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Disruption in the Repo Market - a Sign of Systemic Issues

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Disruption in the Repo Market - a Sign of Systemic Issues

Senior Project Submitted to
The Division of Social Studies
of Bard College

by

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Dedication

This project, as everything I will ever achieve, is dedicated to Nutsa, who I love endlessly.

Abstract

The Repurchase Agreement (repo) market is an essential part of the financial system. Thus, a disruption in the repo market in September of 2019, leading to the first Federal Reserve intervention since the Global Financial Crisis, sowed panic. This paper discusses some of the possible explanations of the repo crisis, such as tax payments draining liquidity at the same time as the Treasury bonds were settled, changes in regulations leading to inability to use the reserves on the market, a problem of market domination and change in behavior of the non-bank participants. It builds on the theories of the economist Hyman Mynsky and examination of the Global Financial Crisis by the economist Thorvald Grung Moe in order to provide some background and examine the role of the repo market in the crisis of 2008. The paper discusses changes the market has undergone since the crisis and underlines issues that have persisted such as market domination of "too big to fail" institutions, no separation between essential and non-essential banking, shadow banking and its role on the repo market. It reaches a conclusion that the disturbance in the repo market might have been yet another consequence of evolution of the financial markets away from relationship banking and towards market-based liquidity provision.

Key Words: Repurchase Agreement Market, Financial Market, Financial Crisis, Federal Reserve
JEL classifications: E430, E580

Table of Content

Figures

Tables

Chapter 1: Introduction

On September 16th, 2019 there was a disruption in the repurchase agreement (repo) market and the interest rates shot up way above the Federal Reserve's target rate. This can be seen in figure 1 which shows the treasury weighted average daily rates for the past year.

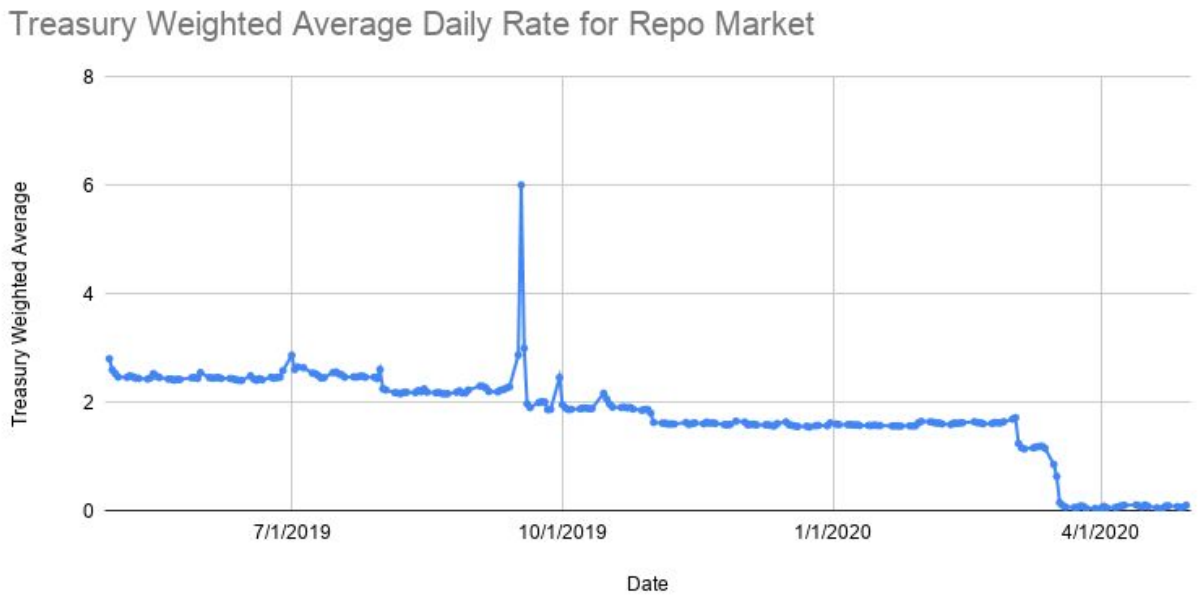


Figure 1 - Treasury Weighted Average Daily Rate for Repo Market

Source: "DTCC GCF Repo Index." The Depository Trust & Clearing Corporation. Accessed May 1st, 2020. http://www.dtcc.com/charts/dtcc-gcf-repo-index#qna.

This led to the intervention by the Federal Reserve, which injected more than 50 billion dollars of liquidity on the next day and has not stopped intervening in the market since as seen on figure 2. The intervention managed to keep the repo rate below the Fed Target. There was a sharp decline in repo rate in late March. This drop was caused by the economic disturbance

caused by the global Pandemic of Covid-19, consequences of which will be discussed later in the paper, as well as the Fed's increased purchase of the securities on the repo market as a response.

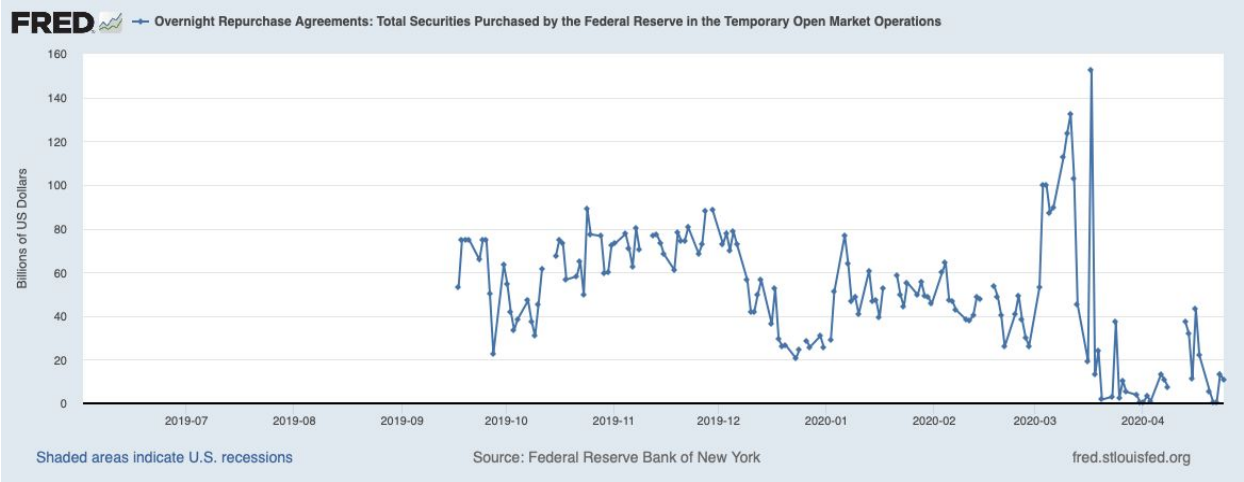


Figure 2[1] - Overnight Repurchase Agreements: Total Securities Purchased by the Federal Reserve in the Temporary Open Market Operations From June 2019 until end of April 2020

Source: Federal Reserve Bank of New York, retrieved from FRED, Federal Reserve Bank of St. Louis, April 30 2020

The Fed has not been involved in the Open Market Operations since the Global Financial Crisis (GFC) of 2008 (as seen in figure 3). Since the GFC, it was expected that the Fed would not need to act as a lender of last resort. The need for intervention emphasized acuteness of the situation. The period of intervention has been further prolonged by the crisis brought on by the global pandemic of Covid-19.

[1] Note that there are several breaks in the graph. There is no official explanation provided, it could be either due to lack of data or some other reason.

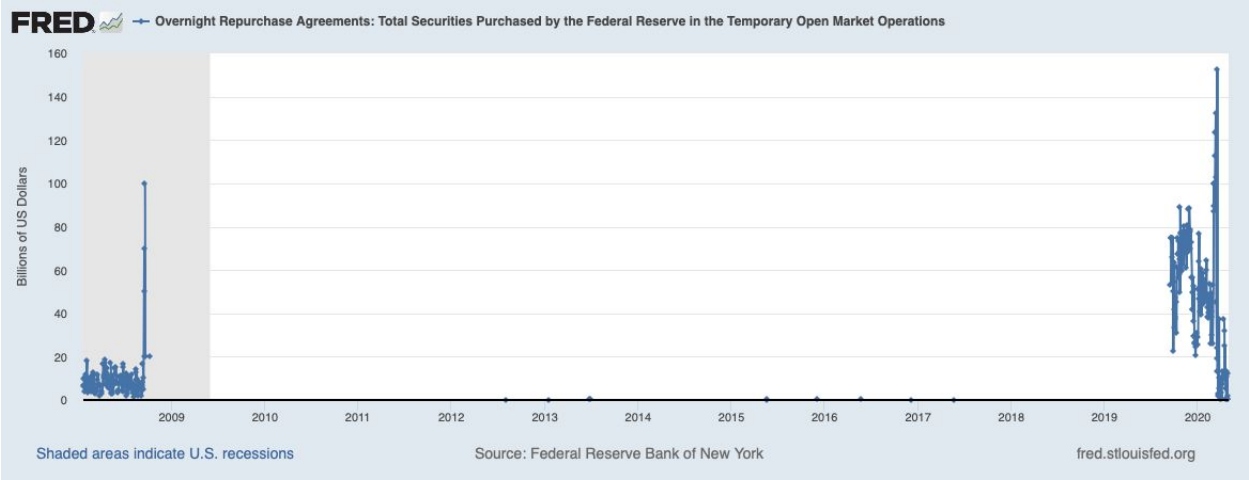


Figure 3 - Overnight Repurchase Agreements: Total Securities Purchased by the Federal Reserve in the Temporary Open Market Operations from 2008 until 2020

Source: Federal Reserve Bank of New York, retrieved from FRED, Federal Reserve Bank of St. Louis, April 30 2020

The sudden spike in the repo rate would not have been as significant or worrisome if the Fed did not have to intervene in order to stabilize the market for such a prolonged period of time. The events of September left many wondering whether this could have been the beginning of a new financial crisis. It leads one to wonder if the disruption in repo markets point to a bigger, institutional problem. It is especially noteworthy that the financial system does not lack reserves - in fact as shown on figure 4, even though the amount of excess reserves has been declining since 2017, it was still quite high in September of 2019. Thus, some wondered whether there were circumstances inducing panic in the bankers that led them to hoard their reserves. Many different explanations of what could have caused the disturbance emerged. Some of the explanations put forward include the regulation changes since the GFC; a combination of large amounts of Treasury bonds being settled and quarterly tax payments; the issue of market

domination by several financial institutions, and a change in behavior of the non-bank participants.

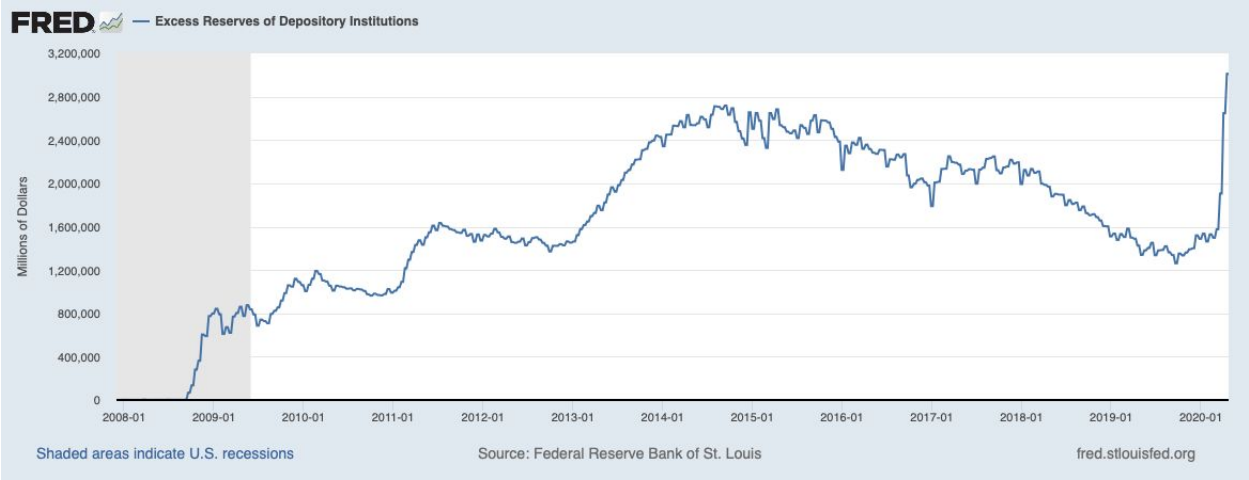


Figure 4 - Excess Reserves of Depository Institutions[2]

Source: Federal Reserve Bank of Saint Louis, retrieved from FRED, Federal Reserve Bank of St. Louis, April 30 2020

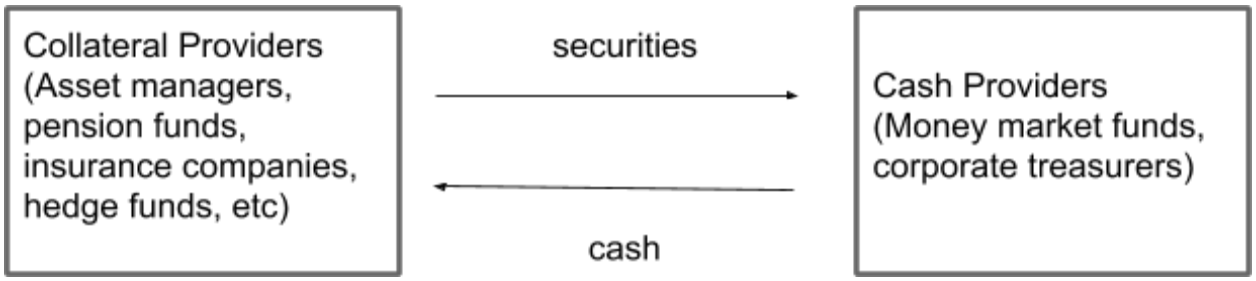
This paper aims to first, give an overview and a background of the repo market, discuss the different explanations of the crisis put forward, and finally, shortly examine the impact of the pandemic. I will discuss the role of the repo market in GFC and the changes that have been made since, in order to argue that the break was a sign of a deeper institutional issue and an inevitable consequence of the evolution of financial markets away from relationship banking towards market-based liquidity provision.

[2] The spike at the beginning of 2020 in excess reserves is caused by unprecedented levels of the Fed's open market operations as it tries to tackle the economic crisis brought by the global pandemic

How the Repo Market Works

The repurchase agreement, or repo, is "a sale of a security or a portfolio of securities, combined with an agreement to repurchase the security or portfolio on a specified future date at a prearranged price"[3]. It is a way for banks to finance their activities overnight. As the securities "provide credit protection in the event that the seller (ie the cash borrower) is unable to complete the second lag of the transaction"[4], a repo could be compared to a collateralized loan.

A bi-party repo transaction happens between two parties - one that provides collateral, in other words securities, and one that provides cash, who will be later called a dealer. The collateral providers are usually asset managers, insurance companies, pension funds and hedge funds. Cash providers are money market funds and corporate treasurers. However, "Money Market Funds (MMFs), asset managers, security lending agents, and investors looking to obtain specific securities as collateral in order to hedge or speculate based on changes in market value of those securities"[5] can also be cash providers. A collateral provider is usually a client for the dealer that needs to borrow cash. Picture 1 below illustrates the relationship between the two parties.



[3] Copelan et al. 2012
[4] Cunliffe, Jon 2017
[5] Copeland et al. 2012

Figure 5: Bi-party repo market

A tri-party repo includes three parties - cash providers, collateral providers and clearing banks that step in to facilitate the transactions (shown on Picture 2). In the US another participant of the process is Fixed Income Clearing Corporation (FICC), which was created in 2003 to ensure efficient and systematic settlement of repo transactions.

Figure 6: Tri-party repo market

The difference between the market value of the securities and the value of cash is called "haircut". When the repo is closed, the collateral provider repurchases the security for the amount of cash loan it got plus the interest rate. The clearing bank clears the transaction on its own books. In the United States, there used to be two clearing banks - Bank of New York Mellon and JPMorgan Chase, until 2018, when JPMorgan Chase left the tri-party repo business. In short, Liz Capo McCormick and Alexandra Harris explained the repo market saying that "Repo deals let big investors -- such as mutual funds -- make money by briefly lending cash that might otherwise sit idle, and enable banks and broker dealers to get needed financing by loaning out securities they hold in return"[6].

[6] McCormick and Harris 2019

The tri-party repo market has two predominant segments - tri-party funded by nondealers and the General Collateral Finance (GCF) repo market. In the segment of the market funded by nondealers, the cash providers are primarily MMFs and other institutional cash providers. They mainly seek interest gain on short maturities. "Together, MMFs and securities lenders account for over half of tri-party repo lending"[7]. The General Collateral Finance repo market is the so-called blind-broker market, where the parties involved in the transaction do not know the identity of each other.

Timeline of Development of the Repo Market

The repo market did not always exist in the form it does now. Before the 1980s daily overdrafts could have been carried overnight. The Fed discouraged this through penalties. In the 1980s, the intraday overdrafts began to rapidly grow, causing the Fed's concern[8]. "The Fed embraced money supply targets and viewed bank's reserve positions as a critical policy lever."[9] The growth of the overdrafts was driven by an increasing transfer of securities using Fedwire. "By 1988, four Clearing banks together accumulated 70% of daily overdrafts attributable to movements of securities over Fedwire"[10]. This was in part driven by growing repo activities. The capital requirements restricted use of repos by bank dealers, but their use by non-bank dealers tripled at the time reaching around 286 billion dollars on average annually by 1985[11]. This also was the year when the Fed decided to step in the market and imposed a cap of three times the level of regulatory capital, but it did not cover the overdrafts generated by transfer of securities via

[7] Copeland et al. 2012
[8] Gabor 2019
[9] Gabor 2019
[10] Gabor 2019
[11] Gabor 2019

Fedwire and thus failed[12]. From 1986 to 1993, Securities-related overdrafts doubled[13]. This led the Fed to take other measures and on April 14th of 1994, it started charging clearing banks a fee on daily overdrafts[14]. In the next six months overdrafts shrank by 40 percent[15]. Salomon Brothers came up with a solution - a tri-party repo market, and in time of the collapse of overdrafts, banks embraced it[16].

Fast forward to the 2008 Global Financial Crisis, when Lehman Brothers collapsed. The market was left with only two US tri-party agents - JPMorgan Chase and Bank of New York Mellon. In response to the GFC the Fed decided that banks should have more liquidity available at any point. This led to the Fed starting to pay interest on excess reserves to encourage holding cash. Additionally, new regulations were put in place. In 2010 and 2011 Basel Committee on Banking Supervision agreed on Basel III, which puts in additional liquidity requirements for the banks. It was initially scheduled to be introduced between 2013-2015. In 2013, implementation of Basel III was extended until March of 2018. In the same year Volcker rule was introduced by the Obama administration. The Volcker rule is a **"**federal regulation that prohibits banks from conducting certain investment activities with their own accounts and limits their dealings with hedge funds and private equity funds, also called covered funds"[17]. It aimed to separate the banks' speculative activities from their essential activities. In times of crisis the banks had to be bailed out because their downfall could have had a negative impact on the payment infrastructure, as the non-essential and essential activities performed by banks were not

[12] Gabor 2019
[13] Gabor 2019
[14] Gabor 2019
[15] Gabor 2019
[16] Gabor 2019
[17] Toussaint 2019

separated. The need for this segregation will be discussed later in the paper. The Volcker rule took three years to be written and was issued in 2013. It was later revised and softened by the Fed and four other regulatory agencies under the Trump administration in August 2019[18]. The amendments that were first proposed in 2018 aimed to simplify the rule[19]. The most significant change made was a revision of the trading account definition, "which defines the scope of the proprietary trading provisions of the Volcker Rule."[20] As summarized by the Fed:

> Under the revised rule, firms that do not have significant trading activities will have simplified and streamlined compliance requirements, while firms with significant trading activity will have more stringent compliance requirements. Community banks generally are exempt from the Volcker rule by statute. The revisions continue to prohibit proprietary trading, while providing greater clarity and certainty for activities allowed under the law. With the changes, the agencies expect that the universe of trades that are considered prohibited proprietary trading will remain generally the same as under the agencies' 2013 rule.[21]

The rules came into effect on January 1st, 2020 and the banks have to comply by January 1st of 2021. Thus, it is still too early to see the impact the amendments might have.

In 2018 JPMorgan Chase left its tri party repo business, leaving the Bank of New York Mellon as the only US clearing bank. In March of the same year Basel III was implemented. This brings us to current events - on the 16th of September, 2019 the repo rates shot up, which led to the Fed injecting liquidity in the market every day since September 17th. A major question that rises is why the Fed has to inject liquidity in the markets, even when there's excess reserves. As

[18] Onaran 2019
[19] Gould 2019
[20] "Volcker Rule 2019 Final Amendments: Summary and Proprietary Trading Flowcharts." 2019.
[21] Board of Governors of the Federal Reserve System 2019

can be seen on figure 4 on page 8, the total reserves level, even though it has decreased since 2015, is still very high.

JPMorgan Chase CEO Jamie Damon noted that "[banks] have a tremendous amount of liquidity, but also have a tremendous amount of restraints on how they use that liquidity"[22]. This leads us to a common argument that the restrictions and reserve requirements are too tough on banks, leaving them unavailable to use the money they have. On the other hand, there's an argument that the banks are simply using the situation to get the requirements to ease up. As Eric Toussaint noted, "The problem is not a structural lack of liquidity but the use banks make of the liquidity available to them[...] they use liquidity placed at their disposal to buy up massive amounts of debt which sooner or later will lead to a major new crisis"[23].

Interest Rates and How They Work

As explained in the Federal Reserve's *The Federal Reserve System Purposes & Functions,* "The Federal Reserve conducts the nation's monetary policy by managing the level of short-term interest rates and influencing the availability and cost of credit in the economy"[24]. Thus, a sudden spike in the interest rate is problematic, as it shows that the Fed failed to manage the level of short-term interest rate in order to achieve its mandated goals. The Fed has a target range for the Federal Funds rate, which can be seen on figure 7.

[22] Selgin 2019
[23] Toussaint 2019
[24] "The Federal Reserve System Purposes and Functions" 2016 p.21

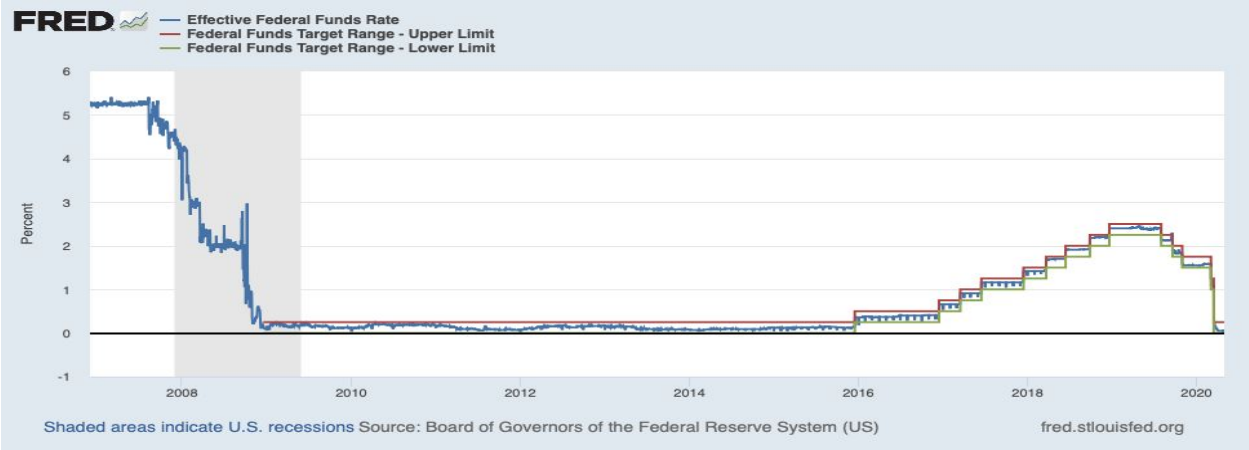


Figure 7 - Effective Federal Funds Rate and Target Range

Source: Board of Governors of the Federal Reserve System (US), retrieved from FRED, Federal Reserve Bank of St. Louis, April 30 2020

The Federal Reserve cannot directly control the market interest rate or the Federal Funds rate. It uses one of its three main monetary policy tools - discount rate, to target the Federal Funds rate. The discount rate is the interest rate charged to commercial banks by the Federal Reserve when they borrow from their lending facility, which is called the discount window. The discount rate is set by the Board of Governors. The Discount window is used by depository institutions to finance any funding shortfalls by the end of the day. Figure 8 shows that the Effective Funds rate does indeed follow the trends of the Discount Rate. Another line shown on the graph shows the interest rate the Federal Reserve pays on excess reserves. The interest paid on reserves sets the lower bound for the federal funds rate.

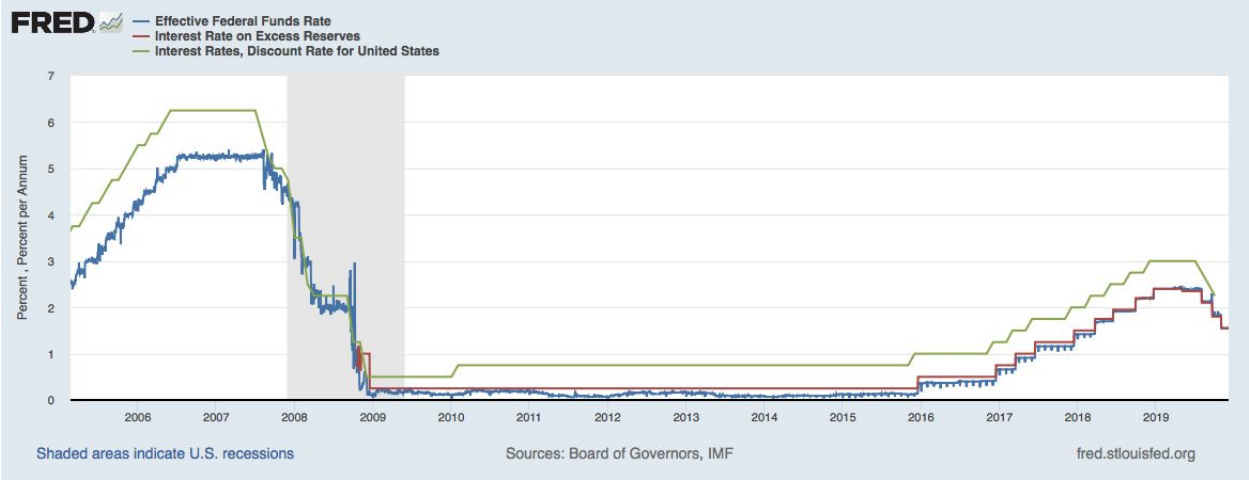


Figure 8 - Effective Federal Funds Rate, Interest Rate on Excess Reserves, Discount Rate

Source: Board of Governors of the Federal Reserve System (US), International Monetary Fund (IMF) retrieved from FRED, Federal Reserve Bank of St. Louis, April 30 2020

Reserve requirements are used to stabilize the short-term interest rate. [25] In absence of the reserve requirements, banks only use reserves to settle payments[26] . As explained by economist Scott Fullwiler In his paper *Modern Central Bank Operations - The General Principles*, contrary to what mainstream economics suggests, reserves provide no constraints on lending[27]. The banks make loans disregarding the reserves and if they lack reserves to meet the requirements by the end of the day do a repo with the Fed, borrow from the discount window or borrow from other banks on the overnight market. Fullwiler explains that demand for reserves is highly inelastic . "If there are too many or too few balances relative to banks' demand, the interbank rate will respectively fall to the rate paid by the central bank on balances or rise to the central bank's penalty rate"[28]. Thus, the interbank rate fluctuates between the interest rate paid on excess

[25] Bindseil 2004 p.202
[26] Fullwiler 2008 p.15
[27] Fullwiler 2008 p.15
[28] Fullwiler 2008 p.15

reserves and the discount rate. In fact, Fullwiler states as one of his ten general principles of modern central bank operation"[29] that the target rate should stay between the two. According to Fullwiler banks are incentivised to hold excess reserves for four reasons. First, holding excess reserves reduced the chances of the bank ending the day in overdraft, reducing the chances of increase in interbank rate. Second, it decreases the inelasticity of demand for the reserves. Third, holding reserves decreases uncertainty for both banks and central banks concerning the amount of reserves demanded at the target rate. And finally, because of decreased inelasticity of demand for reserves, the need for the central bank to intervene in order to meet the target rate might decrease[30] . Before 2003 the Fed used to set the discount rate below the target rate. Since there are non-monetary costs associated with using the discount window, if the reserves were insufficient and could not meet the demand, the federal funds rate could increase considerably. If the reserves exceeded the existing demand, the fed funds rate could fall well below the target rate[31]. While it should be specified that the quantity of reserves does not define the central bank's ability to achieve the target rate, paying interest on reserves decreases potential volatility. "The corridor set by the central bank's penalty rate and the rate paid on reserve balances sets the limit for potential deviations from the target rate"[32]. The fed funds rate mostly stays between the interest rate paid on excess reserves and the discount rate, as shown in Table 1 in the Appendix.

[29] Fullwiler 2008 p.2
[30] Fullwiler 2008 p.15-16
[31] Fullwiler 2008 p.18
[32] Fullwiler 2008 p.20

Why This Matters

Volatility in the repo market pushed the federal funds rate up and above the Federal Reserve's upper limit. It shot up to 2.30%[33] when the upper limit was 2.25%[34]. This happened "just as the Fed was preparing to drop the ceiling to 2%"[35]. In fact, the Fed lowered the upper limit for the federal funds rate target to 2% on September 19th, two days after the spike[36]. As the interest rate is one of the biggest mechanisms the Federal Reserve uses for its monetary policy, this sudden spike does not speak well for it and gives an idea that the Federal reserve must have made a mistake somewhere along the line. "If it persists, it could undermine the belief of those in the financial markets that the Federal Reserve can effectively apply monetary policy as it intends"[37]. Although the spike in Repo market rates might not have had a huge impact on the economy as a whole, the concern is that it might be a result of a bigger, systemic problem. As explained in the quarterly review of the Bank of International Settlements (BIS), the repo market helps financial markets function smoothly by allowing them to redistribute liquidity among each other. Thus, a substantial disruption in the market could easily ripple down through the entire financial system. As repo markets are used by banks to get the necessary liquidity, if it freezes up it could disrupt banking. As will be explained in the next chapter, "The freezing-up of repo markets in late 2008 was one of the most damaging aspects of the Great Financial Crisis (GFC)"[38].

[33] Federal Reserve Bank of New York 2020
[34] Board of Governors of the Federal Reserve System (US) May 2 2020
[35] McCormick and Harris. 2019
[36] Board of Governors of the Federal Reserve System (US) May 2 2020
[37] Phillips. 2019
[38] Avalos and Eren. 2019

Chapter 2: Background and history

The discussion of the importance of the repo market and the role it plays in the modern economy is nothing new. In fact, it played an important role in the Global Financial Crisis (GFC) in 2008. Economist Thorvald Grung Moe discussed the role of the repo market in the GFC in his paper *Shadow Banking and the Limits of Central Bank Liquidity Support: How to Achieve a Better Balance between Global and Official Liquidity.* He writes that "'the repo machine' ... was at the center of the financial crisis in the US"[39]. There were several aspects to the issues around the repo market - collateral, rehypothecation and shadow banking. Before diving into these issues in detail, it's important to do a short overview of the crisis.

What led to the GFC

For several years before the crisis the economy seemed to be doing well. This period of boom increased confidence in actors of the financial sector and led to increased risk taking. The events of the GFC were predicted by the theorems put forward by Hyman Minsky, which will be discussed in the following paragraph. They also are in line with John Cassidy's stage model of credit circle - "displacement, boom, euphoria, profit taking, and panic"[40][41]. In this case, the *displacement* was caused by excitement about the short-term interest rates being lowered to one percent by the Fed and an unexpected influx of money in treasury bonds. This led to the *boom* of the economy. Next came *euphoria* - banks and other financial organizations started taking more

[39] Moe 2012 p. 59
[40] Cassidy 2008
[41] Cassidy calls this Minsky model, but it deviates from Minsky's own explanation and is more consistent with Charles P. Kindleberger's

and more risks and making unreliable loans, including subprime mortgages; they also started bundling up these loans and selling them to the third parties in the form of mortgage backed securities. First, the increased risk taking led to *profit*. But inevitably the fifth stage came - *panic*. It started with the collapse of Lehman Brothers in 2008. Inevitably, stability led to instability as Minsky suggested in his "financial instability hypothesis, which suggests that the financial structure of advanced capitalist economies becomes more fragile over a period of prosperity"[42].

The Financial Instability Hypothesis consists of two theorems. The first theorem dictates that under certain financing regimes the economy is stable, while under others it is unstable. The second theorem suggests that when the economy has a prolonged period of upswing, it tends to transition from financing regimes that make it stable to those that make it unstable. "In particular, over a protracted period of good times, capitalist economies tend to move from a financial structure dominated by hedge finance units to a structure in which there is large weight to units engaged in speculative and Ponzi finance."[43] Hedge financing units are the ones that can pay both principal and interest by their cash flow. Speculative units can only pay interest and not principle. Ponzi units cannot repay either principle or interest with their cash flow and have to either sell assets or borrow in order to repay debt[44]. As the economy was doing well before the GFC, financial firms started taking more and more risks. They were trying to separate risk and responsibility. Financial innovations such as Credit Default Swaps (CDSs) and securitization helped them achieve this goal. The banks would bet on the default of the borrower - they would package the loans into securities and sell them, shifting the risk off of their balance sheets; they would also make Credit Default Swaps, making it so that the bank would win in the case of

[42] Whalen 2012 p. 2
[43] Minsky 1992 p.6
[44] Minsky 1992 p.7

borrower's default. Banks would securitize risky loans, sell CDSs on those securities and then securitize the CDSs, creating debt on debt on debt. Minsky believed that "the banks are central to the operation of a capitalist economy and that the assets and liabilities of banks largely determine the financial framework of the economy"[45]. Thus, as banks increasingly engaged in speculative activities, the financial framework of the economy became more fragile.

Another factor contributing to the increased fragility of the system was financialization, which Krippner defines as a "pattern of accumulation in which profits accrue primarily through financial channels rather than through trade and commodity production"[46]. During this process the financial sector grew and became the most important part of the economy. As manufacturing firms branched out into the financial sector, they became more vulnerable to the financial crisis. The entire economy became more fragile. This was only amplified by the fact that the financial sector was dominated by few institutions that were deemed to be "too big to fail" - these institutions were so big that their downfall could have had a significant impact on the entire economy, thus the Fed would bail them out to avoid the crisis. This policy only gave these institutions opportunity for increased risk taking, as they knew that in case of crisis the Fed would come to the rescue. Finally, an important contributing factor was the rise of money managers and shadow banking, which will be discussed later in the paper.

Collateral Crunch

As the panic grew, banks went to the Fed for liquidity support. "With the markets depending on several trillion dollars' worth of repo funding, the recent scramble for eligible collateral has led

[45] Wray and Nersisyan 2010 p.4
[46] Krippner 2005 p. 173

to a "collateral crunch." Some have observed that "collateral may soon become the key determining factor behind which financial institutions remain profitable and which don't.""[47] Usually central banks accept good collateral. But valuation of collateral is inherently subjective. The value of collateral usually decreases in crisis, when demand for credit from the central bank is high, creating a tension between need for liquidity support and collateral rules. During the crisis banks would try to deposit the lowest quality collateral possible at the Fed and find alternative uses for higher quality collaterals to possibly gain higher returns. As ECB executive board member Chailloux observed, banks would try to use less liquid collateral than the central government bond with the Fed, as there was no demand for them on the market, while government bonds were used on interbank repo market[48]. The Fed could have chosen to only accept high-quality collateral, but this might have led to some solvent illiquid banks failing. By accepting lower quality collateral, the Fed basically encouraged banks to hold substandard collateral.

Rehypothecation

As explained above, "Banks could use their high quality collateral to obtain repo-financing, thereby providing pledgeable collateral for the daisy-chains of rehypothecation in the shadow banking system"[49]. Rehypothecation is when one institution posts a collateral to its prime broker, which uses this collateral for its own purposes, so lends out a posted collateral. Moe states this re-pledging of collateral alongside increased securitization and leverage as factors that led to the

[47] Moe 2012. p. 25
[48] Chailloux and McCaughrin 2008 p.5.
[49] Moe 2012 p. 26

credit boom, which then collapsed in 2008[50]. Rehypothecation is how shadow banks fund themselves. In other words, they reuse collateral that they have posted with banks. Shadow banks are entities extending credit outside the banking system. They made up an increasingly large part of the financial system and were significant contributors to the GFC.

Minsky identifies current phase of capitalism as "money manager capitalism"[51], which is "the economic system characterized by highly leveraged funds seeking maximum returns in an environment that systematically under-prices risk"[52]. So financial markets have become increasingly dominated by institutional investors such as sovereign wealth funds, pension funds, etc. that are run by money managers who aim to maximize profit. Money managers were looking for new ways of increasing returns, including basically gambling with using riskier assets. Other ways of augmenting returns were landing cash on repo market or securities lending [53]. During the crisis, these financial institutions suddenly withdrew their funding, which at that point was a volatile part of the repo market, leading to "repo runs".

Rehypothecation played a crucial role in the augmentation of the impact this had on the financial system. Because the same collateral was posted for different transactions, "several additional actors will be affected by a failure of one key institution"[54]. Singh and Aitken claimed that the size of the shadow banking system was not documented accurately, and in reality, including hypothecation, was bigger[55]. "U.S. banks typically rehypothecate 'collateral received that can be pledged' with European banks and vice versa. The U.S. and European markets are

[50] Moe 2012 p. 36
[51] Wray and Nersisyan 2010 p.4
[52] Wray 2009 p.4
[53] Moe 2012 p. 39
[54] Moe 2012 p. 39
[55] Singh and Aitken 2010

roughly equal in size; hence we add about 50% of the $10 trillion pledged collateral figure for the U.S"[56]. The previous estimate of the US shadow banking system at the end of the year of 2007 was $20 trillion[57]. After the $5 trillion is added, the total number goes up to $25 trillion. This, the shadow banking sector in 2007 was almost twice as big as the traditional banking sector, which was estimated at $13 trillion[58].

The US bankruptcy laws regarding repos and rehypothecation aided their growth. "In the 2005 revision of the law, derivatives and repo transactions were exempted from the general "temporary stay" provision"[59]. Temporary stay provision in case of bankruptcy " freezes creditors' claim [...] and, where a voidable preference can be shown, forces creditors to return assets collected during the period immediately preceding the bankruptcy filing"[60]. As repos are exempt from this provision, in case of bankruptcy the lender gets the collateral back. This protection makes repo transactions more attractive, as creditors can exit quickly in case of bankruptcy of their counterparty, while the debtors get access to inexpensive short-term loans that otherwise would be unavailable to them.

What changed since the GFC

After the GFC the Fed started paying interest on excess reserves. This was meant to decrease the opportunity cost of holding cash. Before the GFC banks preferred to hold loans and securities in order to minimize their cash holdings. But the GFC showed the need for increased liquidity in the financial system. As a response to the crisis the Fed used an unconventional monetary policy

[56] Singh and Aitken 2010
[57] Pozsar et al 2010
[58] Singh and Aitken 2010
[59] Moe 2012 p. 40
[60] Maclachlan 2014

- Quantitative Easing (QE). This meant that the Fed injected liquidity into the market by buying securities. The Fed used several rounds of QE. The first round was initiated in November of 2008 when the Fed proposed to buy around $100 billion worth of agency debt and around $500 billion worth of mortgage-backed securities. In March of 2009 the Fed purchased $850 billion worth of mortgage-backed securities and debt and spent another $300 billion on longer-dated treasuries. The second round of QE started in November of 2010. By mid 2011 the Fed bought $600 billion worth of longer-dated treasuries. In September of 2011 the Fed initiated Operation Twist "with the aim of increasing the average maturity of the bank's treasury portfolio. Hence, the Fed purchased $400 billion worth of treasuries with maturities between 72 and 360 months, and sold off an equal amount of treasuries that had maturities in the 3-36 month range."[61] In September of 2012 the third round of QE began. The Fed spent around $40 billion monthly on mortgage-backed securities. The program ended in October of 2014[62]. As a result of these policies, banks started accumulating reserves as is shown on figure 4. In October 2017 the Fed started to run down its balance sheet, leading to a contraction in the amount of reserves. Since September of 2019 the amount of excess reserves has been increasing again.

According to the Bank for International Settlements (BIS) quarterly review of December 2019, at the same time banks' holdings of US treasuries increased. From mid-2018 the US banking system, which used to be a net-provider of collateral, became a net-provider of funds. This change was mainly driven by the four big banks dominating the industry[63], the role of which is going to be discussed in the next chapter.

[61] Trefis Team 2015
[62] Trefis Team 2015
[63] Avalos and Eren 2019

There were changes in non-bank participants of the repo market as well. "Market commentary suggests that, in preceding quarters, leveraged players (eg hedge funds) were increasing their demand for Treasury repos to fund arbitrage trades between cash bonds and derivatives."[64] So, the repo market was becoming dominated by institutional investors again, just like before the crisis, as explained previously.

[64] Avalos and Eren 2019

Chapter 3: Explanations

It has already been mentioned that there are different potential explanations of what caused the spike in the interest rate in repo markets in September. This chapter will discuss four possible angles that the disruption could be looked at. The first will be a combination of Treasury bonds being settled and quarterly tax payments being due. The second will be changes in regulation. The third reason is the domination of the market by several big institutions. And lastly a change in non-bank participants of the market.

Treasury Bond Settlements and Taxes

One of the explanations of the spike in interest rate in repo markets in September blames a combination of two factors - settlement of Treasury bonds and corporate taxes being due. As the Treasury bonds matured, the amount of securities circulating in the market and being ready to be sold on the repo market suddenly dropped, decreasing the supply. At the same time the companies and banks paid taxes, draining the amount of funds ready to be used on the repo market. According to Internal Revenue Service's *Tax Calendar for use in 2019* tax payments for the third quarter of 2019 for corporations were due on September 16th[65]. This event alone should not have disturbed the market as it did, as the tax payments are quarterly and due every three months. Additionally, in 2017 The Tax Cuts and Jobs Act ("TCJA") was signed into law. The Act "reduced the top corporate income tax rate from 35 percent to 21 percent"[66], which means

[65] Internal Revenue Services 2018
[66] Tax Policy Center

the money taken out of the market in 2019 would actually be a lower percentage of revenue than before.

Since September, there was another period with the same events, but the repo market managed to survive. On December 16th taxes for the fourth quarters for corporations were due and so were the treasury payments[67]. The combination of the same events did not affect the market, although the Fed at the time was still injecting money in the market.

Regulations

Since the Global Financial Crisis of 2008 there have been several regulatory changes that have affected the banking sector. One of the biggest changes was brought by Basel III, on which the Basel Committee on Banking Supervision agreed in 2010 and 2011. Although initially it was set to be implemented by 2015, in 2013 its implementation was extended until March of 2018. Basel III "enhanced minimum capital and liquidity requirements"[68] set in place by Basel II. "Increasing the level of capital requirements to ensure that banks are sufficiently resilient to withstand losses in terms of stress"[69] was one of the main goals of Basel III, alongside improving the quality of the capital. Basel III increased Common Equity Tier 1 (CET1) from 2% to 4.5% and additional Capital Conservation Buffer of 2.5%[70]. The minimum total capital ratio remained at 8%. After adding the Capital Conservation Buffer, "the total amount of capital a financial institution must hold [is brought up to] 10.5% of risk-weighted assets, of which 8.5% must be tier 1 capital"[71] .

[67] "Despite the Fed's Efforts, the Repo Market Risks More Turbulence." 2019.
[68] IBM Knowledge Center
[69] Basel Committee on Banking Supervision 2017
[70] IBM Knowledge Center
[71] IBM Knowledge Center

So what does this change in regulation mean? Increased capital conservation buffer means banks have to have more capital against assets, which in turn decreases capital leverage ratio. Common Equity Tier 1 mostly includes cash and stock; increasing its requirement means banks have to hold more cash and stock against their assets than before. In other terms, the liquidity requirements are increased. Banks use the repo market to get the liquidity they need to meet the obligation. Thus, as the liquidity requirements increase, demand for repo increases too. Consequently, "The big banks' lobby claims that the amount required is too high and that this accounted for the crisis of 17 September 2019."[72] Basel III also demanded higher quality of the capital. For regulatory requirements, both reserves and Treasuries have the same standing and are high-quality liquid assets. "But in practice, especially when managing internal intraday liquidity needs, banks prefer to keep reserves for their superior availability."[73] This explanation claims that the rise in interest rate on the repo market was caused by a rise in demand for repos, which was caused by stricter regulations which require banks to have higher liquidity ratios. It should not be denied that the regulations might have played a role in the disruption of the repo market. On the other hand, the financial institutions could simply be using the disruption of repo market to lobby against the regulations.

It is interesting to mention that while discussing Basel III Moe writes that it " will reduce the need for future liquidity support from central banks."[74] The underlying argument was that higher liquidity ratio and stricter rules about collaterals would "strengthen banks' balance sheets, improve their liquidity position, and in general make them more robust"[75]. One worry Moe had

[72] Toussaint 2019
[73] Avalos and Eren 2019
[74] Moe 2012 p. 72.
[75] Moe 2012 p. 72.

was that the reforms would be too timid and too late. Eight years later, the Fed is facing another crisis and is put in a position where it has to provide liquidity support again. Ironically, one of the factors blamed for the crisis is the set of regulations that was supposed to make the financial sector stable and help the Fed avoid having to provide liquidity support. The Fed needing to provide liquidity support again indicates that the Basel II regulations failed to work as they were intended to. This might indicate that since the GFC the banks have changed their behavior. It also leaves us with a question of what part of the regulation failed. Moe writes that the regulations that were being put in place were not in fact radical enough and proposed five additional regulations to be added - global leverage ratio, divorcing payment system from risky lending activity, limiting the MMLR role of central banks, tougher collateral rules in central banks and ending the "too big to fail" policy[76]. While Basel III proposed bank-specific leverage ratios, Moe worried that would leave off banks' off-balance sheet activity, which was an issue with "sizable volumes of pledged collateral that churn between banks and nonbanks"[77]. It also would not target rehypothecation. Imposing global leverage limits would link these bank-specific regulations to the bigger problem of global liquidity becoming too large.

The second policy proposal was to "Divorce the payment system from risky lending activity"[78]. During the crisis banks were bailed out because they performed functions that were deemed to be critical for the economy, such as providing payment infrastructure. But, this is only part of the services banks provide. Thus, it has to be determined which parts of banks are actually essential or "systemic" and should be saved in times of crisis. But the line between essential and non-essential services provided by banks are highly blurred. The Volcker rule, as

[76] Moe 2012 p. 73
[77] Pozsar and Singh 2011
[78] Moe 2012 p.75

mentioned before, "generally prohibits banking entities from engaging in proprietary trading or investing in or sponsoring hedge funds or private equity funds"[79]. It aims to separate speculative trading and other, essential banking activities. While the Volcker rule was supposed to decrease speculative activities of the banks and draw a line between essential and non-essential activities, Moe believed that it was not enough to protect payment systems in times of crisis. His critique was that it would take a long time to be implemented and would need in-depth discussions of the margins. He was right - Volcker rule became a law in 2010 as part of Dodd-Frank reform, but took three more years to write and was issued in 2013, because of disputes about "how to separate prop trading from market-making and hedging"[80], as predicted. The rule came into effect in 2015, only to be softened by the Trump administration in 2019[81]. As an alternative, Moe discusses a proposal put forward by James Tobin, an economist who has served on the Council of Economic Advisers as well as the Board to Governors of the Federal Reserve. Tobin "suggested that we need a new payment system based on "deposited currency" guaranteed by the state"[82]. The proposal entails some sort of an electronic cash system, that could be run by banks or by the central bank itself. The system would be used by the public for essential banking services. Commercial banks would still retain their functions; they would still offer deposit accounts and payment services. The main benefit of such a system is that in times of crisis banks will not be indispensable, they will no longer be providing essential payment services, so troubled banks will not have to be bailed out because of worries about systematic consequences.

[79] Board of Governors of the Federal Reserve System January 30 2020
[80] Onaran 2019
[81] Onaran 2019
[82] Moe 2012 p.75

The third policy proposal put forward by Moe is what he calls a "new Bagehot rule"[83]. The initial response to the GFC was based on Bagehot's rule, which dictates that "central banks should lend freely in a crisis on good collateral at a high rate of interest."[84] The new rule that Moe puts forward would make it clear that banks would not get liquidity support for speculative activities in times of crisis. The speculative activities should be constrained in times of upswing of the economy, so that when the central banks provide liquidity support in downturn, it is not for speculative activity. The rule would be in favor of protection of the public, instead of large banks. Moe writes that the best approach to the central bank acting as a lender of last resort is that of Minsky, who believed that the central bank should provide liquidity support in times of crisis, as the last option, but should take tough regulatory measures any other time. He believed that central bank acting as the lender of last resort should lead to changes in favor of hedge financing, while the central banks should discourage speculative and Ponzi financing[85]. Minsky and Whalen wrote:

> An essential prerequisite for establishment of a "good financial society" (the term was used first by Henry Simons) in the early 21st Century is a Federal Reserve that continues to prevent debt deflations through its lender-of-last-resort powers. In addition, the Federal Reserve needs to focus more attention on qualitative credit controls (i.e., refusing to guarantee or prohibiting purchase of certain types of assets, particularly those likely to experience speculative price swings) than on quantitative controls.[86]

In other words, they did believe that the Fed should act as a lender of last resort when needed, but as mentioned before, there were some limitations as to what extent and in which cases the

[83] Moe 2012 p.76
[84] Moe 2012 p.6
[85] Minsky 1986 p. 364
[86] Minsky and Whalen 1996 p.14

role should be used. Additionally, they believed that the Fed should focus on controlling the quality of the collateral, which brings us to Moe's next policy proposal - enforcement of tough collateral rules by central banks. This would prevent banks from using cheap collateral, which contributes to the increased fragility of the system. This policy would go hand in hand with the previous two - in order to have tough collateral policies, speculative activities of the banks should be restricted and essential payment functions of banks should be separated from their non-essential activities. "The real bills doctrine" aimed to impose strict collateral rules - "By limiting the type of paper eligible for rediscount, the Federal Reserve ensured that reserves were just sufficient to underwrite production without promoting speculation"[87]. Although, the doctrine had to be revised during the Great Depression as shortage of eligible paper constrained the Fed's supply of liquidity. This experience dictated that reinstating a similar policy might not be wise. Still, some kind of restrictions on collateral quality is needed.

Finally, Moe believed that the size limit should have been enforced on largest SIFIs - Systemically Important Financial Institutions. After the crisis the banking industry became even more concentrated. As Minsky wrote, "If a bank is too big, the central bank cannot stand aside and allow a bank to fail"[88]. So as long as the financial markets are dominated by few large institutions, the Fed will act as their lender of last resort and bail them out in case of failure. Domination of the financial market by several big institutions makes it more fragile, as failure of one can have colossal effects on the entire system or the economy. The GFC was a clear demonstration of this. However, today the financial market is still dominated by several big banks, as will be further discussed next.

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[87] Moe 2012 p.77
[88] Minsky 1985

The GFC left the financial sector in obvious need for stricter regulations. One possibility why the economy after 12 years is in a dire situation again could be that Basel III regulations were in fact too strict and led to an increase in demand on repo that the market could not satisfy. On the other hand, the regulation might not have been strict enough, or might have been too late, as predicted by Moe, and did not manage to stabilize the financial sector. One reason why could be that the regulations did not include one of the changes proposed by Moe - to "Stop the 'Too Big To Fail' Policy"[89]; thus, the market is still dominated by several banks. Another reason could be that while the regulations target banks, the repo market is increasingly used by non-bank financial institutions. These two factors are discussed next.

A problem of market domination

After the GFC, the Fed started buying treasuries, up until October of 2017. The termination of Treasury purchases had a double effect on the repo market - as the Fed was not buying treasuries anymore, banks and investors stepped in, draining money to be used on the repo market, decreasing supply; some used the repo market to finance these purchases, thus increasing the demand. In 2018 the Trump administration decreased corporate taxes, increasing the budget deficit. More treasuries were sold because of the procedures adopted that dictate that outstanding bonds should grow to match the deficit. Again, banks and investors drained cash reserves to buy the treasuries, supply of cash decreased again. In March of 2019 the yield curve inverted, causing some distress and discouraging investors from buying long-term treasuries. Once again cash reserves were drained and supply decreased. In August of 2019 the debt ceiling was suspended,

[89] Moe 2012 p. 78

leading to US Treasury "draining more than $120 billion of reserves in the 30 days between 14 August and 17 September alone, and half of this amount in the last week of that period"[90].

After all these events we get to September 2019 - at this point banks have $1.2 trillion in cash reserves at the Fed[91]. On the repo market they could have earned higher interest, but still they did not lend the cash. While some, as explained above, blame stricter regulations, the problem seems to be not that they are too strict, or the reserves are not enough, but that they are concentrated in large banks, "which have to keep a level of high-quality, liquid assets on their balance sheets"[92]. The US repo market is dominated by four banks that act as lenders. This can be seen on figure 9 - the top four banks are biggest providers of net liquidity. While other banks are still net borrowers, liquidity provided by the top four banks has spiked dramatically since the GFC. According to a quarterly review of the Bank for International Settlements (BIS), "As the composition of their liquid assets became more skewed towards US Treasuries, their ability to supply funding at short notice in repo markets was diminished"[93].

[90] Avalos and Eren 2019
[91] Tilford et al. 2020
[92] Tilford et al. 2020
[93] Avalos and Eren 2019

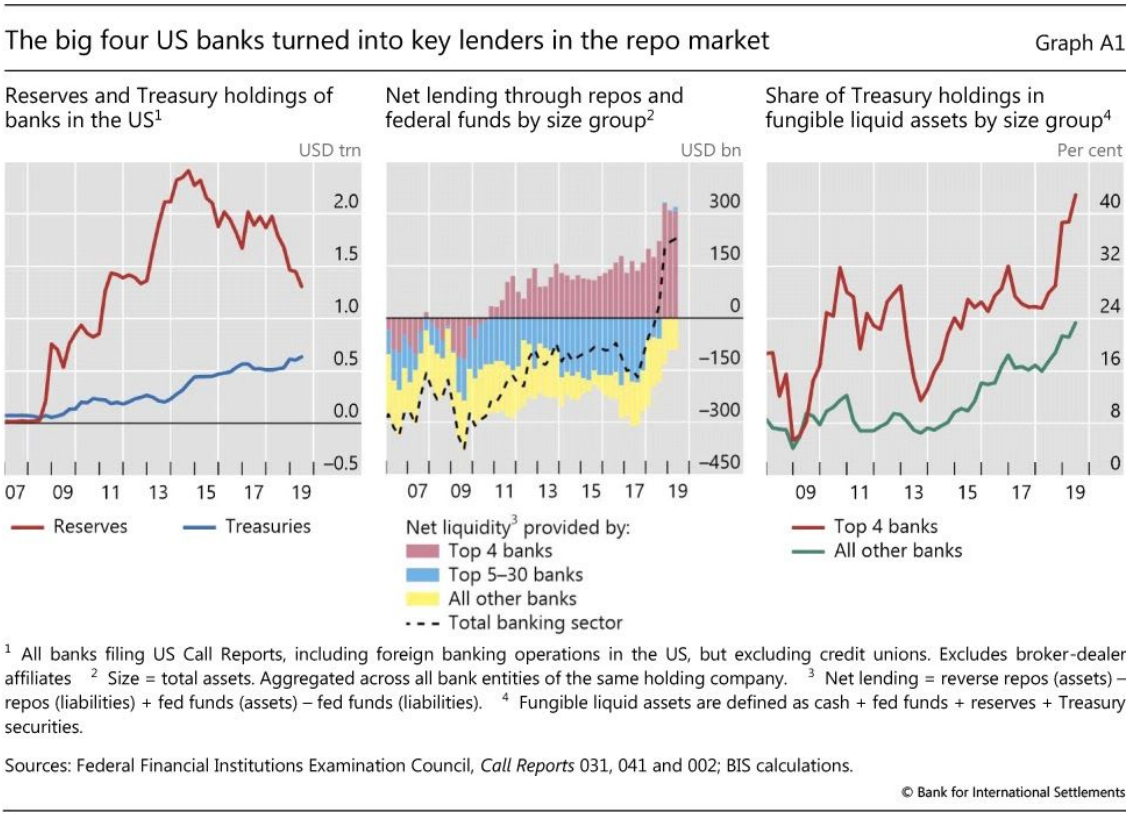

Figure 9 - The big four banks turned into key lenders in the repo market

Source: Federal Financial Institutions Examination Council, Call Reports 031, 041 and 002. BIS calculations. Retrieved from Avalos, F., Ehlers, T., & Eren, E. "September stress in dollar repo markets: Passing or structural?" BIS Quarterly Review. December 08, 2019

Non-bank Participants

Shadow banking, as explained by Moe, played a crucial role in the GFC. It might have played a role in the spike of the rate in September as well. Since before the GFC repo market became increasingly used by non-bank entities. Shifts in their behavior could have also played a role. "Market commentary suggests that, in preceding quarters, leveraged players (eg hedge funds) were increasing their demand for Treasury repos to fund arbitrage trades between cash bonds and derivatives"[94]. Since 2017 Money Market Funds (MMFs) have broadened the range of the repo

[94] Avalos and Eren 2019

counterparties they lend to to include hedge funds. The spike in September suggested a reluctance to lend on the part of the MMFs. "Market intelligence suggests MMFs were concerned by potential large redemptions given strong prior inflows. Counterparty exposure limits may have contributed to the drop in quantities, as these repos now account for almost 20% of the total provided by MMFs."[95] Economist Joseph LaVorgna suggested that the fact that there was no spike in the fed funds rate, a rate at which banks provide loans to each other overnight, meant that the problem was not in the banking sector[96]. This would imply that the spike was in turn caused by the changed activity of the non-bank participants.

[95] Avalos and Eren 2019
[96] Robb 2019.

Chapter 4: Covid-19 and Repo Market

The global Pandemic has disrupted the normal flow of the world, including the financial markets. As the markets are struggling, the Fed started injecting more money into them. This led to an increase in supply in repos, leading to a decrease in the repo rate as is shown on the figure 1 on page 5. The Fed is adding money to the market with repos - The $100 billion cap on overnight repos has been exceeded[97]as the Fed continuously offers $175 billion in overnight repos as well as $45 billion in two-week operations[98].

The Fed cut the rate by half percentage point, leading to Treasury yields dramatically falling[99]. This was the most substantial one-time cut since the Global Financial Crisis[100]. So what was the reason behind the cut? Many believe that "the fire [the Fed] was trying to put out was actually in the repo market" [101] - one that started long before the pandemic. Lower Fed Funds rate was supposed to encourage banks to lend to each other. Although, it did not work as if banks were not willing to lend at 1.5%, they would be even less willing to lend at 1%. Since this outcome was easily predictable, why would the Fed still lower the rates? One theory is that it had to respond with some policy action; an alternative would have been more controversial Quantitative Easing. So the Fed went with lowering rates just to show it took action and is still in control.

[97] Derby 2020
[98] Cox 2020
[99] Derby 2020
[100] Brown March 9, 2020
[101] Brown March 9, 2020

Figure 10 - Effective Federal Funds Rate

Source: Federal Reserve Bank of New York, retrieved from FRED, Federal Reserve Bank of St. Louis April 30, 2020

Treasury bill buying by the Fed started in September and was supposed to be over sometime in the second quarter, but the recent development in the markets have changed the plan [102]. The Fed announced purchases of Treasuries worth $60 billion. It also widened the range of Treasuries purchased, which until now had to be short term T-bills and now include "bills, notes, Treasury Inflation-Protected Securities and other instruments".[103]

The Fed's discount window is open to only licensed depository banks[104], while the repo market is open to hedge funds and shadow banks as well. So as the Fed pours billions of dollars into the repo market, it is not simply helping banks, it is also making risk-free loans to speculators.

[102] Derby 2020
[103] Cox 2020
[104] Brown January 10, 2020.

Chapter 5: Conclusion

The repo market is an important part of the financial system, so a spike in repo rates which led to the Fed injecting billions of dollars in the market for several months was a sign of worry for many. While many explanations were offered, it seems that the disruption is a sign of a deeper systemic problem. Although maturing treasuries and taxes have been blamed, these are recurring events that have happened since the spike without causing any further disruption. Basel III regulations are commonly blamed as well, as they increased liquidity requirements, so the banks have to hold more reserves than before. While this could lead to increased demand for repo lending in order to meet the requirements, it also begs the question of why banks are not lending on the market when they have large amounts of excess reserves.

In order to find an answer we might have to look back at the last crisis and how the markets have changed since. The Repo market played an important role in the GFC in 2008 and even though some regulations were put in place, it has not become a safer part of the financial system since. Some of the issues that became evident during the GFC were the "too big to fail" banks, shadow banking, rehypothecation and quality of collateral. All these aspects contributed to increased fragility of the economy. During the 2008 crisis banks had to be bailed out by the Fed as their failure could have affected the entire economy. Additionally, banks performed essential activities such as providing payment infrastructure. But these activities were not divorced from risky lending activities. So as the Fed was bailing out banks, it was not only saving the essential part of the bank, but also the non-essential one that increased fragility of the economy because of its risk-taking in the first place. Although the Volcker rule tried to separate

the two, it took too long to be implemented and was softened before it could have any effect. The financial system is still dominated by four big banks, who have become net lenders on the repo market. The increase in the repo rate might indicate their reluctance to lend. A possible explanation is that these banks have to hold reserves because of Basel III regulations. Since these four banks are the net lenders, their reluctance to lend could result in a disturbance of the entire market. Additionally, the repo market is also highly used by non-bank financial institutions and shadow banks.

The most recent developments and the economic crisis brought on by the global pandemic makes it hard to say what would have been the long-term impact of the disturbance of the repo market alone. Still, there is reason to say that since the GFC not enough has been done to make financial system less fragile and to avoid the need for the Fed to act as a liquidity supplier - the market is still dominated by “too big to fail” banks, essential and non-essential banking are not separated, shadow banks still pose a threat. The disturbance in the repo market might have been yet another consequence of evolution of the financial markets away from relationship banking and towards market-based liquidity provision.

Appendix

Date	Interest rate on excess reserves	Effective Federal Funds Rate	
2008-10-01	0.84	0.97	1.25
2008-11-01	0.94	0.39	1.25
2008-12-01	0.61	0.16	0.50
2009-01-01	0.25	0.15	0.50
2009-02-01	0.25	0.22	0.50
2009-03-01	0.25	0.18	0.50
2009-04-01	0.25	0.15	0.50
2009-05-01	0.25	0.18	0.50
2009-06-01	0.25	0.21	0.50
2009-07-01	0.25	0.16	0.50
2009-08-01	0.25	0.16	0.50
2009-09-01	0.25	0.15	0.50
2009-10-01	0.25	0.12	0.50
2009-11-01	0.25	0.12	0.50
2009-12-01	0.25	0.12	0.50
2010-01-01	0.25	0.11	0.50
2010-02-01	0.25	0.13	0.75
2010-03-01	0.25	0.16	0.75
2010-04-01	0.25	0.20	0.75
2010-05-01	0.25	0.20	0.75
2010-06-01	0.25	0.18	0.75
2010-07-01	0.25	0.18	0.75
2010-08-01	0.25	0.19	0.75
2010-09-01	0.25	0.19	0.75
2010-10-01	0.25	0.19	0.75

2010-11-01	0.25	0.19	0.75
2010-12-01	0.25	0.18	0.75
2011-01-01	0.25	0.17	0.75
2011-02-01	0.25	0.16	0.75
2011-03-01	0.25	0.14	0.75
2011-04-01	0.25	0.10	0.75
2011-05-01	0.25	0.09	0.75
2011-06-01	0.25	0.09	0.75
2011-07-01	0.25	0.07	0.75
2011-08-01	0.25	0.10	0.75
2011-09-01	0.25	0.08	0.75
2011-10-01	0.25	0.07	0.75
2011-11-01	0.25	0.08	0.75
2011-12-01	0.25	0.07	0.75
2012-01-01	0.25	0.08	0.75
2012-02-01	0.25	0.10	0.75
2012-03-01	0.25	0.13	0.75
2012-04-01	0.25	0.14	0.75
2012-05-01	0.25	0.16	0.75
2012-06-01	0.25	0.16	0.75
2012-07-01	0.25	0.16	0.75
2012-08-01	0.25	0.13	0.75
2012-09-01	0.25	0.14	0.75
2012-10-01	0.25	0.16	0.75
2012-11-01	0.25	0.16	0.75
2012-12-01	0.25	0.16	0.75
2013-01-01	0.25	0.14	0.75
2013-02-01	0.25	0.15	0.75
2013-03-01	0.25	0.14	0.75
2013-04-01	0.25	0.15	0.75

2013-05-01	0.25	0.11	0.75
2013-06-01	0.25	0.09	0.75
2013-07-01	0.25	0.09	0.75
2013-08-01	0.25	0.08	0.75
2013-09-01	0.25	0.08	0.75
2013-10-01	0.25	0.09	0.75
2013-11-01	0.25	0.08	0.75
2013-12-01	0.25	0.09	0.75
2014-01-01	0.25	0.07	0.75
2014-02-01	0.25	0.07	0.75
2014-03-01	0.25	0.08	0.75
2014-04-01	0.25	0.09	0.75
2014-05-01	0.25	0.09	0.75
2014-06-01	0.25	0.10	0.75
2014-07-01	0.25	0.09	0.75
2014-08-01	0.25	0.09	0.75
2014-09-01	0.25	0.09	0.75
2014-10-01	0.25	0.09	0.75
2014-11-01	0.25	0.09	0.75
2014-12-01	0.25	0.12	0.75
2015-01-01	0.25	0.11	0.75
2015-02-01	0.25	0.11	0.75
2015-03-01	0.25	0.11	0.75
2015-04-01	0.25	0.12	0.75
2015-05-01	0.25	0.12	0.75
2015-06-01	0.25	0.13	0.75
2015-07-01	0.25	0.13	0.75
2015-08-01	0.25	0.14	0.75
2015-09-01	0.25	0.14	0.75
2015-10-01	0.25	0.12	0.75

2015-11-01	0.25	0.12	0.75
2015-12-01	0.37	0.24	1.00
2016-01-01	0.50	0.34	1.00
2016-02-01	0.50	0.38	1.00
2016-03-01	0.50	0.36	1.00
2016-04-01	0.50	0.37	1.00
2016-05-01	0.50	0.37	1.00
2016-06-01	0.50	0.38	1.00
2016-07-01	0.50	0.39	1.00
2016-08-01	0.50	0.40	1.00
2016-09-01	0.50	0.40	1.00
2016-10-01	0.50	0.40	1.00
2016-11-01	0.50	0.41	1.00
2016-12-01	0.64	0.54	1.25
2017-01-01	0.75	0.65	1.25
2017-02-01	0.75	0.66	1.25
2017-03-01	0.88	0.79	1.50
2017-04-01	1.00	0.90	1.50
2017-05-01	1.00	0.91	1.50
2017-06-01	1.13	1.04	1.75
2017-07-01	1.25	1.15	1.75
2017-08-01	1.25	1.16	1.75
2017-09-01	1.25	1.15	1.75
2017-10-01	1.25	1.15	1.75
2017-11-01	1.25	1.16	1.75
2017-12-01	1.40	1.30	2.00
2018-01-01	1.50	1.41	2.00
2018-02-01	1.50	1.42	2.00
2018-03-01	1.58	1.51	2.25
2018-04-01	1.75	1.69	2.25

2018-05-01	1.75	1.70	2.25
2018-06-01	1.86	1.82	2.50
2018-07-01	1.95	1.91	2.50
2018-08-01	1.95	1.91	2.50
2018-09-01	1.98	1.95	2.75
2018-10-01	2.20	2.19	2.75
2018-11-01	2.20	2.20	2.75
2018-12-01	2.28	2.27	3.00
2019-01-01	2.40	2.40	3.00
2019-02-01	2.40	2.40	3.00
2019-03-01	2.40	2.41	3.00
2019-04-01	2.40	2.42	3.00
2019-05-01	2.35	2.39	3.00
2019-06-01	2.35	2.38	3.00
2019-07-01	2.35	2.40	3.00
2019-08-01	2.10	2.13	2.75
2019-09-01	1.98	2.04	2.50
2019-10-01	1.79	1.83	2.25
2019-11-01	1.55	1.55	2.25
2019-12-01	1.55	1.55	2.25
2020-01-01	1.55	1.55	2.25
2020-02-01	1.60	1.58	2.25
2020-03-01	0.63	0.65	0.25
2020-04-01	0.10	0.05	

Table 1 - Monthly Interest Rate on Excess Reserves, Effective Federal Funds Rate and Discount Rate

Source: Board of Governors of the Federal Reserve System (US), International Monetary Fund (IMF) retrieved from FRED, Federal Reserve Bank of St. Louis, May 2 2020

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