
W. SCOTT FRAME
DIANA HANCOCK
WAYNE PASSMORE

Federal Home Loan Bank Advances and Commercial Bank Portfolio Composition

Federal Home Loan Bank (FHLB) advances are a source of government-sponsored liquidity intended to encourage housing finance, although “community financial institutions” may use such funds more generally. Because money is fungible, it is an empirical question as to how advances are actually employed. Using panel-vector autoregression techniques, we estimate dynamic responses of U.S. commercial bank portfolios to: FHLB advance shocks, bank lending shocks, and macroeconomic shocks. We find that FHLB advances: (i) are used as a general source of liquidity by U.S. commercial banks of all sizes and (ii) dampen the sensitivity of mortgage lending to macroeconomic shocks at small banks.

JEL codes: G18, G21, G38

Keywords: Federal Home Loan Bank, government-sponsored enterprise, advances, mortgage funding, portfolio shocks, panel-VAR.

THE U.S. GOVERNMENT TAKEOVER of Fannie Mae and Freddie Mac in September 2008 trained a spotlight on the nation’s enormous housing-related government-sponsored enterprises (GSEs). These unusual financial institutions are individually chartered by Congress to perform a public mission, but owned by private shareholders. Fannie Mae and Freddie Mac are broadly charged with maintaining residential mortgage market liquidity, which they do by selling credit guarantees on

The views expressed do not necessarily reflect those of the Board of Governors of the Federal Reserve System, the Federal Reserve Bank of Atlanta, or their respective staffs. We thank Brent Ambrose, Robert DeYoung, Deborah Lucas, Joseph McKenzie, Joe Peek, Larry Wall, two anonymous referees, and various seminar participants for helpful comments on previous drafts. We also thank Melissa Hamilton for her outstanding research assistance.

W. SCOTT FRAME is a *Financial Economist and Senior Policy Advisor, Federal Reserve Bank of Atlanta, Atlanta, GA* (E-mail: scott.frame@atl.frb.org). DIANA HANCOCK is a *Deputy Associate Director, Research & Statistics, Board of Governors of the Federal Reserve System, Washington, DC* (E-mail: diana.hancock@frb.gov). WAYNE PASSMORE is an *Associate Director, Research & Statistics, Board of Governors of the Federal Reserve System, Washington, DC* (E-mail: wayne.passmore@frb.gov).

Received May 9, 2007; and accepted in revised form August 17, 2011.

Journal of Money, Credit and Banking, Vol. 44, No. 4 (June 2012)

© 2012 The Ohio State University

mortgage pools (a form of securitization). The third housing GSE—the Federal Home Loan Bank System—is a collection of 12 regionally dispersed and cooperatively owned wholesale Federal Home Loan Banks (FHLBs). The mission of the FHLBs is to provide their over 8,000 members with financial products and services to assist and enhance in the financing of housing and community lending—principally by making collateralized loans known as “advances.”¹ Historically, FHLB advances were legally required to finance housing-related financial assets. Since 2000, however, FHLB advances made to “community financial institutions” can be used to finance small businesses, small farms, and small agribusinesses.²

Measuring the extent to which a GSE’s primary business activities provide gross social benefits—as defined by its statutory mission—is a critical first step toward understanding whether such interventions are desirable. (Of course, even then, one has not accounted for costs, including general equilibrium distortions.) With respect to Fannie Mae and Freddie Mac, a large literature has emerged that attempts to estimate the effect of their activities on mortgage interest rates.³ Remarkably (as noted by McCool 2005), there has been little attempt to examine similar questions for the FHLB System.⁴

This paper examines the role of FHLB advances as a funding source for U.S. commercial banks—with a special focus on the extent to which these loans particularly assist member banks’ financing of housing.⁵ Three questions are asked. First, are unexpected changes in FHLB advances correlated with changes in residential mortgage lending and other forms of bank lending? Second, are unexpected changes in bank loan portfolios, including residential mortgages, accommodated using FHLB advances? Third, do FHLB advances help to insulate bank mortgage funding from macroeconomic shocks (e.g., unexpected changes in the federal funds rate [FFR] or GDP)? To answer these questions, we estimate the recent dynamic responses of U.S. commercial bank portfolios to FHLB advance shocks, to unexpected loan demand shocks, and to macroeconomic shocks using a panel-VAR. We do this for three time periods: 1997:Q1–2000:Q4, a period during which commercial banks learned how to utilize FHLB advances; 2001:Q1–2007:Q2, a period during which there was a

1. See 12 C.F.R. § 1265. Other FHLB activities include (i) acquiring member assets (e.g., mortgages), (ii) stand-by letters of credit, (iii) intermediary derivative contracts, and (iv) debt or equity investments (which primarily benefit households below 80% of area median income).

2. See 12 U.S.C. § 1430 (a)(2)(A).

3. See McKenzie (2002) for a review of this literature. Ambrose, LaCour-Little, and Sanders (2004) and Passmore, Sherlund, and Burgess (2005) provide recent contributions.

4. Two studies have shown that FHLB members tend to hold more mortgage-related asset holdings, but neither study was able to credibly establish that these higher mortgage holdings are a consequence of FHLB membership or FHLB activities. Neither Thomson (2002) nor Tuccillo, Flick, and Ranville (2005) can ascribe a causal relationship since the reverse relation is unaccounted for (i.e., that more active mortgage lenders are those most likely to join the FHLB System). These papers are also hampered by the fact that the other explanatory variables in the empirical models (the other portions of bank portfolios) are treated as exogenous, when they are endogenously determined.

5. Advances are the primary channel by which the FHLBs fulfill their public mission and commercial banks comprise 71% of FHLB System membership.

nonagency securitization boom; and 2007:Q3–2009:Q4, a financial crisis period during which the FHLBs may have played a special role in stabilizing mortgage credit.⁶

By way of preview, we present the following results. First, bank portfolio responses to FHLB advance shocks are of similar magnitude for residential mortgages, for commercial and industrial loans, and for other real estate loans. Second, unexpected changes in various types of lending are accommodated using FHLB advances, although specific results depend on bank size and the time period studied. Third, small and medium-sized banks appear to have used FHLB advances to reduce the variability in residential mortgage lending resulting from either FFR shocks or GDP shocks. Overall, we find that commercial banks increasingly relied on FHLB advances as a wholesale funding source through the financial crisis and—because money is fungible—advances are being used to fund all types of financial assets, not just residential mortgages. Such findings are consistent with regulatory efforts aimed at strengthening the statutory tie between FHLB membership and mortgage finance (see U.S. Federal Housing Finance Agency 2011) and limiting FHLB access for the very largest U.S. commercial banks (as proposed by U.S. Treasury Department and U.S. Department of Housing and Urban Development 2011).

The rest of the paper is organized as follows: Section 1 provides some background information about the FHLB System and FHLB advances. Section 2 describes the data, while Section 3 outlines our empirical methods. Section 4 presents the results and the last section concludes.

1. BACKGROUND: THE FHLB SYSTEM AND FHLB ADVANCES

The FHLB System was created in 1932 and consists of 12 regional wholesale FHLBs and an Office of Finance that acts as the FHLBs' gateway to the capital markets.⁷ Each FHLB is a separate legal entity, cooperatively owned by its member financial institutions (commercial banks, thrifts, credit unions, and insurance companies), that has its own management, employees, and board of directors. The individual FHLBs do not generally compete for members as each institution is assigned a distinct geographic area to serve.⁸ However, the FHLB System is often viewed as a whole because most of the FHLBs' financing takes the form of debt for which the 12 institutions are jointly and severally liable "consolidated obligations." Flannery and Frame (2006) provide a detailed overview of the structure, activities, and risks of the FHLB System.

6. See Ashcraft, Bech, and Frame (2010) for an overview of FHLB System response to their members' liquidity demands at the outset of the recent financial crisis.

7. The 12 FHLBs are located in Atlanta, Boston, Chicago, Cincinnati, Dallas, Des Moines, Indianapolis, New York, Pittsburgh, San Francisco, Seattle, and Topeka. The Office of Finance is located in Reston, Virginia.

8. Some financial institutions do maintain charters in multiple FHLB districts, which allow them to be members of more than one FHLB. This creates a degree of inter-FHLB competition.

FHLB System assets totaled over \$1.0 trillion at year-end 2009.⁹ Advances comprise the majority of assets (\$631.2 billion, or about 62.1% of total assets). The most common forms of advance collateral are mortgage-related assets (whole loans and mortgage-backed securities) and U.S. Treasury and Federal Agency securities.¹⁰ Beyond the explicit collateral, the FHLBs also have priority over the claims of depositors and almost all other creditors (including the Federal Deposit Insurance Corporation) in the event of a member's default—known as a “super-lien.”¹¹

The FHLBs also maintain portfolios of investments (\$284.4 billion on a consolidated basis) and residential mortgage loans purchased from their members (\$71.4 billion on a consolidated basis). Around 96% of the consolidated asset portfolio of the FHLB System is funded with debt, almost all of which takes the form of the consolidated obligations issued by the Office of Finance. The FHLB System also funds roughly 4% of their assets through equity capital, most of which is derived from mandatory member stock subscriptions.

Advances are the dominant activity conducted by the FHLB System and hence the most natural place to look for an effect of FHLBs on mortgage markets. Historically, these collateralized borrowings could only be used to finance housing-related assets. However, this link is likely to have markedly weakened over the past 75 years due to changes in the legal environment, information technology, and financial practice.

During its first 50 years or so of existence, the FHLB System primarily acted as a reliable supplier of long-term funding via advances for the thrift industry. During this time, Congress imposed asset limitations on thrifts that resulted in balance sheets almost entirely composed of residential mortgage-related assets. All depository institutions were also subject to limitations on the interest rates that they paid depositors (under Regulation Q), which periodically resulted in liquidity pinches. Hence, thrift access to FHLB advances was important for maintaining mortgage funding during deposit shortages. We refer to the view that FHLB advances are tightly linked to residential mortgage lending as the “mortgage funding view” of FHLB activities.¹²

A series of changes since 1980 significantly altered the U.S. mortgage finance system. First, the Depository Institutions Deregulation and Monetary Control Act of 1980 and the Garn-St. Germain Depository Institutions Act of 1982 terminated

9. Financial data for the FHLB System are available from Federal Home Loan Banks' Office of Finance at: <http://www.fhlab-of.com>.

10. See 12 U.S.C. 1430(a)(3) for a complete list of eligible collateral. Federal agency securities are generally synonymous with debt and mortgage-backed securities issued by government sponsored enterprises.

11. In particular, the FHLB maintains a claim senior to depositors, unsecured and secured creditors, and the claims of any receiver, conservator, or trustee. The only excepted claims are those entitled priority under otherwise applicable law or where a secured party has perfected a security interest in specific assets. When resolving an insolvent depository institution, the FDIC has made it a practice to simply make FHLB creditors whole straightaway, including prepayment penalties associated with advances. See Stojanovic, Vaughan, and Yeager (2008) for a description of how FHLB advances may increase the probability of bank default and raise the FDICs expected losses given default.

12. This view is consistent with that articulated in early studies of the FHLB System by Silber (1973), Goldfield, Jaffee, and Quandt (1980), and Mays (1989). Related studies examined whether FHLB debt issuance may also actually lead to some disintermediation (crowding out): Kwon and Thornton (1971), Van Horne (1973), Fortune (1976), and Ostas (1981).

the Regulation Q ceiling on savings account interest rates and gave thrifts expanded investment powers, respectively. Second, the Financial Institutions Recovery and Reform Act of 1989 opened FHLB membership to all depository institutions with more than 10% of their portfolios in residential mortgage-related assets (i.e., whole mortgages and mortgage-backed securities). Third, the Financial Services Modernization Act of 1999 expanded the mission of the FHLB System to act as a general source of liquidity to “community financial institutions” and lifted the requirement that federally chartered thrifts be members of this GSE. Finally, the Housing and Economic Recovery Act of 2008 expanded the definition of a “community financial institution” from \$500 million to \$1 billion in total assets (with each figure adjusted over time to account for inflation).

Today, all types of depository institutions are eligible for FHLB membership (commercial banks, thrifts, and credit unions). In addition, mortgage markets are now national in scope because of the removal of geography-based banking restrictions, improvements in information technology, and the growth in mortgage securitization. Hence, any link between FHLB advances and mortgage lending is likely to be much weaker today than in the distant past. Indeed, given the modest constraint on FHLB membership related to residential mortgage activity, the portfolio composition of most FHLB members (especially the largest commercial members which dominate advance activity), and the simple fact that money is fungible; FHLB advances could be funding virtually any type of asset. We refer to the view that FHLB advances are but one of many sources of wholesale funds that are not linked to any particular asset type as the “wholesale funding view” of FHLB advance activity.

Our analysis below attempts to empirically distinguish the “mortgage funding view” (i.e., advances are used to smooth deposit funding for the purpose of originating mortgages) from the “wholesale funding view” (i.e., advances are but one of many sources of funds that are not linked to any particular asset type) using data on commercial bank portfolios.¹³ Of course, we would expect that the relationship between FHLB advances and mortgage funding to be weaker for small banks over the past decade as many of these institutions could be classified as “community financial institutions.”

2. DATA

Information on FHLB advances held by their members (ADV) is available on a quarterly basis from the Federal Housing Finance Board.^{14, 15} The top panel of Table 1

13. We do not examine thrifts in our analysis because their portfolios remain largely dominated by residential mortgage-related assets. Hence, one would naturally expect a very strong relationship between FHLB advances and mortgage lending for thrifts.

14. As discussed earlier, the Housing and Economic Recovery Act of 2008 created a new regulator for the Federal Home Loan Banks, the Federal Housing Finance Agency (FHFA). Because of this change, the most recent quarterly data came from the FHFA.

15. When two entities merge, the Federal Housing Finance Board information does not add the FHLB advances outstanding for the predecessor and the successor. Rather, the successor entity has its own

TABLE 1
FHLB COMMERCIAL BANK MEMBER ADVANCE BORROWING: 2009:Q4

Panel A. FHLB commercial bank members: 2009:Q4

| Commercial banks asset size | Number of banks (1) | Number of borrowers (2) | Advances outstanding (\$ billions) (3) | Percent of advances to borrower assets (4) | Percent of FHLB advances (5) |
|--------------------------------|---------------------------|-------------------------------|---|---|---------------------------------------|
| Less than \$100 million | 1,749 | 1,106 | 4.1 | 6.2 | 0.7 |
| \$100 million to \$500 million | 2,939 | 2,307 | 32.8 | 6.3 | 5.3 |
| \$500 million to \$1 billion | 516 | 455 | 20.6 | 6.6 | 3.3 |
| \$1 billion to \$50 billion | 435 | 391 | 127.2 | 8.3 | 20.7 |
| Greater than \$50 billion | 26 | 23 | 167.9 | 3.0 | 27.3 |
| Total | 5,665 | 4,282 | 352.6 | — | 57.3 |

Panel B. FHLB commercial bank top holder members: 2009:Q4

| Bank top holder size category | Number of top holders (1) | Number of borrowers (2) | Advances outstanding (\$ billions) (3) | Percent of advances to borrower assets (4) | Percent of FHLB advances (5) |
|--|---------------------------------|-------------------------------|---|---|---------------------------------------|
| Small | 2,200 | 1,201 | 7.7 | 6.3 | 1.3 |
| Medium | 2,503 | 1,818 | 56.4 | 6.3 | 9.2 |
| Large | 282 | 242 | 288.5 | 3.0 | 46.9 |
| Total | 4,985 | 3,261 | 352.6 | — | 57.3 |
| Memo: 10 largest top holder members | 10 | 10 | 158.3 | 2.2 | 25.7 |

NOTE: Small top holders are those with assets at or below the 50th percentile of the distribution of total assets. Medium top holders are those with assets between the 50th and 95th percentiles of the distribution of total assets. Large top holders are those with assets at or above the 95th percentile of the distribution of total assets.

provides data on commercial bank usage of FHLB advances as of 2009:Q4 with the institutions stratified into five asset size groups (less than \$100 million, \$100 million to \$500 million, \$500 million to \$1 billion, \$1 billion to \$50 billion, and greater than \$50 billion).

Collectively, commercial banks account for 57.3% of FHLB advances. However, most striking is how concentrated FHLB advance lending is in the largest banks: commercial banks with greater than \$1 billion in total assets—institutions that typically have many sources of wholesale funding—represent about 8% of FHLB membership but account for about 48.0% of FHLB advances. Furthermore, among the 26 commercial banks with greater than \$50 billion in total assets that are also FHLB members, 23 institutions had advances outstanding totaling \$167.9 billion, or 27.3% of total FHLB advances outstanding. Below, we focus our analysis exclusively on commercial banks given their large and increasing importance to the FHLB System

FHLB advances as of the date of the merger and any additional advances extended after the merger date. Quarterly Call Report data on FHLB advances do pool the advances of the predecessor and successor, but are available only since 2001:Q1.

and because these lenders have greater opportunity to use advances to fund many different types of financial assets—not only residential mortgages.¹⁶

Because asset-liability management is typically centralized within a banking organization, we construct asset and liability data at the “top holder” level. For example, a bank holding company, which is composed of a lead bank and several subsidiary banks, would be the top holder of the banking organization. We aggregated individual bank asset and liability information to the domestic top holder level using information from the National Information Center (NIC), which is the central repository containing information about all U.S. banking organizations and their domestic and foreign affiliates. A bank that is unaffiliated with any other bank is considered to be its own top holder organization.

Top holder entities were stratified into three size groups in each quarter: (i) small top holders have total assets at or below the 50th percentile of the distribution of total assets, (ii) medium top holders have total assets between the 50th and 95th percentiles of the distribution of total assets, and (iii) large top holders have total assets at or above the 95th percentile of the distribution of total assets. As shown in the bottom panel of Table 1, as of year-end 2009, these percentile cutoffs for the three top holder size groups allocate top holders such that 2,200 (44.1%) of the sample is considered “small,” 2,503 (50.2%) of the sample is “medium,” and 282 (5.7%) of the sample is “large.” At the same time, fewer than 1,201 (55%) of the smallest top holder members borrowed from a FHLB and together they borrowed just \$7.7 billion. By contrast, about 72.6 (85.8)% of medium (large) top holders borrowed from their FHLB and together these entities borrowed \$56.4 billion (\$288.5 billion). This is again consistent with FHLB borrowings being heavily skewed toward the largest commercial banking organizations.

FHLB System members generally have a stock of advance-eligible collateral that far exceeds their advance borrowings. Figure 1 presents histograms for advances-to-eligible-asset ratios (in percent) for small top holders (top row), medium top holders (middle row), and large top holders (bottom row) as of: 1997:Q1 (left column), 2001:Q1 (middle column), and 2009:Q4 (right column). Eligible assets are defined as the sum of: U.S. Treasury and Federal Agency securities, total mortgage-backed securities (Federal Agency and privately issued), single- and multifamily residential mortgages, construction and development loans, and commercial real estate loans. This is consistent with the prescribed statutory limits on eligible collateral.¹⁷

Looking across the top row of Figure 1, a fairly high proportion of small top holder FHLB members—40% or more—had no advances at all at each quarters-end.

16. The thrift industry in aggregate is much smaller than the banking industry. As of December 31, 2009, there were 7,270 U.S. commercial banks with combined domestic assets of \$10.34 trillion. By contrast, there were only 284 savings and loans, 362 insured state chartered savings banks, and 483 federal savings banks with combined domestic assets of \$1.25 trillion. Virtually all of these thrift institutions are FHLB members.

17. See 12 U.S.C. § 1430(a)(3). Small business loans and agricultural loans (and securities backed by such loans) are also eligible collateral for FHLB advances to community financial institutions. However, to maintain consistency, we have not included such collateral in our calculations.

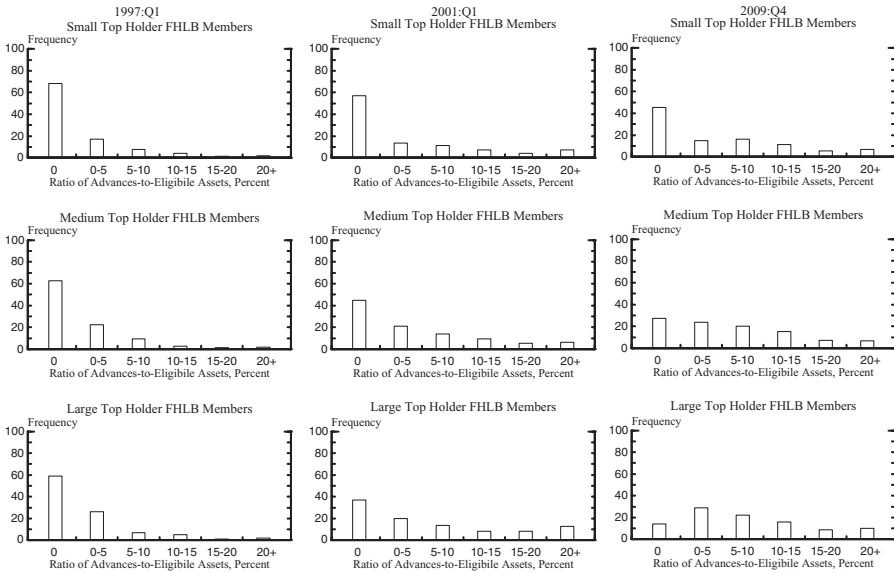


FIG. 1. Ratio of FHLB Advances-to-Eligible Assets by Bank Top Holder Size Category (Small, Medium, and Large) and Time Period (1997:Q1, 2001:Q1, and 2009:Q4).

Comparing the top row with the middle and bottom rows of the figure, the proportion of top holder FHLB members with no advances at all declines as the size of the top holder group increases. Moreover, within each row of Figure 1, the intensity of advance usage increases with higher proportions of members having higher ratios of advances-to-eligible assets in 2009:Q4 (right column) than in 2001:Q1 (middle column) or 1997:Q1 (left column). That said, regardless of top holder size, virtually all top holder FHLB members used much less than 50% of their eligible collateral for FHLB advances. This suggests that collateral is *not* a binding constraint for commercial banks—even when there is financial market turmoil, a shutdown in non-agency mortgage securitization, and significant reductions in the market values of some types of eligible collateral. Given that money is fungible, this constraint would have to be binding in order for us to be confident that FHLB advances are being used exclusively to fund residential mortgage-related assets.

Figure 2 presents aggregate time-series information on the number of FHLB members and their advances outstanding for the three top holder size groups during 1996:Q4–2009:Q4, inclusive. Each series was normalized by its respective time-series mean during the sample period so changes in growth can more easily be discerned. (The two vertical lines in the panel for each top holder size category indicate when each of the two time-series equals its mean value, i.e., when one of the normalized series equals one.) There appear to be three distinct time periods for the growth rates of FHLB membership and advance usage. Over the 1996:Q4–2000:Q4 period,

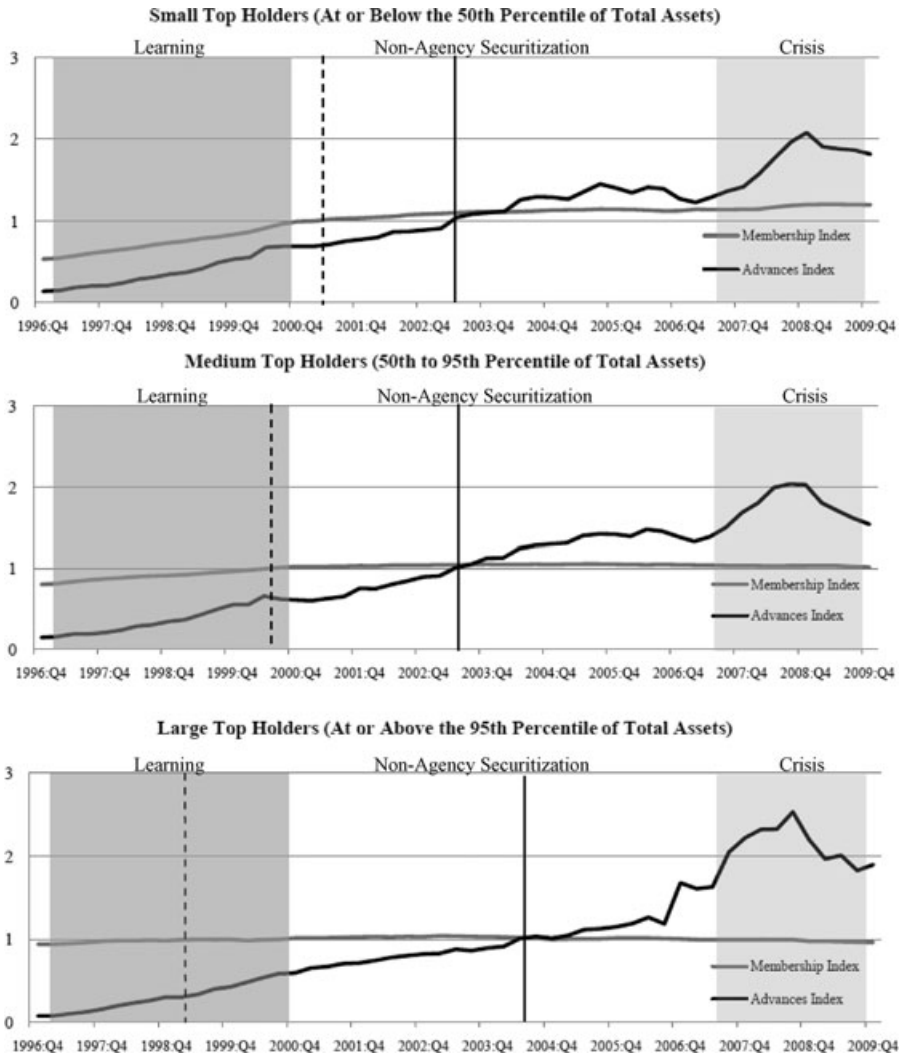


FIG. 2. Trends in FHLB Membership and Advances By Bank Top Holder Size Category (Small, Medium, and Large): 1996:Q4–2009:Q4.

NOTE: Quarterly series for FHLB membership and FHLB advances were constructed for each top holder size group. Size determinations are made on a quarterly basis. Each series was normalized by its respective mean for the 1996:Q4–2009:Q4 period to create indices of membership and advances usage. Vertical lines indicate when the respective indices are equal to their mean value.

both membership and advance usage grew rapidly—with the advances growing faster than membership for small-, medium-, and large-sized top holders. We refer to 1997:Q1–2000:Q4 as the “learning period” for commercial banks using FHLB advances. During 2001:Q1–2007:Q2, nonagency securitization activities, particularly

for nonprime mortgages, grew at a very rapid pace.¹⁸ During this “nonagency securitization boom period,” FHLB membership is stable for each top holder size class and FHLB advance usage appears to be responding to other factors, such as changes in macroeconomic conditions. For these reasons, we view the nonagency securitization boom period as the most useful one for considering whether FHLB advances influence the amount bank mortgage lending in the presence of ample capital market funding opportunities for mortgages. Finally, there is the 2007:Q3–2009:Q4 period that was anything but normal: nonagency mortgage securitization origination ceased, financial markets seized up, and the market valuations for some types of eligible advance collateral plummeted. This “crisis period” is one with stable FHLB membership, but enormous growth in advance usage for each top holder size group. Strikingly, the indexes for advances more than doubled at the respective peaks across the three size groups, but the descent has been steeper for the largest top holder size group and much more gradual for the smallest top holder size group.

Call Reports for individual, federally insured, domestically chartered commercial banks were used to construct quarterly data for six balance sheet components—residential mortgages (MORT), other real estate loans (OREL), securities (SEC), commercial and industrial loans (C&I), domestic deposits (DEP), and equity capital (EQUITY).¹⁹ Call Reports generally include book values, rather than market values, for each balance sheet component. We supplement these balance sheet variables with our quarterly measure of FHLB advances (ADV) obtained from the Federal Housing Finance Board.

Data were constructed for four asset categories. When feasible, only domestic loans were included in each of these asset categories. Residential mortgages (MORT) include (i) the amount of all permanent loans secured by first liens on 1-to-4 family residential properties, (ii) the amount of all permanent loans secured by junior (i.e., other than first) liens on 1-to-4 family residential properties, and (iii) the amount outstanding of “home equity lines.”^{20,21} Other real estate loans (OREL) consist of (i) construction and land development loans, (ii) loans secured by farmland, (iii) loans secured by multifamily (five or more units) residential properties, and (iv) loans secured by nonfarm nonresidential properties.²² Securities (SEC) equaled the sum of the amortized cost for “held-to-maturity” securities and fair value for

18. The International Monetary Fund (2009) provides a chart on global private-label securitization issuance by type—asset-backed commercial paper, mortgage-backed securities, asset-backed securities, collateralized debt obligations (CDOs), and CDOs backed by tranches of other CDOs (CDO²). In 2000, the global issuance of such securities was less than \$1.5 trillion. By 2006, the global issuance of such securities was in excess of \$4.5 trillion.

19. Each bank (i) had positive net loans and leases and positive equity capital, (ii) was headquartered in one of the fifty U.S. states, and (iii) indicated that its primary activity was commercial banking.

20. Home equity lines are typically secured by a junior lien and usually are accessible by check or credit card. The reported value on the Call Report is the amount outstanding as of the report date, not the total amount that the customer is authorized to borrow under such arrangements.

21. $MORT = RCON1797 + RCON5367 + RCON5368$. (RCON is the Call Report mnemonic for domestic balance sheet and income information for banks. RCFD is the Call Report mnemonic for both domestic and foreign information for banks.)

22. $OREL = RCON1415 + RCON1420 + RCON1460 + RCON1480$.

“available-for-sale” securities.²³ Lastly, the amount of commercial and industrial loans (C&I) includes loans to borrowers domiciled in both the U.S. and abroad.²⁴

With regard to the funding mix, besides total FHLB advances outstanding (ADV), data were constructed for domestic deposits (DEP) and total equity capital (EQUITY). Domestic deposits include transaction accounts, nontransaction savings deposits, and total time deposits less than \$100,000.²⁵ Total equity capital includes common stock, perpetual preferred stock, surplus, retained earnings, and accumulated other comprehensive income.²⁶

Table 2 provides summary statistics (means and standard deviations) for each of the six commercial bank balance sheet component variables broken out by: (i) top holder size (small, medium, and large), (ii) institutions with and without FHLB advances, and (iii) the three time periods of interest (learning period, nonagency securitization boom period, and crisis period). Among small and medium top holders, it appears that those with FHLB advances are larger, on average, than those without FHLB advances (in each of the three periods). This does not appear to be the case for large top holders during the learning and nonagency securitization boom periods. Three data series were constructed at a quarterly frequency to gauge aggregate economic conditions. Our measure of aggregate output—quarterly gross domestic product (GDP)—is measured in real time (i.e., without any subsequent revisions).

These data were obtained from the Federal Reserve Bank of Philadelphia. Our measure of the short-term interest rate—the quarter-end daily FFR—was collected from the Federal Reserve Economic Database (FRED) maintained by the Federal Reserve Bank of St. Louis. Our measure of the slope of the yield curve—the difference between quarter-end 10-year and 1-year Treasury rates (YIELD)—was computed using constant maturity Treasury yields, which are also available from the FRED.²⁷ The bottom panel of Table 2 presents summary statistics (means and standard deviations) for FFR, YIELD, and GDP during each of the three periods of interest (identified above).

3. EMPIRICAL MODEL

There is evidence that banks typically make portfolio-wide but gradual, adjustments to their holdings of both financial assets and liabilities in response to unexpected events. For example, using aggregate data, Bernanke and Blinder (1992) and Den Haan, Sumner, and Yamashiro (2004) estimate that interest rate shocks affect

23. $SEC = RCON1754 + RCON1773$.

24. $C\&I = RCON1766$. For banks with less than \$300 million in assets, this item is only reported on a consolidated basis (i.e., commercial and industrial loans = $RCON1766$).

25. $DEP = RCON2702$.

26. $EQUITY = RCON3210$.

27. These yields are interpolated by the U.S. Department of the Treasury from the daily yield curve based mainly on quarter-end “on-the-run” Treasury securities.

TABLE 2
SUMMARY STATISTICS OF VARIABLES IN THE PANEL VECTOR AUTOREGRESSION MODELS FOR COMMERCIAL BANKS WITH AND WITHOUT FHLB ADVANCES BY BANK TOP HOLDER SIZE CATEGORY AND BY TIME PERIOD

| Variable | Small top holders (in millions) | | | | | | | | | | | | | |
|----------|---------------------------------|------------------|----------|-----------------|------------------|-------|-----------------|------------------|----------|---------------|------------------|-------|----------|-------|
| | 1997:Q1-2000:Q4 | | | 2001:Q1-2007:Q2 | | | 2007:Q3-2009:Q4 | | | | | | | |
| | With advances | Without advances | | With advances | Without advances | | With advances | Without advances | | With advances | Without advances | | | |
| Mean | St. dev. | Mean | St. dev. | Mean | St. dev. | Mean | St. dev. | Mean | St. dev. | Mean | St. dev. | Mean | St. dev. | |
| MORT | 9.16 | 6.45 | 5.45 | 5.09 | 11.67 | 8.83 | 7.38 | 7.15 | 14.90 | 11.45 | 9.36 | 9.31 | 14.90 | 14.90 |
| OREL | 7.95 | 5.50 | 5.35 | 5.05 | 14.78 | 11.58 | 9.97 | 10.23 | 23.93 | 17.04 | 14.98 | 14.90 | 23.93 | 14.90 |
| CI | 4.57 | 3.63 | 3.51 | 3.57 | 6.51 | 5.66 | 4.87 | 5.23 | 8.36 | 7.35 | 5.85 | 6.32 | 8.36 | 5.85 |
| SEC | 12.05 | 7.87 | 10.44 | 7.55 | 14.10 | 10.80 | 12.71 | 10.42 | 15.02 | 12.56 | 14.38 | 12.59 | 15.02 | 14.38 |
| DEP | 28.95 | 10.99 | 23.20 | 11.87 | 33.71 | 14.26 | 26.94 | 14.88 | 39.80 | 19.21 | 31.15 | 19.22 | 39.80 | 31.15 |
| EQUITY | 4.56 | 2.07 | 4.18 | 2.39 | 6.44 | 3.18 | 5.95 | 4.04 | 8.67 | 4.44 | 7.93 | 5.40 | 8.67 | 7.93 |
| ADV | 2.53 | 2.73 | — | — | 3.99 | 3.94 | — | — | 5.41 | 5.19 | — | — | 5.41 | 5.19 |
| N | 1,219 | — | 4,350 | — | 2,028 | — | 3,929 | — | 1,720 | — | — | — | 1,720 | 2,466 |

| Variable | Medium top holders (in millions) | | | | | | | | | | | | | |
|----------|----------------------------------|------------------|----------|-----------------|------------------|--------|-----------------|------------------|----------|---------------|------------------|--------|----------|--------|
| | 1997:Q1-2000:Q4 | | | 2001:Q1-2007:Q2 | | | 2007:Q3-2009:Q4 | | | | | | | |
| | With advances | Without advances | | With advances | Without advances | | With advances | Without advances | | With advances | Without advances | | | |
| Mean | St. dev. | Mean | St. dev. | Mean | St. dev. | Mean | St. dev. | Mean | St. dev. | Mean | St. dev. | Mean | St. dev. | |
| MORT | 44.01 | 40.62 | 30.25 | 30.84 | 56.81 | 53.42 | 38.82 | 37.90 | 72.91 | 69.39 | 49.81 | 44.30 | 72.91 | 69.39 |
| OREL | 44.79 | 43.73 | 37.24 | 39.08 | 101.23 | 104.36 | 76.57 | 83.53 | 158.95 | 145.45 | 120.34 | 120.53 | 158.95 | 145.45 |
| CI | 23.25 | 23.62 | 20.35 | 23.21 | 33.99 | 35.39 | 27.34 | 31.97 | 43.23 | 45.16 | 36.42 | 47.47 | 43.23 | 45.16 |
| SEC | 53.26 | 44.62 | 48.65 | 43.31 | 65.46 | 63.70 | 56.59 | 60.71 | 68.76 | 69.93 | 58.60 | 64.72 | 68.76 | 69.93 |
| DEP | 122.99 | 84.97 | 104.75 | 72.92 | 146.44 | 104.62 | 121.57 | 87.24 | 183.99 | 142.04 | 150.03 | 116.44 | 183.99 | 142.04 |
| EQUITY | 19.47 | 15.15 | 17.46 | 14.30 | 29.73 | 23.47 | 25.63 | 23.63 | 39.57 | 30.16 | 34.98 | 31.84 | 39.57 | 30.16 |
| ADV | 10.87 | 16.76 | — | — | 21.06 | 29.29 | — | — | 30.18 | 37.32 | — | — | 30.18 | 37.32 |
| N | 1,921 | — | 3,340 | — | 2,764 | — | 2,594 | — | 2,392 | — | — | — | 2,392 | 1,322 |

(Continued)

TABLE 2
CONTINUED

| Variable | Large top holders (in millions) | | | | | | | | | | | |
|----------|---------------------------------|-----------|----------|-----------------|----------|-----------|-----------------|-----------|----------|-----------|----------|-----------|
| | 1997:Q1-2000:Q4 | | | 2001:Q1-2007:Q2 | | | 2007:Q3-2009:Q4 | | | | | |
| | Mean | St. dev. | N | Mean | St. dev. | N | Mean | St. dev. | N | Mean | St. dev. | N |
| MORT | 1,919.23 | 7,952.48 | 1,908.87 | 5,886.23 | 3,774.01 | 18,484.6 | 3,855.81 | 15,045.02 | 6,615.93 | 34,800.91 | 3,484.49 | 18,942.33 |
| OREL | 1,308.10 | 3,306.81 | 1,248.00 | 2,891.92 | 2,434.80 | 5,933.45 | 2,333.13 | 5,969.89 | 4,139.88 | 10,934.46 | 2,707.28 | 8,139.45 |
| CI | 1,618.07 | 6,974.55 | 2,159.97 | 6,412.58 | 1,892.93 | 7,072.77 | 3,061.04 | 9,356.01 | 3,334.51 | 13,634.18 | 2,319.71 | 9,719.52 |
| SEC | 742.00 | 1,021.01 | 727.50 | 1,235.64 | 954.00 | 1,401.68 | 1,362.65 | 2,752.25 | 2,408.24 | 15,609.58 | 1,687.27 | 5,767.33 |
| DEP | 3,722.40 | 12,821.05 | 4,318.98 | 11,188.77 | 4,875.25 | 19,147.67 | 5,848.58 | 17,093.3 | 7,993.99 | 33,958.32 | 5,177.35 | 18,642.49 |
| EQUITY | 259.50 | 375.19 | 306.74 | 569.07 | 455.55 | 944.22 | 583.17 | 1,280.22 | 574.07 | 1,323.40 | 777.07 | 1,795.43 |
| ADV | 310.73 | 711.60 | — | — | 660.12 | 2,548.98 | — | — | 1,259.24 | 6,004.44 | — | — |
| N | 231 | — | 323 | — | 337 | — | 207 | — | 307 | — | 93 | — |

| Variable | Macro variables | | | | | |
|----------|-----------------|----------|-----------------|----------|-----------------|----------|
| | 1997:Q1-2000:Q4 | | 2001:Q1-2007:Q2 | | 2007:Q3-2009:Q4 | |
| | Mean | St. dev. | Mean | St. dev. | Mean | St. dev. |
| FFR | 5.85 | 0.97 | 2.95 | 1.66 | 1.53 | 1.62 |
| YIELD | 0.30 | 0.40 | 1.48 | 1.21 | 2.01 | 0.92 |
| GDP | 8,096.39 | 907.77 | 10,448.10 | 882.83 | 12,023.82 | 699.09 |

NOTE: Small top holders are those with assets at or below the 50th percentile of the distribution of total assets. Medium top holders are those with assets between the 50th and 95th percentiles of the distribution of total assets. Large top holders are those with assets at or above the 95th percentile of the distribution of total assets. Size determinations are made on a quarterly basis.

the size and composition of banks' portfolios for more than 2 years. Analogously, Hancock and Wilcox (1995) use individual bank data to estimate that portfolio adjustments can take 2–3 years to complete after a bank capital shock. There are several explanations for why bank portfolio adjustments are gradual and have differing speeds across balance sheet categories, including: adjustment of the fixed costs associated with deposit-taking and lending activities, the complexity of loan documentation, the difficulty of judging the quality of loan applicants, the speed with which loan applicants alter their loan demand in response to changing circumstances, and the relative liquidity of secondary markets for the different portfolio components.

We use a panel-VAR technique to obtain banks' dynamic responses to portfolio and macroeconomic shocks because of the ability of this type of model to approximate complicated, interdependent adjustment paths with fairly short time-series information. Our first-order 10-equation VAR system takes into account the dynamic effects on individual banks of unexpected changes in their own balance sheets (i.e., deposits (DEP), advances (ADV), securities (SEC), residential mortgage loans (MORT), other real estate loans (OREL), commercial and industrial loans (C&I), and equity capital (EQUITY)) and of the relatively more exogenous economic conditions (the short rate measured by FFR, YIELD measured by the difference between the 10-year Treasury rate and the 1-year Treasury rate, and GDP). We also allow for individual heterogeneity in the levels of the variables by introducing fixed effects, f_i . In notational terms, our panel-VAR model is

$$y_{it} = \alpha_0 + f_i + Ay_{it-1} + \varepsilon_{it}, \quad (1)$$

where y_{it} is the vector {FFR, YIELD, GDP, DEP, ADV, SEC, MORT, C&I, OREL, EQUITY}.

We impose a block exogeneous structure on the matrix of contemporaneous coefficients (i.e., short-run restrictions) to compute "structural" parameters prior to generating impulse-response functions below. This approach and the variable ordering are based on Hancock and Wilcox (1995). This ordering implies that the three macroeconomic variables are treated as exogenous (with FFR treated as the most exogeneous), while the balance sheet variables are relatively most endogeneous (with EQUITY acting as the most endogenous variable). This order reflects our assessment that it is more likely that holdings of liabilities and securities change in the current period in response to shocks to capital than that capital responded in the current period to shocks in liabilities or securities.

The seven bank balance sheet variables are measured in logs. A log specification ameliorates the error-term heteroskedasticity that unlogged variables would almost certainly entail. It also has a significant advantage over a portfolio shares specification because it permits a bank's size to change in response to shocks. In contrast, the aggregate economic condition variables—GDP, FFR, and YIELD—are measured in levels with output in nominal dollars and interest rates in percent.

Since the fixed effects are correlated with the regressors due to lags of dependent variables, the mean differencing procedure commonly used to eliminate fixed

effects will create biased coefficients. To avoid this problem, we use a forward mean-differencing procedure (the Helmert procedure described in Arellano and Bover 1995). This transformation preserves the orthogonality between transformed variables and lagged regressors. We use lagged regressors as instruments and estimate coefficients by a system of generalized method of moments (GMM).²⁸

The model structure allows us to first consider whether advances play a special role in encouraging residential mortgage funding. Consistent with the “mortgage funding view,” only residential mortgage lending should be sensitive to FHLB advance shocks, while any type of lending could potentially be affected under the “wholesale funding view.”

We can also test the response of FHLB advances to unexpected changes in various types of lending. If the data are consistent with the “mortgage funding view,” then advances should only respond to shocks to mortgage lending. If, however, the data are consistent with the “wholesale lending view,” then the response of advances to an unexpected increase in mortgage loan demand should be similar to an unexpected increase in demand for other types of loans. Of course, these views are less clear for most small top holders whose affiliates can be considered “community financial institutions” since their statutory mandate is more general (i.e., consistent with the “wholesale lending view”).

The model can also help us to examine whether or not FHLB advances help to smooth the response of member mortgage lending to unexpected macroeconomic fluctuations. For example, a monetary tightening (measured by a positive federal funds rate shock) would be associated with a decrease in bank reserves. In this case, access to FHLB advances could be helpful in accommodating the unanticipated funding shock. Whether or not such smoothing occurs and (if so) whether it is unique to mortgage funding can be identified from our VAR model. Below, we look at the relation between shocks to two different macroeconomic variables (GDP and the federal funds rate) and residential mortgage lending for banking organizations with and without FHLB advances.²⁹

Finally, looking across periods, we can analyze whether the learning period, or the nonagency securitization boom, or the recent financial crisis affected the amount or speed of banks’ portfolio responses to (unexpected) changes in FHLB advances, loan demand, and macroeconomic fluctuations. In this exercise, comparisons of responses (and their respective confidence intervals between 5% and 95%) to standardized shocks across adjacent periods are employed.

4. RESULTS

The VAR system was estimated for three time periods. As discussed above, the first time period (1997:Q1–2000:Q4, inclusive) is one that is likely to be a learning

28. See Love (2001) and Love and Zicchino (2002).

29. When the VAR model is run for banks without advances, the variable ADV is omitted from the specification.

period for banks not familiar with using FHLB advances. In that period, regardless of top holder group size, both FHLB membership and advance usage growth were quite rapid (Figure 2). In contrast, during the nonagency securitization boom period (2001:Q1–2007:Q2, inclusive), FHLB membership was relatively stable in each top holder size group, and banks' total advance usage appeared to respond to other factors than membership growth (Figure 2). The crisis period (2007:Q3–2009:Q4, inclusive) is unique because of the significant financial market turbulence, particularly with respect to nonagency mortgage securitization, and the severe housing market downturn that affected mortgage lending.

Below, we consider top holders' responses to one-standard deviation shocks to (i) FHLB advances, (ii) three lending categories (mortgages, C&I loans, and other real estate loans), and (iii) two measures of macroeconomic conditions (the federal funds rate and GDP). Estimated impulse response functions trace out the current and future values of top holders' portfolio components conditional on a one standard deviation increase in the current value of various VAR errors. These experiments assume that each error returns to zero in subsequent periods and that all other errors are equal to zero. Impulse response functions are measured using the percent change from the base value.

4.1 Bank Loan Responses to Advance Shocks: Are Residential Mortgages Special?

Figure 3 contains nine panels and presents impulse-response functions of mortgages (MORT), commercial and industrial (C&I) loans, and other real estate loans (OREL) for a standardized one standard deviation shock to FHLB advances for small top holder members (top row), for medium top holder members (middle row), and for large top holder members (bottom row) for the learning period (left column), for the nonagency securitization boom period (middle column), and for the crisis period (right column), respectively. Statistically significant quarterly estimates (at the 5% level) are indicated by circles along the impulse response functions, whereas a cross along the impulse response functions indicates that the confidence interval (between the 5% and 95% levels) does not overlap with the confidence interval (between the 5% and 95% levels) for the corresponding mortgage response.³⁰

Panels in the top and middle rows show that small and medium top holder FHLB members had a statistically significant positive loan responses to a one standard deviation advance shock during each of the three periods examined. The respective error bands around these impulse response functions at the 5% and 95% levels overlap (i.e., there are almost no responses denoted by crosses) indicating that the estimated responses are statistically indistinguishable from each other. Moreover, these effects appear to be generally quite persistent.

30. Standard errors for the impulse-response functions were obtained using Monte Carlo simulation. Random draws of errors are used together with the estimated coefficients and their variance-covariance matrix to recompute impulse responses. This procedure is repeated 5,000 times. Then, the 5th and 95th percentiles of the resulting distribution are used as a confidence interval for each element of an impulse response (see Love 2001).

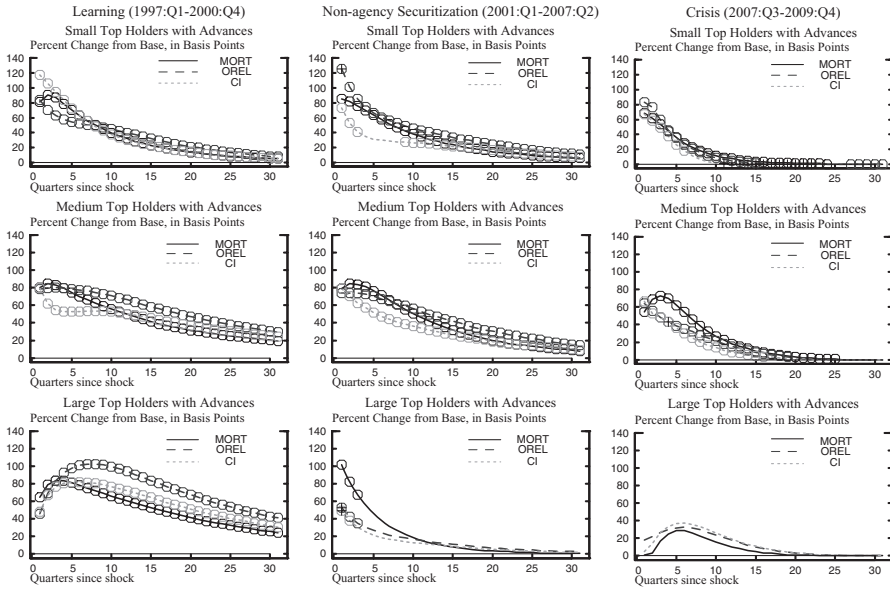


FIG. 3. Commercial Bank Portfolio Responses to FHLB Advances Shocks.

NOTE: Circles indicate statistical significance at the 5% level. Crosses indicate that the 95% confidence interval does not overlap with the confidence interval for the mortgage response.

For large top holder FHLB members, the panels in the bottom row show that they had statistically significant positive loan responses to a one standard deviation FHLB advance shock only in the first two periods examined. (Again the estimated error bands associated with the projections for each loan type suggest that they are statistically indistinguishable.) In the learning period (bottom left panel), these effects were quite persistent and generally consistent with the experience of small and medium top holders. By contrast, during the nonagency securitization boom period, these effects were quite transitory—appearing to last less than 1 year. During the financial crisis period, lending by large top holders did not seem to be systematically affected by FHLB advance shocks.

Overall, a one standard deviation FHLB advance shock has statistically similar effects on mortgages, on commercial and industrial loans, and on other real estate loans for each of the bank top holder groups, suggesting that mortgages are not unique in their response to a shock in FHLB advances. Moreover, in recent years, lending by large top holders does not appear to be sensitive to FHLB advance shocks. Both findings are consistent with FHLB advances being used as a general source of liquidity for commercial banking organizations.

4.2 FHLB Advance Response to Bank Loan Shocks

Bank loan shocks, perhaps due to an increase in the demand for loans of a specific type, could potentially be accommodated by FHLB members using advances.

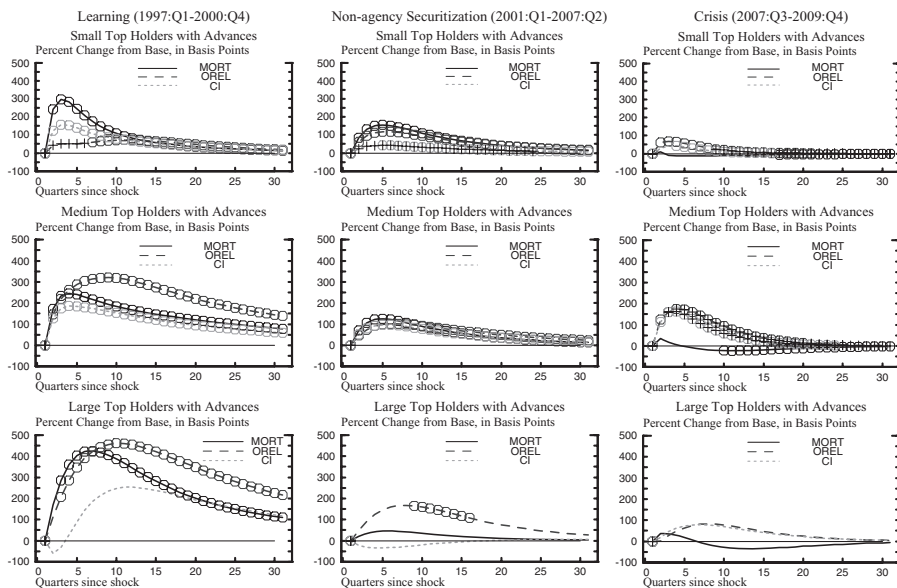


FIG. 4. Commercial Bank FHLB Advances Responses to Loan Shocks.

NOTE: Circles indicate statistical significance at the 5% level. Crosses indicate that the 95% confidence interval does not overlap with the confidence interval for the mortgage response.

To ascertain whether FHLB members employ advances in this manner, we consider how (unexpected) changes in lending affected FHLB advance usage in the following quarter. The results are presented in Figure 4, which has the same format as Figure 3.

During the “learning period,” we find that there often was a statistically significant and persistent increase in FHLB advance usage in response to a one standard deviation increase in each of the three lending categories studied (residential mortgages (MORT), commercial and industrial (C&I), and other real estate (OREL)) in the quarter prior. Error bands for these estimates suggest that the advance response is generally similar for shocks to each of the three loan categories (i.e., there are few responses represented by crosses). There appear to be two exceptions to these findings. First, during the learning period, large top holders do not appear to accommodate shocks to commercial and industrial lending. Second, small top holders appear to have been more likely to use advances to accommodate residential mortgage loan shocks.

During the “nonagency securitization boom,” it appears that small and medium top holders increased their advance usage in response to loan demand shocks. For small top holders, the increase is significantly larger for residential mortgages and for other real estate loans than for commercial loans. Medium top holders seem to have accommodated loan demand shocks using FHLB advances, although there is no statistically significant difference across loan types (i.e., the attendant error bands

all overlap so there are no crosses along the impulse responses). Larger top holders do not appear to have increased advance usage in response to loan demand shocks during the “nonagency securitization boom” period (although there is some evidence of a distantly lagged advance response to a shock to other real estate loans).

Finally, during the “financial crisis period,” small and medium top holders appear to have increased their advance usage in response demand shocks for commercial loans and other real estate loans, but not for residential mortgages. No clear pattern emerges between loan demand shocks and advance usage for large top holders during the financial crisis period.

Overall, it appears that commercial banks use FHLB advances to accommodate loan demand shocks of various types. Prior to the financial crisis, it appears that small top holders were more likely to use advances to accommodate residential mortgage demand shocks than demand shocks for other types of loans. The weak relationship between residential mortgage loan shocks and FHLB advance usage during the crisis is perhaps consistent with banks predominantly choosing to provide mortgages only to agency- and FHA-eligible mortgage borrowers during that time.

4.3 Portfolio Responses to Macroeconomic Shocks: The Role of FHLB Advances

Next we examine whether FHLB advances act to absorb the effect of macroeconomic shocks (federal funds rate or GDP) on residential mortgage lending. We do this by separately comparing the responses of small, medium, and large top holders with FHLB advances on their balance sheets to those without such liabilities during each of the three recent periods studied.

Federal funds shocks. Figure 5 presents the results for federal funds shocks. Starting with the “learning period” (left column), it appears that small top holders generally increased mortgage lending in response to a (positive) federal funds rate shock—and small top holders without advances curtailed such lending over longer horizons (i.e., the responses are statistically different, represented by the crosses for corresponding responses where the respective confidence intervals (at the 5% and 95% levels) do not overlap). However, among medium top holders during this period, the response of mortgage lending to a federal funds rate shock appears to be unrelated to whether the institution maintained advances: initially increasing and then decreasing. Strikingly, large top holders with advances actually appear to have significantly curtailed mortgage lending in response to federal funds rate shocks during the learning period.

During the nonagency securitization boom period (middle column), an unexpected one standard deviation federal funds increase appears to be associated with at least as large an increase mortgage lending at institutions without FHLB advances as compared to those with such liabilities. Small top holders generally appear to initially increase and then decrease residential mortgage lending—independent of FHLB advance usage. Medium and large top holders with FHLB advances actually appear to have significantly reduced residential mortgage lending in response to a federal

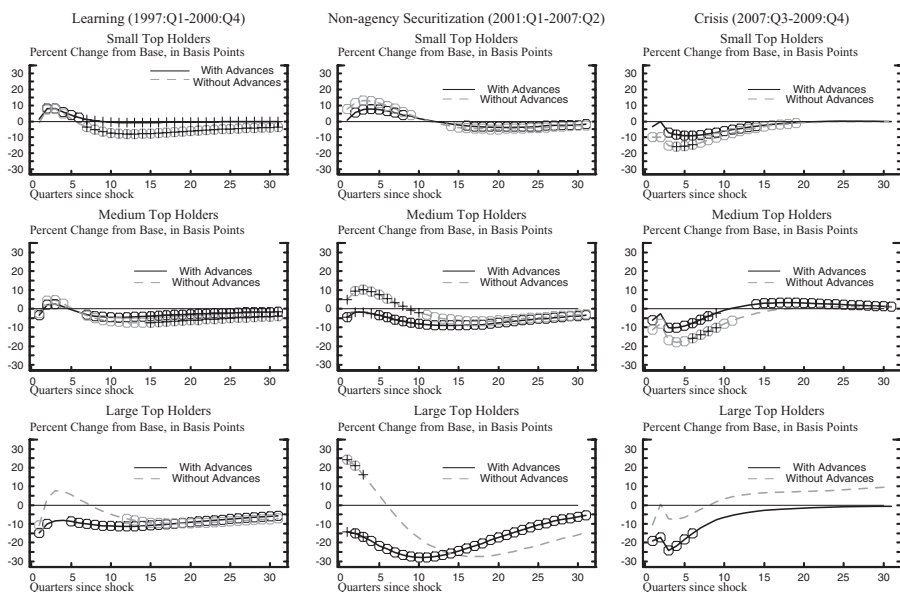


FIG. 5. Commercial Bank Mortgage Responses to Federal Funds Shocks.

NOTE: Circles indicate statistical significance at the 5% level. Crosses indicate that the 95% confidence intervals do not overlap.

funds rate shock, whereas the evidence is mixed for otherwise similar institutions without advances.

In the crisis period (right column), the estimated residential mortgage lending response to a one standard deviation federal funds rate increase was statistically less negative for small and medium top holders with advances than the corresponding response for small top holders without advances (i.e., some responses are denoted by crosses). This is consistent with these institutions using FHLB advances to reduce the impact of a (positive) federal funds rate shock on their loan customers. The same experiment applied to large top holders yields different results: the positive federal funds rate shock is associated with decreased mortgage lending for six quarters for institutions with advances, but has no effect on lending at large institutions without advances.

Overall, it appears that FHLB advances allows small and medium top holders to smooth the response of residential mortgage loans to a federal funds rate shock—that is, the response is less volatile.³¹ Curiously, large top holders with advances appear to significantly reduce their residential mortgage loan exposure more than similar institutions without advances.

31. One possible reason why advances smooth the balance sheet response to federal funds shocks is that top holders that employ advances have more market-sensitive cost of funds than do other top holders, and thus adjust their loan rates more quickly to wholesale funding market developments.

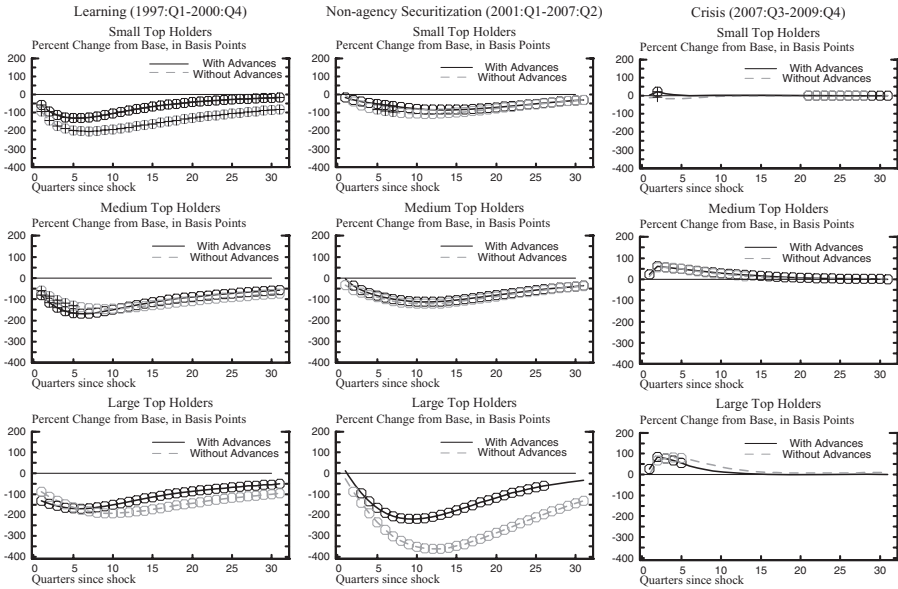


FIG. 6. Commercial Bank Mortgage Responses to GDP Shocks.

NOTE: Circles indicate statistical significance at the 5% level. Crosses indicate that the 95% confidence intervals do not overlap.

GDP shocks. Estimated responses of residential mortgage lending to a (standardized) negative one standard deviation gross domestic product shock are presented in Figure 6. This figure has the same layout and format as Figure 5—with portfolio responses for each top holder size group measured using the percent change from its respective base.

During the learning and nonagency mortgage securitization periods, bank top holders of all sizes curtail mortgage lending in response to a GDP shock. Moreover, the error bands around the estimated impulse-response functions overlap (i.e., there are few responses denoted by crosses), particularly during the nonagency securitization boom period, suggesting that the decline in mortgage lending is generally invariant to whether or not the bank top holders used FHLB advances. One exception is that during the learning period, the negative effect of the GDP shock on mortgage lending is statistically lower for small top holders without advances. During the crisis period, the GDP shock appears to have a modest positive effect on mortgage lending for top holders of all sizes, although for medium and large top holders this finding is invariant to whether the institutions use FHLB advances or not.

Overall, it appears that FHLB advances act to mute the effect of macroeconomic shocks on commercial bank residential mortgage lending by small commercial banking organizations. However, it is not clear that medium and large top holders use advances to buffer their residential mortgage portfolios from macroeconomic shocks.

5. CONCLUSIONS

Using a panel-VAR approach, this paper estimated U.S. commercial bank top holders' responses to shocks to: FHLB advances, loan portfolios, and macroeconomic conditions. We have three principal findings. First, bank portfolio responses to FHLB advance shocks are of similar magnitude for residential mortgages, for commercial and industrial loans, and for other real estate loans. Second, unexpected changes in these three types of lending are accommodated using FHLB advances. Third, only relatively small banks appear to have used FHLB advances to reduce the variability in residential mortgage lending resulting from either federal funds rate shocks or GDP shocks. Overall, we find that commercial banks are increasingly relying on FHLB advances as a wholesale funding source and—because money is fungible—advances are being used to fund all types of financial assets, not just residential mortgages. Our findings seemingly support recent policy initiatives aimed at strengthening the tie between FHLB membership and mortgage finance and at limiting FHLB access for the very largest U.S. commercial banks. This conclusion is predicated on the presumption that FHLB advances have only the narrow policy mission to facilitate stable home mortgage lending, and not a broader policy mission to enhance the stability of bank balance sheets.

LITERATURE CITED

- Ambrose, Brent W., Michael LaCour-Little, and Anthony B. Sanders. (2004) "The Effect of Conforming Loan Status on Mortgage Yield Spreads: A Loan Level Analysis." *Journal of Real Estate Economics*, 32, 541–69.
- Arellano, Manuel, and Olympia Bover. (1995) "Another Look at the Instrumental Variable Estimation of Error Component Models." *Journal of Econometrics*, 68, 29–51.
- Ashcraft, Adam, Morten L. Bech, and W. Scott Frame. (2009) "The Federal Home Loan Bank System: The Lender of Next-to-Last Resort?" *Journal of Money, Credit, and Banking*, 42, 551–83.
- Bernanke, Ben S., and Alan S. Blinder. (1992) "The Federal Funds Rate and the Channels of Monetary Transmission." *American Economic Review*, September, 901–21.
- Bernanke, Ben S., and Ilian Mihov. (1998) "Measuring Monetary Policy." *Quarterly Journal of Economics*, 113, 869–902.
- Den Haan, Wouter J., Steven Sumner, and Guy Yamashiro. (2004) "Bank Loan Components and the Time-Varying Effects of Monetary Policy Shocks." Centre for Economic Policy Research Discussion Paper 4724.
- Flannery, Mark J., and W. Scott Frame. (2006) "The Federal Home Loan Bank System: The Other Housing GSE." Federal Reserve Bank of Atlanta, *Economic Review*, 91, 33–54.
- Fortune, Peter. (1976) "The Effect of FHLB Bond Operations on Savings Inflows at Savings and Loan Associations: Comment." *Journal of Finance*, 31, 963–72.

- Goldfield, Stephen M., Dwight M. Jaffee, and Richard E. Quandt. (1980) "A Model of FHLBB Advances: Rationing or Market Clearing?" *Review of Economics and Statistics*, 62, 339–47.
- Hancock, Diana, Andrew J. Laing, and James A. Wilcox. (1995) "Bank Capital Shocks: Dynamic Effects on Securities, Loans, and Capital," *Journal of Banking and Finance*, 19, 661–77.
- Hancock, Diana, Andreas Lehnert, S. Wayne Passmore, and Shane M. Sherlund. (2005) "An Analysis of the Potential Competitive Impacts of Basel II Capital Standards on U.S. Mortgage Rates and Mortgage Securitization." Basel II White Paper, Board of Governors of the Federal Reserve System, Washington, DC, April.
- Heuson, Andrea, S. Wayne Passmore, and Roger Sparks. (2001) "Credit Scoring and Mortgage Securitization: Implications for Mortgage Rates and Credit Availability." *Journal of Real Estate Finance and Economics*, 23, 337–63.
- International Monetary Fund. (2009) *Global Financial Stability Report: Navigating the Financial Challenges Ahead*, October.
- Kwon, Jene K., and Richard M. Thornton. (1971) "An Evaluation of the Competitive Effect of FHLB Open Market Operations on Savings Inflows at Savings and Loan Associations." *Journal of Finance*, 26, 699–712.
- Love, Inessa. (2001) "Estimating Panel-Data Autoregressions: Package of Programs for Stata." Mimeo, Columbia University.
- Love, Inessa, and Lea Zicchino. (2006) "Financial Development and Dynamic Behavior: Evidence from Panel VAR." *Quarterly Review of Economics and Finance*, 46, 190–210.
- Mays, Elizabeth. (1989) "A Profit-Maximizing Model of Federal Home Loan Bank Behavior." *Journal of Real Estate Finance and Economics*, 2, 331–47.
- McCool, Thomas J. (2005) "Federal Home Loan Bank System: An Overview of Changes and Current Issues Affecting the System." Testimony before the Committee on Banking Housing, and Urban Affairs, U.S. Senate, April 13.
- McKenzie, Joseph A. (2002) "A Reconsideration of the Jumbo/Non-jumbo Mortgage Rate Differential." *Journal of Real Estate Finance and Economics*, 25, 197–213.
- Ostas, James R. (1981) "The Federal Home Loan Bank System: Cause or Cure for Disintermediation?" *Journal of Monetary Economics*, 8, 231–46.
- Passmore, S. Wayne, Shane M. Sherlund, and Gillian Burgess. (2005) "The Effect of Housing Government-Sponsored Enterprises on Mortgage Rates." *Real Estate Economics*, 33, 427–63.
- Silber, William L. (1973) "A Model of the Federal Home Loan Bank System and Federal National Mortgage Association Behavior." *Review of Economics and Statistics*, 55, 308–20.
- Stojanovic, Dusan, Mark D. Vaughan, and Timothy J. Yeager. (2008) "Do Federal Home Loan Bank Membership and Advances Increase Bank Risk-Taking?" *Journal of Banking and Finance*, 32, 680–98.
- Thomson, James B. (2002) "Commercial Banks' Borrowing from the Federal Home Loan Banks." Federal Reserve Bank of Cleveland, *Economic Commentary*, July.
- Tuccillo, John A., Frederick E. Flick, and Michelle R. Ranville. (2005) "The Impact of Advances on Federal Home Loan Bank Portfolio Lending: A Statistical Analysis." Working Paper, Available at: www.fhlbanks.com/html/council_news.html.
- U.S. Federal Housing Finance Agency. (2011) "Members of Federal Home Loan Banks." Advanced Notice of Proposed Rulemaking Available at: http://www.fhfa.gov/webfiles/19621/75_FR_81145_12-27-10.pdf

U.S. Treasury Department and U.S. Department of Housing and Urban Development. (2011) "Reforming America's Housing Finance Market: A Report to Congress." Available at: <http://www.treasury.gov/initiatives/Documents/Reforming%20America%27s%20Housing%20Finance%20Market.pdf>

Van Horne, James C. (1973) "The Effect of FHLB Bond Operations on Savings Inflows at Savings and Loan Associations: Comment." *Journal of Finance*, 28, 194–97.