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Risk management, capital structure and lending at banks ☆

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Abstract

We test how active management of bank credit risk exposure through the loan sales market affects capital structure, lending, profits, and risk. We find that banks that rebalance their loan portfolio exposures by both buying and selling loans – that is, banks that use the loan sales market for risk management purposes rather than to alter their holdings of loans – hold less capital than other banks; they also make more risky loans (loans to businesses) as a percentage of total assets than other banks. Holding size, leverage and lending activities constant, banks active in the loan sales market have lower risk and higher profits than other banks. Our results suggest that banks that improve their ability to manage credit risk may operate with greater leverage and may lend more of their assets to risky borrowers. Thus, the benefits of advances in risk management in banking may be greater credit availability, rather than reduced risk in the banking system.

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1. Introduction

It is difficult to imagine another sector of the economy where as many risks are managed jointly as in banking. By its very nature, banking is an attempt to manage multiple and seemingly opposing needs. Banks stand ready to provide liquidity on demand to depositors through the checking account and to extend credit as well as liquidity to their borrowers through lines of credit (Kashyap et al., 2002). Because of these fundamental roles, banks have always been concerned with both solvency and liquidity. Traditionally, banks held capital as a buffer against insolvency, and they held liquid assets – cash and securities – to guard against unexpected withdrawals by depositors or draw downs by borrowers (Saidenberg and Strahan, 1999).

In recent years, risk management at banks has come under increasing scrutiny. Banks and bank consultants have attempted to sell sophisticated credit risk management systems that can account for borrower risk (e.g. rating), and, perhaps more important, the risk-reducing benefits of diversification across borrowers in a large portfolio. Regulators have even begun to consider using banks' internal credit models to devise capital adequacy standards.

Why do banks bother? In a Modigliani–Miller world, firms generally should not waste resources managing risks because shareholders can do so more efficiently by holding a well-diversified portfolio. Banks (intermediaries) would not exist in such a world, however. Financial market frictions such as moral hazard and adverse selection problems require banks to invest in private information that makes bank loans illiquid (Diamond, 1984). Because these loans are illiquid and thus costly to trade, and because bank failure itself is costly when their loans incorporate private information, banks have an incentive to avoid failure through a variety of means, including holding a capital buffer of sufficient size, holding enough liquid assets, and engaging in risk management. Froot et al. (1993) and Froot and Stein (1998) present a rigorous theoretical analysis of how these frictions can affect non-financial firms' investment as well as banks' lending and risk-taking decisions. According to their model, active risk management can allow banks to hold less capital and to invest more aggressively in risky and illiquid loans.

In this paper, we test how access to the loan sales market affects bank capital structure and lending decisions. Hedging activities in the form of derivatives trading and swap activities – activities that allow firms to manage their *market* risks – have been shown to influence firm performance and risk (e.g. Brewer et al., 2000). Our approach is to test whether banks that are better able to trade *credit* risks in the loan sales market experience significant benefits. We find clear evidence that they do. In particular, banks that purchase *and* sell their loans – our proxy for banks that use the loan sales market to engage in credit-risk management – hold a lower level of capital per dollar of risky assets than banks not engaged in loan buying or selling. Moreover, banks that are on both sides of the loan sales market also hold less capital than either banks that only sell loans but do not buy them, or banks that only buy loans but do not sell them. This difference is important because it suggests that active rebalancing of credit risk – buying *and* selling rather than just selling (or buying) – allows banks to alter their capital structure. Our key results are therefore not driven

by reverse causality whereby banks looking to increase their capital ratios go out and sell loans.

We also find that banks that rebalance through loan sales and purchases hold lower levels of liquid assets (as a percentage of the whole balance sheet) relative to most other banks, although there is no statistically significant difference in the liquidity ratios between the buy-and-sell banks and the banks that just sell loans. These same findings are also evident within the set of buy-and-sell banks – among these banks, a greater *gross* flow of loan sales and purchase activity is negatively related to capital and liquid assets.

Consistent with Froot and Stein (1998), we also find that credit risk management through active loan purchase and sales activity affects banks' investments in risky loans. Banks that purchase and sell loans hold more risky loans (C&I loans and commercial real estate loans) as a percentage of the balance sheet than other banks. [2] Again, these results are especially striking because banks that manage their credit risk (buy-and-sell loans) hold more risky loans than banks that merely sell loans (but do not buy them) or banks that merely buy loans (but do not sell them).

In our last set of results, we test whether loan sales activity leads to lower risk and higher profits and risk-adjusted profits. We find that the buy-and-sell banks do display significantly lower risk and higher profit than banks doing similar activities that do not use loan sales to manage their credit risk. However, while risk-managing banks do have less risk and more profit than banks engaged in similar activities that do not manage credit risk via the loan sales market, the risk managing banks do *not* have lower risk than other banks unconditionally. That is, when compared to banks overall, the buy–sell banks appear no safer and, perhaps, somewhat riskier; but when compared to their peers, banks with similar operating and financial ratios, the buy–sell banks exhibit significantly lower risk. Together with the results on capital structure and lending, these results suggest that banks take advantage of the risk-reducing benefits of risk management through loan sales by adopting more profitable, but higher risk, activities and by operating with greater financial leverage.

While our results are based on data from the late 1980s and early 1990s, they may have implications not only for how banks have managed their credit risk in the past, but also for how policy makers ought to view these efforts in designing regulations. In particular, one of the aims of the recently proposed revisions to the 1988 Basel Capital Accord is to create incentives for banks to engage in more active and sophisticated risk management by offering a range of risk-based capital adequacy rules. The proposal states that "For credit risk, this range (of capital adequacy rules) begins with the standardized approach and extends to the "foundation" and "advanced" internal-ratings based approaches ... This evolutionary approach will motivate banks to continuously improve their risk management and measurement capabilities so as to avail themselves of the more risk-sensitive methodologies and thus more accurate capital requirements" (Bank of International Settlement,

[2] In an earlier draft, we also found that banks that buy-and-sell loans hold more risky loans as a fraction of the whole loan portfolio.

2001). While we agree with the idea of creating incentives for banks to improve their risk management systems, our results suggest that regulators should not expect better risk management to lead automatically to less *risk*. Instead, our results suggest that banks that enhance their ability to manage credit risk may operate with greater leverage and may lend more of their assets to risky borrowers. Thus, the benefits of advances in risk management in banking may be greater credit availability rather than reduced risk in the banking system.

In Section 2, we discuss previous studies of risk management and firm investment. We then explain our empirical methods and results in Section 3. We conclude in Section 4 with implications for the likely effects of recent innovations in bank risk management for the availability of bank credit.

2. Risk management, capital structure and investment

While a significant amount of work has gone into analyzing risk management in banking, the issues are not specific to financial institutions. Non-financial firms also manage their risk exposures extensively, which in turn affects their investment decisions, profitability, and value. Allayannis and Weston (2001), for example, examine the use of foreign currency derivatives in a sample of large US non-financial firms and report that there is a positive relation between firm value and the use of foreign currency derivatives. Their evidence suggests that hedging raises firm value. Minton and Schrand (1999) use a sample of non-financial firms in 37 industries and find that cash flow volatility leads to internal cash flow shortfalls, which in turn lead to higher costs of capital and forgone investments. Firms able to minimize cash flow volatility seem to be able to invest more.

In contrast to our work, extant studies of bank loan sales have not emphasized the links between risk management, capital structure and lending. Recent papers have rather viewed loan sales as a response to regulatory costs (Benveniste and Berger, 1987), as a source of non-local bank capital to support local investments (Carlstrom and Samolyk, 1995; Pennacchi, 1988), as a function of funding costs and risks (Gorton and Pennacchi, 1995), and possibly as a way to diversify (Demsetz, 2000). [3]

In a recent paper, Dahiya et al. (2000) test whether loan sales announcements provide a negative signal about the prospects of the borrower whose loan is sold by a bank. They also examine, in a small sample (19 institutions), the characteristics of loan sellers – their results indicate that sellers have a larger proportion of C&I loans and higher income but are unmotivated by capital constraints. They find that stock prices fall at the announcement of a loan sale of the firms whose loans have been sold, and that many of these firms subsequently go bankrupt. This evidence provides further support for the idea that banks hold private information about their borrowers that makes loan sales difficult due to adverse selection.

Another strand of the banking literature emphasizes the link between the internal capital markets and bank lending. For instance, Houston et al. (1997) report that

[3] For a review of the possible motives for loan sales, see Berger and Udell (1993).

lending at banks owned by multi-bank bank holding companies (BHCs) is less subject to changes in cash flow and capital. Jayaratne and Morgan (2000) find that shifts in deposit supply affects lending most at small, unaffiliated banks that do not have access to large internal capital markets. Bank size also seems to allow banks to operate with less capital and, at the same time, engage in more lending. Demsetz and Strahan (1997) show that larger BHCs manage to hold less capital and are able to pursue higher-risk activities, particularly C&I lending. Akhavein et al. (1997) find that large banks following mergers tend to decrease their capital and increase their lending. There also appears to be evidence that off-balance sheet activities in general and loan sales in particular help banking firms lower their capital levels to avoid regulatory taxes and improve their risk tolerance (Gorton and Haubrich, 1990).

One of the contributions of this paper is to go beyond the internal capital markets, as measured by both bank size and access to a multi-bank BHC, and test whether banks that use the loan sales market to manage credit risk alter their capital structure and lending decisions in a complementary way. If banks with access to bigger internal capital markets (e.g. big banks and banks owned by multi-bank BHCs) hold less capital and lend more, then the same ought to be true for banks that use the external loan sales market to manage their credit risk. We test this idea by estimating whether banks that buy-and-sell loans hold less capital and engage in more risky lending than other banks, even after controlling for their size and holding company affiliation as proxies for the effectiveness and scope of the internal capital market. Our empirical model can be viewed as a simple test of a model of risk management á la Froot and Stein in which hedging activities add value by allowing the bank to conserve on costly capital, and by ensuring that sufficient internal funds are available to take advantage of attractive investment opportunities.

3. Empirical methods and results

3.1. Methods and data

Decision making in banking is not and should not be compartmentalized. Actions that affect capital structure, investment decisions, and portfolio risks are not taken in isolation. It is quite the norm that a single action or trading decision affects all of the above. A bank loan is not purely an investment; this decision also affects risk-based capital requirements, as well as firm risk (through multiple layers of credit, interest rate and other risks). Detailed loan-level data for a broad cross-section of US banks, however, are not available. Thus, one cannot observe how a particular loan decision affects the make-up of the overall portfolio or its risk and capital implications. We are therefore left to infer implications from aggregate data and aggregate actions.

Our data come from the *Reports of Income and Condition* (the "Call Report") for all domestic commercial banks in the United States. These data include the sale and purchase of all loans originated by the bank, excluding residential real estate and consumer loans. If a bank were involved in a syndicated loan and sold its portion of the syndication, this would be counted as a loan sale as well. The data also include

only those loans sold or purchased without recourse, meaning that the risk of the loan must have left the balance sheet of the selling bank to be counted. Data on both loan purchases and sales are available quarterly from June of 1987 through the end of 1993. [4] We use these figures to compute annual flows of loans sold and purchased from June to June in each year from 1988 to 1993. So, for example, the 1988 loan sales figures reflect loans sold between June of 1987 and June of 1988. In this example, we would then assign these flows to the balance sheet figures as of June of 1988.

As noted above, our purpose is to test how active management of credit risk, as proxied by loan sales and purchases, affects a financial institution's capital structure, lending, profits, and risk. We estimate a series of cross-sectional, reduced form regressions that relate measures of capital structure, investments in risky loans, profits and risk to control variables (designed to capture the extent of a bank's access to an internal capital market) and to measures of the bank's use of the loan sales market to foster risk management. Our dependent variables are defined as follows:

Capital and liquidity variables

Capital/Risky assets = Book value of equity/(Total assets − Cash − Fed funds sold − Securities) [5]
Liquidity ratio = (Cash + Net federal funds + Securities)/Assets

Lending variables

Commercial and industrial loans/Assets
Commercial real estate loans/Assets

Risk variables

Time-series standard deviation of each bank's quarterly ROE (Earnings/Book value of equity) [6]
Time-series standard deviation of each bank's quarterly ROA (Earnings/Assets)
Time-series standard deviation of each banks's quarterly Loan loss provisions/Total loans

[4] After 1993, the federal banking agencies stopped collecting data on loan sales and purchases.

[5] Our measure of capital adequacy equals the ratio of the book value of equity (the sum of perpetual preferred stock and related surplus, common stock, surplus, undivided profits and capital reserves, cumulative foreign currency translation adjustments less net unrealized loss on marketable equity securities) to risky assets. Risky assets are defined as total assets minus cash, fed funds sold and securities. We subtract these three elements from total assets to come as close as possible to the definition of risk-weighted assets under the Basel Capital Accord that is available from Call Report data back to 1988. During the years where Call Report data allow us to construct the actual capital/risk-weighted assets ratio, we find that our measure is more correlated than the simple ratio of capital to total assets. Nevertheless, in an early draft we divided capital by total assets and found similar results.

[6] To make the units of the risk and profit variables more familiar, we annualize the quarterly flow variables (ROE, ROA and loan loss provisions) by multiplying by four.

Time-series standard deviation of each banks's quarterly Non-performing loan/Total loans [7]

Profit variables

Time-series mean of each bank's ROE
Time-series mean of each bank's ROA
RAROC = Time-series mean ROE/time-series standard deviation of bank's ROE.

To capture the effect of internal capital markets (Jayaratne and Morgan, 2000; Demsetz and Strahan, 1997; Houston et al., 1997), we include as regressors indicator variables for banks owned by multi-bank holding companies and multi-state bank holding companies. We also create indicators to capture the effect of firm size based on the bank's total assets. Following Demsetz (2000), we avoid imposing a linear (or log-linear) relationship between size and our dependent variables. Instead, we include indicators for eight asset classes, with firms in asset size greater than $10 billion acting as the omitted category. To control for the effects of a bank's management of market – as opposed to credit – risks, we include an indicator equal to one for banks that hold interest rate derivatives contracts (mainly plain-vanilla swaps) as a proxy for banks that manage market risk. [8]

We need to be careful to isolate risk management activities in the loan sales market from other reasons why banks might buy or sell loans. For instance, banks may sell (buy) in response to relatively strong (weak) loan demand conditions. Similarly, unusually strong funding conditions may induce loan purchase activity, while unusually weak funding conditions may induce loan sales. Again following Demsetz (2000), we create three indicator variables to reflect a bank's activities in the loan sales market: these variables denote whether a bank only sells loans, whether it only buys loans, or whether it buys and sells loans; firms that do not participate at all act as the omitted category in the regressions. We focus our attention on banks that both buy-and-sell loans, since demand and funding conditions are unlikely to be driving the results for these banks. Our theory suggests that banks that engage more actively in risk management in this way will be able to conserve capital and operate with fewer liquid assets, and at the same time, they will be able to take advantage of more risky lending opportunities without unduly increasing their credit risk.

Table 1 provides the descriptive statistics for the full sample for each of the variables in the models. The sample starts with 74,045 bank/year observations. (For the risk and profit variables, which are computed from time-series statistics for each bank, we have just a single observation per bank.) [9] We then lose some observations

[7] Non-performing loans are defined as loans 90 days or more past due but still accruing interest plus non-accrual loans. (Data on loans less than 90 days late are confidential.)

[8] The simple indicator variable for interest rate contracts is the best proxy for the use of derivatives by banks that we could construct consistently over time between 1988 and 1993.

[9] For the analysis of risk and profits, which require us to construct the variable from time-series means and standard deviations for each bank, we only include banks that survive the whole period so that we have 28 observations per bank to construct these statistics. We have also estimated the models using all banks and find similar results.

Table 1
Summary statistics

Variable	Full sample statistics			Buy-only	Sell-only	Buy-and-sell	Neither buy nor sell
	Obs.	Mean	Std. Dev.	Mean	Mean	Mean	Mean
Capital/risky assets	74,036	0.193	0.162	0.195	0.167	0.148	0.246
Securities/assets	73,702	0.415	0.171	0.454	0.392	0.372	0.462
C&I loans/assets	73,938	0.105	0.094	0.093	0.111	0.126	0.078
CRE/assets	74,044	0.088	0.083	0.082	0.095	0.104	0.067
Derivatives indicator	72,723	0.035	0.184	0.020	0.020	0.064	0.015
Total assets (millions of $s)	74,045	269	2,599	116	137	530	99
In a multi-bank holding company?	74,045	0.314	–	0.351	0.215	0.477	0.166
In a multi-state holding company?	74,045	0.122	–	0.113	0.090	0.178	0.078
Std. dev. of return on equity (ROE)	10,437	0.149	0.117	–	–	–	–
Std. dev. of return on assets (ROA)	10,437	0.012	0.007	–	–	–	–
Std. dev. of loan loss provisions/ total loans	10,433	0.014	0.012	–	–	–	–
Std. dev. of non-performing loans/ loans	10,462	0.013	0.010	–	–	–	–
Average ROE	10,437	0.159	0.099	–	–	–	–
Average ROA	10,437	0.014	0.008	–	–	–	–
RAROC (avg. ROE/std. dev. of ROE)	10,437	1.611	0.904	–	–	–	–
Buy loans?	73,033	0.119	–	1	0	0	0
Sell loans?	73,033	0.188	–	0	1	0	0
Buy-and-sell loans?	73,033	0.378	–	0	0	1	0
Purchases + sales/loans	73,033	0.043	0.082	0.033	0.039	0.083	0
Purchases − sales/loans	73,033	−0.006	0.056	0.033	−0.039	−0.008	0

due to missing data or obviously incorrect data. For example, we dropped observations where the balance sheet ratios exceeded one. In addition, the capital-to-risky assets ratio, the loan loss ratios (based on loan loss provisions and non-performing loans) and the profit ratios (ROE, ROA, and RAROC) all have large positive and negative outliers. We therefore Winsorize these ratio variables at the 1st and 99th percentiles of their respective distributions. [10]

Table 1 also reports mean characteristics for banks that buy loans, sell loans, buy-and-sell loans, or do neither. These simple comparisons suggest that banks that buy-and-sell loans have the lowest capital-to-assets and liquid assets ratios and the highest levels of risky loans as a percentage of the balance sheet. [11] On its face, these comparisons support the idea that active risk management via the external loan sales

[10] Winsorizing involves assigning to outliers beyond the 1st and 99th percentiles a value equal to the value of the 1st or 99th percentile in order to limit the influence of outliers on the regression.

[11] The simple comparison between buy–sell, buy-only, sell-only and buy–sell banks are not available for the risk and profit variables since these are constructed as time-series averages for each bank. We also averaged our indicator variables for our risk and profit regressions over time, i.e. a bank that sold only in two of the six years will have a sell-only value of 2/6. Note, however, that Demsetz (2000) shows that most banks remain in the same loan sales category from year to year, but some will switch categories in time.

market adds value to banks by allowing them to conserve on capital and liquid assets and engage more in the activity that generates value – risky lending. [12] Banks that buy-and-sell loans, our proxy for credit-risk managing banks, are also about three times as likely as the other banks to use interest-rate derivatives. This correlation suggests that banks managing market risks with derivatives are also more likely to manage credit risks with loans sales, and vice versa. Of course, the banks that buy-and-sell loans are also larger and more likely to affiliate with multi-bank and multi-state bank holding companies than the other banks. Thus, these banks also seem to have access to a better (or at least bigger) internal capital market. We now control for this effect in our regressions.

3.2. Loan sales, capital structure and lending choices

Table 2 reports our regression results for the capital-to-risky assets ratio. Both BHC affiliation and increasing bank size seem to be associated with lower capital ratios, suggesting that larger internal capital markets do allow banks to operate with a smaller cushion against insolvency. In contrast, and somewhat to our surprise, however, banks affiliated with multi-state BHCs do not seem to hold less capital. [13] The derivatives indicator enters negatively in all years, although the coefficient is not always statistically significant.

Our proxy for a bank's use of loan sales activity to manage risk suggests very strongly that banks can conserve on capital by actively managing their credit risk through loan sales. The buy-and-sell variables are negative and significant (both economically and statistically) in all years; they suggest that banks that manage their credit risk by both buying and selling loans have capital-to-risky assets ratios 6.9–8% points lower than banks that do not participate at all in this market. Perhaps more important, the banks that appear to rebalance their risk through both purchase and sale have capital ratios about 1.0–1.3% points lower than banks that just sell loans, and this difference is statistically significant at the 1% level in all six years.

The results for the liquid assets ratio provide further support to our expectation that firms that engage in loan trading can afford to reduce their buffer of liquid assets. Once again, as shown in Table 3, control variables perform as expected – large banks hold fewer liquid assets than smaller banks. In addition, the coefficients on

[12] We reach the same conclusions when we compare medians across banks that sell loans, buy loans, buy-and-sell loans, and do neither. For example, the median bank that neither buys nor sells loans holds the *highest* capital-to-risky assets ratio at 17.6% and the highest securities-to-assets ratio at 45.4%. The median bank that buys and sells loans holds the highest ratios of both C&I loans to assets (10.3%) and the highest ratio of commercial real estate loans to assets (8.6%).

[13] In fact, the coefficients suggest that banks hold more capital when they are owned by multi-state BHCs. This result may be surprising because multi-state banking organizations are likely to be better diversified than less geographically dispersed companies. However, these organizations are also often overseen by multiple regulatory agencies – the Federal Reserve, the FDIC or OCC, and one or more state banking departments – which may increase their need to hold regulatory capital. At the same time, it may be more difficult for multi-state banking companies to move capital between affiliates compared to multi-bank holding companies with subsidiaries in just one state.

Table 2
Regressions relating a bank's capital-to-risky assets ratio to loan sales indicators and bank characteristics

	1988	1989	1990	1991	1992	1993
Constant	0.151**	0.152**	0.147**	0.157**	0.170**	0.183**
	(0.007)	(0.008)	(0.009)	(0.008)	(0.008)	(0.009)
Multi-bank holding company	−0.016**	−0.015**	−0.012**	−0.012**	−0.013**	−0.010**
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Multi-state bank holding company	0.010**	0.010**	0.008*	0.008*	0.012**	0.007
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)
Assets < $10 mil	0.165**	0.166**	0.191**	0.181**	0.186**	0.210**
	(0.011)	(0.012)	(0.014)	(0.014)	(0.016)	(0.019)
$10 mil < assets < $25 mil	0.099**	0.100**	0.100**	0.091**	0.088**	0.086**
	(0.007)	(0.008)	(0.009)	(0.008)	(0.008)	(0.009)
$25 mil < assets < $50 mil	0.076**	0.077**	0.083**	0.071**	0.069**	0.069**
	(0.007)	(0.008)	(0.009)	(0.007)	(0.007)	(0.008)
$50 mil < assets < $100 mil	0.068**	0.066**	0.073**	0.062**	0.061**	0.059**
	(0.006)	(0.008)	(0.009)	(0.007)	(0.007)	(0.008)
$100 mil < assets < $500 mil	0.047**	0.042**	0.048**	0.038**	0.039**	0.040**
	(0.006)	(0.007)	(0.008)	(0.007)	(0.007)	(0.008)
$500 mil < assets < $1 bil	0.028**	0.025**	0.030**	0.023**	0.022**	0.026**
	(0.007)	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)
$1 bil < assets < $5 bil	0.021**	0.020**	0.029**	0.028**	0.027**	0.035**
	(0.005)	(0.006)	(0.007)	(0.008)	(0.007)	(0.008)
$5 bil < assets < $10 bil	0.016**	0.007*	0.005	0.006*	0.009*	0.006*
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.006)
Sell loans	−0.068**	−0.064**	−0.063**	−0.058**	−0.061**	−0.069**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Buy loans	−0.034**	−0.034**	−0.032**	−0.028**	−0.033**	−0.040**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Buy-and-sell loans	−0.079**	−0.074**	−0.073**	−0.069**	−0.074**	−0.080**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.007)
Derivatives indicator	−0.014**	−0.011	−0.007	−0.013*	−0.015*	−0.010
	(0.007)	(0.006)	(0.008)	(0.006)	(0.007)	(0.007)
P-value for *F*-test that sell = buy-and-sell	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
P-value for *F*-test that buy = buy-and-sell	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
R^2	0.135	0.128	0.130	0.118	0.115	0.083
N	13,126	12,675	12,295	11,951	11,559	11,066

Heteroskedasticity-consistent standard errors are reported below coefficients in parentheses (see White, 1980).

**Significant at the 1% level; *significant at the 5% level. Assets above $10 billion is the omitted category for the size indicator variables. Banks that neither buy nor sell loans constitute the omitted category for the sell and buy indicator variables.

both the multi-bank and multi-state BHCs indicators are negative, although only the latter coefficients are statistically significant. Also, banks with derivatives appear to be able to conserve on their holdings of risky assets. We again find that banks that both buy-and-sell loans hold lower levels of liquid assets than either banks that neither buy nor sell, or banks that only buy loans. We find no statistically meaningful

Table 3
Regressions relating a bank's ratio of liquid assets (Cash + Net Fed Funds + Securities) to total assets to loan sales indicators and bank characteristics

	1988	1989	1990	1991	1992	1993
Constant	0.217**	0.223**	0.210**	0.236**	0.284**	0.306**
	(0.022)	(0.021)	(0.019)	(0.019)	(0.020)	(0.021)
Multi-bank holding company	−0.011**	−0.004	−0.001	0.001	−0.002	−0.003
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Multi-state bank holding company	−0.030**	−0.047**	−0.053**	−0.040**	−0.035**	−0.029**
	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)
Assets < $10 mil	0.310**	0.288**	0.317**	0.295**	0.252**	0.244**
	(0.023)	(0.022)	(0.020)	(0.020)	(0.022)	(0.023)
$10 mil < assets < $25 mil	0.279**	0.261**	0.279**	0.252**	0.209**	0.195**
	(0.022)	(0.021)	(0.019)	(0.019)	(0.021)	(0.021)
$25 mil < assets < $50 mil	0.261**	0.241**	0.259**	0.230**	0.189**	0.173**
	(0.022)	(0.021)	(0.019)	(0.019)	(0.020)	(0.021)
$50 mil < assets < $100 mil	0.250**	0.225**	0.243**	0.221**	0.184**	0.161**
	(0.022)	(0.021)	(0.019)	(0.019)	(0.020)	(0.021)
$100 mil < assets < $500 mil	0.204**	0.177**	0.197**	0.177**	0.147**	0.135**
	(0.022)	(0.021)	(0.018)	(0.019)	(0.020)	(0.020)
$500 mil < assets < $1 bil	0.118**	0.088**	0.111**	0.108**	0.104**	0.088**
	(0.024)	(0.022)	(0.020)	(0.020)	(0.021)	(0.022)
$1 bil < assets < $5 bil	0.061**	0.046*	0.078**	0.078**	0.076**	0.072**
	(0.021)	(0.020)	(0.018)	(0.019)	(0.021)	(0.021)
$5 bil < assets < $10 bil	0.015	−0.002	−0.013	0.006	0.030	0.006
	(0.024)	(0.021)	(0.026)	(0.024)	(0.027)	(0.029)
Sell loans	−0.067**	−0.060**	−0.063**	−0.061**	−0.060**	−0.066**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Buy loans	−0.001	0.001	0.004	0.001	0.001	−0.011*
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Buy-and-sell loans	−0.071**	−0.059**	−0.059**	−0.061**	−0.065**	−0.070**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Derivatives indicator	−0.070**	−0.069**	−0.036**	−0.048**	−0.074**	−0.077**
	(0.012)	(0.012)	(0.010)	(0.010)	(0.009)	(0.010)
P-value for *F*-test that sell = buy-and-sell	0.22	0.71	0.29	0.99	0.27	0.40
P-value for *F*-test that buy = buy-and-sell	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
R^2	0.189	0.191	0.188	0.161	0.141	0.142
N	13,126	12,675	12,295	11,951	11,560	11,115

Heteroskedasticity-consistent standard errors are reported below coefficients in parentheses (see White, 1980).
**Significant at the 1% level; *significant at the 5% level. Assets above $10 billion is the omitted category for the size indicator variables. Banks that neither buy nor sell loans constitute the omitted category for the sell and buy indicator variables.

differences in liquidity ratios, however, for the buy-and-sell banks and the sell-only banks.

Overall, Tables 2 and 3 suggest that risk management via the loan sales market affects banks' capital structure and liquidity choices. In Tables 4 and 5, we show that credit risk management through loan purchase and sales activity also affects lending

Table 4
Regressions relating a bank's ratio of C&I loans to total assets to loan sales indicators and bank characteristics

	1988	1989	1990	1991	1992	1993
Constant	0.168**	0.158**	0.152**	0.151**	0.147**	0.132**
	(0.019)	(0.018)	(0.016)	(0.014)	(0.018)	(0.014)
Multi-bank holding company	−0.006*	−0.006*	−0.007*	−0.006**	−0.006**	−0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Multi-state bank holding company	0.002	−0.008*	−0.003	0.001	−0.003	−0.004
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Assets < $10 mil	−0.102**	−0.094**	−0.096**	−0.102**	−0.098**	−0.088**
	(0.019)	(0.019)	(0.017)	(0.015)	(0.018)	(0.014)
$10 mil < assets < $25 mil	−0.087**	−0.084**	−0.081**	−0.085**	−0.086**	−0.074**
	(0.019)	(0.018)	(0.017)	(0.014)	(0.018)	(0.014)
$25 mil < assets < $50 mil	−0.079**	−0.072**	−0.073**	−0.076**	−0.075**	−0.064**
	(0.019)	(0.018)	(0.016)	(0.014)	(0.018)	(0.014)
$50 mil < assets < $100 mil	−0.068**	−0.065**	−0.069**	−0.072**	−0.072**	−0.061**
	(0.019)	(0.018)	(0.016)	(0.014)	(0.018)	(0.014)
$100 mil < assets < $500 mil	−0.052**	−0.050**	−0.056**	−0.059**	−0.058**	−0.051**
	(0.019)	(0.018)	(0.016)	(0.014)	(0.018)	(0.014)
$500 mil < assets < $1 bil	−0.034	−0.022	−0.040*	−0.048**	−0.047**	−0.041**
	(0.020)	(0.020)	(0.017)	(0.015)	(0.018)	(0.015)
$1 bil < assets < $5 bil	−0.021	−0.021*	−0.031	−0.036*	−0.036	−0.032*
	(0.020)	(0.019)	(0.017)	(0.015)	(0.019)	(0.015)
$5 bil < assets < $10 bil	−0.001	−0.006	−0.030	−0.039*	−0.043*	−0.028
	(0.023)	(0.021)	(0.020)	(0.017)	(0.020)	(0.017)
Sell loans	0.037**	0.034**	0.031**	0.027**	0.022**	0.025**
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Buy loans	0.014**	0.014**	0.017**	0.014**	0.012**	0.011**
	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
Buy-and-sell loans	0.057**	0.051**	0.046**	0.038**	0.033**	0.028**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Derivatives indicator	0.015	0.024**	0.028**	0.027**	0.032**	0.021**
	(0.008)	(0.008)	(0.006)	(0.006)	(0.006)	(0.006)
P-value for *F*-test that sell = buy-and-sell	<0.01	<0.01	<0.01	<0.01	<0.01	0.33
P-value for *F*-test that buy = buy-and-sell	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
R^2	0.089	0.092	0.085	0.081	0.081	0.061
N	13,110	12,659	12,288	11,945	11,555	11,110

Heteroskedasticity-consistent standard errors are reported below coefficients in parentheses (see White, 1980).

**Significant at the 1% level; *significant at the 5% level. Assets above $10 billion is the omitted category forthe size indicator variables. Banks that neither buy nor sell loans constitute the omitted category for the sell and buy indicator variables.

decisions – banks that use the loan sales market to manage credit risk invest a greater fraction of their assets in risky loans. In Table 4, we examine the ratio of C&I loans to assets, and in Table 5 we examine the ratio of commercial real estate loans to total assets. The results, after controlling for size and BHC affiliation, provide further support for our hypothesis.

Table 5
Regressions relating a bank's ratio of commercial real estate loans to total assets to loan sales indicators and bank characteristics

	1988	1989	1990	1991	1992	1993
Constant	0.084**	0.094**	0.104**	0.091**	0.077**	0.075**
	(0.011)	(0.012)	(0.011)	(0.010)	(0.009)	(0.008)
Multi-bank holding company	0.004**	0.001	−0.005*	−0.006**	−0.008**	−0.009**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Multi-state bank holding company	−0.001	−0.001	0.001	0.002	−0.002	−0.007**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Assets < \$10 mil	−0.068**	−0.072**	−0.087**	−0.075**	−0.061**	−0.059**
	(0.011)	(0.012)	(0.011)	(0.010)	(0.009)	(0.008)
\$10 mil < assets < \$25 mil	−0.044**	−0.054**	−0.064**	−0.051**	−0.037**	−0.036**
	(0.011)	(0.012)	(0.011)	(0.010)	(0.009)	(0.008)
\$25 mil < assets < \$50 mil	−0.026*	−0.032**	−0.042**	−0.023*	−0.008	−0.003
	(0.011)	(0.012)	(0.011)	(0.010)	(0.009)	(0.008)
\$50 mil < assets < \$100 mil	−0.008	−0.010	−0.021	−0.003	0.012	0.019*
	(0.011)	(0.012)	(0.011)	(0.010)	(0.009)	(0.008)
\$100 mil < assets < \$500 mil	0.010	0.010	0.004	0.021*	0.035**	0.040**
	(0.011)	(0.012)	(0.011)	(0.010)	(0.009)	(0.008)
\$500 mil < assets < \$1 bil	0.030*	0.034**	0.020	0.038**	0.046**	0.043**
	(0.012)	(0.013)	(0.012)	(0.011)	(0.010)	(0.008)
\$1 bil < assets < \$5 bil	0.022*	0.021	0.013	0.022*	0.028**	0.032**
	(0.012)	(0.012)	(0.012)	(0.010)	(0.009)	(0.008)
\$5 bil < assets < \$10 bil	0.018	0.019	−0.003	0.014	0.025	0.026*
	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)
Sell loans	0.022**	0.023**	0.024**	0.022**	0.026**	0.027**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Buy loans	0.007**	0.008**	0.010**	0.013**	0.015**	0.015**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Buy-and-sell loans	0.033**	0.029**	0.031**	0.028**	0.030**	0.031**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Derivatives indicator	−0.018**	−0.014**	−0.008	−0.006	−0.001	−0.003
	(0.005)	(0.006)	(0.005)	(0.005)	(0.004)	(0.004)
P-value for *F*-test that sell = buy-and-sell	<0.01	<0.01	<0.01	0.01	0.17	0.09
P-value for *F*-test that buy = buy-and-sell	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
R^2	0.148	0.146	0.150	0.142	0.131	0.127
N	13,126	12,675	12,295	11,951	11,561	11,115

Heteroskedasticity-consistent standard errors are reported below coefficients in parentheses (see White, 1980).
**Significant at the 1% level; *significant at the 5% level. Assets above \$10 billion is the omitted category for the size indicator variables. Banks that neither buy nor sell loans constitute the omitted category for the sell and buy indicator variables.

Looking first at Table 4 (C&I loans per dollar of assets), we find that, at a minimum, C&I loans-to-assets are 2.8% points higher, on average, at banks that buy-and-sell loans compared to banks that do not participate in the loan sales market. Moreover, the buy-and-sell banks hold C&I loans-to-assets ratio 1.7–4.3% points

higher than the banks that buy-only, and 0.3–2.0% points higher than banks that sell-only. The difference in C&I lending for the buy–sell banks and the sell-only banks is statistically significant in five of the six years.

For commercial real estate lending, the pattern is similar. Relative to banks not involved in the loan sales market, commercial real estate loans per dollar of assets are at least 2.8% points higher at the buy–sell banks. Compared with the buy-only banks, the buy-and-sell banks hold 1.5–2.6% points more commercial real estate loans, and compared with the sell-only banks, they hold 0.4–1.1% points more commercial real estate loans. The difference in commercial real estate lending between the buy–sell and sell-only banks is statistically significant at the 1% level in four of the six years, and at the 10% level in one of the six years. [14]

3.3. The volume of loan sales

As Table 1 shows, more than two-thirds of the bank observations display some loan sales activity, and 37.8% of the banks both buy-and-sell loans. While this figure may seem high, there is considerable variation in the scale of activity across banks. For example, among the buy–sell banks, 25% have gross sales volume below 2% of total beginning-of-period loans on the balance sheet, while 10% of the buy–sell banks have gross volume above 20% of total loans. This latter figure is quite substantial given that the amount of loans on a bank's balance sheet will likely be substantially larger than the flow of loans originated by the bank during the year. [15] Our hypothesis suggests that among the buy–sell banks, those more active on both the buy-and-sell sides are more actively managing their credit risk and thus ought to be able to adjust their financial and operating performance more than banks with less loan sales activity.

Using only banks that both buy-and-sell loans, we test this notion by regressing our capital, liquidity and lending variables on the gross volume of loan sales activity, equal to total loans sold plus total loans purchased, divided by beginning-of-period loans. For this set of tests, we control for the effects of supply and demand conditions in the funding and lending markets by including the ratio of net loans purchased (purchases minus sales) to beginning-of-period loans. The summary statistics for these variables appear at the bottom of Table 1. For the buy-and-sell banks, the gross flow of loan sales activity averages about 8% of total loans, while the net flow is approximately zero on average.

Table 6 reports these results. To preserve space, we only report the coefficients on our measure of gross sales. The results continue to suggest that banks with more loan sales and purchase activity hold less capital (significant in four of six years), fewer liquid assets, and do more C&I and commercial real estate lending. The effects are

[14] Tables 4 and 5 also show that in most years banks owned by multi-bank holding companies hold lower levels of risky loans per dollar of assets than other banks. Like the result for capital held by multi-state BHCs, this lower level of risky lending could reflect the influence of additional regulatory oversight.

[15] For example, if the average loan maturity were five years, then the stock of loans on the balance sheet would be roughly five times larger than the flow of loans originated (assuming zero net purchases).

Table 6
Regression relationship between capital, liquidity and risky lending and the volume of gross loan sales for banks that buy and sell loans

Dependent variable	1988	1989	1990	1991	1992	1993
Capital/risky assets	−0.048**	−0.020	−0.019	−0.046**	−0.071**	−0.096**
	(0.012)	(0.015)	(0.015)	(0.014)	(0.012)	(0.015)
Cash plus securities/assets	−0.221**	−0.183**	−0.215**	−0.239**	−0.257**	−0.277**
	(0.020)	(0.022)	(0.025)	(0.022)	(0.023)	(0.022)
C&I loans/assets	0.177**	0.133**	0.128**	0.094**	0.048**	0.017
	(0.022)	(0.018)	(0.017)	(0.016)	(0.014)	(0.013)
Commercial real estate	0.115**	0.082**	0.125**	0.094**	0.095**	0.105**
Loans/assets	(0.016)	(0.015)	(0.017)	(0.017)	(0.019)	(0.020)

Each cell in this table represents the coefficient estimate from one variable in a multiple regression (i.e. there are 24 regression equations represented here). The dependent variables in each regression are the same as those reported in Tables 2–5. All ofthe bank characteristics (except the loan sales variables) are also the same as those reported in Tables 2–5, but these are not reported to conserve space. The coefficient reported here is the coefficient on the ratio of gross loan sales (sales + purchase) to beginning-of-period total loans. The regressions also include the net purchases to total loans ratio as a control variable. Heteroskedasticity-consistent standard errors are reported below coefficients in parentheses (see White, 1980).
**Significant at the 1% level; *significant at the 5% level.

economically as well as statistically important. For example, based on the 1988 coefficients, a one standard deviation increase in gross sales activity is associated with a 0.4% point decline in the capital ratio, a 1.8% point decline in the liquid assets ratio, a 1.5% point increase in C&I lending and a 0.9% point increase in commercial real estate lending.

3.4. Reverse causality?

The results to this point establish a strong and consistent correlation between capital, liquidity, risky lending and banks' activities in the loan sales market for credit risk management. These correlations suggest that banks that engage in risk management alter their financial and operating strategies toward ones that would, on their own, increase risk. As is always the case, however, it is difficult to rule out reverse causality. Perhaps banks with higher risk (e.g. banks with less capital or banks with higher levels of risky loans) choose to institute a more active risk management program to offset (or partially offset) their greater financial and operating risk, rather than the other way around.

To rule out reverse causality, we replace the three loan sales indicators reported in the regressions of Tables 2–5, with a single variable intended to capture the extent of loan sales activities by *other* banks headquartered in the same area. In one set of specifications, we use loan sales activity by other banks in the same Metropolitan Statistical Area (for banks not headquartered in an MSA, we use the county as the local market); in a second set of results, we use loan sales activity by other banks in the same state. The idea is to replace variables that reflect a bank's *choice* of whether or not to manage risk via the loan sales market (the three loan sales

indicator variables) with a variable that captures the *cost* of using the loan sales market for this purpose. The premise is that a bank is more likely to face a low cost of using the loan sales market for risk management if other banks in the same area do so. This lower cost, for example, could reflect the nature of the borrowers or industries located near the bank. [16]

As a measure of banks' use of the loan sales market – call it the "depth" of the local loan sales market – we compute the sum of all loans made by banks headquartered in the area (MSA or state) that both buy-and-sell loans, divided by all loans made by all banks in the same area. This variable ranges from a low of zero (no other bank in the market is a buy–sell bank) to one (all other banks in the market are buy–sell banks). We do not include lending by the bank in question in constructing loan sales depth because we want our measure of loan sales activity to be insensitive to the actual choices made by the bank. Thus, the results are unlikely to be driven by reverse causality.

Before testing how a bank's capital, liquidity and lending depend on loan market depth, we first note that this variable exhibits a high correlation with the buy–sell indicator variable. Thus, we seem to have identified a good instrument; if a bank is located in a market where many of its competitors actively use the loan sales market, then the bank does too. [17] For example, in year-by-year cross-sectional regressions similar to those in Tables 2–5 with the buy–sell indicator as the *dependent* variable and the size indicators, the multi-bank and multi-state BHC indicators and our measure of local loan market depth as explanatory variables, the coefficient on the market depth variable ranges from 0.17 to 0.20 with a *t*-statistic that never falls below 14.

Table 7 reports the results. Just as in Table 6, we only report the coefficient on the variable of interest. Panel A contains the results using the MSA as the relevant local area, while Panel B contains the results based on the state. In both cases we cluster the errors in the regression model based on the local area to account for the possibility that the observations across banks operating in the same market may not be independent. Since there are only 51 states in the results in Panel B (includes DC), this clustering substantially increases the standard errors.

In Panel A, for all four variables and for all six years, the coefficients are large and statistically significant. First, we find that banks hold less capital per dollar of asset if they are located in markets with many active loan sellers and buyers. For example, a bank in a market where none of its competitors act as both a loan buyer and seller has, on average, a capital-risky assets ratio 1.7–2.7% points higher than a similar bank located in a market where all of its competitors use the loan sales market for risk management. Second, a bank in a market where none of its competitors act as both a loan buyer and seller has, on average, a liquid assets-to-total assets ratio 2.6–4.7% points higher than a similar bank located in a market where all of

[16] Survey evidence suggests that firms (as well as households) tend to borrow from banks that are geographically close.

[17] Note that we cannot reestimate the models of Tables 2–5 using an instrumental variables procedure because the model is not identified. We have three endogenous variables – the three loan sales indicators – but just a single instrument. Thus, we report what could be interpreted as a reduced form instead.

Table 7
Regression relationship between bank capital, liquidity and risky lending to the depth of local loan sales market

Dependent variable	1988	1989	1990	1991	1992	1993
Panel A: Independent variable = local market depth						
Capital/risky assets	−0.027**	−0.018**	−0.018**	−0.017**	−0.018**	−0.017**
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)
Cash plus securities/assets	−0.047**	−0.035**	−0.037**	−0.037**	−0.029**	−0.026**
	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
C&I loans/assets	0.047**	0.038**	0.034**	0.032**	0.024**	0.021**
	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Commercial real estate	0.033**	0.026**	0.028**	0.024**	0.021**	0.018**
Loans/assets	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
Panel B: Independent variable = state market depth						
Capital/risky assets	−0.056	−0.044	−0.045	−0.050*	−0.051*	−0.028
	(0.029)	(0.025)	(0.024)	(0.022)	(0.023)	(0.030)
Cash plus securities/assets	−0.081	−0.086	−0.081	−0.091	−0.044	−0.017
	(0.067)	(0.071)	(0.076)	(0.076)	(0.079)	(0.078)
C&I loans/assets	0.093**	0.080**	0.070**	0.057**	0.048**	0.037
	(0.033)	(0.028)	(0.024)	(0.022)	(0.019)	(0.023)
Commercial real estate	0.083*	0.074	0.097	0.073	0.052	0.024
Loans/assets	(0.041)	(0.044)	(0.049)	(0.053)	(0.049)	(0.059)

Each cell in this table represents the coefficient estimate from one variable in a multiple regression (i.e. there are 24 regression equations represented in each panel). The dependent variables in each regression are the same as those reported in Tables 2–5. All of the bank characteristics (except the loan sales variables) are also the same as those reported in Tables 2–5, but these are not reported to conserve space. The coefficients on our measures of the depth of the loan sales market are reported here, along with its standard error. In Panel A, the depth of the loan sales market is defined as the amount of lending done by banks that both buy-and-sell loans as a fraction of all lending done in the same MSA (or non-MSA county) as the bank. In Panel B, the depth of the loan sales market is defined as the amount of lending done by banks that both buy and sell loans as a fraction of all lending done in the same state as the bank. Standard errors are adjusted to reflect clustering of the errors in the regressiond within a locality (Panel A) or state (Panel B).
**Significant at the 1% level; *significant at the 5% level.

its competitors use the loan sales market. The same story holds for lending. Banks in markets where competitors use the loan sales market as both buyers and sellers hold 2.1–4.7% more C&I loans per dollar of assets and 1.8–3.3% more commercial real estate loans per dollar of assets. [18]

The results in Panel B have the same sign patterns as in Panel A, but the coefficients tend to be somewhat larger. Moreover, as noted above, we lose substantial

[18] This analysis may raise the concern that our results have only to do with differences in bank behavior that reflect difference across local markets. For example, one interpretation of these findings is that they reflect an unobservable characteristic of the loans that makes them both safer and, thus, easier to sell. To rule this out, we have estimated our model with MSA-level (or non-MSA county-level) fixed effects on the assumption that banks tend to lend to local firms, and that loans to firms in the same MSA are homogeneous. In these models we continue to find that the buy–sell banks have statistically significantly lower capital ratios and higher ratios of risky loans to assets than the other banks.

statistical power because there is less variation across banks when we construct the measure of loan market depth at the state rather than local level.

3.5. Loan sales activity, risk, and profits

In our last set of results, we estimate the relationship between loan sales activity and measures of risk and profit. Our risk measures are based on profits (the *time-series* standard deviation of each bank's return on equity and return on assets) and loan losses (the *time-series* standard deviation of each bank's loan loss provisions to total loans and the standard deviation of non-performing loans to total loans). We then test whether profit (mean ROE and ROA) and risk-adjusted profit (the ratio of a bank's mean ROE to the standard deviation ROE, what we call "RAROC") is higher at banks engaged in loan sales and purchases than at other banks. [19] Because the risk and profit measures are based on time-series data for each bank, we only estimate a single cross-sectional model. We thus report the "between" estimator, which exploits the full panel dataset but estimates the regression using the time-series averages of both the dependent and explanatory variables for each bank. This estimator depends on variation between banks, so it is analogous to the earlier annual cross sectional results. [20]

As reported in Table 8, there is a strong relationship between activity in the loan sales market and the profit–risk measures, although the effects depend on whether or not we control for capital structure and lending activities. Without controls for activities, banks that buy-and-sell loans appear to have *higher* volatility of ROE than banks not engaged at all in the loan sales market, or banks that only buy loans (column 1). These buy–sell banks also have *higher* volatility of ROA than banks that only buy loans (column 3). However, controlling for activities, the buy-and-sell banks are safer than otherwise similar banks (i.e. banks with similar capital structures and loan portfolios) that do not avail themselves of the opportunity to manage risks through the external markets (columns 2 and 4). For example, the volatility of ROE (ROA) is about 0.022 (0.0019) lower for the buy–sell banks than for banks outside the loan sales market entirely.

Relative to the sell-only banks, ROE (ROA) volatility is about 0.012 (0.0009) lower for the buy–sell banks; both of these differences are statistically significant at the 5% level. These differences are also economically significant relative to the average volatility of ROE and ROA (0.149 and 0.012, respectively – see Table 1). We do not find statistically significant differences between the buy–sell banks and the buy-only banks.

[19] This analysis is similar in spirit to Demsetz and Strahan (1997), who link stock return volatility to bank characteristics. Here, we use accounting measures of risk rather than market measures of risk because we need to include the smaller banks without publicly traded stock to have sufficient variation in our loan sales variables.

[20] In principle, we could estimate the relationship between ROE and loan sales activity on a year-by-year basis, as we do with the balance sheet ratios. However, since ROE tends to fluctuate over time, we decided to report the relationship based on average profits over our sample period.

Table 8
Regressions relating the volatility of profits (return on equity and return on assets) to loan sales indicators and bank characteristics

	Volatility of return on equity		Volatility of return on assets	
	No controls	With controls	No controls	With controls
Constant	0.241**	0.181**	0.0146**	0.0098**
	(0.022)	(0.022)	(0.0014)	(0.0014)
Capital to risky asset ratio	–	−0.260**	–	−0.0020*
		(0.012)		(0.0008)
Securities to assets	–	0.121**	–	0.0015
		(0.012)		(0.0008)
C&I loans to assets	–	0.367**	–	0.0235**
		(0.018)		(0.0012)
Commercial real estate to assets	–	0.278**	–	0.0163**
		(0.018)		(0.0012)
Multi-bank holding company	−0.014**	−0.010**	−0.0012**	−0.0008**
	(0.004)	(0.003)	(0.0002)	(0.0002)
Multi-state bank holding company	0.012*	0.018**	0.0009**	0.0011**
	(0.005)	(0.005)	(0.0003)	(0.0003)
Assets < $10 mil	−0.084**	−0.012	0.0014	0.0051**
	(0.023)	(0.022)	(0.0015)	(0.0014)
$10 mil < assets < $25 mil	−0.092*	−0.049*	−0.0011	0.0018
	(0.023)	(0.021)	(0.0014)	(0.0014)
$25 mil < assets < $50 mil	−0.106**	−0.077**	−0.0023	−0.0001
	(0.023)	(0.021)	(0.0014)	(0.0014)
$50 mil < assets < $100 mil	−0.121**	−0.102**	−0.0034**	−0.0018
	(0.023)	(0.021)	(0.0014)	(0.0014)
$100 mil < assets < $500 mil	−0.116**	−0.112**	−0.0036**	−0.0029*
	(0.022)	(0.021)	(0.0014)	(0.0014)
$500 mil < assets < $1 bil	−0.102**	−0.105**	−0.0034*	−0.0033*
	(0.024)	(0.022)	(0.0014)	(0.0014)
$1 bil < assets < $5 bil	−0.094**	−0.089**	−0.0030*	−0.0026
	(0.023)	(0.021)	(0.0014)	(0.0014)
$5 bil < assets < $10bil	−0.066*	−0.058*	−0.0012	−0.0007
	(0.030)	(0.028)	(0.0019)	(0.0018)
Sell loans	0.031**	−0.010*	0.0008*	−0.0010**
	(0.005)	(0.005)	(0.0003)	(0.0003)
Buy loans	−0.004	−0.025**	−0.0009*	−0.0015**
	(0.007)	(0.006)	(0.0004)	(0.0004)
Buy-and-sell loans	0.028**	−0.022**	0.0002	−0.0019**
	(0.004)	(0.004)	(0.0002)	(0.0002)
Derivatives indicator	0.023*	0.022*	0.0019**	0.0014*
	(0.010)	(0.010)	(0.0006)	(0.0006)
P-value for *F*-test that sell = buy-and-sell	0.58	0.02	0.09	<0.01
P-value for *F*-test that buy = buy-and-sell	<0.01	0.57	<0.01	0.28
R^2	0.027	0.159	0.036	0.111
N	10,063	10,063	10,063	10,063

This table estimates the relationship between the average volatility of ROA and ROE for each bank on the average value of its balance sheet characteristics and loan sales indicator variables. Heteroskedasticity-consistent standard errors are reported below coefficients in parentheses (see White, 1980).
**Significant at the 1% level; *significant at the 5% level. Assets above $10 billion is the omitted category for the size indicator variables. Banks that neither buy nor sell loans constitute the omitted category for the sell and buy indicator variables.

Table 9 displays a similar pattern for volatility of loan loss provisions and non-performing loans. Unconditionally, the buy–sell banks have loan loss volatility that is not significantly different from that displayed by banks that only buy loans or only sell loans (columns 1 and 3), and they have *higher* volatility of loan loss provisions than banks with no loan sales activity (column 1). Controlling for activities, however, the buy–sell banks have considerably lower volatility of non-performing loans than the buy-only banks (column 2), and the buy–sell banks have lower volatility of loan loss provisions than the other three sets of banks (column 4).

As a final test of our hypotheses, we estimate how bank profit varies with risk management activities in the loan sales market. Our sample period, however, covers a time of turmoil in the US banking industry in which loans to businesses experienced very poor performance. Because the banks active in loan sales held more of these loans (see above), and because these loans turned out to experience losses, the relationship between ex-post profits and loan sales activity would be obscured during our sample period in the absence of controls for activities. We therefore account for the very poor ex-post performance of banks' lending to businesses during this period in our regressions to remove this bias by including the capital structure and lending activity variables analyzed in Tables 2–5 in our last set of regressions.

In Table 10, we report the relationship between loan sales and bank profits (ROE and ROA) and risk-adjusted profits (RAROC). We find that the banks that use loan sales to manage credit risks – the banks that both buy-and-sell loans – have significantly higher ROE, ROA, and risk-adjusted profits (RAROC) than all three other groups of banks. For example, the buy-and-sell banks have an average ROE that is 2.4% points higher than the banks not active in loan sales, they have an ROE 1.6% points higher than the sell-only banks, and an ROE 2.2% points higher than the buy-only banks (column 2). Similarly, the buy-and-sell banks display higher ROA and higher risk-adjusted profits than banks in the other three groups.

Banks that manage their risks by both buying and selling loans appear to benefit. They can operate with less capital and hold fewer liquid assets on their balance sheet, and they can engage in more risky lending – lending to business – rather than safe lending (consumer and residential real estate), all without unduly increasing their risk. These strategies raise profits. What explains the banks that do not manage their risks through the loan sales market? One possibility is that loans with private information are hard to sell at arm's length unless a bank has established a strong reputation over time in this market. In fact, the recent results by Dahiya, Puri, and Saunders are consistent with this view. Alternatively, during our sample period there may be mainly poorly managed banks that have been able to persist in the US due to regulations that reduce competitive pressures and government subsidies (see Jayaratne and Strahan, 1998; Berger et al., 1995).

Trends toward more widespread adoption of risk management techniques support our finding that banks benefit by using these techniques to increase profit. During the past few years, sophisticated banks and financial consultants have begun successfully marketing risk management software to banks. Morgan, for example, developed its *Creditmetrics* model to allow banks to estimate how diversification across rating categories, industries, and countries affect the overall loss distribution for their

Table 9
Regressions relating the volatility of loan performance to loan sales indicators and bank characteristics

	Volatility of non-performing loans/ total loans		Volatility of loan loss provisions to total loans	
	No controls	With controls	No controls	With controls
Constant	0.013**	0.004*	0.025**	0.015**
	(0.002)	(0.002)	(0.002)	(0.002)
Capital to risky asset ratio	–	−0.009**	–	−0.007**
		(0.001)		(0.001)
Securities to assets	–	0.016**	–	0.015**
		(0.001)		(0.001)
C&I loans to assets	–	0.028**	–	0.040**
		(0.002)		(0.002)
Commercial real estate to assets	–	0.023**	–	0.016**
		(0.002)		(0.002)
Multi-bank holding company	−0.002**	−0.002**	−0.003**	−0.002**
	(0.0003)	(0.001)	(0.001)	(0.001)
Multi-state bank holding company	−0.001**	−0.001	0.001*	0.002**
	(0.0004)	(0.001)	(0.0005)	(0.001)
Assets < $10 mil	0.003	0.005**	−0.006*	−0.002
	(0.002)	(0.002)	(0.002)	(0.002)
$10 mil < assets < $25 mil	0.001	0.003	−0.008**	−0.006**
	(0.002)	(0.002)	(0.002)	(0.002)
$25 mil < assets < $50 mil	−0.001	−0.001	−0.010**	−0.009**
	(0.002)	(0.002)	(0.002)	(0.002)
$50 mil < assets < $100 mil	−0.002	−0.002	−0.012**	−0.012*
	(0.002)	(0.002)	(0.002)	(0.002)
$100 mil < assets < $500 mil	−0.003	−0.004*	−0.013**	−0.013**
	(0.002)	(0.002)	(0.002)	(0.002)
$500 mil < assets < $1 bil	−0.002	−0.003	−0.010**	−0.011**
	(0.002)	(0.002)	(0.002)	(0.002)
$1 bil < assets < $5 bil	−0.001	−0.001	−0.008**	−0.008**
	(0.002)	(0.002)	(0.002)	(0.002)
$5 bil < assets < $10 bil	−0.001	0.001	−0.004	−0.003
	(0.002)	(0.001)	(0.002)	(0.002)
Sell loans	0.002**	0.001	0.001	−0.001**
	(0.0004)	(0.001)	(0.001)	(0.0005)
Buy loans	0.003**	0.002**	−0.001	−0.002**
	(0.0005)	(0.001)	(0.001)	(0.0005)
Buy-and-sell loans	0.002**	0.0002	0.001	−0.003**
	(0.0003)	(0.0003)	(0.001)	(0.0004)
Derivatives indicator	0.0003	0.0011	0.0016	0.0017
	(0.0009)	(0.0008)	(0.0010)	(0.0010)
P-value for *F*-test that sell = buy-and-sell	0.64	0.19	0.53	0.01
P-value for *F*-test that buy = buy-and-sell	0.19	<0.01	0.89	0.09
R^2	0.047	0.105	0.041	0.093
N	10,059	10,059	10,059	10,059

This table estimates the relationship between the average volatility of loan loss provisions and non-performing loans for each bank on the value of its balance sheet characteristics and loan sales indicator variables. Heteroskedasticity-consistent standard errors are reported below coefficients in parentheses (see White, 1980).
**Significant at the 1% level; *significant at the 5% level. Assets above $10 billion is the omitted category for the size indicator variables. Banks that neither buy nor sell loans constitute the omitted category for the sell and buy indicator variables.

Table 10
Regressions relating mean return on assets (ROA), return on equity (ROE) and RAROC (Mean ROE/Volatility of ROE) to loan sales indicators and bank characteristics

	Average ROA	Average ROE	RAROC
Constant	0.015**	0.191**	1.782**
	(0.002)	(0.019)	(0.165)
Capital to risky asset ratio	0.024**	−0.006	1.199**
	(0.001)	(0.010)	(0.093)
Securities to assets	−0.013**	−0.056**	−0.802*
	(0.001)	(0.011)	(0.091)
C&I loans to assets	−0.028**	−0.328**	−3.184**
	(0.001)	(0.015)	(0.137)
Commercial real estate to assets	−0.023**	−0.225**	−2.596**
	(0.001)	(0.016)	(0.138)
Multi-bank holding company	0.002**	0.029**	0.166**
	(0.0002)	(0.003)	(0.025)
Multi-state bank holding company	−0.001**	−0.001	−0.108*
	(0.0003)	(0.004)	(0.038)
Assets < \$10 mil	−0.002	−0.045**	−0.493**
	(0.002)	(0.019)	(0.166)
\$10 mil < assets < \$25 mil	0.002	−0.007	0.016
	(0.002)	(0.018)	(0.162)
\$25 mil < assets < \$50 mil	0.004**	0.022	0.355*
	(0.001)	(0.018)	(0.162)
\$50 mil < assets < \$100 mil	0.006**	0.046*	0.615**
	(0.001)	(0.018)	(0.162)
\$100 mil < assets < \$500 mil	0.007**	0.064**	0.775**
	(0.001)	(0.018)	(0.168)
\$500 mil < assets < \$1 bil	0.006**	0.064**	0.735**
	(0.001)	(0.018)	(0.168)
\$1 bil < assets < \$5 bil	0.005**	0.053**	0.552**
	(0.001)	(0.018)	(0.159)
\$5 bil < assets < \$10 bil	0.003	0.037	0.437*
	(0.002)	(0.024)	(0.213)
Sell loans	0.0002	0.008	0.043
	(0.0003)	(0.004)	(0.037)
Buy loans	0.0001	0.002**	0.061
	(0.0004)	(0.005)	(0.046)
Buy-and-sell loans	0.0010**	0.024**	0.151**
	(0.0002)	(0.003)	(0.028)
Derivatives indicator	−0.0006	0.0003	−0.1886**
	(0.0007)	(0.0080)	(0.072)
P-value for *F*-test that sell = buy-and-sell	0.02	<0.01	<0.01
P-value for *F*-test that buy = buy-and-sell	0.02	<0.01	0.05
R^2	0.210	0.142	0.183
N	10,063	10,063	10,063

This table estimates the relationship between the average ROA, average ROE and RAROC on the average value of its balance sheet characteristics and loan sales indicator variables. Heteroskedasticity-consistent standard errors are reported below coefficients in parentheses (see White, 1980).
**Significant at the 1% level; *significant at the 5% level. Assets above \$10 billion is the omitted category for the size indicator variables. Banks that neither buy nor sell loans constitute the omitted category for the sell and buy indicator variables.

portfolio. Our study focuses on banks' uses of the loan sales market for risk management during the late 1980s and early 1990s because of data availability, but we would expect other risk management techniques that have been adopted over the past several years to have had similar effects on bank capital structure, lending and profits. Rigorous testing of the effects of these new risk management techniques, however, will have to wait for more time to pass and more data to be collected.

4. Conclusions

We have long been intrigued by the mechanisms through which banks seem to cater to many and opposing needs. Liquidity, profitability, and solvency goals seem to cross paths and by and large contradict one another. The extant empirical literature for non-financial firms indicates that active risk management through both internal capital markets (e.g. scale and diversification) and through active engagement in the external capital markets (e.g. active use of derivatives) provide ways to manage liquidity and cash flow and achieve higher investment.

We have considered the case of the loan sales market as one tool (that we can measure empirically) which banks use to align their risk management, lending and capital structure goals. The focus in the banking literature has been on how banks use their internal capital markets. Our results support these studies, since we find that bigger banks affiliated with multi-bank BHCs enjoy lower capital ratios and higher lending. We extend these results by showing that access to and aggressive use of an external loan sales market to manage credit risk leads to the same effects. Loan sales activity allows a bank to hold less capital, invest less in low-yield, high-liquidity assets, while at the same time increase its holdings of higher-risk, higher-return assets. The relationship between risk and loan sales activity suggests that these moves toward higher risk activities do not, in fact, result in higher risk. It seems that the risk-reducing benefits of engagement in the loan sales market are, in effect, spent by banks on higher risk activities. The motivation for these changes in capital structure and lending practices is profit – we find that profits are higher at banks that buy-and-sell loans.

We conclude that the banks that engage in both buying and selling of loans may be better able to take advantage of positive net-present-value investment opportunities, as they are able to increase their C&I and commercial real estate loans and are better able to manage with less liquidity and less capital. The buying and selling of loans at the same time seems to allow banks to be more flexible and more aggressive. The flexibility reduces the burden of carrying more capital, and lower yield higher liquidity assets; and the aggressiveness allows them to increase their higher risk and higher yield assets.

In recent years, we have seen banks trade credit risks using credit derivatives, and we have seen the emergence of sophisticated credit risk measurement systems that take account of correlations across borrowers in different industries, countries and market segments. Regulators have decided that such innovations ought to be encouraged and even used to help determine capital adequacy standards. Our look at how

banks have used the loan sales market in the past suggests that developments in risk management are healthy ones that may increase the availability of bank credit, although we caution that our results suggest that regulators ought not expect banks to use these technologies to reduce *risk*.

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