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Is the Federal Home Loan Bank System Good for Banks?

A Look at Evidence on Membership, Advances and Risk

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Abstract

Since the early 1990s, commercial banks have turned to Federal Home Loan Bank (FHLBank) advances to plug the gap between loan and deposit growth. Is this trend worrisome? On the one hand, advances implicitly encourage risk by insulating borrowers from market discipline. On the other, advances give borrowers greater flexibility to managing interest rate and liquidity risk. And access to FHLBank funding encourages members to reshape their balance sheets in ways that could lower credit risk. Using quarterly financial and supervisory data for banks from 1992 to 2000, we assess the effect of FHLBank membership and advances on risk. The evidence suggests liquidity and leverage risks rose modestly, but interest-rate risk declined somewhat. Credit risk and overall failure risk were largely unaffected. Although the evidence suggest FHLBank membership and advances have had, at best, only a modest impact on bank risk, we caution that the 1990s constitute one observation and that moral hazard could be pronounced if leverage ratios revert to historical norms.

Keywords: **Government-Sponsored Enterprises, Federal Home Loan Bank, Market Discipline, Bank Risk, Liquidity Management**

JEL codes: **G21, H25, G28**

1. Introduction

Since the early 1990s, commercial banks have turned to Federal Home Loan Bank (FHLBank) advances to plug the gap between loan and deposit growth. Between 1992 and 2000, for example, annual loan growth at U.S. commercial banks averaged 7.8 percent while annual core deposit growth averaged just 3.4 percent. In contrast, loan growth averaged 5.5 percent per year between 1984 and 1990 and core deposit growth averaged 8.0 percent.[1] The pickup in loan growth in the 1990s, which showed up at large as well as community banks, reflected the length and strength of the economic expansion. The slowdown in core-deposit growth reflected heightened consumer interest in deposit substitutes such as money-market mutual funds.

The increasing importance of the FHLBank System to depository institutions can be seen in the jump in membership and advances. Between 1992 and 2000, the number of FHLBank members more than doubled, fueled by the opening of membership to commercial banks. (See Table 1.) Over the same period, advances outstanding to System members more than quintupled. For community financial institutions (CFIs)—defined by the Gramm-Leach-Bliley Act of 1999 (GLB) as banks with less than $500 million in assets (1999 dollars)—the growth was even more impressive: membership increased by a factor of four, and outstanding advances increased by a factor of 16. Along with broadening the range of permissible activities for banking organizations, GLB relaxed membership and collateral requirements for community financial institutions. As a consequence, nearly all of the nation's thrifts and commercial banks are eligible to join the FHLBank System (Feldman and Schmidt, 2000). At year-end 2004, System membership topped 8,100, over 70 percent of whom were commercial banks. And during 2002, advances outstanding to banks topped advances to thrifts for the first time.[2]

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[1] Core deposits are "sticky," remaining with the bank despite changes in failure risk or economic climate. Bank supervisors classify small time and transactions deposits as core deposits. These deposits are insured, which accounts for their "core" nature. Except where noted, all bank financial data save advances data were drawn from the Reports on Income and Condition for U.S. commercial banks (the Call Reports), various years. Bank level data on advances before 2001 were obtained from the Federal Housing Finance Board. Since 2001, "advances outstanding" has been a line on the Call Report.

[2] Except where noted, all structure and financial data for the FHLBank System were drawn from the Federal Housing Finance Board.

Do FHLBank membership and advances lead to greater bank risk-taking? In theory, advances could lead to an increase or decrease in risk. On the one hand, FHLBank advances permit member banks to fund risky activities without paying a market penalty for increases in failure probability. Indeed, previous research (Ashley, Brewer, and Vincent, 1998) has demonstrated that troubled thrifts used FHLBank funding to evade market discipline during the savings and loan crisis of the late 1980s and early 1990s. On the other hand, the FHLBank System allows banks of all sizes to tap the capital markets at minimal transactions costs. Advances come in a myriad of structures (fixed rate, adjustable rate, and blended) and maturities (overnight to 30 years), and the FHLBanks provide asset/liability-management consulting to help members use products and maturities to manage interest rate and liquidity risk. Finally, access to FHLBank funding implicitly encourages members to reshape their balance sheets in ways that could lower credit risk. Evidence about the cumulative impact of FHLBank activity on risk would help bank managers and bank supervisors distinguish between prudent and imprudent uses of advances.

It is a particularly opportune time to assess the impact of FHLBank activity on bank risk. In the past few years, the other housing government-sponsored enterprises (GSEs), Freddie Mac and Fannie Mae, have come under fire for ineffective interest-rate hedges and irregular accounting practices (Frame, 2004). Freddie and Fannie have also drawn criticism for allegedly diverting housing subsidies to their shareholders and threatening the financial system with their explosive growth (CBO, 2004; Passmore, 2003; Poole 2003). Because the FHLBank System has also grown rapidly, and some FHLBanks have also suffered losses from ineffective hedges, advocates of stronger mortgage-GSE oversight have lumped the three together, arguing that one safety-and-soundness supervisor be given authority over Freddie, Fannie, and the FHLBanks (Carnell, 2004). But the principal business line of the FHLBank system is "discounting" eligible mortgages, not securitizing conforming mortgages. And the FHLBank System is organized as a cooperative, not a publicly traded firm. These differences argue for a close look at the policy issues arising from FHLBank activity to ensure that reforms in mortgage-GSE governance appropriate for Freddie and Fannie are also appropriate for the FHLBank System.

Despite its potential public-policy importance, little research has been conducted on FHLBank activities. To date, scientific study of the System has focused on the wisdom of their mortgage-partnership program (Frame, 2003) and the implicit subsidy of community-bank lending (Craig and Thomson, 2003). Some attempt has also been made to model the decisions of community banks to join the FHLBank System (Collender and Frizzell, 2002), to quantify the influence of FHLBank funding on the behavior of troubled thrifts (Ashley, Brewer, and Vincent, 1998), to assess the impact of Gramm-Leach-Bliley on the solvency of the FHLBank System (Nickerson and Phillips, 2002), and to gauge the effect of FHLBank advances on the deposit-insurance fund (Bennett, Vaughan, and Yeager, 2005). We are aware of no work on the impact of FHLBank membership and funding on bank risk. To remedy this gap in the literature, we utilize quarterly financial and supervisory data to compare the risk profiles of members and nonmembers for the 1992-2000 sample period. We then examine the relationship between dependence on advances and risk-taking among member banks over the same interval. The evidence suggests liquidity and leverage risks rose modestly for members, but interest-rate risk declined somewhat. Credit risk and overall insolvency risk were largely unaffected. Although these findings suggest that the cumulative impact of FHLBank membership and advances on bank risk is modest, we caution that the 1990s constitute a period of robust economic growth and that serious moral-hazard problems could arise if leverage ratios revert to historical norms. The policy implication is that bank supervisors consider levying a capital charge on heavy users of FHLBank advances, pending reform of deposit-insurance pricing.

The remainder of the paper is organized in five parts. Section 2 provides institutional background to facilitate assessment of the research question and strategy. Section 3 offers a framework for analyzing the various influences of FHLBank activities on bank risk; section 4 attempts to quantify the cumulative impact of membership and advances on risk. Section 5 interprets the results and explores policy implications. Section 6 concludes.

2. A Primer on the FHLBank System

The FHLBank System was the first housing GSE.[3] Congress established the System in 1932 to advance funds against mortgage collateral. During the banking panics of the early 1930s, illiquidity produced insolvency in thousands of depository institutions. Savings and loan associations and savings banks—the principal providers of housing finance—were particularly vulnerable because of the absence of a secondary market for mortgages. The FHLBanks gave members access to ready cash. The FHLBanks also enabled members to offer better terms on mortgage loans. In the 1930s, originators typically held hold loans until maturity; consequently, mortgages typically took the form of three-to-five year non-amortizing balloons. The FHLBanks provided a source of long-term stable funding, thereby facilitating separation of the credit and liquidity risks of mortgage lending. Separation of these risks encouraged FHLBank members to originate more mortgages.[4]

Originally, only thrifts and insurance companies could join the FHLBank System, but Congress began broadening membership in the late 1980s. The Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA) opened the System to commercial banks and credit unions with at least 10 percent of their assets in residential mortgage loans.[5] The Federal Home Loan Bank Modernization Act of 1999 (Title VI of the Gramm-Leach-Bliley Act) further widened access by eliminating the 10 percent test for community financial institutions (CFIs). The Act also permitted CFIs to pledge small business, small farm, and small agri-business loans against long-term advances, thereby making membership even more attractive. As of December 2004, the FHLBank System boasted 8,131 members—5,917 banks, 1,320 thrifts, 802 credit unions, and 92 insurance companies. CFIs accounted

[3] Except where noted, institutional details about the FHLBank System and its history were drawn from GAO reports, CBO reports, individual FHLBank websites, the Federal Housing Finance Board website, Hoover (1952), and interviews with FHLBank System employees.

[4] Details on the pre-GSE mortgage market were taken from OFHEO (2003), Chapter 2, "The Development of the U.S. Secondary Mortgage Market."

[5] "Residential mortgage loans" are defined as first- and junior-lien home mortgage loans, multifamily mortgage loans, manufactured housing loans, home equity loans, mortgage-backed securities, residential construction loans, dormitory, retirement home, nursing home, and single-room occupancy loans.

for 78 percent of total membership, though large banks hold over 30 percent of outstanding advances (that is, banks holding more than $500 million in assets in constant 1999 dollars).

The FHLBank System comprises 12 member-owned banks, a centralized debt issuance facility (the Office of Finance) and a safety-and-soundness supervisor (the Federal Housing Finance Board). FHLBanks are located in Atlanta, Boston, Dallas, Des Moines, Chicago, Cincinnati, Indianapolis, New York, Pittsburgh, San Francisco, Seattle, and Topeka. Each bank is a cooperative corporation, wholly owned by its members. Members contribute capital by purchasing stock in their regional bank; in return they receive dividends and a wide range of financial products and services. These products and services include advances, letters of credit, irrevocable lines of credit, interest-rate swaps, asset/liability-management consulting and deposits. Although some FHLBanks have begun to purchase conforming mortgages through the Mortgage Partnership Finance Program, the System's primary business line is still provision of short- and long-term advances (Frame, 2003).

The System covers the cost of its products and services by selling debt instruments, which are joint obligations of the 12 FHLBanks. Buyers include mutual funds, commercial banks and government bodies—both in the United States and abroad. As of June 2004, consolidated obligations summed to $816.3 billion or 95 percent of System liabilities. On the other side of the balance sheet, advances outstanding totaled $564 billion, or 63 percent of assets. The System also invests in obligations of the U.S. government and the other mortgage GSEs; as of June 2004, security holdings summed to $139.9 billion, or 15.6 percent of assets. The FHLBank System is not required to pay federal income tax, but it is required to set aside a portion of earnings to service Resolution Funding Corporation debt and to fund affordable housing initiatives.

Circulars for FHLBank securities warn of the lack of a Treasury guarantee, but debt spreads suggest the capital markets have discounted this warning. The Congressional Budget Office estimated an historical funding advantage of roughly 41 basis points on housing-GSE debt securities (CBO, 2001). The funding advantage derives, in part, from past actions by the federal government such as bailouts of two similar GSEs—the Farm Credit System in the 1980s and the Financing Corporation in the 1990s

(Leggett and Strand, 1997). The consolidated obligations of the FHLBank System enjoy AAA ratings from Moody's and Standard and Poor's. But even without the implicit backing of the Treasury, the System would enjoy a strong credit rating because of its remarkable credit risk record—no FHLBank has ever suffered a credit loss on an advance.

3. FHLBanks and Member Risk: The Theory

Advances implicitly encourage risk taking because their price does not rise with the failure risk of the borrower. At the same time, FHLBank products and services help members manage interest-rate and liquidity risk. And access to FHLBank funding encourages members to reshape their balance sheets in ways that could lower credit risk. So, in theory, FHLBank membership and advances could increase or decrease bank risk. This section brings these arguments into sharper focus.

Access to advances creates a classic moral-hazard problem. When a depository institution assumes more risk, it must typically pay a higher default premium to uninsured, unsecured creditors. Insured depositors, in contrast, do not demand compensation for increasing failure risk because the FDIC stands ready to make them whole. The resulting moral-hazard problem is well known (Merton, 1977). What is not well know is that FHLBanks, like insured depositors, face no credit risk and, consequently, have little incentive to charge more for advances when failure risk increases. FHLBanks face no credit risk because of privileges conferred by their GSE status and monopoly position.[6] For example, FHLBanks insist on collateralization far in advance of that demanded by other secured creditors—the market value of collateral typically covers 125 to 170 percent of an advance and can go much higher. Moreover, FHLBanks are privy to confidential state and federal examination reports, so they can learn about deterioration in a member's loan portfolio—and demand more collateral—before other creditors become aware of problems. Finally, should a member fail and collateral prove insufficient, the exposed FHLBank can assert statutory lien priority on the other assets—thereby gaining priority over all

[6] FHLBanks have, of course, suffered losses for other reasons. For example, the Federal Home Loan Bank of Seattle has recently been forced to suspend dividends and cut staff because of plunge in earnings, a plunge largely traceable to a lost bet on interest rates. For more details see Shenn (2005).

unsecured creditors.[7] Because of this protection, no FHLBank has ever lost a penny on an advance. It is rational, therefore, for an FHLBank to set an "all-in" price on advances—the collateral terms and interest rate—that is independent of the borrower's failure risk.[8] Hence, the moral-hazard problem: banks can use advances to take risks, keep the upside, and shift the downside to someone else.[9]

As with insured deposits, the FDIC is the "someone else." If it were a private insurer, the FDIC would recalculate expected losses every time an FHLBank member borrowed advances.[10] The resulting change in deposit-insurance premiums would compensate for the absence of default-risk premiums on advances, thereby raising the marginal cost of risk-taking and removing the perverse incentive. But the FDIC is not a private insurer, and its latitude to change premiums is limited by statute. Premium schedules are currently set for six-month intervals, based on bank supervisory ratings, bank capital ratios, and the Bank Insurance Fund's (BIF) designated reserve ratio. As of December 2004, only 526 of 7,852 (6.7 percent) BIF institutions paid any premium for deposit insurance, and the average annual assessment rate was just 0.11 basis points (FDIC, 2005). Even by the FDIC's own reckoning, the 27 basis-point spread between assessments on the safest and riskiest banks is inadequate to cover expected losses. Indeed, the FDIC estimates that the premiums necessary to cover average 1984-1999 losses range from 3.7 basis points to 96.8 basis points (FDIC, 2001). Academic research corroborates the need for a greater

[7] The Federal Reserve Discount Window, as well, makes collateralized loans and enjoys many of the same privileges as the FHLBanks. There are two key differences, however. First, Discount Loans are designed to enable banks to cover short-term payments imbalances that occur late in the business day. FHLBank lending is predominately long-term. Second, the Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA) put strict limits on the ability of Federal Reserve Banks to loan to troubled financial institutions. These differences show up in the data: At year-end 2003, Discount Loans outstanding to commercial banks totaled $0.1 billion; advances outstanding to FHLBanks came to $240.8 billion.

[8] In theory, an FHLBank could price discriminate to maximize revenue, charging a price for advances just below the rate a member bank would have to pay in the capital markets. But, as a cooperative, the System has put member goodwill above profit maximization.

[9] Member banks must, of course, hold eligible collateral to take down advances. So an implicit cost of FHLBank funding is the opportunity cost of holding more pledgeable assets than a member bank otherwise would. Evidence suggests, however, that this cost has not been large. According to a recent FDIC survey of FHLBank members, the principal reason for taking down advances is to fund loan growth. Reliance on advances rather than core deposits (which are insured and thus also carry no default-risk premium) implies the marginal cost of advances—including the opportunity cost of holding more pledgeable assets—is lower the marginal cost of core deposits. In addition, FHLBank members report that another important motivation is leveraged growth, by which advances are used to purchase long-term mortgage-backed securities. This strategy has been particularly attractive in recent years because of the unusually large spread between short- and long-term rates (Stark and Spears-Read, 2004).

[10] Even if advances do not alter failure risk, they do subordinate the FDIC's position—thereby increasing loss-given-failure. So a private deposit insurer would recalculate expected losses with every change in advances outstanding. For more discussion, see Bennett, Vaughan, and Yeager (2005).

spread in the premium structure. (See Duffie, et al., 2003 and Falkenheim and Pennacchi, 2003, for example.).

Discipline from other funding markets is unlikely to reduce moral hazard. Irrespective of the level of uninsured deposits and FHLBank funding, uninsured unsecured bank creditors do have an incentive to demand higher default premiums as risk increases. And empirical evidence does confirm a link between failure probability and default premiums on uninsured, unsecured bank debt. (For example, see Hall, King, Meyer, and Vaughan, 2005; Morgan and Stiroh, 2001; Flannery, 1998; and Flannery and Sorescu, 1996; and Gilbert, 1990). But, as Billett, Garfinkel and O'Neal (1998) have noted, discipline from uninsured, unsecured creditors is weakened by the availability of funds with no default premium. They document a tendency in the early 1990s for risky bank holding companies to escape market discipline by substituting insured deposits for market-priced debt. FHLBank funding provides an easier escape from market discipline than insured deposits. With unfettered access to world capital markets and an unlimited implicit Treasury guarantee, the FHLBank System faces an almost perfectly elastic supply curve for its debt. And FHLBanks impose only two substantive constraints on member borrowing: the borrower must have eligible collateral and an acceptable supervisory rating. Because FHLBanks will advance funds to purchase eligible assets—including assets in abundant supply such as mortgage-backed securities—the collateral constraint is not binding. Moreover, in practice FHLBanks define an

"unacceptable" supervisory rating as a CAMELS 4 or 5 composite.[11] At year-end 2004, only 71 U.S. banks (0.92 percent) posted such a rating, and just 47 of those banks were FHLBank members.[12]

Figures 1 and 2, adapted from Billett, Garfinkel and O'Neal (B-G-ON), pull the various threads of the argument together. Figure 1 depicts optimal lending and funding choices for a representative bank with access to core deposits (insured) and jumbo CDs (uninsured deposits). The interest rate, r, appears on the vertical axis and the quantity of loans made and funds required, Q, appears on the horizontal axis. Following B-G-ON (who were drawing on Klein, 1971), the bank's marginal revenue from booking loans, MR_L, slopes downward reflecting the assumption that lending opportunities are restricted because of regulatory or expertise constraints. The bank's marginal cost curve for core deposits (MC_{ID}) slopes upward sloping because of retail adjustment costs. The costs include marketing to attract the deposits and higher explicit or implicit interest rates that must be paid on all existing deposits. We depict the marginal cost curve for uninsured deposits (MC_{UD}) as perfectly elastic, reflecting the assumptions that jumbo CDs are homogeneous instruments priced in a national market, and each bank is a price-taker in that market (MC_{UD}). For simplicity, we assume initial failure risk of the bank is so low that the credit risk exposure of a jumbo-CD holder is comparable to the exposure of an FHLBank.

Under these assumptions, the bank's marginal cost of funding curve will be the darkened line ABCD. Below r*, the market rate on uninsured deposits, the bank will fund with core deposits because they are relatively cheaper. After the bank has raised OQ_{ID} in core deposits, it will switch to jumbo CDs

[11] Under rules set forth in FDICIA, each U.S. commercial bank must be examined every 12 to 18 months. On these examinations, six aspects of safety and soundness are reviewed—"C" for capital adequacy, "A" for asset quality, "M" for management competence, "E" for earnings strength, "L" for liquidity risk, and "S" for sensitivity to market risk. At the conclusion of the exam, a grade of 1 (best) to 5 (worst) is awarded to each component. Examiners then use the component scores to award a composite CAMELS rating for overall bank condition; the composite rating is also expressed on a 1 to 5 scale. All federal and state bank supervisors have used this uniform framework to assign CAMEL ratings since 1978 (Reidhill and O'Keefe, 1997).

[12] The FHLBanks insist that new members boast satisfactory supervisory ratings and, as noted, will not advance funds to members with less than satisfactory ratings—without permission from the principal supervisor. This policy derives from the Federal Home Loan Bank of 1932. Prior to 1989, however, the FHLBank Board had principal supervisory responsibility for thrifts, so the safety-and-soundness constraint was not binding. FIRREA stripped the System of supervisory power, so the constraint now has teeth, in theory. But the FHLBanks do not revoke membership or call advances when members encounter financial trouble—a rational policy given the safeguards against credit losses. The FHLBanks enjoy one other protection. Advances often carry sizable pre-payment penalties. The FDIC as receiver is compelled to pay these fees "off the top." For example, when the $69 million-asset Bank of Alamo (Tennessee) failed in November 2002, the Federal Home Loan Bank of Cincinnati charged the FDIC $906,000, or 14%, for pre-paying $6.4 million of advances (Blackwell, 2003) Pre-payment fees due all other bank creditors are lumped with general obligations further down the pecking order.

because they are now relatively cheaper. The bank maximizes profits by equating the marginal cost of funds and the marginal revenue from loans at point C, with an interest rate of r* and a quantity of loans-made/funds-raised of Q*. Of the total amount lent (OQ*), core deposits cover OQ_{ID} and jumbo CDs cover $Q_{ID}Q^*$.

Now suppose the bank undertakes risky activities that significantly increase failure probability. For simplicity, assume the additional risk is market risk, rather than credit risk, so the marginal revenue curve for loans is unaffected. The marginal cost curve for core deposits, MC_{ID}, does not shift because insured depositors do not care about failure risk. Jumbo-CD holders, however, will insist on compensation, so the MC_{UD} will shift upward at every Q to r'—the interest rate hike from r* reflects the actuarially fair increase in the default premium. The bank's new marginal cost of funding curve will be the line AEFG. The bank now maximizes profits at point F, lending OQ' and funding with OQ_{ID}' insured deposits and Q_{ID}'Q' uninsured deposits. The increase in failure risk leads to: (1) a reduction in the quantity of loans made and funds raised and (2) an increase in the proportion of loans funded with core deposits. The jumbo-CD market does discipline the bank by reducing the optimal quantity of loans, but the effect is muted by the substitution towards insured funding.

Now, suppose advances are available from a regional FHLBank at marginal cost MC_{ADV}. Assume that, apart from their secured status, advances are close substitutes for jumbo CDs—that is, they carry the same maturities, denominations, and pre-payment penalties. MC_{ADV} is perfectly elastic because of the weak constraints on member borrowing and the easy placement of FHLBank System debt. Before the increase in risk, the FHLBank faces the same default risk as jumbo-CD holders, so it will set an all-in rate on advances roughly equal to the going rate on jumbo CDs. In the initial situation, the distribution of non-core funding between advances and uninsured deposits will depend on second order, non-price factors, such as the ability to use jumbo CDs to secure other business from the account holder. Once again, suppose the bank undertakes risky activities, and MC_{UD} shifts upward. As before, the MC_{ID} does not shift because insured depositors face no default risk. Because the lending FHLBank also faces no default risk, MC_{ADV} will not shift, and the marginal cost of funding curve will remain the darkened line

ABCD. The optimal quantity of lending does not change, and the optimal volume of core deposits does not change. The funding mix, however, does change—the bank substitutes advances for the only source of discipline, jumbo CDs. Put another way, absent large business development opportunities with jumbo-CD holders, uninsured deposits will fall from a positive level to zero. The end result: the bank uses advances to escape discipline from the jumbo-CD market and continue lending at Q*.

Consider one more case, depicted in figure 2, in which the bank assumes credit risk instead of market risk. Specifically, imagine that a commercial real-estate (CRE) boom takes place in the bank's market, and the marginal revenue curve for loans shifts to the right (from MR_L to MR'_L). Imagine further that these CRE loans are speculative; they produce high non-current and charge-off rates.[13] Now suppose, for simplicity, that the increase in default premiums on jumbo CDs (r*r') exactly equals the increase in revenue from the high-risk loans. Put another way, the CRE loans now available have zero net present value if funded at the market jumbo-CD rate. Absent access to FHLB funding, the increase in loan demand will not change the optimal quantity of loans. Before the shifts in marginal revenue and cost, the bank maximizes profits at point C, lending OQ*; after the shift the banks optimizes at point F, also lending OQ*. Again, the funding mix does change—as before the bank substitutes insured for uninsured deposits. Before the shifts in marginal revenue and cost, loans are funded with OQ_{ID} core deposits and $Q_{ID}Q^*$ jumbo CDs; after the shifts, loans are funded with OQ_{ID}' core deposits and Q_{ID}'Q*.

Now, imagine FHLBank advances are available, and the bank's initial failure risk is trivial (so the rates on advances and jumbo CDs will be comparable). Once again, a commercial real-estate boom shifts MR_L to the right and significantly increases failure risk. The availability of advances, which carry no default risk, keeps the bank's marginal cost of funding curve equal to the darkened line ABCD The bank will maximize profits at point D, lending OQ' and funding with OQ_{ID} core deposits and $Q_{ID}Q'$ non-core funding (advances and jumbo CDs). The bank will fund the entire increase in loan demand, despite the high risk, because the FHLBank will make advances with no default-risk premium.

[13] Indeed, FDIC studies attribute much of the banking crisis of the late 1990s and early 1990s to heavy bank involvement in commercial real estate loans. For more details, see Freund, et al. (1997).

Figures 1 and 2 are highly stylized, to be sure, and different assumptions about elasticities and risk premiums would produce slightly different results. Still, these figures demonstrate the larger point: other things equal, FHLBank funding subsidizes risk-taking. Absent strict supervisory oversight or actuarially fair deposit-insurance premiums—which would increase the marginal cost of risk taking with FHLB funding—member banks will be tempted to take excessive risks. To be fair, these perverse incentives are not peculiar to FHLBank advances. In theory, any bank could use insured deposits or discount loans (which are also collateralized) to exploit risk subsidies in deposit insurance. In the 1980s, for example, many thrifts used brokered deposits to fund high-risk ventures (White, 1991) while risky banks turned to the Federal Reserve Discount Window (Schwartz, 1992). In practice, however, banks can take risks with advances more cheaply than with other funding sources. Other funding sources—core deposits, brokered deposits, and other secured funding—are subject to increasing marginal costs, due to either the explicit costs of raising additional funds or the implicit costs of greater supervisory oversight.[14] As noted, the FHLBanks impose few constraints on member borrowing and raise funds with ease in world capital markets—so the marginal cost of funding with advances is flat in the face of increasing risk.

Despite the moral-hazard problem, FHLB membership and funding advances could reduce bank risk. As noted, the FHLBanks make advances against a broad range of collateral, thereby reducing the liquidity risk of member banks. In addition, FHLBank members can use advances to manage interest-rate risk. Unlike transactions deposits, advances carry finite maturities ranging from one day to thirty years, so funding with them can reduce confidence intervals around measured exposures. More important, the flexible terms on advances make them a potentially effective tool for hedging exposures arising elsewhere on the balance sheet. And the FHLBanks have asset/liability-management (ALM) experts on staff to advise members—at minimal cost—on strategies to meet target risk profiles. Community financial institutions, which often lack the expertise necessary to hedge with interest-rate caps or floors, particularly value FHLBank hedging products and ALM consulting. Finally, real-estate-backed loans—

[14] For example, FIRREA and FDICIA proscribed the use of brokered deposits by weakly capitalized institutions, and examiners frown on them even in safe-and-sound institutions.

residential mortgages in particular—secure the majority of FHLBank advances. Member banks either stock up on these loans ex ante to maintain an option on advances, or purchase them ex post with advances as part of a leveraged-growth strategy. Either way, FHLBank members have an incentive to alter their portfolio mix in favor of loans with very low credit risk.[15] Between 1991 and 2000, for example, the net charge-off rate for real-estate-backed loans (apart from commercial real-estate loans) averaged 0.14 percent. The charge-off rate for the remainder of the loan portfolio averaged 1.0 percent. So, ultimately, the net effect of FHLBank membership and advances on bank risk is an empirical issue.

4. FHLBanks and Member-Bank Risk-Taking: The Evidence

In this section, we assess the effects of FHLBank membership and advances on commercial bank risk. We treat membership and advances separately because each may have a separate effect on risk. Membership carries an option on advances and that option will influence bank behavior irrespective of whether it is exercised. In addition, new members often wait for a considerable period before taking down an advance. Between year-end 1992 and 2000, for example, the median number of quarters between the time that banks joined an FHLBank and the date of the first advance was two. On average, banks waited a full year after membership to draw their first advance, and ten percent of members waited nearly three years. Our research strategy also tests and controls for adverse selection. Because membership is voluntary, the riskiest banks may have joined the System to evade market discipline.

For the empirical analysis, we drew on three data sources: the Federal Housing Finance Board, the Federal Financial Institutions Examination Council, and the National Information Center of the Federal Reserve System. We obtained most of the income and balance sheet data from the Reports of Condition and Income (Call Reports), which are warehoused by the Federal Financial Institutions Examination Council. We obtained data on FHLBank membership and advances from the Federal

[15] Of course, banks could use FHLBank funding to make CRE loans, which would increase credit risk. Even if the net effect were a reduction in credit risk, as Demsetz and Strahan (1997) have noted, relaxing constraints might simply induce member banks to assume more risk. More concretely, suppose an FHLBank member has a target risk level. Then, that bank might respond to an FHLBank-induced decline in interest-rate, liquidity, or credit risk by taking more risk in these or other areas. Again, the cumulative impact of FHLBank activity on bank risk is ultimately an empirical issue.

Housing Finance Board because. (These data were not available on the call reports before 2001.) Finally, we obtained supervisory ratings from the confidential National Information Center (NIC) database. Our data set includes quarterly observations for all U.S. commercial banks over an eight-year period, from end-of-year 1992 to end-of-year 2000, and includes 316,538 observations.[16] Due to consolidation, the number of commercial banks decreased during the sample period, from 11,365 at year-end 1992 to 8,255 at year-end 2000.

4.1. Composite and Specific Measures of Bank Risk

We analyze the effects of FHLBank membership and advances with a range of measures of bank risk for members and nonmembers. We examine composite measures, which condense a wide array of risks into a single number such as the probability of failure, and specific risk measures, which isolate a source of risk such as loan quality. The composite measures indicate whether members are, in an overall sense, riskier than nonmembers. The specific risk measures help pinpoint the sources of any differences in overall risk.

For our principal measure of composite risk, we rely on output from an econometric model of financial distress. The Federal Reserve uses two econometric models in off-site surveillance, collectively known as SEER, the System to Estimate Examination Ratings. The first model (the SEER *risk rank* model) combines financial ratios to estimate the probability that a given bank will fail within the next two years. The second model (the SEER *rating* model) estimates the CAMELS rating that would be awarded based on the bank's latest balance sheet and income statement information. Historically, the SEER framework has performed quite well in identifying potential bank risk. Cole, Cornyn, and Gunther (1995) demonstrate that the SEER model outperformed a surveillance approach based on supervisory screens, both as a predictor of failures and as an identifier of troubled institutions. Gilbert, Meyer, and Vaughan

[16] We chose to end our sample period at year-end 2000 rather than extend it to later years because by that time more than two-thirds of banks had joined the FHLB System and the incentive to join early to avoid market discipline had clearly diminished. In addition, continuous monitoring by bank regulators since 2000 shows that the relationship between advances and bank risk has not changed materially.

(2001) show that both SEER models perform on par with a CAMELS downgrade model as a tool for flagging downgrades in supervisory ratings. We use the predicted failure probabilities from the SEER *risk rank* model to measure the composite risk of the banks in our sample. To produce the predicted failure probabilities, we obtained the coefficients from the SEER risk rank model, which are kept confidential, from the Board of Governors.

To supplement the econometric measure of composite risk, we also look at the growth rate of total assets for members and nonmembers. In the past, rapid asset growth has often signaled declining underwriting standards, a lax approach to risk management, or outright fraud—all of which can lead to failure. For example, between year-end 1982 and year-end 1985, total assets in the S&L industry grew by 56 percent, more than twice the growth rate of savings banks and commercial banks over the same period. Later, the fastest growing thrifts dominated the list of failures (Moysich, 1997). This perceived link between rapid growth and failure risk led the FDIC to develop a surveillance system centered on asset growth, the Growth Monitoring System or GMS, in the mid-1980s (Reidhill and O'Keefe, 1997; King, Nuxoll and Yeager, 2005). Although econometric models based on financial ratios currently play a dominant role in off-site surveillance at all three Federal bank supervisors, many individual surveillance analysts and field examiners still look at asset growth for clues about impending safety-and-soundness problems.

Unlike composite risk measures, specific risk measures identify the particular areas of bank risk that might be affected by Home Loan Bank membership and advances. We rely on two ratios from each risk category, which include leverage risk, liquidity risk, credit risk, and interest rate risk. These ratios are commonly used by bank examiners and supervisors to assess a bank's risk profile.

Leverage risk is the risk that losses will exceed capital, rendering a bank insolvent. We measure leverage risk with total equity as a percentage of total assets, and total qualifying capital allowable under regulatory guidelines divided by credit-risk-weighted measures of assets and off-balance sheet activity. This risk-weighted equity measure is available beginning in 1996. Lower levels of both equity ratios indicate higher leverage risk.

Liquidity risk is the risk that a bank will be unable to fund loan commitments or meet withdrawal demands at a reasonable cost. We assess liquidity risk with noncore funding as a percentage of assets, and loans as a percentage of core deposits. "Core" funding includes deposits that are relatively insensitive to the difference between the interest rate paid by the bank and the market rate, such as checking accounts, savings accounts, and small time deposits. In contrast, "noncore" funding—which includes brokered deposits, jumbo certificates of deposit (CDs over $100,000), and Home Loan Bank advances—can be quite sensitive to interest rate differentials. Although, strictly speaking, advances will not flee the bank like other noncore funding, they do reprice in step with market rates at maturity or on repricing dates. In addition, advances with embedded options can create funding uncertainty. Higher values for these liquidity ratios imply greater liquidity risk.

Credit risk is the risk that a borrower will fail to make promised interest and principal payments. We measure credit risk with the ratio of nonperforming loans to total loans, and the ratio of commercial real estate loans to total assets. Nonperforming loans—loans that are more than 89 days past due or are no longer accruing interest—are highly correlated with future charge-offs. Commercial real estate loans consist of construction and land development loans and loans secured by nonfarm, nonresidential properties. Historically, the default rate on commercial real estate loans has exceeded the default rates on most other loans. For example, at the beginning of our sample period in 1992, commercial real estate loans were charged-off (net of recoveries) at a rate of 2.1 percent, compared with a rate of 1.3 percent for all loans. This charge-off rate was topped only by the 4.76 percent charge-off rate on credit card loans. Moreover, in every year between 1980 and 1993, the ratio of commercial real estate loans to total assets was higher for banks that subsequently failed than for banks that did not fail (Freund, et al., 1997). An increase in both these ratios suggests higher credit risk. In addition, an increase in commercial real estate holdings would suggest that member banks are not using advances to reduce their holdings of relatively risky loans.

Interest rate risk is the risk that changes in interest rates or security prices will reduce bank income and the market value of bank equity. For most banks, interest rate risk arises from mismatches in

the duration of assets and liabilities. Unfortunately, call report data do not allow precise estimation of asset and liability duration for our entire sample. Instead, we rely on the one-year GAP, which offers a crude estimate of yearly earnings at risk due to interest rate movements. One-year GAP is the absolute value of the difference between assets and liabilities that reprice within one year, expressed as a percentage of total assets. Currently, the Board of Governors of the Federal Reserve System uses a duration-based, Economic Value of Equity (EVE) model to measure interest rate risk exposure (Embersit and Houpt, 1991; Houpt and Wright, 1996). This model simulates the impact of a 200 basis point interest rate increase on the bank's EVE relative to the bank's assets; higher absolute values indicate higher levels of interest rate risk. Recent research by Sierra and Yeager (2004) shows that this model accurately ranks banks by their interest rate sensitivity. Data for the EVE measure of interest rate risk, however, are available only after 1997. Increases in GAP or EVE would suggest that interest rate sensitivity is increasing despite access to advances.

4.2. Economic Significance Benchmarks

When analyzing differences in composite and specific risk ratios, we pay careful attention to the distinction between statistical significance and economic significance (McCloskey and Ziliak, 1996). Tests of statistical significance determine the likelihood that differences in risk measures are the product of chance. Tests of economic significance, in contrast, determine whether observed differences are large enough to matter for policy purposes. Large samples can deliver statistically significant differences that are economically unimportant. For example, it is possible that a hypothetical difference between an average equity ratio of, say, 10 percent for Home Loan Bank members and an average 10.05 percent for nonmembers is statistically significant, given the large number of observations in our sample. Yet, most bank economists and supervisors would conclude that such a small difference in capital ratios, particularly when capital ratios are so high, is not economically important.

We use differences in median risk ratios based on CAMELS ratings to assess economic significance. Under rules set forth in the Federal Deposit Insurance Corporation Improvement Act of

1991 (FDICIA), examiners must visit each U.S. commercial bank every 12 to 18 months. On these visits, they assess six aspects of safety and soundness—"C" for capital adequacy, "A" for asset quality, "M" for management competence, "E" for earnings strength, "L" for liquidity risk, and "S" for sensitivity to market risk. At the conclusion of the exam, a grade of 1 (best) to 5 (worst) is awarded to each component. Examiners then use the component scores to award a composite CAMELS rating for overall bank condition. The composite rating is also expressed on a 1 to 5 scale. All federal and state bank supervisors have used the same uniform framework to assign CAMEL ratings since 1978 (Reidhill and O'Keefe, 1997). Banks with 1 or 2 composite ratings are considered safe-and-sound. At year-end 2000, nearly 94 percent of all banks maintained composite ratings of 1 or 2. Banks with composite ratings greater than 2 are considered less than satisfactory; these banks face considerable supervisory pressure—in the form of informal and formal enforcement actions—to regain safety and soundness.

Because supervisors consider a drop from a CAMELS 2 rating to a 3 rating a significant change in financial condition, we use the differences in risk ratios for 2- and 3-rated institutions as benchmarks to evaluate economic significance. Table 2 displays the median values of these risk ratios over our sample. When assessing the differences in composite risk measures for Home Loan Bank members and nonmembers, we look to the differences in the risk measure across composite 2- and composite 3-rated banks. For example, over the eight-year sample, the median failure probability for composite 2-rated institutions was 0.04 percent, and the median failure probability for composite 3-rated institutions was 0.31 percent. Thus, we would consider a 27 basis point difference in failure probabilities between members and nonmembers to be economically large. When assessing the differences in specific risk measures for members and nonmembers, we look to the differences in the same measure across the component rating for 2- and 3-rated banks. For example, the median bank with 2-rated asset quality had a nonperforming loan to total loan ratio of 1.02 percent; the median bank with 3-rated asset quality had a nonperforming loan ratio of 2.10 percent. We would, therefore, consider a 108 basis point difference in non-performing loan ratios for members and nonmembers to be economically significant. Asset growth is the only economic significance benchmark with the unexpected sign. In fact, 3-rated banks have lower

asset growth than 2-rated banks, possible because regulators impose growth restraints on 3-rated institutions.

4.3. Adverse Selection Incentives

We begin our assessment of the impact of Home Loan Bank membership on risk-taking by exploring the adverse selection incentives. That is, banks with relatively high risk might use FHLB funding to avoid market discipline. Risky banks that must pay above-market rates for uninsured funding would eagerly replace that funding with relatively low-cost advances.

We investigate the importance of the adverse selection incentives by using a Cox proportional hazards model to estimate a bank's duration of time until it joins the FHLB. These models are commonly used in medicine to estimate, say, the change in the duration of a patient's life after receiving a particular treatment. The central idea in this banking context is that a riskier bank might choose to join the FHLB earlier than safer banks, reducing the bank's duration as a nonmember. The proportional hazards model is an ideal approach because it accounts for censored observations and the non-normal distribution of the dependent variable. Certain observation of nonmember banks are censored because such banks leave the sample early (e.g. mergers) or the sample period ends before they join the FHLB. Moreover, the dependent variable—the number of years after the fourth quarter of 1992 that the bank remains a nonmember—cannot be negative because the bank drops out of the sample the quarter after it joins the FHLB.

We employ the Cox proportional hazards model by using quarterly data between 1992 and 2000, regressing each bank's duration as a nonmember on a set of risk and control variables.

$$F^{-1}(Duration_{it}) = \sum_{k=1}^{N} \alpha_k \, Risk_{it} + \sum_{j=1}^{M} \beta_j \, Control_{it} + \varepsilon_{it} \qquad (1)$$

We exclude from the risk variables the risk-based capital ratio and the change in EVE to assets because of the high numbers of missing observations.[17] Control variables include the log of total assets, a CFI indicator variable (with a value of one for banks that qualify as CFIs), and ROA, which controls for the risk-return tradeoff that banks face. If high-risk banks have stronger incentives to join the FHLB, that risk may be at least partially offset by high returns.

The regression results, reported in Table 3, suggest that adverse selection incentives are weak. Only two of the eight risk coefficients are statistically significant with the expected signs. A positive sign suggests that the membership event is *more* likely to occur. Banks with lower ratios of equity to assets and higher levels of nonperforming loans are more likely to join the FHLB than other banks. All the remaining risk ratios, however, indicate that lower-risk banks are more likely to join the FHLB. In particular, banks with higher asset growth and higher ratios of commercial real estate are less likely to join the FHLB. Banks with higher levels of liquidity and interest rate risk are also less likely to become members.

To interpret the economic significance of the coefficients, we examine the hazard ratios. These ratios, reported in the second-to-last column of the table, are computed by taking the exponentials of the coefficients. A hazard ratio of 1.50, for example, would indicate that a one unit change in the independent variable makes the event (FHLB membership) 1.5 times as likely to occur. The *adjusted* hazard ratio is the likelihood of membership given an economically significant change—the CAMELS benchmark change—in the risk variable.

Most of the adjusted hazard ratios are near one, reflecting small economic significance. The largest ratio is the nonperforming loan to total loan ratio, which shows that a bank with a 108 basis-point increase in nonperforming loans is 1.02 times as likely to join the FHLB. Conversely, banks with economically significant increases in the absolute value of one-year GAP and noncore funding to total assets are only 0.95 times as likely to become members. In sum, the evidence suggests that the adverse selection incentives to join the FHLB are unimportant.

[17] We also ran the hazard-model regression including these variables. Results are qualitatively similar.

One potential criticism of the hazard-model approach to adverse selection is that banks may have ramped up risk after 1989—the year that the option to join the FHLB was granted—knowing that they could exercise the option to join if they ran into liquidity problems. The hazard regression model, however, includes bank observations after 1989. As a robustness check to assessing the importance of adverse selection, we employ a logit model to predict FHLB membership. Recall that banks first had an opportunity to join the FHLB in 1989 following implementation of FIRREA. By year-end 1992, 1,284 banks exercised that option. By simply regressing FHLB membership status in 1992 (the first year that we have data on bank membership) on bank risk variables in 1992, we mix adverse selection and moral hazard incentives because some banks may have joined the FHLB early in the three-year period and increased risk further. To control for moral hazard incentives, we define a "joiner" ("nonjoiner") as a bank that was (not) an FHLB member by year-end 1992, and we regress membership status in 1992 on banks' risk ratios from year-end 1989. By using risk ratios from 1989, we reduce the possibility that banks used FHLB advances to increase risk between 1989 and 1992. The logit takes the following form:

$$F^{-1}(Joiner_{i,1992}) = \sum_{k=1}^{N} \alpha_k \, Risk_{i,1989} + \sum_{j=1}^{M} \beta_j \, Control_{i,1989} + \varepsilon_i \qquad (2)$$

where *Joiner* = 0 if the bank did not join the FHLB by year-end 1992;
1 if the bank was an FHLB member by year-end 1992, and

F(.) = the logistic transformation.

The risk and control variables are identical to those in the hazard regression above.

As with the hazard model, the logit regression indicates that adverse selection incentives are weak. Table 4 reports the coefficients. Joiners do have faster asset growth and higher leverage risk than nonjoiners, but they also have lower failure probabilities and lower credit risk. Liquidity ratios are mixed. The positive coefficient on the ratio of total loans to core deposits indicates that joiners have higher liquidity risk than nonjoiners, yet the negative coefficient on noncore funding to total assets indicates the opposite result. Finally, interest rate risk as reflected by the one-year GAP is statistically insignificant.

Economic significance is difficult to interpret from the coefficient estimates, therefore we also report in Table 4 an adjusted odds ratios. This adjusted odds ratio computes the odds of joining the FHLB given an economically significant change in the risk ratio as defined by the CAMELS benchmark differences. The evidence indicates that the loan to core deposit ratio is the most economically important risk difference between joiners and nonjoiners. A bank with a loan to core deposits ratio that is 8.45 percentage points greater than another bank has an odds of joining the FHLB that is 1.11 times that of the other bank. Similarly, a bank with an equity to asset ratio 79 basis points higher than another bank is 0.95 times as likely to join as the other bank. In contrast, a bank with a nonperforming loan ratio 108 basis points above another bank is only 0.92 times as likely as the other bank to join the FHLB. In sum, the adverse selection incentives for banks to evade market discipline by substituting core deposits with advances are weak.

4.4. Risk-Taking Incentives After Membership: Matched Pair Analysis

After banks joined the FHLB, moral hazard incentives might have induced them to take on additional risk by funding that risk with advances. Conversely, advances may have given banks an opportunity to reduce their interest rate sensitivity and to focus more heavily on residential mortgage lending. How important are these effects? We use matched pairs to answer this question. Matched pairs is a valuable tool to measure risk effects because it controls for the adverse selection bias.

We followed the risk profiles for matched pairs of banks that were about to join the Home Loan Bank System and peer banks that would not join for at least eight quarters. Specifically, at time *t* we matched each sample bank that would join the System by time *t+1* with a nonjoiner that had at least a five-year operating history. To ensure a close match, we paired each joiner with a nonjoiner that (1) operated in the same Home Loan Bank District, (2) served a similar banking market (urban/rural), (3) held at least two percent of its assets in mortgages, and (4) maintained the same composite CAMELS rating. We further reduced the adverse selection bias by insisting that peer composite and specific risk ratios as of time *t* were similar for joiners and nonjoiners. Among banks that matched up with joiners in

all these respects, we selected the bank that was closest in asset size to the Home Loan Bank member and designated it the peer bank. Then, we traced changes in the composite and specific risk measures for joiners and peer nonjoiners over a two-year period. Table 5 compares the two-year changes in the various risk measures for matched pairs of joiners and nonjoiners.

The overall risk of Home Loan Bank joiners increased relative to peer nonmember banks during the first two years of membership, though the differences were not large. Two-year changes in failure probabilities for joiners and nonjoiners were indistinguishable statistically. Changes in asset growth gave somewhat stronger evidence of a membership effect. Two years after joining, members increased their annual growth by 2.44 percentage points while peer nonmember banks decreased their growth by 1.11 percentage points.

Turning to specific risk measures, members increased leverage risk somewhat relative to nonmembers in the two years after joining. Equity as a percentage of assets slipped by nearly 5 basis points at joiner banks but climbed by 35 basis points at peer banks. This 39 basis-point difference is statistically significant at the one-percent level and constitutes 50 percent of the economic significance benchmark. Moreover, risk-based capital as a percentage of risk-weighted assets tumbled 101 basis points at joiner banks over the first two years of membership; over the same time horizon, the average risk-based capital ratio at peer banks fell by only 14 basis points. This 87 basis point difference is, again, significant at the one-percent level and equal to 142 percent of the economic significance benchmark.

The two measures of liquidity risk also provide evidence of a modest link between membership and risk-taking. Members increased their reliance on noncore funding by 1.85 percentage points relative to nonmembers. This difference is statistically significant and is 71 percent of the economic significance benchmark. Although the loan-to-core deposit ratio climbed at both joiners and nonjoiners, the ratio for members rose by a much larger margin (7.59 percentage points) than the ratio for nonmembers (4.37)—a difference that is statistically significant and more than one-third of the economic significance benchmark.

The specific measures of credit risk did not show a strong membership effect. The 3 basis point difference in nonperforming loans to total loans between the members and nonmembers was statistically insignificant. Commercial real estate as a percentage of total assets did rise by 1.44 percentage points at joining banks, but the ratio rose as well for nonjoiners—by 1.06 percentage points. This 39-basis point difference, while statistically significant at the one-percent level, amounted to 32 percent of the economic significance benchmark. The increase in commercial real estate lending at joiners, however, suggests that member banks are not using advances to shift out of historically riskier assets.

The interest rate risk measures offered some evidence of an impact of membership on bank risk-taking. Joiners decreased their one-year GAP ratios by an average of 26 basis points, compared with an increase of 48 basis points for peer nonmembers. The 74 basis point difference was statistically significant but equal to just one-fifth of the benchmark for economic significance. When interest rate risk was measured by relative changes in the EVE, a more comprehensive gauge, no statistically or economically discernible differences emerged between the two groups.

The matched-pair evidence suggests that between 1992 and 2000, commercial banks responded only modestly to the risk-taking incentives arising from access to advances and underpriced deposit insurance. Leverage and liquidity risks increased somewhat, and banks used advances to increase their holdings of commercial real estate. However, interest rate sensitivity declined modestly following FHLB membership.

4.5. Risk-Taking Evidence From Drawing Advances

As noted, Home Loan Bank funding and underpriced deposit insurance can combine to subsidize risk-taking implicitly. All other things equal, the size of this subsidy increases with bank risk. The subsidy increases because the value of an option on funding at a pre-specified risk premium increases as overall bank risk increases (Thakor, 1982; Thakor, Hong, and Greenbaum, 1981). Evidence of increased risk-taking behavior, therefore, may show up more clearly when the sample is partitioned by dependence

on advances rather than with membership. Alternatively, banks that use advances more heavily may reduce their interest rate sensitivity and reliance on historically risky assets.

To look for a link between risk and dependence on advances, we estimated a set of ordinary-least-squares, fixed-effects panel regressions on member banks. Specifically, we estimated the following equation:

$$Risk_{it} = \alpha_i + \sum_{k=5}^{8} \beta_k Advances_{i,t-k} + \sum \gamma Time_t + \eta Size_{t-8} + \varepsilon_{it} \qquad (3)$$

where $Risk_{it}$ is the composite or specific risk measure for bank *i* at time *t*, $Advances_{i,t-k}$ is the ratio of Home Loan Bank advances to total assets of bank *i* at time *t-k*, $Time_t$ is a vector of quarterly dummy variables that take a value of 1 in quarter *t* and 0 otherwise, and $Size_{t-8}$ is the log of total assets of bank *i* at time *t-8*. We use advances lagged five to eight quarters rather than contemporaneous advances because changes in advances affect many of our risk measures concurrently through accounting identities. For example, a dollar in new Home Loan Bank advances increases total assets, which, all else equal, decreases a bank's equity to assets ratio. This lag structure reduces the correlation between advances and the error term. Time dummies capture differences in bank risk over time due to changing business cycle conditions. We use a lagged measure of bank size because advances endogenously influence contemporaneous bank size. We exclude *Size* as a control variable in the probability of failure regression because the SEER risk rank model uses size as an explanatory variable. The regression results appear in Table 6.[18]

Our approach to assessing the economic significance of coefficient estimates differs slightly from the approach we used in the membership analysis. Here, we compute the percentage point change in the summed advances-to-assets ratio needed to bring about a change in the benchmark difference in CAMELS composite or component ratings. For example, the coefficient on advances to assets when regressed on equity to total assets is -0.033. Because the economic benchmark for equity to assets is -79 basis points, it would take a 24.1 percentage point increase (-79/-0.033) in the ratio of advances to assets

to bring about a decrease in equity equal to the economic benchmark. Hence, lower numbers denote greater economic significance. A useful rule of thumb is to consider economic significance values below 15 to be economically large because most banks can increase without difficulty their ratios of advances to assets by 15 percentage points.

The regressions offer no evidence of a link between composite risk and dependence on Home Loan Bank advances. The coefficient on failure probability is statistically indistinguishable from zero, and the asset growth variable is negative, suggesting that banks with heavier reliance on advances grow more slowly.

Credit and interest rate risk are also unaffected by banks' use of advances. Although the coefficient on nonperforming loans is positive and statistically significant at the one percent level, it would take a 139.5 percentage point change in the advances-to-assets ratio to bring about an economically significant increase in the ratio of nonperforming loans to total loans. In addition, the coefficient on commercial real estate to total assets is negative, suggesting that member banks substitute away from these loans. Interest rate risk also seems to fall as bank increase reliance on advances. Both the one-year GAP and the change in EVE to assets ratios are negative, although only the GAP coefficient is statistically significant. Again, the evidence suggests that banks have used advances to modestly reduce their interest rate sensitivity.

The specific measures of leverage and liquidity risk do offer evidence of a modest increase in risk-taking. An increase in the advances to assets ratio leads to statistically significant declines in both capital ratios. Moreover, the economic significance of the risk-based capital coefficient is quite large; an 11.9 percentage point increase in the advances-to-assets ratio is all that is required to bring about the economic significance benchmark change. Liquidity ratios also weaken as dependence on advances increases, but only the relationship between advances and dependence on noncore funding seems at all

[18] As a robustness check to the panel regression approach, we ran equation (3) as a series of quarterly cross-sectional regressions. This approach allows us to observe any trends in the coefficients through time. The coefficients (not reported) fluctuate somewhat from year to year but they show no discernable pattern in bank risk-taking.

large—it would take an 8.5 percentage point increase in the noncore-funding-to-total-assets ratio to produce a change equal to the benchmark for economic significance.

As robustness checks, we tried several different specifications of the regression equation. In place of advances to total assets lagged five-to-eight quarters, we used advances to total assets lagged one-to-eight quarters. Not surprisingly, the statistical and economic significance of the leverage and liquidity risk coefficients were stronger than the coefficients derived from the regressions using just the five-to-eight quarter lags. Composite and credit risk coefficients, however, were weaker, reflecting the declining percentage of problem loans that accompany asset growth driven by advances. We also tried a two-stage least squares approach, instrumenting the four-quarters lagged advances-to-total-assets ratio with five-to-eight quarters lagged advances and time dummies. The resulting coefficients were similar to those obtained with ordinary least squares.

Overall, the regression analysis suggests that dependence on advances has had only a modest impact on risk at commercial banks. Leverage and liquidity risks increase somewhat while credit risk and interest rate sensitivity decrease.

5. Explaining the Evidence: Where is the increase in risk-taking?

The evidence suggests that Home Loan Bank membership and advances have had little impact on risk-taking at banks. The strongest evidence of moral hazard shows up in our measures of leverage and liquidity risk. Yet one could argue that banks must pursue leveraged growth strategies to survive and that traditional supervisory measures of liquidity are obsolete. In addition, other risk measures decrease with membership and/or advances.

We believe that the high charter values of banks over our sample period account for the small increase in risk-taking. Keeley (1990) has theorized that high charter values deter bankers from exploiting defects in the pricing of deposit insurance because the owners cannot sell the charter once the bank is declared insolvent. Well-capitalized banks with a strong earnings horizon are less likely to take imprudent risks because the owners have more of their own money at risk. Keeley adduced evidence that

risk-taking at bank holding companies increased as charter values declined in the 1970s and 1980s in response to branching deregulation that intensified bank competition. Despite the erosion of banks' market power, the unprecedented economic expansion of the 1990s produced capital ratios (a proxy for charter value) that are high by historical standards: the average equity-to-asset ratio for banks was 10.08 percent between 1992 and 2000, 108 basis points above the average equity ratio in the 1984-89 period. Moreover, fewer than 0.58 percent of banks had leverage ratios below the 5 percent threshold for well-capitalized banks set by FDICIA in the same 1992-2000 period.

Although bank capital positions are currently strong, these ratios can deteriorate quickly, especially in the current competitive banking environment. Indeed, banks' capital positions declined rapidly between 1984 and 1987. Supervisors consider banks with equity-to-asset ratios less than 2 percent to be critically undercapitalized. At year-end 1984, just 55 of the 14,390 banks had capital ratios below 2 percent; by year-end 1987, 244 banks (1.80 percent) were critically undercapitalized. If a serious decline in capital positions were to occur, reflecting diminished charter values, banks could be tempted to use Home Loan Bank funding to grow their way out of trouble. Looking at the Home Loan Bank borrowing by thrifts in the late 1980s and early 1990s, Ashley et. al. (1998) found just this pattern. They found that advances outstanding to thrifts ballooned in the late 1980s as the industry sank deeper and deeper into trouble. More to the point, financially distressed thrifts borrowed more from the Home Loan Bank System than financially stronger thrifts. Finally, the advances-to-asset ratios at thrifts that were later resolved well exceeded the ratios at thrifts that were not resolved.

Other researchers provide historical examples of moral hazard incentives that seemed to have limited effects on risk early on, but eventually led to financial distress. Wheelock et al. (1995) studies the voluntary Kansas state deposit insurance system, which began operating in 1909. The authors attribute the lower capital to asset ratios at insured banks as weak evidence of adverse selection and moral hazard effects. Nevertheless, the system operated for 20 years before dissolving following a collapse in farm output prices in the mid–1920s. Insured banks failed at a rate of 4.6 percent—twice the failure rate of state uninsured banks. Grossman (1992) studies savings and loans in Chicago and Milwaukee following

the introduction of national deposit insurance. He finds that moral hazard emerged gradually at insured thrifts. Specifically, it took about five years for insured thrifts' risk-taking to surpass the risk of uninsured thrifts.

6. Conclusion

In the last several years, commercial banks have relied on Federal Home Loan Bank advances to help plug the gap between loan growth and core deposit growth. The increasing reliance is a potential safety and soundness concern because access to advances can undermine market discipline, and the Federal Deposit Insurance Corporation cannot raise premiums sufficiently to deter risk-taking.

Using quarterly income and balance sheet data between 1992 and 2000, we assess the effect of Home Loan Bank membership on bank risk. We also examine the relationship between advances and risk among member banks. The evidence suggests that Home Loan Bank members do exhibit somewhat riskier leverage and liquidity profiles than nonmembers and that risk does increase with dependence on advances. But, the differences, thus far at least, do not appear to be large. In addition, member banks have lower interest rate sensitivity and no significant change in overall risk.

We believe that high charter values at commercial banks throughout the 1990s have kept risk-taking in check. Because charter value can deteriorate quickly in a highly competitive banking environment, we argue that bank supervisors should remain vigilant. In a low-charter-value environment, only careful monitoring by state and federal supervisors can prevent distressed banks from responding to the moral hazard incentives associated with Home Loan Bank funding and underpriced deposit insurance.

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Table 1
Trends in FHLB Membership and Advances Outstanding

Between 1992 and 2000, Home Loan Bank membership more than doubled, and advances outstanding more than quintupled. Behind these aggregate numbers lie other interesting trends. The number of thrift institutions belonging to the System dropped by nearly one-third, due to the contraction of the industry. At the same time, the total number of commercial bank members rose by 338 percent. Although the percentage increase in commercial bank borrowing was large, due to the small 1992 base, the dollar value of advances to thrifts rose by slightly more ($182.6 billion) than did the dollar value of advances to commercial banks ($160.7 billion). Also, advances outstanding to large commercial banks at year-end 2000 were more than five times advances outstanding to community financial institutions.

Membership by Type of Financial Institution			
	December-92	**December-00**	**Percentage Change**
Thrift Institutions			
Number of members	**2,291**	**1,547**	**-32.5%**
% of all thrift institutions	95.9%	97.4%	
Large Commercial Banks (>$500 million, 2000 dollars)			
Number of members	**117**	**545**	**365.8%**
% of all large commercial banks	16.3%	79.7%	
Community Banks (<$500 million, 2000 dollars)			
Number of members	**1,167**	**5,083**	**335.6%**
% of all community banks	11.0%	67.3%	
Total Members	**3,624**	**7,777**	**114.6%**
Advances Outstanding By Member Type			
	December-92	**December-00**	**Percentage Change**
Thrift Institutions			
Advances ($Mill.)	**72,331**	**254,900**	**252.4%**
Percent of Total Advances	91.8%	58.2%	
Large Commercial Banks* (>$500 million, 2000 dollars)			
Advances ($Mill.)	**4,395**	**140,470**	**3,096.1%**
Percent of Total Advances	5.6%	32.1%	
Community Banks (<$500 million, 2000 dollars)			
Advances ($Mill.)	**1,582**	**26,201**	**1,556.2%**
Percent of Total Advances	2.0%	6.0%	
Total Borrowers	**1,554**	**5,210**	**235.3%**
Total Advances ($Mill.)	**78,780**	**437,900**	**455.9%**

The Financial Modernization (Gramm-Leach-Bliley) Act of 1999 defines a “Community Financial Institution” as a bank with less than $500 million in assets. We use this standard to define community banks. To account for the effects of inflation, we deflated the $500 million benchmark to $429.5 million for 1992. The total members figure include insurance companies and credit unions.

Sources: Federal Housing Finance Board, Reports of Income and Condition for U.S. Commercial Banks, 1992 and 2000

Table 2
Economic Significance Benchmarks

This table displays the median risk measures for commercial banks with composite or component CAMELS ratings of 2 and 3 over the sample period.* We use these ratios to assess the economic significance of any differences in risk ratios between Home Loan Bank members and nonmembers. For example, the median bank with a composite CAMELS rating of 2 had an estimated probability of failure of 0.04 percent compared with 0.31 percent for the median bank with a composite CAMELS rating of 3. The difference of 0.27 percent is used as the benchmark for an economically significant difference in failure probability between members and nonmembers and as the benchmark for change in the failure probability for members as a result of increased dependence on advances.

CAMELS: Composite	**Failure Probability**		**1-year Growth of Assets**	
2	0.04	0.27	6.42	-3.60
3	0.31		2.83	
Capital Adequacy ("C")	**Equity/Total Assets**		**Risk Based Capital/Risk Weighted Assets**	
2	8.12	-0.79	12.90	-0.61
3	7.33		12.29	
Asset Quality ("A")	**Nonperforming Loans/Total Loans**		**Commercial Real Estate Loans/Total Assets**	
2	1.02	1.08	9.09	1.20
3	2.10		10.29	
Profitability ("E")	**Return on Assets**		**Return on Equity**	
2	1.10	-0.35	11.92	-3.34
3	0.74		8.58	
Liquidity Risk ("L")	**Noncore Funding/Total Assets**		**Loans/Core Deposits**	
2	12.99	2.63	83.91	8.45
3	15.61		92.36	
Sensitivity to Market Risk ("S")	**1-year GAP/Total Assets**		**Change in EVE/Assets**	
2	26.67	3.58	-0.92	-0.47
3	30.25		-1.39	

*The sample period is December 1992 through December 2000 except for Risk Based Capital as a percent of Risk Weighted assets (March 1996 through December 2000) and Change in EVE to Assets (March 1997 through December 2000).

Table 3
Adverse Selection and a Proportional Hazard Model

We employ a Cox proportional hazards model to estimate the importance of adverse selection incentives on the decision by commercial banks to join the FHLB. Specifically, we regress the duration of time that a bank is a nonmember against a set of risk and control variables. Positive coefficients imply that banks are likely to join the FHLB sooner given an increase in the indenpendent variable. The results indicate that adverse selction incentives were weak. Only two of the eight risk coefficients--equity to total assets and nonperforming loans--are statistically significant with the expected signs. The adjusted hazard ratio computes the likelihood of membership given an economically significant change in the risk variable such that ratios far away from one are economically significant. All of the hazard ratios in this regression are economically small. The adjusted hazard ratio for equity to total assets, for example, indicates that a bank with an equity to asset ratio that is 79 basis points higher than another bank is 0.96 times as likely to join the FHLB as the other bank.

$$F^{-1}(Duration_{it}) = \sum_{k=1}^{N} \alpha_k \, Risk_{it} + \sum_{j=1}^{M} \beta_j \, Control_{it} + \varepsilon_{it}$$

Analysis of Maximum Likelihood Estimates

	Coefficient		ChiSquare	Hazard Ratio	Adj. Hazard Ratio
Risk variables:					
Failure probability	0.000		0.0	1.00	1.00
Asset growth	-0.001	***	10.5	1.00	1.00
Equity to total assets	-0.054	***	3217.1	0.95	0.96
Noncore funding to total assets	-0.019	***	1568.4	0.98	0.95
Total loans to core deposits	-0.005	***	1012.6	1.00	0.96
Nonperforming loans to total loans	0.017	***	65.4	1.02	1.02
Commercial real estate to total assets	-0.005	***	162.8	1.00	0.99
One year GAP	-0.013	***	3300.9	0.99	0.95
Control variables:					
Log of Total Assets	0.060	***	518.3	1.062	1.06
ROA	0.012	***	8.0	1.01	1.00

*** significant at the one percent level
** significant at the five percent level

Likelihood Ratio	9,444.4
N	133,720

Table 4
Adverse Selection and Logit Analysis

Banks with relatively high risk in 1989 might have been the first to take advantage of non-risk-priced FHLB funding to avoid market discipline. We investigated the importance of this adverse selection incentive by using a logit model to predict FHLB membership. A joiner (nonjoiner) is a bank that was (not) an FHLB member by year-end 1992. Banks' risk ratios from 1989 are used in the regressions to control for endogenous risk changes after becoming members or anticipating membership. The adjusted odds ratio computes the odds of joining the FHLB given an economically significant change in the risk ratio as defined by the CAMELS benchmark differences.

The results suggest that adverse selection incentives were weak. Banks with higher liquidity and leverage risk joined the FHLB before other banks, but early joiners also had lower credit risk and lower composite risk as measured by failure probability. The most economically significant variable was the total loan to core deposit ratio. A bank with a ratio of loans to deposits that was 8.45 percentage points higher than another bank was 1.11 times more likely to join the FHLB the other another bank

$$F^{-1}(Joiner_{i,1992}) = \sum_{k=1}^{N} \alpha_k \, Risk_{i,1989} + \sum_{j=1}^{M} \beta_j \, Control_{i,1989} + \varepsilon_i$$

Analysis of Maximum Likelihood Estimates					
	Coefficient		**Chi-Square**	**Odds Ratio**	**Adjusted Odds Ratio**
Intercept	-6.68	***	124.4		
Risk variables:					
Failure probability	-0.04	***	9.9	0.97	0.99
Asset growth	0.01	***	14.2	1.01	1.04
Equity to total assets	-0.07	***	17.5	0.93	0.95
Noncore funding to total assets	-0.01	*	3.1	0.99	0.98
Total loans to core deposits	0.01	***	27.4	1.01	1.11
Nonperforming loans to total loans	-0.07	***	9.0	0.93	0.92
Commercial real estate to total assets	-0.01		1.5	0.99	0.99
One year GAP	0.00		2.2	1.00	0.98
Control variables:					
Log of Total Assets	0.35	***	75.3	1.42	1.51
CFI Indicator	0.89	***	25.4	2.44	1.21
ROA	-0.05		0.6	0.95	0.98

*** significant at the one percent level
** significant at the five percent level
* significant at the ten percent level

Number of joiners	1079
Number of nonjoiners	8474
N	9,553
Likelihood Ratio	301.7

Table 5
Risk-Taking Following Membership

This table compares changes in composite and specific risk measures for matched pairs of Home Loan Bank members and nonmembers. Each bank that joined the System between December 1992 and December 1998 was matched with a comparable institution that was not a member and would not become a member for at least two years. We then conducted t-tests of the hypotheses that the means of the changes in risk ratios for the two groups over the two years were equal. Leverage and liquidity risks increased the most following membership. For example, equity as a percent of assets of joiners decreased, on average, over the two years since joining by 5 basis points. At peer banks, equity as a percent of assets increased by 0.35 basis points.The 39 basis point difference (due to rounding) between the two means is statistically significant at the 1-percent level.

We assessed economic significance by comparing the difference in means to the benchmarks established in Table 2. For example, the difference in the change of equity to asset ratios between joiners and peers represents 50 percent of the economic significance benchmark. Taken together, the evidence suggests that membership had a statistically significant but economically small effect on risk-taking.

	Number of banks	Membership Status	Means of Changes	Difference in means of	T-statistic	Significance	
						Statistical	Economic
Failure Probability	3076	Joiner	0.10	-0.02	-0.46		-9%
		Peer	0.13				
Asset Growth	2060	Joiner	2.44	3.55	5.32	***	-99%
		Peer	-1.11				
Equity to total assets	3248	Joiner	-0.05	-0.39	-6.32	***	50%
		Peer	0.35				
Risk-based capital to risk-weighted assets	1136	Joiner	-1.01	-0.87	-6.24	***	142%
		Peer	-0.14				
Noncore funding to total assets	2929	Joiner	3.27	1.85	15.81	***	71%
		Peer	1.42				
Loans to core deposits	2981	Joiner	7.59	3.22	10.79	***	38%
		Peer	4.37				
Nonperforming loans to total loans	3094	Joiner	-0.04	-0.03	-0.99		-2%
		Peer	-0.01				
Commercial real estate to total assets	2864	Joiner	1.44	0.39	3.78	***	32%
		Peer	1.06				
One-year GAP to total assets	2718	Joiner	-0.26	-0.74	-2.83	***	-21%
		Peer	0.48				
Change in EVE to assets	517	Joiner	-0.44	0.04	1.01		-9%
		Peer	-0.48				

Note: * denotes statistical significance at the 1 percent level.**

Table 6
The Impact of Advances on Bank Risk

This table displays the results from a fixed-effects regression, regressing risk measures at commercial banks that belong to the Home Loan Bank System on advances lagged five to eight quarters, bank size lagged eight quarters, and quarterly time dummies. The coefficients on lagged advances are summed for each regression and reported in the table. We assess economic significance by calculating the percentage point change in the advances-to-total assets ratio necessary to produce the relevant CAMELS benchmark change; we view percentage point changes below 15 as significant because most banks can increase their ratios of advances to assets by 15 percentage points with little difficulty.

Overall, the evidence suggests that dependence on advances has only a modest impact on bank risk. Most of the summed advances coefficients are statistically significant at the one-percent level. However, with the exception of risk-based capital and noncore funding, the percentage point increases in the dependence ratios necessary to produce economically significant changes in the risk measures are quite large.

$$Risk_{it} = \alpha_i + \sum_{k=5}^{8} \beta_k Advances_{i,t-k} + \sum \gamma Time_t + \eta Size_{t-8} + \varepsilon_{it}$$

Dependent Variable: Measures of Risk	Sum of coefficients on FHLB advances	T-statistic	Significance		Number of Observations	R-squared
			Statistical	Economic		
Failure Probability	0.004	0.906		61.7	74,402	0.00
1-Year Growth of Assets	-0.125	5.618	***	28.8	72,964	0.05
Equity/Total Assets	-0.033	16.082	***	24.1	72,973	0.05
Risk-Based Capital/Risk-Weighted Assets	-0.051	13.618	***	11.9	65,409	0.07
Noncore Funding/Total Assets	0.309	40.765	***	8.5	72,992	0.28
Loans/Core Deposits	0.350	20.507	***	24.1	72,998	0.27
Nonperforming Loans/Total Loans	0.008	5.951	***	139.5	73,667	0.01
Commercial Real Estate Loans/Total Assets	-0.037	6.047	***	-32.2	72,934	0.17
1-year GAP/Total Assets	-0.045	3.320	***	-79.5	72,925	0.22
Change in EVE/Assets	-0.001	0.975		380.4	55,049	0.19

Figure 1
FHLBank Advances as an Escape from Market Discipline:
The Bank Assumes More Market Risk

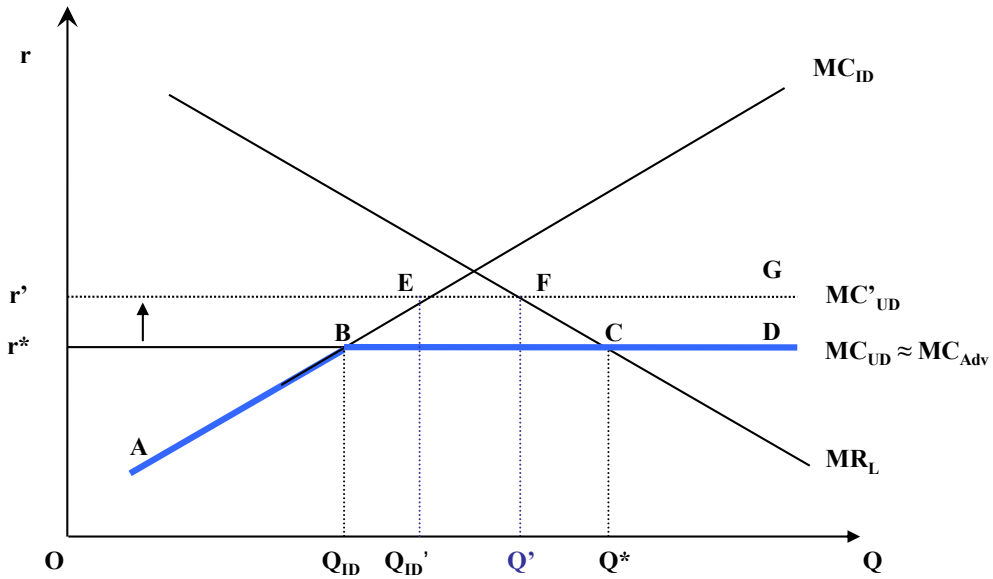

Figure 2
FHLBank Advances as an Escape from Market Discipline:
The Bank Assumes More Credit Risk