Internet Appendix to "Tri-Party Repo Pricing" By Grace Xing Hu, Jun Pan, and Jiang Wang

In this appendix, we provide more details on how we match the securities listed as repo collateral in the N-MFP forms filed by money market funds. We focus on matching securities in three asset classes (equities, corporate bonds and Treasuries) because only these securities have standard and publicly accessible databases on their issuance and historical prices.

1 Collateral matching

Our collateral matching procedure follows a bottom-up approach and contains two major steps: First, we select potential equity, corporate bond and Treasury collateral according to the security type, maturity and coupon. Next, we manually compare the collateral names listed on the N-MFP forms with the official names in the corresponding database to get individual collateral's unique CUSIP number.

After we find collateral's CUSIP codes, we consider a repurchase agreement as an equity repo if more than 85% of its collateral can be matched as equities. Similarly, if more than 85% of the collateral can be matched as corporate bonds, we classify a repurchase agreement as a corporate bond repo.[1] We consider a corporate bond repo as an investment-grade repo if the value-weighted average rating (by Moody's) of the collateral is at or above Baa3; we consider a corporate bond repo as a high-yield repo if the value-weighted average rating of the collateral is below Baa3.[2] For a Treasury repurchase agreement, we require all of its collateral to be matched Treasury securities to avoid noises caused by non-Treasury securities in the collateral pool. This bottom-up approach therefore allows us to determine a repurchase agreement's collateral asset class by examining its collateral pool security by security, a more accurate approach than the ones used by previous studies which rely only on the self-reported repo types.

In total, we have 3,296 equity repos, 750 high-yield corporate bond repos, 1,161 investment-grade corporate bond repos and 15,436 Treasury repos with matched collateral information from November 2010 to August 2013. Compared with the statistics compiled by SIFMA, our matched sample accounts for around 20% of the tri-party repos in these three asset classes during our sample period.[3] Our matched sample is smaller due to several reasons. First, our

[1]Since mixed collateral categories are common in tri-party repurchase agreements, especially for non-government repos, we choose the 85% threshold to balance between the sample size and the potential biases caused by collateral in different asset classes. Our main results do remain robust if we choose higher thresholds such as 90% or 100%.

[2]Because many Fidelity funds misreport the maturity dates of their corporate bond collateral, we can't match a substantial amount of these collateral due to missing information. To deal with this, we consider a Fidelity corporate bond repo as investment-grade if the haircut is between 4% and 6%, and we consider a Fidelity corporate bond repo as high-yield if the haircut is between 7% and 9%.

[3]According to the statistics released by SIFMA, the total tri-party repo market has 243,624 deals with total repo value of $59 trillion for the 34 months from November 2010 to August 2013. Among which, the total numbers of equity, corporate bond and Treasury repos are 17,054; 9,014; and 85,268, respectively.

sample covers only tri-party repos by U.S. money market funds, which accounts for approximately one third of the entire tri-party repo market. Other repo lenders, such as security lenders, are not in our sample of tri-party repos. Second, not all securities have descriptions clear enough to establish a unique match. In equities, we are able to match 98% in terms of collateral numbers and 68% in terms of collateral value. Most of the unmatched cases are because money market funds only disclose the numbers of collateral, not the specific issues. The matching is much noisier in corporate bonds because more information is needed to pin down a unique bond. As a result, some repos are not in our matched sample because we couldn't match the securities in the collateral pool. In addition, we consider only repos consisting primarily of securities from the same asset class and discard those with mixed asset classes.

Matching Equity Collateral

We consider a security as a potential equity collateral if item 32.d in the N-MFP form contains the following keywords: COMMON, STOCK, ETF, STOCK OR ETF, EQUITY, SHARES, DEPOSITORY RECEIPT and GLOBAL DEPOSITORY RECEIPT. In addition, the collateral needs to have null coupon (item 32.c) and null maturity date (item 32.b). We then manually match the collateral names (item 32.a) with the official company names in the CRSP/Compustat database. When there are multiple matches, we choose the parent company's CUSIP and assign it to the collateral security.

For the 34 months from November 2010 to August 2013, we classify 80,354 collateral as potential equity securities, with total collateral value around $505 billion. Among which, we are able to match 78,466 collateral with a total worth of $341 billion. In other words, we are able to match more than 98% of the collateral by their names, but the remaining 2% carry a significant value of $164 billion. The reason is that there are 253 unmatched cases where the issuer names fall into the categories of 51-100, 101-500, 501-1000 or more than 1000. These cases represent $156 billion, or 95% of the value of the unmatched securities. The remaining 1,635 unmatched cases, worth $8 billion in value, are only a tiny fraction of our pool of potential equity securities. Overall, our procedure does a good job in matching collateral by their descriptions in the N-MFP forms.

Matching Corporate Bond Collateral

For potential corporate bond collateral, we check whether item 32.d in the N-MFP form contains the following keywords: BOND, CBND, CORP, CORPORATE, OTHER NOTE and FIXED INCOME. To rule out non-corporate bonds, we also require that the issuer names don't contain keywords such as Treasury, MORTGAGE, FNMA, STRIP, TIPS and etc.[4] We then manually match the collateral name (item 32.a) with the official corporate bond issuer names in the Mergent FISD database. If we find a match in the issuer's name, we

[4]The full list of keywords include FNMS, FXMS, FGHF, FGPC, FMCC, FMHS, FMPC, FRPC, FNAR, FXAR, FGAR, FMPA, FRAR, FMAR, FNMA, GNMA, GMAC, MORTGAGE, ASSOCIATION for agency bonds; TINT, TPRN, PRIN, PMT, INT, STRIP, TRPX for Treasury STRIPS; TIPS, INF, IX, USTIIN, USTIIB, TRIN, TRIB for Treasury inflation protected bonds; Treasury, UNITED STATES, TREAS, NOTE, BILL, NTS, BDS and NOTY for Treasury bonds.

check the maturity date (item 32.b) and coupon (item 32.c) of all bonds issued by the issuer to see whether we can find a unique match. If there are multiple matched bonds, we choose the most recently issued bond. If there is no match, we relax the condition and match only on the maturity date as money market funds sometimes report null or bond yields for the bond coupon item (item 32.c) in the N-MFP forms. In addition, we exclude all convertible bonds.

For the period from November 2010 to August 2013, we classify 257,347 collateral as potential corporate bond securities, with total collateral value at approximately $824 billion. Among which, we are able to match 166,809 collateral with total collateral value of $329 billion. For the remaining 90,538 unmatched collateral, most of the cases are due to poor data quality, such as missing or null issuer names, maturity or coupons. For example, 30,408 of the unmatched corporate bond collateral are by Fidelity money market funds, all due to the reason that the maturity date information is missing in the original N-MFP forms.[5]

Matching Treasury Collateral

To identify potential Treasury bond collateral, we check whether item 32.d in the N-MFP forms contains the following keywords: UNITED STATES, Treasury, TREAS, NOTE, BILL, BOND, NTS, BDS and NOTY. In addition, we rule out collateral which have keywords suggesting the bonds are likely to be agency bonds, Strips, Tips, or corporate bonds. The collateral must also have valid coupon (item 32.c) and maturity date (item 32.b). We then search the CRSP Treasury database to find Treasury securities with the exact same coupon and maturity date. For collateral that can be matched, the matching is always unique as there exists no duplicate Treasury securities with the same coupons and maturity dates.

We consider 137,804 collateral as potential Treasury securities, totaling 4.5 trillion in dollar value.[6] Out of which, we are able to match 128,782 collateral, 93% in terms of numbers and 91% in terms of collateral value. Judging by the reported numbers for item 32.c in the N-MFP forms, most of the unmatched cases are because money market funds report yields instead of coupons for the collateral. Since it is very common for multiple Treasury securities to mature on the same date, we don't relax the criteria to match solely on the maturity date as it often gives multiple matches in the case of Treasury collateral.

[5] An example is the filing of a Fidelity fund (EDGAR series id: S000004822) on June 2013. The fund has a $17 million corporate bond repo with BNP Paribas Securities Corp. However, the fund doesn't report the maturity date information for all the underlying bonds, even though it classifies all collateral as CORPORATE and reports their coupons correctly.

[6] During the period from November 2010 to August 2013, 28,880 repos are reported as Treasury Repurchase Agreements by money market funds (item 31). These repos have in total 210,644 collateral. Of these collateral, we consider 72,840 securities as Strips, Tips, agency bonds, corporate bonds or with missing maturity. We exclude these securities in our matching process.