

The collateral supply effect on central bank policy

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August 21, 2020

Abstract: This paper starts by describing the evolution of US money markets over the course of the 1990s and the 2000s. The crucial transition was from an unsecured core money market, the Federal Funds market, to a collateralized market, the repo market. Due to this shift, collateral supply has become an important factor in money market dynamics. Three important implications of this transformation are discussed: First, government debt issues now affect the money market not just due to the need to settle payment for the debt, but also due to the on-going need to fund the carry of the debt. Second, because long-term debt is an important component of collateral supply, any significant increase in long-term rates will have a dramatic effect on the value of the aggregate collateral supply thereby making monetary policy implementation more difficult. Third, the events of March 2020 provide evidence of structural instability in the repo market, and of the problematic nature of a ‘dealer of last resort’ solution. This paper argues that the collateral supply implications of the new money market environment merit careful study, and critically evaluates the dealer of last resort, the proposal for a centralized counterparty for Treasuries, and the proposal for a standing repo facility.

Key words: money market, repo market, monetary policy, collateral supply, standing repo facility, dealer of last resort, centralized counterparty, March 2020

JEL codes: E5, N22

The genius of the Anglo-American financial structure that has sat at the center of the world financial system throughout the years of modern growth is precisely its construct of two separate, but closely related, spheres of policy implementation. Fiscal policy – together with long-term finance more generally – was able to be implemented mostly independent of monetary policy. The latter was used to keep the economy on an acceptably (un)stable path, while at the same time long-term fund-raising could take place to finance either the government, business activity or both, as the circumstances demanded.

At the core of this system sat a central bank that both supported government debt, and yet did so in a carefully circumscribed manner. In particular, in normal times the central bank did not stand ready to purchase or to repo all maturities of government debt. Only short-term bills could be monetized in this manner on a standing basis (and even that facility was not always available). Effectively, in normal times the private sector was required to both fund and bear the risk of long-term government debt. This structure made possible extraordinary liquidity provision by the central bank in the money market, while deliberately limiting liquidity in long-term markets so that the risks were borne by long-term investors.

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Arguably this dual market structure made possible the separate implementation of monetary and fiscal policy. The central bank provided ample short-term liquidity by setting an interest rate and standing ready to meet the needs of the money market at that rate (Moore 1988; Bindseil and König 2013; Lavoie 2019). This had the effect of stabilizing the value of short-term Treasury bills, since it eliminated the need to sell them on the market for liquidity purposes – liquidity was available from the central bank at a fixed rate. But the central bank did not (with some short-lived exceptions) determine a yield at which it stood ready to buy long-term government debt. Instead private financial institutions mediated between the abundant liquidity provision by the central bank in the money market and the market liquidity that was available in long-term debt markets. This generated an environment where the yield on long term debt was often described as determined by a combination of the expected path of central bank policy rates and a ‘term premium’ that was variable and affected by market forces (e.g. Swanson 2007; Borio and Disyatat 2011). Despite this relationship between the short- and the long-term markets, the separation was sufficiently well defined that monetary and fiscal policy could be treated as distinct instruments.

The evolution of markets over the past two decades has normalized a breakdown in this traditional market structure by inverting the relationship between long-term and short-term markets. In the past the money market was the locus where abundant central bank liquidity flowed – especially in times of crisis, whereas long-term bond investors were viewed as bearing the risk of any price changes in the bond market. Now in times of crisis the money market drains liquidity from the financial system and places immense demands on long-term markets to supply that liquidity. Instead of fluctuations in the price of long-term bonds being a matter for long-term bond investors to deal with, the price of long-term bonds is now a money market problem and more generally a liquidity problem for the economy as a whole. As a result, central banks in 2008 and 2020 have had to step in to provide liquidity through long-term markets rather than through traditional money market channels.

What evolution of markets has caused the roles of long-term and short-term markets to be inverted? The 21st century rise of the modern repo market has converted government long-term debt issues into money market instruments to an unprecedented degree.¹ After explaining how the modern repo market came into existence, this paper investigates the consequences of this integration of long-term government debt and money markets. First, fiscal policy puts new pressures on monetary policy, which therefore needs to be reformulated to take into account the funding demands created by government debt issues that are used as collateral. Second, rising rates on long-term debt have significant collateral supply effects and this changes how policy rates affect the money supply. Leading to a third point: the events of March 2020 indicate that the shift to repo markets as core money markets has changed the relationship between the money market and the market for long-term debt. Instead of being a source of liquidity, the money market drains liquidity from the system, and it is through the long-term debt market that liquidity can be restored by the central bank to the financial system.

¹ While repo-like loans (e.g. call loans) have been in existence since the 19th century (Lavington 1921; Sissoko 2017), their importance today to the international money market does not have a historical precedent.

This inversion of the roles of short-term and long-term markets has implications for the operation of monetary and fiscal policy as independent tools, and policymakers have been slow to recognize this. This essay investigates the transformation of market structure that took place in the decade preceding the financial crisis and the implications of this transformation for the implementation of monetary policy. Note that this paper discusses the transformation of the US monetary system. While the framework developed here has applications to monetary systems outside the US, they are not addressed here.

This paper contributes to the international political economy (IPE) literature on the repo market and how it has transformed market structures. Gabor and Ban (2016) discuss the embrace of this transformation by European policy makers, while Gabor (2016) and Braun (2018) discuss how it has affected the relationship between governments and the dealer banks. Gabor Dafermos and Michell (2020) use a framework based on Minsky to place this transformation in a broad historical context, explaining both how the collateral regime was meant to be a stabilizing mechanism for an unstable economy, and how this mechanism ultimately was not fit for purpose. This paper focuses attention on the infrastructure at the heart of the modern repo market, and in particular on the role played by JPMorgan Chase (JPMC) in establishing this market.² Like the IPE literature this paper depicts the infrastructural entanglement between central bank and the repo dealers, but it goes further to claim that this entanglement has progressed so far that the Federal Reserve has been forced to step into JPMC's shoes. The conclusion will propose some possible mechanisms by which the Federal Reserve can attempt to take back control over the economy's financial infrastructure.

The basic framework that is used to evaluate this transformation of the monetary system is that of endogenous money. This paper takes, however, a very different approach to endogenous money than that espoused by Wray (1998) or Mehrling (2011) who emphasize balance sheet analysis. (For a comprehensive review of current research in the endogenous money literature, see Lavoie 2019.) Because this paper emphasizes the off-balance-sheet money creation activities of banks, it refers back to an older endogenous money literature reviewed in Lavoie (1985) and is most closely connected to the post-Keynesian treatment of shadow banking as reliant on money creation by traditional banks (Michell 2017; Bouguelli 2020).

This paper is closely related to work by Manmohan Singh and Peter Stella (2012) and by Pozsar (2019) on the relationship between collateral and monetary policy. The key distinctions are that this paper presents a novel approach for understanding the monetary nature of collateral, and presents two discrete effects of collateral supply on monetary policy that are distinct from Singh and Stella (2012). The second effect presented here is related to Singh and Goel (2019), which is discussed below. Singh (2013) frames collateral as providing services, whereas collateral here is viewed as generating a money market demand for funding.

Section I starts by introducing an alternative way of thinking about the money supply – by focusing on off-balance-sheet bank liabilities. Section II reviews pre-crisis monetary policy in

² JPMC's role in the modern repo market is comparable to the role played by Drexel Burnham in the junk bond market (Brewer and Jackson 2000).

the US. Section III presents the history of the evolution of financial markets in the decades preceding the crisis. Section IV discusses the importance of collateral supply in modern markets and its implications for monetary policy. Section V evaluates proposals for reform, and Section VI concludes.

I. What is money?

The first step in this exposition of the challenges facing current monetary policymakers is to present a definition of money that expands significantly on the definition that is currently in use. Using this definition, we can see how the modern repo market monetizes sovereign debt of all maturities. The distinction between conventional, or circulating, money and reserve balances will also be discussed in this section.

a. Circulating or conventional money

The standard definitions of money focus on the instruments held by the public that can circulate: M1 is comprised of physical currency and checking accounts, while M2 is very easily convertible into circulating instruments and includes M1 plus savings accounts, retail money market accounts, etc.

Several weaknesses in these monetary measures are well-established. In particular, there is a recognition that broader measures may be more relevant to economic activity, but it is sufficiently difficult to design a broad measure that the Federal Reserve no longer publishes such a measure. M3 was discontinued by the Fed, because as an unweighted sum of very different instruments, it failed to be useful. The Divisia monetary aggregates seek to address the weaknesses in the M3 measure by weighting the different broad instruments by a price that represents the user-cost of each instrument and by including credit card services (Barnett et al. 2013; Barnett & Su 2016).

By contrast, this paper follows Keynes (1930: 41-43) and an older branch of Post-Keynesian monetary theory in emphasizing the importance of overdrafts to the money supply (Lavoie 1985). Note that the contractual commitments represented by overdrafts and similar obligations to fund loans on demand are not reported ‘on-balance-sheet’ and are not a part even of sophisticated monetary measures, such as the credit card augmented Divisia aggregates.

To understand the importance of off-balance-sheet as opposed to the on-balance-sheet commitments of banks, consider this example: if you have an overdraft checking account at a bank with a balance that is currently at \$0, but with a credit limit of \$1000, as a practical matter you have the same spending capacity as someone with \$1000 in a checking account with no overdraft. Only one of these, however, is defined using M1, M2 or a Divisia aggregate as money; the overdraft falls outside the definition. From the bank’s perspective the positive balance in the checking account is an on-balance-sheet liability, while the overdraft is an off-balance-sheet contingent liability that doesn’t need to be accounted for until it becomes more likely than not to be drawn down.

In fact, institutional factors will determine whether or not contractual bank credit commitments of the sort described above should be included in measures of the money supply. If almost everybody has an overdraft, but almost nobody uses them, then it makes sense to exclude them in

the money supply. On the other hand, if everybody is operating on regular overdrafts and the degree to which banks are willing to increase or decrease overdrafts is a factor in economic activity, measuring overdrafts may be important to understanding monetary dynamics.

Using this framework it becomes clear that in the environment leading up to the 2007-09 crisis, off-balance-sheet contingent bank liabilities were an important determinant of the money supply that mattered in determining economic activity. The bank liquidity facilities or contracts that supported the issue of commercial paper were a clear example of this. Both non-financial corporations and asset-backed commercial paper conduits relied on these contingent bank liabilities to finance real economic activity. Indeed, commercial paper couldn't get top credit ratings (or be purchased by money market funds) without such bank support (Sissoko 2013). And in 2007 and 2008 the banks were forced to honor these commitments by expanding their balance sheets. As a practical matter, the expansion of the money supply took place *before* 2007 when the banks entered into the commitments that made it possible for the real activity to be financed. Note that – precisely because the credit rating agencies were taking into account the possibility that these facilities would be drawn down at an inopportune moment – the banks that could offer these contractual facilities were those that had a reasonable expectation of government support, or in other words were too-big-to-fail.

There is, however, another kind of off-balance-sheet bank commitment that is equally important, but not based on contractual commitments. This is the commitment of a market maker. A market maker stands ready to buy at the asking price or sell at the offer price. The market maker has the right to set the ask price and the offer price and has the obligation to execute trades at the given prices. When it comes to the money supply, it is specifically standing ready to buy at the ask price that is important.

Central bank standing facilities give an example of this kind of off-balance-sheet commitment and its importance to the monetary system. When a central bank has a policy of standing ready to purchase an asset in exchange for circulating balances or central bank notes (i.e. not reserves) on specified terms, the effect is to monetize that asset. Examples of such a policy include the Bank of England's commitment dating back to the early 1700s to purchase Exchequer Bills and the Bank of England's 19th century discount policy which set the terms on which it would purchase commercial bills. This was a way of monetizing Exchequer bills and prime commercial bills.³

A central bank commitment to provide a loan secured by an asset that is posted as collateral (or in other words to repo the asset) may have the same *monetary* effect as a central bank providing a standing facility to purchase the asset. In particular, as long as the central bank treats the asset in question as 'good' collateral and implicitly or explicitly guarantees that it will repo the asset with only a small haircut, then the monetary effect of a standing commitment to repo will be the same as a standing commitment to purchase. This is a consequence of the commitment by the central bank to provide circulating balances in exchange for the asset, and the fact that the commitment means that this funding will continue over time.

³ The role of lender of last resort and the monetization of 'good' assets that are accepted at a central bank standing facility are closely related.

Note that the solvency or balance sheet effect of the repo is very different from the monetary effect of the repo. From the balance sheet perspective an outright purchase differs from a repo, because in the case of a purchase the risk of the asset is transferred to the central bank, whereas in the case of the repo the borrower continues to bear the risk of the asset. Thus, a central bank standing repo facility that pays out circulating balances can be expected to monetize those assets that are both eligible for repo and not subject to significant haircuts, while at the same time leaving the risk of carrying those assets on the balance sheets of the repo borrowers.

Note, however, that it is not only a central bank that has the capacity to monetize assets. An FDIC-insured commercial bank that makes markets in assets or in the repo of assets may also have the capacity to monetize those assets. In particular, if a too-big-to-fail commercial bank makes markets in repo and is perceived by market participants as standing ready to fund a specified class of assets on repo, then that policy on the part of the commercial bank may have the effect of monetizing the assets in question.

To summarize in order to measure the money supply that matters in terms of economic activity, it is important to measure not just on-balance-sheet bank obligations, such as deposits and money market savings accounts, but also off-balance-sheet bank obligations. These off-balance-sheet obligations may take the form of contractual obligations, like liquidity facilities, or they may take the form of a market making commitment. As a result, when a too-big-to-fail commercial bank makes markets in repo, that market making commitment may be all that is necessary to monetize the assets that the bank stands ready to repo.

b. Reserve balances

When discussing the challenges of monetary policy, it is essential to draw a distinction between the conventional, circulating money supply and the supply of bank reserves. Banks are required to hold reserves with the Federal Reserve. These reserves are special kind of central bank account that can only be held by a bank,⁴ and that therefore cannot circulate as money.

The system of reserves creates a two-tier monetary system in which the Federal Reserve, by implementing monetary policy through the market for reserves, delegates to private sector banks and their lending criteria the day-to-day decisions as to how and where any changes in Federal Reserve liquidity provision will flow into the circulating money supply. Indeed, whether or not a change in the supply of reserves affects the circulating money supply at all depends largely on the behavior of the banks that hold reserves.⁵ Thus, a Standing Repo Facility proposal that would have the central bank stand ready to exchange *reserves* for certain assets posted by banks as collateral cannot be assumed to have the effect of monetizing the assets in question. Instead, it is essential to carefully analyze the effect that such a policy is likely to have on the behavior of banks with respect to the circulating money supply.

⁴ I'm simplifying a little here because certain other entities, in particular the government as well as government sponsored entities like Fannie Mae and Freddie Mac, can also hold reserves.

⁵ Expectations of the public may also be affected by the announcement of the central bank policy and thus the behavior of the public may change.

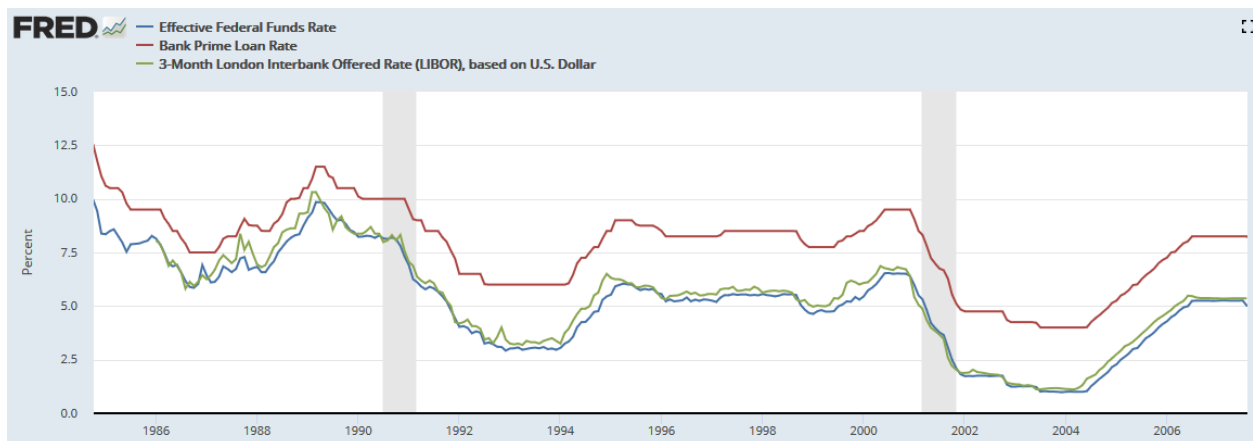
II. Pre-crisis monetary policy in the US

Prior to the financial crisis, monetary policy in the US was set through the Federal Funds market, where reserve balances were loaned and borrowed between banks. The Federal Reserve's Federal Open Market Committee would set a target rate for the interest rate in the Federal Funds market. Observe that this is a private market rate. A bank might need additional reserve balances to meet regulatory requirements and could turn to the Federal Funds market to borrow those reserves. By successfully, targeting and committing to support a specific rate in the Federal Funds market, the FOMC could ensure that each bank faced a predictable rate at which to borrow reserves when needed.

The FOMC could be successful in hitting the target for the Federal Funds rate, precisely because reserves are balances held at the Federal Reserve and their quantity is under the control of the Fed. Thus, the FOMC had a policy of supplying just the right quantity of reserves to ensure that the target rate was met. The supply of reserves was increased by either buying securities from banks and paying for them with reserves, or by lending reserves on the repo (i.e. a reverse repo) of a security. A decrease in reserves was effected by selling securities to banks or by repointing a security, thereby reducing the reserves available to the banks. These transactions were executed by the Fed's open market trading desk.

Hitting the target required maintaining regular, intraday contact with banks so that the Fed's open market trading desk could accurately predict what was going on with money demand. For example, there are predictable increases in money demand around Christmas time that need to be accommodated by an increase in the supply of reserves if the target is to be met. There are also sporadic shifts in demand that may be created by a bad storm or a financial dislocation in a foreign market. On a daily basis, the open market trading desk would tweak the supply of reserves to ensure that the target would be met – and was, prior to the crisis, very successful in meeting the target.

Chart 1: Money market rates



Source: St. Louis Fed Fred database, <https://fred.stlouisfed.org/graph/fredgraph.png?g=q9FK>

Setting the interest rate in the Federal Funds market affected the circulating money supply through the effect that this policy had on the behavior of banks. As Chart 1 demonstrates, changes in the Federal Funds rate were closely followed by other short-term money market rates. In particular, both the bank prime rate, which is nominally the rate that banks charge their best customers, and the London interbank offer rate, or the rate that the bank's charge each other for dollar loans in international markets, moved together with the Federal Funds Rate.

In short, pre-crisis the Fed was very successful at determining the price of money, or in other words the interest rate paid on short term loans from banks. While this did not map immediately into a responsive relationship in terms of monetary aggregates, there is no question that the Fed was able to have an impact on both the terms of bank lending and economic activity through its monetary policy decisions.

Since the crisis, the federal funds market has stopped serving as an effective venue for implementing monetary policy. The basic model that many people have in mind when they think about monetary policy implementation continues, however, to derive from the traditional operation of the federal funds market. For this reason, careful comparisons with pre-crisis monetary policy implementation are important.

To summarize, pre-crisis monetary policy was implemented by setting a key rate that determined US banks' cost of borrowing on an unsecured basis. This rate then determined the terms upon which the banks were willing to lend, which then affected asset prices, exchange rates, non-bank interest rates and economic activity more generally.

III. From Fed Funds to the repo market

While monetary policy implementation was perceived as taking place in the manner described above through 2008 when legislation empowered the Federal Reserve to pay interest on excess reserves, in fact, significant changes in the money market affected the implementation of monetary policy in the 1990s. In particular, the decade and a half preceding the 2007-09 financial crisis was one of dramatic changes in the repo market. First, the tri-party repo market grew as a means of generating virtually unlimited intraday bank credit, while operating 'under the radar' of the bank regulators. Then, in 1997, notably the year in which the Asian Financial Crisis took place, JPMorgan moved its repo market making 'into the bank,' and then in 2000 became one of the core tri-party clearing banks via a merger with Chase Manhattan Corporation. The end result of this bank intermediation of the repo market was to super-charge it with implicit government guarantees, and to convert JPMorgan Chase into a *de facto* central bank implementing its own monetary policy through the repo market.

a. 'Market-based' finance, intraday credit, and the growth of the repo market

Prior to 1994 the Federal Reserve provided intraday credit to banks at no charge. Regulation through the 1980s promoted 'market-based' finance, and the bond markets evolved such that securities dealers were funding their positions overnight on the repo market and relying on their clearing bank's access to intraday Federal Reserve credit to effectively finance the securities

dealers' balance sheets during the day.⁶ In order to constrain this finance of markets rather than banks, the Federal Reserve began charging banks for intraday overdrafts in 1994 (Coleman 2002; Gabor 2019).

The effect of the new policy of charging banks for intraday credit (together with the Federal Reserve's limited understanding of the repo market) was to shift the provision of costless intraday credit from the Federal Reserve to the (too-big-to-fail) clearing banks that intermediated the tri-party repo market. In short, because tri-party repo was an alternate means of generating intraday balances that faced no regulatory charge, the shift towards pricing intraday credit did not reduce its use, but instead promoted the growth of the tri-party repo market (Martin and McLaughlin 2015; Gabor 2019).

Notably, the basic business of a tri-party clearing bank was funding and not trading, and as a result it was common for the clearing banks to hold very little repo in their own name. The market-makers in repo who facilitated pricing in the market – with an effect on the value of the underlying assets – were the securities dealers. This separation meant that the tri-party clearing banks were not both determining the value of the assets that they funded intraday and providing a mechanism to fund those assets indefinitely on the repo market. They were simply funding the assets at the market price as determined by other parties.

In 1997, however, JP Morgan & Co. moved its repo market making into its US domiciled, FDIC-insured bank, the Morgan Guaranty Trust Company. That is, the call reports for Morgan Guaranty show only negligible repo balances in December 1996, but by December 1997 the repo figures for lending (i.e. reverse repo) in the bank call reports have increased by an order of magnitude and comparison with the repo lending of the overall company in the annual report (p. 45) show that the figures roughly match.⁷ Since the 1997 annual report (p. 96 - 97) indicates that 60% of the lending on repo takes place in offices located abroad, whereas virtually all of the borrowing is domestic, it would appear that in 1997 the US FDIC-insured bank began to engage in back-to-back transactions with its foreign affiliates (possibly through the intermediation of a domestic affiliate). This pattern continues through 1999, although with a decline in overseas repo to about one-third of the total for lending on repo. Note that on the liability side of the balance sheet, while there is a dramatic increase in repo borrowings from 1996 to 1997 per the bank call reports, they account for only 45% of the borrowing on repo of the overall company.

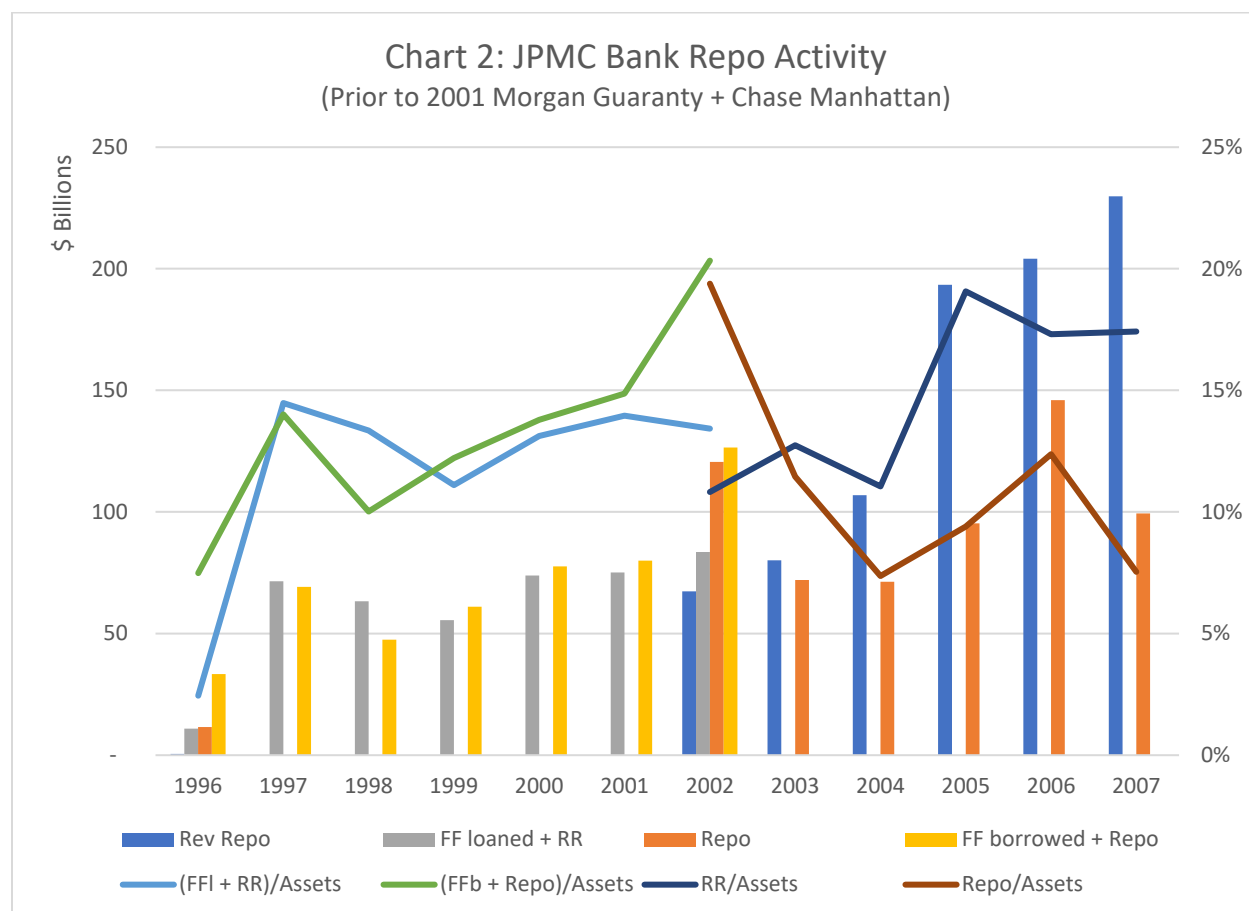
On the last day of the year 2000 JP Morgan & Company merged with the Chase Manhattan Corporation forming JP Morgan Chase & Company (JPMC), and Morgan Guaranty Trust's substantial repo market making and lending business was combined with Chase's tri-party repo

⁶ It would be very interesting to investigate whether the 1987 stock market crash and its aftermath played a role in the development of this system.

⁷ There is an odd discrepancy in the collection of call report data: from 1997 to 2001 on both the asset and liability sides of the balance sheet federal funds and repo are reported together. Only by putting the call report together with the Annual Report can one determine that the increase is in repo, not federal funds (as the amount for federal funds is negligible).

Note also that the 1997 annual report (p. 48) indicates substantial repo activity taking place in 1996 in the *Consolidated* balance sheet for the Morgan Guaranty Trust Company. This indicates that much of the shift in 1997 is from Morgan Guaranty's subsidiaries into the FDIC-insured bank.

clearing activities. The end result was that through the middle years of the first decade of the millennium one of the two tri-party clearing banks was also a substantial provider of liquidity through the repo market (see Chart 2). By 2007 JPMC was lending \$230 billion on repo or 17% of its balance sheet and was borrowing something less than half that amount. And in 2007 JPMC's balance sheet was roughly the same size as the M1 money stock of the US. By contrast, in 2007 the other tri-party clearing bank, the Bank of New York Mellon, was reporting negligible repo activity in its call reports.



Source: end of December call reports.

The evidence indicates that through the first seven years of the millennium JPMC was effectively monetizing the assets that traded on the tri-party repo market. As was discussed above, understanding this point requires a shift in perspective regarding what money is. In particular, it requires treating the market making commitments of commercial banks as a mechanism through which monetization takes place.

Here, it is important to recognize the fundamental difference between market making by a commercial bank and market making by an unlimited liability partnership. Historically, the deep

liquidity of British and American markets relied on the latter. Indeed, market making in Anglo-American securities markets was dominated by unlimited liability partnerships right up until the 1980s.⁸ (And one can't help but wonder whether the growth of corporate market making was related to Federal Reserve and then clearing bank support for the securities dealers' balance sheets.) Because speculating on securities markets is risky and the partners had limited capital and everything at stake, traditional market makers were very conscious of their capital constraints and as a result carried limited inventory and did so with great caution.

A bank, and in particular a too-big-to-fail bank like JPMC, that is engaged in market making faces very different constraints. First of all, with its 'fortress' balance sheet that by 2007 was almost as big as M1 itself, JPMC had vast capital at its disposal. In addition, while it is possible for a bank to be capital constrained, JPMC fell into the regulators 'well-capitalized' category and generally operated well above its regulatory constraints. Furthermore, a too-big-to-fail bank has many channels to plead for regulatory forbearance if it is at risk of temporarily breaching those constraints.⁹ In short, unlike a traditional market maker JPMC faced much more negotiable constraints.

Thus, when JPMC started making markets in and lending on repo 'in the bank,' it was offering a commitment that was different in nature from that of a traditional market maker for two reasons. First, its risk of failure was very remote indeed. Second, by 2001 it was combining its repo market making and lending services with the facilitation of funding for counterparties through its tri-party repo platform, presumably at comparable valuations and for the most part on comparable terms.

These differences created a situation where the assets that JPMC stood ready to repo were effectively monetized. A too-big-to-fail bank stood ready to exchange those assets for cash on specified terms, and provided a mechanism by which the loan could be continued indefinitely. While contractually there was no question that JPMC retained some rights to withdraw funding, monetization took place precisely because there was an ethos that one should keep dancing as long as the music is playing – and implicitly that a systemic stop is a matter for the authorities to address.¹⁰

The growth of the importance of the repo market to the financial system was, of course, only possible because of a regulatory and political environment which was supportive of this development. Sissoko (2010) discusses US policy and how even after the repo-driven Long Term Capital Management crisis in 1998, policymakers doubled down on their reliance on collateralized lending as a means of making banks safer. As for Europe Gabor and Ban (2016) and Braun (2018) exposit in detail how European central banks sought to use the repo market as a means of supporting the Euro by integrating European bond markets.

⁸ The first member of the New York Stock Exchange to go public was Donaldson, Lufkin, & Jenrette in 1969.

⁹ Review of the Federal Reserve's Supervisory Letters dating from August 2007 to 2009 demonstrates this clearly.

¹⁰ As ICMA (2012) put it in a letter to the FSB: "the authorities can be expected to intervene as lenders of last resort to ensure the liquidity of the system as a whole. For their part, market users should be expected to remain creditworthy and to have liquidity buffers sufficient to sustain themselves until official intervention restores sufficient liquidity to obviate the need for fire sales."

b. Implications of the monetization of repo-able assets

Framing JPMC's role in the repo market as having the effect of monetizing the assets that traded on the tri-party repo market helps explain what happened in 2008. It is well documented that long-term bonds, both corporates and securitizations were eligible tri-party repo collateral in 2007 (Krishnamurthy et al. 2014). According to Gorton and Metrick (2012: 438-39), the haircut even on lower-grade BBB collateral was zero for the first half of 2007. This meant that the owner of such an asset could fund the full value of the asset on the repo market: even bonds rated BBB were fully monetized.

The riskiness of these assets became evident in 2008 and not only did prices fall, but also haircuts increased – which had the effect of further reducing the amount of the asset that could be funded on repo. This then had the same effect as a major decline in the money supply. The only possible solution was for the Federal Reserve to step in and prevent the money supply from collapsing by itself providing funding against the collateral of tri-party repo assets. The Fed did this through the Term Securities Lending Facility, through the Primary Dealer Credit Facility and, more subtly, through regulatory exemptions that allowed commercial banks to fund assets held by their broker-dealer affiliates directly.

This monetization of repo-able assets is very different from the traditional operation of securities markets – which, it should be noted, have served our economies very well for almost two centuries of remarkably rapid growth. As was noted above traditional market makers in the key world markets, that is in London and New York, faced capital constraints and were at risk of failure and personal losses. Far from preventing the markets from pricing assets accurately, these constraints and risks are associated with the markets that facilitated rapid economic growth.

During the height of the boom that preceded the 2007-09 crisis, there is every reason to believe that JPMC had the power to define the repo market both by pricing assets and by setting the terms on repos. Indeed, both Bear Stearns and Lehman Brothers failed when JPMC acting as a clearing bank determined that their assets were no longer adequate to support the debt they were carrying. In short, JPMC created a new role in financial markets, the dealer of last resort, a kind of central bank for securities markets that had the capacity, due to the flexibility of too-big-to-fail capital constraints, to price and fund assets over what appeared to be the long-run. Or at least that's how it appeared until the Bear Stearns failure in 2008.

This history of the repo market has been covered in some detail, because it is important that policy-makers do not confuse modern repo-based securities market and their direct access to bank-based liquidity, with the nature of securities markets themselves. Securities markets have historically operated extremely well in environments where market makers were capital constrained and indeed even where they were at risk of personal losses.

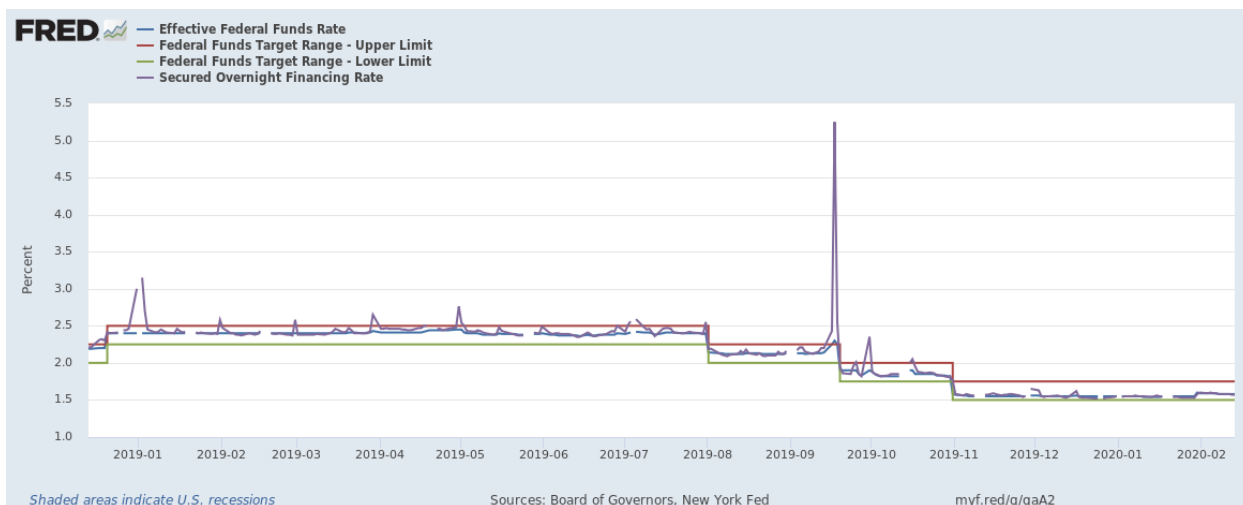
The pricing mechanism in modern securities market may in fact be less efficient than traditional securities markets both due to the role played by banks in these markets and to the now ubiquitous, permissive use of the corporate form to socialize the losses associated with dealer

trading errors. The importance of limiting the flow of bank-based liquidity into securities markets was a basic precept of early approaches to monetary control, as seen both in the ‘real bills doctrine’ and the 1930s US reforms to the banking system, precisely because early policymakers were concerned about feedback loops that could generate pricing inefficiencies, such as asset price bubbles (Sissoko 2016; Sissoko 2017). Furthermore, the pricing mechanism in the modern financial system lacks the discipline that is generated by fear of bearing personal losses on the part of the securities market dealers. The elimination of these disciplining factors has transformed securities markets and the pricing mechanism in ways that have yet to be fully understood.

IV. Implications of the repo market for monetary policy

The Federal Reserve has proposed that the Secured Overnight Financing Rate (SOFR) can be used as replacement for US dollar LIBOR as a reference rate in financial contracts (NY Fed 2019a). SOFR is ‘a broad measure of the cost of borrowing cash overnight collateralized by Treasury securities’ (NYFed 2020), and in colloquial terms can be considered a kind of average of repo rates. The implication of this policy is that the Federal Reserve condones the transformation of money markets that took place over the last twenty years from operating around a core of traditional unsecured interbank markets to operating on a collateralized basis. It is far from clear, however, that the Federal Reserve has carefully evaluated the implications of this transformation of the money markets, and therefore the financial system.

Chart 3: Money market rates, Dec. 2018 to Feb. 2020.



Source: St. Louis Fed Fred database <https://fred.stlouisfed.org/graph/fredgraph.png?g=qaA2>

Through mid-2019 SOFR had a history of staying close to the effective Federal Funds rate with sporadic one day spikes of 25 basis points or less over the effective Federal Funds Rate (and a spike at the 2018 year-end of about 75 basis points). However, on September 17, 2019 the Federal Reserve was caught off guard when SOFR suddenly jumped to over 5%, more than double the policy rate (see Chart 3). The dislocation in the repo market was also reflected in the Federal Funds rate, which jumped above the upper limit on the target range for the Federal Funds

rate – and also spiked dramatically intraday (Avalos et al. 2019). In short, instability in the repo market disrupted the Federal Reserve’s implementation of monetary policy.

Since that date the Federal Reserve has been providing generous liquidity using standard open market operations that use repurchase agreements with primary dealers to increase the supply of reserves. In addition, effective October 15 2019 the Federal Reserve adopted a policy of purchasing \$60 billion of Treasury bills per month in order to increase the supply of reserves (NY Fed 2019b). These policies continued into March 2020.

The question I seek to evaluate in this section is not the narrow question of what happened in September 2019, but the broader question of what is the nature of monetary policy implementation in an environment where the core money market operates on a secured basis. In particular, I want to investigate how a simple model of monetary policy implementation – based on managing the quantity of reserves in order to maintain a target rate – that was accurate in a world of unsecured interbank markets, may be extremely misleading in an environment where interbank markets are collateralized.

a. Issue 1: Repo turns fiscal policy into monetary policy

Now that the core money market is the repo market, government debt issues are money market phenomena, because they increase collateral supply. This means that the effect of a government debt issue is not limited to the traditional settlement pressures on money markets that have always been taken to account. Now a government debt issue also generates funding pressures on money markets that endure as long as the debt is outstanding. Because this effect did not come into play when the core money market was unsecured, the funding effect of government debt issues on money markets is often omitted from analyses.

First, consider fiscal policy under the traditional monetary policy framework. The government issues new debt, (1) selling it to the public, and (2) immediately spending the receipts as a form of stimulus. Because the government both receives money and spends it, the deposit holdings of the public in aggregate are ultimately unchanged. The same is true of the supply of reserves to the banking system. Any pressure on short-term interest rates is generated by the expenditure itself, not by pressures created in the short-term money market.

The focus of this traditional analysis is on the settlement pressures that can be created by issue of government debt. For example, if the government had a one-month delay between selling the new debt and spending the receipts, the funds sitting in the government account (which we assume is not held in the commercial banking system) would represent a withdrawal of deposits from the economy and a withdrawal of reserves from the banking system. A central bank that is not attentive to offsetting these effects would find that the process of paying for government debt had the effect of tightening monetary policy. Such settlement pressures are, however, well understood and well within the scope of the expertise of the typical central bank.

In the traditional framework the fact that the increase in government debt is also an increase in collateral supply does not matter because the core money market is unsecured and functions independent of the collateral supply. The situation is very different where the core money market

is collateralized, because the increase in collateral supply has its own monetary effect. In particular, it generates on-going funding pressures in the money market *in addition to* the settlement pressures that arise when the debt is first issued.

Pozsar (2019) explains in very careful detail the effects of fiscal policy in an environment where relying on repo to fund holdings of government debt is the norm. Again, consider the case of fiscal policy where the government issues new debt and immediately spends the receipts. Now, however, the entity that buys the new debt issue funds it on the tri-party repo market, thus expanding both sides of its balance sheet. The public both holds the repo as an asset on its balance sheet and gets the benefit of the government funds that are spent. As in the traditional case, neither the deposit holdings of the public in aggregate, nor the market for reserves will see any change. However, because the market for repo loans sees an increase in demand due to the increase in collateral supply, the fact that the supply of reserves and of deposits is unchanged implies that this fiscal policy will put pressure on the repo interest rate as the demand for money market loans increases without a corresponding increase in the supply of funds on the money market. In short, fiscal policy can be expected to have a direct effect on quantity and price of the short-term credit available in the repo market – even when the reserve position of the banking system does not change.

To summarize, when the core money market is collateralized a government debt issue creates both settlement pressure and funding pressure on the money market. This is a significant difference from the case where the core money market is unsecured and is not affected by collateral supply, so only settlement pressures need to be taken into account.

That pressures in the repo market will tend to affect other overnight markets is unsurprising due to arbitrage and market participants borrowing on cheaper markets in order to lend into the repo market. On the other hand, while we observe that on a day like September 17 the Federal Funds Rate increases alongside SOFR, given the distinction between the market for reserves and the market for demand deposits the explanation for how this arbitrage takes place is not immediately obvious: The precise mechanism by which the pressures in a public cash market can affect interest rates in a reserves market like the Federal Funds remains to be carefully specified.

Overall, the government's fiscal stance creates pressures on the repo market and on the money markets more generally. And these pressures become the central bank's responsibility to resolve. At a minimum, new models of the money market need to be developed in order for the central bank to be able to do this effectively.

This analysis points to a basic structural problem with the current monetary system that goes beyond analyses that seek to explain how instability in the supply of reserves can explain money market stress (see, for example, Selgin 2019a, b on the effect of shifts in the government's Treasury General Account on reserves). In an environment where funding on repo is the norm, fiscal policy cannot be separated from its effect on the money supply, because the issue of new debt (or in other words collateral supply) has become a money market phenomenon.

When the issue of Treasuries is both a capital market and a money market event, the traditional model of long-term debt issue, where the only challenge is how to ensure that making payment

for the debt does not draw too many resources from the money market, becomes inadequate. Now we have an ongoing money market problem of how to fund the debt after it has already been paid for. From a balance sheet perspective, every Treasury issue represents not just an asset that will sit on the ultimate holder's balance sheet, but also a second asset of equivalent amount, the loan that funds the holding of the asset.¹¹ The problem for a central bank is then not just to stabilize reserves, but also to offset the funding pressures that are created by changes in the collateral supply provided by the government. In short, the traditional model of monetary policy is no longer adequate, and new model that includes collateral supply is needed.¹²

b. Issue 2: Repo transforms the relationship between the policy rate and long-term rates

There is a second important effect that must be considered in order to understand monetary policy in an environment where collateral supply matters. In such an environment, short term interest rates as a monetary policy tool can be expected have a stronger effect than when money markets are unsecured. Indeed, the effect may be so exaggerated that it becomes difficult to use interest rates as a policy tool at all.

First, consider the traditional model of monetary policy. An important aspect of the monetary transmission mechanism was the effect that changes in the Federal Funds rate could have on other interest rates and therefore more generally on the growth of credit throughout the economy. See Chart 4 for a historical example of long-term interest rates more or less following the pattern of the federal funds rate.

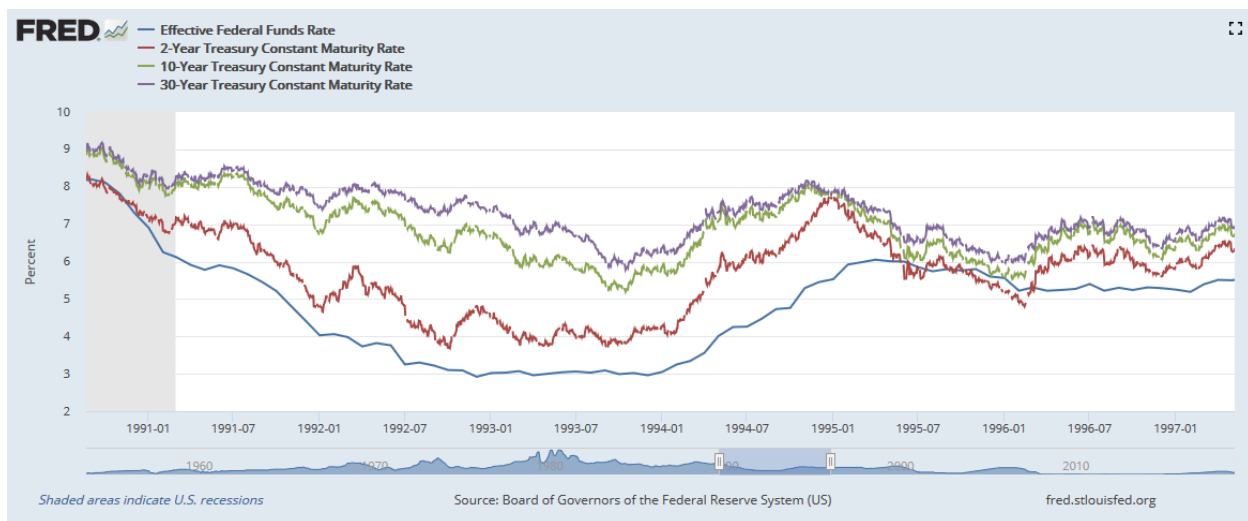
It is important to recognize that in an environment where the core money market is based on repo and long-term collateral is monetized, an interest rate tightening cycle, such as the one depicted in Chart 4 from Dec 1993 to April 1995, would have dramatic effects on the money supply itself. This is because an interest rate increase of 2% on long-term collateral, such as that in Chart 4, generates a massive decline in the value of outstanding long-term debt.

Let's do a back of the envelop analysis of the specific example of the tightening cycle from Dec 1993 to April 1995. Yields on 10 year Treasuries increased by about 2.25% over the course of 1994 and on 30 year Treasuries by about 2%. The duration of seven year notes was approximately 5 and the duration of twenty year bonds was about 10. We know that there were \$1.8 trillion of notes outstanding and \$0.5 trillion of bonds outstanding (2014 Economic Report

¹¹ This discussion implicitly assumes that the asset is funded on the tri-party repo market which does not allow for rehypothecation. If the asset is funded on the bilateral repo market, more than one loan backed by the asset may be created (Singh 2013).

¹² There is another aspect of new debt issues and their effect on money markets that is not addressed in this paper: in an environment where regulators are requiring that intraday bank exposures be fully funded, the issue of government debt creates the additional challenge that the primary dealers are required to purchase the issue in the first instance, which necessarily creates an intraday funding challenge for them. This then creates an intraday funding problem for the dealers' clearing banks. (In the traditional model intraday financing from the central bank was at no charge.) In order to avoid holding inadequate reserves to cover intraday needs as per regulatory requirements, banks may choose to increase the reserves that they hold and are unwilling to lend out. For details on this issue, see Pozsar 2019.

Chart 4: interest rates, mid 1990s



Source: St. Louis Fed Fred database, <https://fred.stlouisfed.org/graph/fredgraph.png?g=q6MY>

of the President). Using these figures we can calculate that the decline in value of long treasuries amounted to approximately:

$\$1.8 \text{ trillion} * 0.0225 * -5 = - \$0.2025 \text{ trillion change in value of notes}$

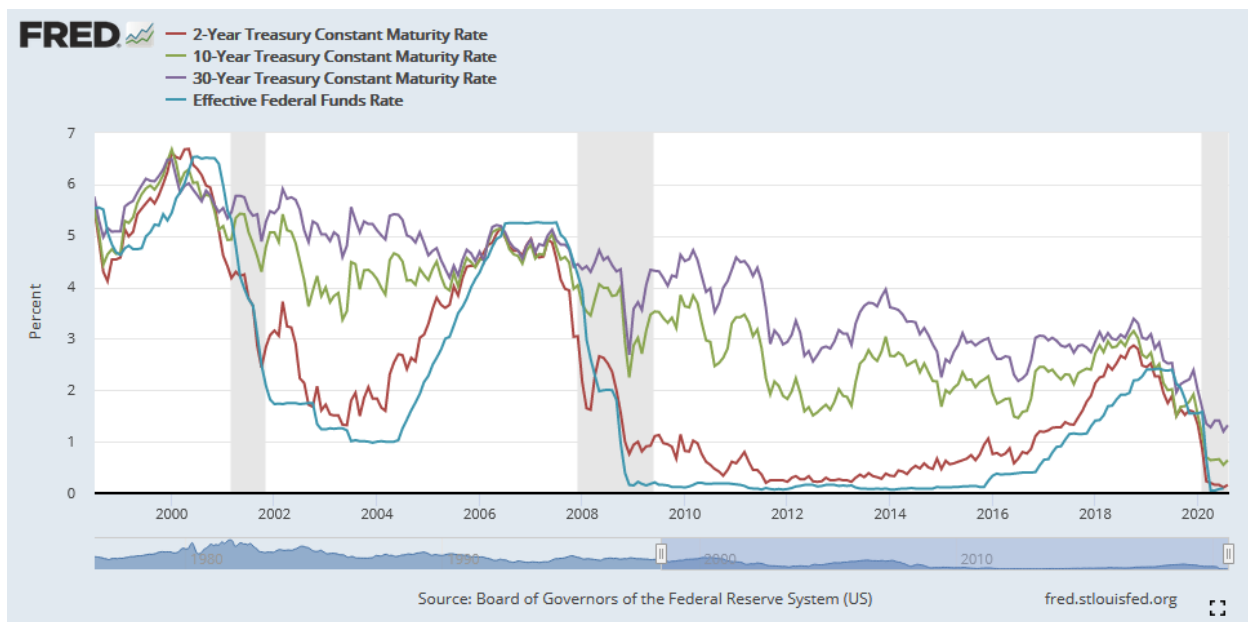
$\$0.5 \text{ trillion} * 0.02 * -10 = - \$0.1 \text{ trillion change in value of bonds}$

These figures add up to a decline of \$300 billion in the value of long-term Treasuries at a time when M1 was \$1.1 trillion, and M2 was \$3.5 trillion. This thought experiment implies that if it were possible for monetary policy implementation to work today as it did in the past, a tightening cycle could easily lead to decline in the collateral supply equal to 27% of M1 or 9% of M2.

Thus, an implication of the move from unsecured money markets to repo-based money markets is that the monetary policy transmission mechanism that operates through the effect of short-term interest rates on long-term interest rates and thus on asset prices is likely to become more important, as there is now a collateral supply channel that did not exist in the past. In particular, to the degree that long term interest rates are responsive to shifts in short-term rates the collateral supply channel will tend to magnify the effect of monetary policy.

In fact, however, the shift to repo-based money markets – together with its concomitant, the collateral supply channel of monetary policy – appears to have been accompanied by a significant weakening in the relationship between the federal funds rate and long-term interest rates. (Compare Chart 4 to Chart 5.) The possibility that the causality runs from the shift to repo-based money markets to the changed relationship between short- and long-term interest rates is surely worth investigating. Indeed, Singh and Goel (2019) test econometrically whether there is support for the view that long term rates drive short term rates along the yield curve and use data from 2002 to 2017 to conclude that there is.

Chart 5: interest rates, 1998 to present



Source: St. Louis Fed Fred database, <https://fred.stlouisfed.org/graph/?g=u7PE>

As long-term rates are less responsive to short-term rates in our modern repo-based monetary system than they were in the past, the tightening of monetary policy is naturally more likely to result in an inverted yield curve than it was when long-term rates were more responsive to policy. For this reason, the new monetary environment may require a re-evaluation of the implications of an inverted yield curve.

In particular, Pozsar (2019) documents an interesting phenomenon driven by yield curve inversion.¹³ The inversion causes a buyers' strike in the Treasury market, since there's no positive carry on the assets. One might think that a buyers' strike would imply that the prices of long Treasuries should fall and yields should rise. Indeed, the whole point of the Federal Reserve's taper policy through 2018 was arguably to put upward pressure on the yields of long Treasuries. Pozsar, however, documents that at the end of 2018 during the 'buyers' strike' the dealers chose to carry the Treasuries themselves. And 60% of these purchases were accounted for by one bank, JPMC (see also Dunbar 2019). As a result, through this period when there was a 'buyers' strike', the yields on long-term Treasuries were falling and their prices were rising.

The underlying forces that generate these phenomena are surely worth studying. Afterall, given that the core money market is now repo-based, there's a genuine problem that can be generated by a rise in the yields on long-term Treasuries: the supply of collateral will shrink and this could potentially cause significant dislocation in collateralized markets. And so far, this has not

¹³ Note that short-term funding costs are higher for the typical Treasury investor than for banks, and Pozsar uses actual funding rates to determine whether the yield curve is inverted. Thus, Pozsar's yield curve may be inverted when the Treasury yield curve is just flat.

happened. But what precisely is the mechanism that prevents long-term yields from rising?¹⁴ In order to study this question carefully it is necessary to have a model of monetary policy that can take into account collateral supply effects. The strategic behaviour of the dealer banks that anchor the repo market and the strategic aspects of their interaction with central banks is surely another important area of study.

c. Issue 3: Repo markets and structural instability

In section I.a above the distinction between the monetary and the balance sheet effect of a repo transaction was discussed: because the collateral stays on the balance sheet of the repo borrower, so does the risk of the asset. Thus, even though a standing repo facility can monetize the underlying collateral, it does so without transferring the risk of the asset from the borrower. Due to this structure in the case of a long-term asset, the borrower bears significant liquidity risk. This liquidity risk follows from the discussion in the previous section of the duration of long-term assets: a 10 basis point rise in interest rates can cause a 1% decline in the value of a 20 year bond. A leveraged borrower who is relying on such long-term ‘safe assets’ for funding can easily find that small shifts in the interest rate cause liquidity problems.

Furthermore, due to the premise upon which the repo market is based, prompt sale of collateral in the event of default, the repo market is designed to draw on market liquidity. The process by which this takes place is the margin call. A repo is a collateralized loan, and when the value of the collateral falls below the level necessary to support the loan, the lender issues a margin call. If the borrower is unable to meet the call within one day, the lender has the right to foreclose on and sell the asset. Gabor (2020) describes the contractual obligation of meeting a margin call as ‘time critical liquidity.’ Arguably however this is not liquidity at all, but instead a drain on liquidity.

Because the forced sales associated with the repo market draw on market liquidity, they can easily result in an imbalance on the market between sellers and buyers that causes the prices of the underlying collateral to temporarily fall. This fall can then trigger more margin calls, more forced sales and a further decline in price. Indeed, such liquidity spirals are characteristic of the repo market (Adrian and Shin 2010; Brunnermeier and Pedersen 2009; Sissoko 2019).

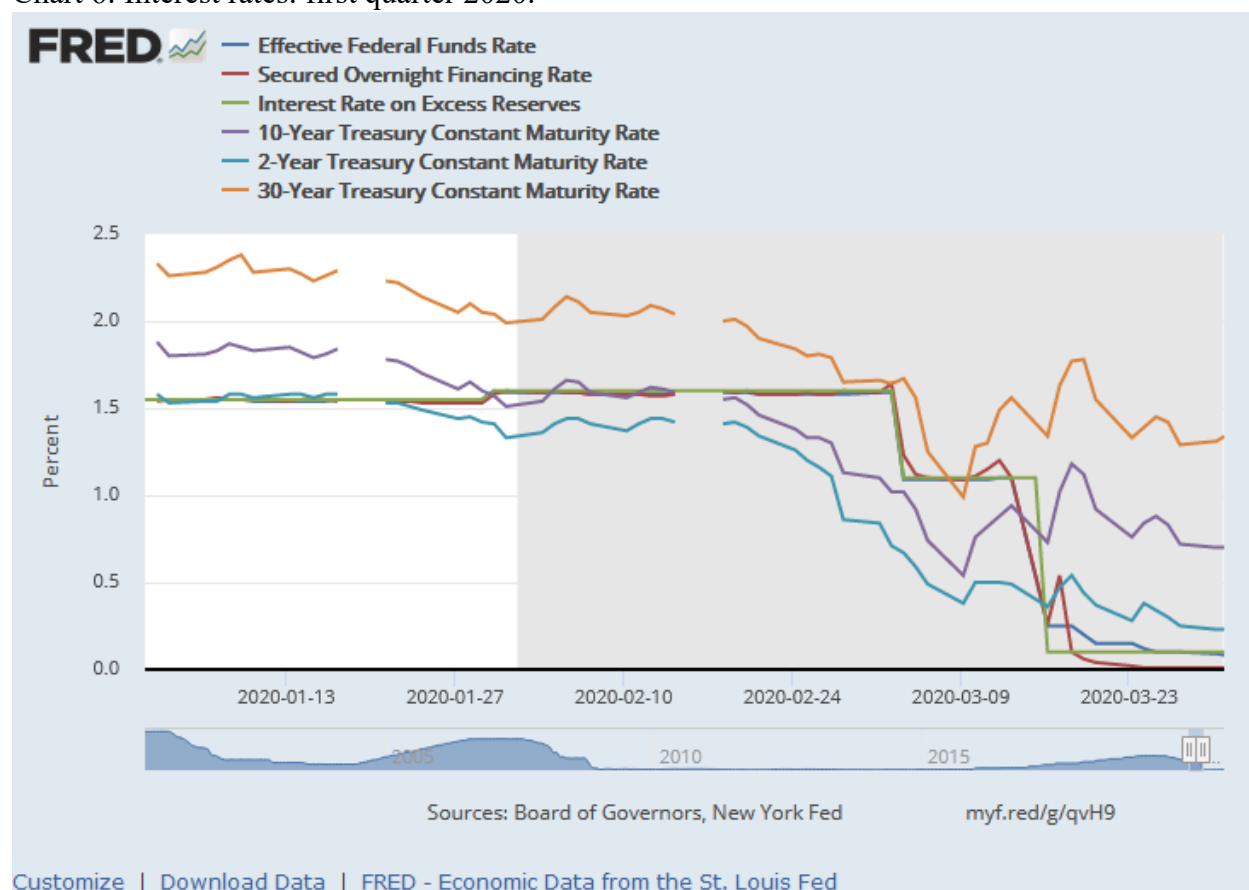
The structure of the repo loan places the whole of this liquidity risk on the borrower, which can easily be driven into bankruptcy due to a temporary fall in the value of the collateral. Bear Stearns and Long-Term Capital Management are perhaps the most famous examples, but there are dozens of hedge fund failures associated with the same dynamic.

Reforms subsequent to the 2008 financial crisis sought to prevent liquidity spirals by – successfully – discouraging the use of private sector assets as collateral for repo loans. In March 2020, we learned however that restricting collateral only to the debt issued by the safest

¹⁴ In these markets dominated by massive dealers who actively employ their balance sheets, it’s not entirely clear that there is such a thing as a ‘market’ yield on Treasuries. The biggest participants in the market have balance sheets that are simply too big for it to be obvious that ‘whale’ effects combined with miscalculations and erroneous strategies are not causing movements in ‘market’ prices. The role of errors in the London whale incident of 2012 is discussed at length in Sissoko (2017).

sovereigns was not adequate to prevent the liquidity spiral dynamics that are intrinsic to the repo market.

Chart 6: Interest rates: first quarter 2020.



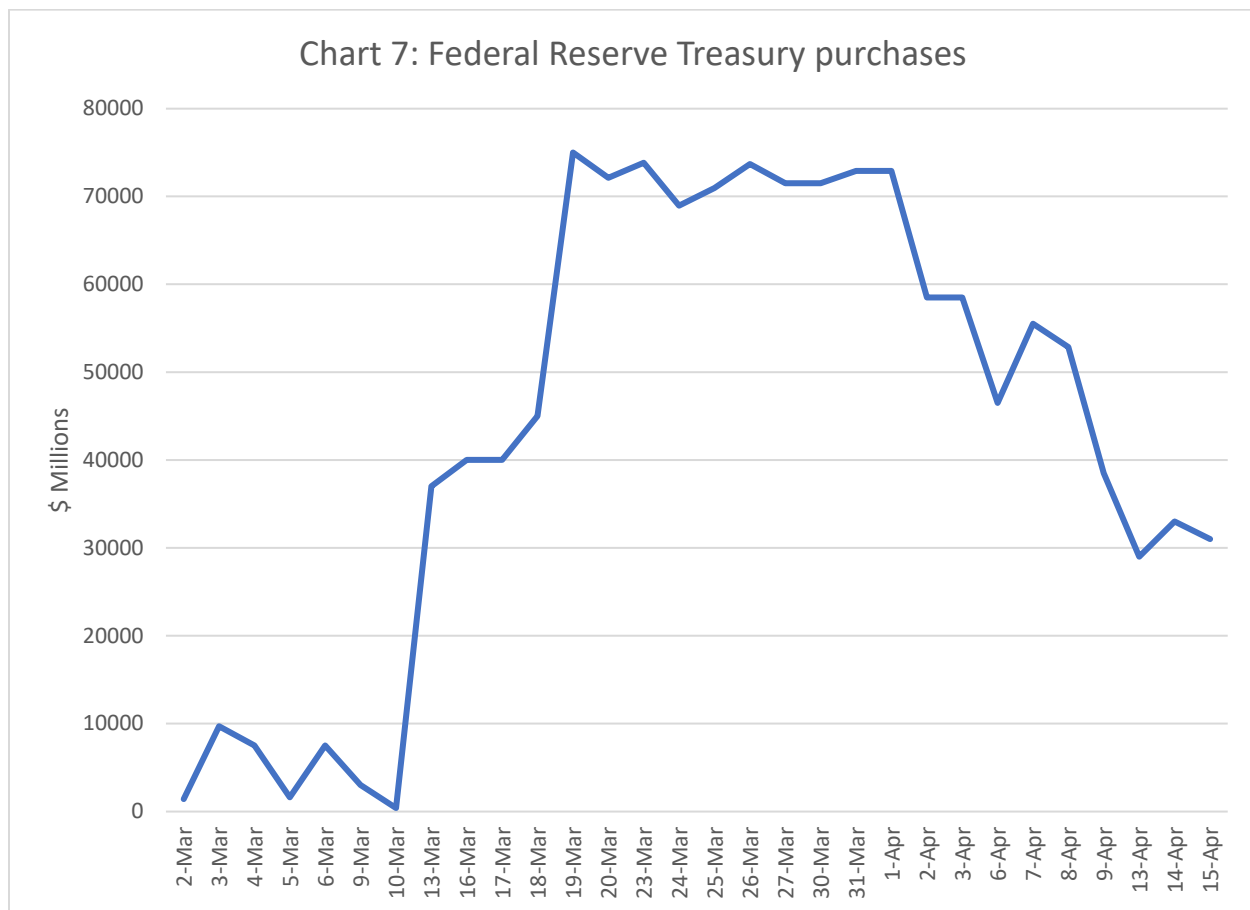
Source: <https://fred.stlouisfed.org/graph/graph-landing.php?g=qvH9>

Chart 6 presents the interest rates on US Treasury debt as well as three Federal Reserve policy benchmark rates for the first quarter of 2020. One can clearly see the flight to quality assets that took place as the severity of the Coronavirus crisis became clear starting in mid-February and continuing through March 9. It was followed, however, by an episode of profound illiquidity in the Treasury market that the Fed struggled for days to manage (BIS 2020; Fleming and Ruela 2020).

Apparently by March 9 the New York Federal Reserve was already seeing some stress on overnight markets, because the New York Fed announced that it would be increasing the amount of its overnight and two-week repo operations by 50% and 100% respectively (NY Fed 2020b).¹⁵ Despite this liquidity provided through the repo market, on March 10 the yield on Treasuries jumps. Indeed, the yield on the 30 year Treasury increases by 29 basis points in a single day. The yield continues to rise throughout the week until by March 13 the increase in the yield over the

¹⁵ On March 11 it added \$50 billion in one month repo transactions starting on March 12 (NY Fed 2020c).

course of the week was 57 basis points which implied a decline in the price of 30 year Treasuries of about 8%. These sudden increases in yield that continue to build up day after day are precisely what one expects to see in a liquidity spiral, where the forced sales associated with the repo market take place too quickly for the buy-side to step in and support prices. Fleming and Ruela (2020) use a variety of other measures of Treasury market liquidity and determine that there was indeed significant illiquidity in the Treasury bond market at this time.



Source: New York Federal Reserve Bank

On March 16 the Federal Reserve accompanied dramatic liquidity provision to the financial system with a commitment to buy \$40 billion in Treasuries. The New York Fed also announced a one-day transaction of \$500 billion in repo for same day settlement – indicating that there was significant stress on intraday financing markets (NY Fed 2020d). March 16 saw a significant decline in the yield on Treasuries – that lasted only one day.

By Tuesday, March 17 yields had risen back above where they had been the preceding Friday, despite on-going daily purchases by the Fed of \$40 billion in Treasuries, an expansion of same-day repos through the end of the week, and the near tripling by the New York Fed of the amount

offered daily on overnight repo (NYFed 2020e).¹⁶ As yields continued to rise, the Fed increased its daily purchases of Treasuries to \$75 billion on March 19. (See Chart 7.) This was enough to stabilize the 30-year yield, but only at 79 basis points higher than the yield 10 days earlier. On March 23 the Federal Reserve's Federal Open Market Committee announced that it would continue to purchase Treasuries 'in the amounts needed to support smooth market functioning' (Federal Reserve 2020).

By committing to a policy of purchasing \$75 billion in Treasuries per day, the Federal Reserve was finally able to stabilize the Treasury market. Notably it is visible in Chart 6 that it was only when these massive purchases began – and not the extraordinary liquidity provided on the repo market from an earlier date – that had the effect of stabilizing the Treasury market.

<Insert Table 1 here>

As Table 1 demonstrates the Federal Reserve's Treasury purchases were heavily weighted towards long bonds. Indeed on March 17 and 18 when the Federal Reserve's purchases were not adequate to stabilize the Treasury market, the Fed was purchasing 'only' \$7 or 8 billion a day in Treasury bonds. On March 19 when that figure doubled, the market finally stabilized.

Federal Reserve purchases over the course of the 13 business days from March 13 to March 31 accounted for almost 5% of the total stock of marketable Treasuries outstanding, and almost 8% of the total stock of Treasury bonds outstanding. This mechanism for supporting the repo market was unsustainable over the long run due first to the extraordinary size and speed of the purchases, and second because these purchases had the effect of expanding the reserves held by the banking system and therefore banking system assets. Of course, any sudden expansion in banking system assets has the effect of driving down the capital adequacy of the banking system on a leverage ratio basis.

The assets in the US commercial banking system assets increased by \$1.5 trillion or almost 9% from December 31, 2019 to March 31, 2020. Of this increase 33% was due to the increase in reserves, 22% to an increase in loans to businesses, and 9% to an increase in loans to foreign banks.¹⁷ Crises are expected to expand the banking system's assets by bringing off-balance-sheet liabilities on balance sheet in the form of loans, and the Federal Reserve on March 15 provided relief to the banks by releasing the capital and liquidity buffers that had been created for this purpose. The additional effect, however, of the Federal Reserve's massive 'rescue' of the Treasury market threatened the banks' capital adequacy as defined by the leverage ratio.

In short, a liquidity spiral that is characteristic of repo market dynamics forced the Federal Reserve to step in and purchase long-term Treasuries in unprecedented quantities in order to arrest the destabilizing feedback loop. While the action was effective in stabilizing the repo

¹⁶ These repo operations would be extended through the end of the month on March 20 (NYFed 2020f).

¹⁷ FDIC Statistics on Depository Institutions comparison reports, <https://www7.fdic.gov/sdi/main.asp?formname=compare>. Note that another 9% of the increase was explained by trading account assets and 7% by GSE-issued securities.

market, the Federal Reserve could only take this action at the cost of undermining the capital adequacy of the banking system.

Thus, the Federal Reserve's rescue of the Treasury market also forced it to announce on April 1, 2020 a one-year suspension of the inclusion of US Treasuries and reserve balances in the assets that make up the denominator of the Supplementary Leverage Ratio, Basel III's leverage ratio measure. Second quarter bank financial disclosures indicate that subsequent to this suspension of the rules, the five largest banks are holding an additional \$1 trillion in these exempt assets on their balance sheets (Woodall 2020).

This episode illustrates importance of the distinction between the monetary and the balance sheet effects of a repo transaction. In normal times, what matters on repo markets are the monetary effects, and thus the repo market can serve as an effective vehicle for money market liquidity. However, the reason this is possible in normal times is because the stability of interest rates and of the value of the Treasury collateral means that the fact that repo leaves the risk of the repo collateral on the balance sheets of the borrowers is not particularly important. By contrast, in a crisis volatility increases, interest rates rise abruptly and balance sheet effects can end up dominating the dynamics of the repo market. Because of the liquidity spiral dynamics that are inherent in the contractual structure of the repo, it is not clear that anything – other than the extraordinary intervention of the central bank – can mitigate the tendency of repo markets to spin into a death spiral in a crisis. Certainly, the events of March 2020 made it clear that providing abundant liquidity through the repo market, the Fed's initial policy starting on March 9, was entirely inadequate to stabilize the market.

This dependence of the repo market on central bank support of long-term asset prices in a crisis has inverted the traditional relationship between short- and long-term debt markets. Traditionally, abundant liquidity was provided by the central bank on short-term money markets to support financial institutions in a crisis, but long-term asset prices were allowed to fluctuate dramatically. Today, the repo-based money market is not a source of liquidity in a crisis, but on the contrary is designed to draw heavily for liquidity on long-term markets. However, because long-term markets are designed to reflect through price changes shifts that take place in the underlying forces of supply and demand (cf. Holmstrom 2015), these markets are not robust to the immense selling pressure that the repo-based money market generates in a crisis. This forces the central bank to step in and provide its abundant liquidity through long-term markets.

In short, the shift from unsecured interbank markets to repo-based interbank markets has precipitated a complete transformation of our financial market structure. One result has been to force the central bank to shift the locus of its liquidity support from short-term markets to long-term markets. Another consequence of this transformation is that the risks of investing in long-term government bonds, which since the Financial Revolution have been borne by the private sector, are now borne in part by the Federal Reserve.

V. Proposals for reform

The preceding section has shown that analogies between the implementation of monetary policy on the Federal Funds market and on the repo market can easily be misleading, since the repo

market does not have the capacity to provide liquidity to the financial system in a way that is comparable to the Federal Funds market. This is due to the structure of the repo market and its reliance on collateral and on the ephemeral liquidity of long-term bond markets. Indeed, because the repo market is now so large, in a crisis it acts a coordination device generating an overwhelming volume of sell orders that all demand to be filled simultaneously (Sissoko 2019). No market structure can possibly be made robust to a coordination device that acts on such a large scale throughout global markets. Our current financial structure is designed to fail – and to be bailed out by dramatic central bank action.

While there is widespread recognition that this central bank duct tape approach to financial stability is unacceptable,¹⁸ proposals for reform are remarkably inadequate to address the structural problem. This section will address three proposals: a central counterparty for Treasuries, dealer of last resort, and a standing repo facility.

Central counterparty for Treasuries

Duffie (2020) proposes to reduce the liquidity needs on the Treasury market by introducing a central counterparty (CCP) and rules requiring central clearing into the Treasury market. The premise underlying this proposal is that the dysfunction in the Treasury market in March 2020 is entirely explained by the lack of capacity on dealer balance sheets. Note, however, that a CCP does not provide additional balance sheet space, but instead allows for more efficient use of existing balance sheet capacity since dealers only need to finance net positions.¹⁹

The problem with the CCP proposal is that it is far from clear that the incremental increase in balance sheet capacity that it can make available is commensurate with the balance sheet demands of the repo market in a liquidity spiral. Recall that within the space of two and half weeks the Federal Reserve had to purchase 8% of the total stock Treasury bonds outstanding and that in liquidity spiral conditions these become – on a mark-to-market basis – very high-risk assets. In addition, over the course of this period Fed purchases of Treasuries amounted to \$812 billion. Unless there is reason to believe that the introduction of a CCP can increase the dealer's capacity to such a degree that they can perform a market intervention of this scale, there is no reason to treat the CCP proposal as a solution to the problem that the financial system faced in March 2020.

Dealer of last resort

The dealer of last resort proposal argues that the Federal Reserve should put a floor under asset prices by setting an ask price and standing ready to buy at that price (Mehrling 2011).²⁰ This, as we have seen, is indeed the policy that the Federal Reserve adopted for Treasuries by the end of

¹⁸ See, for example, Duffie (2020) who writes 'Although the Fed accomplished what it needed to do, as a design principle, the lack of a robust private-market structure should not be acceptable based on the notion that the Fed is available as a dealer of last resort.'

¹⁹ A CCP also addresses concerns over counterparty credit risk, with the danger of concentrating those risks in the CCP. But this is not relevant here.

²⁰ Note that the 'dealer of last resort' is a misnomer, because it is a function of the buy-side to estimate the intrinsic value of an asset and on this basis to set the 'outside' bid for the asset.

March 2020. Now that we know, however, the extent of Federal Reserve intervention that is required to support the current market structure, and the ramifications that this has for banking stability more generally, dealer of last resort hardly seems to be an adequate or sustainable solution to the problem of financial market structure. The sheer size of the necessary intervention by the Fed should prompt us to think about reforming market structure, because it is extremely hard to predict the repercussions of actions that are so very large. Indeed, we find evidence of such repercussions already: the March 2020 dealer of last resort action directly caused the banks to be undercapitalized and to require regulatory relief from their leverage ratio requirements.

While my preferred solution is to roll back the current, very heavy reliance on repo markets in our financial system, a possible alternate solution is to accept the Federal Reserve's dealer of last resort role, but take steps to move away from a two-tiered monetary system. After all, Fed accounts for the public have been proposed (Ricks, Crawford, & Menand 2020), so one possibility would be to combine the establishment of such accounts with a CCP Treasury market structure. Then, the Fed, when acting as dealer of last resort, could make purchases through the CCP with payments in a circulating version of a Federal Reserve account for the public. This would avoid the problem of adversely affecting the capitalization of banks, but do so at the 'cost' of providing a very direct form of monetary stimulus. Of course, during an event such as the coronavirus crisis, direct monetary stimulus could well end up being a benefit rather than a cost of this policy.

Standing repo facility

David Andolfatto and Jane Ihrig (2019) have proposed that the Federal Reserve 'operate a standing overnight repo facility that would permit banks to convert Treasuries to reserves on demand at an administered rate.'²¹ More recently Andolfatto (2020) claims that a standing repo facility (SRF) 'could simultaneously help the FOMC achieve interest rate control, shrink the size of its balance sheet, and prevent unnecessary violent disruptions in the treasury market by setting a corridor around treasury yields at different maturities. The size of the corridor could ultimately be adjusted to help achieve yield curve control if desired.'

The claim that a SRF could help prevent Treasury market dysfunction needs further explanation, given the Fed's Federal Open Market Committee's assessment that the expanded repo facilities of March 2020 were not taken up and resulted in 'little improvement in Treasury market functioning' (FOMC 2020). Indeed, it is not clear by what mechanism a SRF, which sets an administered rate on the repo loan, is expected to help determine the yields on the underlying Treasury securities. The terms of the repo require the Fed to demand additional collateral if the market price of the Treasuries falls. Just as happened in March, when such demands caused relative value traders to sell Treasuries (BIS 2020), these demands can set off adverse dynamics in the repo market. Unless the proposal is for a different kind of debt contract that is not comparable to the industry standard,²² the Fed by adopting a SRF will actually be committed to participating in the procyclical collateral demands associated with a liquidity spiral. (This, in

²¹ This call has been seconded by other experts in the monetary system (Coppola 2020, Selgin 2019b).

²² The current industry standard is the Bond Market Association and International Capital Market Association's Global Master Repurchase Agreement.

fact, is Gabor & Ban 2016's critique of the ECB's use of repo.) Thus, far from preventing violent disruptions in the Treasury market, a SRF is likely to make the Fed part of the problem.

To reiterate, while it is true that repo can be source of liquidity, it is essential to separate the monetary effect of the repo from the balance sheet effect of the repo. In normal times, the monetary effect dominates and repo provides liquidity by serving as a financing mechanism that facilitates the purchase and sale of the underlying asset (and arguably provides some moderate support for the stability of the underlying yields). However, in crisis times, repo acts as a coordinating device that triggers sales forced by margin calls across global markets; under these circumstances the balance sheet effect of the repo dominates and repo drains liquidity from the market, inducing a liquidity spiral. As we have seen, the vast expansion of the Fed's repo facilities from March 9 through March 16 were entirely inadequate to arrest the liquidity spiral, because they were not targeted to the right aspect of the repo contract; instead these repos were contractually designed to incorporate, not to offset, the falling value of Treasuries. To address the balance sheet effect of the repo, Fed purchases in extraordinary size were required; these started on March 19 and successfully stabilized the market.

VI. Conclusion

Implementation of monetary policy through the Federal Funds market was fairly straightforward and is well understood. Now that our market structure is very different and monetary policy can no longer be implemented through the Federal Funds market, simple analogies to the Federal Funds market can be misleading. The Standing Repo Facility cannot be used to implement a target rate analogous to the Federal Funds Rate, because of the nature of the repo contract and the procyclical dynamics inherent in these contracts. This means that repo markets must be carefully studied as a particular species of debt market in order to understand how (and perhaps whether) monetary policy can be implemented on them.

Thus, this paper advocates on the one hand for the modelling and careful study of repo markets, as the search for simple, stabilizing reforms is important. On the other hand, subsequent to the events of March 2020, the possibility must be considered that the only stabilizing reform will be a rollback of our current reliance on repo or collateralized money markets.

The need to for the Federal Reserve to act through long-term debt markets is a very new phenomenon that is closely associated with the instability of the repurchase agreement market. This inversion of the traditional role of money markets, which in the past were, with the support of the Fed, a source of liquidity rather than a drain on liquidity, and of long-term markets should be a matter of concern. Indeed, this inversion of the two markets interferes with policymakers' ability to use monetary and fiscal policy as separate tools.

If a decision is taken to roll back our current reliance on repo collateral, how might that be implemented? One possibility is to establish a schedule of minimum repo haircuts that increase with the duration of the sovereign debt instrument and are designed to discourage reliance on long-term debt as repo collateral. There would most likely have to be an implementation process over a period of years that allowed for steady incremental increases in the minimum haircuts until the destination schedule was reached.

Alongside this reform of repo markets, it would be equally necessary to reform the closely related markets for derivatives collateral. I have long advocated that derivatives markets that do not allow for collateralization of exposures may be more efficient than our current structure, because of the incentives uncollateralized markets create to trade only with well-managed and highly capitalized counterparties (Sissoko 2010). Thus, I would favor regulation that first permits the development of uncollateralized markets for derivatives, and then reforms the existing collateralized derivatives by mimicking the repo market policy discussed above and steadily discouraging the use long-term sovereign bonds as collateral via a schedule of incrementally increasing haircuts.

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could have a significant effect on the interest rate on long-term government debt

[I]t is better to regard [interest rates] as determined by the interplay between the central bank's policy reaction function and private sector expectations and preferences as embedded in financial markets. With respect to risk-free interest rates, the short end of the maturity spectrum is set largely by monetary policy, while the rest of the term structure reflects market expectations of future short rates (and hence the future stance of monetary policy) plus a term premium... If at any given point in time market interest rates are determined as we suggest, then they are not directly influenced by changes in the ex ante saving-investment balance. ([Borio and Disyatat](#), 2011, 20)

A thwarting (or stabilization mechanism?)

23

GDM Supercycles paper: changes the relationship bt CB and govt. Debt financed consumption in anglo-saxon economies. Expansion fragile due to leverage and collateral-based connectedness. Collateral as a 'disciplinary' thwarting mechanism, but an illusory one – MMLR

Observe that, because the policy rate was an unsecured lending rate and the Federal Reserve's capacity to expand the supply of reserves has no fixed limit, monetary policy was implemented in a short-term market with effectively unlimited capacity.²⁴ The importance of this capacity was illustrated in September 11, 2001: the flow of payments froze up and the Fed's capacity for liquidity provision in the money market was essential to ensuring that a fundamentally political event was not converted into a financial crisis (McAndrews and Potter 2002).

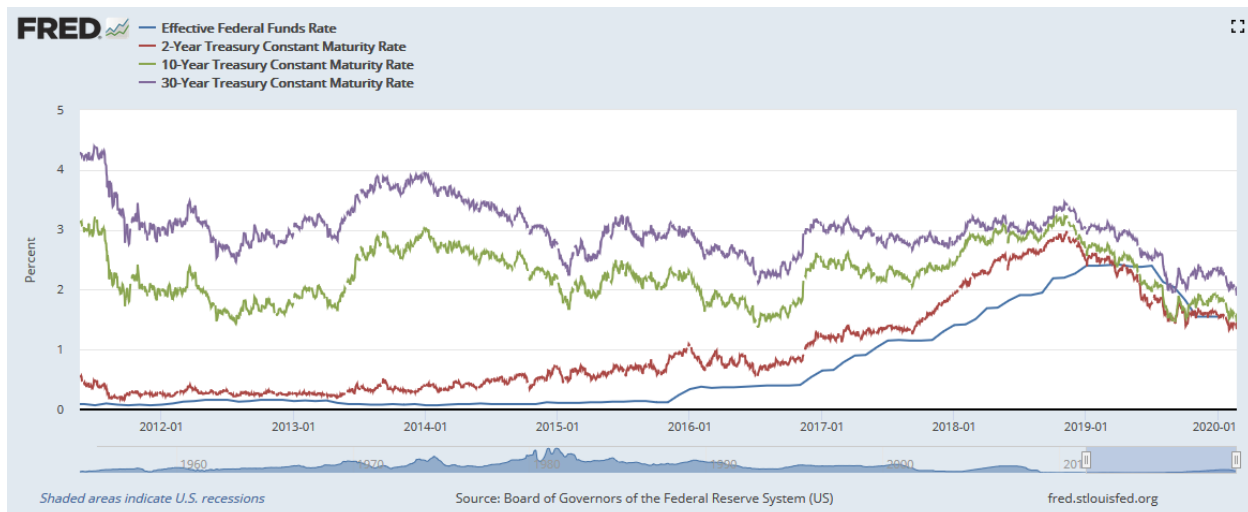
[Rewrite]

²³ See Swanson (2007) reviews efforts to break historical interest rates down into expected short term rates and a term premium. In fact, this is a very difficult exercise and thus it is difficult to be precise about the extent to which market forces affect long-term rates.

<https://fred.stlouisfed.org/graph/fredgraph.png?g=tYAE>

²⁴ Technically it is limited by the availability of discountable assets at the banks with access to the discount window. However, since what is or is not a discountable asset is left to the discretion of the Federal Reserve, it is far from clear that this is a meaningful limit – as some of the debates over the Federal Reserve's actions in 2008 indicate. Also in extraordinary circumstances such as those of September 11, 2001, the Federal Reserve extends unauthorized loans in the form of overnight overdrafts.

The pricing mechanism in modern securities market may in fact be less efficient than traditional securities markets due to public sector guarantees of the solvency of the too-big-to-fail banks that have now been funding dealer portfolios for decades and to the now ubiquitous, permissive use of the corporate form to socialize the losses associated with dealer trading errors. That is, the pricing mechanism in the modern financial system lacks the discipline that is generated by fear of bearing personal losses on the part of the securities market dealers and by structural constraints on the monetization – or in other words the use of bank-based borrowing to fund the carry – of securities market assets. The elimination of these disciplining factors has transformed securities markets and the pricing mechanism in ways that have yet to be fully understood.



Source: St. Louis Fed Fred database, <https://fred.stlouisfed.org/graph/?g=qdSM>

The March 2020 crisis should lay to rest proposals for a standing repo facility, as there is no reason to believe that the liquidity provided by such a facility can be an adequate substitute for the Federal Funds market.

Given the discussion above, the question of whether or not this is a good idea may depend on the question of whether it is advisable for the Federal Reserve to step into JPMC's shoes and thereby endorse the shift from unsecured core money markets to a repo-based core money market.

First, however, it is necessary to consider to what degree a standing repo facility would in fact constitute a Federal Reserve endorsement of the repo market as a whole: would a standing repo facility have the effect of monetizing all the assets that are accepted at the facility? In other words, could we expect the banks to intermediate between the market for reserves and the market for circulating balances, thereby monetizing the assets in question?

The answer to these questions is almost certainly affirmative. Two factors lie behind this conclusion. On the one hand, reserves comprise the asset that is most accepted by regulators when banks seek to meet their regulatory requirements. On the other hand, any repo of eligible collateral will transfer that collateral to the bank, making it possible for the bank to engage in a

back to back repo, effectively funding the loan to the public by reserves. In short, due to the nature of collateralized loans, a loan on repo secured by eligible collateral cannot worsen a bank's access to reserves and therefore cannot make it harder for a bank to meet regulatory requirements.²⁵

Because banks can be expected to intermediate between the Federal Reserve's SRF and the public repo market, the assets eligible at the SRF will almost certainly be monetized. This indirect Federal Reserve backstop of the repo market would have the effect of condoning that transformation in money markets that took place over the course of the past two decades and resulted in the current system where core money markets are repo-based.

The reasons for questioning whether this is a good idea are discussed above. The problem of collateral supply and the interaction between collateral supply and monetary policy in an environment where long-term Treasuries are monetized has not yet been fully explored or understood. Are these repo markets preventing monetary policy from heading back to normal because of the interaction between short-rates that are expected to remain elevated and the value of the outstanding stock of collateral? Are they causing fiscal policy to have effects that overwhelm monetary policy? These questions should be carefully considered, before the Federal Reserve embraces the new repo-based monetary regime.

To summarize, it is a category error to assume that an SRF can substitute for the Federal Funds market as a source of liquidity for banks. The money markets that operate today are very, very different from those that operated in the 1990s and there is no way for "normal service" to be resumed by simply substituting a repo market for the federal funds market.

Proposals for a standing repo facility (SRF) or a dealer of last resort appear to be based on loose analogies between the Federal Funds market and the repo market, and do not engage with the specific characteristics and properties of the repo market.

By all means, the collateralized money market should be carefully studied and modeled. The search for simple, stabilizing reforms is an important one. But the possibility must be considered that the only stabilizing reform will be a rollback of our current reliance on collateralized money markets.

Global Savings Glut, structurally low interest rates

²⁵ Observe that this policy would probably be effective at addressing even intraday money market stresses, largely because bank intraday overdrafts are almost always collateralized (Pozsar 2019) and the standing repo facility ensures that there is a venue for getting the reserves to pay the collateralized overdraft. This means that intraday overdrafts will not be transformed into stress on overnight lending markets.

Duffie (2020): ‘Although the Fed accomplished what it needed to do, as a design principle, the lack of a robust private-market structure should not be acceptable based on the notion that the Fed is available as a dealer of last resort.’

What can be done? Steadily increasing haircuts. What about pre-positioned collateral or big haircuts. LoLR purchase facility.

Since overindebted firms would in all likelihood be shut out of these markets, a transitional period would probably be necessary. Thus, a two track uncleared OTC market could be allowed to operate for 5 to 10 years. One class of derivatives would involve neither collateral posting nor capital charges and the other class would have capital charges that increased steadily over time until the market in “old-fashioned” destabilizing derivatives was finally shut down.

LT government debt is risky due in particular to interest rate risk. Should be treated as such in both capital frameworks and liquidity frameworks (haircuts).

Reducing collateral availability in the money market.

The Federal Reserve was unable to stabilize US financial markets via the money market, precisely because the repo market leaves the risk of the repo collateral on the balance sheets of the borrowers. It was only when the Federal Reserve intervened in the market for long-term debt by purchasing the long-term bonds that were used as collateral, transferring them to the Federal Reserve’s balance sheet, that financial markets stabilized.

Long-term asset markets are now fully integrated with money markets and as a result the abundant liquidity that traditionally supported the growth of economic activity by flowing to firms, large and small, from the banks, which in turn were able to borrow on an as needed basis from the central bank, now funds the carry of sovereign debt. And this same sovereign debt is required by sophisticated financial market participants as a means of supporting/guaranteeing payment on their derivatives liabilities.

Such safe asset demand plays a structural role in the modern money market. And surely explains at least in part the 21st century decline in interest rates on long-term government debt.

Highly leveraged Treasury trades playing an important role in the March 2020 crisis.

It also explains how central banks have been boxed into a corner. Raising rates is destabilizing.

Deleveraging has never been a smooth process for the financial system. Now deleveraging entails massive sell-offs of ‘safe assets’ rendering them – at least from a market point of view – anything but safe. Forced the Fed to step in (i) via direct purchases (ii) via regulatory relief.

Massive fiscal policy while at the same time raising money market rates.

We do not understand what has caused interest rates to remain trapped at low rates – and it is at least possible that the close relationship between a tightening cycle and the value of the outstanding collateral supply plays a role in this trap in which monetary policy makers find themselves. Furthermore, the ways in which repo markets transform fiscal policy into monetary policy may also be hampering monetary policy implementation in the current era. Further study is clearly needed in order to determine whether the embrace of repo markets by central banks is likely to have the effect of constraining the policy space in which they operate for a generation or more.

Inverts the role of the CB and the public with the public bearing risk for the sov. CV Harvard derivatives.

While these authorities may be right that there is no turning back from the financial world that JPMC created, the Fed would be wise to take the time to study very carefully and in detail the implications of condoning the monetization of long-term Treasuries.

Effectively, in normal times the private sector was required to both fund and bear the risk of long-term government debt.²⁶

²⁶ The statement requires a caveat: call loans, the early 20th century equivalent of repo, existed, but their use was limited with certain specific exceptions, such as the US in the late 1920s, that have been studied elsewhere (Sissoko 2017).

Because the central bank did not stand ready on a standing basis to lend against long-term debt, neither did the private banks that relied on the central bank for liquidity. While the private banks were certainly willing to accept long-term government debt as collateral, this was as additional security over and above loan criteria that were designed to ensure that a loan could be repaid.