Loan Sales and Bank Liquidity Management: Evidence from a U.S. Credit Register

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We examine how banks use loan sales to manage liquidity during periods of marketwide stress and the associated spillovers to market prices. We track the dynamics of loan share ownership in the secondary market using data from a U.S. supervisory register of syndicated loans. Controlling for loan quality using loan-year fixed effects, we find that banks reliant on wholesale funding were more likely to exit syndicates through sales during 2007/08. This effect is stronger for banks dependent on short-term funding and holding fewer liquid securities. In addition, secondary market prices decrease significantly more for loans funded by liquidity-strained banks. (*JEL* G01, G21, G23)

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An important topic in macroeconomics and finance is the asset sales and trading behavior of financial institutions and its contribution to the fragility of the financial system (Shleifer and Vishny 2011). As the recent financial crisis illustrated, liquidity shortfalls at intermediaries can prompt fears of forced asset sales and destabilizing defaults that may lead to unprecedented policymaker interventions. While nascent liquidity regulation has the potential to improve financial stability and limit the need for future bailouts (Carlson, Duygan-Bump, and Nelson 2015), it may tax socially valuable liquidity provision services by banks (Stein 2013). Despite its importance for the design of interventions during crises and liquidity regulation, little is known about asset sales and trading by modern banks and, in particular, how they might be used to manage liquidity during times of marketwide stress.

In this paper, we document the trading activities by U.S. bank holding companies in the secondary market for syndicated corporate loans. Anecdotes suggest that banks were engaging in loan sales in the crisis due to funding troubles.[1] We build on these anecdotes by analyzing essentially the universe of syndicated loan shares held by U.S. bank holding companies from 2002 until 2010. Our main contribution is to establish, on the most granular scale, a direct connection from banks' exposure to disruptions in short-term wholesale funding markets in the crisis to greater selling in the loan secondary market.[2] In addition, we document the negative spillover effects of this selling activity in terms of greater price declines among loans funded by liquidity-strained banks.

Our empirical tests are based on a confidential credit register of syndicated loan commitments, the Shared National Credit Program, which is maintained by the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, and the Office of the Comptroller of the Currency. This data set allows us to track the dynamics of loan share ownership in the years following origination. We use these data to isolate secondary market sales of loan shares, defined as reductions in loan share ownership occurring after origination.

We link the loan share ownership data to bank balance sheet information to estimate the impact

[1] For example, Citigroup's loan portfolio sale of about $12.5 billion of assets to a group of private equity firms—Apollo Management, TPG Capital, and Blackstone Group—in April 2008. See "Citigroup nears deal to sell leveraged loans," *New York Times*, April 9, 2008.

[2] Wholesale funding refers to the use of uninsured liabilities including interbank borrowing, repurchase agreements, and asset-backed commercial paper.

of funding disruptions on the loan sale decision in the crisis. Our measurement of funding troubles comes from banks' reliance on short-term wholesale funding markets at the onset of the crisis following Acharya and Mora (2015). Our empirical tests control for bank-borrower matching and changes in borrower quality (e.g., unobservable changes in default risk) using a loan-year fixed effects approach that exploits the multi-bank financing aspect of loan syndication, as well as our complete panel data of loan share holdings. This empirical approach accounts for changes in borrower (and loan) quality at the loan syndicate level by comparing the loan sale decisions across lenders as a function of wholesale funding reliance within loan syndicate-year pairs.

Our main findings can be summarized as follows. We find that banks more exposed to disruptions in wholesale funding markets had a higher probability of selling loan shares during the crisis. We investigate the impact of banks' holdings of liquid assets (e.g., cash reserves) on the relation and find higher liquid holdings mitigate the funding effect, consistent with a buffer of liquid assets reducing the need for banks to sell off less liquid corporate loans. We document a powerful interaction effect between the composition and maturity structure of wholesale funding and selling activity. In particular, we find that banks' exposure to short-term funds, including repos and interbank borrowing, drives our baseline result.

On the timing of this effect, we find that the positive relation between wholesale funding and loan sales peaks in 2008, at the time when wholesale funding markets were most stressed (see, e.g., Cornett, McNutt, Strahan, and Tehranian 2011). We investigate which types of loans were most likely to be sold and find that exposed banks were most likely to sell larger and more widely held loans, for which a greater amount of public information is likely to exist (see Sufi 2007). We also examine secondary loan share purchases and show that banks less reliant on wholesale funding in the crisis were able to act as liquidity providers, especially during 2008.

We analyze how wholesale funding interacts with loan performance and bank fundamentals—loan losses, leverage, and capital adequacy—and three key results emerge. First, the coefficient on wholesale funding is similar to the baseline estimate in the subsample of underperforming loans—loans with failing regulatory ratings or covenant noncompliance—indicating that our measure of bank illiquidity is unlikely to proxy for insolvency or capital constraints. Second, bank fundamentals

have an independent impact on sales, and we also find that well-capitalized banks were more likely to purchase loans during the crisis. Third, we find evidence that the effect of wholesale funding on sales is larger for banks with greater holdings of mortgage-backed securities or lower regulatory capital, consistent with amplification effects arising due to interactions between illiquidity and insolvency.

Having connected loan sales during the crisis to the funding profile of banks, in the final part of the paper we investigate the consequences of these sales in terms of their impact on market prices. We collect daily secondary market loan pricing data for syndicated loans from the Loan Syndication and Trading Association and combine this with our information on syndicate composition at the onset of the crisis from the credit register. Our evidence shows that syndicated loans held by banks with heavy exposure to wholesale funding experience steeper drops in secondary market prices during the crisis. This result obtains after controlling for differences in characteristics between loans (e.g., default risk and liquidity), as well as within-loan by exploiting daily variation in the costs of wholesale funding during the crisis. Combined with our results on loan sales, our findings suggest that the sharp fall in loan prices during the crisis is at least partly due to fragile funding and the resulting illiquidity of banks owning these loans.

Our results contribute to two main strands of the literature. First, our findings improve our understanding of how banks manage their balance sheets in response to disruptions in wholesale funding markets. Prior empirical research shows how banks scramble for liquidity by attracting deposits (see, e.g., Acharya, Afonso, and Kovner 2016; Acharya and Mora 2015), hoarding cash in interbank markets (see, e.g., Acharya and Merrouche 2013), or turning to the lender-of-last-resort (see, e.g., Campbell, Covitz, Nelson, and Pence 2011). Among several others, Cornett, McNutt, Strahan, and Tehranian (2011) and Acharya and Mora (2015) provide bank-level evidence connecting unstable sources of financing to reduced credit supply in the context of the U.S. subprime crisis. More in line with our empirical approach, Iyer, Peydró, et al. (2014) and Dagher and Kazimov (2015) use loan-level data and empirical strategies that explicitly control for demand to show how banks respond to wholesale funding shocks by cutting new credit to businesses and households, respectively. Our main contribution is to document the prevalence of asset sales—syndicated loan

sales, in particular—for liquidity management. The closest paper in this regard is Granja, Matvos, and Seru (2015), who show that buyers of the assets of failed banks in Federal Deposit Insurance Corporation auctions are well-capitalized and less dependent on wholesale funding. In contrast, we focus on the behavior of solvent banks. Moreover, given our unit of analysis is mostly a syndicated loan share, we develop an estimation strategy that separates changes in risk at the level of the loan from the bank-driven effects that are the focus of this literature.

Second, we contribute to the emerging empirical literature on securities trading by banks and the important spillovers associated with these activities. To the best of our knowledge, Abbassi, Iyer, Peydró, and Tous (2016) is the only other paper to provide micro-evidence on the secondary market trading activities of commercial banks based on security-level data. Using German securities and credit registry data, these authors examine debt securities trading during the European sovereign crisis and find well-capitalized banks withdraw funds from lending to the real sector to pursue profitable trading opportunities. Most likely due to the availability of comprehensive data in the United States, we are the first to analyze trading by U.S. commercial banks in the corporate loan secondary market and connect this activity to balance sheet shocks. Our results indicate that during periods of market stress, liquidity-strained banks may be forced to sell loans and these sales have negative spillovers to market prices.[3] Consistent with Abbassi, Iyer, Peydró, and Tous (2016), we also find evidence that well-capitalized banks are more likely to make secondary market purchases of syndicated loans during the crisis.

1 Data and Summary Statistics

1.1 Sample selection and variable construction

We first obtain quarterly bank holding company balance sheet data from the Federal Financial Institutions Examination Council Consolidated Financial Statements for Holding Companies (Form

[3]Other work examines trading activity in the U.S. corporate bond market by nonbanks of varying financial health. Notably, Manconi, Massa, and Yasuda (2012) show that mutual funds experiencing negative flows sell relatively liquid corporate bonds, whereas Ellul, Jotikasthira, and Lundblad (2011) find insurance companies constrained by regulatory capital requirements sell downgraded corporate bonds. In both cases, the authors argue that these bond sales are forced and associated with spikes in yields, which is consistent with fire sales.

FR Y9-C). Bank holding companies must file these reports with the Federal Reserve. These data are used to construct a number of standard accounting variables at the bank holding company level, including measures of bank size, capitalization, and performance.

We collect loan share–level data from the Shared National Credit Program (SNC), a credit register of syndicated loans with coverage from 1977 to present. The SNC is an annual survey of syndicated loans carried out by the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation (FDIC), the Office of the Comptroller of the Currency, and, until recently, the Office of Thrift Supervision. The program obtains confidential information from administrative agent ("agent") banks on all loan commitments (including term loans and drawn and undrawn lines of credit) exceeding $20 million and shared by three or more unaffiliated federally supervised institutions, or a portion of which is sold to two or more such institutions. This includes loan packages containing two or more facilities to the same borrower for the same origination date where the sum exceeds $20 million. New and existing loans meeting this criteria are surveyed on December 31 each year.[4]

For each qualifying loan, information is provided about the identity of the borrower, as well as several terms of the contract, including the origination date, the maturity date, the type of loan (e.g., credit line or term loan), and the regulatory assessment of loan quality (pass or fail). Crucially, the SNC data provide complete information on loan syndicate membership each year following origination. That is, for each year, the program identifies the agent bank and non-agent ("participant") lenders, as well as their respective shares of the loan commitment. Each loan in the SNC is assigned a unique credit identifier. This identifier remains unchanged in years when the loan terms are amended or the loan is refinanced.

For each loan and year of the SNC, the data have one observation per loan share, so each observation can be identified as a loan share–lender–year triple. To ensure this identifier is unique, if a lender holds several shares of the same loan in a given year, we aggregate all shares to arrive at a total loan share–lender–year triple. This occurs either because the same institution owns

[4]Information on the purpose of the SNC is provided at `www.federalreserve.gov/bankinforeg/snc.htm` and inclusion criteria at `www.newyorkfed.org/banking/reportingforms/guidelines.pdf`. The SNC data do not indicate whether a given loan is held in trading or banking book.

several shares of the same loan or different institutions belong to the same holding company. In the case of banks and their subsidiaries, the data identify the current holder of a loan share by the Replication Server System Database (RSSD) ID number and the ultimate parent of the lender (bank or financial holding company or "top holder"). Lenders belonging to the same bank holding company are assigned to a common top holder and considered as a single "bank." This loan share–lender–year triple is the unit of observation in our analysis.

We use the SNC data set to track the dynamics of loan share ownership and identify sales of loan shares occurring after origination, that is, ownership transfers occurring in the secondary market. We identify sales of loan shares on a loan-by-loan basis by comparing the set syndicate members between two consecutive years. In particular, if a lender is a member of a loan syndicate in year t but not in the same loan syndicate in year $t+1$, then we record a loan share sale for $t+1$. We require that the loan has not matured in year $t+1$ to avoid the problem of all lenders being coded as selling their participations at maturity. We primarily consider loan shares sold in their entirety, although we later analyze partial loan sales whereby banks reduce but retain some ownership.

In some tests, we distinguish between loan-years in which there are no changes in the underlying contract and loan-years in which the loan is refinanced or some terms of the loan were amended. In such cases the credit identifier will not change, so we pinpoint refinanced or amended loans by observed changes in maturity dates, origination dates, or total loan amounts at origination. In our tests, we sometimes use a restricted "No Amend" sample including only loan share sales that occur in years with no contract term changes or refinancing activity. This classification is imperfect, however, as the SNC data set does not contain information about some material contract terms including interest rates. We use this sample to directly address the concern that a borrower may remove a bank from the syndicate, under the assumption that it is more difficult to do so when the contract is not renegotiated or refinanced. We further discuss the use of this sample in Section 2.

The SNC data structure also allows us to control for merger and acquisition activity among banks as a potential source of misclassification of loan sales. Sales are identified on the lender level, typically a commercial bank subsidiary, and assigned to a top holder, which is usually a bank

holding company. If the lender RSSD ID does not change but the top holder RSSD ID does change, then we record this instance as a merger and not a sale. For example, if bank holding company A acquires bank holding company B—and A consolidates its loan portfolio with B's—then we do not record B's disposal of loan shares as a sale in the year when the balance sheet consolidation takes place. Similarly, sometimes a loan share is transferred from one lender to another lender but both have the same top holder. Such within-organization reallocations of loan shares, while interesting in their own right, are beyond the scope of this paper and therefore not recorded as sales.

We estimate the impact of bank liquidity management on loan sales using cross-sectional variation in banks' dependence on wholesale deposits as well as nondeposit funding, such as reverse repurchase agreements, interbank borrowing, and commercial paper. We capture this reliance on "wholesale funding" sources through the ratio of non-core funding (sum of large time deposits, foreign deposits, repurchase agreements sold, other borrowed money, subordinated debt, and federal funds purchased) to total assets. This is essentially the non-core funding dependence ratio reported by regulators and used in prior academic research (e.g., Acharya and Mora 2015). Figure 1 shows the pattern in wholesale funding for our event window between 2003 and 2010. Consistent with the well-documented shift from retail deposits to wholesale funding in recent decades among U.S. banks (e.g., Dagher and Kazimov 2015), there is a sharp increase (nearly 20%) in wholesale funding between 2004 and 2007. This trend completely reverses in the subsequent two years and aftermath of the crisis.[5] This abrupt reversal of banks' liability structure lines up with shifts in funding costs during the crisis, as evidenced by an elevated level of the TED spread.[6]

1.2 Summary statistics

We start our sample description of loan share sales with graphical evidence based on aggregated data from the SNC.[7] Figure 2 plots loan share sales by U.S. bank holding companies (BHCs) during

[5] Appendix IA.II provides additional statistics on the dynamics of wholesale funding from 2003:Q1 until 2009:Q4 at the quarterly frequency. It shows the reversal in wholesale funding is pronounced among large banks.

[6] The TED spread is the difference between the three-month London Interbank Offered Rate and the three-month Treasury rate. An elevated TED spread reflects worse conditions in banks' access to wholesale funding (Cornett, McNutt, Strahan, and Tehranian 2011).

[7] These estimates of aggregate trading volumes represent a lower bound for at least four reasons. First, we focus on loan shares sold (or purchased) in their entirety. Second, the annual SNC data may omit ownership transfers with multiple legs within the year. Third, we require a loan to be in the SNC for two consecutive years, so we may omit

the period from 2002 until 2010. Sales are represented both in terms of dollar value (left axis) and as a fraction of the beginning-of-year total loan commitments (right axis). The latter measure better captures the economic importance of these sales by accounting for the cyclicality of loan originations (Ivashina and Scharfstein 2010). Some notable patterns emerge. First, a large peak in sales occurs in 2008: the total dollar value of sales exceeds $100 billion, corresponding to about 10% of the dollar value of outstanding claims changing hands. Before this peak, sales activity was considerably lower. Second, the economic magnitude of loan sales is large. About $200 billion or 20% of the aggregate bank loan portfolio was sold from 2007 until 2010.[8]

Figure 3 plots loan share sales and purchases over the same time period for all financial institutions. We adopt the classification of lenders provided by the SNC—domestic banks, domestic nonbanks (e.g., collateralized loan obligations, pension funds, and investment management firms), foreign banks, and foreign nonbanks. While the focus of this paper is trading activity by domestic banks,[9] other financial institutions are clearly major players. Focusing first on sales, the data show an important role for foreign banks and domestic nonbanks, consistent with evidence from the primary market (e.g., Benmelech, Dlugosz, and Ivashina 2012). Once the crisis hits, domestic banks and nonbanks, and foreign banks, all show a sharp increase in sales activity, and share the market equally in terms of volumes sold. For purchases, we observe a sharp uptick in 2008 with domestic banks and nonbanks, as well as foreign banks again dominating this activity. Interestingly, from 2008 onward we see foreign nonbank organizations becoming active among secondary loan purchases. Overall, these data suggest that institutions aside from domestic banks are actively trading and may provide liquidity to the market in the event of a negative shock.

The sample used in our empirical analysis consists of data from 2002 to 2010. We define the "before-crisis" period to be the years from 2003 to 2006 and the "during-crisis" period from 2007

trades of short maturity or maturing loans, as well as trades occurring before the first respective SNC review. Fourth, the SNC inclusion criteria omit small loans or those held by fewer than three federally supervised institutions.

[8]Sales by investment banks that converted to BHCs in 2008 are included in the 2009 and 2010 aggregates only. In 2009 and 2010, these institutions account for about 2.5% and 10% of loan sales by U.S. BHCs, respectively. Moreover, conversions between lender types do not trigger loan sales in our data since SNC top-holder identifiers are fixed.

[9]For a typical bank in our sample, syndicated loans are 4.8% of total loans and 2.6% of total assets at the beginning of 2007. These numbers are greater for the large banks (assets above $50 billion): 20.4% of total loans and 10.9% of total assets, on average. Moreover, U.S. bank holding companies hold a significant portion of the market in the aggregate (e.g., 41.6% of the $2.40 trillion SNC portfolio in 2007; see Figure 4).

to 2010. The before crisis period serves as a benchmark against which bank behavior during the financial crisis is compared. The sample is restricted to loan shares held by U.S. bank holding companies and includes 9,627 unique syndicated loans (67,647 loan share–lender–year triples, 322 banks) before the crisis and 9,599 loans (81,011 loan share–lender–year triples, 349 banks) during the crisis. Bank-level variables are measured at the end of the calendar year at the top holder level. Variables requiring stock market data are calculated using data from the Center for Research in Securities Prices (CRSP). This additional requirement reduces the number of loan share-lender-year observations by approximately one-third. Definitions of these variables are found in Appendix A. Bank variables are winsorized at the 1st and 99th percentiles to mitigate the effect of outliers.

Panel A of Table 1 presents the summary statistics of the loan- and bank- level variables for the two time periods, averaged across loan share–years and bank-years, respectively. Before the crisis, banks have average total assets of about $2.87 billion, hold 19% of assets in liquid instruments, and finance 25.6% of liabilities from wholesale sources. These banks have average book capital ratios of 8.8% and ratios of market equity value to total assets of 19.6%. The average nonperforming loan ratio is 0.7%. On average, loan shares are sold 6.6% of the time, each bank holds a 13.1% share of a given loan commitment, and 18.6% of the shares have a bank acting as an agent. The average total loan commitment in the sample is roughly $280 million; however, at the 25th percentile, this drops to $64 million. This indicates that the loans in the sample are granted to both medium and large firms, but not the smallest in the economy.

Comparing these statistics across the two periods, we see that, first, the fraction of bank funding that comes from wholesale markets increases to 27.7% at the onset of the crisis, a trend consistent with Figure 1. Second, the nonperforming loan ratio more than quadruples in the crisis. Third, the ratio of equity market capitalization to assets declines significantly in the crisis, reflecting the crash in market valuations of U.S. banks. Finally, consistent with the run-up in loan sales shown in Figure 2, Table 1 indicates that the unconditional probability of a loan sale increases during the crisis by roughly 3 percentage points.

Panel B of Table 1 gives a sense of the differences across banks by wholesale funding dependence. The table splits the sample according to whether the bank falls above or below median wholesale

funding in 2006:Q4. The major differences between these groups are that banks with above-median wholesale funding dependence are larger in terms of book assets, are more likely to be the lead arranger, and also hold fewer liquid assets. Indeed, if we compare liquid assets with liquid liabilities (wholesale funding) between the two groups, we can see a stark mismatch (0.365 – 0.147 = 0.218) for the above-median dependence group only. These differences are both large in magnitude and significant at the 1% level, using standard difference of means tests. Other differences are either small or insignificant, including measures of losses and capitalization. This indicates that these two bank groups did not differ much in terms of observable performance or risk-taking.

2 Empirical Methodology

Our empirical approach is based on the idea that tight liquidity conditions during the financial crisis surprised banks, leading to a change in their liquidity management strategies. That is, when the crisis hits, banks with high exposure to funding withdrawals would be expected to build up cash by selling loans more than banks with low exposure.

This estimation poses an identification challenge that requires separating changes in lending behavior due to supply-side factors (e.g., bank liquidity management) from changes in perceived loan quality (e.g., default risk). We address this identification challenge directly by controlling for changes in borrower quality at the loan-year level in the spirit of Khwaja and Mian (2008). We exploit the fact that firms borrow from multiple banks in the syndicated loan market and compare the loan sale decision across lenders within a given loan syndication in a particular year. This level of analysis allows us to control for potentially confounding borrower risk factors at the level of the loan. We therefore avoid the potential for our estimates to be biased by unobservable changes in loan quality across firms and even across different loan types within a firm. This last concern is especially relevant in the syndicated loan market where a borrower might receive a package of loans with different loan purposes, and levels of subordination or collateral.

We formally implement our baseline empirical strategy using ordinary least squares (OLS) to

estimate:

$$Loan\ Sale_{ijt} = \alpha_{it} + \beta\ Wholesale\ Funding_{j,2006Q4} + \gamma'\ X_{ij,t-1} + \epsilon_{ijt}, \tag{1}$$

where $Loan\ Sale_{ijt}$ is the loan sale indicator variable equal to one if a loan share i held by bank j in year $t-1$ is sold in year t. The coefficient α_{it} captures loan-year fixed effects. $Wholesale\ Funding_{j,2006Q4}$ is the wholesale funding exposure of bank j measured as of 2006:Q4, our independent variable of interest. Standard errors are clustered at the firm level to allow for correlation of error terms across loans, years, and banks within the same firm.

In the vector $X_{ij,t-1}$, we include control variables to ensure that the results are not driven by differences in bank or loan share characteristics that might also influence loan sales. We follow recent work on bank liquidity management and include lagged balance sheet variables as controls for bank characteristics (see also Cornett, McNutt, Strahan, and Tehranian 2011). These include various measures of bank loan losses and leverage, the natural logarithm of assets, and whether the bank has engaged in merger activity in the current and previous years. The loan-level controls are defined at the loan share–lender–year level and capture banks' importance within the loan syndicate. For example, agent banks may be more likely to cross-sell other products and thus prefer not to sell their participation in the loan, all else equal (Bharath, Dahiya, Saunders, and Srinivasan 2007). We therefore control for the fraction of the loan held by the lender and an indicator variable for whether the lender is an agent bank or not.

The coefficient of interest, β, measures the impact of wholesale funding dependence on loan sales after accounting for loan-specific changes in credit quality. If banks sell loans to manage liquidity in response to funding disruptions during the crisis, the coefficient β will be strictly positive. The null hypothesis that wholesale funding is irrelevant for loan sales (because banks can find substitute financing or loans cannot be sold), which corresponds to expecting that β will be zero.

Unbiased estimation of β hinges on two identification assumptions. The first identifying assumption is that the expected rate of separation desired by firms is the same across all lenders in the respective syndicate during the crisis. This assumption is necessary for us to identify a bank-driven effect, and it is plausible for two main reasons. First, the homogeneity of loan shares within

a given syndicated credit: a loan share from lender A has identical contract terms as a loan share from lender B. Therefore, since shares are identical, it is unlikely firms will change preferences over banks for a given loan during the crisis. Second, a key institutional feature of our setting is that borrowers have little influence over the composition of their loan syndicate, especially ownership changes occurring in the secondary market. While we do not expect borrowers to remove banks from loan syndicates for reasons related to loan quality, we separately investigate this issue under the assumption that borrower-driven factors are less likely to play a role when a contract is not being renegotiated or refinanced. We thus examine the impact of bank liquidity management on the incidence of loan sales for observations where the contract is not amended (i.e., the "No Amend" sample defined previously) and in all other observations.

The remaining identification challenge stems from banks' choice to use wholesale funding. In particular, if banks that are more likely to use wholesale funding are also more conservative in terms of risk-taking or have different investment opportunities in the crisis, then β may be biased. As a first step in addressing this issue, we control for bank size, losses, and leverage, as prior theoretical and empirical work suggests these factors determine banks' access to wholesale funding markets.[10] Panel B of Table 1 underscores the importance of bank size: when we split the bank sample according to 2006:Q4 wholesale funding dependence, we find that bank size (and the large bank indicator) differs significantly across the two groups.

In addition to controlling for bank characteristics, we take the following steps. First, following Iyer, Peydró, et al. (2014), we measure wholesale funding dependence at the onset of the crisis (2006:Q4) to capture banks' ex ante exposure to funding disruptions. Our wholesale funding measure is not time-varying during the crisis, as such variation might proxy for changes in banks' investment opportunities or credit risk management concerns. Second, we examine several bank fixed effects models that control for time-invariant characteristics that may codetermine loan sales and wholesale funding. This approach is by no means definitive if unobserved heterogeneity varies

[10] Park and Pennacchi (2009) argue that only large banks have access to wholesale funding because institutional investors consider large banks to be more transparent, geographically diversified, or potentially "too big to fail." This argument is supported in theory by Diamond (1984), who predicts that larger, better-diversified banks have greater incentives to monitor borrowers and to make payments to uninsured depositors. Conversely, Stein (1998) shows that smaller, less transparent banks will have difficulty raising funds from sources other than insured deposits.

over time. We therefore conduct cross-sectional tests that examine how banks' liquidity management through loan sales interacts with holdings of cash and liquid debt securities, short-term wholesale funding dependence (e.g., a reliance on overnight interbank borrowing, as opposed to long-term certificates of deposit), and sales across different credit quality buckets. This last test allows us to rule out the possibility that wholesale funding dependence is proxying for lower loan portfolio quality.

3 Results

3.1 Liquidity management and loan sales

3.1.1 Baseline analysis

With the cost of wholesale funding increasing and funding shortfalls becoming a first-order concern during the financial crisis, we expect banks to manage their balance sheet and liquidity position by selling off assets. To test this hypothesis in the context of syndicated loans, we estimate Equation (1) where wholesale funding dependence is measured using data from 2006:Q4. If liquidity management considerations caused bank loan sales, then we expect the coefficient on wholesale funding to be positive.

Table 2 provides the main results. In Column [1], we first perform the estimation for the full sample of loan shares held by U.S. bank holding companies during the period from 2007 to 2010. The coefficient on the wholesale funding variable is positive (0.076) and significant at the 1% confidence level. The direction of this estimate is consistent with our expectation that banks exposed to the disruptions in short-term funding markets had a greater probability of selling loan shares to manage liquidity. In terms of economic magnitudes, the estimate implies that increasing wholesale funding by one standard deviation (0.14 for this regression sample) leads to a 1.1% higher probability of a loan sale during the crisis, holding all else constant. The magnitude of this relation is large given that the frequency of loan sales was on average around 3 percentage points higher during the crisis as compared with before (the unconditional probability of a sale during the crisis was 9.5%, as shown in Table 1). This finding indicates that secondary loan sales play an important

role in bank liquidity management when wholesale funding markets become stressed.

Columns [2] to [8] consider variants of this baseline estimation to check for robustness. We first restrict the sample to loans outside of industry sectors acutely affected, in terms of fundamentals, by the financial turmoil and subsequent recession—finance, insurance, and real estate and construction (FIRE) industries. While loans to these industries constitute less than 10% of the sample, it may be the case that the bulk of the selling by banks occurred here. Column [2] indicates that dropping these industries has no effect on any of the point estimates.

We next restrict the sample to loan-years in which the contract was not amended or refinanced. In Column [3], we see the estimates remain unchanged in both magnitude and significance when we remove these loans from the sample (about 2,000 loans). This shows that banks dependent on wholesale funding were equally likely to sell loans experiencing some change in borrower condition leading to the contract renegotiation, as compared with other loans. In such non-amended loan-years, it is less likely that borrower factors play a role in the loan sale decision. This reassures us that the loan sale decision reflects bank characteristics, including wholesale funding dependence.

Column [4] re-estimates the regression model in Equation (1) measuring the bank controls as of 2006:Q4 instead of lagged values. We continue to find that the coefficient on wholesale funding remains positive and statistically significant. This alleviates a potential concern that our estimates are biased by changes in control variables occurring due to wholesale funding pressures during the crisis.

Our benchmark model imposes a linear relationship between wholesale funding dependence and loan sales and therefore may be sensitive to outliers. Although we address such concerns by winsorizing our bank-level variables, including wholesale funding dependence, we now consider an approach that does not impose linearity. We rank banks as having high, medium, and low exposure to the liquidity shock. Banks are assigned to exposure groups depending on the tercile wholesale funding distribution the bank falls into as of 2006:Q4. We then estimate the following model:

$$\begin{aligned} \textit{Loan Sale}_{ijt} = \alpha_{it} + \beta_1 \ \textit{Medium Exposure}_{j,2006Q4} + \beta_2 \ \textit{High Exposure}_{j,2006Q4} \\ + \gamma' \ X_{ij,t-1} + \epsilon_{ijt}, \end{aligned} \tag{2}$$

where β_1 and β_2 capture the average propensity of banks in the medium- and high-exposure groups, respectively, to sell loans relative to the omitted group of low-exposure banks.

Column [5] estimates Equation (2) on the full sample of loan shares. We find that medium- and high-exposure banks increase their likelihood of selling their loan share by 0.5% and 1.2%, respectively, relative to low-exposure banks. The estimate on high exposure is significant at the 1% level; however, the medium exposure estimate is insignificant. This nonlinear model indicates that our results are concentrated among the high-exposure banks.[11]

We also consider two alternative definitions of our loan sale variable. First, we restrict the definition of a loan sale to include only sales for which at least 1% of the total loan commitment was sold by a bank in a given year and drop loan shares smaller than 1%. We conduct this test to rule out the concern that our results are driven by a large number of small loan share sales. Column [6] indicates that this concern does not show up in the data, as evidenced by a similar estimate of the wholesale funding effect.

Next, we relax the requirement of a complete sale of a loan share. This choice was motivated by the fact that we infrequently observe partial sales. Nevertheless, a concern is that classifying such partial sales as non-sales may introduce measurement error into and bias our estimates, especially for lead banks for whom partial sales are more common (Bord and Santos 2012). For instance, a bank more dependent on wholesale funding may choose to reduce its exposure to a given syndicated loan by selling only 50% of an existing share, rather than 100%. This might lead us to underestimate β, since such observations would not be coded as sales.

We examine this issue by redefining our loan sale variable to be equal to one if any reduction in the loan share is observed from year t to year $t+1$. Using this definition and re-estimating Equation (1) in Column [7], we find the magnitude of the coefficient appears to be slightly larger than the baseline result. This suggests that banks may use partial sales to handle liquidity shortages. Thus, our estimates that use loan shares sold in entirety may understate the true effect.

In Column [8], we use data from the period before the financial crisis to benchmark our estimates.

[11] Appendix IA.II shows that, at the onset of the crisis, the difference between average liquid liabilities and liquid assets is most pronounced among banks in the top (0.407 - 0.151 = 0.256) versus middle (0.260 - 0.155 = 0.105) versus bottom (0.163 - 0.195 = -0.032) terciles of wholesale funding.

We shift the event window and measure wholesale funding dependence in 2002:Q4.[12] The coefficient on the wholesale funding variable is negative (–0.012) and significant at the 1% confidence level. The sign of this estimate implies that banks with greater use of wholesale funding have a lower probability of selling loan shares during this period. This finding suggests that, in contrast to the crisis period, banks with access to well-functioning wholesale funding markets have greater financial flexibility (e.g., Calomiris and Kahn 1991) and the ability to fund additional syndicated loans.

Columns [1] to [8] control for a large array of bank characteristics. Several robust relations emerge that relate to previous literature. First, on the lenders' role in the syndicate, we find that agent banks or lenders that retain a large portion of the loan are less likely to sell their share. This is consistent with lead arrangers retaining their skin-in-the-game to create future lending or underwriting opportunities (e.g., Bharath, Dahiya, Saunders, and Srinivasan 2007), or to commit to monitoring the borrower (e.g., Ivashina 2009; Sufi 2007). Indeed, throughout our empirical tests, we find that participant banks are considerably more likely to sell their loan shares. Second, larger banks are less likely to sell, as indicated by the negative and significant coefficient on the large bank indicator. This may be due to the fact that larger banks have access to alternative sources of funding (Acharya, Afonso, and Kovner 2016). Third, the lagged bank merger variables indicate that loan share sales occur more frequently after mergers among banks, consistent with portfolio rebalancing. Finally, loan losses (nonperforming loans ratio and net charge-offs) and hence credit risk concerns are important determinants of sales, consistent with evidence from the primary market (e.g., Santos 2011).[13,14]

Taken together, the evidence is strong for an increase in loan sales during the crisis among banks with greater wholesale funding dependence. We find the opposite result for the pre-crisis period, casting doubt on an alternative explanation that banks with wholesale funding have a greater propensity to sell loans through the credit cycle. Our findings suggest that banks facing liquidity shortages and scrambling for cash may actively manage their balance sheets by liquidating

[12] Net charge-offs (lagged) cannot be calculated in 2003, so this variable is dropped here.

[13] A one-standard-deviation increase in *Net Charge Offs* (0.1413×10^{-3}) leads to an increases of ($23.64 \times 0.1413\times10^{-3} =$) 0.334 percentage points in the probability of a loan sale.

[14] In Appendix IA.III, we show that the wholesale funding effect persists when we augment Equation (1) with control variables for loan portfolio risk, asset composition, and nontraditional bank activities that have been emphasized in the prior literature (e.g., Demsetz and Strahan 1997).

loan shares in the secondary market. This evidence complements recent work showing bank-level effects on loan originations (e.g., Cornett, McNutt, Strahan, and Tehranian 2011), borrowing from other sources (e.g., Acharya, Afonso, and Kovner 2016), and raising deposit rates (e.g., Acharya and Mora 2015), in response to the collapse of U.S. wholesale funding markets.

3.1.2 Bank fixed effects models

We next examine bank fixed effects models to address alternative explanations related to the organizational form of the bank holding company. One possibility is that large, broker-dealer banks trade more actively in secondary markets, so they mechanically sell more loans during the crisis. Incorporating bank fixed effects helps rule out this concern, as it allows for differential selling behavior within banks during the crisis period and between non-crisis and crisis periods.

We first modify Equation (1) by including the lagged wholesale funding along with bank fixed effects (α_j):

$$Loan\ Sale_{ijt} = \alpha_{it} + \alpha_j + \beta\ Wholesale\ Funding_{j,t-1} + \gamma'\ X_{ij,t-1} + \epsilon_{ijt}. \tag{3}$$

We estimate this model for the period from 2007 until 2010, including the same set of controls as in the baseline specification, but now allowing for within-bank variation in wholesale funding dependence. The estimate of β is of interest and captures how wholesale funding dependence influences loan sales controlling for loan-year fixed effects, as well as observable and time-invariant unobservable differences between banks.

Our second model groups the before- and during-crisis periods together to consider the full sample of loans from 2003 until 2010. We measure bank-level wholesale funding dependence using data from 2002:Q4 and include an interaction term to account for the differential impact of wholesale funding dependence in normal and crisis times:

$$Loan\ Sale_{ijt} = \alpha_{it} + \alpha_j + \beta\ Crisis_t \times Wholesale\ Funding_{j,2002Q4} + \gamma'\ X_{ij,t-1} + \epsilon_{ijt}. \tag{4}$$

Here, $Crisis_t$ is an indicator variable equal to one if the year is between 2007 and 2010 and zero

otherwise. In both bank fixed effects models, the set of controls is the same as in the baseline model shown in Equation (1), and standard errors continue to be clustered at the firm level.[15]

Table 3 shows the results. Columns [1] and [2] examine the period from 2007 until 2010 and allow for time variation in wholesale funding dependence as in Equation (3). Column [1] shows that the coefficient of interest remains positive and statistically significant at the 1% confidence level after switching to this dynamic specification. Similar findings emerge in Column [2] when we include bank fixed effects to control for time-invariant unobservable differences between banks. To get a sense of the economic magnitude of the estimate in Column [2], note that the within-bank standard deviation of wholesale funding from 2007 until 2010 is 0.041. Thus, a one-standard-deviation change translates into an increase of ($0.041 \times 0.254 =$) 1.04 percentage points in the probability of a loan sale, very similar to the baseline estimate from Column [1] of Table 2.

Columns [3] to [5] shows estimates based on the bank fixed effects model shown in Equation (4), measuring wholesale funding dependence as of 2002:Q4. Column [3] conducts a preliminary test that restricts the sample to the loan-years from 2007 until 2010 and finds that wholesale funding measured in 2002:Q4 has a positive and statistically significant impact on loan sales during the crisis. Columns [4] and [5] consider the longer event window from 2003 until 2010 and include a crisis interaction term. Column [4] shows that the effect of wholesale funding dependence on loan sales is positive and statistically significant at the 1% confidence level for the crisis period only. The coefficient on the main effect is negative, which is consistent with wholesale funding improving financial flexibility in the period from 2003 until 2006. Column [5] adds controls for bank fixed effects and finds similar results.

Next, we replace the crisis indicator variable with a continuous measure of the tightness of banks' funding conditions, the TED spread. The TED spread peaks in 2008, but also varies from year to year (see Figure 1). We test the idea that banks dependent on wholesale funding are more likely to sell loans when the TED spread is elevated, as compared with banks with stable

[15] In Appendix IA.V, we show these results are robust to clustering by bank, firm-bank, firm-year, bank-year, and double-clustering by firm and bank. In each case the estimate remains significant at the 1% level, with the exception of clustering at the bank-year level (significant at the 10% level). In untabulated results, we double-cluster standard errors by firm and bank in the baseline model (Column [1] of Table 2) and find the estimate remains significant at the 1% level.

funding. Column [6] shows that the estimated effect of wholesale funding remains similar when we use this continuous measure of wholesale funding conditions. This holds when we include bank fixed effects (Column [7]), and the magnitude of the estimate is similar to the one-percentage-point effect described above.[16] Thus, time-invariant observed or unobserved bank characteristics that may be correlated with wholesale funding dependence are not driving our main results.

3.1.3 Further Evidence on the Liquidity Management Channel

In this section, we test two auxiliary theoretical predictions that provide more stringent tests of a liquidity management channel. First, we examine whether the wholesale funding effect is less pronounced for banks with greater holdings of liquid assets. In theoretical models of financial intermediation, banks raise equity and carry liquid assets—cash reserves and debt securities—to manage the risk of cash shortfalls stemming from unexpected demand from borrowers or creditors (e.g., Diamond and Dybvig 1983). As argued by Bolton, Santos, and Scheinkman (2011), banks experiencing withdrawals can draw upon cash reserves ("inside liquidity") to meet liquidity demands rather than asset sales ("outside liquidity") that may suffer fire sales. We therefore expect banks with more liquid asset holdings to sell fewer loans during the crisis.

Following Acharya and Mora (2015), we define liquid assets as the ratio of cash (including repurchase agreements and federal funds sold) and debt securities (excluding mortgage- and asset-backed securities) to total bank assets. We then append the baseline specification in Equation (1) to include the liquid assets ratio measured as of 2006:Q4. We include controls for loan-year fixed effects and the full set of loan and bank covariates. Table 4 presents the results.

Column [1] shows the baseline estimate on the full sample from Table 2 for ease of comparison. In Column [2], we include the liquid assets ratio and find it has a negative and statistically significant impact on loan sales during the crisis: banks with more liquid asset portfolios are less likely to sell loans. This effect does not drive out the magnitude or statistical significance of the wholesale funding dependence coefficient. Indeed, the magnitude of the coefficient on wholesale funding increases when we control for liquid asset holdings, from 0.076 in the baseline estimation to 0.101.

[16] The within-bank standard deviation of interaction term is 0.141, which, multiplied by the point estimate of 0.115, yields a magnitude of 1.62 percentage points.

We now include the interaction of wholesale funding and liquid assets in the regression. Doing so allows us to test the joint effect of wholesale funding dependence and banks' liquid asset holdings on loan sales. If banks have sufficient liquid assets on hand, then we would expect this to offset the positive impact of wholesale funding dependence on loan sales during the crisis. This would translate into a negative coefficient on this interaction term. Column [3] shows that the coefficient estimate on the interaction term is negative and statistically significant at the 10% confidence level. Thus, we find an increase in liquid assets reduces the propensity to sell loans during the crisis, consistent with liquid securities holdings mitigating the effects of wholesale funding dependence on sales.

Next, we examine how the composition and maturity structure of wholesale funding affects the propensity of banks to sell loan shares. Wholesale funds consist of a variety of debt instruments ranging from long-term, large-denomination certificates of deposit to overnight, unsecured interbank borrowing. In practice, funds raised on a short-term rollover basis enjoy greater effective seniority and, naturally, provide a less stable source of financing for banks when an aggregate shock materializes (Huang and Ratnovski 2011). We therefore test to see whether banks more reliant on short-term wholesale funding have a greater propensity to sell loan shares.

We first classify funding sources as short- and long-term. Short-term components include repos sold and federal funds purchased plus the following instruments with maturity of one year or less: time deposits and brokered deposits of $100,000 or more, other borrowed money, and time deposits held in foreign offices.[17] We label the other components of wholesale funding as long-term. We then classify banks using wholesale funds as "short-term" ("long-term") if they have a dependence on these shorter-term funds that is above (below) the median value among banks. We define an indicator variable accordingly, interact it with wholesale funding in Equation (1), and re-estimate this equation on the full sample. Column [4] shows the result of the estimation. The coefficient estimate on the short-term interaction term is positive and statistically significant at the 1% confidence level, but negative and insignificant for the long-term interaction. This indicates that the relation between liability structure and loan sales is present only among banks with a reliance on short-term, potentially unstable, wholesale funds.

[17] This is "short-term non-core funding dependence" from the FDIC's Uniform Bank Performance Report.

The results in this section support the bank liquidity management channel. The point estimates indicate that liquidity management stemming from both the asset and liability sides of the balance sheet had important effects on bank loan sales during the crisis. Importantly, the negative interaction effect of wholesale funding dependence and liquid assets shows that cash-rich banks exposed to the liquidity shock were less likely to sell loans, consistent with Bolton, Santos, and Scheinkman (2011). We find similar, intuitive results when examining the maturity composition of wholesale funding. These findings alleviate residual concerns about an omitted variable correlated with bank-level wholesale funding, since such a variable would now also have to correlate with the liquid assets interaction term and short-term wholesale funding dependence in a very precise way.

3.1.4 Dynamics of liquidity management and loan sales

The coefficients in the baseline estimation in Table 2 capture time-averaged estimates across the period from 2007 to 2010. We now examine the relation between wholesale funding and loan sales on a year-by-year basis by estimating our model separately for each year.

Table 5 provides the results. Columns [1] to [4] show a hump-shaped pattern in the coefficients on wholesale funding dependence across the years. From the end of 2007 to the end of 2008, the point estimate increases by more than a factor of three, from 0.081 to 0.299. From the end of 2008 to the end of 2009, this pattern sharply reverses, and the point estimate decreases from 0.299 to 0.047. The statistical significance increases from 5% in 2007 to 1% in 2008, and is insignificant for subsequent years. Regarding the economic magnitude of this relation, in 2008 the estimate becomes as large as a one-standard-deviation increase in wholesale funding accounting, for a 4.2% increase in the likelihood of a loan sale (up from 1.1% in the baseline estimation).

We interpret these findings in the context of the squeeze in wholesale funding markets during the financial crisis. As shown in Figure 1, in mid-2007—widely accepted as the onset of the financial crisis—the TED spread jumped from around 0.5% to elevated levels between 1% and 2.5%. It remained at these levels until shortly after the Lehman bankruptcy, when the spread peaked at around 5.8%. From this peak, the spread declined until by the end of 2009 it had returned to 0.5%. Thus, we find time variation in the relation between wholesale funding dependence and bank loan

sales that corresponds to shifts in funding costs during the crisis.

3.1.5 The impact of loan liquidity on loan sales

What is the role of loan liquidity—loan shares with lower information asymmetry and thus greater secondary market depth—on banks' decisions to sell loans during the crisis? On the one hand, banks may be hesitant to sell illiquid loans at discounts, booking significant losses in the process, and would prefer to sell more liquid loans.[18] On the other hand, banks facing uncertainty going forward may value keeping some liquidity cushion in their portfolios to insure against future liquidity needs and would thus choose to sell less liquid loan shares first (e.g., Brown, Carlin, and Lobo 2010).

We explore three proxies for loan liquidity from recent research on bank loan trading. First, we examine the effect of borrower size. Small firms borrowing in the syndicated loan market are more informationally opaque (e.g., Sufi 2007), and thus less likely to be actively traded in the secondary market (Bushman and Wittenberg-Moerman 2009). Indeed, many of the smaller borrowers in the SNC data set are private firms and likely subject to an adverse selection problem if a bank tries to liquidate their loans at short notice. We define a firm as large if its loan size is above the upper quartile of $300 million and small if it is below the lower quartile of $50 million and re-estimate Equation (1) separately on these two groups. Second, we examine the effect of whether a loan is securitized or not. Securitized loans must be of sufficient quality and transparency (e.g., have an external credit rating) and include contractual features that make them easier to trade, such as tighter covenants (Drucker and Puri 2009). We classify a loan share as securitized if its syndicate contains a collateralized loan obligation in the current year—otherwise, a loan is not classified as securitized. Finally, we consider loan syndicate size. Our basic intuition is that loan shares from syndicates featuring more lenders may be easier to sell, as one of the other lenders in the syndicate may be informed and willing to take up the share. We classify a syndicate as large if it contains

[18] Prior to the crisis, syndicated bank loans had low correlation with other asset classes, as well as low default and high recovery rates (Taylor and Sansone 2007). Arguably, syndicated loans were "information-insensitive," allowing uninformed investors to hold the loans without fear of adverse selection—see Gorton and Pennacchi (1990) and, recently, Dang, Gorton, and Holmström (2012). Once the crisis arrived, however, negative public information may have caused some syndicated loans to be subject to adverse selection, resulting in trades occurring with greater price impact.

greater than the median number of lenders (eight) and small otherwise.

For each proxy, we split the sample according to whether a loan share is liquid or not and re-estimate Equation (1) on each subsample. Table 6 provides the results of this analysis. In Columns [1] and [2], we split the sample on the basis of borrower size. We find the coefficient on the wholesale funding variable is positive for small borrowers; however, it is not statistically significant. The coefficient on *Wholesale Funding* is positive, larger in magnitude, and significant at the 1% level for large borrowers. Columns [3] and [4] report the result by securitized status and show that the estimate for the securitized group is more than twice the size as compared with the nonsecuritized group. Finally, we find a similar pattern when comparing large and small loan syndicates.

Looking across the columns and comparing the point estimates between the two groups, we see that the coefficient on *Wholesale Funding* is larger in magnitude for the liquid loan group for all three proxies. However, while each of the point estimates in the liquid loan subgroups are statistically significant at conventional levels, the differences are not.[19] Thus, we must interpret these results with caution given the weak evidence that that the coefficients are statistically distinct.

These results suggest that banks facing liquidity shortfalls are more likely to sell liquid loan shares. This finding relates to Manconi, Massa, and Yasuda (2012), who document trading behavior by mutual funds experiencing liquidity shortages during the financial crisis. These authors show that these investors prefer to sell relatively liquid, less information-sensitive corporate bonds rather than securitized bonds. Indeed, the results in this section suggest that a similar mechanism operates from bank liquidity shortages to trading activity in liquid segments of the secondary loan market.

3.1.6 Interaction of liquidity management with loan and bank performance

We now analyze how bank liquidity management considerations interact with both loan performance and bank fundamentals. We begin by investigating loan performance. If wholesale funding dependence proxies for changes in bank risk appetites or binding capital constraints—despite con-

[19] For each proxy, we interact every variable in Equation (1) with the liquidity dummy and estimate the model on the full sample. F-tests of the alternative that the coefficient on the loan liquidity times wholesale funding interaction is greater than the wholesale funding main effect fail to reject the null at conventional levels in all three cases.

trolling explicitly for the bank capitalization and loan losses—then we might expect a larger estimate of β for nonperforming loans. We test this alternative using loan-level credit ratings and covenants compliance information provided by bank examiners. Loans are classified as "pass" or "fail" when the SNC review is conducted. Loans are classified as fail if they are criticized or classified in any way by the examiner, which means they are either in default (and are soon to be charged off), nonaccrual, doubtful, substandard, or special mention. The latter three categories are assigned at the discretion of the examiner and are intended to reflect deficiencies in repayment prospects of the borrower or quality of pledged collateral. Similarly, when loans are examined, information is gathered on whether borrowers are in compliance with covenants or not.

We consider ratings and covenants separately and estimate our baseline specification in Equation (1) on loan-year observations that are classified as pass or fail. Table 7 shows the results. In Columns [1] and [2], we find similar point estimates for the rating pass and fail subsamples, respectively, essentially the same as the baseline estimate. Columns [3] and [4], however, indicate that the positive relation between wholesale funding and loan sales is only statistically significant for the loans in compliance with covenants. Hence, the loading on wholesale funding dependence is independent of loan performance and therefore unlikely to proxy for bank insolvency risk.

We next analyze how the effect of funding fragility on loan sales varies across bank fundamentals, as measured by loan losses, capital adequacy, and leverage. In models of bank runs, fundamentals play an important role in debtors' decisions to withdraw or refuse to roll over funds, and therefore liquidity problems may be exacerbated at banks with weaker fundamentals.[20] We therefore interact wholesale funding with proxies for bank fundamentals and test for amplification effects via connections between bank illiquidity and insolvency.

Table 8 presents the results across various measures of bank insolvency risk. In Panel A, we consider variables related to economic capital and losses, and in Panel B regulatory capital, including tier 1 and total regulatory capital to risk-weighted assets. Three key results obtain. First, the

[20]The link between bank fundamentals and runs comes out of both information-based models (e.g., Calomiris and Kahn 1991) and models based on debtor coordination problems (e.g., Diamond and Dybvig 1983; Goldstein and Pauzner 2005; Rochet and Vives 2004). The empirical literature finds that greater withdrawals can occur at weaker banks during crises (e.g., Calomiris and Mason 1997), although there is evidence that runs can be panic-based, in the sense that they are unrelated to fundamentals (e.g., Calomiris and Mason 1997; Iyer, Puri, and Ryan 2012).

coefficient on wholesale funding is similar in terms of sign and significance across all specifications, which reassures us that this variable is not simply proxying for bank capital. Moreover, in terms of magnitudes, the coefficient is stable. For example, in Column [4] of Panel B, on inclusion of the *Wholesale Funding* × *Tier 1 Capital/RWA* interaction term, the effect of wholesale funding evaluated at the mean of tier 1 capital (11.44%) is equal to (0.259 – 0.017 × 11.44 =) 0.065, which is similar to the baseline effect in Table 2 (0.076).

Second, the estimated main effect of each insolvency measure has the correct sign in every case and is statistically significant at conventional levels in most cases. For example, we use banks' participation in the Troubled Asset Relief Program (TARP) as a measure of capital inadequacy (Bayazitova and Shivdasani 2012). Column [1] of Panel A indicates that when we include TARP in the regression it enters with a positive sign, indicating that banks requiring additional capital injections were also more likely to sell loans in the secondary market, perhaps to deleverage.

Third, where statistically significant, the interaction effect of wholesale funding and insolvency enters with a sign consistent with the theory. For example, greater regulatory capital appears to be a countervailing force against the impact of wholesale funding on loan sales, as shown in Columns [4] and [6] of Panel B. On the other hand, banks' holdings of mortgage- and asset-backed securities appear to amplify the effect of wholesale funding on loan sales.

These results indicate that loan losses and capital adequacy have a significant and independent impact on loan sales in the crisis, consistent with deleveraging behavior found in more aggregated data (e.g., Adrian and Shin 2010a; Greenwood, Landier, and Thesmar 2015), as well as theoretical models on the relation between bank equity and loan sales (e.g., Pennacchi 1988). Second, we find evidence that the funding effect is amplified for banks with weaker fundamentals (specifically, lower regulatory capital and higher holdings of mortgage-backed securities), suggesting that insolvency risk aggravated liquidity problems stemming from wholesale funding markets.

3.2 Liquidity management and loan purchases

In this section, we investigate the relation between funding structure and loan buys by banks. We collect all loan-share buy and sell transactions from 2003 until 2010. We define loan buys

analogously to loan sales: bank A buys a given loan in year t whenever this bank was absent from the corresponding syndicate in year $t-1$ and present in t. Using these transactions, we test whether banks with greater wholesale funding dependence—and later capital—are more or less likely to buy loans. A regression analysis of buyers is not feasible, as we observe only the actual buyer and not all bidders (or potentially interested buyers). Hence, we explore differences between buyers and sellers by comparing the average wholesale funding dependence of banks buying loan shares with the average for banks selling loan shares.

We use two different samples. The first incorporates the set of all loan transactions. The second uses the set of transactions where for a particular loan-year pair exactly one bank sells a share (i.e., exits the syndicate) and exactly one bank buys a share (i.e., enters the syndicate and holds a share of exactly the same size). This second sample ("Matched bank-to-bank trades") resembles a loan fixed effects model, as, holding the loan constant, we compare the wholesale funding dependence of the syndicate entrant (buyer) with the bank exiting the syndicate (seller).

Panel A of Table 9 shows tests for whether banks with greater wholesale funding dependence were more likely to buy or sell loan shares. We begin by examining the crisis period from 2007 until 2010 with wholesale funding dependence measured as of 2006:Q4. Here, we find consistent evidence that banks buying loan shares had less wholesale funding than banks selling loan shares, especially during the 2008 peak of the crisis. Columns [1] to [3] of the top panel show, first, that the number of loan share sales during the crisis (7,705) exceeds the corresponding number of loan share sales before the crisis (4,363) and the number of purchases during the crisis (4,337). Thus, overall sales activity increased by banks during the crisis, and banks switched from being net buyers to being net sellers. Second, the average wholesale funding dependence of sellers exceeded the buyers' average by 2.5 percentage points. This difference increases to 4.7 percentage points for amendment-free trades. When we consider the second sample of banks entering and exiting the same syndicate, the difference has a similar magnitude, although the statistical significance drops below conventional levels. When we examine the 2008 peak, this contrast becomes particularly stark. In this year, we find that the wholesale funding difference between sellers and buyers increases to somewhere between 8 and 9 percentage points, depending on the sample used, and remains highly statistically

significant when we consider amendment-free as well as matched bank-to-bank trades.

We repeat the same tests for the pre-crisis period and find suggestive evidence that banks buying loan shares had more wholesale funding. For instance, if we simply look at all transactions (4,363 sales and 5,556 buys) and compare the average wholesale funding of loan sellers (34.9% of assets) versus loan buyers (37.2% of assets), we find a difference of roughly 2.3 percentage points, significant at the 1% confidence level. When we restrict the sample to amendment-free trades only, the number of transactions reduces by a factor of four, but the same pattern emerges. For matched trades, this relation disappears; however, the number of transactions is small. Overall, this suggests that in the benign period before the crisis, wholesale-funded banks were actively adding loan shares to their portfolios through secondary transactions. This mirrors the findings in Column [8] of Table 2, where these banks were less likely to sell loan shares before the crisis.[21]

In Panel B of Table 9, we extend this analysis to the relationship between bank capital and buying activity. Consistent with the evidence on capital and loan sales, we find evidence that banks purchasing loan shares during the crisis were more well-capitalized than sellers. These differences are pronounced during 2008. Prior to the crisis, we find some evidence that buyers have more equity capital than sellers, although the differences are less economically meaningful.[22]

Taken together, these results show that banks reliant on wholesale funding switched from being net buyers before the crisis to being net sellers of loan shares during the crisis. Indeed, banks with relatively low wholesale funding were active buyers during the crisis, corroborating Acharya, Gromb, and Yorulmazer (2012), who argue that the asset sales market is a mechanism through which banks with surplus liquidity make transfers to funding constrained banks. The reverse is true for the benign period before the crisis, where wholesale funding appears to support lending activity.

[21] In Panel A of Appendix IA.VI, we show a similar relation between wholesale funding dependence and net buying and selling activity. A bank is defined to be a net buyer if overall it purchases more loans in the secondary market than it sells (in dollar terms) and a net seller otherwise.

[22] In untabulated results, we further extend this analysis to examine the role of syndicate membership of loan buyers and find the agent bank is more likely to purchase loan shares from exiting banks than other syndicate participants.

3.3 How do banks adjust their balance sheets?

A natural question that arises from the analysis thus far is how banks rebalance their portfolio in response to liquidity pressures. While banks with greater wholesale funding reduce exposure to syndicated loans via secondary market sales, it is important to understand whether this coincides with lower credit supply and if these banks hoard liquidity freed up from these sales.

To investigate this issue, we shift our unit of analysis to the bank level and examine adjustments in total assets and portfolio allocation during the crisis. Separating borrower-related from supply-side effects is challenging in this setting, and so, in Table 10, we provide simple descriptive statistics on bank portfolio adjustments during the crisis. We sort banks into two groups depending on whether they have above- or below-median wholesale funding dependence at the onset of the crisis. We then measure the growth rate in the various balance sheet items over the course of the crisis. To provide a benchmark, we also examine adjustments in the period before the crisis.[23]

As the table shows, before the crisis, comparing the growth in assets, banks with above-median wholesale funding dependence expanded their balance sheets at a faster pace than banks with below-median dependence. In terms of composition, we see that above-median banks expanded credit supply and liquid assets at a faster pace. During the crisis, we see that wholesale funding collapsed for above-median dependence banks. During this period, while both sets of banks exhibit slower asset growth and shift the composition of their assets away from credit supply—including C&I and syndicated loans—and toward liquid assets and cash, these effects are more pronounced for banks with above-median wholesale funding dependence.[24]

[23] In Panel B of Appendix IA.VI, we provide analogous statistics on bank portfolio adjustments among banks that were net sellers and net buyers during the crisis and find similar results.

[24] In Appendix IA.I, we estimate the sales activity of other loan types to better understand the relative contribution of syndicated loan sales to banks' liquid assets holdings. The FR Y-9C data gives information on the outstanding balance of loans sold and securitized where the selling bank retains servicing rights or provides full recourse or some credit enhancement to the asset. Importantly, given these sales data are in stocks rather than flows, events such as the acquisition by Bank of America of Countrywide Financial and Citigroup bringing asset-backed commercial paper conduits back on balance sheet during the crisis (Acharya, Schnabl, and Suarez 2013) mechanically increase these sales without reflecting cash-generation—we exclude these two data points for this reason. With these measurement issues in mind, the aggregate trends suggest that securitized residential mortgages increased by $80 billion, whereas the stock of all other sold loan types remained flat during the 2007 to 2008 timeframe for which syndicated loan sales matter for liquidity management (see Table 5). This is consistent with the collapse of asset-backed securities issuance during the crisis documented by Adrian and Shin (2010b) and suggests that syndicated loan sales—about $125 billion in 2007 and 2008 (see Figure 2)—are on the same order of magnitude as the combined sales of these other loan types. These syndicated loan sales therefore likely made an important contribution to the liquid asset holdings

These findings suggest that those banks with a greater reliance on wholesale funding slow down asset growth during the crisis. Within the asset portfolio, these banks choose to cut credit supply and instead hoard liquidity. These findings mirror the prior literature (notably, Acharya and Mora 2015; Cornett, McNutt, Strahan, and Tehranian 2011), which finds similar credit supply and liquidity hoarding effects among the full sample of U.S. bank holding companies.

3.4 Price impact of loan sales by liquidity-strained banks

Having connected loan sales during the crisis to the funding liquidity pressures of banks, we next investigate an important implication of these sales: their impact on market prices. Prior literature focuses on how liquidity shortfalls in the aggregate may force banks to pay off maturing debt through asset sales even when, due to shortages of potential buyers in a crisis, transaction prices may occur well below fundamental values.[25] Given that U.S. bank holding companies hold a significant fraction of the syndicated loan market, syndicated loan sales by stressed banks with heavy exposures to wholesale funding may result in negative spillovers to secondary market prices.

We collect secondary market loan price quotes for syndicated loans from the Loan Syndication and Trading Association (LSTA) Mark-to-Market Pricing data. The unit of observation in these data is a loan facility–quotation date pair. For each observation, we obtain the number of quotes, the average bid quote, and the average ask quote. Based on issuer names, loan origination dates, and other loan characteristics, we hand-match observations in the SNC with the LSTA data at the loan facility level. We further incorporate issuer long-term credit ratings data from Standard and Poor's Compustat, loan secured status from Loan Pricing Corporation's Dealscan, and information on covenant violations kindly provided by Amir Sufi on his website.

The main dependent variable in our empirical analysis is the "peak-through-trough" change in the secondary market loan price. The loan price is measured as the bid-ask midpoint, which we calculate as the midpoint of the average bid quote and the average ask quote. Since the loan pricing data is based off quotes rather than transactions, we are careful to interpret our estimates as changes in the willingness-to-pay for traded loans. We take the peak (trough) price as the daily

of banks in our sample, which stood at approximately $1.4 trillion at the onset of the crisis.

[25] Shleifer and Vishny (2011) survey the literature on fire sales in finance and macroeconomics.

average from January 1, 2007, until June 30, 2007 (July 1, 2008, until December 31, 2008). We choose to end the peak price period immediately before the collapse of the asset-backed commercial paper market in mid-2007. In robustness tests described later, we consider annual and daily price changes.

Our main independent variable is the wholesale funding dependence across all bank syndicate members as of 2006:Q4. We must aggregate wholesale funding to the syndicate level, as secondary market prices are only available at the level of the loan facility. We take the equal-weighted average wholesale funding across all banks in the loan syndicate. We consider two alternatives to this simple approach. First, we examine the median wholesale funding level across syndicate members to alleviate potential concerns regarding outliers. Second, we repeat our tests excluding the agent bank from the aggregation, since the agent bank is unlikely to sell, as discussed in Section 3.1.1.

Figure 5 plots daily secondary market loan prices during the period from 2006 until 2011. In the top panel, we plot the average price across all loans in our sample, and in the bottom panel, we show various quantiles of the distribution based on January 1, 2007, loan prices. The top plot shows that the average price drop is about –35% from January 1, 2007, to December 31, 2008, and rebounds thereafter. Most loans traded close to par before the summer of 2007. The bottom plot indicates that there is heterogeneity in this price drop closely related to the loan price level as of January 1, 2007. Hence, in some of our tests we incorporate this initial loan price level as a measure of loan quality.

In Table 11, we present detailed descriptive statistics for the subsample of 306 loans in SNC matched to the LSTA data. We note that these statistics line up well with Gande and Saunders (2012), who conduct a similar matching exercise, but three notable differences emerge relative to the SNC population. First, these loans have larger syndicates: the median syndicate size of the matched sample is twelve, as compared with eight for the SNC sample. Second, they are held by larger banks. Third, these banks have greater wholesale funding dependence, on average. Thus, traded loans—those loans with prices publicly posted by the LSTA—are larger, more widely held, and therefore more likely to be liquid. Hence, we believe the price impact estimates presented in this section are likely to represent a lower bound. Finally, notice that the average price change is

-15.3%, since we take the difference between the second half of 2008 and the first half of 2007.

We use several multivariate linear regression models to estimate the relation between syndicate-level wholesale funding dependence and the discount at which loans are traded during the crisis. Our baseline model is a cross-sectional regression of the form:

$$\textit{Price Change}_i = \alpha + \beta \ \textit{Wholesale Funding}_{i,2006Q4} + \gamma' \ X_i + \epsilon_i, \tag{5}$$

where $\textit{Price Change}_i$ is the peak-through-trough change in the price of loan i and $\textit{Wholesale Funding}_{i,2006Q4}$ is the equally weighted average wholesale funding exposure of the banks composing the syndicate as of 2006:Q4. A negative coefficient on wholesale funding indicates that loans funded by banks with high liquidity needs are associated with greater price discounts during the crisis.

Since identification of β is coming from between-loan variation, it is important to control for differences in syndicate and loan characteristics—particularly, loan credit quality and liquidity—that might drive loan prices during the crisis. To this end, we incorporate control variables measured at the syndicate level (X_i). We control for bank characteristics (losses, size, capitalization, etc.), which are also measured as of 2006:Q4 and equally weighted across syndicate members.

In all regressions, to control for credit risk, we include issuer ratings fixed effects based on the long-term credit ratings from Compustat (21 dummy variables). We also include the price level as of January 1, 2007, as a catchall for loan quality. While most loans trade at par, there is some variation around this value that may correlate with loan quality. We include a dummy for whether the loan is secured or not, as well as the (log) remaining maturity of the loan to capture effective seniority. To proxy for ex post changes in credit risk, we include three sets of dummies for whether the loan is downgraded by the regulator or credit rating agency (Standard and Poor's), or experiences a covenant violation during any quarter of 2007 or 2008. For loan liquidity, we use the (log) syndicate size, an indicator for whether the loan is securitized, and also the number of quotes provided in the LSTA, following Gande and Saunders (2012). In addition, we control for loan type—in particular, whether a loan is a credit line or term loan, since credit lines tend to be held only by commercial banks and therefore may trade in thinner markets (Gatev and Strahan 2009).

The results of estimating Equation (5) are presented in Table 12. As indicated in Column [1], there is a negative and statistically significant estimated effect of the pre-crisis syndicate wholesale funding dependence on the peak-through-trough loan price change. As we move across the columns, we include blocks of control variables for syndicate and loan characteristics. In each case, the coefficient on wholesale funding is negative and statistically significant at the 1% level. These estimates are economically meaningful: focusing on the point estimate in Column [8], a one-standard-deviation change in wholesale funding (0.069, see Table 11) translates into a -4.01% peak-through-trough price change. Given the average price drop of 15.3%, this indicates that the wholesale funding effect accounts for roughly 26.2% of the average loan price decline.

In Panel A of Table 13, we examine the robustness of these baseline results to alternative measurements of bank characteristics at the syndicate level. In Column [1], we take the median bank characteristic among syndicate members as of 2006:Q4.[26] This alleviates concerns regarding outliers. It also addresses the concern that the wholesale funding of the agent bank is driving the results, which would be counterintuitive and difficult to reconcile with the evidence in Table 2 that agent banks are unlikely to sell. In Column [2], we address this latter concern directly by excluding the agent bank from the measurement of bank characteristics at the syndicate level. In both cases, the effect of wholesale funding dependence on the price discount is largely unchanged.

In Panel B of Table 13, we consider alternative measurements of the dependent variable. In Columns [1] to [3], we simply subtract the average daily price in 2008 from the corresponding value in 2007. The main result holds, although the point estimates become smaller in magnitude. This is unsurprising as the peak-through-trough price change should yield a larger effect, by construction. In Columns [4] to [6], we estimate the model on daily data, with the dependent variable now the daily loan price change. In this specification, we interact the bank characteristics with the daily TED spread and include loan and day fixed effects. The coefficient on *Wholesale Funding* $\times TED_t$ therefore captures how loan prices respond to day-to-day variation in funding conditions between syndicates differing in their wholesale funding dependence. The daily specification is particularly powerful, as the inclusion of loan fixed effects absorbs any time-invariant differences in loan quality.

[26] The median value of 2006:Q4 net charge-offs is zero in every syndicate, and therefore the coefficient is not identified in Column [1].

This could matter if syndicates reliant on wholesale funding match with borrowers or write looser loan contracts along dimensions that we cannot measure. In both cases, we continue to find a negative and significant relation between syndicate-level wholesale funding at the onset of the crisis and the loan price change during the crisis.

Overall, the impact of banks' wholesale funding dependence on price decreases is consistent with selling pressure being exerted on loans by banks experiencing difficulties rolling over debt in illiquid capital markets. These findings provide the final connection between bank liability structure, secondary market trading, and the market prices of corporate loans. Combined with our results on loan sales, it suggests that banks had negative effects on the secondary market prices of the sold assets in a way that was closely related to the fragility of their funding.

4 Concluding Remarks and Policy Implications

We provide new evidence on the determinants of trading activity by U.S. bank holding companies in the secondary loan market. We exploit a U.S. credit register of syndicated loans to track the dynamics of loan syndicates after origination. This allows us to identify loan sales, as well as control for shifts in loan quality using a loan-year fixed effects approach. Our paper shows that banks with a greater reliance on wholesale funding attempt to smooth out funding disruptions via loan sales and that this trading activity has a negative spillover to secondary market prices.

Our results may have important implications for the design and implementation of liquidity regulation under the new Basel III framework. The Basel Committee has finalized the liquidity coverage ratio (LCR), which requires banks to hold a liquidity buffer of unencumbered "high-quality liquid assets" to meet net cash outflows over a 30-day horizon in a liquidity stress scenario.[27] The rationale behind the LCR is that liquidity-strained banks will voluntarily sell off their liquidity buffers rather than fire-selling other less liquid assets. Less progress has been made on the net stable funding ratio, which will require that banks achieve a more resilient funding profile.

These liquidity requirements may impose a tax on liquidity provision (e.g., Stein 2013). It is

[27] These objects are defined in a revised final version of the LCR that was released on January 6, 2013, by the Basel Committee on Banking Supervision; see `www.bis.org/publ/bcbs238.pdf`. The U.S. rule is to be fully implemented by the calendar year 2017; see `www.federalreserve.gov/newsevents/press/bcreg/20140903a.htm`.

therefore important to understand how these regulations should be designed to trade off efficiency losses against improvements to financial stability. Our results speak to the potential benefits of liquidity regulation. In particular, we find that banks with adequate liquidity (i.e., stable, long-term funding or holdings of liquid assets for a given level of wholesale funding) were less likely to sell loan shares during the crisis. Moreover, we examine the price impact of these trading activities explicitly and show that liquidity-strained banks were selling loans at discounts, as compared with loans held by banks with more stable funding. While we find some evidence that banks with adequate liquidity, well-capitalized banks, and nonbanks were able to step in, our evidence is broadly consistent with fire sales. Taken together, our evidence suggests that liquidity regulation that either reduces exposure to non-core funding or requires liquid asset holdings may have the benefit of limiting destructive fire sales during bad times. We caution, however, that our results do not say anything about the overall effect of liquidity regulation on welfare and efficiency, since this would require a greater understanding of the costs of these policies.

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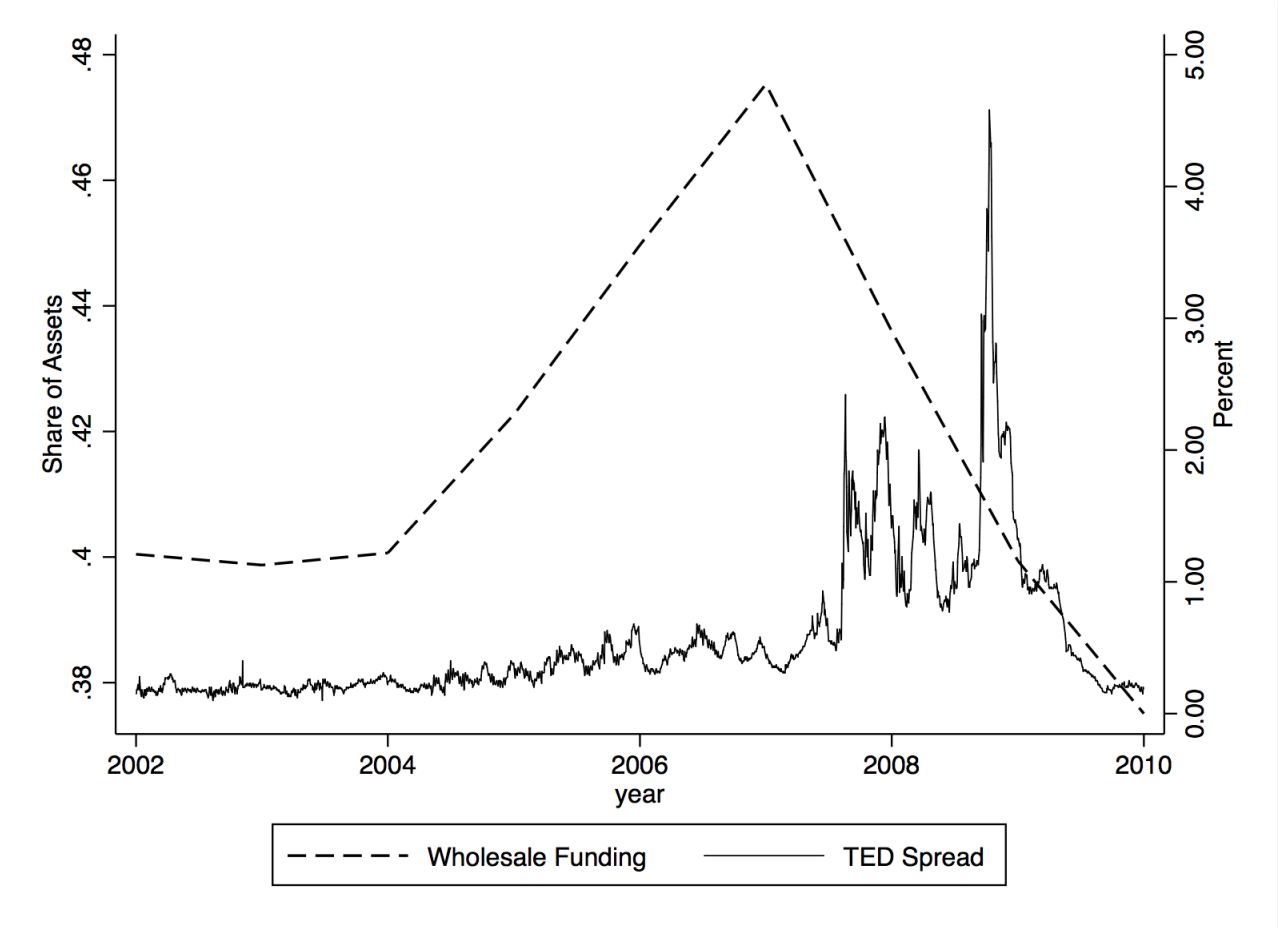


Figure 1
Wholesale funding of U.S. BHCs and TED spread (annual, 2002–2010)
The left y-axis corresponds to U.S. bank holding companies' wholesale funding (annual, as a fraction of assets, size-weighted average) and the right y-axis corresponds to the TED spread (daily, percent) for the period from 2002 until 2010. The TED spread is defined as the daily difference between the three-month London Interbank Offered Rate (LIBOR) and the three-month Treasury bill rate. Wholesale funding is the sum of large time deposits, foreign deposits, repo sold, other borrowed money, subordinated debt, and federal funds purchased divided by total assets.

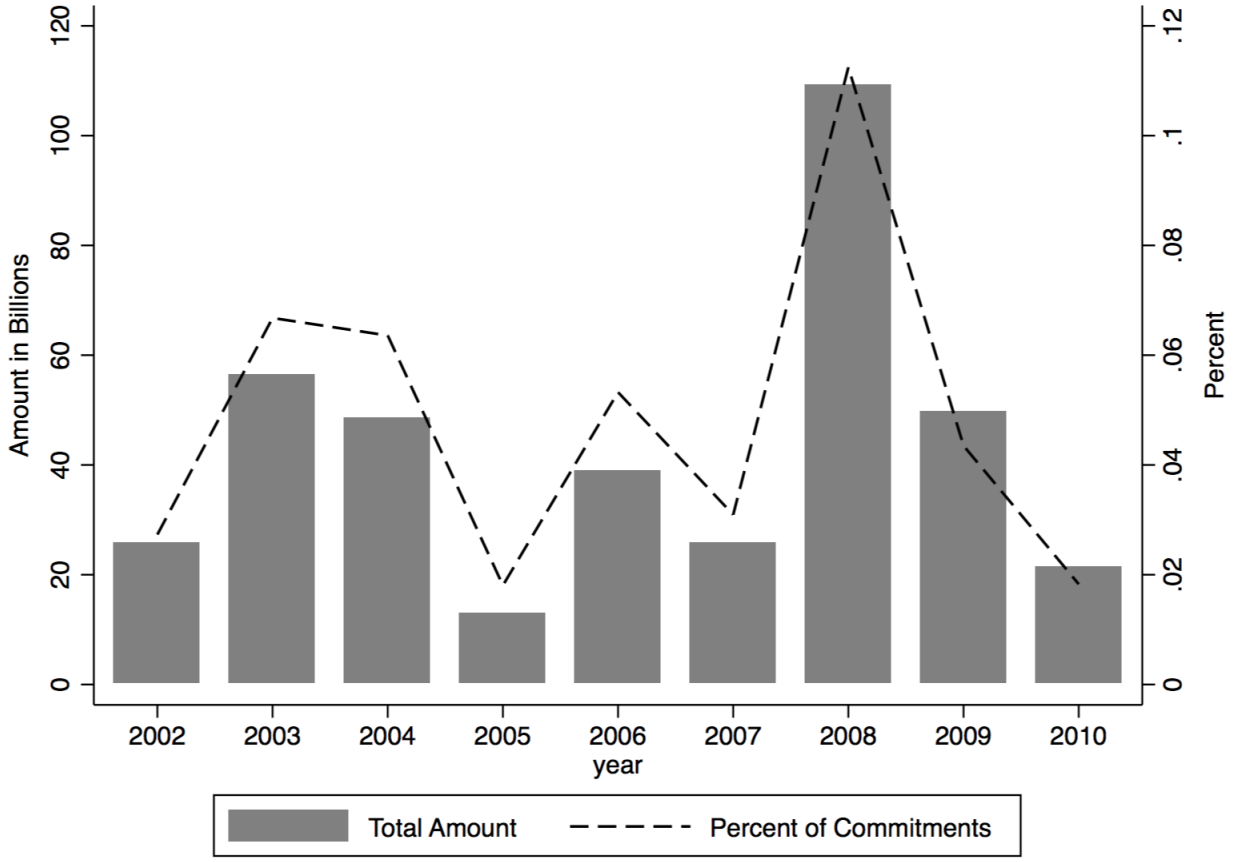
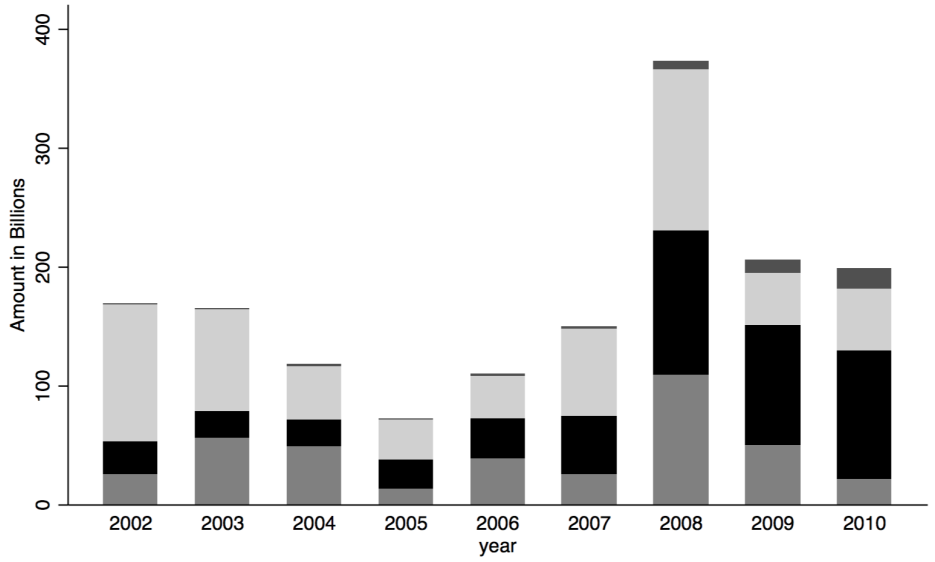
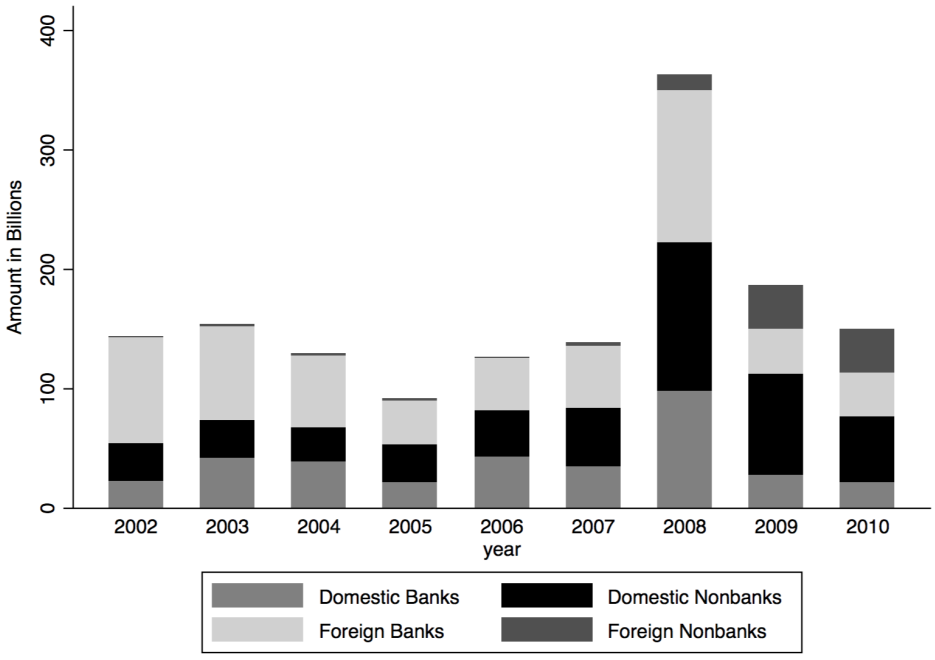


Figure 2
Secondary market loan share sales by U.S. BHCs (annual, 2002–2010)
Total value in billions of dollars (left axis) and share of lagged outstanding commitments (right axis) of shares of syndicated loan commitments (including term loans and drawn and undrawn lines of credit) registered with the Shared National Credit Program that were sold in the secondary market by U.S. bank holding companies (BHCs) during the period from 2002 until 2010. A loan share is a fraction of a syndicated loan commitment. A loan share sale occurs when a U.S. bank holding company ceases to own a loan share relative to the previous year.



(a) Secondary loan sales



(b) Secondary loan buys

Figure 3
Secondary market loan share buys and sells by all institutions (annual, 2002–2010)
Total value in billions of dollars of syndicated loan commitments (including term loans and drawn and undrawn lines of credit) registered with the Shared National Credit Program that were sold (top panel) and purchased (bottom panel) in the secondary market during the period from 2002 until 2010. A loan share is a fraction of a syndicated loan commitment. A loan share sale occurs when a financial institution ceases to own a loan share relative to the previous year. A buy occurs when a financial institution owns a loan share that it did not in the previous year.

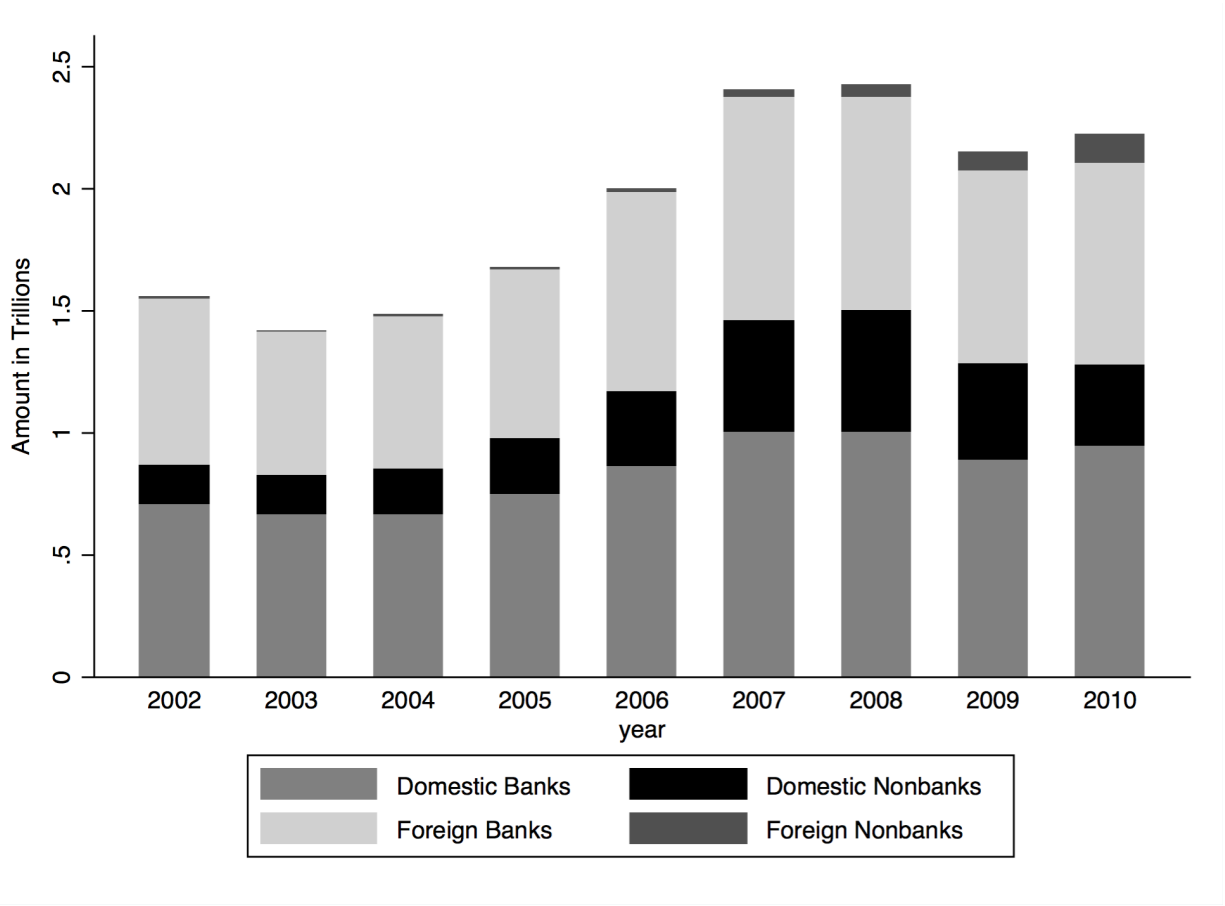
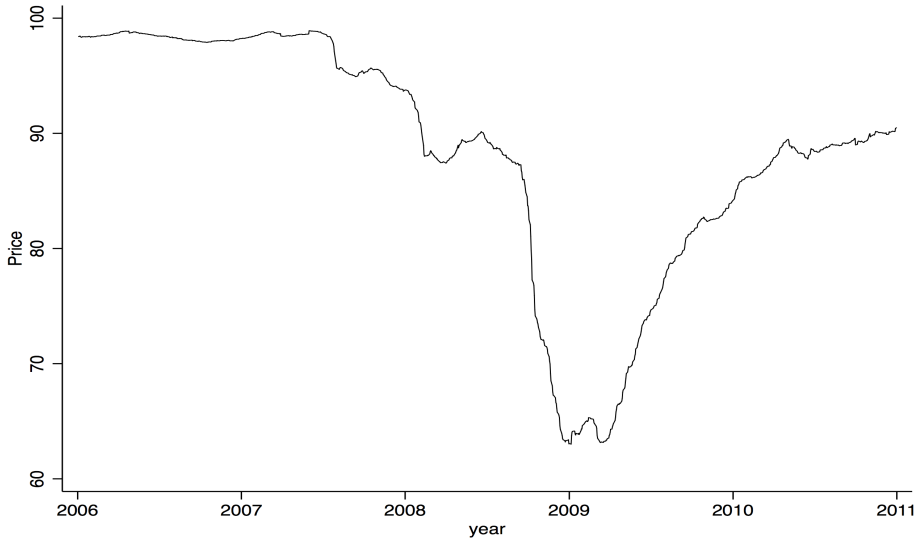
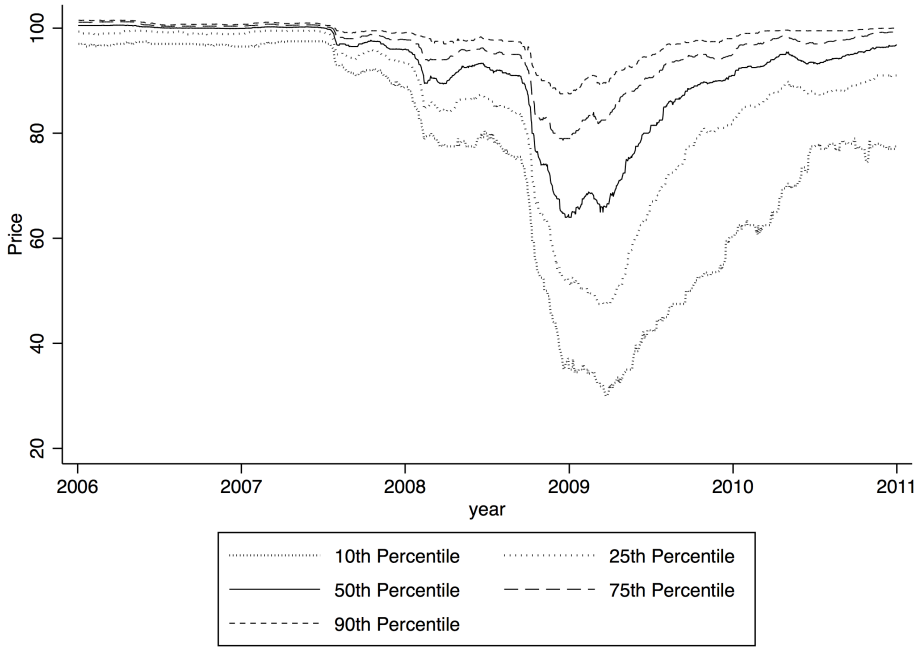


Figure 4
Stock of outstanding syndicated loans by investor type (annual, 2002–2010)
Total value in trillions of dollars of syndicated loan commitments (including term loans and drawn and undrawn lines of credit) registered with the Shared National Credit Program during the period from 2002 until 2010.



(a) Average price



(b) Quantiles

Figure 5
Secondary loan market prices (daily, 2006–2011)
Prices of shares of syndicated loan commitments (including term loans and drawn and undrawn lines of credit) trading in the U.S. loan secondary market from 2006 until 2011. The price (as a fraction of face value) is based on the daily bid-ask midpoint of price quotes averaged across dealers. Loans are sorted into quantiles as of January 1, 2007. The data are from the Loan Syndications and Trading Association (LSTA) and Loan Pricing Corporation (LPC) mark-to-market pricing service for the subset of loans matched with the Shared National Credit Program.

Table 1
Shared national credit program summary statistics

	N	Mean	Std.	p25	Med.	p75	N	Mean	Std.	p25	Med.	p75
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
Panel A: Summary statistics for 2002–2010 by time period												
	Before crisis (2003–2006)						During crisis (2007–2010)					
Loan-level variables												
Loan Sale	67,647	0.066	0.249	0	0	0	81,011	0.095	0.294	0	0	0
Agent Dummy	67,647	0.186	0.390	0	0	0	81,011	0.169	0.375	0	0	0
Loan Fraction Held	67,647	0.131	0.108	0.005	0.100	0.182	81,011	0.114	0.108	0.034	0.083	0.160
Loan Size	67,647	280.9	319.7	64.00	160.0	390.3	81,011	369.3	457.3	85.00	217.1	500.0
Bank-level variables												
Wholesale Funding$_{200XQ4}$	322	0.256	0.115	0.174	0.238	0.317	349	0.277	0.121	0.198	0.261	0.328
Liquid Assets$_{200XQ4}$	322	0.190	0.104	0.113	0.171	0.248	349	0.167	0.104	0.094	0.143	0.205
NPL Ratio	1,209	0.007	0.008	0.003	0.005	0.009	1,067	0.029	0.023	0.010	0.022	0.042
Net Charge-Offs	1,209	0.003	0.044	0.000	0.000	0.000	1,067	0.011	0.141	0.000	0.000	0.000
Real Estate Loan Share	1,209	0.672	0.154	0.585	0.704	0.789	1,067	0.700	0.147	0.622	0.741	0.813
Capital Ratio	1,209	0.088	0.023	0.072	0.085	0.099	1,067	0.090	0.027	0.071	0.088	0.105
Bank Size	1,209	14.87	1.567	13.53	13.40	15.67	1,067	15.07	1.553	13.92	14.66	15.82
Large Bank	1,209	0.062	0.241	0	0	0	1,067	0.070	0.256	0	0	0
TARP/Assets	-	-	-	-	-	-	1,067	0.003	0.008	0	0	0
MVE/Assets	373	0.196	0.056	0.160	0.196	0.241	384	0.105	0.059	0.069	0.099	0.143
Tier 1 Capital/RWA	1,209	11.41	2.693	9.560	10.88	12.61	1,067	11.44	2.927	9.470	11.04	13.08
MBS+ABS/Assets	1,209	0.094	0.080	0.025	0.081	0.144	1,067	0.049	0.068	0	0.002	0.090
Criticized Ratio	1,149	0.040	0.150	0	0	0.009	1,024	0.232	0.322	0	0.090	0.314
Panel B: Summary statistics for 2007–2010 by wholesale funding dependence												
	Below-median dependence						Above-median dependence					
Loan-level variables												
Loan Sale	39,985	0.093	0.291	0	0	0	36,636	0.092	0.288	0	0	0
Agent Dummy	39,985	0.113	0.317	0	0	0	36,636	0.244	0.430	0	0	0
Loan Fraction Held	39,985	0.116	0.119	0.032	0.080	0.163	36,636	0.115	0.114	0.029	0.085	0.163
Loan Size	39,985	381.2	539.1	79.25	200.0	500.0	36,636	412.5	510.0	100.0	250.0	550.0
Bank-level variables (2006:Q4)												
Wholesale Funding	174	0.188	0.050	0.150	0.198	0.230	175	0.365	0.106	0.292	0.329	0.400
Liquid Assets	174	0.187	0.097	0.121	0.166	0.240	175	0.147	0.097	0.078	0.118	0.179
NPL Ratio	174	0.007	0.007	0.002	0.005	0.008	175	0.007	0.007	0.003	0.005	0.009
Net Charge-Offs	174	0.006	0.056	0.000	0.000	0.000	175	0.001	0.013	0.000	0.000	0.000
Real Estate Loan Share	174	0.682	0.147	0.614	0.709	0.787	175	0.714	0.143	0.653	0.759	0.820
Capital Ratio	174	0.093	0.027	0.075	0.090	0.106	175	0.085	0.023	0.071	0.081	0.095
Bank Size	174	14.50	1.067	13.60	14.27	15.00	175	15.15	1.733	13.86	14.58	16.07
Large Bank	174	0.017	0.131	0	0	0	175	0.097	0.297	0	0	0
TARP/Assets	133	0.005	0.010	0	0	0	145	0.008	0.011	0	0	0.020
MVE/Assets	75	0.162	0.263	0.007	0.111	0.294	49	0.167	0.240	0.004	0.140	0.262
Tier 1 Capital/RWA	174	11.81	2.654	9.870	11.16	12.98	175	10.82	2.572	9.200	10.08	11.70
MBS+ABS/Assets	174	0.068	0.064	0.011	0.054	0.109	175	0.094	0.069	0.047	0.087	0.127
Criticized Ratio	173	0.048	0.150	0	0	0.019	169	0.054	0.175	0	0	0

Panel A summarizes the data for the 2003–2006 "before-crisis" and the 2007–2010 "during-crisis" periods. The sample is restricted to loans held by at least two U.S. bank holding companies with valid covariates at the beginning of the year. There are 9,627 (9,599) loans funded by 322 (349) banks in the 2003–2006 (2007–2010) period. Loan-level variables are averaged (unweighted) across loan share–years. Bank-level variables are averaged across bank–years in each period, with the exception of *Net Charge-Offs* which is measured beginning 2003:Q4 in the before-crisis period. *Net Charge-Offs* is multiplied by 1,000 for readability. Bank variables denoted with the "200XQ4" subscript are measured as of the fourth quarter of 2002 (2006) in the before- (during-) crisis periods. Panel B provides summary statistics for the 2007–2010 event window split by above- and below-median wholesale funding dependence measured as of 2006:Q4, with the exception of *TARP/Assets* which is measured as of 2008:Q4. All variables are defined in Appendix A.

Table 2
Loan sales and bank liquidity management: Main results

Dependent variable: *Loan Sale*$_t$	2007–2010							2003–2006
	Baseline Model	Exclude FIRE	No Amend	2006Q4 Controls	Ranked Dependence	Sale ≥1%	Partial Sales	Baseline Model
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Wholesale Funding$_{2006Q4}$	0.076***	0.074***	0.066***	0.065***		0.066***	0.089***	–0.012***
	(0.015)	(0.016)	(0.017)	(0.0175)		(0.015)	(0.016)	(0.002)
High Exposure$_{2006Q4}$					0.012**			
					(0.006)			
Medium Exposure$_{2006Q4}$					0.005			
					(0.004)			
Net Charge-Offs$_{t-1}$	23.64***	22.93***	5.135*	–15.90	20.89***	22.27***	20.74***	
	(3.440)	(3.561)	(3.059)	(14.52)	(3.459)	(3.494)	(3.638)	
NPL Ratio$_{t-1}$	0.317*	0.302*	0.362**	0.310	0.290*	0.234	0.494***	0.127
	(0.167)	(0.177)	(0.165)	(0.333)	(0.170)	(0.154)	(0.176)	(0.314)
Real Estate Loan Share$_{t-1}$	–0.031*	–0.030*	–0.057***	–0.004	–0.048***	–0.025*	–0.038**	–0.023
	(0.016)	(0.017)	(0.018)	(0.015)	(0.016)	(0.014)	(0.017)	(0.014)
Capital Ratio$_{t-1}$	0.172	0.120	0.115	0.210	0.036	0.010	0.115	–1.071***
	(0.107)	(0.112)	(0.109)	(0.135)	(0.100)	(0.097)	(0.111)	(0.154)
Bank Size$_{t-1}$	0.004**	0.004**	0.001	0.003**	0.004**	0.001	0.003*	–0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Large Bank$_{t-1}$	–0.065***	–0.066***	–0.042***	–0.045***	–0.066***	–0.062***	–0.065***	–0.001
	(0.007)	(0.008)	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)
Bank Merger$_t$	–0.021**	–0.020**	–0.012	–0.019**	–0.024**	–0.005	–0.018*	–0.0155
	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.008)	(0.010)	(0.010)
Bank Merger$_{t-1}$	0.145***	0.143***	0.047***	0.178***	0.144***	0.149***	0.132***	0.204***
	(0.014)	(0.014)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)	(0.021)
Agent Bank$_{t-1}$	–0.017***	–0.018***	–0.006**	–0.017***	–0.018***	–0.015***	–0.008**	–0.022***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Loan Fraction Held$_{t-1}$	–0.181***	–0.176***	–0.078***	–0.189***	–0.186***	–0.139***	–0.078***	–0.172***
	(0.022)	(0.023)	(0.018)	(0.022)	(0.022)	(0.021)	(0.026)	(0.026)
Loan-year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
N	76,621	70,031	46,210	76,621	76,621	69,836	76,621	66,267
R^2	0.42	0.42	0.43	0.42	0.42	0.42	0.43	0.36

This table examines the impact of wholesale funding dependence on bank loan sales. The unit of observation in each regression is a loan share–bank–year triple. The dependent variable is an indicator variable equal to one if a lender exits a loan syndicate that it was present in during the previous year. *Wholesale Funding* is measured as of 2006:Q4. Column [1] includes the sample of loans from 2007 to 2010. Column [2] excludes loans made to finance, insurance, and real estate sectors. Column [3] restricts the sample to loan-years where no contract amendment or refinancing took place during the year. Column [4] measures control variables as of 2006:Q4. Column [5] uses a ranked measure of wholesale funding dependence: high-, medium-, and low-exposure banks fall into the upper, middle, and lower terciles of the 2006:Q4 wholesale funding distribution. Low-exposure banks are the omitted group. Column [6] conditions on loan sales greater than 1% of the total commitment. Column [7] redefines the loan sale variable to include partial loan sales, which are identified as any reduction in loan share size. Column [8] examines the 2003–2006 before-crisis period measuring *Wholesale Funding* as of 2002:Q4. All columns include controls for loan-year fixed effects. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered at the firm level. ***, **, and * denote 1%, 5%, and 10% statistical significance, respectively.

Table 3
Bank fixed effects models

Dependent variable: *Loan Sale*$_t$							
	2007–2010			2003–2010			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Wholesale Funding$_{t-1}$	0.079***	0.254***					
	(0.015)	(0.054)					
Wholesale Funding$_{2002Q4}$			0.067***	–0.065***		–0.107***	
			(0.017)	(0.013)		(0.016)	
Wholesale Funding$_{2002Q4}$ × *Crisis*$_t$				0.107***	0.076***		
				(0.017)	(0.018)		
Wholesale Funding$_{2002Q4}$ × *TED*$_t$						0.156***	0.115***
						(0.020)	(0.021)
Bank fixed effects	N	Y	N	N	Y	N	Y
Bank controls	Y	Y	Y	Y	Y	Y	Y
Loan controls	Y	Y	Y	Y	Y	Y	Y
Loan-year fixed effects	Y	Y	Y	Y	Y	Y	Y
N	80,416	80,416	71,272	135,941	135,941	135,941	135,941
R^2	0.42	0.44	0.43	0.41	0.43	0.41	0.43

This table examines the impact of wholesale funding dependence on bank loan sales using bank fixed effects models. The unit of observation in each regression is a loan share–bank–year triple. The dependent variable is an indicator variable equal to one if a lender exits a loan syndicate that it was present in during the previous year. Columns [1] to [3] examine the crisis period using lagged wholesale funding or its value as of 2002:Q4. Columns [4] to [7] consider the sample window from 2003 until 2010. These models use either a crisis indicator variable equal to one for observations in the years 2007 until 2010 or the TED spread as a continuous measure of stress in wholesale funding markets. The TED spread is defined as the yearly average of the daily difference between the three-month London Interbank Offered Rate (LIBOR) and the three-month U.S. Treasury rate. All columns include controls for loan-year fixed effects, bank controls, and loan controls. Bank controls comprise net charge-offs, NPL ratio, real estate loan share, capital ratio, bank size, a large bank indicator, and bank merger controls. Loan controls comprise an agent bank indicator and loan fraction held. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered at the firm level. ***, **, and * denote 1%, 5%, and 10% statistical significance, respectively.

Table 4
Further evidence on the bank liquidity management channel

Dependent variable: *Loan Sale*$_t$				
	[1]	[2]	[3]	[4]
Wholesale Funding$_{2006Q4}$	0.076***	0.101***	0.158***	
	(0.015)	(0.021)	(0.033)	
Liquid Assets$_{2006Q4}$		–0.053**	0.042	
		(0.023)	(0.062)	
Wholesale Funding$_{2006Q4}$ × *Liquid Assets*$_{2006Q4}$			–0.217*	
			(0.112)	
Wholesale Funding$_{2006Q4}$ × *Long-Term Funding*				–0.024
				(0.020)
Wholesale Funding$_{2006Q4}$ × *Short-Term Funding*				0.085***
				(0.011)
Bank controls	Y	Y	Y	Y
Loan controls	Y	Y	Y	Y
Loan-year fixed effects	Y	Y	Y	Y
N	76,621	76,621	76,621	76,621
R^2	0.42	0.42	0.42	0.42

This table examines how the extent of funding constraints affects the impact of wholesale funding dependence on loan sales during 2007–2010. The unit of observation in each regression is a loan share–bank–year triple. The dependent variable is an indicator variable equal to one if a lender exits a loan syndicate that it was present in during the previous year. Wholesale funding dependence is measured as of 2006:Q4. Columns [1] to [3] include bank liquid assets in the regression model. *Liquid Assets* is the ratio of cash and short-term investments to total bank assets measured as of 2006:Q4. Column [4] classifies banks as "Long-Term Funding" and "Short-Term Funding" wholesale funding dependent. *Short-Term Funding* is an indicator equal to one if a bank has above-median short-term wholesale funding dependence as of 2006:Q4. Short-term funding components include repos sold and federal funds purchased plus the following instruments with maturity of one year or less: time deposits of $100m, brokered deposits of less than $100m, other borrowed money, and time deposits held in foreign offices. All columns include controls for loan-year fixed effects, bank controls, and loan controls. Bank controls comprise net charge-offs, NPL ratio, real estate loan share, capital ratio, bank size, a large bank indicator, and bank merger controls. Loan controls comprise an agent bank indicator and loan fraction held. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered at the firm level. ***, **, and * denote 1%, 5%, and 10% statistical significance, respectively.

Table 5
Dynamics of loan sales

Dependent variable: *Loan Sale*$_t$				
	2007	2008	2009	2010
	[1]	[2]	[3]	[4]
Wholesale Funding$_{2006Q4}$	0.081**	0.299***	0.047	0.056
	(0.038)	(0.039)	(0.035)	(0.040)
Bank controls	Y	Y	Y	Y
Loan controls	Y	Y	Y	Y
Loan-year fixed effects	Y	Y	Y	Y
N	19,856	16,895	23,051	16,819
# loans	4,893	4,558	5,634	3,790
R^2	0.38	0.42	0.42	0.45

This table examines the impact of wholesale funding dependence on loan sales on a year-by-year basis during 2007–2010. The unit of observation in each regression is a loan share–bank–year triple. The dependent variable is an indicator variable equal to one if a lender exits a loan syndicate that it was present in during the previous year. *Wholesale Funding* is measured as of 2006:Q4. Columns [1] to [4] separate the sample and use different event windows. All columns include controls for loan-year fixed effects, bank controls, and loan controls. Bank controls comprise net charge-offs, NPL ratio, real estate loan share, capital ratio, liquid assets, bank size, a large bank indicator, and bank merger controls. Loan controls comprise an agent bank indicator and loan fraction held. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered at the firm level. ***, **, and * denote 1%, 5%, and 10% statistical significance, respectively.

Table 6
Impact of loan liquidity on loan sales

Dependent variable: *Loan Sale*$_t$						
	Borrower Size		Securitized		Syndicate Size	
	Small	Large	No	Yes	Small	Large
	[1]	[2]	[3]	[4]	[5]	[6]
Wholesale Funding$_{2006Q4}$	0.053	0.076***	0.045***	0.105**	0.056***	0.078***
	(0.041)	(0.019)	(0.013)	(0.042)	(0.022)	(0.016)
Bank controls	Y	Y	Y	Y	Y	Y
Loan controls	Y	Y	Y	Y	Y	Y
Loan-year fixed effects	Y	Y	Y	Y	Y	Y
N	12,009	30,285	63,145	13,476	29,311	47,310
R^2	0.50	0.36	0.36	0.36	0.49	0.39

This table examines the impact of wholesale funding dependence on loan sales sorted by loan liquidity during 2007–2010. The unit of observation in each regression is a loan share–bank–year triple. The dependent variable is an indicator variable equal to one if a lender exits a loan syndicate that it was present in during the previous year. *Wholesale Funding* is measured as of 2006:Q4. Columns [1] and [2] define borrowers as small (large) if they take out a loan in the bottom (top) 25th percentile of the loan size distribution. Columns [3] and [4] define a loan as securitized if we identify a syndicate participant as a collateralized loan obligation and not securitized otherwise. Columns [5] and [6] define a loan as having a large syndicate if the number of syndicate members is above the median (eight) and small otherwise. All columns include controls for loan-year fixed effects, bank controls, and loan controls. Bank controls comprise net charge-offs, NPL ratio, real estate loan share, capital ratio, bank size, a large bank indicator, and bank merger controls. Loan controls comprise an agent bank indicator and loan fraction held. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered at the firm level. ***, **, and * denote 1%, 5%, and 10% statistical significance, respectively.

Table 7
Interaction of liquidity management and loan performance

Dependent variable: *Loan Sale*$_t$				
	Regulatory Rating		Covenant Compliance	
	Pass	Fail	Pass	Fail
	[1]	[2]	[3]	[4]
Wholesale Funding$_{2006Q4}$	0.077***	0.078*	0.076***	0.094
	(0.014)	(0.037)	(0.016)	(0.102)
Bank controls	Y	Y	Y	Y
Loan controls	Y	Y	Y	Y
Loan-year fixed effects	Y	Y	Y	Y
N	59,288	14,679	74,144	2,477
R^2	0.38	0.45	0.42	0.47

This table examines the impact of wholesale funding dependence bank loan sales during the crisis period by measures of contemporaneous loan performance during 2007–2010. The unit of observation in each regression is a loan share–bank–year triple. The dependent variable is an indicator variable equal to one if a lender exits a loan syndicate that it was present in during the previous year. Columns [1] and [2] classify a loan as "Pass" by the examining agency if it has not been criticized in any way and "Fail" otherwise (i.e., the loan is rated special mention, substandard, doubtful, or loss). Columns [3] and [4] categorize observations depending on whether they are in compliance with covenants or not. All columns include controls for loan-year fixed effects, bank controls, and loan controls. Bank controls comprise net charge-offs, NPL ratio, real estate loan share, capital ratio, bank size, a large bank indicator, and bank merger controls. Loan controls comprise an agent bank indicator and loan fraction held. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered at the firm level. ***, **, and * denote 1%, 5%, and 10% statistical significance, respectively.

Table 8
Interaction of liquidity management and insolvency risk

Panel A: Economic capital and losses

Dependent variable: *Loan Sale*$_t$

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Wholesale Funding$_{2006Q4}$	0.073***	0.074***	0.062***	0.080**	0.080***	0.053***	0.079***	0.058***
	(0.015)	(0.016)	(0.021)	(0.039)	(0.016)	(0.018)	(0.015)	(0.021)
TARP/Assets$_{t-1}$	1.776***	1.839***						
	(0.282)	(0.483)						
MVE/Assets$_{t-1}$			–0.335***	–0.280**				
			(0.062)	(0.111)				
MBS+ABS/Assets$_{t-1}$					0.036	–0.142*		
					(0.035)	(0.077)		
Criticized Ratio$_{t-1}$							0.184***	0.129**
							(0.036)	(0.064)
Wholesale Funding$_{2006Q4}$ ×								
... *TARP/Assets*$_{t-1}$		–0.237						
		(1.521)						
... *MVE/Assets*$_{t-1}$				–0.139				
				(0.250)				
... *MBS+ABS/Assets*$_{t-1}$						0.488***		
						(0.183)		
... *Criticized Ratio*$_{t-1}$								0.199
								(0.164)
Bank controls	Y	Y	Y	Y	Y	Y	Y	Y
Loan controls	Y	Y	Y	Y	Y	Y	Y	Y
Loan-year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
N	76,621	76,621	53,565	53,565	76,621	76,621	76,621	76,621
R^2	0.42	0.42	0.48	0.48	0.42	0.42	0.42	0.42

Panel B: Regulatory capital

Dependent variable: *Loan Sale*$_t$

	[1]	[2]	[3]	[4]	[5]	[6]
Wholesale Funding$_{2006Q4}$	0.040**	0.090*	0.078***	0.259***	0.067***	0.193***
	(0.016)	(0.046)	(0.014)	(0.057)	(0.014)	(0.070)
Tier 1 Capital/Assets$_{t-1}$	–0.006***	–0.004				
	(0.002)	(0.002)				
Tier 1 Capital/RWA$_{t-1}$			–0.006***	0.004**		
			(0.001)	(0.003)		
Tier 1 + Tier 2 Capital/RWA$_{t-1}$					–0.001	0.003
					(0.001)	(0.002)
Wholesale Funding$_{2006Q4}$ ×						
... *Tier 1 Capital/Assets*$_{t-1}$		–0.007				
		(0.006)				
... *Tier 1 Capital/RWA*$_{t-1}$				–0.017***		
				(0.005)		
... *Tier 1 + Tier 2 Capital/RWA*$_{t-1}$						–0.009*
						(0.005)
Bank controls	Y	Y	Y	Y	Y	Y
Loan controls	Y	Y	Y	Y	Y	Y
Loan-year fixed effects	Y	Y	Y	Y	Y	Y
N	76,621	76,621	53,565	53,565	76,621	76,621
R^2	0.42	0.42	0.42	0.42	0.42	0.42

This table examines the interaction of wholesale funding dependence and bank fundamentals on loan sales during 2007–2010. Panel A examines the relation between loan sales, bank wholesale funding, and measures of economic capital and losses. Panel B considers measures of bank regulatory capital. The unit of observation in each regression is a loan share–bank–year triple. The dependent variable is an indicator variable equal to one if a lender exits a loan syndicate that it was present in during the previous year. *Wholesale Funding* is measured as of 2006:Q4. Bank controls comprise net charge-offs, NPL ratio, real estate loan share, capital ratio, bank size, a large bank indicator, and bank merger controls. Loan controls comprise an agent bank indicator and loan fraction held. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered at the firm level. ***, **, and * denote 1%, 5%, and 10% statistical significance, respectively.

Table 9
Analysis of loan share buys

Panel A: Wholesale funding dependence						
	Unmatched bank trades			Matched bank-to-bank trades		
	Sellers	Buyers	Diff. [t-value]	Sellers	Buyers	Diff. [t-value]
	[1]	[2]	[3]	[4]	[5]	[6]
2007–2010 crisis period						
Sample: All trades						
Wholesale Funding$_{2006Q4}$	0.395	0.369	0.025*** [8.77]	0.343	0.321	0.022 [1.44]
N	7,075	4,337		145	145	
Sample: No amendments						
Wholesale Funding$_{2006Q4}$	0.424	0.378	0.047*** [8.50]	0.348	0.327	0.021 [1.02]
N	2,234	1,219		86	86	
2008 only						
Sample: All trades						
Wholesale Funding$_{2006Q4}$	0.432	0.352	0.079*** [15.36]	0.359	0.277	0.082*** [3.36]
N	1,664	1,272		48	48	
Sample: No amendments						
Wholesale Funding$_{2006Q4}$	0.452	0.360	0.092*** [10.18]	0.374	0.296	0.078** [2.29]
N	703	391		28	28	
2003–2006 before-crisis period						
Sample: All trades						
Wholesale Funding$_{2002Q4}$	0.349	0.372	–0.023*** [-9.04]	0.354	0.340	0.014 [1.35]
N	4,363	5,556		255	255	
Sample: No amendments						
Wholesale Funding$_{2002Q4}$	0.359	0.399	–0.041*** [-7.33]	0.348	0.340	0.009 [0.63]
N	1,056	1,150		143	143	

Panel B: Measures of bank capital							
		Capital Ratio			*Tier 1 Capital/RWA*		
		Sellers	Buyers	Diff. [t-value]	Sellers	Buyers	Diff. [t-value]
		[1]	[2]	[3]	[4]	[5]	[6]
2007–2010 crisis period							
Sample: All trades							
Bank Capital$_{2006Q4}$		0.091	0.096	–0.005*** [-11.61]	0.092	0.093	–0.002*** [-5.18]
	N	7,075	4,337		7,075	4,337	
Sample: No amendments							
Bank Capital$_{2006Q4}$		0.088	0.096	–0.008*** [-10.24]	0.091	0.094	–0.003*** [-5.80]
	N	2,234	1,219		2,234	1,219	
2008 only							
Sample: All trades							
Bank Capital$_{2006Q4}$		0.090	0.097	–0.007*** [-9.18]	0.083	0.097	–0.008*** [-12.43]
	N	1,664	1,272		1,664	1,272	
Sample: No amendments							
Bank Capital$_{2006Q4}$		0.087	0.097	–0.010*** [-7.59]	0.087	0.098	–0.010*** [-9.19]
	N	703	391		703	391	
2003–2006 before-crisis period							
Sample: All trades							
Bank Capital$_{2002Q4}$		0.081	0.080	0.001*** [7.59]	0.087	0.088	–0.001 [-2.75]
	N	4,363	5,556		4,363	5,556	
Sample: No amendments							
Bank Capital$_{2002Q4}$		0.080	0.077	0.002*** [3.40]	0.087	0.087	–0.000 [-0.71]
	N	1,056	1,150		1,056	1,150	

The table reports the average wholesale funding dependence and bank capital of buyers and sellers of loan shares during 2003–2010. Panel A examines the relation between loan transactions and bank wholesale funding. Panel B considers measures of bank economic and regulatory capital for unmatched bank trades. Unmatched bank trades include all buy and sell transactions by banks. Matched bank-to-bank trades restrict the set of transactions to those where, in a given year and syndicate, one bank exits the syndicate and exactly one other bank enters and holds a loan share of the same size. A transaction is classified as a loan share sale whenever a bank that was in the syndicate the previous year is not present this year and similarly for a loan share buy. "No Amendments" excludes transactions in years where the loan contract is amended. Each cell shows the average characteristic of the banks engaged in a loan share transaction as either sellers or buyers. A simple average is taken across loan transactions. The number of loan transactions (N) is indicated. The difference in the mean characteristic for each transaction type is indicated. The t-value from an independent two-sample test with equal variances are shown below in parentheses. ***, **, and * denote 1%, 5%, and 10% statistical significance, respectively.

Table 10
Adjustments in bank portfolio allocation

Wholesale funding dependence:	Below-median					Above-median				
	Mean	Std.	p25	Med.	p75	Mean	Std.	p25	Med.	p75
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Panel A: Adjustments before crisis (2003–2006)										
$\Delta Liquid\ Assets_t/Liquid\ Assets_{t-1}$	0.46	0.61	0.05	0.34	0.66	0.64	1.12	0.10	0.38	0.81
$\Delta Wholesale\ Funding_t/Wholesale\ Funding_{t-1}$	0.34	0.54	0.04	0.20	0.46	0.04	0.24	–0.13	0.02	0.17
$\Delta Cash_t/Cash_{t-1}$	0.33	0.55	–0.07	0.23	0.59	0.50	0.98	–0.03	0.28	0.71
$\Delta Loans_t/Loans_{t-1}$	0.67	0.73	0.35	0.50	0.75	0.87	1.18	0.35	0.61	0.89
$\Delta Credit\ Supply_t/Credit\ Supply_{t-1}$	0.73	0.77	0.38	0.56	0.79	0.92	1.22	0.39	0.67	1.02
$\Delta C\&I\ Loans_t/C\&I\ Loans_{t-1}$	0.57	0.86	0.15	0.35	0.69	0.76	1.36	0.19	0.48	0.90
$\Delta Syndicated\ Loans_t/Syndicated\ Loans_{t-1}$	1.22	1.95	–0.16	0.67	2.07	1.17	1.95	–0.05	0.57	1.87
$\Delta Assets_t/Assets_{t-1}$	0.60	0.60	0.30	0.43	0.68	0.68	0.91	0.25	0.48	0.72
Panel B: Adjustments during crisis (2007–2010)										
$\Delta Liquid\ Assets_t/Liquid\ Assets_{t-1}$	1.07	1.15	0.35	0.75	1.40	1.12	1.10	0.37	0.80	1.61
$\Delta Wholesale\ Funding_t/Wholesale\ Funding_{t-1}$	0.00	0.35	–0.23	–0.03	0.17	–0.24	0.23	–0.41	–0.27	–0.10
$\Delta Cash_t/Cash_{t-1}$	1.51	1.81	0.41	0.97	2.04	1.91	2.37	0.49	1.21	2.51
$\Delta Loans_t/Loans_{t-1}$	0.20	0.33	0.02	0.17	0.35	0.15	0.43	–0.13	0.08	0.30
$\Delta Credit\ Supply_t/Credit\ Supply_{t-1}$	0.14	0.32	0	0.10	0.27	0.07	0.08	–0.19	0.02	0.22
$\Delta C\&I\ Loans_t/C\&I\ Loans_{t-1}$	0.21	0.71	–0.08	0.10	0.34	0.10	0.67	–0.26	–0.01	0.26
$\Delta Syndicated\ Loans_t/Syndicated\ Loans_{t-1}$	0.60	1.85	–0.50	0.13	1.00	0.46	1.60	–0.55	–0.11	0.90
$\Delta Assets_t/Assets_{t-1}$	0.29	0.37	0.08	0.24	0.39	0.21	0.44	–0.03	0.14	0.35

This table reports summary statistics for growth in liquid assets, cash, loans, and credit supply measured once per bank over the period from 2003:Q1 until 2009:Q4. Banks are partitioned according to whether they are below or above median in terms of beginning-of-period wholesale funding dependence. Cash is the sum of non-interest-bearing cash balances and interest-bearing cash balances. *Liquid Assets* is the sum of cash, federal funds sold, repo bought, and securities (excluding mortgage- and asset-backed securities). *Credit Supply* is the sum of loans plus undrawn commitments.

Table 11
Secondary market loan price summary statistics

	N	Mean	Std.	p25	Med.	p75
	[1]	[2]	[3]	[4]	[5]	[6]
Loan-level variables						
Price Change	306	–0.153	0.134	–0.206	–0.111	–0.058
Loan Price Level	306	0.997	0.015	0.995	1.002	1.005
Secured	287	0.965	0.184	1	1	1
Log(Remaining Maturity)	306	1.588	0.282	1.386	1.609	1.792
Non-Pass	306	0.359	0.481	0	0	1
Downgrade	157	0.166	0.373	0	0	0
Upgrade	157	0.096	0.295	0	0	0
Covenant Violation	138	0.101	0.303	0	0	0
Syndicate Size	306	13.24	8.981	8	12	16
Number of Quotes	306	2.702	2.463	1	2	3
CLO	306	0.729	0.445	0	1	1
Bank-level variables (syndicate average)						
Wholesale Funding	306	0.416	0.069	0.371	0.408	0.458
NPL Ratio	306	0.009	0.002	0.007	0.008	0.010
Net Charge-Offs	306	0.006	0.018	0.000	0.000	0.000
Real Estate Loan Share	306	0.512	0.068	0.475	0.512	0.559
Capital Ratio	306	0.086	0.008	0.082	0.087	0.091
Bank Size	306	19.18	1.323	18.28	19.20	20.31
Tier 1 Capital/RWA	306	0.089	0.005	0.086	0.088	0.091
MBS+ABS/Assets	306	0.093	0.016	0.082	0.093	0.102
Bank-level variables (syndicate median)						
Wholesale Funding	306	0.411	0.079	0.368	0.414	0.453
NPL Ratio	306	0.008	0.002	0.070	0.007	0.010
Net Charge-Offs	306	0.000	0.000	0.000	0.000	0.000
Real Estate Loan Share	306	0.521	0.077	0.455	0.559	0.559
Capital Ratio	306	0.089	0.008	0.086	0.092	0.093
Bank Size	306	20.01	1.038	19.02	20.08	21.02
Tier 1 Capital/RWA	306	0.087	0.320	0.086	0.087	0.087
MBS+ABS/Assets	306	0.083	0.020	0.069	0.076	0.092
Bank-level variables (syndicate participant average)						
Wholesale Funding	306	0.410	0.071	0.363	0.398	0.455
NPL Ratio	306	0.008	0.002	0.007	0.008	0.010
Net Charge-Offs	306	0.007	0.020	0.000	0.000	0.000
Real Estate Loan Share	306	0.520	0.073	0.481	0.521	0.566
Capital Ratio	306	0.086	0.009	0.081	0.087	0.092
Bank Size	306	19.06	1.403	18.19	19.12	20.25

This table summarizes the secondary market loan pricing data and corresponding syndicate member characteristics. The unit of observation is a loan. Bank-level variables are measured as of 2006:Q4 and are either the equally weighted average across all banks in the syndicate, the median value among banks within the syndicate, or the equally weighted average across all banks in the syndicate excluding agent banks. *Net Charge-Offs* are multiplied by 1,000 for readability. All variables are defined in Appendix A.

Table 12
Change in secondary market loan price

Dependent variable: *Price Change*								
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Wholesale Funding	–0.551***	–0.887***	–0.901***	–0.993***	–0.743***	–0.636***	–0.611***	–0.581***
	(0.117)	(0.197)	(0.199)	(0.186)	(0.176)	(0.170)	(0.172)	(0.178)
Net Charge-Offs		189.9	270.4	224.2	57.01	–156.0	–400.4	–495.5
		(326.1)	(319.5)	(309.5)	(336.8)	(355.1)	(348.5)	(392.3)
NPL Ratio		7.417	5.829	7.077	6.432	5.847	7.995*	8.432*
		(4.628)	(4.735)	(4.743)	(4.337)	(4.062)	(4.510)	(4.493)
Real Estate Loan Share		–0.366*	–0.394*	–0.366*	–0.331**	–0.374**	–0.475***	–0.460***
		(0.200)	(0.201)	(0.203)	(0.160)	(0.156)	(0.149)	(0.154)
Bank Size		0.011	0.017*	0.016*	0.005	0.003	0.004	0.006
		(0.009)	(0.010)	(0.009)	(0.008)	(0.007)	(0.007)	(0.007)
Capital Ratio		0.525	–0.714		1.010	1.146	1.294	0.882
		(1.193)	(1.625)		(1.194)	(1.169)	(1.164)	(1.291)
MBS+ABS/Assets				–0.338**				
				(0.161)				
Tier 1 Capital/RWA				–0.001				
				(0.004)				
Loan Price Level					2.663**	2.686**	2.166	2.039
					(1.256)	(1.222)	(1.503)	(1.507)
Secured						0.047	0.061*	0.064*
						(0.043)	(0.036)	(0.035)
Log(Remaining Maturity)						–0.088***	–0.094***	–0.089***
						(0.031)	(0.031)	(0.033)
Non-Pass							–0.088***	–0.083***
							(0.020)	(0.020)
Downgrade							–0.043*	–0.042*
							(0.024)	(0.025)
Upgrade							–0.009	–0.015
							(0.028)	(0.029)
Covenant Violation							–0.048	–0.040
							(0.034)	(0.033)
Log(Syndicate Size)								0.001*
								(0.008)
Number of Quotes								–0.018
								(0.021)
CLO								–0.033*
								(0.018)
Loan type fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Issuer rating fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
N	306	306	306	295	306	306	306	306
R^2	0.23	0.26	0.27	0.27	0.33	0.34	0.44	0.45

This table examines the impact of wholesale funding dependence on the change in the secondary market loan price. The unit of observation in each regression is a loan. The dependent variable is the peak-to-trough change in the price level, where the peak (trough) price is time-averaged from January 1, 2007, until June 30, 2007 (July 1, 2008, until December 31, 2008). The price level is measured as the average bid-ask midpoint. Bank-level variables are averaged across all bank syndicate members (equally weighted) as of 2006:Q4. Loan-level variables are measured as of 2006:Q4, except for *Non-Pass*, *Downgrade*, *Upgrade*, and *Covenant Violation*, which are measured over 2007 and 2008. All columns include loan type and issuer long-term credit rating fixed effects. Columns [6] to [8] include dummy variables (coefficients not shown) for observations missing secured or covenant violation data. All variables are defined in Appendix A. Heteroscedasticity-robust standard errors are reported in parentheses. ***, **, and * denote 1%, 5%, and 10% statistical significance, respectively.

Table 13
Change in secondary market loan price: Robustness checks

Panel A: Alternative measurement of bank characteristics		
Dependent variable: *Price Change*		
	Median bank	Exclude agent
	[1]	[2]
Wholesale Funding	–0.459**	–0.778***
	(0.192)	(0.183)
Net Charge-Offs		182.0
		(301.0)
NPL Ratio	3.891	4.611
	(3.430)	(4.142)
Real Estate Loan Share	–0.050	–0.255
	(0.174)	(0.180)
Bank Size	–0.007	0.012
	(0.010)	(0.009)
Capital Ratio	0.070	0.198
	(0.978)	(1.158)
Loan type fixed effects	Y	Y
Issuer rating fixed effects	Y	Y
N	306	306
R^2	0.27	0.25

Panel B: Alternative measurement of price change

Dependent variable:	*Price Change* (Annual)			*Price Change* (Daily)		
	[1]	[2]	[3]	[4]	[5]	[6]
Wholesale Funding	–0.351***	–0.645***	–0.429***			
	(0.091)	(0.202)	(0.134)			
Net Charge Offs		60.91	–36.61			
		(242.8)	(234.5)			
NPL Ratio		1.208	3.126			
		(3.691)	(2.567)			
Real Estate Loan Share		–0.281	–0.342***			
		(0.179)	(0.119)			
Bank Size		0.025**	0.013**			
		(0.009)	(0.006)			
Capital Ratio		–0.853	–0.409			
		(1.266)	(0.890)			
Wholesale Funding × TED_t				–0.350**	–0.937***	–0.908***
				(0.172)	(0.302)	(0.305)
Net Charge-Offs × TED_t					486.4	442.6
					(434.6)	(420.9)
NPL Ratio × TED_t					1.690	2.486
					(4.570)	(4.561)
Real Estate Loan Share × TED_t					–0.535**	–0.497**
					(0.244)	(0.241)
Bank Size × TED_t					0.026**	0.026**
					(0.011)	(0.011)
Capital Ratio × TED_t					–1.080	–1.302
					(1.870)	(1.912)
Loan price level	N	N	Y	N	N	N
Loan quality controls	N	N	Y	N	N	Y
Loan liquidity controls	N	N	Y	N	N	Y
Loan type fixed effects	Y	Y	Y	N	N	N
Issuer rating fixed effects	Y	Y	Y	N	N	N
Day fixed effects	N	N	N	Y	Y	Y
Loan fixed effects	N	N	N	Y	Y	Y
N	254	254	254	100,867	100,867	100,867
R^2	0.18	0.23	0.62	0.04	0.05	0.05

This table conducts various robustness checks on the relation between wholesale funding dependence and the change in the secondary market loan price. Panel A considers alternative measurement of bank characteristics. The dependent variable in each column of this panel is the peak-to-trough change in the price level, where the peak (trough) price is time-averaged from January 1, 2007, until June 30, 2007 (July 1, 2008, until December 31, 2008). The price level is measured as the average bid-ask midpoint. In Columns [1] and [2], bank-level variables are constructed using the median syndicate bank characteristic and excluding the agent bank is excluded from the syndicate average, respectively. Panel B considers alternative measurement of the dependent variable. Columns [1] to [3] examine the annual price change, calculated as the average loan price in 2008 is subtracted from the average loan price in 2007. In Columns [4] to [6], daily price changes are examined. The unit of observation is a loan times day. Bank and loan characteristics are interacted with the TED spread. The TED spread is defined as the daily difference between the three-month London Interbank Offered Rate (LIBOR) and the three-month U.S. Treasury rate. Point estimates in Columns [4] to [6] are multiplied by 100 for readability. Loan quality controls include *Secured* and *Log(Remaining Maturity)*, *Non-Pass*, *Downgrade*, *Upgrade*, and *Covenant Violation*, and Loan liquidity controls include *Log(Syndicate Size)*, *Number of Quotes*, and *CLO*. Bank- and loan-level variables are measured as of 2006:Q4, except for the Loan quality controls, which are measured over 2007 and 2008. Columns [3] and [6] include dummy variables (coefficients not shown) for observations missing secured or covenant violation data. Where indicated, columns include loan type, issuer long-term credit rating, day, and loan fixed effects. All variables are defined in Appendix A. Heteroscedasticity-robust standard errors are shown in parentheses and additionally clustered at the loan level in columns [4] to [6] of Panel B. ***, **, and * denote 1%, 5%, and 10% statistical significance, respectively.

Appendix A: Variable definitions

Variable	Definition	Source
Panel A: Loan-level variables		
Loan Sale	Indicator variable equal to one if bank exits syndicate that it participated in last year that continues to exist in the current year	SNC
Loan Share Decrease	Indicator variable equal to one if bank decreases share of syndicate that it participated in last year that continues to exist in the current year	SNC
Agent Dummy	Indicator variable equal to one if SNC identifies lender as administrative agent	SNC
Loan Fraction Held	Fraction of total loan commitment held by syndicate member	SNC
Loan Size	Dollar value of loan commitment	SNC
Loan Price Level	Bid-ask quote midpoint	LSTA
Secured	Indicator variable equal to one if loan is secured	Dealscan
Log(Remaining Maturity)	Natural logarithm of the number of years until loan matures	Dealscan, SNC
Non-Pass	Indicator variable equal to one if loan is criticized	SNC
Downgrade	Indicator variable equal to one if issuer S&P long-term credit rating is downgraded	Compustat
Upgrade	Indicator variable equal to one if issuer S&P long-term credit rating is upgraded	Compustat
Covenant Violation	Indicator variable equal to one if issuer violates a covenant	Amir Sufi
Syndicate Size	Number of lenders in the syndicate	SNC
Number of Quotes	Indicator variable equal to one if the number of unique institutions providing price quotes for loan is greater than one	LSTA
CLO	Indicator variable equal to one if syndicate contains a collateralized loan obligation (CLO)	SNC
Panel B: Bank-level variables		
Wholesale Funding	Sum of large time deposits, foreign deposits, repo sold, other borrowed money, subordinated debt, and federal funds purchased divided by total assets	Y-9C
Liquid Assets	Sum of cash, federal funds sold, repo bought, and securities (excluding mortgage- and asset-backed securities) divided by total assets	Y-9C
NPL Ratio	Non-performing loans divided by total loans	Y-9C
Net Charge-Offs	Charge-offs net of recoveries divided by total assets	Y-9C
Real Estate Loan Share	Real estate loans divided by total loans	Y-9C
Capital Ratio	Book capital divided by total assets	Y-9C
Bank Size	Natural logarithm of total assets	Y-9C
Large Bank	Indicator variable equal to one if total assets greater than $50bn	Y-9C
Merger Dummy	Indicator variable equal to one if lender top holder ID changes in current year	SNC
C&I Loan Share	C&I loans divided by total loans	Y-9C
Syndicated Loan Exposure	Syndicated loan commitments divided by total assets	SNC, Y-9C
Syndicated Loan Concentration	Herfindahl-Hirschman index of syndicated loan industry concentration across two-digit SIC codes	SNC
Criticized Ratio	Ratio of (dollar value) of criticized to total loan commitments	SNC
Non-Interest Income/Net Income	Non-interest income divided by net income	Y-9C
Trading Assets/Assets	Trading assets divided by total assets	Y-9C
TARP/Assets	Funds extended under Troubled Asset Relief Program divided by total assets	Treasury
MVE/Assets	Market value of equity scaled by total assets	CRSP, Y-9C
MBS+ABS/Assets	Sum of mortgage- and asset-backed securities over total assets	Y-9C
Tier 1 Capital/Assets	Ratio of tier 1 capital to total assets	Y-9C
Tier 1 Capital/RWA	Ratio of tier 1 capital to risk-weighted assets	Y-9C
Tier 1 + Tier 2 Capital/RWA	Ratio of tier 1 and tier 2 capital to risk-weighted assets	Y-9C

This appendix presents the definitions for the variables used throughout the paper.