Who Ran on Repo?

Gary B. Gorton, Andrew Metrick, Chase P. Ross*

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Abstract

The sale and repurchase (repo) market played a central role in the recent financial crisis. From the second quarter of 2007 to the first quarter of 2009, net repo financing provided to U.S. banks and broker-dealers fell by about $900 billion—more than half of its pre-crisis total. Significant details of this "run on repo" remain shrouded, because many of the providers of repo finance are lightly regulated or unregulated cash pools. Our analysis highlights the danger of relying exclusively on data from regulated institutions, which would miss the most important parts of the run.

Repo finance is a multi-trillion dollar market that plays a central role in the modern financial system.[1] From the second quarter of 2007 to the first quarter of 2009, net repo financing provided to U.S. banks and broker-dealers fell by $914 billion—more than half of its pre-crisis total. We argue in a series of papers that this "run on repo" played a crucial role in the recent financial crisis.[2]

Significant details of this run remain shrouded, however, because many of the providers of repo finance are unregulated cash pools. In this paper, we provide an updated picture of the dynamics of the repo run by supplementing the best available official data sources with a unique market survey and data from the footnotes of public companies' filings. We provide evidence that the flight of foreign financial institutions, domestic and offshore hedge funds, and other unregulated cash pools

* Gorton: Yale School of Management, 165 Whitney Ave., P.O. Box 208200, New Haven, CT 06520 and NBER (email: Gary.Gorton@yale.edu); Metrick: Yale School of Management, 165 Whitney Ave., P.O. Box 208200, New Haven, CT 06520 and NBER (email: Andrew.Metrick@yale.edu); Ross: Yale School of Management, 165 Whitney Ave., P.O. Box 208200, New Haven, CT 06520 (email: Chase.Ross@yale.edu). We thank Carol Bertaut, Susan Hume McIntosh, and seminar participants at the Federal Reserve Board of Governors for helpful comments and Lei Xie for research assistance.

[1] A repo contract is an arrangement in which one party, the lender, provides cash to the other party, the borrower. The contract is collateralized and often overnight. The borrower (often a bank) provides collateral with a market value equal to or greater than the amount of cash the depositor provides. Gorton and Metrick (2012) describes repo contracts in detail.

[2] Gorton (2010), Gorton and Metrick (2010a, 2010b, 2012)

predominantly drove the run on repo. Our analysis highlights the danger of relying exclusively on data from regulated institutions, which would miss the most important parts of the run.

There are two repo markets: "tri-party repo" and "bilateral repo." Reliable data is available for only tri-party. In tri-party repo, a clearing bank stands between borrowers and lenders. Regulated institutions dominate tri-party repo, and thus the data on tri-party repo is relatively complete. However, accounting rules allow netting of offsetting repo liabilities and repo assets under certain conditions; ignoring offset repo risks underestimating the actual size of repo.

Unlike tri-party, bilateral repo is the home of hedge funds, many types of offshore institutions, and other unregulated cash pools. The data gap between tri-party and bilateral repo markets is significant; a 2005 survey by the Bond Market Association finds bilateral repo three times as large as tri-party repo in 2004.

Since the financial crisis, there have been several proposals for reform of repo markets and a nascent debate about the role of repo in the financial system. The most related paper to ours is Krishnamurthy et al. (2014), who perform a detailed analysis of the tri-party and securities-lending market focused on money-market mutual funds. They analyze the same raw data used in the Flow-of-Funds and find only a small run by money-market funds on repo during the crisis. Based on this evidence, they conclude the run on repo was not central to the financial crisis. The evidence in our paper shows that this conclusion is premature, as it ignores the role of non-reporting institutions. Since money-market mutual funds make up only about two percent of the bilateral market, and the bilateral market is the main contributor to the $569 billion of statistical discrepancy that disappeared during the crisis, it is not possible to draw conclusions about the repo run by focusing only on money-market mutual funds and other regulated institutions.

1 Flow-of-Funds Evidence

Table L.207 in the Flow-of-Funds combines all the primary sources for tri-party repo with the available sources for bilateral repo. The Flow-of-Funds data on total repo liabilities is relatively complete, even for bilateral repo, because the borrowers are mostly banks and broker-dealers. The online appendix summarizes the sources used for each category in L.207. In contrast, the lenders come from both regulated and unregulated sectors, so that the official totals for liabilities (borrowers) typically exceed those for assets (lenders), often by a significant amount, resulting in a meaningful "statistical discrepancy." The statistical discrepancy was the single largest repo lender on the eve of the crisis, with a $632 billion difference between reported assets and liabilities. Over the subsequent seven quarters, this discrepancy completely disappeared. A first-order—albeit unsatisfying—answer to "who ran on repo?" is that "the statistical discrepancy ran on repo." Discrepancy aside, there are several notable facts revealed by the Flow-of-Funds.

The largest repo borrowers are banks and broker-dealers. Figure 1 plots the

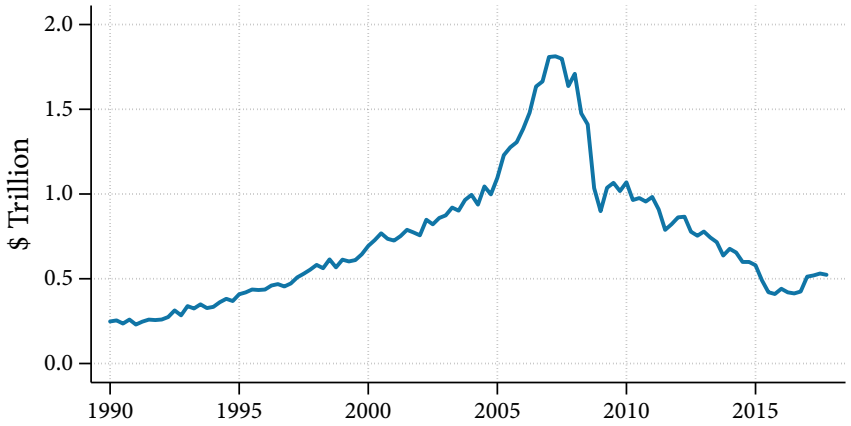

Figure 1: **Net Repo Funding to Banks and Broker-Dealers**. Series includes Federal Funds and repo for banks and only repo for broker-dealers. Table L.207 separates repo and Federal funds data only after 2012. See the online appendix for calculation details and a comparison of the Federal Funds and repo measures and the repo-only measure. Source: Federal Reserve Flow of Funds Table L.207, as of April 2019.

combined net repo liabilities for the two groups since 1990. After growing at a steady rate beginning in the 1990s, financing exceeded $1.8 trillion by the eve of the crisis in the second quarter of 2007. During this buildup, broker-dealers became especially reliant on repo, with approximately 50 percent of their assets funded through these markets. Repo finance to broker-dealers and banks then fell over the next two years, reaching a local minimum below $900 billion in the first quarter of 2009.

Table 1 shows the primary holders of repo assets in 2007Q2, just before the first panic phase of the financial crisis, and in 2009Q1, after the worst part of the post-Lehman panic phase ended. In 2007Q2, the largest category is the "statistical discrepancy," with $632 billion.

Of the remaining categories, the two most significant are rest-of-world (ROW) at $519 billion and money-market mutual funds (MMFs) at $435 billion. MMFs are the leading domestic repo funders, with such funding taking place almost exclusively in the tri-party market. The ultimate source of ROW data in the Flow-of-Funds is the Treasury International Capital System, which is itself compiled from a variety of sources. As with other parts of the Flow-of-Funds, the ROW data necessarily relies on regulatory filings, and will not capture information from unregulated capital pools: any missing data from ROW will end up in the discrepancy. Combined, "discrepancy," MMFs, and ROW constitute about 80 percent of net repo funding sources in 2007Q2.

The last column in Table 1 shows analogous information from 2009Q1. The three main categories all show striking changes. The discrepancy fell 90 percent to $63 billion: Half a trillion dollars of financing from non-reporting sources disappeared during the financial crisis. ROW also experienced a substantial reduction, dropping from $519 billion in 2007Q2 to $53 billion in 2009Q1. The drop represents only

$ Billions	2007Q2	2009Q1
Discrepancy	632	63
Rest-of-World	519	53
MMF	435	578
Municipal	148	125
GSE	145	159
Other MF	43	24
Corporate	9	7
Pension	7	6
Holding/Funding	0	28
Insurance	-12	4
Total	1,926	1,049

Table 1: **Net Repo Funding Sources.** Net repo funding is equal to repo assets less repo liabilities. MMF is money-market funds; Municipal is state and local governments; GSE is government-sponsored enterprises; other MF is all other mutual funds; pension is private pensions and state and local government defined benefit retirement funds; holding/funding is holding companies and funding corporations. The totals in Table 1 are for all repo assets, and thus do not match the totals in Figure 1 for the liabilities of just banks and broker-dealers. Source: Federal Reserve Flow of Funds Table L.207, as of April 2019.

the reporting component of the ROW, with any non-reporting capital pools—both foreign and domestic—swept into the discrepancy.

In contrast, MMFs increased their repo funding during the panic phases of the financial crises, with $435 billion in 2007Q2 rising to $578 billion in 2009Q1. At first glance, the increased funding from MMFs may appear inconsistent with the near-runs in MMFs themselves following the Lehman bankruptcy in September 2008. A resolution of this puzzle is more straightforward with a more dynamic picture of the repo funding during the crisis.

MMFs increased repo funding from about $200 billion in 2000 to over $400 billion just before the crisis. Then, panics in other short-term debt markets drove MMF dynamics. The first panic, in August 2007, manifested itself most clearly in runs in asset-backed commercial paper (ABCP) markets, as documented by Covitz et al. (2013). As MMFs were significant holders of ABCP, many funds faced pressure to maintain par value, and at least 44 funds received material support from their sponsors. (McCabe, 2010). After that support, MMFs appeared to be havens and received the inflow of cash exiting other short-term investments. Some of that inflow made it into repo. In the panic that followed the Lehman bankruptcy, however, sponsor support was insufficient. When the Reserve Primary Fund "broke the buck" by falling below $1 per share on September 16, only unprecedented government intervention averted an incipient run on MMFs. When this intervention arrived, the MMF industry stabilized with its repo funding still above its 2007Q2 levels.

In addition to the net funding losses coming from the ROW and the discrepancy, repo markets also suffered substantial reductions in gross interdealer funding. The left panel of Figure 2 shows both repo assets and repo liabilities for broker-dealers. Repo liabilities peaked over $3.1 trillion in 2007Q3 and stayed around that threshold for the next four quarters before falling steadily during the crisis to $1.8 trillion in

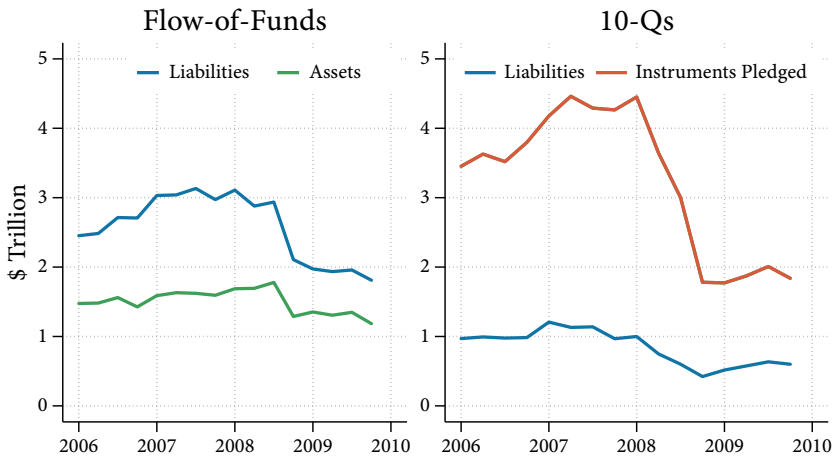

Figure 2: **Repo in Flow of Funds and 10-Qs**. Instruments pledged is the sum of trading assets which are pledged and cannot be repledged, trading assets which are pledged and can be repledged, and collateral received which has been repledged. 10-Q figure includes data from six firms: Goldman Sachs, Lehman Brothers, Bear Stearns, Merril Lynch, Morgan Stanley, and J.P. Morgan. Source: Company reports, Federal Reserve Flow of Funds Table L.207, as of April 2019.

2009Q4. At the same time, repo assets also dropped. These dynamics are consistent with an initial shift from unsecured funding (e.g., commercial paper) to repo funding in interdealer markets following the first panic in August 2007, with even secured repo funding facing a run after Lehman.

The Flow-of-Funds does not, however, represent the total volume of repo lending and borrowing even for regulated sectors. Accounting rules let companies offset repo borrowing and lending (and other collateralized transactions) when the transactions are with the same counterparty, subject to a master netting agreement, and settle on the same day.[3] Netting does not require the collateral underlying offsetting transactions to be the same or otherwise similar.

To understand the magnitude of this netting, we collect data from six large broker-dealers' and banks' quarterly filings.[4] Companies report the total value of the collateral they received which they repledged, along with the value of their own financial assets pledged in a footnote. The sum of these measures is the total instruments pledged, which we compare against the repo liabilities reported on the 10-Qs for the same six companies on the right panel of Figure 2. Other forms of collateralized lending, collateral received due to derivatives trading, and the allowable netting mentioned above explain the difference between total instruments pledged and the balance-sheet-reported repo liabilities.

[3] Financial Accounting Standards Board Interpretation No. 41 describes allowable netting of collateralized transactions, and Financial Accounting Standards No. 140 describes circumstances in which firms are not required to report security-for-security repo on their balance sheets.

[4] Kirk et al. (2014) and Singh (2011) both analyze the collateral data contained in the footnotes of 10-Q filings.

Beyond the lack of data for unregulated capital pools, the large gap between instruments pledged and repo liabilities highlight limitations of the Flow-of-Funds data. First, Table L.207 does not include other forms of collateralized financing which are conceptually and legally similar to repo: securities lending, for example. Second, gross repo numbers in the Flow-of-Funds are lower than the actual gross numbers due to individual companies' netting of offsetting positions. The magnitude of gross repo liabilities—before taking out offsetting transactions—better reflects the true extent of the financial system's use of repo. The magnitude of offsetting transactions may be particularly important when different types of collateral underlie the offsetting transactions.

Gross volumes matter because the legs of offsetting repo transactions are linked. Broker-dealers' largest use of repo is in their so-called matched book, where a broker-dealer enters into two offsetting repos (one an asset, the other a liability) by borrowing a security from counterparty A, pledging the collateral to counterparty B, and returning B's cash to A. So long as these two legs meet the criteria mentioned, they can offset each other and will not appear on the broker-dealer's balance sheet. Should the cash-lender stop rolling the repo—or more likely, should the cash lender raise the haircut on their leg—the broker-dealer needs to find additional collateral elsewhere. It can be costly to find or finance additional collateral, especially when haircuts rise. The gross volume of the matched book better reflects the degree to which broker-dealers intermediate, even though the transactions do not appear on balance sheet, and therefore do not appear in the Flow-of-Funds.

The Flow-of-Funds data shows a significant drop in repo funding to banks and broker-dealers during the financial crisis. The drop was rapid, with net funding to banks and broker-dealers falling from $1.8 trillion in 2007Q2 to $900 billion in 2009Q1. Broker-dealers also contributed to the run on liabilities by withdrawing funding themselves. Although it is washed out in the net funding numbers, broker-dealers reduced both gross repo assets and gross repo liabilities, with the former dropping by about $490 billion just in 2008Q3, the quarter of the Lehman failure. Notwithstanding the large drops in reported repo funding from the institutions reporting in these categories, the most significant drop occurred for non-reporting cash pools. These pools end up as part of the statistical discrepancy in the Flow-of-Funds accounts, which saw a drop of about $570 billion from 2007Q2 to 2009Q1. These non-reporting pools could be both foreign and domestic, and it is necessary to turn to non-official sources to get some sense of the composition of these pools.

The difference between balance sheet reported repo liabilities and collateral pledged, although a coarse measure, suggests that the Flow-of-Funds underestimates the contraction in gross repo volumes even for regulated institutions. Across our sample of six broker-dealers and banks, instruments pledged halved between 2007Q2 and 2009Q1, as shown in Figure 2. Balance sheet repo liabilities for the same companies also approximately halved over the same period, but instruments pledged peaked at $4.5 trillion whereas repo liabilities peaked $1.1 trillion. The contraction in instruments pledged was not limited to firms that subsequently went bankrupt or

were acquired; instruments pledged by firms that survived the crisis as stand-alone institutions also halved on average.[5] Total instruments pledged by Lehman Brothers alone fell $450 billion between 2008Q1 and 2008Q2, its last quarterly filings, despite the relatively small decline in repo funding from $197 to $128 billion over the same period.

2 Survey Evidence

The Bond Market Association conducted a dealer survey in September 2004 of bilateral repo, tri-party repo, and securities lending and borrowing. Fifteen primary dealers responded. The survey asked major market participants about the identity of their counterparties and provided estimates of market size by counterparty-type. The survey did not distinguish between borrowing and lending and did not reveal the methodology for its market-size estimates, so it is not possible to make a direct comparison to aggregate data in the Flow-of-Funds. Nevertheless, the survey is invaluable for the view it gives into the composition of counterparties, particularly those that do not report through official sources. For our purposes, the key findings from the survey—subject to caveats explained below—are (1) bilateral repo is about three times the size of tri-party repo; (2) money-market mutual funds comprise only about two percent of bilateral repo; and (3) hedge funds and other unregulated capital pools represent a significant fraction of the counterparties to dealers in bilateral repo.

Table 2 reproduces the summary data from the survey. The survey estimates the total market—including bilateral repo, tri-party repo, and securities lending—for secured borrowing at $7.8 trillion in June 2004. We focus on the totals for bilateral and tri-party repo, estimated at $3.9 and $1.4 trillion, respectively. Flow-of-Funds data counts assets and liabilities separately, but the survey does not distinguish between them, and thus the total may include double-counting. Given this limitation, we cannot directly compare the survey aggregates with the Flow-of-Funds. Instead, we focus on the percentages of the total, particularly for the non-dealer categories, where the ratios of borrowing to lending are likely to be similar across counterparties. Under any reasonable assumption for the proportion of borrowing and lending by counterparty, there is significantly more bilateral than tri-party repo. For example, even if there is no double-counting of tri-party repo and full double-counting of bilateral repo, the latter would still be nearly 50 percent larger than the former.

Within bilateral repo, interdealer transactions count for 41 percent of the overall total and about 60 percent of the domestic total. Outside of dealers, the largest category is "Other Investment Managers, Hedge Funds," with 9 percent of the total. If we also include off-shore hedge funds (8 percent), then more than 17 percent of bilateral repo comes from hedge funds and other unregulated investment managers. These hedge funds may represent a significant component of the statistical discrep-

[5] The online appendix includes a figure of company-specific instruments pledged and repo liabilities.

Panel A: Participants in the Bilateral Repo Market		
U.S. Counterparties	**$ Billions**	**Percent**
Dealers	1,566	40.6
Other Invest. Managers, Hedge Funds	348	9.0
Other U.S.[a]	260	6.8
Financial and Mortgage Companies	148	3.8
Corporate	132	3.4
Agent Bank	113	2.9
Registered 40 Act Funds (incl. MMF)	60	1.6
Insurance Companies	26	0.7
Municipal	23	0.6
Foundations and Endowments	20	0.5
Federal Reserve Bank	14	0.4
Govt. Agencies	12	0.3
ERISA Pension Funds	8	0.2
Non-ERISA & Public Pension	7	0.2
Sub-Total	2,739	71.0
Non-U.S. Counterparties		
Other Non-US[b]	614	15.9
Off Shore Hedge Funds	319	8.3
Sovereign Govt. & Central Banks	159	4.1
Non-U.S. Sovereign Govt Entities	14	0.4
Supranationals	13	0.3
Sub-Total	1,119	29.0
Total	3,858	100.0
Total Hedge Funds, Invest. Managers	667	17.3
Panel B: Secured Borrowing and Lending Markets		
Bilateral Repo	3,858	49.2
Securities Lending	2,355	30.1
Tri-party Repo	1,350	17.2
NASD/NYSE	275	3.5
Total	7,838	100.0

Table 2: **BMA Survey: June 30, 2004.** [a]Type of counerparty was not specified. [b]Denotes foreign affiliates, foreign dealers, corporations, insurance companies, and managed funds. Source: Bond Market Association Research (2005).

ancy from the Flow-of-Funds: hedge funds do not report their repo activity, so Table L.207 sweeps their repo activity—as a residual—into the statistical discrepancy.

The other significant categories of bilateral repo are "Other U.S." (7 percent) and "Other Non-U.S." (16 percent). "Other U.S." represents all domestic counterparties that have been left unspecified by survey respondents. "Other Non-U.S." is a catch-all category intended to lower the paperwork burden on survey respondents, by asking for less detail in the foreign section than the domestic section. This category includes foreign affiliates, foreign dealers, corporations, insurance companies, and managed funds. In general, most of these capital pools would not be captured in the underlying Flow-of-Funds data, and would also show up as part of the statistical discrepancy.

Overall, 30 percent of total repo—40 percent of bilateral repo—in the survey is hedge funds or "other," with more than half of this amount coming from foreign

sources. Very little—if any—of this amount comes from sources covered in the Flow-of-Funds. For comparison, the statistical discrepancy of $632 billion in the Flow-of-Funds repo data in 2007Q2 is about 13 percent of the total repo liabilities from all sources.

3 Conclusion

This paper analyzes the "run on repo" during the recent financial crisis using data from the Federal Reserve's Flow-of-Funds, supplemented by companies' public filings and a unique market survey conducted by the Bond Market Association. Net repo funding sources in the Flow-of-Funds withdrew about $900 billion in funding between 2007Q2 and 2009Q1. The Flow-of-Funds only captures half of the reduction in funding, mainly from the "rest-of-world." The remaining decline shows up as a reduction in the "statistical discrepancy." Evidence from the survey suggests that the Flow-of-Funds is missing about 40 percent of the bilateral repo market. This missing data comes predominantly from foreign and domestic hedge funds and other unregulated capital pools. The Flow-of-Funds also excludes offsetting transactions and other repo-like items, such as securities lending. Thus, the $2.7 trillion decline in instruments pledged from 2007Q2 to 2009Q1 for only the six largest broker-dealers and banks is double the fall in Flow-of-Funds banks' and broker-dealers' repo liabilities over the same period.

Our analysis demonstrates the danger of relying exclusively on official sources of data for repo markets. While it is tempting to focus where the data is most reliable, such analyses can be misleading. For repo, the tri-party market has the best data, and money-market mutual funds have the most detailed data within tri-party repo. As it turns out, MMFs were not representative during the crisis, with MMFs' repo assets increasing by a third at the same time that net repo funding nearly halved.

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A Online Appendix

We now provide additional data from the Federal Reserve's Flow-of-Funds on select repo asset series.[6]

1. Rest of the world; security repurchase agreements; asset

    - Series ID: FL262051003.Q
    - Description: Unadjusted transactions from BEA, ITA, Table 8.1, U.S. International Financial Transactions for Other Investment, line 69, Transactions with deposit-taking institutions excluding the central bank, deposits, of which: Resale agreements plus line 81, Transactions with other financial institutions and non-financial institutions excluding general government, loans, of which: resale agreements. Level is calculated as the previous level plus the unadjusted transactions. Data for the most recent ten years shows no significant seasonality.

2. Money market funds; security repurchase agreements; asset

    - Series ID: FL632051000.Q
    - Description: From 2013Q1, level from N-MFP data, taken from ICI table "Monthly Taxable Money Market Fund Portfolio Data", Repurchase agreements total. Sum of Prime, Government, and Tax-exempt totals. Prior to 2013Q1, Level from ICI by subscription, Trends in Mutual Fund Activity, table 8, Month-End Portfolio Holdings of Taxable Money Market Funds, Repurchase agreements. Series includes variable annuity money market funds. Series includes variable annuity money market funds. Unadjusted transactions are the change in the level; seasonally adjusted transactions are obtained using X-13-ARIMA procedure.

3. Mutual funds; security repurchase agreements; asset

    - Series ID: FL652051003.Q
    - Description: Level from ICI by subscription, Quarterly Long-Term Mutual Fund Asset Composition report, calculated as one-sixth of line item cash and receivables minus liabilities. Data for the most recent quarter estimated as one-sixth of quarter end, long-term mutual fund liquid assets from ICI Monthly Trends report Table 6, less an estimate for short term municipal bonds and short term government bonds. Series includes variable annuity long term mutual funds. Unadjusted transactions are the change in the level; data for the last ten years show no significant seasonality.

[6] Additional detail, and useful links across the series, is available at `https://www.federalreserve.gov/apps/fof/AdvancedSearch.aspx?ck=a`.

4. Government-sponsored enterprises; federal funds and security repurchase agreements; asset

    - Series ID: FL402050005.Q (which is the sum of FL402050013.Q, FL402050023.Q, FL402051033.Q and FL402052033.Q)
    - Description: For FL402050013.Q: Level from FNMA, Condensed Consolidated Balance Sheets, Federal funds sold and securities purchased under agreements to resell. Transactions are calculated as the change in level. Data for the most recent ten years show no significant seasonality.

      For FL402050023.Q: Level from Freddie Mac, Consolidated Balance Sheets, Securities purchased under agreements to resell and federal funds sold. Transactions are calculated as the change in level. Data for the most recent ten years show no significant seasonality.

      For FL402051033.Q: Level from FHLBs, Combined Statements of Condition, Securities purchased under agreements to resell. Transactions are calculated as the change in level. Data for the most recent ten years show no significant seasonality.

      For FL402052033.Q: Level from FHLBs, Combined Statements of Condition, Federal funds sold. Transactions are calculated as the change in level. Data for the most recent ten years show no significant seasonality.

5. Nonfinancial corporate business; security repurchase agreements; asset

    - Series ID: FL102051003.Q
    - Description: Starting in 2010:Q4; level is calculated from QFR Table 70.1 - Balance Sheet for Corporations in the NAICS Manufacturing Sector, Total Assets $25 Million and Over, line U.S. Treasury and Federal agency securities, Subject to agreements to sell, plus a percentage of QFR short-term investments for all other QFR industries. The percentage is calculated as U.S. Treasury and Federal agency securities, Subject to agreements to sell from QFR Table 70.1, divided by line Total Cash, U.S. Government and other securities less line Total cash on hand and in banks. QFR short-term investments for other industries are calculated as the sum of line Other short-term financial investments, including marketable and government securities, commercial paper, etc. from Table 82.1 - Balance Sheet for Corporations in NAICS Mining and Wholesale Trade sectors, Table 84.1 - Balance Sheet for Corporations in NAICS Retail Trade Sector, Table 86.1 - Balance Sheet for Corporations in NAICS Information Sector, and Table 89.1 – Balance Sheet for Corporations in NAICS Professional and Technical Services Sector (except Legal Services). The QFR total is multiplied by the ratio of line Total Assets from the SOI Corporation Income Tax Returns, Returns of Active Corporations, Table 6 - Balance Sheet, Income Statement, Tax, and Other Selected Items, by Major Industry, Services sector, to line

Total Assets from the QFR Table 1.1 - Balance Sheet for Corporations in the NAICS Manufacturing Sector, All Total Asset Sizes. Unadjusted flow is the change in the level; data for the most recent ten years show no significant seasonality.

6. State and local governments, excluding employee retirement funds; security repurchase agreements; asset

   - Series ID: FL212051003.Q
   - Description: Level is calculated as approximately 5 percent of total financial assets from the U.S. Census Bureau's Table 1–State and Local Government Finances by Level of Government and by State, Cash and security holdings, Other than insurance trust funds, adjusted to match financial accounts framework. Percentage is based on detailed data for fiscal year 2011 on security repurchase agreements from CAFRs for the largest state and local governmental units. Transactions are calculated as the change in level. Data for the most recent ten years show no significant seasonality.

7. Property-casualty insurance companies; security repurchase agreements, including those held by U.S. residual market reinsurers; asset

   - Series ID: FL512051005.Q (which is the sum of FL512051003.Q and FL512451003.Q)
   - Description: For FL512051003.Q: Level from financial statements compiled by and purchased from S&P Global. Series from Supplemental Investment Risk Interrogatories, Question 20, net admitted assets subject to reverse repurchase agreements plus dollar reverse repurchase agreements. Transactions are calculated as the change in level. Data for the most recent ten years show no significant seasonality.

     For FL512451003.Q: Levels are FOF Section calculation from property and casualty insurance statutory financial statement Schedule F data compiled by and purchased from S&P Global. Unadjusted transactions are the change in the level. Data for the most recent ten years show no significant seasonality.

8. Life insurance companies, general accounts; security repurchase agreements, including those held by U.S. captive reinsurers; asset

   - Series ID: FL542051075.Q (which is the sum of FL542051073.Q and FL542451073.Q)
   - Description: For FL542051073.Q: Level from financial statements compiled by and purchased from S&P Global. Series from Supplemental Investment Risk Interrogatories, Question 20, net admitted assets subject to reverse repurchase agreements plus dollar reverse repurchase

agreements. Transactions are calculated as the change in level. Data for the most recent ten years show no significant seasonality.

For FL542451073.Q: Levels are FOF Section calculation from life insurance statutory financial statement Schedule S data compiled by and purchased from S&P Global. Unadjusted transactions are the change in the level. Data for the most recent ten years show no significant seasonality.

9. Pension funds; security repurchase agreements; asset

   - Series ID: FL592051005.Q (which is the sum of FL222051043.Q, FL572051043.Q and FL572051033.Q)
   - Description: For FL222051043.Q: Second quarter levels are benchmarked annually to U.S. Census Bureau, Annual Survey of Public Pensions (ASPP), State & Local Data, Table 1: National Summary of Public-Employee Retirement Systems. Second quarter level estimated as a portion of other short-term cash investments (Z68) from ASPP fund level individual unit file applied to the ASPP summary total cash and short-term investments (X21) less time and savings deposits (Z87; see FL223030043), and less cash on hand (Z88; see FL223020043). The portion of other short-term cash investments is estimated from a sample of Comprehensive Annual Financial Reports of the largest state and local governmental units taken in 2004:Q2 and 2011:Q2. Quarterly levels between ASPP Q2 benchmarks are computed by increasing the previous level using the quarterly growth rate of U.S. Census Bureau, Quarterly Survey of Public Pensions (QSPP) cash short-term investments (X21). Any residual difference between Q2 benchmark level and quarter level method is spread evenly over the previous quarters. The unadjusted transactions are the change in the level. Data for the most recent ten years show no significant seasonality.

     For FL572051043.Q: Year-end level estimated from DOL Employee Benefits Security Administration, Private Pension Plan Bulletin: Abstract of Form 5500 Annual Reports and DOL Form 5500 Direct Filing Entity Bulletin: Abstract of Form 5500 Annual Reports table 12, Defined Benefit, as Assets in registered investment companies, plus a portion of Assets in common/collective trusts and Assets in master trusts, where the portion is estimated using DFE Table 2 and Table 12 (Excluding real estate). The level is then adjusted for plans whose fiscal years do not end on December 31 and to include plans with fewer than 100 participants. Data are available with a two-year lag. Series is converted to quarterly and estimated for quarters assuming constant transactions throughout the year. The growth rate of the Milliman 100 Pension Funding Index market value of assets (adjusted for market gains of debt securities) is used to estimate total assets after benchmark years. The unadjusted

transactions are the change in the level. Data for the most recent ten years show no significant seasonality.

For FL572051033.Q: Level from the H.4.1 Federal Reserve statistical release, table 5 Consolidated Statement of Condition of All Federal Reserve Banks, Repurchase agreements. While data is released weekly (Wednesday), we use only quarter end dates. Unadjusted transactions are the change in the level; seasonally adjusted transactions are obtained using X-13-ARIMA procedure.

For FL542451073.Q: Levels are FOF Section calculation from life insurance statutory financial statement Schedule S data compiled by and purchased from S&P Global. Unadjusted transactions are the change in the level. Data for the most recent ten years show no significant seasonality.

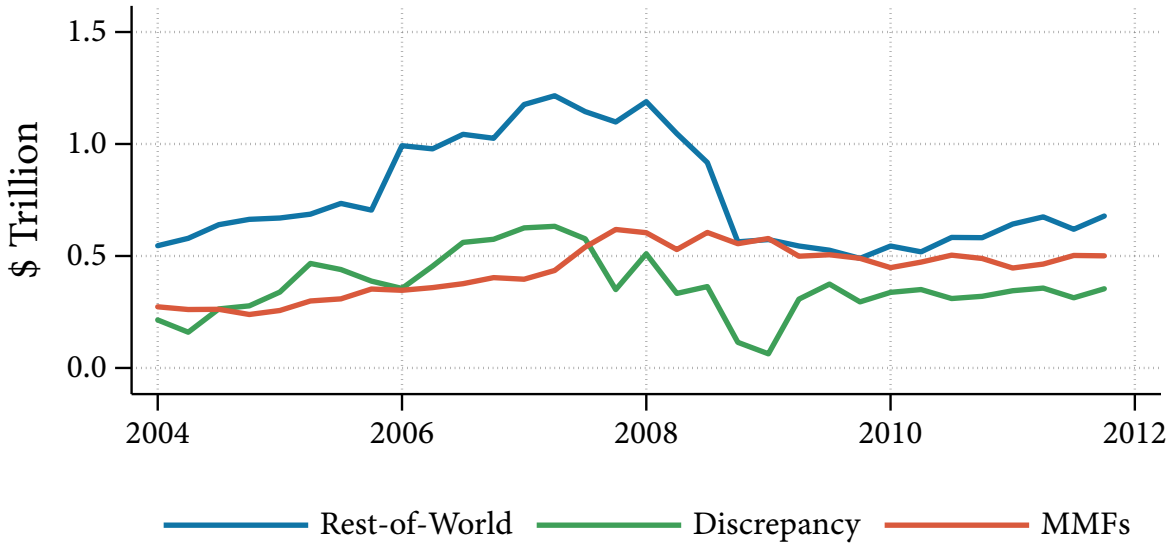

Figure 3: **Major Holders of Repo Assets**. Source: Federal Reserve Flow of Funds Table L.207, as of April 2019.

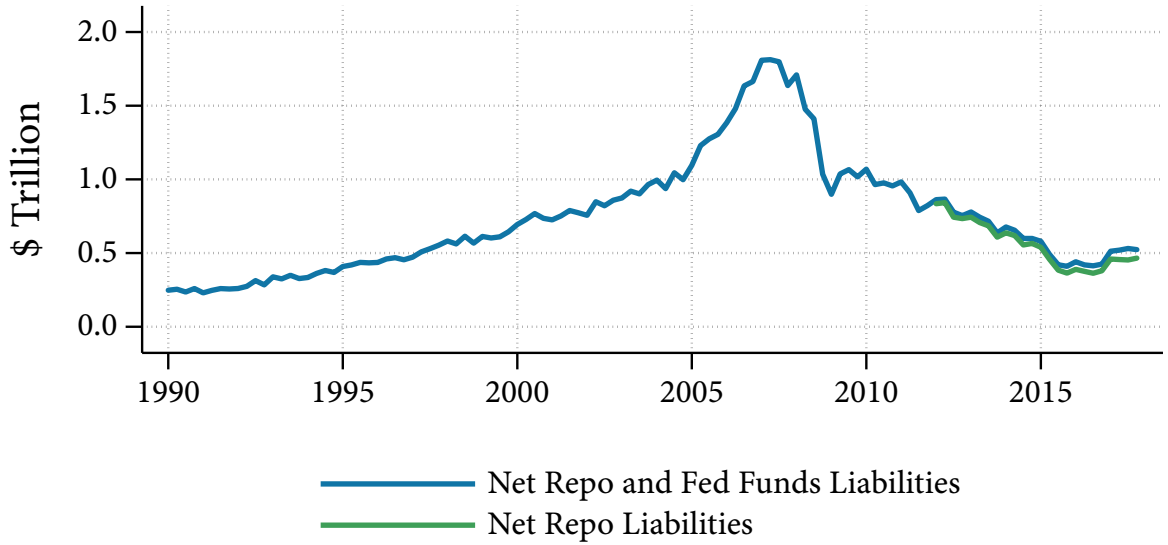

Figure 4: **Net Repo Funding to Banks and Broker-dealers, excluding Federal Funds.** Source: Federal Reserve Flow of Funds Table L.207, as of April 2019.

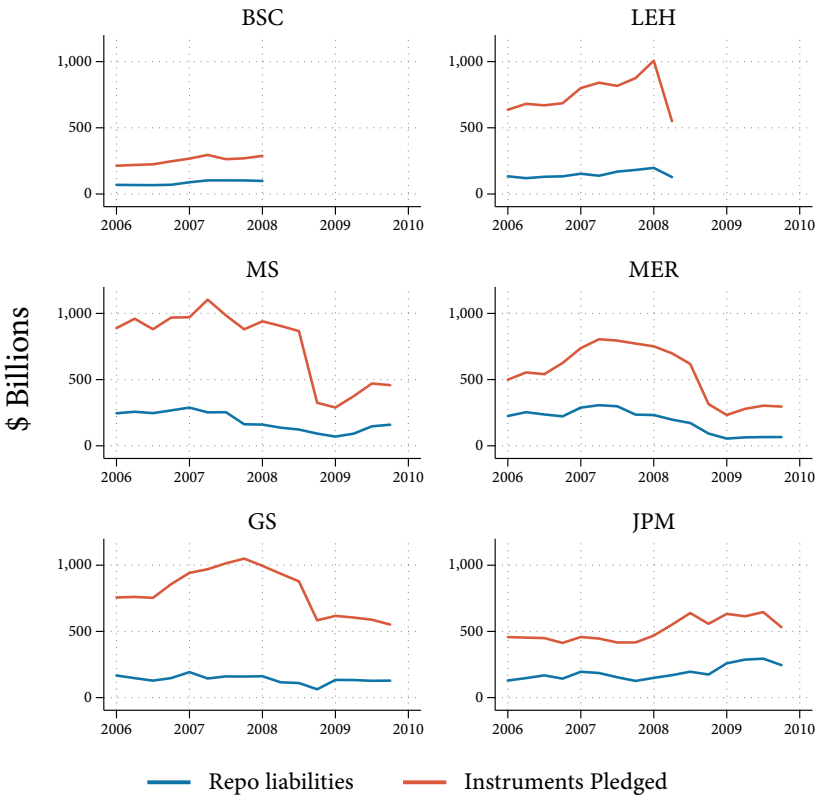

Figure 5: **Instruments Pledged and Repo Liabilities.** Instruments pledged is the sum of trading assets which are pledged and cannot be repledged, trading assets which are pledged and can be repledged, and collateral received which has been repledged. Source: Company reports.

	Series ID	Description	Source
Net Repo Funding to Banks and Broker-Dealers			
+	FL762150005.Q	U.S.-chartered depository institutions, including IBFs; federal funds and security repurchase agreements; liability	FFIEC 002, FFIEC 031, FFIEC 041, FFIEC 051
+	FL752150005.Q	Foreign banking offices in the U.S., including IBFs; federal funds and security repurchase agreements; liability	FFIEC 002
+	FL472150053.Q	Credit unions; federal funds and security repurchase agreements held by Corporate Credit Unions; liability	NCUA 5310
+	FL662151003.Q	Security brokers and dealers; security repurchase agreements; liability	FOCUS, FOGS
-	FL762050005.Q	U.S.-chartered depository institutions, including IBFs; federal funds and security repurchase agreements; asset	FFIEC 002, FFIEC 031, FFIEC 041 and FFIEC 051
-	FL752050005.Q	Foreign banking offices in the U.S. including IBFs; federal funds and security repurchase agreements; asset	FFIEC 002
-	FL472050053.Q	Credit unions; federal funds and security repurchase agreements held by Corporate Credit Unions (net of liabilities before 2002:Q4); asset	NCUA 5310
-	FL662051003.Q	Security brokers and dealers; security repurchase agreements; asset	FOCUS, FOGS
Net Repo Funding to Broker-Dealers			
	Series ID	**Description**	**Source**
+	FL662151003.Q	Security brokers and dealers; security repurchase agreements; liability	FOCUS, FOGS
-	FL662051003.Q	Security brokers and dealers; security repurchase agreements; asset	FOCUS, FOGS

Table 3: **Calculating Repo from Flow of Funds**. Series ID is the Flow-of-Funds series identification number. Source: Federal Reserve Flow of Funds Table L.207, as of April 2019.