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Market Liquidity Risk and the Role of Fed Interventions

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1. Introduction

Liquidity risk generally refers to two types of risks: liquidity trading risk (as known as market liquidity risk) and liquidity funding risk.

Market liquidity risk occurs when there is a cost of trading for a market participant to execute or liquidate an asset within a reasonable amount of time at a fair value. The fair value is determined by the mid-price, set at the middle of the bid-ask spread and most objective but fluctuates vigorously (Stange& Kaserer, 2009).

Liquidity funding risk is the loss incurred when the bank cannot fund the needed cash or settle obligations. The main parties involved in liquidity risk and fed interventions are the buyers who buy the financial assets, including the depositors, the sellers that sell the assets, the market maker such as dealers and brokers, and the federal reserve as the policymaker and regulator.

Funding liquidity is one of the primary drivers of historical banking crises (Drehmann & Nikolaou, 2013). There is a close relationship between trading risk and funding risk, reinforcing each other in liquidity spirals. When banks incur a funding risk, they can neither fund their liquidity needs nor their clients. Inadequate funding leads to less trading, which reduces market liquidity, increases margins, and tightens risk management, thus further worsens funding, and so on. As market liquidity risk is one of the most significant drivers of security prices, risk management, and arbitrage speed, the most extreme form could be dealers' shutting down.

Examples of the liquidity risk's disastrous effect include the financial crisis around 2007-2008, the market meltdowns in the repo market in Sep 2019 and the COVID-19 pandemic. Liquidity crises can also induce and exacerbate severe and widespread recessions, such as the crises in 1930 and 2008 (Lucas,Robert Jr.& Stokey., 2011).

This report analyzes some recent financial market crises resulting from the effect of liquidity risk. We introduce the market nature and mechanism during the crises and discover the major problems, conflicts and causes. We also provide our insights and recommendations to the government and Fed Reserve facilities to prevent a recurring liquidity crisis in the future.

Literature

The report relates to further strands of the theoretical and empirical literature on liquidity risks and Fed interventions, starting from Stange and Christoph (2009), which defines liquidity risk as the potential loss of the liquidity cost at varying times. A few empirical papers have effectively shown that liquidity risk is a significant component of the market risk, especially when only the bid-ask-spread level is considered. Le Saout (2002) reveals that more than half of the total risk for illiquid stocks could be explained by the bid-ask liquidity component, while Lei and Lai (2007) find liquidity contributes to 30% of the total intraday risk in low price stocks.

Our report is composed based on the literature discussing the financial crises in the U.S. market after 2000. Bordo (2008) suggests that the financial crisis of 2007-2008 occurred following two years of rising policy interest rates, started in the U.S. with the collapse of the subprime mortgage market at the beginning of 2007 due to liquidity funding risk and developed to a global recession. The Fed Reserve and other central banks came up with a classical response of injecting liquidity into the financial markets. Bordo (2008) also concludes that the Fed expanding services to most financial institutions in panics is essential, and the faster the response, the better. In September 2019, the U.S. money market, especially the repo market, experienced severe upward pressure on several rates unexpectedly. Even though the drop in reserves due to the corporate tax date and increase in the Net treasury was seasonal and expected,

the extent of the rise in rates was pretty surprising. Anbil, Anderson, and Senyuz (2020) conclude the Fed's response; it lowered two administered rates below the bottom of the target lines cooperating with the conduct of an overnight repo operation that provided hundreds of billion dollars in the market. To further boost the trading volumes, the Fed also announced it would purchase about $60-million T-bills per month. Those actions successfully stabilized the market. However, Boyson, Helwege, and Jindra (2014) points out that simply providing liquidity may be insufficient to solve the underlying conflicts and avoid a recurrence without understanding the disruptions' underlying cause. Hu and Zhang (2020) analyze the role and performance of a unique monetary program, Term Auction Facility, during the financial crisis by models. We would further investigate it in our report.

The rest of the paper is organized as follows. Section 2 introduces the 2019 Repo Crisis and the Fed intervention, cooperating with some analysis over the 2007-2008 Global Financial Crisis and COVID-19. Section 3 assesses the Fed interventions to control the crises. Section 4 provides our recommendation of the Standing Repo Facility by analyzing its effectiveness and challenges. Section 5 concludes our report. The appendix contains a related table.

2. Analysis of 2019 REPO Crisis

2.1 Background

There are three sources of short-term funding for banks to meet the reserve requirement, the federal funds market, the discount window, and the repo market.

Banks are required to hold a certain amount of federal funds as reserves in their Federal Reserve accounts each night. The federal funds market is where banks with excess reserves lend to another bank that cannot meet the requirement at the end of the day. Most of the transactions are conducted in the overnight setting and do not require collaterals. Lenders will charge an interest, known as the fed funds rate, which has a target range set by the Federal Reserve Open Market Committee (FOMC)[1]. In 2019, the rate was targeted between 2% and 2.5%. The specifics are included in the **Appendix 1**. In addition to the fed funds market, banks can directly borrow from the Federal Reserve through the discount window. The Fed charges a discount rate as the interest rate, which is usually higher than the fed funds rate to encourage interbank transactions. Collaterals are also required by the Fed to grant loans to the borrowing banks. The discount window usually acts as the last resort. With control in the fed funds rate, discount rate, and reserve requirement, the Fed ensures a certain degree of liquidity in the market.

In short, a repo market is where financial institutions can obtain overnight funding from each other through pledging liquid collaterals like securities. A repurchase agreement is signed when the institutions with financing needs sell securities to another institution and agree to purchase those back for a higher price on a specified later date, typically overnight in the U.S market (Cheng & Wessel, 2020). It's similar to a short-term collateralized loan, where the difference between prices consists of the interest paid on that loan, known as the repo rate. The repo rate is usually in line with the Fed's benchmark funds rate. The repo market is necessary for keeping these banks solvent and satisfying their regulated reserve requirements. Also, it allows them to earn small returns on cash without significant risks since the collateral is often U.S.

[1] The Federal Reserve Open Market Committee (FOMC) is a subsector of the Federal Reserve System that has power of conducting monetary policies. They announce decisions regarding the target interest rate range at its regular committee meetings.

Treasury securities. Statistics show that the U.S repo market finances around $2 trillion to $4 trillion of debts on a daily basis, contributing to the overall health of the financial system (Foster, 2020). The repo market reinforces the connection between funding risk and trading risk when in turmoil, which we will examine in the following 2019 repo crisis analysis.

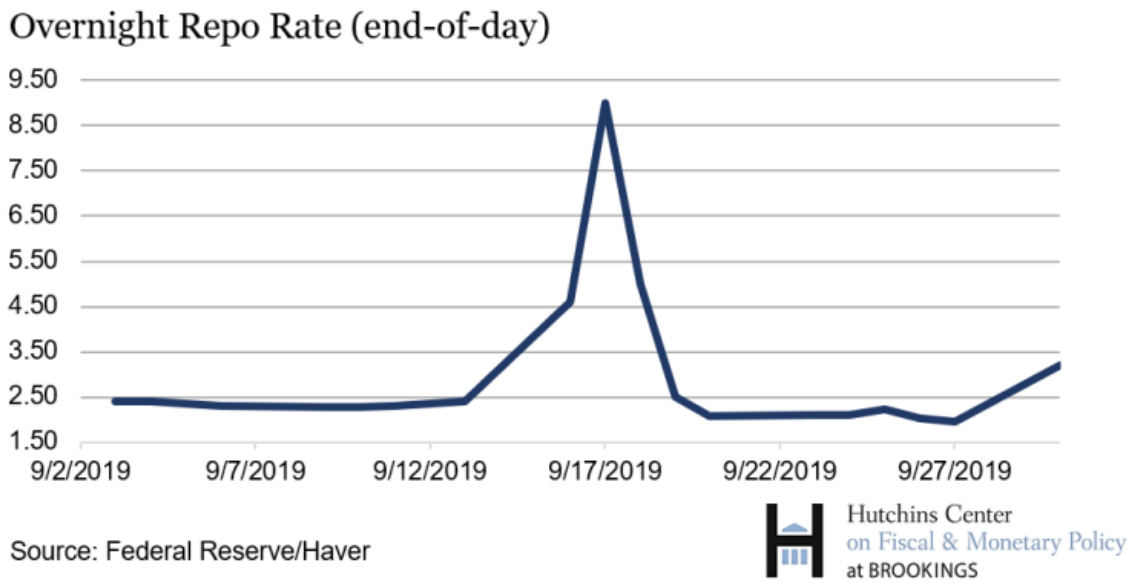

Figure 1. Overnight Repo Rate in U.S (2019)

2.2 What Happened

In mid-September 2019, there was a liquidity crisis in the U.S overnight market. A credit crunch emerged on September 16, resulting from sudden funds shortages. Banks were unwilling to lend because they worried about defaults, thus demanding higher return in the repo market. As shown in **Figure 1**, the repo rate surged to 10% on September 17, which is about five times larger than the target rate. Other lenders in the money market funds quickly followed and pushed the interest rates, resulting in a spike in funding costs. Banks were reluctant to lend at the 2% target interest rate. Minimal activities took place in both overnight markets as the liquidity dried up between banks. To soothe the market, the Fed financed through offering 2% interest repos that injected 53 billion dollars of liquidity on September 17. Then it kept making new injections of liquidity every day, totaling 229 billion in January 2020. With the repo operations, the overnight rates stabilized over the remaining week and fell back to the target range. In this event, the funding risk dominated while Fed's quick intervention minimized the impact of trading risk.

The 2019 repo crisis's primary frictions are interbank. Financial institutions with excess reserves were unwilling to lend, resulting in plummets in lending activities and a lack of liquidity in markets. Two main reasons led to the frictions. First, the sudden fund shortages and uncertain market conditions increase the level of information asymmetry in the market. Lenders are unsure about borrowers' capability to fulfill the obligations in short periods, which may lead to severe consequences for the lenders, such as increasing their possibility of experiencing a liquidity shortage for operation. Therefore, they tend to elevate the interest rates to compensate for the rising risks. Second, the strict supervisory factors and the internal risk management may exacerbate the friction. To avoid being unable to meet the requirement, banks acted more

conservatively to minimize the exposure to risks and consistently maintain the excess reserves. Correspondingly, the money market became even more illiquid.

2.3 Causes

Six factors may lead to the unexpected upward pressure on the overnight money market rates in the repo market on September 16. The tax payment and Treasury debt settlement were predictable to lead to a higher overnight rate, which resulted from the lower bank reserve. However, unwinding quantitative easing, regulatory factors, financial reporting and lower quality of collaterals exacerbated the volatility in the repo market, which may be considered as the real underlying reasons.

1. The corporations needed to withdraw the deposits from the commercial banks to fulfill their quarterly corporation tax obligations, which were due on September 16 (Anbil et al., 2020). The money for tax payment was transferred to the Federal Reserve and recorded on the Treasury's account. This led to the lower reserve in the commercial bank.

2. 54 billion of long-term Treasury debt were auctioned by the primary dealers and the transactions were settled on September 16 (Anbil et al., 2020). The financial institutions needed to pay a significant amount of cash to the Fed for buying the Treasury securities. Without enough liquidity, the financial institutions needed to fund through the repo market to complete the transaction. Therefore, combining the first two reasons, the banking system's reserve reduced 120 billion in two days, which increased the money demand dramatically.

The above reasons are apparent and foreseeable because the higher demand for money will increase the overnight rate in the repo market under a basic supply and demand model. However, they are not sufficient to explain the volatility in real-world data.

3. The unwinding quantitative easing in the previous years reduced the bank reserve that foreshadows this abnormal overnight money market rate. From the 2008 financial crisis, the Fed accumulated a huge reserve through the asset purchase program to conduct the quantitative easing policy. Since October 2017, the Fed started to reduce the holdings of securities by applying the balance sheet normalization program, which demonstrated an unwinding quantitative easing. The program reached the end in August 2019 and led to a continuous decline in the commercial banks' excess reserves (Afonso et al., 2020). Simultaneously, the treasury bond issuance was increasing, and the financial institutions as the primary dealers needed to fund the purchase through the repo market. Thus, given the Fed's policy changes, the commercial banks' reserves decreased, which introduced more pressure on the repo market when facing an additional treasury issuance.

4. Due to the strict liquidity capital ratio, some banks may not be willing to actively support the repo market when facing a liquidity shortage. In the recent year, with the introduction of the Liquidity Capital Ratio requirement, most commercial banks' ability to meet the short term obligations have improved. Typically, liquidity capital ratio (LCR) asks the banks to maintain enough high-quality liquid assets, which needs to equal to at least the projected cash outflows under the 30-day stress scenario designed by regulators. The LCR was introduced by Basel III that was reformed after the 2008 financial crisis. However, in order to maintain the required liquidity requirement, financial institutions may be less willing to lend in the repo market (Pan, 2019). Thus, this leads to higher volatility in the financial market.

5. Banks need to publish financial reports at the end of each quarter. They will be temporarily less willing to lend in the repo market at that time because it may reflect badly on the

financial performance with less liquidity on statements. The third quarter has a convention to end on Sep 30, which is close to the crisis.

6. Due to the Central Bank interventions in 2008, US government bonds were purchased massively by the Fed, which made them more difficult to obtain. Traditionally, the safest collaterals are US government bonds because they are guaranteed by the US government and are treated as risk-free securities (Groslin, 2019). Due to the less available volume, repo transactions start to use corporate bonds as the collaterals. However, corporate bonds typically have lower quality because of the potential default risk. Therefore, when facing an economic downturn, they will be less liquid and face a higher risk premium, which may cause market liquidity problems.

2.4 Fed Intervention

In order to control the abnormally high overnight rate, the Fed conducted a series of policies, which focused on the short horizon and relatively longer horizon, respectively.

In the short run, the Fed offered 2% interest on the short-term loans to deal with the serious cash crunch. Firstly, the Fed conducted overnight repo operations, which provided up to $75 billion funds against the Treasury and MBS collaterals (Anbil et al., 2020). This action successfully reduced the overnight rate because it brings $53 billion in additional reserves. The massive injection of money eased the severe situation by increasing the liquidity in the money market. It also enabled financial institutions to raise enough money to maintain the reserve requirement and reduce the cash crunch problem. Secondly, after controlling the circumstance, the Fed kept offering up to $75 billion in the repo market every day for the rest of the week. This action stabilized the overnight rate and gave the banking system a long time to adjust to the normal liquidity level. Combined with two actions, the overnight rate became less volatile, and the federal fund rates returned to the target range.

In the long run, the Fed announced the changes of interest rate on excess reserves and conducted long-term repo operations to prevent this problem. Firstly, the Fed reduced the interest rate on excess reserves by 20 basis points, which directly lowered the risk that the federal funds rate becomes higher than the target range (Anbil et al., 2020). Secondly, the Fed extended the short-term repo operations that it promises to purchase the Treasury bills by $60 billion per month until at least the second quarter of 2020. This action ensured that the reserve supply is adequate to face unexpected pressures on the future money market.

2.5 Empirical Evidence

In the past crises, we can always find the involvement of liquidity risks in the financial markets, soothed by various Fed interventions. Here we will discuss two notable events, the 2008 financial crisis, and the recent COVID-19 crisis. For each empirical evidence, we will analyze the events in terms of funding and trading liquidity risks and then compare the Fed interventions.

2.5.1 2007-2008 Global Financial Crisis

The financial crisis in 2007-2008 is a classic example to demonstrate the downward liquidity spiral. It started with the collapse of the subprime mortgage market. As foreclosure and the supply of houses increased, the real estate bubble burst and millions of mortgage loans became non-performing. Consequently, the MBS packages that were previously thought to be safe began to be viewed as risky. Subprime lenders stuck with the MBS packages and were unable to liquidate them. Trading risks were amplified since most financial institutions like investment banks and commercial banks have been exposed to these illiquid packages. Banks

suffered from massive losses, and the credit crunch took place. Short-term creditors, financial firms, and primer brokerage services all became reluctant to provide funding to the banks, leading to massive bankruptcies. The interbank funding market was also under predental pressure; thus, the liquidity in markets has almost dried up. Meanwhile, investors in aggregate began to shift their asset allocation away and resulted in bank runs, which can be described as liquidity stress in the economy.

The Fed implemented various interventions to flood the market with liquidity and prevent the recurrence of similar incidents. In 2008, the Fed aggressively lowered the federal fund rate from 5.25% to 2% and the discount rate from 5.75% to 2.25%. It has conducted measures including credit easing, tightening mortgage lending rules, open market operation assistance to individual institutions, and broad-based programs. For quantitative easing, the Fed launched three rounds between 2008 and 2014, ballooning its balance sheet with mortgage-backed securities and treasury bonds. Statistically, the Fed has increased its total assets from 900 million to 4.5 trillion in total (Schulze, 2017) .The Fed finalized stricter regulation for mortgage lenders by requiring them to verify borrowers' ability to fulfill obligations on schedule. As an open market operation, the Fed published the Emergency Economic Stabilization Act of 2008 as a bailout package. The act authorized the Treasury 700 billion to buy distressed assets, including agency MBS, and restore liquidity in the financial markets. To address the concern about the failure of investment banks, the Federal Reserve Board extended its borrowing facility to both commercial and investment banks in March 2008. The Treasury spent 141.8 billion in exchange for 92% ownership of loaned AIG and took over the mortgage company Fannie Mae and Freddie Mac. It has also provided an overnight loan of 12.9 billion to JPMC to support the purchase of Bear Stearns, a financial institution with substantial MBS (Singh, 2021). For the facilities, we listed the important ones in **Table 1**. They injected massive liquidity into different aspects of the financial system. All of them were newly instituted to solve the subprime mortgage crisis and were closed afterward.

Table 1. Broad-based Programs: Facilities Instituted during 2008 Financial Crisis

Term Auction Facility (TAF)	- increase monthly auctions of collateral-backed short-term loans to depository institutions[2]
Term Securities Lending Facility (TSLF)	- allow primary dealers to borrow monthly U.S Treasury securities with eligible collaterals
Primary Dealer Credit Facility (PDCF)	- allow primary dealers to borrow overnight cash loans with eligible collaterals
Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF)	- offer loans to depository institutions to purchase eligible collateralized commercial paper
Commercial Paper Funding Facility (CPFF)	- include commercial paper as eligible collateral - offer loans to a special purpose vehicle to purchase both unsecured and asset-backed commercial paper
Term Asset-Backed Securities Loan Facility (TALF)	- offer loans to eligible investors to purchase eligible collateralized securities

[2] Depository institutions include commercial banks, credit unions, saving banks, savings and loan associations

In short, these actions ensured that banks have access to funds when in need and there was enough liquidity created in the market, minimizing the liquidity risks. According to Bordo (2008), there were two essential lessons learned from this empirical market turbulence. One is the importance of the Fed expanding services to most financial institutions in panics. For instance, the Fed only assisted commercial banks first and then decided to include investment banks on Wall Street as eligible borrowers later. Since the financial institutions connect closely in the system, expansion of the list will eliminate ripple effects. The other is the speed of response by authorities in resolving the liquidity crisis. Immediate responses will help inject confidence into the financial market and avoid further influential consequences from the liquidity spiral.

2.5.2 COVID-19

Due to the outbreak of the COVID-19, the money market becomes illiquid and more volatile as the economy stagnates. The Fed expanded the repo operations in order to make more money available in the banking system, aming to inject liquidity into the money market. The Fed started by offering $100 billion in the overnight repo market and increased the amount to $175 billion on March 9 (Cheng et al., 2020). After that, the Fed kept raising its maximum limit for the repo operations in order to ensure that the financial institutions could borrow enough money to maintain sufficient reserve. The Fed's main actions in dealing with the coronavirus outbreak are similar to the actions taken for the abnormal overnight rate on September 16, 2019. For both circumstances, the Fed tries to increase the money market's liquidity by providing almost "unlimited" loans to the financial institutions to maintain the overnight rate as targeted.

2.5.3 Compare & Contrast

Table 2. Similar Facilities and Different Facilities Instituted in 2008 Financial Crisis and COVID-19

Same facilities	Different facilities	
Commercial Paper Funding Facility (CPFF)	2008 Financial Crisis	COVID-19
Primary Dealer Credit Facility (PDCF)	Term Auction Facility (TAF)	Paycheck Protection Program Liquidity Facility (PPPLF)
Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (ABCP MMMF)	Term Securities Lending Facility (TSLF)	Main Street Lending Program
Term Asset-Backed Securities Loan Facility (TALF)		Primary Market Corporate Credit Facility (PMCCF)
		Secondary Market Corporate Credit Facility (SMCCF)
		Municipal Liquidity Facility

When comparing the facilities instituted during the 2008 financial crisis and the COVID-19 pandemic, four facilities were reused in the pandemic, demonstrated in **Table 2**. The functions of these common facilities are suitable for Fed interventions' objective for both the

2008 financial crisis and pandemic. Basically, they aim at providing loans to financial institutions to facilitate the process of authorized asset purchasing. Massive asset purchasing will inject huge money into the financial market and thus achieve the purpose of increasing the market liquidity.

Some different facilities are instituted to deal with specific situations. The Term Auction Facility (TAF) and Term Securities Lending Facility (TSLF) were created and used during the 2008 financial crisis. The Federal Reserve uses TAF to auction collateral-backed short-term loans to depository institutions (Banton, 2021). TSLF is a facility that provides loans to financial institutions by lending U.S. Treasury securities on a monthly term by pledging eligible collateral (Blessing, 2020). Both facilities focus on providing short-term loans to primary dealers to mitigate the stress they face. By specifying the eligible securities, the liquidity is improved in the Treasury bond market and collateral markets.

During the pandemic, five new facilities are created to deal with the difficult situation. Though these facilities also target increasing liquidity, they mainly support companies of different sizes and governments. Paycheck Protection Program Liquidity Facility (PPPLF) supplies liquidity to the participating banks, which provide loans to eligible small firms. The Main Street Lending Program is similar to the previous but offering loans to small and medium-sized enterprises. The Fed purchases loans granted by the financial institutions through a Special Purpose Vehicle[3]. Primary Market Corporate Credit Facility (PMCCF) buys the corporate bonds directly from the issuers with investment-grade credit ratings, which provides the company direct access to credits. Secondary Market Corporate Credit Facility (SMCCF) is similar to the previous but functions in a different market. It purchases investment-grade U.S. corporate bonds in the secondary market to support the American companies. Municipal Liquidity Facility tries to help local governments to ease their cash flow pressures. It purchases short-term notes issued by eligible state-level issuers (Federal Reserve, 2020).

Unlike specific facilities created in 2008, the pandemic's unique facilities mainly focus on helping companies and governments of different sizes maintain operations and capacity. For the 2008 financial crisis, injecting money to promote liquidity in the financial market by providing loans seems to be the primary objective. For COVID-19, the business operations are significantly influenced by the lockdown policies, which causes illiquidity in corporations. With poor financial conditions, companies' default risk increases significantly and thus the risk premium increases, which finally leads to market illiquidity. Therefore, the facilities dealing with pandemics need to increase the liquidity in corporations primarily.

3. Assessment

3.1 Effective Crisis Control

To reduce the spread of the repo crisis in the financial system, the Fed immediately carried out an overnight repo operation, providing $53 billion in additional reserves, and cut the two administered rates. Moreover, it offered up to $75 billion in overnight repo each morning for the rest of the week. Though these actions efficiently stabilized the overnight interest rate, the Fed continued to implement other follow-up actions to avoid the re-occurrence. The Fed purchased approximately $60 billion of Treasury bills per month through the second quarter of

[3] A special purpose vehicle is a subsidiary company that is created to undertake a specific business purpose or activity. It also functions in particular structured finance applications.

2020 and extended its overnight and repo operations through at least January 2020. However, the markets did not let the Fed make adjustments until the second quarter of 2020. The outbreak of COVID-19 caused severe frictions in the money market again. To solve the problem, the Fed has been injecting thousands of billions into the markets, along with some facilities' operations. On its face, the repo crunch in December 2019 was expeditiously solved as the overnight interest rate returned to the target range within the next day and the crisis in the repo market did not outspread. The Fed has been devoting to bump the economy up through the facilities so far. The recent statistics also indicate that the U.S. economy is recovering from the ongoing impact of the virus in response to the rollout of vaccines and stimulative monetary policies. Real gross domestic products increased at an annual rate of 33.4 percent in the third quarter of 2020 and 4.3 percent in the fourth quarter (Bureau of Economic Analysis, 2021); effective federal funds rate has remained within the target range since March 2020 **(Figure 2)**; the unemployment rate has declined after the peak in April 2020.

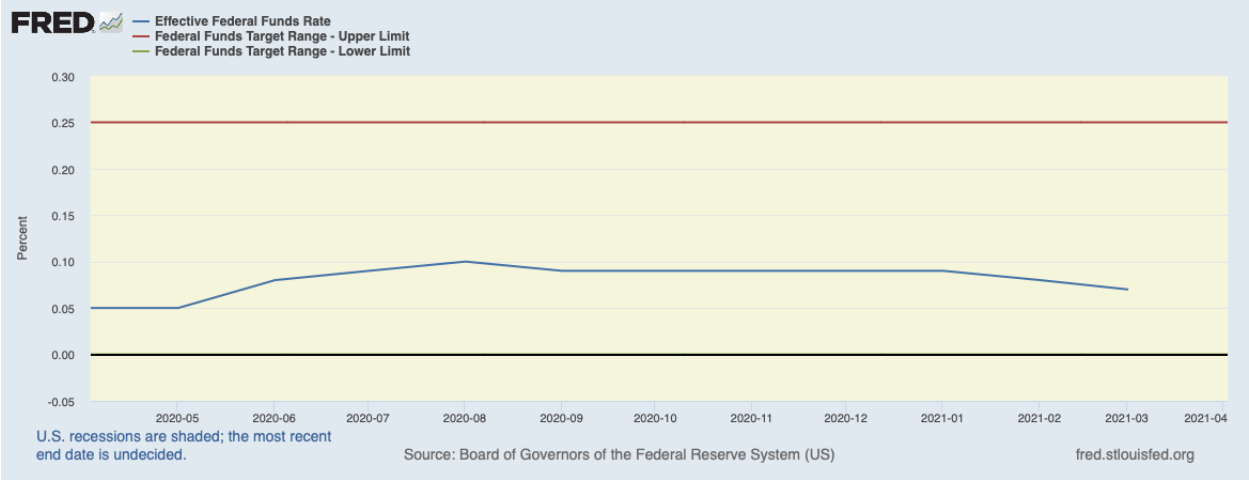

Figure 2. Federal Funds Rates in the U.S.

3.2 Inevitable Downsides

Until now, what the Fed has done successfully maintained the operation in the money market and the economy. Trillions of capitals have been infused into the financial system; it seems like that the U.S. economy has been addicted to monetary stimulus and cannot get off the drug. When there are pros, there are cons; the Fed also triggers other problems when dealing with the liquidity risk. The economy is still obscured by the pandemic, and the recovery is choppy and uneven; therefore, the current inflation rate is under the target. However, such an unprecedented amount of capital injection is feeding people's inflation expectations. Many doubted that the economy would boom, and the prices would rise as soon as the vaccines put an end to the pandemic and the world backs to normal. Meanwhile, when market participants anticipate upcoming higher inflation, bond yields rise, thereby reducing prices. As the Fed lowered its target funds rate, the cost of borrowing became cheap, and the housing market burnt. The U.S. housing market reached record highs in 2020, with an increase of 22.2% in sales compared to 2019 (Santarelli, 2021). The continuous injection of liquidity in the money market also has weakened the U.S. dollar. The value of the U.S. dollar has dropped since March 2020. The depreciation of the currency can diminish its purchasing power compared to other countries

and lower the domestic consumption level. All these knock-on effects are exacerbating the economic inequality in the U.S. — the poor become poorer, and the rich become richer.

3.3 Broad Picture of Vicious Cycle

Examining the broad picture of the Fed's actions over the past decades – the global financial crisis, the repo crisis, and the pandemic – a vicious cycle is clearly illustrated. During the global financial crisis, the Fed launched a quantitative easing program, which lasted for seven years. Over the period from 2008 to 2015, the Fed purchased trillions of government bonds and mortgage-backed securities. By the end of 2015, when the Q.E. ended, there were a total of $4.5 trillion of assets on the Fed's balance sheet. In June 2017, the Fed entered new territory as it began to wind down its trillion-dollar balance sheet. Instead of auctioning off the treasury bills and securities, the Fed allowed approximately $10 billions of securities to roll off each month to drain the market's excess liquidity (Cox, 2020). However, the size and scale of the quantitative easing were unprecedented; thus, the impacts of unwinding quantitative easing were unpredictable. The economy could not put up with the pace of unwinding Q.E. and thus induced the repo crisis in 2019. The Fed has been injecting thousands of billions into the market since the repo crisis, followed by the global pandemic. Indeed, it is not easy to decide the amount of capital injection or drain and estimate their effects. There is always a trade-off between the speed of solving the problem and the spread of the problem. However, these crises only stopped when the Fed started to pump capital back into the system, suggesting a structural problem in the vital part of the financial system. The Fed has always been curing the symptoms rather than digging up the roots.

3.4 Lessons from The Past

The origination and the solution of the global financial crisis provide hints to solve the repo crisis better. The repo rate is used as a benchmark for other short-term interest rates. The crash in the repo market directly and adversely affects the economy. In comparison, the power of MBS was not realized by the public until the global financial crisis. The federal government sponsored three entities, the Government National Mortgage Association (GNMA) or "Ginnie Mae," the Federal National Mortgage Association (FNMA) or "Fannie Mae," and the Federal Home Loan Mortgage Corporation (FHLMC) or "Freddie Mac", in order to increase the liquidity of the U.S. mortgage market and facilitate the growth of homeownership. GNMA has always been government-owned, whereas FNMA and FHLMC used to be private corporations with shareholders. Initially, these three agencies bought pools of mortgages and then packed them into mortgage-backed securities. They then sold these MBS to investors. In 1999, the agencies started to guarantee subprime loans (C.Hull, 2018). Due to Fannie Mae and Freddie Mac's nature and the loose control over them, they later turned into key players in the global financial crisis. Eventually, they were taken over by the government in 2008. Considering the already realized importance of the repo rate in the economy, the federal government should build a standing repo facility to control the repo rate directly before the recurrence of the repo crisis.

4. Recommendation

4.1 The *Standing Repo Facility*

As discussed in the analysis section, the role of the Fed and its interventions have played a key role in episodes of the global financial crisis in 2007-2008, liquidity crisis in 2009 and the COVID-19 pandemic. In addition to the implemented policies, another viable approach to tackle the problem of market liquidity is through establishing a *standing repo facility*. Such facility permits a permanent offer for eligible counterparties to enter repo transactions at the administered repo rates with the Fed (Andolfatto & Ihrig, 2019). This transaction allows those eligible counterparties to exchange Treasury securities for cash when encountering liquidity issues (Pan, 2019). If ingeniously designed, the standing repo facility will suffice for the three-pronged purposes — (1) preventing the abrupt spikes of the repo rate; (2) enhancing the control over the Fed funds rate; and (3) demand reduction with regard to reserves. Even though the above mentioned rationales are all potentially achievable through this particular facility, each lays emphasis on distinctly precise aspects. Policymakers will need to judiciously evaluate the tradeoffs among them and make decisions accordingly in terms of defining and setting the parameters for structuring. Such decisions are not easy to make; and they come along with foreseeable challenges. In the following two subsections, we will dive into the three-pronged purposes as well as the challenges to be faced by policymakers with more details.

4.2 Three-Pronged Purposes

4.2.1 Preventing the Abrupt Spikes of the Repo Rate

Setting up the standing repo facility can effectively prevent a repeat of the past of what happened in the repo market in 2019. In light of the main frictions discussed earlier, if the standing repo facility was available back then, the surge in the repo rate could be controlled with the precondition that those banks with liquidity needs were the eligible participating counterparties of the standing repo facility. In this way, those banks who had difficulties with interbank borrowing and in the meanwhile were reluctant to borrow from the discount window, would thereby turn to the standing repo facility which they have access to. Therefore, the spike would have been avoided in the first place.

4.2.2 Enhancing the Control over the Fed Funds Rate

The standing repo facility also serves the purpose of reinforcing the control over the Fed fund rates. Despite the fact that the existing discount window is initially designed with the same purpose, it is deemed as somewhat ineffective in this aspect. This is primarily due to the stigma associated with it that has been deeply rooted in many institutions (Carlson & Rose, 2017). The mechanism behind the standing repo facility is essentially different from that of the discount window which mitigates the stigma to a large extent. This will be thoroughly discussed in the next sub-section.

4.2.3 Demand Reduction with regard to Reserves

Subsequent to the global financial crisis in 2008, the FMOC stated that it would operate under the regime of the floor system for monetary policy implementations where there would be ample or excessive reserves (Board of Governors of the Federal Reserve System, 2019). However, banks are demanding roughly fifty times more for the reserves as compared to the level prior to the global financial crisis (Andolfatto & Ihrig, 2019). This phenomenon poses

pressure for the Fed as a larger balance sheet is required as a consequent. More specifically, the size of the balance sheet matters because larger in size implies larger costs and higher risks both economically and politically. Making the standing repo facility available will lower the demand for reserves by the banks and thus vastly decrease the size of the Fed's balance sheet, which is in line with the objective as per the balance sheet normalization process by the Fed (Powell, 2019). This purpose is attainable through the standing repo facility because the Treasury securities to banks can now be considered as a substitute to reserves with the preconditions that the administered rate is set closely to the market rates and the open time is at least the same as the Fedwire (Nelson, 2019).

4.3 Foreseeable Challenges

We observe three major challenges for setting up the standing repo facility. Among them, interrelationship exists which requires comprehensive tradeoff analyses of the market conditions and desired outcomes from the policymakers.

4.3.1 Setting the Administered Repo Rate

It is quite a challenge to determine the repo rate that the standing repo facility should use. It is only certain so far that the repo rate should be higher than the market rate but lower than the discount rate, as in the range of $(market\ rate,\ discount\ rate)$. The lower bound is to discourage the frequent use of this facility such that eligible counterparties would only turn to the standing repo facility in the times of liquidity needs. The upper bound is the discount rate of the discount window which is to avoid the stigma of borrowing at a high interest rate. The following two challenges would also affect the decision for the repo rate. However, exactly by how many basis points extra should be charged and the outcome of such a decision is indeterminate. In this context, a narrower spread would work towards reducing the stigma but it is also important to note that having this spread in the first place destines for the stigma problem to take root.

4.3.2 Eligibility of the Participating Counterparties

The criteria for the eligibility of the participating counterparties of the standing repo facility is another fundamental question to be discussed with careful analysis. This challenge essentially comes down to the question of whether or not to include the non-bank repo borrowers since the depository institutions should be eligible by default. Regardless of including the non-bank repo borrowers or not, the administered rate of the standing repo facility would be a more effective tool in terms of controlling the Fed funds rate as per 4.2.2. But if the facility only permits access to the depository institutions and excludes the non-bank repo borrowers, purpose 4.2.3 is mostly fulfilled but not quite for 4.2.1. It is obvious that there are tradeoffs in which the purposes that policymakers choose to lay emphasis on.

4.3.3 Stigma

The most critical challenge for the standing repo facility is the potential risk of being stigmatized. The associated stigma, if it indeed exists, will render all the purposes of setting up the facility as "missions impossible". This challenge is also interrelated to the other two challenges as policymakers aim to reduce the stigma throughout the design of this facility.

It is worth alluding to the discount window and the stigma associated with it here as the Fed had found a way to mitigate the stigma. Stigma has long been troubling the discount window as the use of it reflects weakness of the borrower in a manner. Part of this is due to the high

discount rate. During the period of the global financial crisis, banks were unwilling to borrow from the discount window despite the fact that they were in desperate need of funds. The Fed then introduced TAF which had successfully mitigated the stigma of borrowing and helped many institutions pull through the crisis according to the empirical findings by Hu and Zhang (2020). Even though TAF had similar terms to the discount window, the mechanisms differed. Rather than directly borrowed from the discount window, institutions bidded for the collateralized loans through auctions. The form of auction, which according to them, not only attracted both the weak and strong participants in the market, but more importantly, allowed participants to internalize the stigma of borrowing (Hu & Zhang, 2020). The discount window and TAF in a sense complemented each other.

4.4 Overall Comment on the Standing Repo Facility

With reference to the rather successful precedent, TAF, we believe that establishing such a standing repo facility will be necessary and effective to solve the market liquidity problems as a complementary facility to the discount window. In light of it being permanent and government-owned, the repo market can be monitored better and the Fed could make immediate responses whenever liquidity issues arise. Other than being permanent, some mechanisms between the two facilities are shared in common. Both involved collaterals when borrowing, which is one of the major differences from the discount window. The standing repo facility uses Treasury securities as collaterals in the repo transaction. We argue that this fact would substantially mitigate the stigma problem here as eligible counterparties who are capable of securing the loan with such collaterals would generally be considered as free of liquidity issues.

5. Conclusion

In this report, we have investigated the causes and the Fed's actions of the liquidity risk, mainly through the repo crisis in 2019, supplemented by the global financial crisis and COVID-19. We have observed that the repo crisis was resulted from the concurrence of tax settlements, unwinding quantitative easing regulatory factors, financial reporting and lower quality of collaterals. In order to address the crisis, the Fed carried out a series of overnight repo operations and cut administered rates. In all the three episodes, monetary stimulus is the most vital method for the Fed's intervention; capital injection is commonly used and seems to be the panacea for the economy. However, the connection among the three episodes illustrates that the Fed also builds a fundament to other problems when addressing current issues. Ultimately, we suggest that the Fed should build its own standing repo facility on top of the existing facilities, such as the discount window, to better tackle the liquidity problems from the root. Based on our analysis, the major challenge of having the associated stigma would be mitigated to a great extent given the mechanisms behind the standing repo facility. This argument is also backed by the empirical findings of TAF. Other supporting arguments and foreseeable challenges are also provided and discussed to back our suggested alternative. Nevertheless, there are still many uncontrollable and interrelated factors in the market that we are not able to take into account at the current moment for this report. The design for our recommendation is purely based on theoretical evidence and market observations. Only the market will tell whether the implementation of the standing repo facility is successful or not. By then, we will conduct an ex-post analysis to assess the validity of our proposal.

Appendix

Appendix 1. Benchmark Federal Funds Rate Range

2019

Make Full Screen

Date	Increase	Decrease	Level (%)
October 31	0	25	1.50-1.75
September 19	0	25	1.75-2.00
August 1	0	25	2.00-2.25

Source : https://www.federalreserve.gov/monetarypolicy/openmarket.htm

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