Bank Balance Sheets and Liquidation Values: Evidence from Real Estate Collateral

By RODNEY RAMCHARAN*

Abstract

Deflation in real asset prices, such as real estate, can last years and sometimes decades after an initial financial shock. This paper finds that bank balance sheet pressures can depress the liquidation value of distressed real assets. Using a large sample of foreclosed properties, the liquidity and solvency of a financial institution can significantly influence the timing of asset sales and the liquidation values of these assets at auction. These effects are especially large among banks with historically illiquid balance sheets or larger off-balance sheet commitments. I also find that balance sheet pressures at banks spillover onto the prices of even assets sold by non-bank owners. Taken together, the prolonged asset price busts common after crisis events can in part reflect ongoing balance sheet pressures at financial institutions.

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I. Introduction

Most asset prices decline when the health of the financial sector deteriorates. But in the case of some assets, especially real estate, deflation can last years and sometimes decades. The long slow deflation of real assets, often a key source of collateral in credit transactions, can in turn contribute to the depressed pace of economic activity commonly observed after major crisis events (Chaney, Sraer, and Thesmar (2012). This real asset price deflation, notably in the case of residential real estate, partly reflects households' desire to deleverage. But influential theoretical arguments also observe that the dynamics of asset prices in some markets might be related to the balance sheet of financial intermediaries. [1]

Equity constraints at intermediaries can for example restrict participation in asset markets, leading to deleveraging and lower asset prices. Similarly, if liquid on-balance sheet assets are scarce, a withdrawal of deposits or the inability to roll over short-term liabilities can force a financial institution to sell quickly illiquid or troubled assets to meet the liquidity demands of creditors. Either because of equity constraints or illiquidity, the rapid liquidation of troubled assets when potential buyers might themselves have limited financing capacity can cause liquidation values to dislocate sharply from fundamentals, leading to bank-runs, deflation and depressed economic activity. [2] In this paper, I investigate the role of

[1] Theoretical treatments of these ideas include Acharya, Shin and Yorulmazer (2011), Allen and Gale (1994, 2000, 2005), Brunnermeier and Pedersen (2009), Diamond and Rajan (2001, 2005), He and Krishnamurthy (2013), Rochet and Vives (2004) and the survey in Shleifer and Vishny (2011)).

[2] Annenberg and Kung (2014), Campbell, Giglio and Pathak (2010) and Mian, Sufi and Trebbi (2010) provide evidence on the economic effects of foreclosures in the 2008-2009 crisis. Peek and Rosengren (2000) is a classic reference on the real effects of the Japanese banking crisis. In the context of models of bank runs such as Diamond and Dybvig (1983), low liquidation values can act as a coordinating mechanism for beliefs about the bank's ability to honor the sequential service constraint, inducing a run. Variations of this idea center on only some individuals being partially informed about solvency and the future returns to deposits, as proxied for by low liquidation values. This again can induce a run, as less informed agents observe the "length of the withdrawal line" and run on the bank (Chari and Jagannathan (1988), Bhattacharya and Gale (1987). He and Manela (2016) models depositors' endogenous acquisition of noisy information about bank liquidity, such as observing liquidation values in the current context, when there is uncertainty about the bank's capacity to honor the sequential service constraint. This approach creates rich withdrawal dynamics and endogenous failure rates based on the quality of the information.

bank balance sheets in shaping the liquidation value of distressed real estate collateral, and depressing the price of even non-bank owned real estate.

This idea that financial intermediaries' balance sheets might influence asset price dynamics and economic activity during and after crisis periods is now enormously influential in shaping narratives of financial crises and financial regulation. Motivated by arguments about the potential negative effects of balance sheet illiquidity, US and international banking rules now regulate liquidity among large banks, despite concerns that these regulations might restrain lending and economic activity ((BIS (2013), Cecchetti and Kashyap (2016)).[3] And amid similar concerns about diminished lending, Basel III capital requirements have not only increased, but countercyclical buffers are now in place to avoid procyclcial asset liquidations.

However, causal evidence connecting the balance sheet of financial institutions to asset price declines, especially for major asset classes like real estate, remains limited.[4] To be sure, there is now compelling evidence that aggregate credit availability, such as changes in banking competition within a geographic area might affect local real estate prices (Favarra and Imbs (2015), and Rajan and Ramcharan (2015)).[5] But little is known about the underlying mechanism and in particular, whether intermediary balance sheets, especially liquidity, can directly shape asset price movements (Diamond and Kashyap

[3] A popular criticism centers on the concern that the requirement to hold additional liquid assets on the balance sheet, such as government securities, might crowd out less liquid loans to businesses. See for example: https://www.nytimes.com/2017/05/15/opinion/bank-regulations-liquidity.html?mcubz=1.

[4] Beginning with Pulvino (1998), there is a sizeable literature documenting real fire sales among non-financial corporations. A recent example is Benmelech and Bergman (2008) linking the balance sheet of airlines to the value of collateral. An important literature beginning with Adrian and Shin (2008) provide time series evidence linking financial institution's balance sheets to financial asset prices. Adrian, Etula, Muir (2014) and He, Kelly and Manela (forthcoming) provide more direct tests using standard asset price models for financial assets. It is however difficult to determine causality and identify underlying mechanisms within the context of time series asset pricing models.

[5] Beyond real estate, Benmelech, Meisenzahl and Ramcharan (2017) provide evidence that illiquidity among non-depository institutions can affect consumer durable goods credit. Irani and Meisenzahl (2017) study banks' incentives to make syndicated loan sales while Acharya and Mora (2015) provide evidence on liquidity stress in the traditional banking system during the 2007-2010 period. Also, Rajan and Ramcharan (2016) provide evidence linking banking sector distress during the Great Depression to real local asset values.

(2015)). Yet real estate collateral is frequently at the center of financial crises: Over the period 2007 Q1 though 2013 Q4, total real-estate-related charge-offs was around $750 billion in the banking system alone.

There are at least three principal factors that make it difficult to interpret causally studies of the effects of balance sheets on the liquidation values of collateral: ex-ante endogenous matching between collateral quality and intermediaries; unobserved current economic conditions; and non-random selection into foreclosure. In the case of endogenous matching, banks for example with more conservative management might both maintain bigger equity cushions and also originate loans backed by higher quality or safer collateral ex-ante that in turn yield higher liquidation values ex-post. This match between collateral quality and balance sheet outcomes based in part on persistent unobserved bank characteristics can then lead to spurious associations between subsequent balance sheet outcomes and liquidation values.

Similarly, current unobserved local economic conditions that simultaneously affect the liquidation values of distressed collateral and balance sheet outcomes, such as depositor liquidity demand or bank losses, can also make it difficult to interpret the evidence. In the case of selection bias, loan delinquency is often precipitated by borrower-specific shock. But a bank's current balance sheet health can shape its incentives to renegotiate loan terms, and consequently whether the bank forecloses upon the property or exercises forbearance. As a result, potentially unobserved balance sheet factors that affect liquidation values can also correlate with selection into the subsample of delinquent loans that end in foreclosure. These selection forces could in turn bias estimates of the impact of balance sheet observables on liquidation values.

The research design use highly detailed transaction level information on collateral to help address these endogeneity concerns. Let us first consider the case of unobserved local economic conditions. With information on the precise location of the collateral as well as the exact date of the auction, the basic specifications can absorb most plausible controls for local economic conditions, such as zip code level house price growth, and non-parametrically, zip code by time fixed effects. The dataset also contains about 340,000 liquidations spanning some 5,000 zip codes, across 12 states and about 800 banks. This geographic diversification allows specifications that focus on banks with liquidations across a large number of states or even zip codes.

The detailed information available on collateral can also address concerns about endogenous matching. The data identifies key hedonic characteristics of the property such as the number of bedrooms, square footage, bathrooms, and in some cases the building quality itself and other details such as the roof type, and heating and plumbing systems. This level of detail permits empirical specifications that can control for most relevant observables that might determine the ex-ante quality of the collateral. But the dataset also identifies when the loan originated and which bank financed the transactions. Thus, beyond bank fixed effects, some specifications can directly control for matching by observing both balance sheet outcomes around the time of loan origination, as well as the collateral characteristics.

In the case of selection bias concerns, I collected information on the population of delinquent properties for each bank in the sample period—the population from which foreclosed properties are selected—in order to model directly selection into foreclosure. There is little evidence that contemporaneous balance sheet observables predict selection into foreclosure conditional on delinquency. But using mortgage information at origination, such as the maturity of the mortgage contract, the analysis can correct for any residual selection bias in the pricing equation.

I find that balance sheet pressures impact liquidation values. Using the one quarter lag in the change in deposits scaled by assets as the main measure of a liquidity shock, there is significant evidence that the loss of deposits is associated with a decline in liquidation values. On average, a one standard deviation decrease in deposits is associated with about a 1.5 percent drop in the average liquidation value of real estate collateral in the next quarter. But this average effect masks considerable heterogeneity. For banks that entered the period of asset liquidation with less cash on their balance sheet, a similar loss of deposits is associated with a 2.5 percent drop in subsequent liquidation values.

A quantity based measure of illiquidity can be misleading, as banks that either anticipate or directly face funding pressures could increase their deposit rates to stem deposit outflows or even induce additional flows. For each bank, the analysis collected proprietary data on the deposit interest rate. Both quantity and prices matter. For a bank at the median change in the deposit rate, a one standard deviation decrease in deposits is associated with a 1.2 percent drop in liquidation values. But for a bank at the 90th percentile of the 6-month rate change, and presumably trying to attract scarce liquidity, a similar loss of deposits is associated with a 1.9 percent drop in liquidation values. The evidence on equity is similar. In the benchmark specification, a one standard deviation decrease in the ratio of tier 1 capital to risk weighted assets implies a 2.4 percent decline the value of the distressed real estate collateral.

Balance sheet pressures also affect the timing of asset sales. There is evidence that banks with scare liquidity—those experiencing deposit outflows and in need of cash—sell more quickly distressed real estate assets, helping to explain the lower liquidation values. And in keeping with predictions from economic theory, the impact of balance sheet pressures on liquidation values are higher in areas with less local absorptive capacity. For the same loss of deposits, liquidation values decline by a greater amount in "power of sale" states, where lenders can seize and liquidate collateral relatively quickly without going through the courts. Finally, using detailed data on the location of non-bank owned forecolsure prices, there is also evidence that balance sheet pressures at banks spill over onto the price of nearby similar but non-bank owned assets. These effects are larger when the two properties are adjacent or within a block of each of other.

These results suggest that the balance sheet of a financial institution can significantly influence the liquidation values of disposed collateral. But the evidence on spillovers suggests that intermediary balance sheet pressures can resonate more broadly: The sharp and extended deflation in real estate prices common after crisis events might reflect both the effects of household deleveraging and balance sheet adjustments at financial institutions. Therefore, despite their potential economic costs, regulations that constrain balance sheet choices during boom times might in turn limit the potential for prolonged asset price busts when adverse shocks occur. This paper is organized as follows: Section 2 describes the data, while Section 3 presents the main results. Section 4 focuses on the underlying mechanism and extensions, while Section 5 concludes.

II. Empirical Framework and Data

There are at least two major channels through which a financial intermediary's balance sheet might affect the liquidation value of distressed or troubled assets. First, models of financial intermediation emanating from Diamond and Dybig (1983) observe that a loss of liquidity can force a financial institution to sell quickly illiquid assets to meet the liquidity demands of creditors. When cash-in-the-market is limited, this rapid selling of illiquid assets can in turn depress liquidation values and the prices of similar assets, possibly culminating in insolvency, and further disruptions in financial intermediation.

Also, illiquidity on both the asset and liability sides of the balance sheet can interact in shaping the liquidation values of collateral: When confronted with an increase in the demand for liquidity from depositors, banks with more liquid assets might face less pressure to sell quickly illiquid assets and depress liquidation values, limiting the scope for contagion through asset write downs.

A second key channel centers on the high cost and slow pace of raising equity during times of crisis in conjunction with risk-based capital regulation. Unable to raise outside equity easily when the financial sector is in distress, banks have powerful incentives to deleverage through asset sales, primarily of assets with greater risk weights. Specifically, for much of the sample period, the risk weight on foreclosed real estate assets owned by banks was 100 percent or twice as large as real estate loans in good standing.

Using the typical 8 percent minimum equity constraint before regulators mandate "prompt and corrective action", the capital requirement for bank owned foreclosed real estate with a fair value of $100,000 would be $8,000; a loan of similar value would only have a capital charge of $4,000.[6] Conditional on the property becoming bank-owned, an intermediary facing binding equity constraints would then prefer to liquidate rapidly on-balance-sheet foreclosed real estate assets, possibly depressing liquidation values below fundamentals and spilling over more broadly (See the discussion in Kashyap, Stein and Rajan (2008) and analytical treatments of these ideas in Brunnermeir and Pedersen (2008) and He and Krishnamurthy (2013)).

While economic theory predicts that intermediary balance sheet pressures can affect liquidation values, establishing a causal relationship between balance sheet illiquidity and solvency on liquidation values remains difficult. In the context of real estate collateral, the endogenous matching between collateral quality and bank balance sheets can make it hard to differentiate the effects of balance sheet pressures from intrinsic collateral quality on observed liquidation values. That is,

[6] An overview of the Basel 1 risk weighting rules can be found here: https://www.occ.gov/static/news-issuances/ots/exam-handbook/ots-exam-handbook-120ab.pdf

because banks might strategically select the types of collateral that they originate and retain on balance sheet, this matching decision can be closely connected to other balance sheet decisions and the liquidity demands of creditors.

"Conservative" banks for example might operate with more cash or higher levels of equity and also originate loans backed by higher quality or safer collateral ex-ante. This matching between collateral quality and persistent balance sheet decisions can then induce a positive association between book equity and liquidation values, making it hard to identify whether observed liquidation values stem from current balance sheet pressures or the matching between intrinsic collateral quality and persistent bank risk preferences. Prevailing unobserved economic conditions can also simultaneously affect the demand for liquidity or a bank's equity constraint as well as liquidation values. Adverse economic shocks for example that affect a bank's depositors could both increase the demand for liquidity and depress the liquidation value of assets sold in local markets, again making it difficult to identify a causal relationship between balance sheet pressures and liquidation values.

Selection bias can also distort inference. Foreclosed properties are drawn from the population of delinquent loans. And once a loan becomes delinquent, a bank's current balance sheet health could shape its incentives to renegotiate the mortgage, and consequently whether the property enters the foreclosure subsample. It thus becomes possible that potentially unobserved balance sheet factors that affect liquidation values could also be correlated with selection into the foreclosure subsample drawn from the population of delinquent loans. A priori, it is hard to gauge the direction of this potential bias.

For instance, banks that are closer to insolvency or facing illiquidity may also face greater regulatory pressure to avoid politically costly foreclosures. For these banks then, those properties that do end up in the sample of foreclosed properties might have especially low liquidation values that make it optimal for the borrower to walk away despite the bank's best attempt to avoid foreclosure. If systematic, then these selection forces could induce a positive association between adverse balance sheet outcomes—proximity to insolvency or illiquidity—and liquidation values.

But selection bias could also alter the sample of liquidated properties in the opposite direction. Banks facing insolvency or illiquidity might have less capacity to realize large losses on collateral that currently have low liquidation values either because of too thin an equity cushion or out of fear that realizing losses could also adversely signal asset quality and exacerbate funding pressures. These banks would then have a greater incentive to avoid or delay the foreclosure of loans backed by poor collateral. In this case, potentially unobserved negative balance sheet characteristics could select higher quality collateral into the sample of foreclosed properties, making it harder to detect whether insolvency or illiquidity affects liquidation values. To wit, banks facing insolvency might only liquidate good quality collateral that is expected to fetch high prices at auction.

Finally, apart from these conceptual challenges to identification, data on liquidation values, especially for real assets, are generally unavailable. Regulatory financial statements—the call report—records coarse quarterly information on charge-offs and recoveries, containing no data on the prices obtained from the sale of underlying assets and the characteristics of the collateral sold. The coarseness of public regulatory information makes it impossible to address the conceptual challenges to identification when using typical datasets.

To address these identification challenges, the analysis uses data from Zillow's ZTRAX database on the liquidation of foreclosed properties collected in 12 states, including Arizona, California, Florida—the three states with the most number of foreclosures in the United States. The ZTRAX database contains information on the near universe of housing transactions drawn from county records across the country. Importantly for the analysis, the database lists the price and date of liquidation; the property address and key collateral characteristics, including price and leverage at origination. ZTRAX also lists in text form the name of the bank that liquidated the foreclosed property, allowing a manual match with financial institutions' regulatory balance sheet and income data. The sample period runs from the first quarter of 2006 through the final quarter of 2015.

The ZTRAX database reproduces the well-known fact that foreclosures rapidly increased in 2008 and 2009 during the housing collapse, before gradually tapering off in the years after the financial crisis. Column 1 of Table 1A lists the total number of recorded foreclosed properties in each year across the 12 states in the sample. The data include liquidations by commercial banks, private securitization trusts as well as properties foreclosed upon by quasi-government agencies such as Fannie Mae and Freddie Mac. There are about 1.6 million foreclosures in the dataset when totaled over the entire sample period.

Columns 2 and 3 of Table 1A also disaggregate the number of foreclosed properties liquidated by government agencies as well by commercial banks. In the case of the latter, there are about 530,000 properties—about a third of the sample—that were liquidated directly by commercial banks. The remaining number of foreclosed properties, just under half the total sample, come from private label securitization trusts. To be sure, the number of bank-owned properties in the database reflects the raw count and about a third of these bank-owned properties do not have recorded prices, or lack information to match the commercial bank to the liquidation; observations with missing or non-matched data are excluded from the subsequent analysis. For the remaining 450,000 properties that can be matched to a bank and that has a recorded liquidation value, Table 1B tabulates by state the number of bank-owned foreclosures with non-missing matched data. California, Arizona and Florida top the list of states with the most number of bank liquidated properties.

Table 2A illustrates the potential for endogenous matching. It uses the detailed data on collateral characteristics to compare properties liquidated directly of off the balance sheet of banks versus those sold by securitization trusts. Table 2A shows that banks tended to liquidate collateral that sold for significantly lower price per square foot at origination. Bank-owned properties were also more leveraged at origination relative to those properties liquidated by Fannie Mae, Freddie Mac and the various private label securitization trusts. And there is also evidence that liquidation values obtained by banks are lower than non-banks.

However, because leverage and price at origination can also affect liquidation values, these differences in liquidation values could reflect intrinsic differences in collateral quality rather than any liquidity pressures at banks. But even among the sample of properties liquidated by commercial banks, there can still be endogenous matching. Table 2B shows for example that larger banks tended to have newer more leveraged real estate owned properties relative to their smaller counterparts. The next section develops various empirical tests to identify the effects of balance sheet liquidity, solvency and other observables on liquidation values.

To measure balance sheet liquidity, in much of the analysis, I use a bank's change in deposits relative to the same quarter in the previous year and scaled by assets. This approach builds on the evidence that the traditional banking system faced significant liquidity pressures during much of the sample period, as aggregate deposit inflows weakened and funding shortfalls increased (Acharya and Mora (2015)). Panel A of Table 3 provides summary statistics for this variable from 2006 through 2015. Across the distribution of banks, Panel A shows a marked decline in deposit growth over the sample period, with the mean growth rate falling by half in 2010 relative to its 2006 peak. The growth rate measured at the 25th percentile turned negative in 2010, as a greater number of banks faced net deposit withdrawals during this period.

A quantity based measure of liquidity pressures is only partially informative of underlying balance sheet funding pressures. Banks that either anticipate or directly face funding pressures could increase their deposit rates to stem deposit outflows or even induce additional flows. Ratewatch, a proprietary data source, collects information on the deposit rate for various term products at the branch-week level for a large sample of US bank. Data on deposit pricing can in turn permit more informative measures of balance sheet funding pressures.

Panel B of Table 3 reports summary statistics for the difference between a bank's interest rate on its three month certificate of deposit (CD) product—a bank specific indicator of the cost of retail deposit funds—and the risk-free three month Treasury rate. Across the distribution, this spread is predominantly negative in 2006 and 2007, as most banks could access deposit financing cheaply during the boom. But as deposit growth slowed for many banks beginning in 2008, this spread turned sharply positive, suggesting that some banks may have had to increase deposit rates in order to stem a loss of deposit financing.

Figure 1 illustrates more clearly the relationship between deposit flows and the cost of deposit financing over the sample period. For each of the 40 quarters in the sample beginning in 2006, I regress the change in the three month CD rate on the growth in deposits for the cross-section of banks observed in each quarter. Figure 1 plots this coefficient, observed for each quarter, along with its 95 percent confidence band. During the boom period, the relationship between deposit flows and changes in the cost of funds is positive. But after 2007, this relationship becomes strikingly negative, as banks appeared to compete for scarce liquidity by raising deposit rates: Deposit rates tended to increase sharply when deposit flows declined. Moreover, while liquidity pressures at banks abated after their 2008 Q1 peak, this relationship remains significantly negative at least through early 2011. Both quantity flows as well as price changes likely proxy for illiquidity.

Table 4 summarizes some of the other balance sheet variables both in 2006 and again at the end of the sample period in 2015. Consistent with the significant changes in financial regulation over the sample period, median tier 1 capital to risk weighted asset ratios are about two percentage points higher in 2015 compared to 2006. Similarly, over this period, balance sheet illiquidity, as measured by both the ratios of loans to deposits, and cash to assets appear to have decreased. Surviving banks also appear to be much larger.

III. Main Results

III.A Balance Sheets and Liquidation Values

This subsection studies the impact of bank balance sheets on the liquidation values of foreclosed bank-owned property. To avoid mechanical endogeneity concerns, all bank balance sheet variables are observed in the quarter before the asset is liquidated. For the 75 percent of cases when liquidation occurs in an auction, the liquidation date is chosen to be the date of auction. In the remaining cases, there is either no formal auction recorded in the dataset and the property is sold to an arm's length buyer. In this case, I use the recording date in the county deed's office as the date on which the price was obtained.

All specifications include zip code fixed effects to control for time invariant local factors that could both influence liquidation values and bank balance sheet outcomes; aggregate shocks are absorbed by year-by-quarter fixed effects. Furthermore, we have already seen evidence that banks might selectively match with some kinds of collateral, and all regressions also include bank fixed effects in order to examine the impact of within-bank variation in balance sheet outcomes on liquidation prices observed one quarter ahead. That is, bank fixed effects absorbs non-parametrically time invariant bank characteristics that might determine the choice of collateral quality at the time of its origination, the subsequent liquidation value of the collateral, and the condition of the bank's balance sheet in the quarter before liquidation.

Column 1 of Table 5 presents the most parsimonious model. The dependent variable is the log price of the liquidated property. To establish simply the relationship between liquidity pressures and liquidation values, this section uses the change in deposits relative to the same quarter in the previous year and scaled by assets as the main measure of balance sheet liquidity pressure. From column 1, the point estimate is statistically significant at the one percent level and positive: a one standard deviation decrease in deposits in the previous quarter is associated with about a 0.7 percent decline in the subsequent liquidation value of the property.

Illiquidity and insolvency can be closely related, and column 2 includes the ratio of tier 1 capital to risk weighted assets—book equity. This variable is economically and statistically significant. A one standard deviation decrease in the tier 1 ratio is associated with a 1.8 percent drop in the liquidation value of the collateral; also, although illiquidity and solvency are closely related, the point estimate on balance sheet liquidity remains unchanged.

Because the effects of book equity and deposit flows could proxy for other balance sheet observables, column 3 adds other standard balance sheet controls such as the return on assets, the ratio of cash to assets; loans to deposits; deposits to assets as well as the size of the bank, measured in terms of log assets. These variables all enter with a one quarter lag. The point estimates on liquidity and solvency increase after controlling for these additional variables. A one standard deviation decrease in deposit flows is associated with a 1.4 percent drop in liquidation values in the subsequent quarter. A similar decrease in the tier 1 ratio implies a 2.4 percent decline the value of the distressed collateral.

To help address concerns about the endogenous matching between the bank and the collateral, column 4 takes advantage of the rich information on collateral characteristics and include several hedonic variables to control for quality. These variables include the age of the property; an indicator for whether the property was remodeled in the last 10 years; the log of the square footage; the log of the total number of bathrooms; and the log of the total number of bedrooms. These variables all enter with their expected signs. For example, liquidation values are about 8 percent higher for properties remodeled in the last 10 years. The sample size shrinks by about 20 percent as not all of these variables are available for every transaction, but the liquidity and solvency point estimates remain unchanged.

Information about the loan contract at origination can help up further gauge the relevance of endogenous matching. In particular, the choice of leverage at loan origination can be closely related to a bank's business model and its subsequent exposure to illiquidity or losses. At the same time, leverage can itself proxy for collateral quality. For example, the debt capacity might be greater for collateral perceived to be more liquid, resulting in higher loan to value (LTV) ratios at origination and possibly higher ex-post liquidation values (Shleifer and Vishny (1992)). Alternatively, because of debt overhang, high LTV ratios could depress the liquidation value of troubled assets.

To assess the impact of leverage, column 5 includes the price of the property at origination, while column 6 adds the loan to value ratio, also observed at origination. The coefficient on the price at origination documents the low recovery rate of distressed collateral during the bust. A 10 percent increase in the price at origination is associated with only a 1.7 percent increase in the subsequent liquidation value (column 5). There is also significant evidence that increased leverage at origination depresses liquidation values (column 6). There is no change however in the liquidity and solvency point estimates.

Rather than using information about the loan contract at origination to gauge the impact of endogenous matching, column 7 uses the information about the bank's balance sheet itself at origination. The endogenous matching concern centers on the possibility that the ex-ante variation in bank balance sheets might determine both the choice of collateral quality and subsequent liquidation values as well as the bank's exposure to liquidity and equity shocks during the liquidation period. The analysis has already controlled for hedonic characteristics and loan terms that might indicate collateral quality. But directly observing key balance sheet variables around loan origination can help further gauge the extent of any bias emanating from the endogenous matching between bank type and collateral quality.

Column 7 thus includes asset liquidity, the tier 1 capital to risk weighted assets ratio, total assets and the deposit to asset ratio, all observed in the quarter before loan origination. The regression also includes year-by-quarter loan origination fixed effects. There is some evidence that asset liquidity at the time of origination is correlated with subsequent liquidation values, but there is again little change in the deposit flows or the book equity point estimates observed before liquidation. The evidence thus continues to suggest that balance sheet liquidity and solvency might shape liquidation values, even after controlling for key collateral characteristics and the potential for endogenous matching at origination.

The endogenous selection of delinquent properties into foreclosure is however still a potential source of bias. Once a loan becomes delinquent or troubled, the bank and borrower can agree to revise the loan terms and return the loan to current status. Otherwise, failing agreement, the bank can foreclose upon the property; the property then enters the sample of liquidated bank collateral. This sequence of decisions imply that unobserved bank-level characteristics that drive selection into foreclosure might also be correlated with the balance sheet variables, leading to biased estimates in the pricing equation.

For example, banks that are closer to insolvency or facing funding pressures may also face greater regulatory pressure to avoid politically costly foreclosures. For these banks then, those properties that do end up in the sample of foreclosed properties may have especially low liquidation values that made it optimal for the borrower to walk away. These selection forces could then induce a positive association between solvency and liquidation values. Alternatively, banks with limited equity or those concerned that realized losses could signal deeper balance sheet problems and exacerbate funding pressures might only foreclose upon higher quality collateral. This could bias downwards the relationship between solvency or illiquidity and liquidation values in the pricing equation. To be sure, the set of collateral and balance sheet controls can help mitigate these selection concerns.

But to address more directly selection bias concerns, for each bank in the sample, I collected data on its population of delinquent loans. Together, the number of delinquent properties is about 1.6 million for the 600 banks in the sample. The delinquency data includes the usual underlying collateral characteristics; the date the property first became delinquent, and of course the date that the property is foreclosed upon and liquidated or the date that the property is no longer delinquent. These data allow us to model directly the selection into foreclosure decision.

Using the population of delinquent loans, column 1 of Table 6 examines whether the balance sheet liquidity and solvency measures help predict whether a delinquent property is selected into foreclosure. The dataset is an unbalanced quarterly panel of delinquent properties that begins in the quarter of delinquency and ends if the property is either liquidated or is no longer delinquent; the data are censored when the sample ends in 2015 Q4. The dependent variable equals 1 in the quarter when the property is foreclosed upon and liquidated, and 0 otherwise. From column 1, there is no significant evidence that the one quarter lagged liquidity and solvency measures are related to whether a delinquent property is selected into foreclosure.

Nevertheless, the remaining columns of Table 6 attempt to correct for any sample selection bias in the pricing equation. The main exclusion restriction uses the duration of the mortgage contract. Buyers using short-term mortgage contracts are more likely to be speculative short term investors, and thus more willing to allow a property to enter foreclosure, conditional on delinquency. Information on the term of the mortgage contract is available for only a subset of the delinquent properties, and column 2 includes the log of the number of days from origination until the first mortgage interest rate reset in the selection-into-foreclosure equation: The dependent variable equals 1 in the quarter the delinquent property is foreclosed upon.

As before, the balance sheet variables are not significant in the linear probability model, but the maturity of the mortgage reset enters negatively: a 10 percent decrease in the number of days from origination until the first reset is associated with a 0.01 percent increase in the probability that delinquency culminates in foreclosure. Using a probit model to estimate the selection equation with around four million observations is computationally infeasible, and to reduce this burden, column 3 draws a 40 percent random sample of the properties with information on mortgage maturity. Column 4 includes the inverse Mills ratio in the pricing equation for the subsample of foreclosed properties , while for comparison column 5 uses the same sample of properties, but without the sample selection correction.

Despite the considerably smaller sample—only 29,815 properties in the pricing equation, the liquidity and tier 1 equity point estimates are nearly identical to that observed in the large sample of 335,264 observations (column 2 of Table 5). The liquidity point estimate is however imprecisely estimated in this smaller sample. Also, the inverse Mills ratio is significant, and the point estimates on the balance sheet coefficients in column 4 are slightly higher than those without the sample correction (column 5). Taken together, this evidence suggests that any bias from non-random selection into the pool of foreclosed properties is likely to be small and negative.

Neither endogenous matching nor selection appear to be significant sources of bias, but balance sheet outcomes at banks might be affected by potentially unobserved local economic conditions that also shape liquidation values. Table 7 exploits the geospatial detail in the data to help gauge the potential for biased estimates due to unobserved local economic conditions. To this end, since the dataset observes the property's address, column 1 includes zip code-level house price changes observed from one month before the transaction and up to six months prior to help assess the extent to which local economic conditions might drive these results.

House price changes at this fine level of spatial disaggregation are likely to be a useful proxy for local economic conditions. The number of observations decline slightly as zip code level house price data are not uniformly available for all zipcodes. Unsurprisingly, there is some evidence that local house price dynamics is positively related to liquidation prices. Over the six-month window, a one standard deviation increase in the house price index is associated with a 2.1 percent increase in liquidation values—these coefficients are omitted for concision. The impact of illiquidity and equity continues to be unchanged.

However, even within a zip code, properties that are foreclosed upon might be different than those sold by private individuals. Because the zip-code level price index is primarily composed of the latter transactions, the index might only imperfectly proxy for the local economic shocks in a zip code that are relevant for the liquidation values of bank-owned properties. To address this concern, column 2 includes the log number of properties in a zip code-quarter observation liquidated by non-bank entities such as Fannie Mae and Freddie Mac, as well private label securitization trusts. These properties are on average different in quality relative to their bank-owned counterparts (Table 2), but they are still nevertheless likely to be more similar than the bulk of properties that comprise the price index.

There is evidence that increased selling pressure from non-bank entities are associated with lower liquidation values for bank collateral. A 10 percent increase in the number of non-bank foreclosures is for example associated with a 6 percent drop in the bank-owned liquidation value. Column 3 uses zip code—there are 4,582 zip codes in this sample--by year-quarter fixed effects—the period spans 31 quarters--to non-parametrically absorb zip code-level shocks that vary over time. The balance sheet variables remain unchanged.

The remaining tests try to parse the influence of local economic conditions by using the fact that the vast majority of foreclosure observations in the sample come from banks that operate across multiple markets, such as Bank of America and Wells Fargo. For these large multi-state banks then, local economic conditions in any given market will likely have a small or negligible impact on bank balance sheet outcomes. But for banks that operate within a single market, often smaller community banks, current local economic shocks are more likely to jointly influence both the balance sheet of the bank and subsequent liquidation values.

Systematically exlcuding the smaller less geographically diversified banks thus provides a way to limit any biases from unobserved current local economic conditions. There are 12 states in the sample, and to exploit this geographic diversification, column 4 of Table 7 uses the baseline specification from column 3 of Table 5, but excludes observations from banks that operate within only a single state. The results are unchanged. Conversely, about 90 percent of foreclosure observations in the sample come from banks that operate across all 12 states in the sample, and column 5 restricts the sample to this geographically diversified group. The results again remain unchanged. Column 6 measures geographic range at the county level. About 95 percent of liquidations in the sample stem from banks that have liquidated at least one foreclosure across 112 counties or more. For this subsample of banks operating across such a large geographic range, county-level unobserved economic shocks are unlikely to both influence liquidation prices and bank balance sheet outcomes.

Column 7 focuses on the finer zip code level outcomes. At this level of spatial disaggregation, unobserved local shocks are even less likely to be a source of bias for diversified banks. Using the same 95 percent threshold, column 7 restricts attention to the top 95 percent of liquidations: banks with foreclosures spread across more than 553 zip codes. The results remain robust.

Taken together, the evidence suggests that unobserved local economic shocks, endogenous matching at origination or selection bias in the foreclosure decision are unlikely to offer a compelling alternative explanation for the positive impact of deposit flows and book equity on liquidation values. The next section develops a number of tests to understand better the underlying mechanism behind this relationship to address further the issues of causality and interpretation.

IV. Mechanism

IVA. Measurement and Heterogeneity

Figure 1 suggests that banks that either anticipate or directly face funding pressures likely increased deposit rates to stem deposit outflows. Therefore, liquidity pressures may still be present even absent deposit outflows, and relying solely on a quantity based variable can imperfectly measure the impact of illiquidity. Similarly, regulatory or book equity is often a backward-looking indicator of solvency. For public banks, changes in the stock price might be a more informative forward looking indicator of solvency than book equity

To this end, column 1of Table 8 replaces the change in the deposits variable with the quarter on quarter change in the bank's six month certificate of deposit rate. This variable is available for a smaller number of banks, shrinking the sample size; but the point estimate is significant and negative. Consistent with illiquidity pressures leading to lower liquidation values, the coefficient implies that a one standard deviation increase the deposit rate is associated with a 0.5 percent decline in liquidation values.

Column 2 models the potential interaction between the price and quantity based measures of illiquidity. This specification includes an interaction term between the change in deposits variable and the change in the interest rate. The evidence suggests that a loss of deposit financing in conjunction with an increase in the deposit rate—outcomes consistent with increased funding pressures—are associated with significantly lower liquidation values. For a bank at the median change in the deposit rate, a one standard deviation decrease in deposits is associated with a 1.2 percent drop in liquidation values. But for a bank at the 90t[h] percentile of the 6-month rate change, and presumably trying to conserve or attract scarce liquidity, a similar loss of deposits is associated with a 1.9 percent drop in liquidation values.

The remaining columns of Table 8 examine the relative importance of market versus book equity in shaping liquidation values. Using data from the Center for Research on Security Prices, column 3 replaces the book equity variable with the average quarter on quarter change in the bank's stock price, lagged one quarter. Only 190 banks are public in the sample, and this reduces the sample of liquidated properties. But the change in market equity is positively associated with liquidation values. A one standard deviation decrease in market equity is associated with about a one percent drop in liquidation values. Rather than reflecting information in book equity, column 4 shows that both book and market equity independently affect liquidation values.

Heterogeneity in the impact of balance sheet observables on liquidation values can help further identify the underlying mechanism. Notably, economic theory observes that illiquidity on both sides of the balance sheet can interact to shape liquidation values. And if indeed these results reflect the causal effect of funding pressures on liquidation values, then the impact of a loss of deposit financing on liquidation values should be larger among banks with less liquid assets. Unable to meet easily the liquidity demands of depositors, banks with less cash face greater pressures to liquidate quickly troubled assets (Diamond and Kashyap (2015), Diamond and Rajan (1999)). To wit, asset illiquidity would be expected to amplify the effect of an adverse liquidity shock on liquidation values.

Columns 1 and 2 of Table 9A report the baseline results for those banks that entered the sample period with a cash to assets ratio above the sample median. Column 1 uses the deposit flows variable to measure illiquidity, while column 2 employs the change in the six month deposit rate. Columns 3 and 4 repeat the exercise, but for the sample of banks with below median cash to asset ratios. The differences across the samples are stark and consistent with the prediction that asset illiquidity might amplify the impact of an adverse liquidity shock on liquidation values.

For the sub-sample of banks with relatively liquid balance sheets, the liquidity coefficients are small; in the case of deposit rates, this coefficient is insignificant. In contrast, for the sample of banks where balance sheet liquidity is relatively scarce, the liquidity coefficients are large and significant. In the case of deposit flows for example, the implied effect on liquidation values is about 50 percent larger in column 3 compared to column 1. Similarly, the role of deposit rate changes is now significant at the one percent level among banks with less liquid assets at the beginning of the sample period (column 3). Columns 1-4 also reveal that among banks with plentiful balance sheet liquidity, the implied effects of solvency on liquidation values is much larger. That is, for these banks, concerns about solvency rather than illiquidity might have featured more prominently in the liquidation decision.

The off-balance sheet commitments of a bank also provides a powerful source of variation to identify the channels through which illiquidity might affect liquidation values (Gatev and Strahan (2006), Acharya and Mora (2015). If off-balance sheet commitments are drawn down rapidly, a bank will have to issue new liabilities or equity, or rapidly sell other assets to finance the expansion in its loan portfolio. Thus, banks with substantial concurrent off-balance sheet loan commitments are likely to be especially sensitive to a loss of deposits, and we would expect an even bigger relationship between the change in deposits and liquidation values for these banks.

Columns 1 and 2 of Table 9B evaluate this hypothesis, interacting the change in deposits with a measure of off-balance sheet commitments: the ratio of off-balance sheet loan commitments plus assets to assets, all observed in the previous quarter. Column 1 restricts the sample to banks with above median cash assets, and column 2 uses those banks with above median cash ratios. The interaction terms are jointly significant at the one percent level, and the evidence suggests that larger off-balance sheet commitments might amplify the impact of illiquidity on liquidation values, especially in the case of banks with less liquid assets.

For example, from column 2 a one standard deviation decrease in deposits is associated with a 2.9 percent decline in average liquidation values the next quarter for a bank at the 90th percentile of the off-balance sheet commitment ratio. The implied effect is about a third smaller for a bank at the 10th percentile of this ratio. This pattern is also present in column 1—the interaction terms are jointly significant at the one percent level—but the magnitudes are substantially smaller.

Apart from the balance sheet of the bank, the variation in the local capacity to absorb asset sales can also provide another source of heterogeneity that can help identify the underlying mechanism. In zip codes with a larger number of non-bank foreclosure sales, there may be more limited financing capacity to absorb additional bank asset sales without dislocating prices. Sales of bank collateral in these areas should then be associated with even lower liquidation values. Thus, if these results stem from faster liquidations due to a greater demand for cash among more illiquid banks, then the impact of balance sheet pressures on liquidation values should larger when the local capacity to absorb more asset sales is limited and the bank also has less cash.

For the below-median cash subsample, column 3 adds the interaction between the deposit growth variable with the log of the number of non-bank foreclosures within the zip code—all variables also occur linearly. The interaction term is positive and significant—both variables are jointly significant at the 1 percent level—and suggests that asset sales by non-bank institutions amplify the impact of bank balance sheet liquidity on liquidation values. For a zip code-quarter observation at the 10^{th} percentile of non-bank foreclosure sales, a one standard deviation decrease in deposit growth is associated with a 1.6 percent drop in liquidation values. But at the 90^{th} percentile of non-bank foreclosure sales, a similar loss of funding is associated with a 2.5 percent drop in the liquidation value of the distressed collateral. Column 4 restricts the sample to the more liquid banks. A similar pattern emerges, but the economic magnitudes are about 30 percent smaller.

Differences in state foreclosure laws provide a source of plausiby exogenous variation in local absorptive capacity that can help identify how the local supply of distressed assets might interact with balance sheet pressures to shape liquidation values. Foreclosures are much slower in states that require lenders to use the courts in order to foreclose upon real estate collateral (judicial foreclosure states). While in "power of sale" states, lenders can in many cases seize and liquidate collateral after due notice of default, without going through the courts (Pence (2006)).

There is already evidence that foreclosure rates in "power of sale" states are higher, and that the impact of these laws can affect local prices (Mian, Sufi and Trebbi (2010), Rajan and Ramcharan (2016)). And we would expect then that balance sheet pressures should have a bigger effect on liquidation values in "power of sale" states. To this end, columns 5 and 6 estimate separately the baseline regression for liquidations in judicial and power of sale states. In the latter states, a one standard deviation decrease in deposit growth is associated with a 1.4 percent decline in the liquidation value. But in judicial foreclosure states, where legal frictions preclude rapid asset disposition, the same decrease in deposit growth is associated with only a 0.7 percent price decline in the liquidation value of the collateral.

IVA. Timing

Data on the timing of asset sales can also help uncover further the mechanism underlying the relationship between bank balance sheets and liquidation values. If for example the positive relationship between deposit flows and liquidation values reflect the causal impact of liquidity, then banks with scare liquidity—those experiencing deposit outflows and in need of cash—would be expected to sell more quickly distressed real estate assets, helping to explain the lower liquidation values. If however deposit growth proxies for good local economic fundamentals and plentiful cash in the local market, then positive deposit growth should positively affect both liquidation values as well as the probability that a foreclosed asset sells.

To test this hypothesis, Table 10 use a linear probability model to understand how illiquidity might affect the probability of selling available-for-sale foreclosed properties in a given quarter. Using information on the date the property first became available for sale along with the actual date of sale, Table 10 creates an unbalanced panel. The dependent variable equals 0 in the quarters when the property is available for sale and 1 in the quarter when the property is finally sold. The median property takes about three quarters to sell. Column 1 models the probability that an available-for-sale property is sold as a function of the baseline bank balance sheet variables.

Consistent with the balance sheet channel, illiquidity increases the probability of observing a sale. A one standard deviation decrease in deposit growth is associated with a 1 percent increase in the probability that a property is sold in next the quarter. The tier 1 capital coefficient is however insignificant. Column 2 next includes the rich set of hedonic controls. There is little change in the deposit growth point estimate. Finally, columns 3 and 4 split the sample into those banks with above median (column 3) and below median (column 4) cash to asset ratio in the period before the sample begins. Among the banks that began the sample period with scare liquidity (column 4), the deposit growth coefficient is about 75 percent larger than the coefficient obtained in column 3. Thus, given that deposit outflows are associated with a greater probability of sale, it seems unlikely that deposit flows proxy for local economic conditions.

V. Spillovers

Balance sheet pressures appear to depress liquidation values and increase the probability of asset sales, among bank-owned properties. But these balance sheet pressures might have broader consequences, and this subsection now examines whether the liquidation values among bank-owned properties might affect the prices of other nearby properties. Because pricing in real estate is based in part on the price of previous sales of comparable assets, low liquidation values among bank owned properties could also depress the subsequent price of otherwise similar non-bank owned properties (Murfin and Pratt (2016). In this way, bank balance sheet pressures could negatively spill over onto the prices of nearby assets. But it is also possible that in areas where cash-in-the market is limited, high liquidation values among bank-owned properties could absorb local liquidity and depress the prices of asset that are subsequently sold in the local market.

To understand then the spillover effects of bank sales, the analysis turns to the sales of non-bank foreclosed properties—these are foreclosed properties that are part of a securitization trusts and are not directly sold from the balance sheet of a bank. Using the date of sale for each of the non-bank foreclosures in the 12 states, I use a simple nearest neighbor approach: I identify the physically closest bank foreclosure sold within the previous 3 months and that is located no further away than 12 kilometers or 7.5 miles from each non-bank sale. The "nearest" bank foreclosure to the non-bank foreclosure in the sample is on average about 1.4 kilometers away; the median distance is 0.86 kilometers. Given this relative geographic and temporal proximity, the nearest bank foreclosure is likely to be a relevant comparable for the pricing of the subsequent non-bank sale.

Using this simple nearest neighbor approach, column 1 of Table 11 regresses the price of a non-bank foreclosure on the liquidation value of the nearest bank foreclosure within the last three months. Not surprisingly given the geographic and temporal proximity, the coefficient is positive and significant. A one percent increase in the price of the nearest bank foreclosures in the last three months is associated with a 0.09 percent increase in the price of the non-bank foreclosure. Column 2 expands the sample temporally, including the geographically nearest bank sale within the previous 18 months. This increases the sample size, and a one percent increase in the price of the nearest bank foreclosure in the last 18 months suggests a 0.12 increase in the non-bank prices.

Column 3 retains the 18 month window but shrinks the physical matching radius, restricting the nearest bank-owned property to be no further away than 0.3 miles—about a block. The median distance in this subsample is about one tenth of a mile. So many of the properties are either physically adjacent or in the same building structure—condominiums for example. The point estimate is about 25 percent larger for these more comparable properties. These estimates are suggestive then that low liquidation values for bank-owned properties on account of balance sheet pressures might then depress the price of nearby non-bank sales.

A major advantage to the nearest neighbor approach is that I can build on the previous analyses to identify more directly the role of bank balance sheet pressures in pricing spillovers. In particular, column 4 instruments the price of the nearest-neighbor bank sale with the change in deposits and tier 1 capital ratio of the bank, as always, observed in the previous quarter before the bank sale. As before, these bank-level variables are likely orthogonal to the local economic conditions that might affect the price of bank and non-bank distressed sales. The IV point estimate is large and statistically significant. A one percent increase in the liquidation value of the bank-owned property is associated with a 0.33 percent increase in the price of the nearest non-bank owned sale observed in the subsequent 18 months.

III. Conclusion

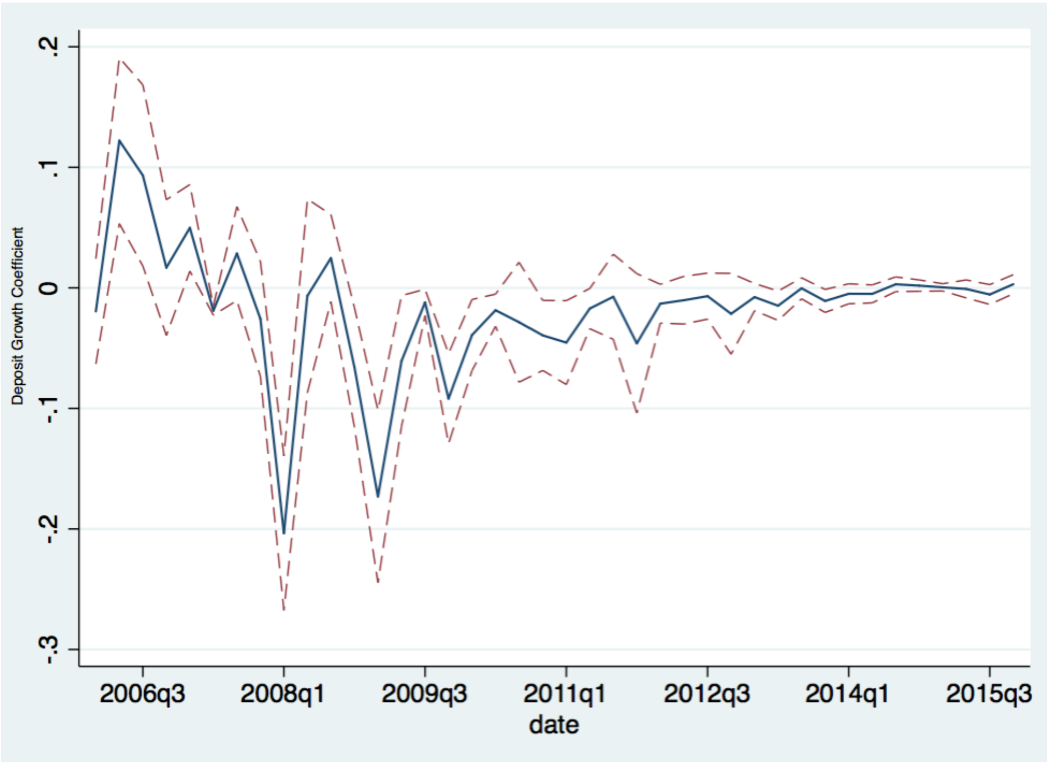
This paper has studied how a bank's balance sheet structure might affect the sale of troubled real estate assets. I find that the balance sheet of a financial institution can significantly influence the liquidation values of disposed collateral. Liquidation values tend to decline and the probability of an asset sale tends to increase when banks lose deposits or are forced to increase deposit rates to attract liquidity. These effects are substantially larger when asset liquidity is limited or when banks have large off-balance sheet exposures. Similarly, declining equity buffers or falling stock prices are also associated with lower liquidation values

There is also evidence that low liquidation values among bank-owned properties might spillover onto non-bank owned sales. These effects are especially large for recent nearby non-bank owned sales. All this suggests that the sharp and extended deflation in real estate prices common after crisis events might reflect both the effects of household deleveraging as well as ongoing balance sheet adjustments at financial institutions. It would seem then that despite their potential economic costs, regulations that constrain balance sheet choices during boom times might in turn limit the potential for prolonged asset price busts when adverse shocks occur.

Figures and Tables

V.A Figures

FIGURE 1. RELATIONSHIP BETWEEN DEPOSIT GROWTH AND CHANGE IN THREE MONTH DEPOSIT RATE CERTIFICATE OF DEPOSIT, 2006Q1: 2015Q4.



For each quarter in the sample period, the regression $Change\ in\ three\ month\ deposit\ rate\ CD = \beta_0 + \beta_1 change\ in\ deposits + \epsilon$ is performed for the crossection of banks. Figure 1 plots β_1--the solid line—along with the 95 percent confidence band using robust standard errors.

V.B Tables

TABLE 1A. THE NUMBER OF FORECLOSED PROPERTIES, 2006 Q1-2016 Q4.

	Total	Quasi-Public Agencies	Commercial Banks
2006	594	79	172
2007	47,125	2931	4,107
2008	220,280	22,911	34,947
2009	257,507	38,049	55,535
2010	231,120	64,855	67,422
2011	220,728	59,187	67,837
2012	182,189	41,876	91,791
2013	147,991	41,422	82,929
2014	129,689	33,388	7,637
2015	112,800	20,570	1300
Total	1550023	325268	527510

This table reports the total number of foreclosed properties in the ZTRAX dataset by year. "Quasi-public agencies" include Fannie Mae and Freddie Mac. The states in the sample are Arizona, California, Colorado, Florida, Illinois, Michigan, New Jersey, Nevada, Ohio, Pennsylvania, Texas and Washington.

TABLE 1B. BANK-OWNED PROPERTIES IN THE SAMPLE, BY STATE

State	Frequency	Percent
AZ	59,692	13.4
CA	112,877	25.34
CO	18,109	4.07
FL	111,925	25.13
IL	22,966	5.16
MI	12,799	2.87
NJ	2,819	0.63
NV	12,862	2.89
OH	50,384	11.31
PA	10,616	2.38
TX	14,392	3.23
WA	16,014	3.59
Total	445,455	100

This table lists the number of liquidated bank-owned properties by each state in the sample.

TABLE 2A. FORECLOSED PROPERTY CHARACTERISTICS, BY OWNER

	Characteristics of Foreclosed Properties, by Seller			
	Year Built	Price Sq. Foot at Origination	Leverage at Origination	Price Sq. Foot at Liquidation
	Banks			
mean	1975	31.27	0.89	20.24
median	1979	22.43	0.88	13.81
variance	699.787	1003.24	1.15	510.46
obs	420,000	310,000	310,000	281,061
	Non-Banks			
mean	1974	39.44	0.82	27.94
median	1978	28.48	0.80	20.2
variance	724.89	1384.72	0.98	668.05
obs	940,000	720,000	700,000	693,741

"Banks" denote the liquidation of "other real estate owned properties" off the balance sheet of banking institutions. "Non-Banks" include the liquidation on properties from either public "Fannie Mae and Freddie Mac" or private-label securitization trusts. "Year Built" is the year the property was built; "Price per Square Foot" is the price at origination divided by the lot square foot. "Leverage at Origination" is the ratio of loan amount at origination to price paid. "Price Sq. Foot at Liquidation" is the liquidation value of the property divided by the square footage of the lot.

TABLE 2B. FORECLOSED PROPERTY CHARACTERISTICS, BY COMMERCIAL BANK CHARACTERISTICS

	Large Banks (Assets>$50 billion)			Small Banks (Assets<$50 billion)		
	Year Built	Leverage at Origination	Price Sq. Foot at Origination	Year Built	Leverage at Origination	Price Sq. Foot at Origination
mean	1975	0.89	30.74	1971	0.86	32.59
median	1979	0.89	22.41	1974	0.80	22.46
variance	709	1.09	939.93	745	1.34	1168.76
obs	470,000	350,000	350,000	88,000	87,000	88,000

Table 3 reports the median year built, price per square foot and loan to value ratio at origination for foreclosed properties, separately for banks in the bottom quartile of tier 1 capital to asset ratio, averaged 2002-2007 and for those above the 25th percentile. Columns 3 and 4 repeat this exercise for banks in the bottom quartile of deposits to asset ratio and for those above this threshold, again averaged 2002-2007.

TABLE 3. DEPOSIT FLOWS AND INTEREST RATE SPREADS

This table reports summary statistics for the change in deposits divided by assets, and the spread between the three month certificate of deposit rate and the rate on the three month Treasury bond for banks. The summary statistics are computed by year for the cross-section banks.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	change in deposits/assets									
mean	0.085	0.072	0.075	0.075	0.047	0.035	0.044	0.004	0.028	0.034
p25	0	0.004	0	0.005	-0.006	-0.01	-0.003	-0.015	-0.011	-0.008
p50	0.044	0.044	0.042	0.05	0.035	0.03	0.034	0.019	0.019	0.023
p75	0.103	0.096	0.097	0.106	0.082	0.075	0.075	0.057	0.058	0.063
p90	0.196	0.194	0.189	0.202	0.155	0.135	0.135	0.11	0.116	0.121
sd	2.987	0.315	1.618	0.273	0.163	0.268	0.235	1.629	0.217	0.126
	three month deposit rate-3 month Treasury									
mean	-1.994	-1.328	0.67	0.861	0.448	0.284	0.125	0.105	0.119	0.1
p25	-2.491	-1.964	0.215	0.588	0.226	0.16	0.043	0.04	0.059	0.032
p50	-1.97	-1.332	0.58	0.84	0.39	0.244	0.11	0.09	0.101	0.082
p75	-1.482	-0.595	1.138	1.09	0.64	0.373	0.178	0.148	0.167	0.157
p90	-1.032	-0.032	1.668	1.367	0.86	0.51	0.279	0.218	0.227	0.225
sd	0.789	1.004	0.707	0.394	0.293	0.182	0.126	0.098	0.092	0.101

TABLE 4. SUMMARY STATISTICS: BANK BALANCE SHEET VARIABLES, 2006 AND 2015

	Tier 1 Capital /Risk Weighted Assets	Loans/Deposits	Deposits/Assets	Cash/Assets	Return on Assets	Assets (log)
	2006					
mean	0.166	0.63	0.8	0.046	0.007	11.789
median	0.134	0.665	0.836	0.033	0.006	11.663
Standard deviation	0.103	0.182	0.145	0.062	0.023	1.383
	2015					
mean	0.179	0.604	0.823	0.098	0.007	12.271
median	0.153	0.635	0.85	0.066	0.005	12.112
Standard deviation	0.092	0.18	0.121	0.104	0.026	1.403

TABLE 5. THE IMPACT OF BANKS'S BALANCE SHEETS ON LIQUIDATION VALUES.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	change in deposits	solvency	balance sheet controls	collateral characteristics	price at origination	leverage at origination	balance sheet at origination
Year on year change in deposits, scaled by assets	0.0514**	0.0527**	0.104***	0.0967**	0.104***	0.104***	0.123***
	(0.0216)	(0.0218)	(0.0363)	(0.0374)	(0.0391)	(0.0393)	(0.0367)
Tier 1 Capital/Risk Weighted Assets, lagged one quarter		0.297**	0.402***	0.351***	0.336**	0.340**	0.557**
		(0.132)	(0.140)	(0.123)	(0.147)	(0.146)	(0.222)
Loans/Deposits, lagged one quarter			-0.270**	-0.250*	-0.238	-0.236	-0.265**
			(0.121)	(0.137)	(0.148)	(0.148)	(0.132)
Deposits/Total Assets, lagged one quarter			-0.308*	-0.280	-0.287	-0.286	-0.322
			(0.184)	(0.196)	(0.201)	(0.200)	(0.205)
Cash/Total Assets, lagged one quarter			-0.337**	-0.270**	-0.234**	-0.235**	-0.331***
			(0.137)	(0.132)	(0.114)	(0.113)	(0.119)
Return on Assets, lagged one quarter			-0.545	-0.403	-0.765	-0.765	-0.727
			(0.644)	(0.603)	(0.730)	(0.732)	(0.851)
Log of Total Assets, lagged one quarter			0.0632	0.0631	0.0579	0.0574	0.0670
			(0.0473)	(0.0438)	(0.0443)	(0.0442)	(0.0491)
Lot size, square feet, logs				0.216***	0.200***	0.199***	
				(0.00557)	(0.00562)	(0.00568)	
Total number of bedrooms, logs				0.0532***	0.0373***	0.0373***	
				(0.0135)	(0.0128)	(0.0127)	
Total number of baths, logs				0.504***	0.427***	0.425***	
				(0.0167)	(0.0143)	(0.0142)	
Year built, logs				18.67***	17.28***	17.24***	
				(0.673)	(0.687)	(0.689)	
Remodeled in last 10 years				0.0826***	0.0724***	0.0722***	
				(0.0155)	(0.0162)	(0.0162)	
Previous Market Sales Price, log					0.167***	0.172***	
					(0.00474)	(0.00459)	
Loan to Value Ratio, at Origination						-0.0500***	
						(0.00542)	

TABLE 5, CON'TD. THE IMPACT OF BANKS'S BALANCE SHEETS ON LIQUIDATION VALUES

Tier 1 Capital/Risk Weighted Assets, at loan origination							-0.0203
							(0.0951)
Deposits/Total Assets, at loan origination							0.0442
							(0.0465)
Cash/Total Assets, at loan origination							0.313***
							(0.103)
Log of Total Assets, at loan origination							0.00477
							(0.00971)
Return on Assets, at loan origination							-0.876**
							(0.442)
Observations	335,264	335,264	335,264	273,846	220,838	220,838	220,749
R-squared	0.605	0.605	0.605	0.694	0.706	0.706	0.607

This table investigates the impact of bank balance sheet outcomes, observed the quarter before, on the liquidation value of bank-owned real estate. In all specifications, the dependent variable is the log price of the foreclosed property. All specifications include zip code, bank and year-by-quarter fixed effects, and standard errors, in parentheses, are clustered by zip code and bank. Bank balance sheet variables at origination (column 7) are observed in the quarter before origination.

TABLE 6. SELECTION INTO FORECLOSURE

	Probability of foreclosure			Log Liquidation Value	
	Linear Probability Model		Probit		
	(1)	(2)	(3)	(4)	(5)
Year on year change in deposits, scaled by assets	0.00265	0.00114	0.053	0.0689	0.0647
	(0.00249)	(0.00329)	(0.031)	(0.066)	(0.0664)
Tier 1 Capital/Risk Weighted Assets, lagged one quarter	0.00240	0.00378	0.523	0.501**	0.477**
	(0.0185)	(0.0321)	(0.349)	(0.247)	(0.216)
Mortgage Maturity: Log Number of Days Until the Mortgage Interest Rate Resets		-0.00105***	-0.0192***		
		(0.000221)	(0.0039)		
Inverse Mills Ratio				0.347**	
				(0.164)	
Observations	18,753,374	3,585,020	1,809,031	29,815	29,815
R-squared	0.013	0.021		0.67	0.668

Table 6 models the selection into foreclosure decision. For a delinquent mortgage, the dependent variable in columns 1-3 equals 1 if the mortgage is foreclosed upon in the quarter and 0 otherwise. Column 1 uses the full sample of delinquent properties. Column 2 uses the sample of delinquent loans that also have information on the maturity of the mortgage. Column 3 draws a 40 percent sample of delinquent properties with information on mortgage maturity and estimates the probability of foreclosure using a probit model. The dependent variable in columns 4 and 5 is the log liquidation value. Column 4 includes the Inverse Mills Ratio obtained from column 3. Column 5 reports the benchmark OLS specification with the sample correction.

TABLE 7. THE IMPACT OF THE BANKS' BALANCE SHEET ON LIQUIDATION VALUES, ADDITIONAL ROBUSTNESS CHECKS

This table studies the impact of the bank balance sheet outcomes, observed the quarter before, on the liquidation value of bank-owned real estate. In all specifications, the dependent variable is the log price of the foreclosed property. All specifications include zip code, banks and year-by-quarter fixed effects, and standard errors are clustered by zip code and bank.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	zip code house price changes	non-bank foreclosures	zip code*year-quarter fixed effects	multi-state banks	all-state banks	banks active in >112 counties	banks active in >553 zip codes
Year on year change in deposits, scaled by assets	0.0951***	0.102***	0.114***	0.113***	0.121***	0.117***	0.120***
	(0.0339)	(0.0345)	(0.0322)	(0.0364)	(0.0393)	(0.0390)	(0.0388)
Tier 1 Capital/Risk Weighted Assets, lagged one quarter	0.400***	0.367***	0.205**	0.390***	0.544**	0.396**	0.386**
	(0.150)	(0.131)	(0.104)	(0.136)	(0.251)	(0.163)	(0.156)
Loans to Deposits, lagged one quarter	-0.311***	-0.270**	-0.230**	-0.276**	-0.246*	-0.263*	-0.257*
	(0.111)	(0.122)	(0.0949)	(0.127)	(0.133)	(0.133)	(0.133)
Deposits/Total Assets, lagged one quarter	-0.304*	-0.296	-0.347**	-0.345*	-0.412*	-0.376*	-0.386*
	(0.175)	(0.189)	(0.157)	(0.183)	(0.208)	(0.203)	(0.203)
Cash/Total Assets, lagged one quarter	-0.327**	-0.338**	-0.240***	-0.350**	-0.341**	-0.336**	-0.336**
	(0.134)	(0.137)	(0.0894)	(0.139)	(0.147)	(0.146)	(0.146)
Return on Assets, lagged one quarter	-0.592	-0.457	-0.535	-0.413	-0.127	-0.495	-0.475
	(0.565)	(0.625)	(0.515)	(0.743)	(0.933)	(0.889)	(0.886)
Log of Total Assets, lagged one quarter	0.0693	0.0626	0.0369	0.0619	0.0614	0.0567	0.0547
	(0.0479)	(0.0473)	(0.0271)	(0.0475)	(0.0510)	(0.0502)	(0.0498)
log number of non-bank foreclosures		-0.0594***					
		(0.0112)					
Observations	301,236	326,250	301,757	330,764	312,004	319,183	319,036
R-squared	0.592	0.604	0.693	0.605	0.604	0.605	0.605

TABLE 8. THE IMPACT OF THE BANKS' BALANCE SHEET ON LIQUIDATION VALUES: MEASUREMENT

	(1)	(2)	(3)	(4)
VARIABLES	6 month CD rate	Deposits and CD Rate	Market Equity	Book and Market Equity
Year on year change in deposits, scaled by assets		0.161***	0.111***	0.116***
		(0.0504)	(0.0378)	(0.0429)
change in 6 month deposit rate	-0.0252**	-0.0501***		
	(0.0104)	(0.0184)		
change in deposits*change in 6 month deposit rate		0.456**		
		(0.181)		
Tier 1 Capital/Risk Weighted Assets, lagged one quarter	1.246**	1.109**		0.325*
	(0.522)	(0.554)		(0.180)
Loans to Deposits, lagged one quarter	-0.412**	-0.436**	-0.288	-0.274
	(0.201)	(0.205)	(0.191)	(0.178)
Deposits/Total Assets, lagged one quarter	-0.256	-0.316**	-0.554***	-0.578***
	(0.156)	(0.160)	(0.154)	(0.157)
Cash/Total Assets, lagged one quarter	-0.568***	-0.581***	-0.262*	-0.305**
	(0.175)	(0.165)	(0.134)	(0.139)
Log of Total Assets, lagged one quarter	0.0835**	0.0746*	0.0793**	0.0818**
	(0.0392)	(0.0402)	(0.0343)	(0.0361)
Return on Assets, lagged one quarter	-0.686	-0.837	-0.334	-0.460
	(0.634)	(0.581)	(0.593)	(0.889)
change in stock price, previous quarter			2.393***	2.470***
			(0.787)	(0.719)
Observations	259,584	258,760	232,857	229,706
R-squared	0.604	0.604	0.614	0.614

In all specifications, the dependent variable is the log price of the foreclosed property. All specifications include zip code, bank and year-by-quarter fixed effects, and standard errors, in parentheses, are clustered by zip code and bank.

TABLE 9A. THE IMPACT OF THE BANKS' BALANCE SHEET ON LIQUIDATION VALUES: HETEROGENEITY

	(1)	(2)	(3)	(4)
VARIABLES	above median cash		below median cash	
Year on year change in deposits, scaled by assets	0.140***		0.174***	
	(0.0224)		(0.0295)	
change in 6 month deposit rate		-0.0183		-0.0388***
		(0.0222)		(0.0129)
Tier 1 Capital/Risk Weighted Assets, lagged one quarter	0.646***	1.498**	0.197	1.710**
	(0.227)	(0.671)	(0.149)	(0.828)
Loans to Deposits, lagged one quarter	-0.116	-0.650***	-0.292***	-0.312***
	(0.174)	(0.197)	(0.0803)	(0.111)
Deposits/Total Assets, lagged one quarter	-0.0753	-0.0496	-0.585***	-0.0124
	(0.139)	(0.188)	(0.182)	(0.224)
Cash/Total Assets, lagged one quarter	-0.449*	-0.867***	-0.247**	-0.339**
	(0.228)	(0.215)	(0.114)	(0.153)
Log of Total Assets, lagged one quarter	-0.0621	0.0490	0.0709	0.109
	(0.0477)	(0.0315)	(0.0513)	(0.0863)
Return on Assets, lagged one quarter	0.0472	2.354*	0.492	-0.00172
	(0.673)	(1.205)	(0.884)	(0.733)
Observations	196,272	173,363	137,868	85,040
R-squared	0.609	0.608	0.622	0.629

In all specifications, the dependent variable is the log price of the foreclosed property. All specifications include zip code, bank and year-by-quarter fixed effects, and standard errors, in parentheses, are clustered by zip code and bank. The above and below median cash subsamples are based on the cash to assets ratio averaged between 2001-2006

TABLE 9B. THE IMPACT OF THE BANKS' BALANCE SHEET ON LIQUIDATION VALUES: HETEROGENEITY

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	above median cash	below median cash	above median cash	below median cash	Judicial States	Power of Sale States
Year on year change in deposits, scaled by assets	-0.447	0.0365	0.123**	0.106***	0.066**	0.107***
	(0.319)	(0.154)	(0.0521)	(0.0308)	(0.031)	(0.025)
Tier 1 Capital/Risk Weighted Assets, lagged one quarter	0.409*	0.344**	0.743*	0.0790	0.314*	0.373**
	(0.246)	(0.146)	(0.389)	(0.168)	(0.178)	(0.148)
year on year change in deposits, scaled by assets*off-balance sheet comittments+assets/assets	0.406	0.104				
	(0.247)	(0.144)				
off-balance sheet comittments+assets/assets	0.496***	0.268***				
	(0.0732)	(0.0886)				
change in deposits*log of non-bank foreclosures in zip code			0.00663	0.0199**		
			(0.0186)	(0.00948)		
Tier 1 Capital/Risk Weighted Assets*log number of non-bank foreclosures in zip code			-0.0481	0.0158		
			(0.136)	(0.0506)		
log number of non-bank foreclosures in zip code			-0.0526***	-0.0723***		
			(0.0196)	(0.00512)		
Observations	196,296	137,847	191,032	134,200	137,463	197,752
R-squared	0.609	0.622	0.608	0.619	0.487	0.579

In all specifications, the dependent variable is the log price of the foreclosed property. All specifications include zip code, bank and year-by-quarter fixed effects, and standard errors, in parentheses, are clustered by zip code and bank. The sum of the coefficients: Year on year change in deposits, scaled by assets+ year on year change in deposits, scaled by assets*off-balance sheet comittments+assets/assets in column 1 is -0.04 (p-value=0.57). The value of this sum in column 2 is 0.140 (p-value=0.00). The sum of "Year on year change in deposits, scaled by assets+ change in deposits"*"log of non-bank foreclosures in zip code" is 0.129 (p-value=0.03) in column 3. In column 4 this sum is 0.126 (p-value=0.00). In column 3 the sum of the coefficients: Tier 1 Capital/Risk Weighted Assets*log number of non-bank foreclosures in zip code+ Tier 1 Capital/Risk Weighted Assets, lagged one quarter is 0.69 (p-value=0.02). In column 4 the sum is 0.09 (p-value=0.64).

TABLE 10. THE IMPACT OF BANKS' BALANCE SHEETS ON QUANTITIES.

The dependent variable equals 1 if a property is sold in the quarter and 0 otherwise. The sample begins in 2006 Q1 and ends in 2015 Q4. Columns 2-4 include the hedonic controls from column 4 of Table 5. All specifications include zip code, banks and year-by-quarter fixed effects, and standard errors are clustered by zip code and bank. Above (below) median cash denote the sample of banks whose cash to asset ratio, averaged from 2001-2006, is above (below) the median.

	(1)	(2)	(3)	(4)
	Full Sample	Hedonic Controls	Above median cash	Below median cash
Year on year change in deposits, scaled by assets, lagged one quarter	-0.0709***	-0.0751***	-0.0810***	-0.139***
	(0.0193)	(0.0206)	(0.0170)	(0.0381)
Loans/Deposits, lagged one quarter	0.239***	0.239***	0.412***	0.0788
	(0.0713)	(0.0705)	(0.131)	(0.129)
Cash/Total Assets, lagged one quarter	0.218***	0.218***	0.251***	0.119***
	(0.0512)	(0.0504)	(0.0797)	(0.0339)
Deposits/Total Assets, lagged one quarter	-0.103	-0.109	-0.323***	0.111
	(0.126)	(0.132)	(0.106)	(0.110)
Return on Assets, lagged one quarter	0.235	0.209	0.921***	-0.305
	(0.272)	(0.261)	(0.342)	(0.653)
Log of Total Assets, lagged one quarter	0.0503***	0.0549***	0.0790*	0.0966***
	(0.0139)	(0.0146)	(0.0457)	(0.0109)
Tier 1 Capital/Risk Weighted Assets, lagged one quarter	0.194	0.189	0.0557	-0.0212
	(0.147)	(0.145)	(0.130)	(0.213)
Lot size, square feet, logs		-0.0115***	-0.0116***	-0.0113***
		(0.000631)	(0.000737)	(0.000712)
Total number of bedrooms, logs		0.000828	0.00211	0.000246
		(0.00172)	(0.00370)	(0.00116)
Total number of baths, logs		-0.00702***	-0.00702*	-0.00745***
		(0.00189)	(0.00399)	(0.00210)
Year built, logs		0.0120	0.0717	-0.0256
		(0.0462)	(0.0878)	(0.0428)
Observations	1,173,942	975,498	397,068	578,423
R-squared	0.126	0.129	0.144	0.127

TABLE 11. SPILLOVERS: THE IMPACT OF BANK LIQUIDATION VALUES ON NON-BANK SALES

The dependent variable is the log price of a non-bank owned foreclosed property. The variable the variable "log price of nearest bank foreclosure, previous 3 (18 months) months" is the price obtained in the nearest bank sale—from the sample used in column 2 of Table 5—in the previous 3 (18) months. In columns 1 and 2, this distanced is capped at no more than 7.5 miles away from the non-bank property. Columns 3 and 4 limit the maximum distance to no more than 0.3 miles. Column 4 instruments the price of bank-owned sale with the Year on year change in deposits, scaled by assets in the previous quarter, and tier 1 capital to assets, again in the previous quarter (column 2 of Table 5). All specifications include year-by-quarter and zipcode fixed effects. Standard errors are clustered at the zipcode and year-by-quarter level. Column 4 also includes bank fixed effects based on the nearest bank-owned sale.

	(1)	(2)	(3)	(4)
VARIABLES	three months and less than 7.5 miles	18 months and less than 7.5 miles	18 months and less than 0.3 miles	18 months and less than 0.3 miles
	OLS			2SLS
log price of nearest bank foreclosure, previous three months	0.0925***			
	(0.00724)			
log price of nearest bank foreclosure, previous eighteen months		0.121***	0.148***	0.328**
		(0.00929)	(0.00979)	(0.159)
Observations	320,400	326,549	199,730	194,869
R-squared	0.547	0.555	0.515	0.523

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