties eligible to receive interest on reserves, the structure of the discount window, and the collateral eligible for liquidity provision remain the same as at present in both regimes.

This memo builds on 2016 staff work on the long-run monetary policy implementation framework, and those materials are available for deeper reference on some issues.¹¹

A Regime of Limited Excess Reserves

Interest rate control and the target interest rate: The choice of operating regime has important implications for the choice of a policy rate. Any market overnight interest rate consists of the risk-free overnight rate plus a relative price that reflects particular characteristics of that rate, and operating regimes differ in their ability to influence the relative price component of market rates.¹² In a regime with limited excess reserves, the Federal Reserve influences money market rates primarily by changing the supply of reserves, thus increasing or decreasing the scarcity value of reserves relative to other overnight instruments. It is therefore natural for the target interest rate in a regime with limited excess reserves to be the price for reserves in the interbank market, such as the effective federal funds rate (EFFR), or if a broader measure of unsecured bank funding costs is desired, the overnight bank funding rate (OBFR). The memo on “The Federal Reserve’s Target Interest Rate” provides further detail on these considerations.

The operational approach in this regime would be conceptually similar to that used before the crisis: adjust reserve supply relative to demand to achieve the FOMC’s target rate. By operating on the steep part of the reserve demand curve, small changes in supply would have a predictable effect on overnight interbank rates, and remunerating excess reserves at a lower rate than required reserves would encourage banks to economize on their excess reserve holdings.¹³

Prior to the crisis, this regime maintained good monetary control, albeit with a high degree of operational complexity.¹⁴ However, since the financial crisis, the sources of demand for reserves have fundamentally changed and have become both more complex and more heterogeneous across banks. In the new environment, with reserve demand being importantly influenced by banks’ assumptions about stress outflows and limits to monetization of their securities holdings, it is less certain that reserve demand could be reduced to a low level or that it would be stable enough to be able to maintain rate control.

¹¹ Please see the memo titled “Interest Rate Targets and Operating Regimes,” October 14, 2016.

¹² Relative price characteristics of a market rate include risk premia, the abundance or scarcity of assets financed at the rate, and the bargaining power of participants in the particular market.

¹³ For purposes of our analysis, we assume that IOER is set at a level approximately 50 basis points below interest on required reserves (IORR). In practice, this spread could be higher or lower. Before the crisis, reserve balances were unremunerated, implying that the opportunity cost of holding excess reserves was roughly equal to the target rate.

¹⁴ Reserve requirements and contractual clearing balances set a predictable level for reserve demand over the maintenance period, and reserves averaging provided banks some flexibility, which stabilized rates.

To the extent that banks' reserve demand is interest rate sensitive, the difference in remuneration between required and excess reserves could encourage banks to economize on reserve balances, especially over the longer term.¹⁵ Whereas certain securities and excess reserves have equal treatment in some contexts, such as the liquidity coverage ratio, banks may view them as imperfect substitutes in other contexts, for example if there are limits on their ability to monetize securities in a stress scenario, making banks less sensitive to return differentials.^{16,17} In the recent survey of banks, the level of return sensitivity in demand seemed both heterogeneous across banks and, in aggregate, relatively low.¹⁸ However, over the longer term, banks would likely adjust their balance sheets to respond more strongly and uniformly to the incentives provided by lower IOER levels, but the degree and predictability of this adjustment are difficult to assess.

Even if demand could ultimately be reduced to a low level, the predictability of that demand is uncertain. Individual banks' liquidity-driven reserve demand is likely to be stable on most days, but on any given day, some banks could make changes to their business lines, funding models or liquidity portfolios that would change their desired level of reserve holdings. Given the likely steepness of the demand curve, an inability to predict these shifts could make it difficult to provide the appropriate level of reserves, resulting in heightened volatility in interest rates. On the other hand, such shifts could be rare or sufficiently anticipated that the Desk could appropriately adjust reserve supply in response. These dynamics create uncertainty about whether reserve demand could be forecast with sufficient accuracy to meet a target rate – particularly during the transition to a regime with more limited excess reserves – and about how effectively policy could be implemented in such a regime in the longer run.¹⁹

Policy space: Returning to an operating framework similar to that used before the crisis could increase confidence in the Federal Reserve's ability to unwind unconventional monetary policy tools, which could ease public concern about the future

¹⁵ At a 50 basis point spread of IOER to market rates, each \$10 billion of excess reserves would cost banks \$50 million per year, providing a significant motivation to reduce reserve holdings.

¹⁶ Securities issued by the U.S. Treasury or by a U.S. government agency whose obligations are explicitly guaranteed by the U.S. government receive no haircut in the LCR calculation.

¹⁷ Reclassification of required reserves as HQLA could provide an overall higher level of HQLA for the same level of liquidity.

¹⁸ The SFOS asked banks about their minimum comfortable reserve levels at different spreads to IOER. Please see the memo titled "Recent Developments in Reserve Markets and Understanding Reserve Demand."

¹⁹ From 2006 to 2009, the Bank of England (BoE) employed voluntary targets to create a stable reserve demand at levels determined by banks. However, this tool is untested in the United States, and the BoE has indicated that it is "minded to" continue a system of abundant excess reserves for future implementation. Please see the memo titled "Future Plans for Monetary Policy Implementation at the Bank of England and European Central Bank."

deployment of such tools. However, from a purely economic perspective, limiting the supply of reserves does not itself provide greater capacity for the Federal Reserve to stimulate the economy by purchasing longer-term assets. This capacity depends on the quantity of longer-term assets on the balance sheet, which can be managed independently of the quantity of reserves in a regime of either limited or abundant excess reserves.²⁰

Money market activity: The pre-crisis operating framework featured an active interbank market because banks had strong incentives to redistribute reserves to the firms that valued them most on any given day.²¹ This activity provided some information on liquidity conditions facing banks. Interbank overnight trading nearly disappeared once reserves became abundant in late 2008. Although interbank trading could revive if the Federal Reserve were to return to a system of limited excess reserves, post-crisis regulations have encouraged banks to reduce their reliance on overnight unsecured funding. Banks might now prefer to use term and secured markets to redistribute reserves.²²

Federal Reserve interest expense: The payment of interest on reserves (IOR) is an important tool for monetary policy implementation even in regimes with limited excess reserves, as it strengthens monetary control by limiting the opportunity cost to banks of holding required reserves.²³ Although interest expense on Federal Reserve liabilities is more than offset, under nearly all circumstances, by interest income on the assets held, the total amount of interest expense may be of independent concern.

Given the overall increase in reserve demand since the financial crisis, IOR payments are likely to be notable even in a system of limited excess reserves. If the rate paid on required reserves equaled the policy target and IOER were set roughly 50 basis points lower, then based on the range of staff estimates for reserve demand given in the Appendix, and using the long-run target rate of 3.0 percent from the September 2018 Summary of Economic projections, the interest expense on reserves might be in the range of \$10 billion to \$30 billion a year. Of course, if reserve demand diminished further over

²⁰ The Committee could choose, for example, to hold primarily short-term assets against reserves in normal times and move to a longer-duration portfolio when needed to ease financial conditions.

²¹ Lack of remuneration on reserve balances gave banks their main incentive to redistribute excess reserves.

²² See Kyungmin Kim, Antoine Martin, and Ed Nosal, 2018, “Can the US interbank market be revived?,” manuscript, Federal Reserve Banks of Atlanta and New York and Board of Governors.

²³ The proposal to pay IOR was initiated prior to the financial crisis when the Federal Reserve operated with scarce reserves. Banks had been using sweep accounts and other mechanisms to reduce reservable deposits, resulting in very small required reserve levels relative to the overall size of the banking system. Policymakers believed that, by alleviating the opportunity costs of holding reserves, they could mitigate reserve avoidance behaviors and broaden the base of required reserves. Other major central banks, including the BoE, European Central Bank, and Bank of Japan, use remunerated reserves both in environments of limited excess reserves and environments of abundant excess reserves.

time in the face of a significant opportunity cost of holding reserves, so too would interest expense.

A benefit of a regime with limited excess reserves is that money market rates are expected, on average, to trade close to the interest rate on required reserves and well above the interest rate on excess reserves, suggesting little, if any, premium paid to banks on reserves over other money market assets.

Liquidity provision: Banks rely importantly on holdings of reserves for both payment and precautionary liquidity purposes. A regime of limited excess reserves would reduce banks' ability, in the aggregate, to rely on reserves for precautionary liquidity purposes and would require them to rely more on other forms of high-quality liquid assets (HQLA). In addition, to the extent that banks operate with significantly lower levels of reserves, payment activity could occur later in the day.

Offsetting these considerations, in a system with limited excess reserves, banks clearly desire to hold at least the quantity of reserves supplied given that, on the margin, reserve holdings have an opportunity cost represented by the spread of market rates over IOER. This situation is in contrast to a system with abundant excess reserves, in which market interest rates may need to fall below IOER in order to induce banks to hold the quantity of reserves that the central bank supplies.

Because a system with limited excess reserves operates on the steep part of the demand curve, it is not robust to large injections of liquidity during times of stress, either through facilities or in connection with asset purchase programs at the effective lower bound (ELB). These liquidity injections must be sterilized to maintain interest rate control, which proved challenging in the financial crisis. On the other hand, the drop in rates that results from liquidity injections might be viewed as an appropriate monetary policy response to a shock rather than as a problem that needs to be solved, and at the ELB it would be possible to transition to a regime of abundant excess reserves. However, if the policy target were still above the ELB, allowing rates to drop below that target could signal increased concern by the Committee about financial and economic conditions, and could create greater uncertainty and volatility in financial markets.

A Regime of Abundant Excess Reserves

Interest rate control and the target interest rate: The essence of monetary control in a regime with abundant excess reserves is that the Federal Reserve changes administered rates on its liabilities, which then influence other overnight rates roughly equally through arbitrage and have little effect on spreads between rates. Most central banks that operate with abundant excess reserves convey the stance of policy in terms of

their administered rates – often the interest rate on reserves – rather than targeting any single market interest rate. However, in the U.S. system, although the FOMC determines the appropriate stance of policy, it does not set the level of interest on reserves. This governance structure may make it more appropriate in the United States to communicate the stance of policy by other means, such as by setting a range for a particular market rate or for the general level of short-term market rates. Consistent with current practice, the interest rate on reserves would be the primary tool to influence overnight market rates to achieve that stance, and supportive tools, such as the overnight reverse repo facility, could help maintain rates within desired ranges.²⁴

The Federal Reserve now has many years of experience implementing monetary policy in an abundant excess reserves regime in the post-crisis regulatory environment, with successful rate control. Arbitrage has worked well to transmit the administered interest rates to other rates even as new regulations have reshaped money market activity. With abundant excess reserves, the Federal Reserve operates on the flat part of the demand curve for reserves, where the shape has been generally well known, and there is less need to resolve uncertainty about the shape of the steeper part of the curve.

Operating on the flat part of the reserve demand curve can also simplify the operational infrastructure for controlling interest rates. There would be little need to use reserve requirements for monetary policy implementation. In addition, based on past experience, the system can accommodate larger and more volatile autonomous factors, because changes in reserve supply do not move interest rates.

Policy space: The provision of abundant excess reserves need not materially change the term premium or the natural rate of interest. These effects depend on the quantity of longer-term assets on the Federal Reserve’s balance sheet, which can be managed independently of the choice of reserve supply, because in principle the reserves could be backed by shorter-dated securities such as Treasury bills. Nor would the provision of abundant excess reserves necessarily reduce the scope for the Federal Reserve to stimulate the economy by purchasing longer-term assets, as this stimulus could be achieved by exchanging the shorter-term assets for longer-term ones.

²⁴ In targeting the general level of interest rates, the Committee could communicate its intended stance of policy by setting a range for short term rates, and then could choose to communicate about the effectiveness of implementation through an index of such rates or more generally. If policymakers preferred to target a single rate in a regime with abundant excess reserves, a variety of options would be available, although targeting any single rate would make the regime dependent on that rate’s robustness and consistency. The memo titled “The Federal Reserve’s Target Interest Rate” provides further detail on these considerations.

Money market activity: Environments of abundant excess reserves tend to reduce the need for overnight interbank trading, as most banks have sufficient reserves to withstand payment shocks. Interbank trading today represents only about 5 percent of measured federal funds volume. Nonetheless, wholesale deposit markets have remained active because the non-bank sector continues to place deposits with banks. In 2018 through September, non-interbank unsecured deposit activity has averaged \$80 billion per day in federal funds and \$85 billion per day in Eurodollars. In addition, preliminary results based on data that the Federal Reserve began collecting data in October suggest that onshore wholesale deposits could represent about an additional \$50 billion, on average, per day. This wholesale activity can provide a similar window on bank funding conditions as the interbank market did in the past.²⁵

Federal Reserve interest expense: Interest payments on reserves are larger in a regime of abundant excess reserves than in one of limited excess reserves, although the difference in interest expense would typically be more than offset by the additional income on assets. The increase in interest payments with abundant excess reserves comes mainly from the interest paid on the excess reserves supplied, and secondarily from remunerating the entire stock of reserves at the policy rate rather than remunerating a portion at a lower rate as in a regime of limited excess reserves. Based on the range of staff estimates for reserve demand detailed in the Appendix, and using a long-run policy rate of 3.0 percent from the September 2018 Summary of Economic projections, the interest expense on reserves would be in the range of \$20 billion to \$40 billion a year.

In an abundant excess reserves regime, interest payments would likely be – as they are now – concentrated in certain banking sectors. Currently, holdings of reserves are highly concentrated in foreign banking organizations (FBOs), which have lower balance sheet costs, and in the largest money-center banks. As of early October, FBOs held 37 percent of total reserves, and the eight largest domestic holders held almost 40 percent. As total reserve balances diminish, the reductions will likely come disproportionately from the current largest holders, reducing the concentration of reserve holdings and interest payments. Nonetheless, more concentration would likely still remain in a system with abundant excess reserves than in one where excess reserves were limited and, hence, incentives to redistribute were stronger. The concentration of reserve holdings could create the perception that interest payments on reserves disproportionately favor certain bank sectors.

²⁵ Nonetheless, wholesale unsecured activity may be somewhat vulnerable to shifts in investor behavior or regulations, as demonstrated by the drop in Eurodollar volume during 2016 when implementation of money market mutual fund reform resulted in investors shifting from funds that invest in wholesale deposits to funds that invest in repo.

Liquidity provision: In an environment of abundant excess reserves, banks would have access to plentiful reserves to accommodate stress liquidity flows. These reserves could be an important cushion against shocks during times of systemic stress, as they would reduce the need for the banking system as a whole to rapidly convert securities holdings to reserves, and might decrease reliance on central bank facilities.

In addition, a regime with abundant excess reserves is robust to large injections of liquidity during times of stress, either through facilities or in connection with asset purchase programs at the effective lower bound.²⁶ Such regimes allow for the separation of liquidity provision and interest rate policy, which provides more flexibility to respond to stress conditions.

Nonetheless, operating with abundant excess reserves may require banks to hold more reserves relative to other assets than they would demand if all overnight risk-free assets had equal yields. Some evidence of this can be found by looking at the rate on alternative risk-free assets relative to the rate paid on reserves. From 2008 to early 2018, for example, Treasury bill yields were consistently below IOER, indicating that Treasury bill yields had to fall in order for banks to be willing to hold the aggregate quantity of reserves supplied relative to the stock of Treasury bills. These effects are likely to be minimal; however, if the Federal Reserve reduces excess reserve balances to the lowest levels consistent with operating on the flat part of the reserve demand curve.

²⁶ Most central banks that have implemented negative rates did so in environments of abundant excess reserves, although it is possible to implement negative rates with limited excess reserves. The Swedish Riksbank implemented negative rates in a structural surplus corridor framework with draining operations.

Appendix

The Senior Financial Officer Survey (SFOS), conducted in August,²⁷ can broadly inform estimates of the aggregate demand for reserves, albeit with a wide band of uncertainty around those estimates. We note, though, that banks have been operating in an environment of abundant reserves for many years. They themselves express some degree of uncertainty about the ultimate shape of their reserve demand and expect that it will evolve over time, perhaps due to potential changes in regulations, the payments system, or their business models. As such, banks' eventual behavior could differ considerably from what they predicted in the survey. Although observing banks' reaction to declining reserve balances will be informative, some uncertainty will likely persist due to variation in banks' business models and liquidity assumptions.

Limited Excess Reserve Regime: We benchmarked the likely quantity of total reserves in a limited excess reserves regime by assuming that the Federal Reserve would set IOER at 50 basis points below the target rate and that other money market rates would be maintained roughly around the target rate. Aggregating respondents' reported lowest comfortable reserve levels in this rate scenario and then estimating the demand of the remaining population by assuming that each non-responding bank's ratio of reserves to assets is equal to the ratio for similar banks in the survey, we estimate total reserve demand of \$700 billion.²⁸

One source of uncertainty is the potential differences in behavior of banks that are not in the survey. More importantly, even the banks in the sample might ultimately behave differently than they reported in the survey. As a result, the average responses could either overestimate or underestimate banks' true demand for reserves. In particular, there is substantial uncertainty about the interest rate spreads that would induce banks to satisfy HQLA requirements by holding Treasury securities in place of reserves, or by shifting to more stable liabilities that permit smaller holdings of HQLA. If the 25th or the 75th percentile of survey responses is more representative of how banks will ultimately respond, then aggregate reserves in a limited excess reserves regime could range from \$400 billion to \$1,200 billion.²⁹

²⁷ Please see the memo titled "Recent Developments in Reserve Markets and Understanding Reserve Demand" for background on the SFOS.

²⁸ The survey respondents held roughly \$1.3 trillion of reserves at the time of the survey, representing approximately 67% of the reserve holdings in the banking system.

²⁹ Lower reserve balances might be possible if IOER were set more than 50 bps below the target rate. The SFOS did not ask about reserve demand at larger spreads to IOER. Please see the memo titled "Recent Developments in Reserve Markets and Understanding Reserve Demand" for details on the weighting procedure used in these calculations.

Abundant excess reserves regime: We assume that the configuration of money market rates relative to IOER in this regime would be broadly in line with that observed in August of this year. The weighted total reserve demand of SFOS respondents in this scenario is \$800 billion. While total reserve demand would only be \$500 billion assuming that banks at the 25th percentile of the survey are representative of future demand, it can be as high as \$1,300 billion under the assumption that banks at the 75th percentile are the best representatives.

Additional reserves above banks' demand would be required to remain on the flat part of the demand curve. The size of the reserves buffer for this purpose would rely importantly on expected volatility in autonomous factors and banks' reserve demand as well as a cushion for potential uneven distribution of reserves.

Volatility in autonomous factors has grown significantly since the crisis, due largely to growth in Treasury and foreign official institution accounts. The size of the buffer needed to accommodate fluctuations in these factors depends on the operational framework for providing reserves. Should a regime be implemented that provides reserves frequently or as demanded by banks, there could be less need to accommodate volatility in these factors with a reserve buffer.³⁰ However, should policymakers choose a regime in which they operate somewhat less frequently, a buffer of, on average, \$100 billion would be sufficient to accommodate fluctuations, based on the variability observed in recent years. The size of the buffer would be influenced by seasonal variation and uncertainty associated with reserve projections; it might also be lower if the Federal Reserve adopted policies to limit the variability of the foreign repo pool or coordinated with the U.S. Treasury to reduce the volatility of the Treasury General Account.

In addition, in an environment where reserves are remunerated at market rates, the incentive to economize on reserves is weak. Some banks could persistently hold more reserves than their minimum demands and be less willing to lend them at modest spreads to IOER. Staff estimates that a buffer of up to \$100 billion is required to accommodate such distributional issues and to ensure that uncertainty about the exact location of the demand curve on each day does not result in inadvertently supplying too few reserves to remain on the flat part of the curve. This buffer would likely be needed only at lower levels of reserve demand, as higher overall levels would suggest that banks were already building a distributional buffer into their minimum reserve levels. Combining these two buffers with the estimates of reserve demand, a central estimate for aggregate reserves in a regime of abundant excess reserves is \$1,000 billion, with a range of \$700 billion to \$1,400 billion.

³⁰ Because banks would not have visibility into or control of autonomous factor changes, on-demand facilities to offset these fluctuations would have to be available frequently.