Transformed Intermediation:
Credit Risk to NBFIs, Liquidity Risk to Banks[1]

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First Draft: August 28, 2023; This Draft: December 29, 2025

Abstract

We argue that the rapid asset growth of nonbank financial intermediaries (NBFIs) relative to banks is the outcome of transformations of risks between banks and NBFIs that increase the interconnectedness of the two sectors. These transformations are consistent with avoiding tighter, post-GFC bank regulation while harnessing the funding and liquidity advantages of bank deposit franchises and access to safety nets. Specifically, we show that banks fund NBFIs through senior loans and credit lines, which NBFIs use for acquiring junior credit claims, warehouse financing, and liquidity management. We empirically demonstrate that shocks experienced by NBFIs spillover to the banks that provide them with credit lines, particularly in times of stress. We then suggest policy approaches consistent with our transformation view and conclude with suggestions for future research.

Keywords: non-bank financial intermediaries, nonbanks, shadow banking, bank regulation, regulatory arbitrage, systemic risk, credit lines, derivatives margin.

JEL: G01, G21, G23, G28

[1] We are grateful to participants at the AFA Meetings (2025), Juliane Begenau (discussant) and Arvind Krishnamurthy (editor) for helpful comments, as well as to Jessica Chen, Saketh Prazad and Sneha Parthasarathy for excellent research assistance. The views expressed in this paper are those of the authors and do not necessarily represent those of the Federal Reserve Bank of New York, the Federal Reserve System, or any of their staff.

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Non-bank financial intermediaries (NBFIs) have become the dominant sector of the global financial system, with assets growing faster than those of banks over the last two decades. In percentage terms, NBFIs' share of assets recently exceeded 50%, while banks' share has steadily declined. This trend has been even more pronounced in the United States, with NBFIs recently holding over 60% of financial assets.

This apparent rise in the importance of NBFIs relative to banks has attracted significant attention because NBFIs are regulated so much less stringently than banks. True, in an aspirational, *parallel* view of the two sectors, banks are financial intermediaries, with a traditional focus on deposits, loans, and payments, while NBFIs provide other financial services, focused on capital markets. In this view, banks have to be heavily regulated to protect depositors and the real economy, while NBFIs can be lightly regulated and allowed to fail (Volcker, 2009). Furthermore, this parallel view has long been embedded in laws in the United States that attempt to restrict the scope of bank activities (e.g., the National Bank Acts of the 1860s, the Glass-Steagall Act of 1933, and the Volcker Rule in 2010). In practice, however, NBFIs have not been allowed to fail and have received official support, most notably during the great financial crisis (GFC), but more recently as well, e.g., the Federal Reserve's interventions in the repo markets in 2019 and through the COVID pandemic and shutdowns (Duffie, 2020, Schrimpf, Shin, and Sushko, 2020); the Bank of England's support of the gilt market in response to the liquidity problems of UK pension funds in 2022; and European governments' protection of energy producers and derivatives users, also in 2022. Furthermore, as a matter of law, while the Dodd Frank Act (DFA) of 2010 modified the Federal Reserve's 13(3) powers to lend to NBFIs, it essentially left these broad powers in place.

By contrast, a *substitution* view of the NBFI and bank sectors sees NBFIs as engaging in some of the same activities as banks, like lending and providing liquidity. Furthermore, NBFIs have been able to take market share from banks because of relatively burdensome bank regulation. In this view, NBFIs can grow to become systemically important intermediaries, like banks, and could be deemed in need of rescue by authorities in times of financial stress. In fact, this conclusion is the implicit foundation of the powers given to authorities by the DFA to designate NBFIs as systemically important financial institutions (SIFIs), to regulate them accordingly, and to resolve large and complex financial companies that are failing. Metrick and

Tarullo (2022) suggest mitigating the dangers of NBFIs substituting for banks through a "congruence principle" that would regulate similar activities similarly, wherever they take place.

The problem with the substitution view as a complete explanation of the evolution of the NBFI and bank sectors, however, is that NBFIs and banks often complement rather than compete with one another. One of the many such complementarities described in this paper, for example, is that banks offer warehouse financing to nonbank securitizers of mortgage, CLO, and other ABS products.

In this paper, we explain these complementarities as the outcome of *transformations* of NBFIs' and banks' businesses and risks. Our argument is as follows. The tightening of post-GFC bank regulations discouraged banks from holding weaker credits and encouraged banks to hold larger liquidity buffers. This led to the emergence of less-regulated NBFI competitors, as predicted by the substitution view. However, despite the post-GFC regulatory tightening, banks maintained their special role as routine providers of funding and emergency providers of liquidity, which derive from their advantages from deposit franchises and access to official backstops (i.e., deposit insurance, access to central bank's discount window and lender-of-last-resort (LOLR) facilities, and implicit too-big-to-fail guarantees). Therefore, NBFI and bank businesses and risks transform, in a complementary manner, to avoid the consequences of stricter bank regulation while utilizing the funding and liquidity advantages of the banking system. The implication of our *transformation* view is that NBFI and bank businesses and risks become increasingly intertwined, but in a very particular way: banks make senior loans to NBFIs; NBFIs take on junior credit exposures to nonbank borrowers; and banks provide NBFIs with credit lines. This view provides a counterpoint to the perspective that the growth of NBFIs necessarily reduces bank risks: while banks may reduce their direct risks to the real economy, they remain exposed indirectly through their obligations to NBFIs. We do not, however, make any welfare claims, which would include, for example, a valuation of intermediation services provided by NBFIs that, for various reasons, are not provided by banks.

Our paper follows lines of research showing how banks adapt to change. Boyd and Gertler (1995) argued that the perceived decline of the banking sector at that time ignored the growth of off-balance sheet exposures from derivatives, lines of credit, and guarantees. In particular, as large corporations shifted from bank borrowing to commercial paper issuance, banks shifted to wrapping that issuance with lines of credit and guarantees. Similarly, a decade

later, other research (Cetorelli, Mandel, and Mollineaux, 2012, Cetorelli and Peristiani, 2012, Mandel, Morgan, and Wei, 2012, and Acharya, Schnabl, and Suarez, 2013) demonstrated that banks were not circumvented by the growth of securitization, but rather enabled securitization through liquidity and credit guarantees.[2]

Our argument for a unifying view of transformations in the NBFI and bank sectors is consistent with the papers describing developments in individual markets. In the mortgage market, Kim, Laufer, Pence, Stanton, and Wallace (2018) describe bank provision of lines of credit to nonbank mortgage originators and servicers; Benson et al. (2023) show that banks exiting the businesses of purchasing, pooling, and securitizing government-guaranteed mortgages funded the nonbanks that replaced them; and Jiang (2023) shows that banks both fund and compete with nonbank residential mortgage originators and makes the case that bank market power with respect to funding enables the capture of NBFI profits.

While we do not link transformations with particularly regulatory changes, other papers have done so. For example, Yankov (2020) shows that the Liquidity Coverage Ratio (LCR) and other changes to the financial landscape resulted in banks holding more liquidity and offering more credit lines to NBFIs, while, conversely, NBFIs hold less liquidity and rely more on bank credit lines. In the private credit market, Chernenko, Ialenti, and Scharfstein (2024) show that relative capital requirements make it more attractive for banks to lend through senior tranches to middle-market lenders than to lend directly to middle-market borrowers. They also quantify the extent to which, in times of stress, BDC credit provision might contract. Additional examples are relegated to a footnote.[3]

Section I of the paper presents evidence that NBFIs are particularly dependent on banks for funding. Section II gives examples and case studies of how various NBFI and bank complementarities are the result of transformations of the forms we have identified. Section III presents an empirical analysis that, to the best of our knowledge, is the first to provide direct evidence that shocks experienced by NBFIs spillover to the banks that provide them with credit

[2] Cetorelli, Jacobides, and Stern (2021) and Cetorelli and Prazad (2025) add that these earlier transformations often manifested as NBFIs growing within banking firms, as subsidiaries of bank holding companies.

[3] Buchak et al. (2024) argue that the long-term shift from bank to nonbank lending has been partly due to regulation. Chernenko et al. (2022) and Kim et al. (2016) focus in particular on the riskiest lending segments; Chen et al. (2017), Cortes et al. (2018), Gopal and Schnabl (2022), and Irani et al. (2020) focus on small-business lending; and Buchak et al. (2018) and Buchak et al. (2022) focus on residential mortgages.

lines, particularly in times of stress.[4] Section IV draws out some regulatory implications, and Section V lays out some directions for future research.

I. Liability-Interdependencies of Banks and NBFIs

Figure 1, using non-public, loan-level data, illustrates the increasing interconnectedness of banks and NBFIs from 2013 to 2024. Panel A shows that bank loans to NBFIs, as a percentage of all loans, and unused credit commitments to NBFIs, as a percentage of all unused commitments, have risen from about 12% and 15%, respectively, to about 28% and 21%, respectively.[5] Panel B shows that drawdowns of bank credit lines by NBFIs has increased both in dollars and as a percentage of all bank credit lines.

The transformation view of the NBFI and bank sectors is certainly consistent with these trends, but goes further. Because of the special role of banks arising from their deposit franchises and access to official backstops, transformations will result in NBFIs being more dependent on banks than *vice versa* and in NBFIs being more dependent on banks than on each other.

We support these hypotheses empirically using an expansion of the Federal Reserve's Flow of Funds data, FWTW (From Whom To Whom), first made public in 2023. Figure 2, which we call the "Matrix of Liability-Dependencies," gives the percentage of the borrowing or issuance of each sector of the financial system that is provided or held by each of the other sectors.[6]

The take-aways from the FWTW data are as follows:

- Banks are not particularly dependent on any single NBFI sector. The largest dependence is to *GSE*s, which supply only 4% of bank funding.

[4] The growing interconnectedness between banks and NBFIs and the associated risk implications have been recognized recently in many studies (e.g., IMF, 2025, BIS, 2025, Duque Gabriel and Serling, 2025), but our paper is unique in identifying a specific mechanism of risk transmission and amplification from NBFIs to banks.

[5] Acharya, Cetorelli and Tuckman (2024) document the large exposure of banks to NBFIs with the same data, showing that, as of 2023Q4, outstanding bank term loans and unused credit line commitments to NBFIs were over $300 billion and $1.5 trillion, respectively.

[6] For convenience, we have aggregated across all financial instruments and across some subsectors. Details are provided in Acharya, Cetorelli and Tuckman (2024). Also, in analysis not reported here, we find that this snapshot as of Q1 2023 is generally representative of dependencies over longer periods of time.

- Banks do depend on the NBFI sector as a whole for 13% of their funding.[7] Although not shown in the figures, this amount includes deposits, commercial paper investments by money market funds, repo lending from broker-dealers, and bond investments by insurance companies, pension funds, and mutual funds.
- NBFI sectors are heavily dependent on banks for their funding. *GSEs*, *Broker-Dealers*, and *Equity REITs* receive 25% or more of their funding from banks. *Finance companies* and *ABS Issuers* receive 15% and 10%, respectively. Note that these percentages, which do not include undrawn credit commitments, understate the dependencies of these sectors on banks.
- NBFI sectors are generally not dependent on each other for financing, although the figure shows some scattered exceptions.[8]

With respect to systemic risk, the liability-dependence of NBFIs on banks directly implies that losses at NBFIs can directly result in losses at banks. Indirectly, these dependencies imply that fire-sale liquidations by banks of assets of NBFIs can transmit shocks to other banks. Furthermore, more subtly, Cetorelli, Landoni, and Lu (2023) show theoretically and empirically that forced liquidations of any asset in some group of portfolios can result in fire sales of other assets in those portfolios. This would imply that shocks to NBFIs can impact banks even without exposure to that particular set of NBFIs.

II. Examples and Case Studies of the Transformation View

Having established the general interdependence of banks and NBFIs, which implies complementarity of their businesses, this section analyzes the nature of those complementarities through example and case studies. The conclusion is that business lines have transformed from banks' holding and financing assets on their own to banks' holding senior claims on NBFIs and NBFI assets, banks' providing NBFIs with credit lines, and NBFIs' holding junior claims on assets. As mentioned above, we argue that these transformations take on this general configuration because regulation has particularly discouraged banks from bearing credit risk and

[7] This finding is consistent with Forbes, Friedrich, and Reinhardt (2023).

[8] We note that the exact extent of dependencies across banks and NBFIs would need to account for foreign banks and NBFIs included in the Rest of World aggregate. Presently, this decomposition is unavailable.

because banks are the ultimate and particularly well-suited provider of liquidity. Figure 3 diagrams the recent transformations discussed in this section, which are divided into three broad categories: loans and mortgages, activities using short-term funding, and contingent funding.

A. *Loans and Mortgages*

Not too long ago, banks typically made and held corporate and mortgage loans. More recently, however, in part due to higher capital requirements and tighter regulations on leveraged lending, large volumes of these loans no longer reside on bank balance sheets. Instead, banks hold indirect exposures through senior loans and credit lines to private credit companies, collateralized loans to mortgage Real Estate Investment Trusts (REITs), and the generally more senior claims of mortgage-backed securities (MBS) and collateralized loan obligations (CLOs). Hence, bank exposures to the underlying loans have not fully left the banking system: they have been transformed into senior exposures to NBFIs.

The private credit market, which typically lends to medium- and small-sized businesses, has recently attracted a great deal of interest from market participants, regulators, and academics because it has grown so quickly: private credit assets under management currently exceed 30% of the total outstanding of high-yield bonds, syndicated loans, and private credit.[9] As an example of private credit as a transformation rather than as a displacement of banks, consider Blackstone Private Credit Fund (BCRED), one of the largest private credit fund in the world with over $50 billion of assets.[10] According to its 10-K, BCRED subsidiaries had 19 secured credit commitment facilities as of December 2022, 18 of which and 98% of the total committed amount were provided by 13 banks. Furthermore, the outstanding or amounts drawn on these facilities accounted for about 50% of BCRED's total debt liabilities.

It has been argued that the relatively low balance-sheet leverage of private credit lenders implies that they contribute little to systemic risk. But the transformation view highlights the liability-dependence of NBFIs on banks, not only through loans but also through credit lines. Therefore, to the extent that the disruption of private credit intermediation disrupts the real

[9] See, Blackstone (2022), Exhibit 2, Ren (2023), and van Steenis (2023).
[10] See privatedebtinvestor.com

economy, any manifestations of liquidity risk in the private credit sector can contribute to systemic risk and, likely in large part, ultimately revert to the banking sector.[11]

B. *Activities Using Short-Term Funding*

Traditionally, banks participated in various businesses that rely on regular or continuing short-term funding. Examples include the following: securitization, in which purchases of underlying assets are funded until they are securitized and sold as MBS (mortgage-backed securities), collateralized loan obligation (CLOs), or other ABS (asset-backed securities); financing acquisitions in general, and leveraged buyouts (LBOs) in particular, in which acquisitions are funded in anticipation of bond sales to investors; and mortgage servicing, which requires servicers to fund payments of delinquent amounts to MBS investors until government insurance pays the related claims. These activities used to be dominated by banks, but are now dominated by NBFIs. However, banks provide NBFIs with the short-term funding used to carry out these activities in the forms of direct loans, warehouse financing, credit lines, subscription finance loans, and bank-sponsored (or credit-enhanced) commercial paper. Another potential example is proprietary trading, which the Volcker Rule forced out of banks and into entities like hedge funds, but which still relies on bank funding through banks' prime brokerage businesses.[12]

In short, activities using short-term funding are another category of activities that seem to have moved from banks to NBFIs, but are better described as having transformed. Furthermore, as predicted by the transformation view, the transformed role of banks does not preclude the need for authorities to intervene in times of stress. For example, government-sponsored enterprises (GSEs) and other government insurers chose to provide liquidity support to NBFI mortgage originators and servicers in 2020.[13]

[11] See Board of Governors (2023). Fleckenstein et al. (2024) and Ben-David, Johnson, and Stulz (2022) show that NBFI difficulties in funding themselves during stress periods led to overall declines in lending to businesses.
[12] See, for example, Levine (2024).
[13] See Bancroft (2022), FDIC (2019), Chart 2, and Loewenstein (2021).

C. *Contingent Funding*

The previous two categories describe the transformation of balance sheet items, namely assets or short-term funding of assets. This category, contingent funding, describes the transformation of unusual or emergency funding, or liquidity insurance. Bank businesses that needed contingent funding, which banks managed for themselves, have transformed into NBFI businesses that need contingent funding, which NBFIs get from banks. Bank-provided contingent funding manifests itself most often by drawing down bank credit lines in unusually high volumes.

While sometimes the hardest to detect given data limitations, this transformation is perhaps the least surprising because of the special role of banks in the financial system. First, deposit and lending franchises diversify liquidity risk because depositor demand for liquidity is not perfectly correlated with borrower demand for drawdowns (Kashyap, Rajan, and Stein, 2002). Second, bank access to official backstops (e.g., deposit insurance, central bank lender-of-last-resort financing, access to funds from Federal Home Loan Banks, and implicit too-big-to-fail guarantees) has enormous and unique value due to the high correlation of liquidity demand with financial conditions. Third, banks gain deposits in a systemic "flight to safety" because of these official backstops precisely when liquidity is most scarce and valuable (Gatev and Strahan, 2006). Figure 1, discussed earlier, shows the growing importance of bank credit lines to NBFIs and of the drawdown of those credit lines.[14]

A relatively unheralded example of a transformation involving contingent funding to NBFIs is derivatives clearing. Before the GFC, bank-dealers did not collect margin on interest rate swaps (IRS) from many of their clients, like pension funds. Instead, bank-dealers managed their portfolio of counterparty risks by charging fees and imposing credit limits. Post-GFC, however, regulations mandated that most derivatives, including IRS, be cleared by central counterparties (CCPs), which require initial and variation margin. To manage the liquidity risks arising from these margin requirements, many derivatives users, like pension funds, arranged loans and credit lines from their bank-dealers.

[14] Similarly emphasizing the increasing importance of NBFI drawdowns, Acharya, Gopal, Jager, and Steffen (2024) show that credit line utilization rates for REITs are particularly high relative to those of nonfinancial corporates and other types of NBFIs, and especially so during market downturns.

When long-term U.K. interest rates spiked higher in September 2022, U.K. pension funds suffered losses on IRS positions that hedged their liabilities and faced significant margin calls. While the funds, for the most part, were not losing value because the value of their liabilities were falling as well, cash had to be raised to meet IRS margin calls. Banks provided some of the needed liquidity through various loans and advances, but pension funds were nevertheless forced to sell government bonds as well. These sales pushed bond prices lower (and rates higher), led to additional margin calls, to fire sales of bond positions, and to liquidation of IRS hedges that left funds exposed to additional losses when rates ricocheted back down. In response, the Bank of England intervened by committing to purchase and fund large volumes of bonds and by expanding the scope of eligible collateral against loans banks made to pension funds.[15]

A similar situation arose as energy prices increased in Europe in 2021 and 2022. Electricity producers that had sold electricity futures contracts to hedge against falling prices faced liquidity pressures both from variation margin calls and increases in initial margin rates. While several banks supplied significant liquidity, many governments nevertheless decided to intervene by offering these producers financial guarantees. While electricity producers are not normally considered NBFIs, derivatives margin requirements mean that they have to manage liquidity like other NBFIs.[16]

III. Empirical Analysis of NBFI Shocks Impacting Banks

In the substitution view, NBFIs grow by replacing bank generation and warehousing of various risks, which implies that bank balance sheets become better insulated against economic and financial shocks. By contrast, views that NBFI and bank businesses are complementary recognize that banks might very well remain subject to these shocks. In fact, our transformation view goes further. Because transformations, by design, preserve banks as the ultimate providers of liquidity, banks remain particularly exposed to shocks that cause NBFIs to draw down on bank lines of credit.

More specifically, banks are exposed from loans to both non-financial firms (NFCs) and NBFIs, but those exposures are known and do not change suddenly over time. In contrast, bank

[15] See Plender (2022), for example, for a news account of this episode.

[16] See Turnstead (2023), Wilkes and Turnstead (2022), and Wilson and Stafford (2022) for accounts of this episode.

exposures from credit lines to individual firms and sectors change, sometimes suddenly, as credit lines are drawn. With respect to NFCs, drawdowns of credit lines will be idiosyncratic except during the largest economic and financial shocks. Therefore, at least in normal times, the portfolio of bank businesses will be relatively immune to NFC drawdowns of credit lines.

Bank exposure from NBFI credit lines, however, is qualitatively different. NBFIs—as financial intermediaries—are likely to draw down bank credit lines at the same time, that is, when there is a broad liquidity shock to the financial system. Furthermore, banks themselves are likely to need liquidity in these scenarios. Consequently, bank exposures from NBFI credit lines can increase suddenly, and a bank's profitability, over and above general market fluctuations, can be impacted by the profitability of those NBFIs to which it has extended lines.[17]

To test these explicit conjectures of the transformation hypothesis, we analyze bank stock returns, with bank and time fixed effects, on the returns of NFCs and NBFIs to which they have term loan and credit line exposures. More specifically, using daily CRSP and quarterly FR-Y14 data from 2013 to 2023, we estimate the following regression model:

$$R_{it} = \beta_1^J \boldsymbol{w_{it}^{NBFIJ}} \boldsymbol{R_t^{NBFI}} + \beta_2^J \boldsymbol{w_{it}^{NFCJ}} \boldsymbol{R_t^{NFC}} + \gamma_1^J X_t \boldsymbol{w_{it}^{NBFIJ}} \boldsymbol{R_t^{NBFI}} + \gamma_2^J X_t \boldsymbol{w_{it}^{NFCJ}} \boldsymbol{R_t^{NFC}} + \Gamma_i + \Psi_t + \varepsilon_{it} \quad (1)$$

where:

$\boldsymbol{R_{it}}$ is the stock return of bank *i* at day *t*;

$\boldsymbol{R_t^{NBFI}}$ is the market capitalization-weighted stock return index for NBFIs at day *t*. This index is calculated as the weighted-average of stock returns at day *t* for each public corporation in the CRSP database in the industry clusters of Finance and Insurance and of Real Estate and Rental and Leasing.[18]

$\boldsymbol{w_{it}^{NBFIJ}}$ are the holdings of bank *i* at day *t* of credit product $J = \{\text{Credit Lines, Term Loans}\}$ of NBFI obligors, as a fraction of bank *i* total assets.[19]

[17] These conjectures are consistent with Acharya, Engle, Jager and Steffen (2024), who argue that drawdowns of credit lines and amplify the impact of market returns on bank stock returns.

[18] These are firms with a 4-digit NAICS industry code within the 2-digit clusters 52 and 53, excluding subcategories that are the banks themselves.

[19] These NBFI obligors are also identified by their 4-digit NAICS industry code.

$\boldsymbol{R_t^{NFC}}$ is the corresponding market capitalization-weighted stock return index for non-financial corporations (NFC) at day t.[20]

$\boldsymbol{w_{it}^{NFCJ}}$ are the holdings of bank *i* at day *t* of credit product *J* ={Credit Lines, Term Loans} of NFC obligors, as a fraction of bank *i* total assets.

$\boldsymbol{X_t}$ is a vector of time-varying factors, in particular the VIX and a COVID dummy.

$\boldsymbol{\Gamma_i}$, $\boldsymbol{\Psi_t}$ are bank and time (day) fixed effects, respectively. Bank-quarter fixed effects are included in alternative specifications.

The null hypothesis of this regression is that all of the beta and gamma coefficients are zero. Day fixed effects absorb market-wide, common exposures, while bank or bank-quarter fixed effects absorb potential selection biases due to the exposures of banks to specific obligor types.[21]

An alternative hypothesis, that emerges from the transformation view, is that the beta of credit lines to NBFIs are positive: even after controlling for market and bank-specific factors, individual banks returns are exposed to those NBFIs that can draw on that bank's credit lines. Another alternative hypothesis is that the gamma of the interaction of credit lines to NBFIs and periods of stress, measured by VIX and a COVID dummy, is positive: during these stress events, drawdowns by NBFIs are even more correlated than in normal times and, consequently, amplify stress on banks in proportion to their credit line exposures to impacted NBFIs.

The power of this regression specification comes from the time-varying exposures of each bank to the NBFI sector to which it has exposures, further separated into credit line and term loan components. For example, two banks may have exactly the same asset size and exactly the same dollar credit line exposures to NBFIs. However, the first bank's exposures are mainly to life insurance companies, while the second bank's are to mortgage companies. If the NBFI stock index is especially impacted by the stock returns of insurance companies, then the first bank becomes more exposed than the second one, which should be reflected in the estimated coefficient β_1^J for *J*=Credit Lines. The regression specification includes analogous exposures to NFCs, to test the transformation view's emphasis on credit lines to NBFIs.

[20] These are firms with a 4-digit NAICS industry code *not* within the 2-digit clusters 52 and 53.

[21] For instance, BHCs may hold specific NBFI types as subsidiaries, and these specific organizational structures may drive the choice of obligors, and therefore of exposures.

We ran regression specification (1) and several alternative specifications. The full set of results are presented in the Appendix, including specifications with the VIX and COVID interaction terms and with the more stringent bank-quarter fixed effects. For the discussion here, however, we focus on the baseline specification (1).

Figure 4 presents a binscatter visualization of the results, which are consistent with the transformation view. More specifically, the confidence intervals for the fitted line with respect to credit line exposures to NBFIs are the only ones that do not contain the horizontal line corresponding to a slope of 0. In other words, bank returns significantly (at the 99% level) depend on the returns of NBFIs to which they have extended credit lines. In contrast, bank stock returns do not robustly depend on NBFI stock returns through term loan obligations or on NFC stock returns.

In terms of economic magnitude, the first to third quartile range of bank credit lines relative to assets is 6%. Using the appropriate regression coefficient, then, a 6% increase in this ratio increases a bank's stock return sensitivity by 2.297 x 6%, or 13.78%. Hence, a 1% decline in the NBFI stock return index would translate into a 1 % x 13.78% or about 0.14% in bank stock return. This magnitude is economically significant given that the daily mean bank stock return is about 0.05%.

These regression results have implications with respect to systemic risk. To the extent that the provision of bank liquidity to NBFIs is not correctly priced by the regulatory system, or the extent to which bank credit lines are implicitly subsidized, there are negative externalities from the spillovers of negative NBFI returns into bank returns. In addition, as mentioned previously, the positive correlations across NBFI returns during liquidity stress events amplify any such spillovers. These implications are consistent with Acharya, Cetorelli, and Tuckman (2024), who show that, in terms of SRISK, a measure of market-equity-based capital shortfall under aggregate market stress,[22] the systemic risk of the bank and NBFI sectors and their co-movement have increased since the GFC.

[22] See Acharya, Engle, and Richardson (2012).

IV. Regulatory implications

The transformation view, supported by the results presented in this paper, implies that risks in the financial system cannot be understood by examining banks and NBFIs separately. Furthermore, absent recognition of the differential impact of regulation on banks and NBFIs, including but not limited to the cost of capital, business and risk transformations across banks and NBFIs are likely. These implications are dramatically different from those of the substitution view. In particular, according to the substitution view, regulations should make it more costly for banks to engage in the riskiest intermediation activities, leaving those to entities that—at least seemingly—do not have access to official backstops and that—again seemingly—could be allowed to fail. According to the transformation view, however, raising regulatory burdens on banks does not necessarily reduce their riskiest exposures, but instead changes their nature. More specifically, banks remain exposed to systemic distress; incentives across banks and NBFIs may lead to higher levels of risk taking across the system; the transformation of business lines across banks and NBFIs may amplify the transmission of economic and financial shocks; and these same transformations may make the intermediation system less transparent to regulators. With these considerations in mind, we make a number of regulatory suggestions.

A first policy goal could simply be to improve the measurement and monitoring of systemic risks that appear on account of the NBFI-bank interdependencies described in this paper. Existing work along these lines include ECB (2023), FDIC (2019), and FSB (2022). A related policy goal is to incorporate NBFI-bank interdependencies into the supervision of banks and currently supervised NBFIs. Progress here has been made on CCPs: CFTC (2019) and Bank of England (2022) conducted stress tests of CCPs that considered not only defaults of large derivatives counterparties, including clearing members, but also the resulting demands on all of their banks. And more recently, the Bank of England conducted a system-wide exploratory scenario (SWES) aimed at enhancing the understanding of the behavior of banks and NBFIs in stressed scenarios (Bank of England, 2024). Finally, some progress has been made in the U.S. to specifically monitor credit line drawdowns by NBFIs, in an exploratory analysis of risks to banks, as a companion to the 2025 supervisory stress testing (Federal Reserve Board, 2025).

To the extent that expanded measurement and monitoring reveal systemic risk externalities in bank financing of NBFIs, a further policy goal could be to internalize these

externalities. A possibility is to require banks to preposition collateral against NBFI exposures, particularly credit lines, in recognition of the possibility that these exposures might lead to future bank borrowing from central banks during times of aggregate funding stress. Three existing proposals along these lines are Committed Liquidity Facilities (Nelson, 2023), Pawnbroker for All Seasons (King, 2016), and Federal Liquidity Options (Tuckman, 2012). The societal pricing of these liquidity puts should reflect the systemic externalities that individual banks engender as a result of their specific exposures to NBFI counterparties. Alternatively, one could consider imposing leverage constraints on NBFI sectors indirectly through the design of bank liquidity regulation. For example, bank exposures to NBFIs with leverage above a pre-determined critical threshold could be subject to supplementary liquidity requirements.

Finally, given the difficulties of anticipating capital market transformations, authorities might also try to internalize systemic risk externalities by making credible *ex-post* commitments. For example, Acharya (2022) suggests that NBFIs receiving LOLR support could be presumptively subject to regulation by the Federal Reserve, while Acharya and Tuckman (2014) explore imposing one-off corrective actions after such support, such as requiring gradual deleveraging or larger liquidity buffers.

V. Directions for Future Research

To the extent that our transformation view is correct, there is much research to be done on better understanding and quantifying its drivers. Exactly which components of the regulatory regime are most responsible for the relative advantages of banks in attracting stable funding and providing contingent liquidity, and exactly which components are most responsible for the relative disadvantages of banks in bearing credit risk? How much of a cost advantage do banks actually enjoy because of their deposit franchises and access to official liquidity and backstops, and how much of a cost disadvantage to retain junior credit exposure? Furthermore, how do these relative advantages and disadvantages vary by asset class and across market conditions, business cycles, and the regulatory drivers themselves?[23]

[23] We note just a few works along these lines: Palvia et al. (2025) on deposit insurance and the stability of bank funding; Morgan Stanley (2018) on the impact of Basel III's liquidity coverage ratio, net stable funding ratio, and leverage ratio on bank incentives to provide liquidity services; and Fleckenstein, Gopal, Gutiérrez, and Hillenbrand (2024) on the cyclicality of NBFI funding of syndicated loans.

While we focus on the impacts of capital, funding, and liquidity regulation, there is certainly room for work on other drivers. The most obvious candidates are the many other dimensions of the bank regulatory regime, e.g., supervision by multiple regulators, anti-money-laundering responsibilities, consumer protection rules, Community Reinvestment Act obligations and merger approvals, activity restrictions under the Volcker Rule, etc. Other candidates for drivers might be relative NBFI advantages with respect to new businesses opportunities, technology, and financial engineering, but it would need to be established that these drivers are truly exogenous, rather than endogenously determined by bank regulation. (See, e.g., Buchak et al, 2018, on technological innovation and regulation jointly driving the rise of nonbank intermediaries.)

We describe transformations in which credit and liquidity risks are sliced and allocated across NBFIs and banks. But, as described in Cetorelli and Prazad (2025), bank holding companies have created captive NBFIs to optimize internal funding and liquidity resources. Exploring why and when banks choose to partner with captive rather than external NBFIs is another promising line of research, with an importance highlighted by the recent decision by JPMorgan Chase to establish a private credit business within its bank (i.e., depository subsidiary), which reversed an earlier decision to establish that unit as a nonbank subsidiary (JP Morgan, 2025).

Forward-looking lines of research might explore how recent innovations might blunt the relative advantages of banks with respect to funding and liquidity, which, in turn, could halt, reverse, or alter the specific forms of the transformations we describe. For example, increased funding of loans from nonbanks, like insurance companies and retail, might compete successfully with bank funding. And fintech payment systems, stablecoins, and money market fund access to the Federal Reserve's reverse repo facility might erode the value of bank deposit franchises (see, e.g., Morningstar, 2025). Furthermore, these payment and deposit alternatives, together with the generally improving technology available to depositors, might reduce the stickiness of bank deposits and, therefore, the ability of banks to provide liquidity through stress events.

We also believe there is room to what our transformation view means for general equilibrium in the markets for financial assets and products. In particular, how has the evolution of the bank-NBFI nexus impacted the costs of corporate capital and household financing? What

have been the effects on the real economy, e.g., the creation and growth of nonfinancial firms, returns on investments, housing, and household consumption?

Last but not least, going beyond the empirical evidence provided in this paper, an important line of inquiry is the implications of our transformation view for systemic risk and welfare. Specific areas of investigation might be the following: expressing bank loans to NBFIs in terms of risk rather than dollar amounts; quantifying the extent to which bank exposures to NBFIs could be marked down in a crisis, even without a significant amount of ultimate defaults; quantifying the degree to which banks would themselves experience stress as NBFIs simultaneously draw down on their credit lines in a crisis; and discovering whether banks increase overall risk by replacing credit risk reductions (from the shift from junior to senior claims) not only with increased credit lines to NBFIs, but potentially also to other business lines that we have not identified.

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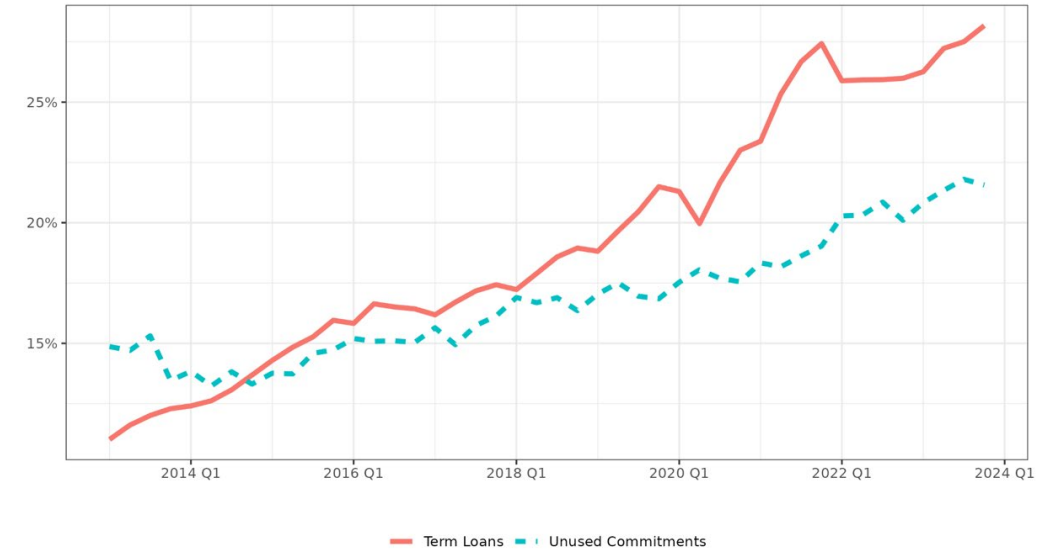
Figure 1. Bank Loans and Credit Lines to NBFIs, 2013-2024

Panel A: Term loans and credit line commitments from banks to NBFIs as a share of total loans and commitments. Banks include U.S. bank holding companies, U.S. intermediate holding companies of foreign banking organizations, and savings and loans holding companies subject to consolidated financial statement reporting requirements. Source: Form FR Y-9C.



Panel B: Quarterly drawdowns of bank credit lines to NBFIs in $billions and as a share of aggregate drawdowns (i.e., of NBFIs and non-financial corporations). Source: Form FR Y-14Q, Schedule H.1

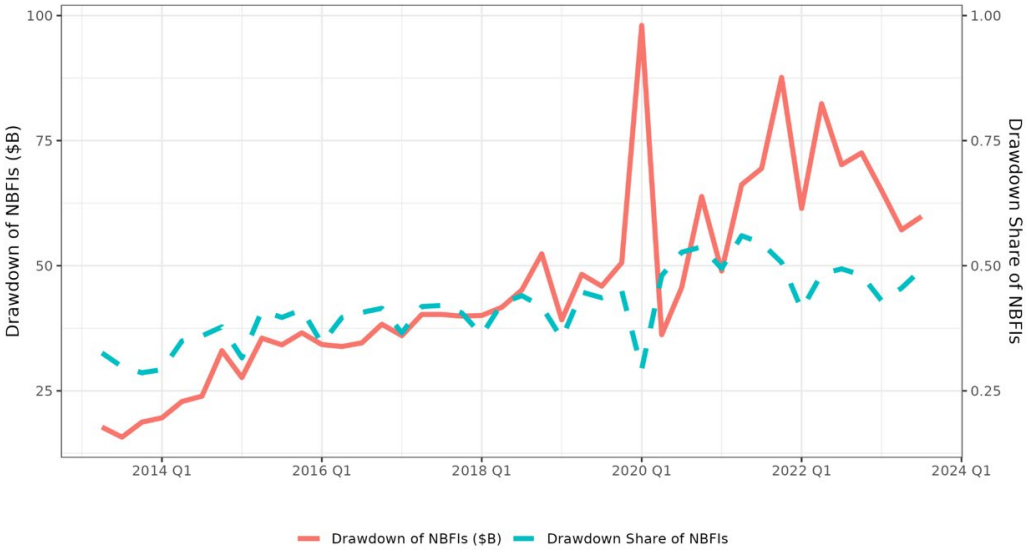


Figure 2: Matrix of Liability-Dependencies, Q1 2023

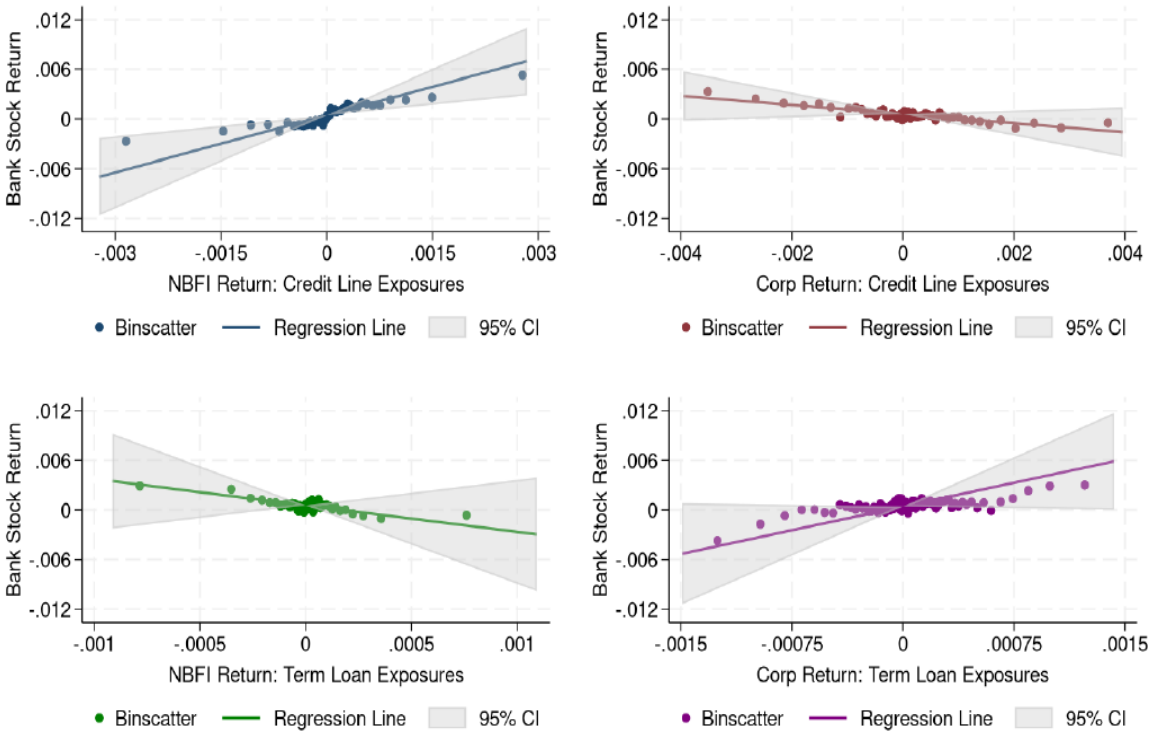
Percentage of total issued liabilities. For example, 25% of Broker/Dealers liabilities are held by banks. Source: Federal Reserve System, Enhanced Financial Accounts (From Whom To Whom)

	HOLDERS															
		NBFIs														
ISSUERS	Banks	ABS issuers	Broker/Dealers	Equity REITs	Finance Companies	GSE and Agency	Life Ins.	MMF	Mortgage REITs	Mutual Funds	Other Fin. Bus.	PC Ins.	Pensions	Real Sector	Rest of World	TOTAL
Banks	10	0	2	0	0	4	2	1	0	1	1	0	1	62	15	100
NBFIs: ABS Issuers	10	0	0	0	0	1	40	3	0	3	5	8	2	3	26	100
NBFIs: Broker/Dealers	25	0	24	0	0	2	0	8	0	1	0	0	0	11	29	100
NBFIs: Equity REITs	25	3	0	1	1	1	14	0	2	7	0	3	7	19	18	100
NBFIs: Finance Companies	15	0	0	0	0	0	11	0	0	7	1	3	6	22	33	100
NBFIs: GSE and Agency	35	0	1	0	0	3	3	9	2	6	0	1	4	21	15	100
NBFIs: Life Ins.	4	2	0	0	0	2	6	0	0	0	0	0	11	73	2	100
NBFIs: MMF	0	0	0	0	0	0	1	0	0	4	8	1	5	77	4	100
NBFIs: Mortgage REITs	8	0	13	0	0	3	8	10	0	6	0	2	5	7	38	100
NBFIs: Mutual Funds	0	0	0	0	0	0	8	0	0	0	0	0	27	59	6	100
NBFIs: Other Fin. Bus.	3	0	54	0	0	0	2	1	0	1	7	0	4	25	2	100
NBFIs: PC Ins.	1	0	0	0	0	0	1	0	0	0	0	8	2	74	13	100
NBFIs: Pensions	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	100
Real Sector	14	1	1	0	1	9	3	1	0	3	0	1	11	37	19	100
Rest of World	22	0	3	0	3	1	7	3	0	5	1	3	4	48	0	100

Figure 3. Examples of Transformations of Intermediation Activities Across the NBFI and Bank Sectors

Transformation	Activities and Products Historically Within the Banking System	Activities and Products Spread Across Banks and NBFIs
Loans and Mortgages Loans shift from being made and held by banks to being made by NBFIs with collateralized or senior financing provided by banks.	· Corporate loans · Mortgage loans	· Banks make senior loans to private credit companies. · Banks make collateralized loans to mortgage REITs. · Banks hold senior tranches of MBS and CLOs.
Activities Using Short-Term Funding Activities that require short-term funding transform from being conducted and funded by banks to being conducted by nonbanks and funded by banks.	· Mortgage, CLO, and other ABS origination · Acquisition/LBO financing · Mortgage servicing	· Banks offer warehouse financing to nonbank mortgage, CLO, and other ABS originators. · Banks make short-term loans to private equity companies, including subscription finance loans. · Banks sponsor CP or directly lend to nonbank mortgage servicers.
Contingent Funding While the footprint of NBFIs has grown relative to that of banks, banks retain responsibility for providing contingent funding in the form of credit lines to the NBFI sector.	· Credit lines to nonfinancial businesses · OTC bilateral derivatives	· Banks provide credit lines to NBFIs to be drawn down during periods of stress. · Banks bear mutualized counterparty risk as derivative clearinghouse members and provide credit lines to NBFIs to meet margin requirements.

Figure 4. Binscatters From Baseline Regression of Bank Stock Returns on Returns of NBFI and Non-Financial Corporate Stock Returns



Notes: The y-axis variable is Bank Stock Return and the x-axis variables are NBFI Return: Credit Line Exposures (top left), Corp Return: Credit Line Exposures (top right), NBFI Return: Term Loan Exposures (bottom left), and Corp Return: Term Loan Exposures (bottom right). Bank and day fixed effects are included in all regressions. The x-axis range depends on the support of the independent variable.

APPENDIX

In this appendix we provide the full set of regressions run to test the prior that banks' credit line exposures to NBFIs embed a systemic externality that may not be reflected in the underlying contractual terms, thus leaving banks potentially exposed to market's repricing of their stocks when NBFIs experience shocks.

The baseline specification, off of model specification (1), includes the credit-line and term-loan exposure-weighted returns of NBFIs and NFCs, and the bank and day fixed effects. The results, are reported in column (1) of Table A1 below. Confirming the binscatter visualization of Figure 3, and corroborating the prior, bank stock returns respond to NBFI stock returns, through the (bank-specific, time varying) portfolios of credit line obligations to each of the 4-digit NAICS segments capturing NBFI activities. The point estimate is large, and very precisely estimated. Exposures to NBFIs through term loans do not appear to have a significant impact on stock prices – in fact are estimated with a negative sign. Likewise, exposures to NFCs via credit lines have a negative point estimate, but it is insignificant. Exposures via term loans have a positive sign, but statistically still imprecisely estimated.

In column (2), we augment the regression model by including terms of interactions with the VIX, to capture possible amplifications in times of heightened market turbulence. The results show that. at the 95% confidence level, the dependence of bank returns on the returns of NBFIs to which they have extended credit lines is significantly higher when market volatility is high. The third column shows the results where we introduced a term of interaction with a dummy equal to one during the days between March 9th and March 17th 2020. March 9th marked the start of a particularly high level of turmoil, when stock price declines first triggered a "circuit breaker" halt of trading, and, on March 17th, the Federal Reserve first announced the introduction of liquidity facilities. This regression also shows that the dependence of bank returns on the returns of NBFIs to which they have extended credit lines is significantly higher during days of significant market disruption. Column (4)-(6) repeats the regression specifications in (1)-(3) but replacing bank fixed effects with the more stringent bank-by-quarter ones. The idea was to check for possible selection biases, if, for instance, banks sort themselves in terms of NBFI exposures: the BHCs in our sample are the largest ones, all of them including NBFI subsidiaries in their organization (see, eg, Cetorelli and Prazad, 2025). Hence, what appears as a systemic spillover from NBFI shocks may instead be reflecting a common exposure via direct equity ownership in

those NBFI segments. The bank-by-quarter dummies should capture time-varying, individual BHCs organizational structure decisions that might give rise to such bias. The results of the regressions in (4)-(6) show hardly any difference in the overall estimates.

Table A1. Regressions of Bank Stock Returns on Returns of NBFI and Non-Financial Corporate Stock Returns

The dependent variable in all regressions is R_{it} : the stock return of bank *i* at day *t*. $\boldsymbol{R_t^{NBFI}}$ is the market capitalization-weighted stock return index for NBFIs at day *t*, i.e., the weighted-average of stock returns at day *t* for each public corporation in the CRSP database with NAICS industry code ={52, 53}. $\boldsymbol{w_{it}^{NBFIJ}}$: the holdings of bank *i* at day *t* of credit product *J* ={Credit Lines - CL, Term Loans - TL} of NBFI obligors, as a fraction of bank *i* total assets (FR Y-14 data). $\boldsymbol{R_t^{NFC}}$ is the market capitalization-weighted stock return index for non-financial corporations (NFC) at day t, namely for corporations in the CRSP database with NAICS industry code ≠{52, 53}. $\boldsymbol{w_{it}^{NFCJ}}$ is the holdings of bank *i* at day *t* of credit product *J* ={Credit Lines - CL, Term Loans - TL} of NFC obligors, as a fraction of bank *i* total assets (FR Y-14 data). *VIX* is the CBOE volatility index. And COVID-19 is a dummy equal to 1 for *t* between March 9th 2020 and March 17th 2020. Bank *i* and Time (day) *t* fixed effects are included in the regressions displayed in columns (1)-(3). Bank *i* by quarter and day fixed effects in the last three columns.

Dependent Variable:	Bank Stock Return					
Column:	(1)	(2)	(3)	(4)	(5)	(6)
NBFI Return: Credit Line Exposures	2.297***	1.023	2.152**	2.308***	1.041	2.162***
	(0.738)	(0.942)	(0.775)	(0.730)	(0.948)	(0.770)
NBFI Return: Term Loan Exposures	-3.209	-3.439	-2.633	-3.356	-3.666	-2.779
	(3.208)	(3.865)	(3.252)	(3.273)	(3.965)	(3.320)
Corp Return: Credit Line Exposures	-0.552	-0.219	-0.483	-0.566	-0.226	-0.493
	(0.385)	(0.444)	(0.392)	(0.384)	(0.449)	(0.391)
Corp Return: Term Loan Exposures	3.831*	3.297	3.862*	3.926*	3.460	3.970*
	(2.094)	(2.543)	(2.143)	(2.150)	(2.603)	(2.199)
VIX × NBFI Return: Credit Line Exposures		0.046**			0.046**	
		(0.022)			(0.022)	
VIX × NBFI Return: Term Loan Exposures		-0.007			-0.003	
		(0.100)			(0.100)	
VIX × Corp Return: Credit Line Exposures		-0.012			-0.012	
		(0.013)			(0.013)	
VIX × Corp Return: Term Loan Exposures		0.018			0.016	
		(0.067)			(0.067)	
COVID-19 × NBFI Return: Credit Line Exposures			2.051***			2.051***
			(0.540)			(0.645)
COVID-19 × NBFI Return: Term Loan Exposures			-5.025			-4.737
			(7.368)			(7.421)
COVID-19 × Corp Return: Credit Line Exposures			-0.921			-0.953
			(0.627)			(0.636)
COVID-19 × Corp Return: Term Loan Exposures			0.818			0.578
			(5.051)			(5.065)
Bank	Yes	Yes	Yes	No	No	No
Bank-Quarter	No	No	No	Yes	Yes	Yes
Day	Yes	Yes	Yes	Yes	Yes	Yes

*Clustered (Bank & Day) standard-errors in parentheses. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*