AEA Papers and Proceedings 2020, 110: 487–492
https://doi.org/10.1257/pandp.20201100

Who Ran on Repo?[†]

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

Repo finance is a multitrillion-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 US banks and broker-dealers fell by $914 billion—more than half of its precrisis 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 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 are available only for 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 are 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 paper most related to ours is Krishnamurthy, Nagel, and Orlov (2014), which performs a detailed analysis of the tri-party and securities-lending market focused on money-market mutual funds (MMFs). They analyze the same raw data used in the Flow of Funds and find only a small run by MMFs on repo during the crisis. On the basis of 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 nonreporting institutions. Since MMFs make up only about 2 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 MMFs and other regulated institutions.

I. Flow of Funds Evidence

Table L.207 in the Federal Reserve 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 are relatively complete, even for bilateral repo, because the borrowers are mostly banks and broker-dealers. The online Appendix

*Gorton: Yale School of Management and NBER (email: Gary.Gorton@yale.edu); Metrick: Yale School of Management and NBER (email: Andrew.Metrick@yale.edu); Ross: Yale School of Management (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.

[†]Go to https://doi.org/10.1257/pandp.20201100 to visit the article page for additional materials and author disclosure statement(s).

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

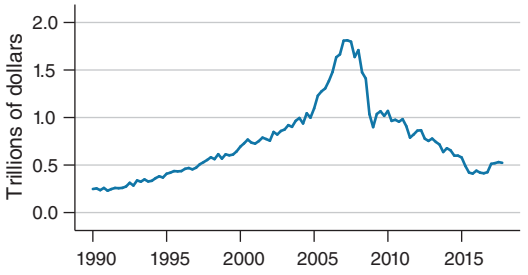

Figure 1. Net Repo Funding to Banks and Broker-Dealers

Notes: The 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 with the repo-only measure.

Source: Federal Reserve Flow of Funds Table L.207, as of April 2019

Table 1—Net Repo Funding Sources

	2007:II	2009:I
Discrepancy	632	63
ROW	519	53
MMFs	435	578
Municipal	148	125
Government-sponsored enterprises	145	159
Other mutual funds	43	24
Corporate	9	7
Pension	7	6
Holding/funding	0	28
Insurance	−12	4
Total	1,926	1,049

Notes: Net repo funding is equal to repo assets less repo liabilities, in billions of dollars. Municipal is state and local governments; 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

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 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 2007:II, just before the first panic phase of the financial crisis, and in 2009:I, after the worst part of the post-Lehman panic phase ended. In 2007:II, 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 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 compiled from a variety of sources. As with other parts of the Flow of Funds, the ROW data necessarily rely 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 2007:II.

The last column in Table 1 shows analogous information from 2009:I. The three main categories all show striking changes. The discrepancy fell 90 percent to $63 billion: half a trillion dollars of financing from nonreporting sources disappeared during the financial crisis. ROW also experienced a substantial reduction, dropping from $519 billion in 2007:II to $53 billion

in 2009:I. The drop represents only the reporting component of the ROW, with any nonreporting 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 2007:II rising to $578 billion in 2009:I. 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 more than $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 markets, as documented in Covitz, Liang, and Suarez (2013). As MMFs were significant holders of asset-backed commercial paper, 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 2007:II 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. Panel A of Figure 2 shows both repo assets and repo liabilities for broker-dealers. Repo liabilities peaked at more than $3.1 trillion in 2007:III and stayed around that threshold for the next four quarters before falling steadily during the crisis to $1.8 trillion in 2009:IV. 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 that 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 in panel B 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.

Beyond the lack of data for unregulated capital pools, the large gap between instruments pledged and repo liabilities highlights limitations of the Flow of Funds data. First, Table L.207 does not include other forms of collateralized financing that 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.

[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.

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 the balance sheet and therefore do not appear in the Flow of Funds.

The Flow of Funds data show 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 2007:II to $900 billion in 2009:I. 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 2008:III, 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 nonreporting 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 2007:II to 2009:I. These nonreporting pools could be both foreign and domestic, and it is necessary to turn to unofficial 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 2007:II and 2009:I, 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 at $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 2008:I

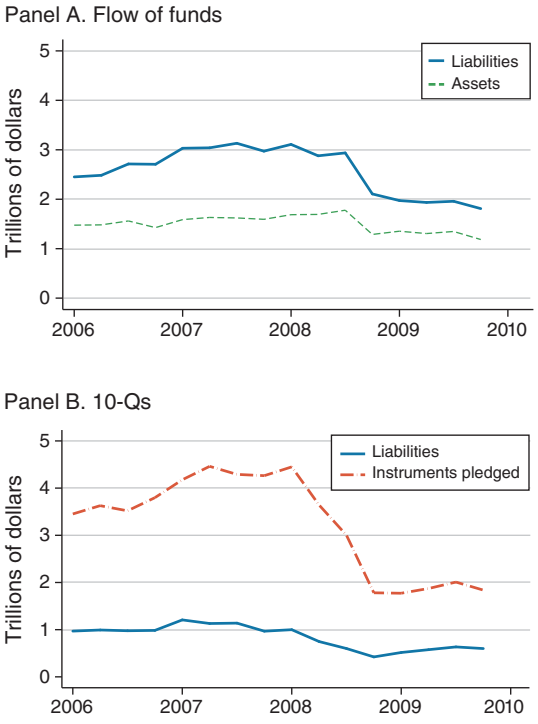

FIGURE 2. REPO IN FLOW OF FUNDS AND 10-QS

Notes: Instruments pledged is the sum of trading assets that are pledged and cannot be repledged, trading assets that are pledged and can be repledged, and collateral received that has been repledged. The 10-Q figure includes data from six firms: Goldman Sachs, Lehman Brothers, Bear Stearns, Merrill Lynch, Morgan Stanley, and J. P. Morgan.

Source: Company reports, Federal Reserve Flow of Funds Table L.207, as of April 2019

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

and 2008:II, its last quarterly filings, despite the relatively small decline in repo funding from $197 to $128 billion over the same period.

II. 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 that (i) bilateral repo is about three times the size of tri-party repo, (ii) MMFs comprise only about 2 percent of bilateral repo, and (iii) 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 count 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 nondealer 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.

TABLE 2—BOND MARKET ASSOCIATION SURVEY: JUNE 30, 2004

	Billion $	Percent
Panel A. Participants in the bilateral repo market		
US counterparties		
Dealers	1,566	40.6
Other investment managers, hedge funds	348	9.0
Other US	260	6.8
Financial and mortgage companies	148	3.8
Corporate	132	3.4
Agent bank	113	2.9
Registered 40 Act funds (incl. MMFs)	60	1.6
Insurance companies	26	0.7
Municipal	23	0.6
Foundations and endowments	20	0.5
Federal Reserve Bank	14	0.4
Government agencies	12	0.3
ERISA pension funds	8	0.2
Non-ERISA and public pension	7	0.2
Subtotal	2,739	71.0
Non-US counterparties		
Other non-US[b]	614	15.9
Offshore hedge funds	319	8.3
Sovereign government and central banks	159	4.1
Non-US sovereign government entities	14	0.4
Supranationals	13	0.3
Subtotal	1,119	29.0
Total	3,858	100.0
Total hedge funds, investment 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

Notes: Other US means the type of counterparty was not specified; other non-US denotes foreign affiliates, foreign dealers, corporations, insurance companies, and managed funds. ERISA is Employee Retirement Income Security Act, NASD is National Association of Securities Dealers, and NYSE is New York Stock Exchange.

Source: Bond Market Association Research (2005)

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 offshore 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 discrepancy 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 US" (7 percent) and "other non-US" (16 percent). "Other US" represents all domestic counterparties that have been left unspecified by survey respondents. "Other non-US" 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 2007:II is about 13 percent of the total repo liabilities from all sources.

III. Conclusion

This paper analyzes the "run on repo" during the recent financial crisis by 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 2007:II and 2009:I. The Flow of Funds captures only half of the reduction in funding, mainly from the ROW. 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. These missing data come 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 2007:II to 2009:I 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 are most reliable, such analyses can be misleading. For repo, the tri-party market has the best data, and MMFs have the most detailed data within tri-party repo. As it turns out, MMFs were not representative during the crisis, with their repo assets increasing by a third at the same time that net repo funding nearly halved.

REFERENCES

Bond Market Association Research. 2005. "Total Outstanding Repo and Securities Lending Volume Estimated to Exceed $7.84 Trillion." *Research: Repo and Securities Lending Survey of U.S. Markets Volume and Loss Experience*, January 2005. https://www.sifma.org/wp-content/uploads/2017/05/repo-securities-lending-survey-of-us-markets-volume-and-loss-experience.pdf.

Covitz, Daniel, Nellie Liang, and Gustavo A. Suarez. 2013. "The Evolution of a Financial Crisis: Collapse of the Asset-Backed Commercial Paper Market." *Journal of Finance* 68 (3): 815–48.

Gorton, Gary B. 2010. *Slapped by the Invisible Hand: The Panic of 2007*. London: Oxford University Press.

Gorton, Gary, and Andrew Metrick. 2010a. "Haircuts." *Federal Reserve Bank of St. Louis Review* November/December: 507–20.

Gorton, Gary, and Andrew Metrick. 2010b. "Regulating the Shadow Banking System." *Brookings Papers on Economic Activity* 40 (2): 261–312.

Gorton, Gary, and Andrew Metrick. 2012. "Securitized Banking and the Run on Repo." *Journal of Financial Economics* 104 (3): 425–51.

Kirk, Adam, James McAndrews, Parinitha Sastry, and Phillip Weed. 2014. "Matching Collateral Supply and Financing Demands in Dealer Banks." *Federal Reserve Bank of New York Economic Policy Review* 20 (2): 127–51.

Krishnamurthy, Arvind, Stefan Nagel, and Dmitry Orlov. 2014. "Sizing Up Repo." *Journal of Finance* 69 (6): 2381–417.

McCabe, Patrick E. 2010. "The Cross Section of Money Market Fund Risks and Financial Crises." FEDS Working Paper 2010-51.

Singh, Manmohan. 2011. "Velocity of Pledged Collateral: Analysis and Implications." IMF Working Paper 11/256.