Bank Capital and Loan Liquidity*

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Abstract

We find that higher capital ratios for a lead bank are associated with greater secondary market liquidity of loans the bank syndicates. This effect is stronger when banks are more subject to external financing frictions and during the 2007:Q3 – 2009:Q4 financial crisis. Tests using exogenous shocks to capital generated by banks' housing market exposure and the 2012 JPMorgan Chase 'London Whale' shock are suggestive of causality. Overall, our paper contributes to the research and policy debates on the efficacy of bank capital. We also shed new light on the link between intermediary capital and asset liquidity.

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1. Introduction

Large financial intermediaries dominate trading in many asset classes and often play a central role in providing liquidity to other market participants. A key issue for these markets is how financial intermediary's capital adequacy affects the liquidity of assets that they trade (e.g., Gromb and Vayanos (2002); Brunnermeier and Pedersen (2009); He and Krishnamurthy (2013, 2018)). In this paper, we investigate the association between bank capital and bank's market liquidity provision. Specifically, we examine how the capital ratios of the lead banks of syndicated loans affect the secondary market liquidity of these loans. Our paper sheds light on the longstanding research and policy debates regarding the benefits and costs of bank capital.

Many researchers find benefits to bank capital in terms of reducing moral hazard incentives to take excessive risks in lending and enhancing bank performance during financial crises (e.g., Koehn and Santomero (1980); Calem and Rob (1999); Admati, DeMarzo, Hellwig, and Pfleiderer (2014); Berger and Bouwman (2013); Acharya, Mehran, and Thakor (2016)). However, while trading and market-making has become an important part of the business model of banks, the literature investigating the relation between bank capital and bank trading and market liquidity provision is still sparse. We are the first to address the role of bank capital in the secondary loan market.

The secondary market for syndicated loans has grown substantially over the past two decades. In 2016, the annual trading volume of U.S. syndicated loans reached a record $600 billion, approximately eight times that in 1999.[1] Despite its size, we have little understanding of the secondary loan market and its liquidity. The secondary loan market offers an attractive venue to

[1] Source: Thomson Reuters and the Loan Syndication and Trading Association (LSTA).

examine the link between bank capital and loan liquidity, as most trades are done over-the-counter and lead banks are usually prominent secondary market dealers of the loans that they arrange. For example, the Loan Syndication and Trading Association (LSTA) states: "*Banks were not simply originators of these loans but now were also loan traders, and thus, in their role as market makers, began to provide liquidity for the (secondary) market*." Standard & Poor also observes: "… *(loan) investors usually trading through dealer desks at the large underwriting banks.*"[2]

We assemble a comprehensive new dataset that links secondary market pricing information of individual syndicated loans (from the LSTA/Thomson Reuters Mark-to-Market Pricing Services) with the balance sheet of the loan's lead bank (from bank regulatory filings) and borrower characteristics (from Compustat). Since the late 1990s, the LSTA/Thomson Reuters Mark-to-Market Pricing Services has worked with major loan dealers, collecting daily loan bid/ask price quotes and other information. Our data covers a large sample of syndicated loans with lead bank/loan/borrower information from 1999:Q2 to 2016:Q1. As our available data shows, the lead bank of a loan appears as a quote-providing dealer in approximately 88.5% of the calendar trading quarters and 84.5% of the trading days in a quarter. The granularity of our data allows us to associate time-varying loan liquidity with time-varying lead bank financial conditions. We are also able to directly measure loan liquidity using the bid-ask spreads of dealer price quotes, information not generally available in many other fixed-income markets (e.g., Bessembinder, Spatt, and Venkataraman (2019)).[3]

[2] https://www.spglobal.com/marketintelligence/en/pages/toc-primer/lcd-primer#sec18. Also see "*The Handbook of Loan Syndications and Trading*," 2006, by Loan Syndication and Trading Association (LSTA) and Sansone. Some large loan mutual fund portfolio managers also told us that the lead bank is the first and the most important one to call if they want to trade a loan.

[3] Importantly, using price quotes instead of actual transaction prices avoids introducing a selection bias towards more actively traded loans. LSTA/Thomson Reuters Mark-to-Market Pricing Services has an evaluation team to ensure that these price quotes reflect an accurate market value and the quoted prices are sufficiently comparable to actual trade prices. Specifically, buy-side customers often communicate transaction prices to Thomson. Thomson does not use

Using this comprehensive loan sample, we find strong evidence that greater lead bank capital ratios are associated with significantly lower secondary market bid-ask spreads of the loans they originate. Our estimation suggests that all else equal, one standard deviation increase in Tier 1 risk-based capital ratio of a lead bank lowers loan bid-ask spreads by approximately 13 to 16 basis points, or 12% to 14.8% relative to its sample mean of 108 basis points.

In our baseline regressions, we control for an exhaustive list of bank and loan characteristics. We also account for time-varying unobserved borrower characteristics by including borrower firm-by-year fixed effects.[4] That is, we compare the liquidity of loans of different lead banks to the *same* firm during the *same* year to minimize the impact of borrower factors. Additionally, we strengthen our identification with lead bank fixed effects to control for time-invariant heterogeneity across these banks. The relation between lead bank capital ratios and loan bid-ask spreads is also robust to various alternative bank capital ratios and holds in different subsamples.

We further find that the impact of bank capital on loan bid-ask spreads is stronger when a lead bank relies more on wholesale funding or when a lead bank is more subject to financial constraints. As well, lead bank capital has a more pronounced impact on bid-ask spreads when the loan price is more volatile. The effect of bank capital on loan liquidity also manifests strongly during the 2007:Q3 – 2009:Q4 financial crisis period, when many players were financially constrained and markets were particularly illiquid. In addition, we document that higher lead bank capital ratios are also associated with lower volatility of the quoted bid-ask spreads. All these

these prices as inputs but the evaluation team compares these values to broker quotes received to help assess the ongoing quality of the broker quotes. Also, as will be discussed later, recent studies demonstrate that loan price quotes are informative.

[4] The firm-by-year fixed effects work well to control for time-varying borrower characteristics. See, e.g., Khwaja and Mian (2008); Jiménez, Peydró, and Saurina (2012); Abbassi, Iyer, Peydró, and Tous (2016).

results are consistent with the role of equity capital in alleviating bank funding constraints and thus facilitating secondary market trading.

While our baseline specification largely controls for borrower demand-side factors, we acknowledge that potential biases such as the endogenous bank-borrower matching may still arise. To address these potential biases, we use two tests to establish causality. First, we exploit relatively exogenous variations in bank capital levels resulting from a banks' exposures to the housing market (e.g., Granja, Matvos, and Seru (2017); Chakraborty, Goldstein, and MacKinlay (2018)). We find that decreases in bank capital caused by housing price declines are associated with significantly higher loan bid-ask spreads.

In the second test, we use JPMorgan Chase's unexpected capital loss from credit derivative trading in the 2012 'London Whale' incident as a quasi-natural experiment. Using a difference-in-difference approach, we find that the 'London Whale' shock leads to a significant decline in liquidity of loans with JPMorgan Chase as the lead bank relative to other loans. Both tests mitigate the potential endogeneity concerns and support a causal interpretation of our main results.

The rest of our paper proceeds as follows. Section 2 provides a discussion of related literature. We then describe our data and the sample construction in section 3. Sections 4 and 5 present our empirical analyses. Section 6 concludes.

2. Related Literature

Our paper has important implications for the link between intermediary capital and asset liquidity. Earlier studies such as Shleifer and Vishny (1992, 1997) study the implications of limited funds and capital constraints for arbitrageurs' ability to exploit mispricing. They show that

arbitrageurs' capital constraints affect equilibrium asset prices and liquidity. In Gromb and Vayanos (2002), arbitrageurs act as intermediaries that facilitate trade among the other investors. The funding constraints of these intermediaries affect asset prices and give rise to a suboptimal level of liquidity provided to the market (also see Gromb and Vayanos (2018)). Gromb and Vayanos (2010) present an explicit model of financially constrained intermediary's liquidity provision and show that market liquidity increases with the intermediary capital levels. In Brunnermeier and Pedersen (2009), intermediary capital interacts with margin constraints and affects asset liquidity. He and Krishnamurthy (2013) model the role of intermediary equity capital constraints on asset risk premia and liquidity. More recently, Kondor and Vayanos (2019) show that adverse shocks to intermediary capital cause liquidity to decline due to intermediary risk aversion, even with minimal constraints or contracting frictions. Andersen, Duffie, and Song (2019)'s model suggests that dealer funding costs are an important factor affecting dealer's bid and ask quotes. Our findings are consistent with the general predictions of these theories.[5]

In our case of lead banks that syndicate loans and make markets in them, greater capital alleviates financial market frictions and allows banks to access external funding at lower costs (Flannery and Rangan (2008)). Regulatory capital requirements mandate banks to set aside equity capital against risky trading positions. Higher capital enables lead banks to better absorb risks associated with holding loans in their inventory to satisfy regulatory requirements (e.g., Repullo (2004); Von Thadden (2004); Berger and Bouwman (2009)). Moreover, to the extent that bank trading is done through collaterized borrowing, greater capital helps to finance margin requirements (Brunnermeier and Pedersen (2009)). Banks with lower capital levels also likely cut

[5] See related evidence from the equity market (e.g., Hammeed, Kang, and Viswanathan (2010); Comerton-Forde, Hendershott, Jones, Moulton, and Seasholes (2010); Kahraman and Tookes (2017)) and the corporate bond market (e.g., Bao, O'Hara, and Zhou (2018); Bessembinder, Jacobsen, Maxwell, and Venkataraman (2018); Adrian, Boyarchenko, and Shachar (2017)).

back funding to other loan traders such as collateralized loan obligations (CLOs) and hedge funds.[6] A reduction of bank funding available to other traders may adversely affect market liquidity as well.[7]

A more liquid secondary market for a loan could benefit the lead bank, loan investors, and the borrower. For the bank, the improved secondary market liquidity enhances its reputation and helps it gain market share as it is able to attract more loan investors and borrowers. For both the bank and the loan investors, better secondary market liquidity improves risk sharing (e.g., Parlour and Winton (2013)). Finally, for the borrower, better secondary market liquidity lowers their cost of capital and alleviates their financial constraints (e.g., Güner (2006); Gupta, Singh, and Zebedee (2008); Gande and Saunders (2012)). Our paper thus sheds new light on the real benefits of having higher bank capital.

Our paper also contributes to a research debate over whether more capital reduces or expands the ability of banks to perform their key function of creating liquidity. Theories argue that banks create liquidity on the balance sheet by financing relatively illiquid assets with relatively liquid liabilities (e.g., Bryant (1980) and Diamond and Dybvig (1983)). Holmstrom and Tirole (1998) and Kashyap, Rajan, and Stein (2002) suggest that banks also create liquidity off the balance sheet through loan commitments and similar claims to liquid funds. A central question in this literature is how bank capital affects bank liquidity creation (e.g., Berger and Bouwman (2009); Francis and Osborne (2009); Distinguin, Roulet, and Tarazi (2013); Bouwman (2020)). However,

[6] For example, CLO managers often use bank bridge loans to finance CLO deals at the warehousing stage and use a bank revolving credit facility to post cash collaterals to their margin accounts. Hedge funds rely on banks as their primary brokers (e.g., Aragon and Strahan (2012)).

[7] Bank capital may also affect loan liquidity because it affects bank monitoring incentives and the associated information asymmetry. But theories are ambiguous about whether greater or less capital incentivizes more monitoring (e.g., Holmstrom and Tirole (1997); Diamond and Rajan (2000, 2001); Wittenberg-Moerman (2008); Mehran and Thakor (2011); Berger and Bouwman (2013); Berger, Zhang, and Zhao (2019)).

extant studies of bank liquidity creation focus on primary market liquidity creation, and pay little attention to a bank's market liquidity creation, although banks are active traders in the secondary market of many asset classes.[8] We provide direct empirical evidence suggesting higher bank capital also enhances a bank's market liquidity provision.

3. Data, Summary Statistics, and Descriptive Analysis

3.1 Data and Sample Construction

We obtain the daily secondary market loan quotes data from 1999:Q2 to 2016:Q1 from the LSTA/Thomson Reuters Mark-to-Market Pricing Service database (LSTA/Thomson thereafter). We match loans in the LSTA/Thomson database with primary market data from the LPC Dealscan using the loan identification number (LIN) to obtain key loan contract characteristics, such as loan amount, interest spread, maturity, and covenants. We focus our analysis on term loans, as opposed to revolving credit lines, as only a small fraction of the latter is traded in the secondary market (e.g., Bord and Santos (2012); Beyhaghi and Ehsani (2017)).

Since banks report financial information quarterly, we calculate the quarterly average of daily quoted bid-ask spreads. We also compute the bid-ask spread volatility as the standard deviation of daily bid-ask spreads over the quarter. We exclude trading quarters in which there are

[8] Several recent papers examine bank trading behaviors, but with different focuses. Abbassi et al. (2016) analyze security-level data of German banks and find that during the financial crisis banks are net buyers of fire-sold securities to profit from trading opportunities, but at the expense of reduced credit supply to the real sector. In contrast, Timmer (2018) documents a procyclical securities-buying behavior of banks: They tend to buy securities when securities returns have been high and sell them when returns have been low. Using the proprietary shared national credit (SNC) data, Irani and Meisenzahl (2017) report that banks that depend more on wholesale funding tend to sell their loan holdings during the crisis but do not directly examine neither the role of bank capital nor loan liquidity.

no changes in daily bid-ask spreads (i.e., zero standard deviation), which could indicate stale pricing.[9]

We obtain borrower information from Compustat using the Dealscan-Compustat link (Chava and Roberts (2008), updated in 2018). We exclude firms headquartered outside the U.S. and those labeled as foreign firms in Compustat. We also exclude regulated borrowers in the financial (SIC=6000-6999) and utility (SIC=4900-4999) industries because these firms have very different capital structure and financial policies (Graham, Leary, and Roberts (2015)). Between 1999:Q2 and 2016:Q1, there are 26,790 loan-quarter observations with non-missing key loan characteristics from Dealscan and with borrower information from Compustat.

For these traded loans, we match their lead banks in Dealscan with banks in the Call Reports to collect lead bank's financial information. We keep lead banks that are designated as commercial banks (RSSD 9048=200). Following the literature (e.g., Acharya and Mora (2015); Berger and Roman (2015); He, Kelly, and Manela (2017)), if a lead bank is associated with a parent bank holding company, we use the consolidated financial information of its regulatory bank holding company from its FY-9C filings. If the lead bank is independent, we keep the data for the commercial bank from its Call Reports. For each traded loan-quarter observation at quarter *t*, the lead bank characteristics are measured at the end of quarter *t-1*. Among these traded term loans, there are 15,281 loan-quarter observations for which we can obtain lead bank information. After filtering out missing bank variables, our main regression sample contains 13,071 loan-quarter observations for 1,707 traded loans from 1999:Q2 to 2016:Q1.

[9] Loan-quarters with no movements are infrequent, and our results are similar if we keep these observations.

Starting from 2005, the LSTA/Thomson data also provides loan dealer IDs if there are three or more quotes on a day. To identify whether the lead bank of a loan is among the loan dealers, we use a mapping table provided by Thomson to convert dealer IDs to dealer names and manually match them with lead bank names in Dealscan. Our available data reveals that lead banks are prominent secondary market dealers of the loans originated by them: On average a lead bank shows up as a quote-providing dealer in 84.5% of the trading days in a calendar quarter (the median is 100%).[10]

3.2 Sample Summary Statistics

We provide an overview of the sample in Table 1. Panel A reports summary statistics of loan characteristics. The variable names are self-explanatory, and detailed variable definitions are in Appendix A. All continuous variables are winsorized at the 1% level to mitigate the influence of outliers. The mean and median of *Quarterly Average Bid-Ask Spread* are 1.08% and 0.68% of the par value, respectively. The mean and median of *Quarterly Standard Deviation of Bid-Ask Spread* are 0.21% and 0.09%, respectively. The *Number of Days with Price Quote in a Quarter* is the number of days for which we see quoted prices in the LSTA/Thomson database for a loan. The average value of this variable is 61.99.[11]

Secondary loan market liquidity varies significantly over time. Figure 1 plots the *Quarterly Average Bid-Ask Spread* and *Quarterly Standard Deviation of Bid-Ask Spread* by calendar quarters. There was a temporary fall in liquidity (i.e., a rise in bid-ask spread averages and standard deviations) between early 2000 and late 2002, which was largely associated with a jump in

[10] In those quarters, on average 84.6% of the trading days have loan dealer identity information (the median is 98.4%).
[11] We exclude the first and the last trading quarter of a loan in calculating summary statistics of this variable because it may be affected by loan inception and termination, respectively. Also note that, because the actual trades are undisclosed, there is not necessarily actual trade(s) on each day that we see quote(s).

corporate debt default and the bursting of dot-com bubble. After that, spreads gradually declined until the onset of the Global Financial Crisis in late 2007, after which loan liquidity significantly deteriorated. At the height of the crisis (i.e., late 2008 after Lehman Brothers bankruptcy), the bid-ask spreads shot up to an unprecedented level of over 300 basis points, approximately three times the average of the full time period. The bid-ask spread volatility also substantially increased over the crisis period. While loan liquidity recovered in 2010, it experienced another spike in late 2011, mainly due to fears of contagion of the European Sovereign Debt Crisis.

In Table 1 Panel A, we also report loan contract characteristics. On average, there are 13.07 lenders in a syndicate at loan origination. The average loan size is $556.97 million and the average maturity is about 75.59 months. The average primary market interest rate spread is 288.86 basis points over LIBOR and the 10th percentile is 175 basis points. These numbers suggest that many of the loans in our sample are leveraged loans, which tend to have higher spreads.[12] On average, the age of loans in our sample is 1.88 years since loan issuance. Most of these traded loans are senior secured facilities (*Secured Facility Dummy*) while 43% of our loans have a performance pricing grid (*Performance Pricing Dummy*). The average number of financial covenants is 2.64. The quarterly average of the midpoint of bid price and ask price (*Bid-Ask Midpoint*) is 94.19 (percentage of par value).

The sample size is reduced from 26,790 loan-quarter observations to 13,071 due to matching with the Call Reports. To check for selection bias, we also report the summary statistics of the broader sample of traded loans before we match lead banks to their regulatory filings in Appendix B. The summary statistics are generally similar to our main regression sample. While

[12] The Loan Pricing Corporation defines a leveraged loan as a syndicated loan that is rated BB+ or lower or an unrated loan with an interest rate spread larger than 150 basis points.

the z-tests indicate that some loan characteristics are statistically different, the economic magnitudes of these differences are fairly small. The univariate differences in bid-ask spread, bid-ask spread volatility, and trading days indicate that loans in our main regression sample may be more liquid. Having a sample of more liquid loans would bias *against* finding a relation between bank capital and loan liquidity as the impact of dealers' balance sheet strength should be stronger for illiquid loans.

Table 1 Panel B reports lead bank characteristics. The observations are at the level of bank-calendar quarter combinations. On average, the *Tier 1 Capital* ratio is 10% with a standard deviation of 2%. The average *Leverage Ratio* is 7% and the average *Book Equity Capital* is 9%. These capital ratios are in line with the literature (e.g., Purnanandam (2010); Mehran and Thakor (2011); Dell'Ariccia, Laeven, and Suarez (2017)). The average book value of bank total assets is $791.4 billion, suggesting that they are generally very large banks. On the asset side, the average bank cash and reserves to total book asset ratio (*Bank Cash*) is 6%. The average commercial and industrial (C&I) loans to total book asset ratio (*Bank C&I Loans*) is 12%. The mean of bank trading assets to total assets ratio (*Bank Trading Assets*) is 12%. This ratio is higher because larger banks engage in proportionally more trading. On the liability side, the average total deposits to total asset ratio is 52%. This is consistent with large banks relying less on deposits as a source of funding than small banks, which typically are funded much more with deposits. The average ratio of unused loan commitment to total asset ratio is 39%, suggesting that these large banks can be subject to significant liquidity risk from off-balance sheet liabilities.

We report key borrower characteristics in Table 1 Panel C. The average total assets of borrowers is 4.05 billion, indicating that they are relatively larger firms. The average borrower leverage is 0.53. The ratio of cash and marketable securities to total assets averages 0.06. These

numbers are in line with the literature (Graham, Leary, and Roberts (2015)). The average borrower return on assets (ROA) is negative, consistent with the fact that leveraged loans tend to be issued to riskier firms.

3.3 Descriptive Regression Analysis

The literature has little evidence on secondary market liquidity for syndicated loans. Firm and security characteristics are shown to have significant impacts on trading liquidity for securities like stocks. To establish a benchmark, we next conduct a descriptive regression analysis to shed light on how some key borrowing firm and loan characteristics may affect loan bid-ask spreads. We regress loan bid-ask spreads on a variety of borrower and loan characteristics, leaving aside bank variables. The descriptive regression results are reported in Table 1 Panel D. In Columns (1) and (2), we first examine the impact of borrower characteristics alone. Column (1) does not include borrower firm fixed effects while Column (2) does. In Column (1), *Borrower Total Assets* exhibits a significantly negative sign. But the significance is gone after we control for firm fixed effects. In both models, *Borrower Leverage* has positive coefficients, yet statistically insignificant. *Borrower ROA* is negatively and significantly associated with loan bid-ask spreads in both models. This is consistent with the fact that many financial covenants are written upon borrower income (e.g., EBITDA) and cash flows and covenant violations are often triggered by negative cash flow shocks (e.g., Sufi (2009)). Other firm-level variables are insignificant in both models. It is not surprising that loan liquidity seems to be relatively insensitive to these borrower characteristics since loans have the highest seniority in the capital structure and are mostly secured by collateral.

We then turn attention to loan characteristics in Column (3). Among many variables, *Loan Maturity*, *Number of Lenders*, and *Bid-Ask Midpoint* enter with statistically significant coefficients. The positive coefficient on *Loan Maturity* reflects that loans with longer maturity are less liquid.

Number of Lenders at Origination is positively associated subsequent bid-ask spreads. Similar as in Prilmeier and Stulz (2019), the negative sign on *Bid-Ask Midpoint* suggest that higher priced loans tend to have significantly lower bid-ask spread.

In Column (4), when we jointly examine the impact of loan and borrower characteristics, *Loan Age* turns positively significant. This pattern resembles other fixed-income markets (e.g., Schultz (2001); Goyenko, Subrahmanyam, and Ukhov (2011)), where seasoned securities are found to be less liquid. *Loan Amount* shows a significant negative sign. Better liquidity for larger loans could imply that dealers can more easily manage their inventory of larger issues (e.g., Hong and Warga (2000); Alexander, Edwards, and Ferri (2000)). Larger loan amount likely reflects larger trade transaction amount. This result is also consistent with the finding in the corporate bond literature that larger transactions tend to have lower execution costs. The results are generally similar when we add lead bank fixed effects (in Column (5)).

4. Empirical Analysis of the Impact of Lead Bank Capital on Loan Liquidity

4.1 Baseline Results

In this section, we present the baseline results on how lead bank capital affects secondary market loan liquidity. We use a firm-by-year fixed effects model to isolate the impact of bank-related factors (see, e.g., Khwaja and Mian (2008), Jiménez, Ongena, Peydró, and Saurina (2012), and Abbassi, Iyer, Peydró, and Tous (2016) for similar empirical strategies). Essentially, this empirical strategy allows us to compare the liquidity of two or more traded loans of the same firm in the same year. Thus, any effects of borrower heterogeneity are effectively neutralized.

The model specification is as follows:

$$Bid\text{-}Ask\ Spread_{ijkt} = \alpha_0 + \alpha_1 \times Tier\ 1\ Capital_{k,t-1} + \alpha_2 \times Bank\ Controls_{k,t-1} + \alpha_3 \times Loan\ Controls_j + Fixed\ Effects + \varepsilon_{ijkt}$$

where *i*, *j*, *k*, and *t* index borrowing firm, loan, lead bank, and time, respectively, and each observation is a loan-quarter combination. We control for a variety of lead bank and loan characteristics. In all specifications we control for the firm-by-year fixed effects as well as the loan purpose and type fixed effects to address different sources of potential bias. In some specifications, we also include lead bank fixed effects to effectively remove any bias caused by different lead banks and focus only on the effects of capital differences over time for individual lead banks. Heteroscedasticity-robust standard errors are clustered at the borrower level.

The estimation results are reported in Table 2. In all model specifications, the dependent variable is the *Quarterly Average Bid-Ask Spread*. The key explanatory variable of interest is *Tier 1 Capital*, which is the Tier 1 risk-based capital ratio. In all columns, we include the firm-by-year fixed effects, and as a result, the firm characteristics drop out from the regressions. In Column (1) we include lead bank characteristics as controls. In Column (2) we add a set of loan characteristics. In Column (3), we control for more lead bank characteristics. In Column (4), we further include lead bank fixed effects. In all columns, the estimated coefficients on *Tier 1 Capital* are negative and statistically significant at the 1% level. These results suggest that when a lead bank has greater capital, all else equal, its loan has a lower bid-ask spread in the secondary market.

The impact of lead bank *Tier 1 Capital* is also economically significant. All else being equal, a one standard deviation (2%) increase in *Tier 1 Capital* is associated with a decrease of 13 to 16 basis points (bps) in *Quarterly Average Bid-Ask Spread*. Evaluated at the sample mean of loan bid-ask spreads (108 bps), the resulted decrease represents a reduction of bid-ask spread by approximately 12% to 14.8%.

In Table 2, *Bank Total Assets* has an insignificant effect on loan liquidity except in Column (4), where it exhibits a positive sign at the 5% significance level. Duffie, Gârleanu, and Pedersen (2005) show that a monopolistic market maker in over-the-counter markets can provide easier access to investors and charge a higher bid-ask spread. The positive coefficient on *Bank Total Assets* is consistent with their dealer market power model. Consistent with being a relatively stable bank funding source, *Bank Total Deposits* negatively affect bid-ask spreads, but its significance is muted once we control for lead bank fixed effects. *Bank C&I Loans* are positively associated with bid-ask spreads across all models. Consistent with bank funding constraints, *Bank Loan Charge-offs* exhibit strong significance and indicates that greater loan loss is associated with subsequently more illiquidity.

In terms of loan characteristics, *Loan Amount* still has a significantly negative coefficient, indicating larger loans have better liquidity. *Loan Age* also exhibits a significant positive effect on loan liquidity in one model. Again, *Bid-Ask Midpoint* exhibits significantly negative signs in all models, suggesting that higher priced loans tend to have lower bid-ask spreads. Nevertheless, regardless of model specifications, the negative impact of bank capital on loan bid-ask spreads is very robust.

It is also important to point out that, although we calculate bid-ask spread using price quotes, we are unlikely to introduce a systematic bias in our regression analysis for several reasons. First, while Thomson doesn't disclose actual trade prices, it has an evaluation team to ensure that price quotes reflect an accurate market value and the published quoted prices are sufficiently comparable to actual trade prices.[13] Second, recent studies also confirm that loan price quote contains critical

[13] Specifically, buy-side customers often communicate transaction prices to Thomson Reuters. Thomson Reuters does not use these prices as inputs but the evaluation team compares these values to broker quotes received to help assess the ongoing quality of the broker quotes.

value-relevant information (e.g., Beyhaghi and Ehsani (2017), Addoum and Murfin (forthcoming)). Third, noise in loan price quotes, if any, will introduce an attenuation bias that goes *against* finding any significant results.

4.2 Alternative Measures of Bank Capital

To make sure that our results are not driven by a specific measure for bank capital levels, we use the model specification in Column (4) of Table 2 and re-estimate our model using several alternative measures of bank capital.[14] We report the results in Table 3.

We first use *Leverage Ratio* as a measure of bank capital. *Leverage Ratio* is calculated as Tier 1 capital divided by bank total (unweighted) assets, mitigating the potential impact of risk weight manipulations by banks. We report this result in Table 3 Column (1) and find very similar negative effect of leverage ratio on loan liquidity. In Column (2) we use *Book Equity Capital*, the book value of equity capital over bank total (unweighted) assets. In Column (3), the regression is estimated using *Total Equity Capital*, which is the sum of Tier 1 and Tier 2 regulatory equity capital over bank total risk-weighted assets. In all columns, higher bank capital is significantly associated with lower secondary market bid-ask spreads. These results demonstrate that our baseline findings are not sensitive to different measures of bank capital levels.

Another measure we use is the *change* of lead bank Tier 1 capital ratio from the loan issuance to the current trading quarter. While the lead bank fixed effects in our baseline regressions control for time-invariant bank characteristics, the change of bank capital from loan issuance to current trading quarter may capture the change in bank risk appetite over this particular time interval. We report the estimation results in Column (4) of Table 3. Consistent with previous

[14] Other model specifications as in Table 2 give similar results.

findings, an increase in bank capital level from loan issuance is also significantly associated with a narrower bid-ask spread.

4.3 Heterogeneity of Bank Capital's Impact on Loan Liquidity

We next examine how the impact of lead bank capital on loan bid-ask spreads varies in the cross section or in the time series. We report the results in Table 4.

First, it is well known that asset price volatility negatively affects trading liquidity due to higher adverse selection and inventory risks (e.g., Stoll (1978)). Brunnermeier and Pederson (2009) predict that market liquidity declines as volatility increases. This effect is especially relevant when dealers' capital deteriorates because capital deteriorations induce dealers to shift some liquidity provision to less volatile securities that require less capital. Thus, we expect the association between lead bank capital and loan liquidity to vary with loan price volatility.

We measure the price volatility for a loan using the standard deviation of the loan's quoted prices in the quarter (*Loan Price Volatility*) and report the regression results in Table 4 Column (1). Consistent with the predicted association between asset price volatility and trading liquidity, higher loan price volatility itself positively and significantly affects loan bid-ask spreads. Moreover, the interaction term, *Tier 1 Capital*Loan Price Volatility*, is negative and statistically significant at the 1% level. This result suggests that the impact of lead bank capital on loan liquidity is more pronounced when loan price is more volatile.

Under the bank funding constraint hypothesis, higher capital helps a lead bank to absorb demand and supply shocks in loan trading by providing funding to satisfy trading margin requirements and by easing the cost of external financing. Along this line, we first show that, when a greater portion of a bank's external funding is wholesale funding, the effect of bank capital on

loan liquidity is stronger. Several recent studies find that bank wholesale funding is subject to flight risk, especially during financial crises (e.g., Ivashina and Scharfstein (2010); Cornett, McNutt, Strahan, and Tehranian (2011); Chu, Zhang, and Zhao (2019)). In Column (2) of Table 4, we estimate the effect of *Tier 1 Capital*Bank Wholesale Funding* on loan bid-ask spreads. We find that this interaction term is negative and statistically significant at the 10% level, suggesting that the effect of bank capital on loan liquidity is stronger when a bank obtains a higher portion of its external financing from wholesale funding markets.

We also investigate how the effect of bank capital on loan trading liquidity varies with nonperforming loans. Increases in nonperforming loans imply that banks must set more capital side to absorb potential loan losses. Literature finds that high level of nonperforming loans is associated with slower future lending growth (e.g., Becker and Ivashina (2014)). In Table 5 Column (3), *Tier 1 Capital*Bank Nonperforming Loans* is negative and highly significant, suggesting that bank capital is more strongly associated with lower loan bid-ask spreads when the lead bank has more nonperforming loans. In a similar vein, in Table 4 Column (4), we also find that the effect of bank capital on loan bid-ask spreads is more pronounced when a bank has higher loan chargeoffs.

Theory also suggests that the impact of dealer capital on loan liquidity should be particularly acute during crisis times when a bank's funding constraints become more binding. Such binding constraints adversely affect the bank's willingness to take positions that require capital (e.g., Ivashina and Scharfstein (2010)). Binding capital constraints also likely aggravate funding situations of other traders who rely on the bank as a primary funding source (e.g., Aragon and Strahan (2012)). Precisely over the same time, margin requirements typically increase as adverse selection problems become more severe and financiers expect more future volatility

(Brunnermeier and Pederson (2009)).

We therefore examine whether being in the Global Financial Crisis has any incremental effect on the association between lead bank capital and loan liquidity by interacting bank capital with a *Crisis Period Dummy*. Following Berger and Bouwman (2013), we define the crisis period to be between 2007:Q3 and 2009:Q4 (*Crisis Period Dummy*=1). In Column (5), *Tier 1 Capital*Crisis Period Dummy* is negative and significant at the 5% level. This result suggests that the effect of bank capital on loan liquidity becomes much stronger during the crisis period, providing further support to our hypothesis. The individual effect of *Tier 1 Capital* remains negative and statistically significant at the 10% level. The *Crisis Period Dummy* is positive and statistically significant, consistent with a substantial decline of loan liquidity over the crisis period.

4.6 Additional Tests

In this section, we present a set of additional tests to further demonstrate the robustness of our key findings. The results are documented in Table 5.

We first replace our dependent variable with the natural logarithm of quarterly average bid-ask spread (*Ln (Bid-Ask Spread)*) and re-estimate our model. The results are reported in Panel A Column (1). *Tier 1 Capital* remains negative and statistically highly significant. In Panel A Column (2), we examine how bank capital affects the *Quarterly Bid-Ask Spread Volatility*, the standard deviation of daily bid-ask spreads over a quarter. The literature suggests that the volatility of bid-ask spreads also captures liquidity risk in trading (e.g., Dick-Nielsen, Feldhutter, and Lando (2012)). Consistent with the hypothesis that higher capital allows a bank to better absorb risk

associated with trading, the results in Column (1) show that higher bank capital significantly reduces the volatility of bid-ask spreads as well.[15]

In Panel A Column (3), we add calendar quarter fixed effects to the baseline model to account for the potential impact of credit market seasonality (Murfin and Petersen (2016)). We find our results also hold. We also estimate a loan-by-year fixed effects model in Panel A Column (4). The loan-by-year fixed effects control for time-varying unobserved loan characteristics that may affect loan liquidity. Note that, in this specification the firm-by-year, lead bank, and other loan level fixed effects are subsumed because they remain constant within a loan-year cell. As shown in Column (4), higher lead bank capital is still significantly associated with lower bid-ask loan spreads, suggesting that our baseline finding is very unlikely to be driven by unobserved loan characteristics.

Next, we re-estimate our model with a subsample that excludes the first/last trading quarters and trading quarters with fewer than 40 days with quotes. As mentioned before, the first and last trading quarters may be affected by loan issuance/maturity/refinance. The calculation of average bid-ask spread may be less noisy when there are more trading days per quarter. As shown in Panel B Column (1), our main finding is robust.

In Panel B Column (2), we re-calculate the *Quarterly Average Bid-Ask Spread* using only the days that the lead bank is among the reported dealers that provide quotes. The sample size is reduced because Thomson starts to report dealer information from early 2005. Also, Thomson only

[15] In Appendix C Panel A, we show that the relations between the volatility measure and alternative bank capital measures are similar. As shown in Appendix C Panel B, we also find that greater Tier 1 Capital is associated with higher average loan price and smaller loan price volatility.

reports daily dealer information when a day has three or more quotes.[16] Nevertheless, it shows that *Tier 1 Capital* is still negatively and significantly associated with loan bid-ask spreads for this subsample.

We then address a potential bias with low pricing quotes. Industry practitioners point out that some low pricing quotes could be 'fishing' quotes given by some vulture investors and thus do not reflect true dealer quotes. Following their suggestions, we re-estimate our model using loans with quarterly average quoted price at or above 90. We report the estimation results in Panel B Column (3) and show that our main finding is still preserved.

Lastly, we recalculate loan quarterly bid-ask spread by only using trading days that have three or more quotes. The result is presented in Panel B Column (4), and we find that the impact of lead bank capital is still robust. Because days with more quotes are also more likely to be days with actual trades, this robustness test again mitigates the potential concern that price quotes are merely a marketing tool for banks to attract trading.

5. The Impact of Bank Capital on Loan Liquidity: Two Causality Tests

It is possible that lead bank capital can be endogenously determined by some unobserved factors related to loan trading. For example, better-capitalized banks may choose to lend to borrowers whose loans will have better anticipated secondary market liquidity. In this section, we conduct two additional tests that suggest that our findings are causal.

[16] Note that we are not implying that a lead bank does not show up at all on other days. In fact, given that a lead bank on average shows up as a dealer over 80% of the days for which Thomson does report loan dealer identity, a lead bank is also likely to be an active dealer in other days.

5.1 Bank Real Estate Exposure and Bank Capital

First, we exploit exogenous variations in bank capital resulting from banks' exposure to the housing market (e.g., Chu (2015); Granja, Matvos, and Seru (2017); Chakraborty, Goldstein, and MacKinlay (2018)). Following the literature, we use the weighted housing price change as an instrument for change in bank capital at the first stage, with the weight being each bank's geographic exposure to the housing market. The geographic exposure is proxied by bank deposits in various locations, given that complete information on the locations of deposits are available from the FDIC summary of deposits (SoD) data. This instrument likely satisfies the exclusion condition as real estate price changes are likely to be out of the control of an individual bank.

Specifically, we first obtain quarterly house price indexes from the Federal Housing Finance Agency (FHFA) to calculate the changes in house price indexes. We use the FDIC SoD data and weight the changes in the local housing price indexes by the percentage of deposits of a bank has in each geographical area.[17] Considering a bank *i* that operates in a set of locations Ω_i with deposits d_{ir} in location r. We denote the house price index in each location as P_{rt}. The weighted change of bank portfolio housing price in a quarter is therefore:

$$\Delta P_{it} = \Sigma_{r\in\Omega_i}\left[(P_{rt} - P_{rt-1})\frac{d_{ir}}{\Sigma_{r\in\Omega_i} d_{ir}}\right]$$

We then estimate the impact of the weighted changes of housing prices on the changes of bank capital by running the following 1st stage regression:

[17] For metropolitan statistical areas (MSA), we use the MSA level housing price from the Federal Housing Finance Agency (FHFA). For geographic areas that do not belong to an MSA, we use the state level housing price from the FHFA.

$$\Delta Tier\ 1\ Capital_{it} = \beta_0 + \beta_1 \times \Delta P_{it} + \beta_2 \times Controls_{it} + Fixed\ Effects + \varepsilon_{it}$$

We include bank characteristics controls as in our baseline regression and bank fixed effects. The 1st stage regression result is reported in Table 6 Column (1). We calculate the change of Tier 1 capital and the change of housing price as the difference between their current quarter values from their values in the same quarter but a year before. In the regression, Δp_{it} has a positive and significant effect on $\Delta Tier\ 1\ Capital_{it}$, consistent with housing price fluctuations leading to change in bank capital. The F-statistic is well above the conventional threshold for a strong instrument.

We then obtain the predicted bank capital change, $Predicted\ \Delta Tier\ 1\ Capital_{it}$, from the 1st stage regression. In the 2nd stage, we regress loan bid-ask spreads on this predicted bank capital change with all other control variables and fixed effects from our baseline regression. We report the 2nd stage regression estimates in Table 6 Column (2). It shows that an increase of bank capital is still significantly associated with lower bid-ask spreads, confirming our previous results.

Housing price appreciation and depreciation may not have symmetric effects on bank capital. To show that this possibility does not bias our result, we re-estimate the 1st and 2nd stage regressions for a subsample period between 2006 and 2011, which corresponds to a period of nationwide housing price decline. Specifically, following Granja, Matvos, and Seru (2017), we recalculate both the change in housing price and the change in bank capital as the change from 2006:Q4 to the current quarter. We then re-estimate the 1st stage regression and report result in Table 6 Column (3). In the 1st stage, Δp_{it} still has a positive sign and its significance becomes even stronger. We run the 2nd stage regression and report the results in Column (4). The predicted bank capital change still exhibits a strong negative association with loan bid-ask spreads.

5.2 The 2012 JPMorgan Chase Trading Loss as a Quasi-Natural Experiment

In the second causality test, we exploit the 2012 JPMorgan Chase's unexpected loss due to a flawed credit derivative trading strategy (also known as the "London Whale" incident) as a quasi-natural experiment.[18] The event was largely unanticipated and did not affect other banks much at the same time. Moreover, the event caused loss of bank capital for trading and thus provides us an identification to further isolate the effect of trading capital on loan liquidity.

On April 6 of 2012, a massive credit derivative bet by a trader at the London office of JPMorgan Chase was first reported by media such as *Bloomberg* and the *Wall Street Journal*. On May 10 of 2012, JPMorgan Chase admitted that the credit derivative bet, which JPMorgan Chase claimed to be part of a high yield bond hedging strategy, backfired and disclosed $2 billion in trading losses. By December of 2012, the losses associated with the flawed credit derivative trading mounted to a final total of $6.2 billion and caused the stepping-down of then CFO Douglas Braunstein (Zeissler, Bennett, and Metrick (2015)).

Using a difference-in-differences (DiD) approach, we compare the liquidity of loans of JPMorgan Chase as the lead bank relative to the liquidity of loans with other lead banks before and after the "London Whale" incident. Since the incident happened in the second quarter of 2012, we focus on a subsample of loans from the fourth quarter of 2011 to the fourth quarter of 2012 to have two quarters before and after. In the DiD regression, *JPM* is a dummy variable equals to one if a loan's lead bank is JPMorgan Chase and zero otherwise. *Post Event* is a dummy variable equals to one if a trading quarter is on or after the second quarter of 2012. The coefficient of the interaction term *JPM*Post Event* is the difference-in-differences estimator.

[18] See "Whale's Tail Hits Bank on Buyback" in the *Wall Street Journal* (Aug. 9, 2012). The article reports that the loss led the bank to restate down its tier 1 capital ratio from 10.3% to 9.9% as of June 30, 2012.

We report the estimation results in Table 7. In Column (1), we first show that the event adversely affects bank capital to validate our identification assumption. Using *Tier 1 Capital* as the dependent variable, we find that the coefficient on *JPM*Post Event* is negative and statistically significant. In Column (2), we estimate the shock's impact on loan liquidity in a DiD regression with the firm-by-year and lead bank fixed effects. The firm-by-year fixed effects control for time-varying borrower characteristics. In both columns, the lead bank fixed effects subsume any permanent differences between loans arranged by JPMorgan Chase and loans arranged by other lead banks.

In Column (2), *JPM*Post Event* has a positive and significant sign, suggesting that the trading capital loss leads to a significant *increase* of the bid-ask spreads of loans arranged by JPMorgan Chase relative to other loans. In Column (3), we control for firm-by-year fixed effects and loan fixed effects as an alternative specification. The coefficient on *JPM*Post Event* is still positive and is statistically significant at the 5% level, yielding the same conclusion. Economically, after the shock, the *Quarterly Average Bid-Ask Spread* of loans led by JPMorgan Chase increases by 26 basis points, approximately 22.2% relative to other loans evaluated at the subsample mean (117 bps).[19] This test further sheds light on the causal impact of bank capital on loan liquidity.

6. Conclusions

In this paper, we provide evidence on the importance of bank capital on the secondary market for syndicated loans, a growing and important market. Our results also help test the intermediary asset pricing theory using a new setting. The lead banks that initiate syndicated loans

[19] We find qualitatively similar results using the standard deviation of bid-ask spreads as the dependent variable.

have strong reputational and financial interests in these loans and almost always act as prominent secondary market dealers for them. We construct a comprehensive dataset covering a long time period that links secondary market pricing information of syndicated loans, balance sheet data of lead banks, and financial data of the borrowers.

With a very broad set of controls and fixed effects, we find that higher capital ratios for lead banks result in greater liquidity of the loans that they syndicate. Various measures of bank capital are negatively associated with the levels and volatility of the secondary market bid-ask spreads. Greater bank capital also leads to low loan price volatility. All these effects are statistically and economically significant, and all reflect improved liquidity. The effects are also stronger during the financial crisis, when liquidity concerns are most severe. Our findings support the financial intermediary asset pricing theory, which predicts that reduced financial constraints of market makers due to higher capital ratios improves market liquidity. We show that our results are highly robust. We are also able to establish causality using plausibly exogenous variations in bank capital levels from exposure to the housing market and the 'London Whale' incident.

Our findings may also contribute to on-going debates about whether post-crisis regulatory burdens impair financial institutions' intermediation capacity and jeopardize market liquidity. Of particular concern is the Volcker Rule (Section 619 of the Dodd Frank Act), which prohibits banking organizations from proprietary trading in many securities and derivatives. Some recent studies examine the impact of the Volcker Rule on corporate bond liquidity with mixed results (e.g., Adrian, Boyarchenko, and Shachar (2017); Bao, O'Hara, and Zhou (2018); Bessembinder, Jacobsen, Maxwell, and Venkataraman (2018); Goldstein and Hotchkiss (2019)). In contrast to

corporate bonds, banks' trading of syndicated loans is exempted in the final version of the Volcker Rule.[20]

Our findings have at least three potential policy implications. First, our evidence strongly suggests that bank involvement can improve secondary market trading. This suggests potential costs in terms of the secondary market liquidity of corporate bonds and other securities under the restrictions of the Volcker Rule. Second, our findings support the conclusion that higher bank capital requirements may help control risk in bank trading, and could potentially substitute in part or in whole for Volcker Rule restrictions. This is consistent with arguments in Richardson, Schoenholtz, and White (2018). Finally, our results provide an additional argument for the policy of bank capital requirements generally. Our finding that higher capital improves liquidity in secondary markets in which banks are market makers contributes to the large literature on the benefits and costs of capital requirements (e.g., Koehn and Santomero (1980); Berger and Bouwman (2013); Admati, DeMarzo, Hellwig, and Pfleiderer (2014)).

[20] The Volcker Rule allows banking entities to hold proprietary trading positions in excluded financial instruments. The final version of Volcker Rule excludes a loan from the definition of "a covered financial instrument". Other excluded financial instruments include foreign exchange or currency and commodities that are not derivatives.

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Figure 1 Secondary Market Loan Liquidity Over Time

This figure plots the *Quarterly Average Bid-Ask Spread* (solid line) and the *Quarterly Standard Deviation of Bid-Ask Spread* (dashed line) against calendar trading quarters between 1999:Q2 to 2016:Q1. The detailed definitions of the *Quarterly Average Bid-Ask Spread* and the *Quarterly Standard Deviation of Bid-Ask Spread* are in Appendix A.

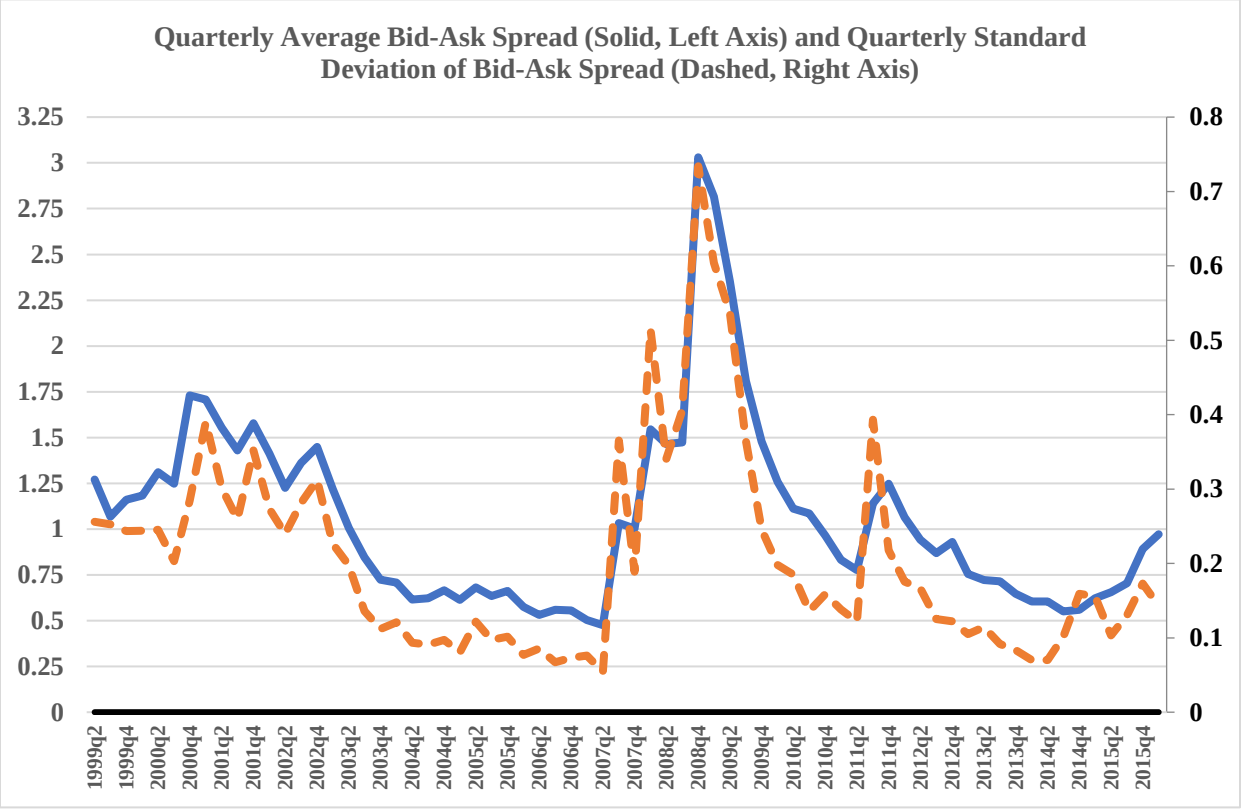

Table 1 Summary Statistics and Descriptive Regression Analysis

The sample period is from 1999:Q2 to 2016:Q1. In Panel A, we report the summary statistics for traded loans. Each observation is a loan-quarter combination. Thomson reports the average bid-ask spread for loans on a daily basis, and *Quarterly Average Bid-Ask Spread* is the quarterly average of the reported daily bid-ask spreads of a loan. *Quarterly Standard Deviation Bid-Ask Spread* is the standard deviation for a given quarter of the reported daily bid-ask spreads. Both variables are reported as percentage of par. The key independent variable is *Tier 1 Capital*, which is defined Tier 1 capital over bank total risk-weighted assets based on the Call Reports. The other variables are self-explanatory, and detailed definitions of all variables can be found in Appendix A. In Panel B, we report the summary statistics for lead banks. The observation is at the bank-quarter frequency. Note that each lead bank can have multiple traded loans in a quarter. In Panel C, we report the summary statistics for borrowers with non-missing information. The observation is at the borrower-year frequency. In Panel D, we report the results of the descriptive regression analysis. In all the regressions, the dependent variable is the *Quarterly Average Bid-Ask Spread*. In Panel D Column (1), year fixed effects and loan purpose/type fixed effects are included. In all other regressions, firm fixed effects, year fixed effects, and loan purpose/type fixed effects are included. In Panel D Column (4), lead bank fixed effects are also included. Robust standard errors are clustered at the firm level, and t-statistics are reported in the parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. All continuous variables are winsorized at the 1% level at two tails.

Panel A: Characteristics of Traded Loans

Variable (in decimals unless noted otherwise)	N	Mean	STD	P10	Median	P90
Quarterly Average Bid-Ask Spread (% of Par)	13,071	1.08	1.00	0.40	0.68	2.35
Quarterly Standard Deviation Bid-Ask Spread (% of Par)	13,012	0.21	0.31	0.02	0.09	0.52
Quarterly Average of Number of Daily Price Quotes	13,071	3.67	2.61	1.00	3.00	7.13
Number of Days with Price Quote in a Quarter	11,181	61.99	6.46	61.00	63.00	64.00
Borrower-Bank Relationship	13,071	0.31	0.39	0.00	0.00	1.00
Number of Lenders at Origination	13,071	13.07	13.70	3.00	9.00	27.00
Loan Amount ($million)	13,071	556.97	820.07	100.00	305.00	1,250.00
Ln (Loan Amount ($million))	13,071	5.79	0.99	4.61	5.72	7.13
Performance Pricing Dummy	13,071	0.43	0.49	0.00	0.00	1.00
Number of Financial Covenants	13,071	2.64	1.57	0.00	3.00	4.00
Loan Maturity (months)	13,071	75.59	16.92	58.00	82.00	96.00
Ln (Loan Maturity (months))	13,071	4.29	0.29	4.06	4.41	4.56
Secured Facility Dummy	13,071	0.96	0.20	1.00	1.00	1.00
Loan Age	13,071	1.88	1.64	0.00	2.00	4.00
Loan Spread (bps)	13,071	288.86	122.22	175.00	275.00	400.00
Ln (Loan Spread (bps))	13,071	5.59	0.39	5.16	5.62	5.99
Bid-Ask Midpoint (% of Par)	13,071	94.19	14.57	81.40	99.68	100.97

Panel B: Characteristics of Lead Banks

Variable (in decimals unless noted otherwise)	N	Mean	STD	P10	Median	P90
Tier 1 Capital	526	0.10	0.02	0.07	0.08	0.14
Total Equity Capital	526	0.13	0.02	0.11	0.12	0.17
Leverage Ratio	526	0.07	0.02	0.05	0.07	0.09
Book Equity Capital	526	0.09	0.02	0.07	0.09	0.11
Bank Total Assets ($billion)	526	791.40	731.11	76.91	551.17	2,041.00
Ln(Bank Total Assets($million))	526	13.01	1.18	11.25	13.22	14.53
Bank Cash	526	0.06	0.04	0.03	0.05	0.12
Bank Total Deposits	526	0.52	0.17	0.35	0.58	0.69
Bank C&I Loans	526	0.12	0.07	0.03	0.11	0.24
Bank Loan Chargeoffs (%)	526	0.35	0.35	0.02	0.25	0.80
Bank Trading Assets	526	0.12	0.11	0.01	0.09	0.30
Bank Unused Commitment	526	0.39	0.27	0.02	0.41	0.76

Panel C: Characteristics of Borrowers

Variable (in decimals unless noted otherwise)	N	Mean	STD	P10	Median	P90
Borrower Total Assets ($million)	2,275	4,052.01	5,804.70	463.21	1,878.00	10,221.92
Ln(Borrower Total Assets ($million))	2,275	7.61	1.17	6.14	7.54	9.23
Borrower Leverage	2,275	0.53	0.30	0.21	0.49	0.88
Borrower ROA	2,275	-0.01	0.12	-0.12	0.02	0.08
Borrower Intangible Assets	2,275	0.35	0.25	0.02	0.32	0.71
Borrower Cash Holdings	2,275	0.06	0.07	0.01	0.04	0.15
Rated Borrower Dummy	2,275	0.81	0.39	0.00	1.00	1.00

Panel D: Descriptive Regression Analysis

	Dependent Variable: *Quarterly Average Bid-Ask Spread*				
	(1)	(2)	(3)	(4)	(5)
Borrower Total Assets	-0.13***	0.02		0.03	0.04
	(-7.15)	(0.30)		(0.52)	(0.62)
Borrower Leverage	0.12	0.09		0.03	0.05
	(1.63)	(0.87)		(0.21)	(0.34)
Borrower ROA	-2.30***	-0.67***		0.07	0.07
	(-10.71)	(-3.85)		(0.44)	(0.46)
Borrower Intangible Assets	-0.11	0.11		0.21	0.20
	(-1.11)	(0.36)		(0.78)	(0.74)
Borrower Cash Holdings	0.08	-0.01		-0.35	-0.42
	(0.23)	(-0.02)		(-0.74)	(-0.88)
Rated Borrower Dummy	-0.04	0.00		-0.00	-0.02
	(-0.73)	(0.02)		(-0.07)	(-0.32)
Borrower-Bank Relationship			0.03	-0.00	0.00
			(0.56)	(-0.00)	(0.05)
Number of Lenders at Origination			0.00*	0.00**	0.00*
			(1.92)	(2.06)	(1.91)
Loan Amount			-0.03	-0.07***	-0.07***
			(-1.41)	(-2.89)	(-2.90)
Performance Pricing Dummy			-0.01	0.02	0.02
			(-0.16)	(0.52)	(0.51)
Number of Financial Covenants			-0.02	-0.04	-0.04
			(-0.99)	(-1.61)	(-1.51)
Loan Maturity			0.11*	0.02	0.04
			(1.95)	(0.40)	(0.57)
Secured Facility Dummy			0.05	0.06	0.08
			(0.56)	(0.58)	(0.94)
Loan Age			0.02	0.05***	0.05***
			(1.06)	(3.63)	(3.53)
Loan Spread			-0.03	0.01	-0.01
			(-0.55)	(0.19)	(-0.16)
Bid-Ask Midpoint			-0.03***	-0.04***	-0.04***
			(-7.16)	(-8.22)	(-8.16)
Constant	2.11***	0.36	3.85***	5.13***	4.42***
	(7.81)	(0.67)	(6.46)	(5.39)	(4.40)
Observations	8,908	8,908	13,071	8,908	8,908
Firm FEs	No	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes
Lead Bank FEs	No	No	No	No	Yes
Loan Purpose & Loan Type FEs	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.377	0.602	0.658	0.708	0.709

Table 2 The Effect of Lead Bank Capital on Loan Liquidity: Baseline Results

In this table we report the baseline regression results on the effect of lead bank capital on secondary market loan bid-ask spreads. The dependent variable in all columns is *Quarterly Average Bid-Ask Spread* of a traded loan. The key independent variable in all columns is *Tier 1 Capital*, which is the ratio of Tier 1 capital over bank risk-weighted assets. Detailed variable definitions are in the Appendix A. We include the firm-by-year fixed effects, loan purpose and loan type fixed effects in all columns. Note that borrowing firm characteristics drop out because of the inclusion of the firm-by-year fixed effects. In Column (4), the lead bank fixed effects are also added. In the regressions, we scale *Bank Loan Charge-offs* by 100 to avoid showing too small coefficient estimates. Robust standard errors are clustered at the firm level, and two-tail t-statistics are reported in the parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: *Quarterly Average Bid-Ask Spread*			
	(1)	(2)	(3)	(4)
Tier 1 Capital	**-7.54*** **	**-7.82*** **	**-6.81*** **	**-8.41*** **
	(-3.12)	**(-3.42)**	**(-2.92)**	**(-3.55)**
Bank Total Assets	-0.07	-0.07	0.01	0.39**
	(-0.85)	(-0.77)	(0.06)	(2.05)
Bank Cash and Reserves	0.09	0.05	1.21*	0.50
	(0.14)	(0.08)	(1.76)	(0.70)
Bank Total Deposits	-0.60*	-0.61*	-1.63***	-0.22
	(-1.85)	(-1.86)	(-3.77)	(-0.27)
Bank C&I Loans			6.43***	6.93***
			(3.08)	(3.00)
Bank Loan Charge-offs			9.09***	9.46***
			(4.28)	(4.29)
Bank Trading Assets			0.54	1.08
			(0.67)	(1.12)
Bank Unused Commitment			0.06	-0.06
			(0.69)	(-0.63)
Borrower-Bank Relationship		-0.02	-0.04	-0.05
		(-0.24)	(-0.46)	(-0.60)
Number of Lenders at Origination		0.00*	0.00*	0.00**
		(1.87)	(1.87)	(2.07)
Loan Amount		-0.05***	-0.05**	-0.05***
		(-2.62)	(-2.56)	(-2.83)
Performance Pricing Dummy		-0.02	-0.01	-0.00
		(-0.58)	(-0.42)	(-0.03)
Number of Financial Covenants		0.01	0.00	0.00
		(0.36)	(0.15)	(0.09)
Loan Maturity		0.05	0.04	0.04
		(0.83)	(0.75)	(0.65)
Secured Facility Dummy		0.06	0.08	0.09
		(0.57)	(0.67)	(0.84)
Loan Age		0.02*	0.02	0.02
		(1.78)	(1.51)	(1.65)
Loan Interest Spread		0.08	0.10	0.08
		(1.01)	(1.21)	(1.04)
Bid-Ask Midpoint	-0.05***	-0.05***	-0.05***	-0.05***
	(-11.53)	(-11.55)	(-12.07)	(-11.77)
Constant	7.95***	7.40***	5.94***	1.14
	(5.72)	(4.59)	(3.04)	(0.38)
Observations	13,071	13,071	13,071	13,071
Firm-by-Year FEs	Yes	Yes	Yes	Yes
Lead Bank FEs	No	No	No	Yes
Loan Purpose & Loan Type FEs	Yes	Yes	Yes	Yes
Adjusted R-Squared	0.827	0.828	0.830	0.831

Table 3 Alternative Measures of Bank Capital

In this table we report the regression results on the effect of lead bank capital on secondary market loan bid-ask spreads, using alternative measures of bank capital. The dependent variable in all columns is *Quarterly Average Bid-Ask Spread* of a traded loan, and the model specification is the same as in Table 2 Column (4). In Column (1), the bank capital measure is *Leverage Ratio*. In Column (2), the bank capital measure is *Book Equity Capital*. In Column (3), the bank capital measure is *Total Equity Capital*. In Column (4), the bank capital measure is *Change of Tier1 Capital Ratio since Loan Issuance*, which is the difference between current quarter Tier 1 capital ratio and the Tier 1 capital ratio at the time of loan issuance. Detailed variable definitions are in the Appendix A. In all columns, we include the firm-by-year fixed effects, lead bank fixed effects, loan purpose and loan type fixed effects. For brevity, we only report the coefficients and t-statistics of the key independent variable. Robust standard errors are clustered at the firm level, and two-tail t-statistics are reported in the parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: *Quarterly Average Bid-Ask Spread*			
	(1)	(2)	(3)	(4)
Leverage Ratio	**-8.35*** **			
	(-2.89)			
Book Equity Ratio		**-9.41*** **		
		(-3.88)		
Total Equity Ratio			**-4.65** **	
			(-2.00)	
Change of Tier 1 Capital Ratio from Loan Origination				**-7.57*** **
				(-4.05)
Bank Characteristics Controls	Yes	Yes	Yes	Yes
Loan Characteristics Controls	Yes	Yes	Yes	Yes
Observations	13,071	13,071	13,071	13,071
Firm-by-Year FEs	Yes	Yes	Yes	Yes
Lead Bank FEs	Yes	Yes	Yes	Yes
Loan Purpose & Loan Type FEs	Yes	Yes	Yes	Yes
Adjusted R-Squared	0.830	0.831	0.830	0.831

Table 4 Heterogeneity of Bank Capital's Impact on Loan Liquidity

In this table we report the regression results on the heterogenous impact of lead bank capital on secondary market loan bid-ask spreads. The dependent variable in all columns is *Quarterly Average Bid-Ask Spread* of a traded loan. In Column (1), the proxy for loan trading characteristics is *Loan Price Volatility*, the quarterly standard deviation of daily average loan price. Columns (2) to (3) show how the impact of bank capital varies with bank funding conditions. In Column (2), the proxy for bank funding conditions is *Bank Wholesale Funding*. In Column (3), the proxy for bank funding conditions is *Bank Nonperforming Loans*. In Column (4), the proxy for bank funding conditions is *Bank Loan Chargeoffs*. In Column (5), *Crisis Period Dummy* equals to 1 if a loan trading quarter falls between 2007:Q3 to 2009:Q4 and 0 otherwise (Berger and Bouwman (2013)). Detailed variable definitions are in the Appendix A. In all columns, we include the firm-by-year fixed effects, lead bank fixed effects, loan purpose and loan type fixed effects. For brevity, we only report the coefficients and t-statistics of the key independent variables. Robust standard errors are clustered at the firm level, and two-tail t-statistics are reported in the parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: *Quarterly Average Bid-Ask Spread*				
	(1)	(2)	(3)	(4)	(5)
Tier 1 Capital	-4.37*	11.78	-0.01	-4.97**	-4.03*
	(-1.90)	(0.98)	(-0.00)	(-2.29)	(-1.87)
Loan Price Volatility	0.29***				
	(6.60)				
Tier 1 Capital*Loan Price Volatility	**-2.07*** **				
	(-5.83)				
Bank Wholesale Funding		5.02*			
		(1.93)			
Tier 1 Capital*Bank Wholesale Funding		**-50.90***			
		(-1.72)			
Bank Nonperforming Loans			0.39***		
			(3.60)		
Tier 1 Capital*Bank Nonperforming Loans			**-3.18*** **		
			(-3.36)		
Bank Loan Chargeoffs				0.76***	
				(4.49)	
Tier 1 Capital*Bank Loan Chargeoffs				**-6.25*** **	
				(-4.05)	
Crisis Period Dummy					1.34***
					(3.22)
Tier 1 Capital*Crisis Period Dummy					**-12.22** **
					(-2.43)
Bank Characteristics Controls	Yes	Yes	Yes	Yes	Yes
Loan Characteristics Controls	Yes	Yes	Yes	Yes	Yes
Observations	13,012	13,071	11,825	13,071	13,071
Firm-by-Year FEs	Yes	Yes	Yes	Yes	Yes
Lead Bank FEs	Yes	Yes	Yes	Yes	Yes
Loan Purpose & Loan Type FEs	Yes	Yes	Yes	Yes	Yes
Adjusted R-Squared	0.853	0.831	0.829	0.831	0.877

Table 5 Additional Tests

In this table we report several additional test results. In all columns in both panels, the key independent variable is *Tier 1 Capital*. Panel A contains robustness tests using alternative model specifications. In Panel A Column (1), the dependent variable is natural log of *Quarterly Average Bid-Ask Spread*. In Panel A Column (2), the dependent variable is *Quarterly Average Bid-Ask Spread Volatility*. In Panel A Column (3), we also add the calendar quarter fixed effects. In Panel A Column (4), we estimate a loan-by-year fixed effects model. Panel B contains robustness tests using various subsamples. In Panel B Column (1), we exclude a loan's first and last trading quarter and trading quarters with less than 40 days with quotes. In Panel B Column (2), when we calculate the *Quarterly Average Bid-Ask Spread*, we only use days for which the lead bank is among the dealers that supply quotes (according to the Thomson data). The sample size is smaller because Thomson started to provide broker-dealer information from 2005 and Thomson does so only when there are three or more quotes. In Panel B Column (3), the sample includes loan with average quarterly price equal or greater than 90. In Panel B Column (4), when we calculate the *Quarterly Average Bid-Ask Spread*, we only use days when there are equal or more than three quotes (according to the Thomson data). Detailed variable definitions are in the Appendix A. For brevity, we only report the coefficients and t-statistics of the key independent variables. In all columns except for Panel A Columns (3) and (4), we include the firm-by-year fixed effects, lead bank fixed effects, loan purpose and loan type fixed effects. Robust standard errors are clustered at the firm level, and two-tail t-statistics are reported in the parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Alternative Model Specifications

	Log (Bid-Ask Spread) as Dependent variable	Quarterly Bid-Ask Spread Volatility as Dep. Var.	Add Calendar Quarter FEs	Loan-by-Year FEs
	(1)	(2)	(3)	(4)
Tier 1 Capital	**-3.14*** **	**-5.99*** **	**-9.42*** **	**-9.13*** **
	(-4.47)	**(-5.17)**	**(-3.88)**	**(-3.97)**
Bank Characteristics Controls	Yes	Yes	Yes	Yes
Loan Characteristics Controls	Yes	Yes	Yes	Yes
Observations	13,071	13,012	13,071	13,071
Firm-by-Year FEs	Yes	Yes	Yes	No
Loan-by-Year FEs	No	No	No	Yes
Lead Bank FEs	Yes	Yes	Yes	No
Loan Purpose & Loan Type FEs	Yes	Yes	Yes	No
Adjusted R-Squared	0.850	0.559	0.832	0.828

Panel B: Subsample Tests

	Exclude First/Last Trading Quarter and Quarters with Less than 40 Trading Days	Use Days in Which Lead Bank is a Reported Dealer	Use Loans with Price Equal or Above 90	Use Days with Equal or More than 3 Quotes
	(1)	(2)	(3)	(4)
Tier 1 Capital	**-9.40*** **	**-8.68*** **	**-9.21*** **	**-5.66*** **
	(-3.67)	**(-4.19)**	**(-4.28)**	**(-2.93)**
Bank Characteristics Controls	Yes	Yes	Yes	Yes
Loan Characteristics Controls	Yes	Yes	Yes	Yes
Observations	11,657	4,037	11,046	8,260
Firm-by-Year FEs	Yes	Yes	Yes	Yes
Lead Bank FEs	Yes	Yes	Yes	Yes
Loan Purpose & Loan Type FEs	Yes	Yes	Yes	Yes
Adjusted R-Squared	0.828	0.879	0.697	0.872

Table 6 Bank's Housing Market Exposure, Bank Capital, and Loan Liquidity

In this table we report the results using bank's exposure to housing price fluctuations as a source of exogenous variation in bank capital. In Columns (1) and (2), the sample period is from 1999 to 2016 (i.e., the whole sample period). In Column (1), the dependent variable is *Δ Tier 1 Capital*, the change of Tier 1 risk-based capital from a year before. The key independent variable is *Δ Bank Portfolio Housing Price*, the deposit-weighted change in housing price index from a year before. The sample in this regression includes all commercial banks in the Call Report/FY-9C. In Column (2), the dependent variable is *Quarterly Average Bid-Ask Spread.* The key independent variable is *Predicted Δ Tier 1 Capital*, which is the predicted change of Tier 1 capital from the 1st stage regression (in Column (1)). In Columns (3) and (4), the sample period is from 2006 to 2011. In Column (3), the dependent variable is *Δ Tier 1 Capital*, the change of Tier 1 capital from 2006:Q4 to current calendar quarter. The key independent variable is *Δ Bank Portfolio Housing Price*, the deposit-weighted change in housing price index from 2006:Q4 to current calendar quarter. In Column (4), the dependent variable is *Quarterly Average Bid-Ask Spread.* The key independent variable is *Predicted Δ Tier 1 Capital*, which is the predicted quarterly change of Tier 1 capital from the 1st stage regression (in Column (3)). In Columns (2) and (4), we include the firm-by-year fixed effects, lead bank fixed effects, loan purpose and loan type fixed effects. Detailed variable definitions are in the Appendix A. For brevity, we only report the coefficients and t-statistics of the key independent variables. Robust standard errors are clustered at the firm level, and two-tail t-statistics are reported in the parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Whole Sample Period		2006-2011	
	1st Stage	2nd Stage	1st Stage	2nd Stage
	Δ Tier 1 Capital	*Quarterly Average Bid-Ask Spread*	*Δ Tier 1 Capital*	*Quarterly Average Bid-Ask Spread*
	(1)	(2)	(3)	(4)
Δ Bank Portfolio Housing Price	**0.05*** **		**0.04*** **	
	(6.10)		**(3.36)**	
Predicted Δ Tier 1 Capital		**-59.38*** **		**-26.70*** **
		(-7.23)		**(-4.78)**
Bank Characteristics Controls	Yes	Yes	Yes	Yes
Loan Characteristics Controls	No	Yes	No	Yes
Observations	139,449	13,051	44,654	3,933
Firm-by-Year FEs	No	Yes	No	Yes
Lead Bank FEs	Yes	Yes	Yes	Yes
Loan Purpose & Loan Type FEs	No	Yes	No	Yes
1st Stage F-statistics	66.67		75.72	
Adjusted R-Squared	0.329	0.832	0.838	0.834

Table 7 2012 JPMorgan Chase 'London Whale' Incident as a Quasi-Natural Experiment

In this table we report the difference-in-differences (DiD) estimation results using the 2012 JPMorgan Chase 'London Whale' incident as a quasi-natural experiment. The sample period is from 2011:Q4 and 2012:Q4. *JPM* is an indicator variable that equals to one if JPMorgan Chase is the lead bank and 0 otherwise. *Post Event* is an indicator variable that equals to one if a trading quarter is on or after 2012:Q2 and 0 otherwise. In Column (1), the dependent variable is *Tier 1 Capital*. In Columns (2) and (3), the dependent variable is *Quarterly Average Bid-Ask Spread*. In Columns (2) and (3), we include the firm-by-year fixed effects and lead bank fixed effects. Column (2) includes loan purpose and loan type fixed effects and Column (3) includes loan fixed effects. Detailed variable definitions are in the Appendix A. For brevity, we only report the coefficients and t-statistics of the key independent variables. Robust standard errors are clustered at the firm level, and two-tail t-statistics are reported in the parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Tier 1 Capital	*Quarterly Average Bid-Ask Spread*	
	(1)	(2)	(3)
JPM*Post Event	**-0.01****	**0.26***	**0.26****
	(-3.37)	**(1.90)**	**(2.46)**
Post Event	0.01**	-0.33**	-0.32***
	(2.38)	(-2.23)	(-2.76)
Bank Characteristics Controls	Yes	Yes	Yes
Loan Characteristics Controls	No	Yes	Yes
Firm-by-Year FEs	No	Yes	Yes
Lead Bank FEs	Yes	Yes	No
Loan Purpose & Loan Type FEs	No	Yes	No
Loan FEs	No	No	Yes
Observations	589	589	589
Adjusted R-Squared	0.961	0.867	0.821

Appendix A: Key Variable Definitions

Variable	Definition	Source
Quarterly Average Bid-Ask Spread	The average of daily bid-ask spreads of quoted loan price in a quarter, % of par value	Thomson
Quarterly Standard Deviation of Bid-Ask Spread	The standard deviation of daily bid-ask spreads of quoted loan price in a quarter, % of par value	Thomson
Quarterly Average of Number of Daily Price Quotes	The average of daily number of price quotes in a quarter	Thomson
Number of Days with Price Quote in a Quarter	The total number of days on which there is one or more price quote in a quarter	Thomson
Borrower-Bank Relationship	A borrower's prior lending relationship with the lead arranger. The lending relationship is calculated as the ratio of the total dollar amount of loans borrowed by the firm and arranged by the lead arranger in the past five years scaled by the total dollar amount of loans borrowed by the firm (regardless of lead arrangers)	Dealscan
Number of Lenders at Origination	The total number of different lenders in a loan facility.	Dealscan
Loan Amount	Natural log of the total amount of a loan facility in $ millions	Dealscan
Performance Pricing Dummy	A dummy variable that equals one if a loan facility has a pricing grid, and zero otherwise	Dealscan
Number of Financial Covenants	The total number of financial covenants in a loan package	Dealscan
Loan Maturity	A loan facility's maturity in months	Dealscan
Secured Facility Dummy	A dummy variable that equals one if a loan facility is secured by collateral, and zero otherwise	Dealscan
Loan Spread	All-in-drawn spread over LIBOR in basis points	Dealscan
Bid-Ask Midpoint	The average of daily bid and ask price midpoint in a quarter, % of par value	Thomson
Tier 1 Capital	Tier 1 capital over bank total risk-weighted assets	Y-9C/Call Report
Leverage Ratio	Tier 1 capital over bank total assets	Y-9C/Call Report
Book Equity Capital	Book equity capital over bank total assets	Y-9C/Call Report

Appendix A continued:

Variable	Definition	Source
Total Equity Capital	Tier 1 plus Tier 2 capital over bank total risk-weighted assets	Y-9C/Call Report
Bank Total Assets	Bank total assets in $ millions	Y-9C/Call Report
Bank Cash	Cash and balances due from depository institutions over bank total assets	Y-9C/Call Report
Bank Total Deposits	Total deposits over bank total assets	Y-9C/Call Report
Bank C&I Loans	Commercial and industrial loans over bank total assets	Y-9C/Call Report
Bank Loan Charge-offs	Loan and lease charge-offs over bank total assets	Y-9C/Call Report
Bank Trading Assets	Bank total trading assets over bank total assets	Y-9C/Call Report
Bank Unused Commitment	Total unused commitment/bank total assets	Y-9C/Call Report
Bank Wholesale Funding	Total wholesale funding over bank total liabilities	Y-9C/Call Report
Bank Non-Performing Loan	Non-performing loans over bank total assets	Y-9C/Call Report
Bank Loan Loss Allowance	Loan Loss Allowance over bank total assets	Y-9C/Call Report
Borrower Total Assets	Borrowing firm total assets in $ millions (AT)	Compustat
Borrower Leverage	Sum of total debt in current liabilities (DLC) and total long-term debt (DLTT) over total assets (AT)	Compustat
Borrower Intangible Assets	Intangible assets (INTAN) over total assets (AT)	Compustat
Borrower Cash Holdings	Cash and marketable securities (CHE) over total assets (AT)	Compustat
Borrower ROA	Net income (NI) over total assets (AT)	Compustat
Rated Borrower Dummy	A dummy variable that equals one if a firm has an S&P long-term credit rating, and zero otherwise	Compustat

Appendix B: Comparison of Loan Characteristics

We report summary statistics for the traded loan sample before matching to lead banks and borrowers. The sample period is from 1999 Q2 to 2016 Q1. *, **, and *** indicate statistical significance of two sample z-test of zero sample mean difference at the 10%, 5%, and 1% levels, respectively. Detailed variable definitions are in the Appendix A. All continuous variables are winsorized at the 1% level at two tails.

Traded Loans with Compustat Match and Non-Missing Loan Characteristics

Variable (In decimals unless noted otherwise)	N	Mean	STD	P10	Median	P90	Mean (Table 1)	Diff-in-Mean
Quarterly Average Bid-Ask Spread (% of Par)	26,790	1.12	1.10	0.40	0.70	2.39	1.08	-0.03***
Quarterly Standard Deviation Bid-Ask Spread (% of Par)	26,673	0.23	0.35	0.03	0.10	0.55	0.21	-0.02*
Quarterly Average of Number of Daily Price Quotes	26,790	3.55	2.45	1.00	3.00	7.03	3.67	0.12***
Number of Trading Days in a Quarter	22,929	61.37	8.50	61.00	63.00	64.00	61.99	0.63***
Borrower-Bank Relationship	26,790	0.29	0.38	0.00	0.00	1.00	0.31	0.02**
Number of Lenders at Origination	26,790	11.50	12.42	2.00	7.00	26.00	13.07	1.56***
Ln(Loan Amount ($million))	26,790	5.76	1.01	4.61	5.70	7.13	5.79	0.03***
Performance Pricing Dummy	26,790	0.41	0.49	0.00	0.00	1.00	0.43	0.02
Number of Financial Covenants	26,790	2.51	1.63	0.00	3.00	4.00	2.64	0.13***
Ln(Loan Maturity (months))	26,790	4.29	0.29	4.06	4.39	4.56	4.29	0.00
Secured Facility Dummy	26,790	0.96	0.21	1.00	1.00	1.00	0.96	0.00
Loan Age	26,790	1.82	1.62	0.00	1.00	4.00	1.88	0.06***
Ln(Loan Spread (bps))	26,790	5.63	0.41	5.16	5.62	6.11	5.59	-0.04***

Appendix C: Additional Tests

In Panel A we report additional regression results on the effect of lead bank capital on secondary market loan bid-ask volatility, using alternative measures of bank capital. The dependent variable in all columns of Panel A is *Quarterly Bid-Ask Spread Volatility* of a traded loan. In Column (1), the bank capital measure is *Leverage Ratio*. In Column (2), the bank capital measure is *Book Equity Capital*. In Column (3), the bank capital measure is *Total Equity Capital*. In Panel B we report additional regression results on the effect of lead bank capital on secondary market loan price and price volatility. Detailed variable definitions are in Appendix A. For brevity, we only report the coefficients and t-statistics of the key independent variables. We include the firm-by-year fixed effects, lead bank fixed effects, loan purpose and loan type fixed effects in all columns. Robust standard errors are clustered at the firm level, and two-tail t-statistics are reported in the parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A

	Dependent Variable: Bid-Ask Spread Volatility		
	(1)	(2)	(3)
Leverage Ratio	**-7.18*** **		
	(-4.55)		
Book Equity Capital		**-5.98*** **	
		(-5.71)	
Total Equity Capital			**-3.94*** **
			(-3.65)
Bank Characteristics Controls	Yes	Yes	Yes
Loan Characteristics Controls	Yes	Yes	Yes
Observations	13,012	14,119	13,012
Firm-by-Year FEs	Yes	Yes	Yes
Lead Bank FEs	Yes	Yes	Yes
Loan Purpose & Type FEs	Yes	Yes	Yes
Adj. R-Squared	0.561	0.567	0.559

Panel B

	Avg. Loan Price	Loan Price Volatility
	(1)	(2)
Tier 1 Capital	**235.82*** **	**-34.17*** **
	(6.54)	**(-4.91)**
Bank Characteristics Controls	Yes	Yes
Loan Characteristics Controls	Yes	Yes
Observations	13,071	13,012
Firm-by-Year FEs	Yes	Yes
Lead Bank FEs	Yes	Yes
Loan Purpose & Type FEs	Yes	Yes
Adj. R-Squared	0.883	0.482