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Capital market frictions and the role of internal capital markets in banking

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Abstract

The extent to which banking firms face external financing costs when funding new loans has important implications for the role of banks in the corporate capital acquisition process, for the effectiveness of monetary policy and for the impact of capital requirements. We investigate this issue by examining the cash-flow sensitivity of loan growth at bank holding companies, and by examining the extent to which holding companies establish an internal capital market to allocate capital among their various subsidiaries. Overall, we find that loan growth at subsidiary banks is more sensitive to the holding company's cash flow and capital position than to the bank's own cash flow and capital. Moreover, we find that bank loan growth is negatively correlated with loan growth among the other subsidiaries within the holding company. Overall, this evidence suggests that bank holding companies establish internal capital markets to allocate scarce capital among their various subsidiaries.

Keywords: Bank holding company; Internal capital markets; Capital allocations

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1. Introduction

It is widely accepted that commercial banks and other private lenders play an important role in mitigating information problems and other capital market

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frictions that make external financing costly.¹ This role suggests that a large portion of bank assets may be difficult for outside investors to value, which, in turn, can create information problems for banks themselves when they have to raise external capital. Diamond (1984), made this argument several years ago, arguing that financial intermediation may create an additional layer of agency problems, which creates the need for contracts and institutions to ‘monitor the monitor’.

Whether or not these mechanisms completely resolve banks’ agency problems is an open question with important implications for understanding the role that banks play in the capital allocation process. If the private information a bank has about the value of its portfolio creates adverse selection and moral hazard problems which make it costly to issue uninsured deposits or external equity, and if capital requirements limit the ability to use insured deposits, then it follows that banks with limited internal funds may be forced to curtail loan growth, particularly if the bank faces a binding capital requirement. Indeed, a critical assumption underlying explanations for the so-called ‘credit crunch’ of the early 1990s, in which banks allegedly decreased lending in response to an increase in capital requirements, is that banks find raising new equity from external sources to be expensive relative to internally generated funds. As Froot and Stein (1996) point out, adverse selection problems not only affect bank investment policy but also provide a motivation for risk management at commercial banks.

While the difficulty of valuing bank assets suggests that banks raising external capital face capital market frictions at least equal to those of non-financial firms, the empirical evidence on the importance of these problems is mixed. Slovin et al. (1991) find evidence that, on average, bank stock prices fall when the bank issues new equity. They find, however, that the market’s reaction depends on the bank’s capital position and whether the equity issuance was part of a series of multiple offers. Much of the recent empirical work in this area focuses on the relationship between bank loan or asset growth, earnings, and the level of bank capitalization. Most recent studies focus on effects of the increase in capital requirements on bank lending during the late 1980s and early 1990s to determine whether the decline in lending during this period was the result of more stringent capital requirements. For an excellent review of this literature, see Berger and Udell (1994) and Sharpe (1995). While these studies generally find a strong positive correlation between loan growth and capitalization, it is

¹ There is a large (and growing) literature on the role of banks in the corporate capital acquisition process. See, for, example the theoretical work of Berlin and Loeys (1988); Diamond (1984, 1991, 1993), Fama (1985), Rajan (1992) and Thakor (1996). Empirical studies by James (1987), Lummer and McConnell (1989), Petersen and Rajan (1994) and Houston and James (1996a,b) provide evidence consistent with banks playing an important role in mitigating information problems in financial markets.

unclear whether this relationship arises from liquidity constraints caused by capital market frictions or simply because earnings and capitalization serve as a proxy for the profitability of lending opportunities.

An additional problem with most prior studies of the relation between bank investment and capitalization is that they are based on data concerning individual banks. However, most banks are subsidiaries of multiple bank holding companies. If holding companies manage capital and liquidity on a consolidated basis, one would expect that the primary determinant of loan growth would be the capital position and earnings of the holding company and not the capital or earnings of the subsidiary bank. In general, the holding company structure in banking suggests investment activity of individual subsidiaries may reflect the operation of an internal capital market as described in Williamson (1975) and Stein (1997). However, as we discuss in Section 2, bank regulators can restrict intercompany transfers within the holding company and thereby frustrate attempts to manage growth and capital on a consolidated basis.

In this paper we examine the relationship between loan growth and internally generated funds for a sample of 281 publicly traded bank holding companies and approximately 2000 of their bank subsidiaries. Following the approach of Fazzari et al. (1988), we assume that capital market frictions create a wedge between the cost of internal and external financing that is manifest in the sensitivity of investment, or loan growth, to bank earnings. While we control for the profitability of future lending by including a measure of Tobin's Q as an explanatory variable, the estimated relationship between loan growth and earnings may still be biased if current earnings provide a better, or additional, measure of future loan demand than Tobin's Q .

To separate better the effects of liquidity from the profitability of loan opportunities, we follow an approach similar to Lamont (1997) and examine the relation between loan growth, or investment, of individual subsidiaries of bank holding companies and the subsidiary's own cash flows, as well as the cash flows of other subsidiaries within the same holding company. If adverse selection and moral hazard problems create a wedge between the cost of internal and external funds then, absent restrictions on inter-subsidiary transfers, loan growth at the subsidiary level will be driven primarily by the earnings and capital position of the holding company and not by the subsidiary's own capitalization or earnings. To control for the possibility that cash flows throughout a holding company serve as a proxy for investment opportunities at the individual bank level we also include loan growth at other subsidiaries once the earnings of nonbank subsidiaries of the holding company as explanatory variables.

Overall, we find a strong positive relation between loan growth of bank holding companies and internally generated additions to capital while controlling for differences in Tobin's Q . We also find that banks facing a binding capital requirement have lower rates of loan growth. Moreover, we find that the sensitivity of loan growth to earnings is significantly greater among banks that

are close to or below the minimum capital requirement. At the subsidiary level we find that loan growth is positively related to the subsidiary's own earnings as well as the earnings of other subsidiaries within the holding company. However, loan growth is significantly more sensitive to the earnings of the other subsidiaries. Moreover, subsidiary loan growth is unrelated to the subsidiary's own capitalization but positively related to the capitalization of the holding company.

Consistent with capital-induced loan supply effects, we also find that loan growth at other subsidiaries is negatively related to a bank's own loan growth. While it is difficult to explain this finding based on loan demand factors, this result is consistent with the operation of an internal capital market in which the overall lending capacity of the holding company is constrained.

The remainder of the paper is organized as follows. Section 2 provides a background discussion of the effects of capital requirements on bank investment activity and a discussion of regulatory restrictions on inter-subsidiary transfers within bank holding companies. The primary hypotheses tested in the paper are also described in Section 2. In Section 3, we describe our data and empirical methodology. Section 4 presents our empirical findings relating loan growth to cash flow at the holding company level. Section 5 looks at this relationship at the subsidiary level and documents the existence of internal capital markets. Section 6 contains our summary and conclusions.

2. Background and empirical tests

Even though banks invest heavily in informationally intensive assets, access to an elastic supply of federally insured deposits and the absence of minimum capital requirements would insulate banks from any adverse selection and moral hazard problems that arise from difficulties in valuing bank asset portfolios. However, capital requirements together with limited access to insured deposits – perhaps arising from regulatory taxes, local deposit market conditions or Federal Reserve policy – imply that at least a portion of a bank's financing must be raised in markets in which information problems potentially create a wedge between the cost of internal and external financing (see Myers and Majluf, 1984). Indeed, to the extent that capital requirements restrict the flexibility of bank financing, external financing costs can make bank loan and asset growth particularly sensitive to internally generated additions to capital.

If capital market frictions create a wedge between internal and external financing, these frictions will occur at the holding company level, since typically the parent company accesses the capital market. The Bank Holding Company Acts authorize the Federal Reserve to regulate bank holding companies. Under this authority the Federal Reserve regulates and periodically examines bank holding companies to insure they are operated in a 'safe and sound' manner. As

part of the regulatory process, holding companies are subject to the same minimum capital requirements that are imposed on insured commercial banks. For example, if individual banks are subject to a minimum capital-to-total-asset ratio of 5%, the holding company is subject to the same requirement based on its consolidated assets.

If bank holding companies are free to manage their capital and liquidity on a consolidated basis then capital market frictions would make loan growth sensitive to internally generated capital on a consolidated basis. In this case, loan growth for subsidiary banks would be related primarily to capitalization and earnings at the holding company level. However, several regulatory restrictions impair the ability of holding companies to manage their capital on a consolidated basis. One restriction is the Federal Reserve's practice of following a 'building block' approach when evaluating capital adequacy. This practice requires individual subsidiaries to be adequately capitalized as well as requiring adequate capitalization for holding companies on a consolidated basis (see Sections 2010 and 4060.2 of the Bank Holding Company Supervision Manual, 1986). This policy suggests that the failure of individual subsidiaries to meet capital guidelines will impede the holding companies' ability to manage capital on a consolidated basis. Banks are more likely to be managed on a consolidated basis if they are adequately capitalized. As the examination manual discusses: "The amount of dividends from subsidiaries to the parent is affected by the parent's philosophy on the distribution of capital throughout the organization. Some companies tend to keep the minimum capital levels in their subsidiary banks by transferring excess capital to the parent in the form of dividends. The parent then invests these funds for its own benefit and downstream the funds as needed. Other companies calculate dividends based strictly on the parent's cash needs and keep any excess at the bank level" (Bank Holding Company Supervision Manual, 1986 Section 2010.1). Given this practice, it is not surprising that there is at best a weak relationship between capitalization and loan growth at the individual bank level.

A second and related impediment to consolidated capital management is the long standing Federal Reserve policy of viewing a bank holding company as a source of strength to individual bank subsidiaries. This principal is reflected in Regulation Y12 CFR (Section 225.4(a)(1)) which states: "A bank holding company shall serve as a source of financial and managerial strength to its subsidiaries ...". The source of strength doctrine gives rise to a perceived obligation on the part of the holding company to downstream capital to inadequately capitalized subsidiaries. The requirement to downstream funds implies that the holding company may not be able to allocate capital to its subsidiaries with projects having the highest net present value (NPV) levels.

A third and final restriction on consolidated capital management establishes limits on inter-subsidiary transactions. These restrictions arise from provisions of Sections 23A and 23B of the Federal Reserve Act. The restrictions place limits

on dividends, fees, and inter-subsidiary asset sales. In general, these restrictions place limits on transfers that constitute more than ten percent of the subsidiary bank's capital (see 2020.1 of the Bank Holding Company Examination Manual, June 1986 for a discussion of these restrictions). Again, these restrictions limit the ability of the holding company to allocate capital to subsidiaries with the most profitable projects.

We analyze the effects of capital market frictions on the sensitivity of bank investment to changes in cash flow at both the holding company and the subsidiary level. We assume that in banking, loan growth, net of loan losses, is the activity that is equivalent to investment by nonfinancial firms. Bank investment in real assets is generally quite small, amounting to, on average, less than 3% of total assets. Arguably, investment activity should include investments in securities. However, one important reason for bank investment in securities is liquidity, to insure the bank's ability to finance future loan growth. In the empirical analysis we control for the securities holdings of the bank when analyzing loan growth.

If external capital is costly relative to internally generated funds we would expect a positive relation between consolidated loan growth at the holding company level and internally generated funds. Moreover, since capital requirements serve to limit a bank's ability to substitute deposits for equity capital, or for other sources of funding that are subject to potential adverse selection problems, we would expect that the sensitivity of loan growth to internally generated funds would be greatest for firms where the capital requirement is most binding.

As discussed earlier, a common criticism of studies of the cash flow sensitivity of investment is that current cash flow may be correlated with the profitability of investment opportunities. As a result, even in the absence of capital market frictions, investment and cash flows may be positively correlated. We address this issue by including in the regression analysis the holding company's market-to-book value of assets as a measure of Tobin's *Q*. We expect a positive relation between loan growth and the holding company's market-to-book value of assets.

An alternative and perhaps cleaner way of examining the importance of external financing costs in banking is to examine the operation of the internal capital market within a bank holding company. Specifically, if the positive relation between loan growth and internally generated cash results primarily from a positive correlation between cash flows and loan demand then one would expect a positive correlation between subsidiary loan growth and subsidiary cash flows. Indeed, if changes in loan demand induce the positive correlation between loan growth and cash flows, then holding company cash flows, net of the subsidiary's earnings, will be related to loan growth at the subsidiary level only to the extent that they serve as a proxy for local demand conditions. Since holding company cash flows are likely to be a poorer proxy for demand factors

than the subsidiary's own earnings, holding company cash flows would be expected to be less important than the subsidiary's own cash flows. Finding evidence that holding company cash flows are more important than subsidiary cash flows would be evidence consistent with the hypothesis of costly external capital. Finally, if demand factors induce a positive correlation between subsidiary loan growth and holding company cash flows, a positive relation is expected between subsidiary loan growth and loan growth at other subsidiaries within the holding company. In contrast, capital constraints and the operation of an internal capital market are consistent with a negative relationship between loan growth among the subsidiaries.

3. Data

We collected bank holding company data from the Federal Reserve Y-9 tapes from 1981–1989, using annual observations. To be included in our sample, holding companies must have a minimum of two years of data, a non-negative book value of equity, and an available market value of common equity. All stock data come from the Center for Research in Security Prices (CRSP) master tapes. Our sample contains 281 bank holding companies, 237 of which are multi-bank holding companies.

Subsidiary bank data are collected from the Federal Reserve Reports of Income and Condition (Call Reports) for the bank holding companies in our sample. Call Report data is available to us beginning in 1986, so our sample spans 1986–1989. To be included in our sample, subsidiary banks must have at least two year-end observations and be part of a multi-bank holding company. We restrict our subsidiary bank sample to those of multi-bank holding companies because we are interested in examining whether holding companies act as an internal capital market. The subsidiary bank sample contains 2001 different bank subsidiaries of the 237 multi-bank holding companies. There are a total of 4398 observations over the sample period.

We restrict our sample period to the 1980s because, after 1989, all banks, and bank holding companies, became subject to risk-based capital requirements. Risk-based requirements represented a major regime change in regulatory behavior. Hence we choose to study a period for which the regulatory regime for bank capital is held constant. We have extended our holding company sample tests through 1992, with no significant difference in results (not reported). One additional complication when extending the data through 1992 is that complete risk-weighted asset data are not available. In these instances, we rely on a technique developed by Takeda (1994) for the estimation of risk-based capital ratios. Regression analysis is used to approximate the risk weights associated with on and off-balance sheet assets (see Takeda, 1994 or Marcus, 1996, for a complete discussion).

Studies of investment spending for nonfinancial firms consider investment to be a function of internally generated funds after controlling for firm growth opportunities (see for example, Fazzari et al., 1988). Typically, investment is measured by changes in capital deflated by the firm's capital stock at the end of the previous year. Capital stock is usually represented by a proxy measuring property, plant, and equipment. In addition, the existing literature generally deflates internally generated funds by the capital stock. We consider bank investment to be changes in loans outstanding, and the capital stock to be the loans outstanding at the end of the previous year. Therefore, investment or loan growth, is defined as the percentage change in loans outstanding.

The appropriate measure of internally generated funds for banking firms differs slightly from the measure used in studies of nonfinancial firms. Specifically, studies of nonfinancial firms generally measure internally generated cash flows as net income before extraordinary items plus depreciation. However, banks may not be as constrained by cash flow as nonfinancial firms because of the availability of insured deposits. Nevertheless, they are constrained by the proportion of debt financing they can utilize. Regulations mandate capital requirements that limit the ability of banks to borrow funds, and thus banks should be concerned with the amount of regulatory capital that they generate. We measure internally generated funds as net income before extraordinary items plus depreciation and additions to loan loss provisions, since loan loss provisions are a noncash expense and are included in regulatory capital, and we scale this measure by the company's loan balance at the end of the previous year. To control for differences in investment opportunities, we use the holding company's market-to-book ratio, a proxy for Tobin's *Q*, at the end of the prior year. Our results are similar if we do not include additions to loan losses in our measure of internally generated funds. See Walter (1991), for a discussion of regulations pertaining to loan loss provisions. Our results are also similar if we deduct dividend payments from internally generated funds.

To measure the extent to which a bank holding company or subsidiary is capital constrained, we calculate its surplus capital at the end of the previous year. Surplus capital is the holding company or subsidiary's Tier II capital ratio minus the ratio which was required by regulators in that given year. Required capital ratios have varied over time. Specifically, from 1981–1989, regulators enforced leverage-based capital ratios, which are defined as total equity plus subordinated notes plus the allowance for loan losses, all divided by total assets. Surplus capital equals the capital ratio minus the required ratio. Required ratios were 5.5% from 1981–1984, and were 6% from 1985–1989. As an alternative measure of the regulatory constraint, we also include a dummy variable, *BIND*, which equals one if surplus capital is nonpositive, and zero otherwise. This variable indicates whether a bank failed to meet the minimum capital requirement at the end of the previous year.

To examine the cost of external securities offerings for the banks in our sample, we collected information about securities issued including common stock, preferred stock and subordinated debt from the Investment Dealer's Digest (IDD). The underwriter spread and issue size were also collected from IDD.

4. Holding company analysis

4.1. Summary statistics

Panel A of Table 1 contains descriptive statistics for the holding companies in our sample, while Panel B provides descriptive statistics for the subsidiaries of the multi-bank holding companies in our sample. As shown in Table 1, the holding companies in our sample are relatively large, with a median total assets of about \$2.5 billion during the 1986–1989 period. The size of holding companies in our sample ranged from \$203 million to \$208 billion in assets. Since information problems are generally thought to decrease with the size of the firm, the relatively large banks in our sample are expected to face the least severe adverse selection problems when raising new capital.

For the subsample of 237 multiple bank holding companies, the median number of subsidiaries is 15 banks. The median subsidiary bank is small relative to its holding company, with assets equal to only about two percent of the holding companies total assets (not shown). As shown in Table 1, the median bank holding company's Tier II capital ratio exceeded the regulatory minimum by approximately two percentage points. Over the period 1986–1989, only about 3% of the bank holding companies (31 out of 954) were below the regulatory minimum. As discussed previously in Section 2, since the Federal Reserve follows a building block approach to measuring adequate capital, meeting the capital requirement on a consolidated basis is a necessary but not sufficient condition for being adequately capitalized. As a result, our classification is likely to understate the differences in loan growth rates between adequately and inadequately capitalized banks.

Loan growth at both the subsidiary and holding company level averaged over 10% a year during the period. Internal additions to capital for the average and median bank and bank holding company was almost two percent of total loans, and slightly less than 1% of assets. Given capital requirements of 6% during the 1986–1989 period, internal additions to capital appear, on average, to be sufficient to support the observed asset and loan growth.

One frequently cited implication of costly external equity financing in banking is that banks that do not meet minimum capital requirements are more likely to pass up profitable new lending opportunities than banks that maintain

Table 1

Descriptive statistics for a sample of publicly traded bank holding companies and their subsidiary banks. The holding company sample includes data for 281 holding companies drawn from the Federal Reserve Y-9 tapes for the period 1982–1989. The subsidiary bank sample includes data for 2001 different bank subsidiaries drawn from the annual call reports for the subsidiary banks for the period 1986–1989. Data for the holding company sample is displayed for the total sample period and for the period 1986–1989 to facilitate comparison with the bank subsidiary sample.

	1982–1989		1982–1989	
	Mean	Median	Mean	Median
<i>Panel A: Holding companies</i>				
Total assets (millions)	\$7,498	\$2,113	\$8,396	\$2,452
Loan growth ^a	0.17	0.13	0.13	0.10
Asset growth	0.15	0.11	0.12	0.09
Internal additions to capital/loans _{t-1} ^b	0.02	0.02	0.02	0.02
Securities/total assets	0.20	0.19	0.20	0.19
Market-to-book ratio ^c	1.00	1.00	1.02	1.00
Book capital in excess of requirement/total assets ^d	0.02	0.02	0.02	0.02
Number of subsidiaries	–	–	20	15
<i>Panel B: Bank subsidiary sample</i>				
Total assets of bank (millions)			\$293	\$111
Loan growth of bank			0.08	0.10
(Internal additions to capital/loans) _{bank}			0.02	0.02
(Internal additions to capital/loans) _{H-net} ^e			0.02	0.01
(Internal additions to capital/loans) _{Non-bank} ^f			0.003	0.002
Securities/total assets			0.21	0.22
Lead bank total assets/total holding company total assets			0.36	0.31
((Book capital in excess of requirement)/total assets) _{Bank}			0.02	0.02
((Book capital in excess of requirement)/total assets) _H			0.02	0.02

^aLoan growth equals change in total loans outstanding divided by loans outstanding at time $t - 1$.

^bInternal additions to capital equals net income plus changes in loan loss provisions (up to the regulatory maximum).

^cMarket-to-book value of assets equals (total assets – book equity + market value equity)/total assets. Market value of equity equals market value of common stock and is taken from the Center for Research in Security Prices. The market-to-book ratio is calculated at year end for the prior year.

^dBook capital in excess of the minimum requirement equals the bank's book capital for regulatory minimum Tier II capital ratio. Tier II capital equals common stock, preferred stock plus eligible subordinate debt and loan loss reserves. For the period 1981–1984, the minimum requirement is a 5.5%. For the period 1988–1989, the minimum requirement is 6.0%.

^eInternal additions to capital H-net equals holding company additions to capital less the bank's additions to capital divided by total holding company loans less the loans of the subsidiary bank.

^fInternal additions to capital Non-Bank equals holding company additions to capital, net of the aggregate additions to capital of all bank subsidiaries, divided by total holding company loans less the loans of the subsidiary bank.

capital in excess of the regulatory minimum. While there are many other reasons why poorly capitalized banks might grow slower than well-capitalized institutions (these arguments are at the heart of the ‘capital crunch’ debate, see Sharpe, 1995), it is interesting to examine whether loan growth is related to capitalization for the banks in our sample and, if so, whether holding company or bank capitalization is most important. A simple, albeit crude, way to address this issue is to examine differences in the mean and median loan growth rates by whether or not the bank or holding company meets minimum capital requirements.

The results of this analysis are reported in Table 2. In Panel A we examine differences in loan growth at the holding company level for two groups classified by whether or not the holding company meets its capital requirements. As shown in Panel A, while both groups of holding companies experienced loan growth, growth at adequately capitalized holding companies was significantly greater than growth at holding companies that failed to meet the regulatory minimum.

Table 2

Difference in loan growth based on whether minimum capital requirements are binding for a sample of bank holding companies and their subsidiary banks from 1986–1989. The holding company sample includes 281 holding companies drawn from the Federal Reserve Y-9 tapes. The subsidiary bank sample includes data for 2001 different bank subsidiaries drawn from the annual call reports for the subsidiary banks. The pooled sample for holding companies includes 954 observations during the period, and the pooled subsidiary bank sample includes 4398 observations.

	N	Loan growth	
		Mean	Median
<i>Panel A: Holding Companies</i>			
Capital less than or equal to regulatory minimum	31	0.041	0.047
Capital greater than regulatory minimum	923	0.132	0.107
Test statistic of difference		$t = 2.760$	$z = 3.310$
<i>Panel B: Subsidiary Bank</i>			
Holding company capital less than regulatory minimum	130	0.053	0.038
Holding company capital greater than regulatory minimum	4,268	0.100	0.080
Test statistic of difference		$t = 2.630$	$z = 3.120$
Bank capital less than or equal to regulatory minimum	159	0.104	0.080
Bank capital greater than regulatory minimum	4,239	0.100	0.080
Test statistic of difference		$t = -0.220$	$z = -0.430$

If bank holding companies manage their capital on a consolidated basis one would expect that loan growth at the subsidiary level will be limited primarily by the availability of capital at the holding company level and not at the subsidiary level. The results reported in Panel B of Table 2 are consistent with consolidated capital management. In particular, notice that loan growth is significantly less at subsidiaries of holding companies that are inadequately capitalized on a consolidated basis. In contrast, we find no difference between loan growth at adequately and inadequately capitalized subsidiary banks.

4.2. Regression analysis

While the results in Table 2 are consistent with capital requirements and costly external capital constraining loan growth, capitalization and loan growth may be correlated for a variety of reasons unrelated to the cost of external financing. For example, a primary reason banks are inadequately capitalized is because of loan losses (Peek and Rosengren, 1992). Since loan losses are likely to be correlated with weak loan demand, the positive relation between capital and loan growth may reflect demand as opposed to supply characteristics. To address these concerns we proceed by examining the relation between loan growth and internal additions to capital, first at the holding company level then at the subsidiary level.

In Table 3 we present the results of regressions relating loan growth to cash flows, the market-to-book value of assets, bank size, asset composition and the two variables designed to measure the extent to which the bank faces binding capital requirements. We interact these two variables with our cash flow variable to investigate whether the cash flow sensitivity of loan growth varies depending on whether the holding company faces a binding capital requirement. We assume that the lower the capital surplus the greater the likelihood that the capital requirement is binding. In other words, these banks are most likely to limit their loan growth because of external financing costs. We estimate these regressions using a fixed effects model that controls for both firm and year effects. Ordinary least-squares (OLS) estimates are also reported.

As shown in Table 3, loan growth is positively related to internally generated capital even after controlling for differences in the holding company's market-to-book ratio. The estimated coefficient is 4.53, 3.55 and 6.94 for the three specifications. These coefficients are highly significant. This result is consistent with the hypothesis that external equity financing is expensive relative to internally generated funds. Notice also that loan growth is positively related to the holding company's capital surplus and is significantly lower among holding companies that are at or below the minimum capital requirements. Finally, the sensitivity of loan growth to internal additions to capital decreases as the capital surplus of the bank increases. A similar result is obtained when banks are classified on the basis of whether or not they meet minimum

TABLE 3

Loan growth and internally generated additional to capital: 1982-1989

Fixed-effects regressions and ordinary least squares (OLS) regressions relating loan growth to internal additions to capital, capital requirements, and firm financial characteristics. The sample consists of publicly traded bank holding companies over the period 1982-1989. Balance sheet information is from the Federal Reserve Y-9 tapes. The dependent variable for all regressions is calculated by subtracting loans in the previous period from loans in the current period, then dividing the total by loans in the previous period $((\text{Loans}_t - \text{loans}_{t-1})/\text{loans}_{t-1})$. Fixed effects models include holding company and year effects. OLS models include dummy variables for years (not reported). *t*-statistics are in parentheses.

Coefficient	Fixed effects		Ordinary least squares		
	(1)	(2)	(3)	(4)	(5)
Additions to capital/loans _{t-1} ^a	4.53 (13.96)	3.55 (13.39)	6.94 (6.19)	9.25 (11.23)	6.28 (14.10)
Surplus capital/total assets _{t-1} ^b	0.708 (2.62)			0.47 (2.72)	
Bind ^c		-0.026 (-2.750)	-0.20 (-2.96)		-0.017 (-2.980)
Surplus capital*(additions to capital/loans _{t-1})	-34.95 (-2.92)			89.91 (-3.63)	
Bind*(additions to capital/loans _{t-1})		1.49 (3.14)	1.12 (2.67)		1.30 (3.60)
(Market-to-book ratio) _{t-1} ^d	0.262 (3.640)	0.263 (3.660)	0.277 (3.760)	0.027 (0.671)	0.025 (0.621)
(Securities-to-assets ratio) _{t-1} ^e	0.226 (3.570)	0.242 (3.900)	0.300 (4.250)	0.058 (2.000)	0.046 (1.590)
Securities/total assets _{t-1} *(additions to capital/loans _{t-1})			-4.26 (-1.56)		
log(total assets)	-0.018 (-2.760)	-0.019 (-2.740)	-0.020 (-2.970)	-0.008 (-0.471)	-0.004 (-0.799)
R ²	0.240	0.245	0.246	0.357	0.353
N (categories)	1366(278)	1373(278)	1373(278)	1366(278)	1373(278)

^aAdditions to capital equal net income (before extraordinary items) plus additions to loan loss reserves.

^bSurplus capital equals actual capital less capital required to meet minimum capital requirements.

^cBind = 1 if surplus capital is less than or equal to zero.

^dMarket-to-book ratio equals total assets minus book equity plus market value of common stock, divided by book value of assets.

^eSecurities-to-assets ratio equals cash, marketable securities and Fed Funds sold divided by total assets.

capital requirements. Both of these results are statistically significant at the 0.01 level.

It is difficult to compare these coefficient estimates to those found in studies of nonfinancial firms, which generally report lower estimates. There are considerable differences in operating characteristics and leverage between banking and nonbanking firms, which may explain a considerable portion of the variation. For example, the results in Table 2 indicate that the average ratio of cash flow to loans is less than 2%, and that loan growth averages 17% a year for our sample of bank holding companies. By contrast, in a recent study of nonfinancial firms, Houston and James (1996b) find that the average ratio of cash flow to investment is 40% and the average growth in capital is 25% a year. Consequently, it is not surprising given the greater leverage among banking firms that we find a higher coefficient relating loan growth to cash flow.

The results in Table 3 indicate that loan growth is positively related to the holding company's securities-to-asset ratio. This is evidence that banks are liquidity constrained since sales of securities represent one way that capital-constrained banks are able to fund profitable loan opportunities. This result is also consistent with the recent findings of Kashyap and Stein (1996), who demonstrate that the impact of monetary policy on bank lending depends critically on the bank's liquidity. To examine this issue further we interacted the securities-to-asset ratio with the cash flow variable. If securities represent 'stored' liquidity, we would expect a negative relation between loan growth and this interactive variable. The results, not reported, provide weak support for this hypothesis.

Overall, these results suggest that loan growth among capital deficient bank holding companies is significantly more sensitive to internally generated funds than it is for holding companies that maintain a capital surplus. Moreover, the magnitude of the estimated coefficients indicate that this observed relationship is economically meaningful. The results in the first column of Table 3 suggest that for a bank whose capital ratio exactly equals the required ratio, that is, its surplus capital equals zero, a \$1 increase in internal capital translates, on average, into \$4.53 in additional loans. The results also indicate that the median bank, which has a capital ratio two percentage points above the required level, will have an estimated sensitivity of 3.83 (calculated as follows: $4.53 + (0.02)(-34.95)$). Moreover, the bank's surplus capital would have to reach nearly 13 percentage points before its estimated cash-flow sensitivity would equal zero.

The results in Table 3 are based on data for holding companies over the period 1982–1989. Since we were able to match holding company data with data from subsidiary banks only for the 1986–1989 period, we re-estimated the model using data from this 4-year period. These results, reported in Table 4, are qualitatively similar to those for the full sample.

Table 4

Loan growth and internally generated additions to capital: 1986–1989

Between-effects regressions and ordinary least-squares (OLS) regressions relating loan growth to internal additions to capital, capital requirements, and firm financial characteristics. The sample consists of publicly traded bank holding companies over the period 1986–1989. Balance sheet information is from the Federal Reserve Y-9 tapes. The dependent variable for all regressions is calculated by subtracting loans in the previous period from loans in the current period, then dividing the total by loans in the previous period $((\text{loans}_t - \text{loans}_{t-1})/\text{loans}_{t-1})$. *t*-statistics are in parentheses.

Coefficients	Between effects (1)	OLS (2)	Between effects (3) ^a	OLS (4)
Additions to capital/ loans_{t-1} ^b	3.079 (7.007)	4.734 (11.874)	1.70 (5.051)	3.624 (11.058)
Surplus capital/total assets _{<i>t-1</i>} ^c	1.762 (4.172)	0.506 (2.187)		
Bind ^d			− 0.058 (− 4.03)	− 0.018 (− 2.610)
Surplus capital*(additions to capital/ loans_{t-1})	− 52.94 (− 3.093)	− 34.051 (− 2.230)		
Bind*(additions to capital/ loans_{t-1})			2.340 (3.814)	1.170 (2.629)
(Market/book) _{<i>t-1</i>} ^e	0.260 (2.074)	0.036 (6.690)	0.285 (2.288)	0.0274 (0.510)
(Securities/total assets) _{<i>t-1</i>} ^f	0.442 (4.34)	− 0.001 (− 0.035)	0.458 (4.553)	− 0.013 (− 0.352)
log (total assets)	− 0.145 (− 6.628)	− 0.003 (− 1.583)	− 0.137 (− 6.294)	− 0.004 (− 1.593)
<i>R</i> ²	0.262	0.311	0.266	0.345
<i>N</i> (categories)	765(274)	765	775(274)	775

^aResults for fixed effects techniques are similar to those reported.

^bAdditions to capital equals net income before extraordinary items plus additions to loan loss reserves.

^cSurplus capital equals actual capital less capital required to meet minimum capital requirements. Capital is Tier II. Common stock, preferred stock plus eligible subordinate debt and loan loss reserves, also known as Tier II capital.

^dBind equals one if surplus capital is less than or equal to zero.

^eMarket-to-book ratio equals total assets minus book equity plus market value of common stock, divided by book value of assets.

^fSecurities-to-assets ratio equals cash, marketable securities and Fed Funds sold, divided by total assets.

4.3. Underwriting fees as a measure of the cost of external financing

In a recent paper, Calomiris and Himmelberg (1995), argue that underwriting fees provide a measure of the cost of raising external capital, and that firms with

Table 5
Underwriting fees and investment-cashflow sensitivities

Fixed effects regressions relating loan growth to internal additions to capital, expected underwriting fees, and firm financial characteristics by type of security issued. The sample consists of publicly traded bank holding companies over the period 1982–1990. Balance sheet information is from the Federal Reserve Y-9 tapes. The dependent variable for all regressions is calculated by subtracting loans in the previous period from loans in the current period, then dividing the total by loans in the previous period $((\text{Loans}_t - \text{loans}_{t-1})/\text{loans}_{t-1})$. t -statistics are in parentheses.

Variable	Predicted fees for common stock		Predicted fees for preferred stock		Predicted fees for subordinated notes	
	(1)	(2)	(3)	(4)	(5)	(6)
Additions to capital/ loans_{t-1}	4.336 (13.34)	3.172 (12.32)	4.258 (13.09)	3.100 (12.02)	4.354 (13.39)	3.185 (12.37)
High Fees _{t-1} * (additions to capital/ loans_{t-1}) ^{b)}	0.659 (3.545)	0.709 (3.835)	0.755 (4.309)	0.809 (4.648)	0.589 (3.275)	0.639 (3.583)
Surplus capital/total assets _{t-1} ^{c)}	1.082 (3.918)		1.044 (3.789)		1.077 (3.889)	
Surplus capital*(additions to capital/ loans_{t-1})	-42.86 (-3.609)		-42.25 (-3.572)		-43.14 (-3.627)	
Bind ^{d)}		-0.027 (-2.949)		-0.027 (-2.942)		-0.027 (-2.948)

Bind*(additions to capital/loans _{t-1})	1.922 (4.092)	1.917 (4.095)	1.918 (4.076)
Securities-to-total assets ratio _{t-1} ^e	0.205 (3.400)	0.211 (3.505)	0.208 (3.440)
Market-to-book ratio ^f	0.194 (2.405)	0.252 (3.091)	0.193 (2.393)
log (Total assets _{t-1})	-0.019 (-2.714)	-0.020 (-2.875)	-0.019 (-2.833)
R ²	0.231	0.239	0.230
N (categories)	1285 (251)	1285 (251)	1285 (251)

^aAdditions to capital equals net income before extraordinary items plus additions to loan loss reserves.

^bHigh Fees equals one if the firms predicted fees from the Underwriting Fees model in Table 10, corrected for selectivity bias, are greater than the median predicted fees, and equals zero otherwise.

^cSurplus capital equals actual capital less capital required to meet minimum capital requirements. Capital is defined as Tier II capital which equals common stock, preferred stock plus eligible subordinate debt and loan loss reserves.

^dBind equals one if surplus capital is less than or equal to zero, and equals zero otherwise.

^eSecurities-to-assets ratio equals cash, marketable securities and Fed Funds sold, divided by total assets.

^fMarket-to-book equals total assets minus book equity plus market value of common stock, divided by book value of assets.

high underwriting fees face a higher cost of external financing. Evidence that high-fee firms are more liquidity constrained would therefore lend additional support to the hypothesis that information problems may force bank holding companies that have limited internal funds or face a binding capital requirement, to limit their loan growth.

While the costs of external financing can be directly observed only at the point in time when the firm issues capital, a continuous variable which provides a proxy for the costs of external financing, can be obtained by controlling for any selection biases that relate to the characteristics of the firms issuing capital. In the appendix, we report the frequency of capital issuances for each year of our sample period. Also in the appendix, we report our results using Heckman's two-step procedure to estimate the underwriting fees for a given bank holding company. This procedure controls for any selectivity biases regarding the characteristics of the holding companies that issue securities.

From the estimates derived in the appendix, we can examine whether high-fee firms show more evidence of being liquidity constrained relative to firms that face below-median underwriting fees. Holding companies were classified as having high fees if their predicted fees are greater than the median predicted fee that year for a particular type of security issue in our sample.

Table 5 reports fixed-effects regressions once again relating holding company loan growth to holding company cash flow, controlling for the size, liquidity, and capital position of the holding company. In these regressions we also include the predicted underwriting fees, as described above. Since the fee structures for each type of security issue are very different, we provide separate estimates for each type, namely, common stock, preferred stock, and subordinated notes.

As shown in Table 5, we continue to find a strong positive correlation between cash flow and loan growth. We also continue to find that holding companies facing a binding capital requirement have significantly lower levels of loan growth and have a greater sensitivity of lending to cash flow. More importantly, we find that holding companies that face higher than average underwriting fees are more cash-flow sensitive. These results hold for each of the three different types of securities being issued. Overall, these results suggest that firms that face the highest underwriting fees, and therefore face the greatest wedge between internal and external financing costs, are also the firms that demonstrate the highest correlation between lending and cash flow.

5. Analysis of subsidiaries

The above evidence suggesting that bank holding companies are liquidity constrained also raises the interesting question of how bank holding companies allocate scarce capital among their various activities and subsidiaries. Stein

(1997), following the arguments originally made by Williamson (1975), has recently suggested that underinvestment problems may induce firms to establish internal capital markets to allocate capital among their various projects. Stein speculates that the incentives to establish internal capital markets may be strongest among firms that are narrowly focused and whose assets are relatively hard to value. In many respects, bank holding companies appear to meet these criteria. To the extent that we find that subsidiary loan growth is more strongly related to internal additions to capital at the holding company level than at the individual bank level, this relation would provide further evidence that bank holding companies are capital constrained, and that they establish internal capital markets to allocate scarce capital among their various subsidiaries.

In Table 6 we present the regression results relating subsidiary loan growth to the same measures used to explain holding company loan growth in Table 3. In Table 6, however, we include separate measures for the cash flows produced by the bank and the cash flows produced by the rest of the holding company. We also include separate measures indicating the surplus capital at the bank and, at the holding company, as well as separate dummies indicating whether the bank or holding company faces a binding capital requirement.

The results in Table 6 are presented for the overall sample, and for the sample of small banks whose assets represent less than 15% of their holding company's assets (the bottom three size based deciles). We report results using a between-effects regression which pools the observations for each subsidiary using the mean values of both the right- and left-hand-side variables. This controls for the autocorrelation in residuals across the various years for each bank. Given the relatively short time period for which we had subsidiary data (1986–1989), we chose not to use fixed-effects regression. For comparison purposes, we also report the OLS estimates. In general, the results are quite similar using the two approaches. For the overall sample, we again find that loan growth is positively related to the profitability of lending opportunities, as represented by the holding company's market-to-book ratio, and positively related to the proportion of liquid assets, as measured by the ratio of securities to total assets. Bank loan growth is also significantly and positively related to the subsidiary's own internal additions to capital.

Even more interesting, however, is the fact that we find that bank loan growth is positively and significantly related to the cash flow produced by the other subsidiaries of the holding company. Indeed, the coefficient on the cash flow measure for the other subsidiaries' cash flow is nearly eight times that of the estimated coefficient on the bank's own cash flow. While there does not appear to be a strong link between the proportion of surplus capital and bank loan growth, Table 6 does suggest that bank subsidiaries are less likely to lend if their holding company, and not the bank itself, faces a binding capital requirement. A similar result is obtained when we examine the relationship between loan growth and a dummy variable which indicates whether both the holding

Table 6
Subsidiary loan growth and holding company internal additions to capital

Between-effects regressions and ordinary least squares (OLS) regressions relating subsidiary loan growth to internal additions to capital, capital requirements, and financial characteristics of subsidiaries and bank holding companies. The sample consists of 2001 subsidiaries of 237 multiple bank holding companies from 1986–1989. Data for subsidiary banks is from the call report. Balance sheet data on holding companies are from the Federal Reserve Y-9 tapes. Market value of holding company common stock is from the CRSP master tapes. The small bank sample consists of banks with less than 15% of total holding company assets. The dependent variable for all regressions is calculated by subtracting loans in the previous period from loans in the current period, then dividing the total by loans in the previous period $((\text{Loans}_t - \text{loans}_{t-1})/\text{loans}_{t-1})$. *t*-statistics are in parentheses.

Variable	Overall sample			Small bank sample		
	Between effects (1)	OLS (2)	Between effects (3)	Between effects (1)	OLS (2)	Between effects (3)
(Additions to capital/ loans_{t-1}) ^a	2.002 (7.371)	1.576 (7.394)	1.78 (6.00)	2.04 (7.11)	1.960 (7.887)	2.21 (7.54)
(Additions to capital/ loans_{t-1}) ^b	0.263 (4.545)	0.251 (7.538)	0.257 (4.44)	0.251 (4.371)	0.249 (7.328)	0.248 (4.356)
(Surplus capital/ $\text{total assets}_{\text{holding company}}$) ^c	–0.100 (–0.031)	–0.021 (–0.078)		–0.034 (–0.100)	–0.132 (–0.438)	
(Surplus capital/ $\text{total assets}_{\text{bank}}$) ^d	0.332 (1.545)	0.336 (0.100)		0.298 (1.397)	0.274 (2.681)	
Bind _{holding company} ^e			–0.056 (–2.920)			–0.058 (–2.984)
						–0.052 (–2.582)

Bind _{Bank}		0.025	0.031			0.037	0.027
		(1.106)	(1.75)			(1.124)	(1.421)
Market-to-book _{holding company} ^f	0.555	0.578	0.528	0.660	0.690	0.631	0.665
	(4.188)	(7.011)	(4.07)	(4.068)	(7.007)	(3.951)	(6.697)
(Securities-to-assets) _{bank} ^g	0.067	0.067	0.074	0.043	0.036	0.048	0.041
	(2.196)	(2.593)	(2.43)	(1.348)	(1.315)	(1.524)	(1.500)
R ²	0.056	0.066	0.056	0.06	0.07	0.06	0.07
N (categories)	4375 (2001)	4375	4375 (2001)	3974 (1839)	3974	3974 (1839)	3974

^aAdditions to capital H-Net equals holding company additions to capital less the bank's additions to capital divided by total holding company loans, less the loans of the subsidiary bank.

^bAdditions to capital Bank equals subsidiary additions to capital divided by loans of the subsidiary bank.

^cSurplus capital equals actual capital/less capital required to meet minimum capital requirements for the holding company.

^dSurplus capital equals actual capital held by the subsidiary bank less the minimum required for the subsidiary.

^eBind equals one if bank capital ratio is less than or equal to the regulatory minimum.

^fMarket-to-book equals total assets minus book equity plus market value of common stock, divided by book value of assets.

^gSecurities-to-assets equals cash, marketable securities and Fed Funds sold, divided by total assets.

company and the bank subsidiary face a binding capital requirement. For this dummy variable, the estimated coefficient is -0.80 and the t -statistic is -6.342 for the overall sample. We also estimate regressions where we separately consider whether a binding capital requirement at the holding company or subsidiary level is most responsible for a decline in lending. Consistent with the results in Table 6, we find that what matters is whether the holding company, and not the bank itself, faces binding capital requirements.

The results in Table 6 suggest that bank holding companies find it costly to raise external capital, and that in response to this constraint they establish an internal capital market among their various subsidiaries. This interpretation follows from the observation that subsidiary loan growth is strongly related to internal additions to capital at the holding company level. It remains possible, however, that this result stems from the fact that holding company cash flow serves as a proxy for investment opportunities at the bank level that are not captured in the market-to-book ratio, or in the bank's own additions to cash flow.

We provide two tests to address this concern. First, we control for the cash flows of the holding company's non-banking subsidiaries. These results are presented in Table 7. The results indicate that bank loan growth is positively related to the cash flows of the nonbanking subsidiaries, which provides further evidence of an internal capital market. Moreover, the magnitude of this effect, as measured by the estimated coefficient, is similar to the effect for the holding company cash flows. It is harder to conclude that these results are spurious, since it is less likely that cash flows of the nonbanking subsidiaries are positively correlated with the lending opportunities of the banking subsidiaries. In this regard, the results in Table 7 provide a closer parallel to the experiment provided by Lamont (1997).

As a final and more complete robustness check, we include in Table 8 the loan growth of the rest of the holding company as an additional variable to explain the subsidiary's loan growth. Despite controlling for the loan growth at the holding company's other subsidiaries, we still find that bank loan growth is positively related to cash flow at the bank and holding company level, and that the holding company effect remains considerably stronger. Indeed, the estimated coefficient is even larger after controlling for the holding company's loan growth. The estimated coefficient corresponding to the cash flow from other subsidiaries is more than 15 times the estimated coefficient on the bank's own cash flow. In addition, we still find that binding capital requirements matter at the holding company level, but not at the bank level.

Perhaps most notably, in three of the four specifications, we find that the estimated coefficient on the holding company's loan growth is negatively related to the individual bank's loan growth. It is difficult to come up with an argument for the negative coefficient except in the context of the operation of an internal capital market in which capital-constrained banks allocate capital across

Table 7

Subsidiary loan growth and holding company internal additions to capital from nonbank sources

Between effects and ordinary least squares (OLS) regressions relating subsidiary loan growth to internal additions to capital, capital requirements and financial characteristics of subsidiaries and bank holding companies. The sample consists of 2001 subsidiaries of 237 multiple bank holding companies from 1986–1989. Data for subsidiary banks is from the call report. Balance sheet data on holding companies are from the Federal Reserve Y-9 tapes. Market value of holding company common stock is from the CRSP master tapes. The small bank sample consists of banks with less than 15% of total holding company assets. The dependent variable for all regressions is calculated by subtracting loans in the previous period from loans in the current period, then dividing the total by loans in the previous period $((\text{Loans}_t - \text{loans}_{t-1})/\text{loans}_{t-1})$. *t*-statistics are in parentheses.

Variable	Overall sample		Small bank subsidiaries	
	Between effects (1)	OLS (2)	Between effects (1)	OLS (2)
(Additions to capital/ loans_{t-1}) _{Non-bank} ^a	1.006 (4.432)	0.844 (6.347)	2.504 (6.576)	1.696 (8.662)
(Additions to capital/ loans_{t-1}) _{Bank} ^b	0.265 (5.061)	0.136 (2.979)	0.244 (4.434)	0.074 (1.584)
Bind _{Holding company} ^c	−0.035 (−1.308)	−0.022 (−1.966)	−0.0345 (−1.197)	−0.020 (−1.684)
Bind _{Bank} ^d	0.014 (0.613)	−0.024 (−2.102)	0.0292 (1.198)	−0.0149 (−1.265)
Market-to-book ratio _{Holding company} ^e	0.994 (9.038)	0.490 (9.962)	1.024 (7.823)	0.528 (9.094)
(Securities-to-assets ratio) _{Bank} ^f	0.085 (2.705)	0.150 (9.424)	0.0860 (2.533)	0.162 (9.689)
<i>R</i> ²	0.08	0.097	0.093	0.114
<i>N</i> (categories)	4398 (2001)	4398	3965 (1839)	3965

^aAdditions to capital/ loans_{t-1} _{Non-bank} equals holding company additions to capital net of the aggregate additions to capital of all bank subsidiaries divided by total holding company loans less the loans of the subsidiary bank.

^bAdditions to capital/ loans_{t-1} _{Bank} equals subsidiary additions to capital divided by loans of the subsidiary bank.

^cBind_{Holding company} equals one if bank holding company capital ratio is less than the loans of the subsidiary bank.

^dBind_{Bank} equals one if bank capital ratio is less than or equal to the regulatory minimum.

^eMarket-to-book ratio equals total assets minus book equity plus market value of common stock, divided by book value of assets.

^fSecurities-to-assets ratio equals cash, marketable securities and Fed Funds sold, divided by total assets.

competing uses. Whether this capital is allocated efficiently is an open question. In one respect, these results suggest that firms engage in the type of 'winner picking' and 'loser sticking' discussed in Stein (1997). Alternatively, these results may also be consistent with the bureaucratic rigidity hypothesis proposed by

Table 8

Subsidiary loan growth, holding company internal additions to capital, and loan growth in related subsidiaries

Between effects regressions and ordinary least squares (OLS) regressions relating subsidiary loan growth to internal additions to capital, capital requirements, and financial characteristics of subsidiaries and bank holding companies. Data for subsidiary banks is from the call report. Balance sheet data on holding companies are from the Federal Reserve Y-9 tapes. Market value of holding company common stock is from the CRSP master tapes. The small bank sample consists of banks with less than 15% of total holding company assets. The dependent variable for all regressions is calculated by subtracting loans in the previous period from loans in the current period, then dividing the total by loans in the previous period $((\text{loans}_t - \text{loans}_{t-1})/\text{loans}_{t-1})$. *t*-statistics are in parentheses.

Variable	Overall Sample		Small bank subsidiaries	
	Between effects (1)	OLS (2)	Between effects (1)	OLS (2)
(Additions to capital/loans _{<i>t-1</i>}) _{Nonbank} ^a	0.182 (3.040)	1.971 (12.703)	3.58 (11.09)	2.415 (13.068)
(Additions to capital/loans _{<i>t-1</i>}) _{Bank} ^b	-0.063 (-2.752)	0.0618 (1.385)	0.166 (2.660)	0.024 (0.516)
Bind _{Holding company} ^c	0.022 (1.160)	-0.0417 (-3.715)	-0.067 (-2.765)	-0.046 (-3.0966)
Bind _{Bank} ^d	-0.138 (-4.884)	-0.012 (-1.101)	0.020 (1.006)	-0.007 (-0.648)
Market-to-book ratio _{Holding company} ^e	0.600 (-5.814)	0.003 (0.231)	-0.171 (-5.540)	-0.035 (-2.169)
(Securities-to-assets ratio) _{Bank} ^f	0.0234 (0.845)	0.312 (6.292)	0.660 (5.777)	0.358 (6.118)
<i>R</i> ²	0.06	0.108 (6.825)	0.0015 (0.959)	0.103 (6.119)
<i>N</i> (categories)	4307 (2001)	0.143	0.06	0.150

^aAdditions to capital/loans_{*t-1*} _{Non-bank} equals holding company additions to capital net of the aggregate additions to capital of all bank subsidiaries divided by total holding company loans less the loans of the subsidiary bank.

^bAdditions to capital/loans_{*t-1*} _{Bank} equals subsidiary additions to capital divided by loans of the subsidiary bank.

^cBind_{Holding company} equals one if bank holding company capital ratio is less than the loans of the subsidiary bank.

^dBind_{Bank} equals one if bank capital ratio is less than or equal to the regulatory minimum.

^eMarket-to-book ratio equals total assets minus book equity plus market value of common stock, divided by book value of assets.

^fSecurities-to-assets ratio equals cash, marketable securities and Fed Funds sold, divided by total assets.

Shin and Stulz (1996), which would imply that capital is not allocated efficiently across bank subsidiaries. The negative coefficient on other subsidiaries' loan growth is somewhat sensitive to the sample and specification used in our tests. For example, if banks from Texas and Oklahoma are excluded, banks that were arguably the most constrained, the coefficient on loan growth is positive, though not statistically significant. Overall, the results in Table 8 are consistent with the hypothesis that bank holding companies establish internal capital markets to transfer capital among their various banking subsidiaries.

6. Summary and conclusions

Overall, our results suggest that bank holding companies allocate capital in a way consistent with the operation of an internal capital market operated by bank holding companies that find equity and subordinated debt expensive to raise externally. These results are surprisingly strong in light of regulatory restrictions on bank holding companies that impair the management of capital on a consolidated basis.

Our results have implications for a variety of issues that have arisen in the literature in recent years. First, our results lend support to those who argue that bank profitability, liquidity, and capital requirements may have important effects on aggregate bank lending. Indirectly, our results also have implications for the transmission of monetary policy. The so-called credit channel or lending view of monetary policy holds that Fed policy can have a direct effect on the supply of bank loans.² A necessary, although not sufficient, condition for the operation of a lending channel is that banks are unable to costlessly substitute nondeposit sources of funding for insured deposits. This condition is met if the bank's private information about the value of its portfolio creates adverse selection and moral hazard problems that increase the cost of externally raising uninsured deposits or equity.

Second, our results have implications regarding the management and regulation of commercial bank holding companies. In recent years, an increasing number of bank holding companies have begun to develop models to allocate capital among their various projects and subsidiaries (see, for example, James et al., 1996; and Froot and Stein, 1996). Systems of capital allocation particularly make sense if bank holding companies find themselves to be liquidity constrained. Our finding that individual loan growth is negatively correlated with loan growth at other subsidiaries is consistent with a system of 'winner-picking',

² A number of recent papers examine this lending view. For example, see Bernanke and Blinder (1992), Kashyap et al. (1993), Bernanke et al. (1994), and Kashyap and Stein (1994), Kashyap and Stein (1996). For an excellent review of this literature see Hubbard (1994).

in which capital is allocated based on the relative profitability of growth opportunities (see Stein, 1997).

A third, and more subtle implication of our findings concerns the process of financial intermediation. Theoretical models by Diamond (1984) suggest that while financial intermediaries may have incentives and technology to reduce agency costs, their existence also creates another layer of potential agency problems. Diamond demonstrates that diversification may provide a mechanism for reducing the need to ‘monitor the monitor’. Our results, indicating that financial intermediaries find it costly to raise capital externally, suggest that intermediaries face adverse selection and moral hazard costs similar to that of other firms. In this respect, our results do not necessarily contradict the framework suggested by Diamond (1984), but they suggest that the intermediation process is not complete. Similarly, Stein (1997) has argued that the creation of an internal capital market has many features similar to the intermediation problem modeled by Diamond. In particular, internal capital markets may reduce some agency costs while at the same time creating another layer of agency problems. Our results suggest that bank holding companies find that the benefits of internal capital markets exceed the additional agency costs involved in coordinating actions within the holding company.

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Appendix: Calculating the predicted underwriting fees

As detailed in Table 9, there were 264 capital issuances during the time period 1982–1989. Of this total, 73 of the issues were common stock, 65 were preferred stock, and 126 were subordinated notes that are classified as capital for regulatory purposes. The average amount of capital raised was just over one percent of the holding company’s assets. Consistent with Myers and Majluf (1984), we find that the mean abnormal return to shareholders was negative (– 1.29%) for the sample of bank holding companies that issued common equity. The abnormal returns were not statistically significant for the sample of preferred stock and subordinated debt issues.

Table 10 describes regression models relating underwriting fees to issuer characteristics, correcting for selectivity bias using the two-step procedure presented in Heckman (1979). The framework and variables used is similar to

Table 9

Summary of Security Issuances from 1982–1989 for a sample of 278 publicly traded bank holding companies. Security issuances are from the *Investment Dealers Digest*. Announcement dates are from the Dow Jones News Retrieval Service. Underwriter fees are from the *Investment Dealers Digest* and are expressed as a percent of offer size. Abnormal returns are calculated using the methodology described in Mikkelsen and Partch (1986). Market model parameters are estimated from 260 trading days to 10 days prior to the security issuing announcement.

Year	Common stock	Preferred stock	Subordinated notes	Total
1982	1	10	4	15
1983	4	19	4	27
1984	9	8	17	34
1985	19	6	26	51
1986	28	4	16	48
1987	7	8	35	50
1988	1	4	9	14
1989	4	6	15	25
Total	73	65	126	264
Mean offer size (thousands)	78,304	103,825	111,675	100,515
Mean offer size relative to total assets	1.09%	0.71%	1.29%	1.09%
Mean underwriter fees	4.49%	2.69%	1.35%	2.55%
Mean abnormal return	– 1.29% ($z = -4.54$)	– 0.08% ($z = -1.03$)	– 0.04% ($z = -0.35$)	– 0.42% ($z = -3.01$)

that employed by Calomiris and Himmelberg (1995). The results of the estimated probit model show that the probability of a stock issue is positively related to the firm's stock return over the preceding three months, positively related to the firm's cash flow in the previous year, and positively related to the dummy variable which equals one if the bank faces a binding capital requirement. Likewise, the size of the holding company, the recent stock price run-up, and a binding capital requirement were all positively related to the likelihood of issuing preferred stock. Finally, holding company size and the cash flow generated in the previous year are positively related to the likelihood of issuing subordinated notes.

From the probit estimates, the Inverse Mills Ratio provides an estimate of the extent to which the market was surprised by the issuance, and therefore relates to the estimated probability of issuance. Including this term in a model estimating the percentage fee paid by the issuing holding company provides a control for sample-selectivity bias (see Heckman, 1979).

As expected, we find that underwriting fees are typically lower for larger holding companies, holding companies with high market-to-book ratios, and

Table 10

Regression models relating underwriting fees to firm characteristics, correcting for selectivity bias using Heckman's two step procedure. The sample consists of 278 publicly traded bank holding companies over the period 1982-1989. In the models, the variable kinds equals one if surplus capital is less than or equal to zero, and the variable is set to zero otherwise. Additions to capital equal net income, before extraordinary items, plus additions to loan loss reserves. The ratio of securities to assets is calculated using the sum of cash marketable securities and Fed funds, divided by total assets. The market-to-book ratio equals total assets minus book equity plus market value of common stock divided by book value of assets. Risk equals the standard deviation in daily stock returns calculated over 250 trading days prior to the security issue. In the probit model, the dependent variable takes a value of one to represent the event of a capital issue. The percentage fee model estimates the percentage fee paid by the issuing holding company. The number of observations for all models is 1,498. *t*-statistics are in parentheses. Balance sheet data are from the Federal Reserve Y-9 tapes.

Variable	Common stock models		Preferred stock models		Subordinated note models	
	Probit model	Percentage fee model	Probit model	Percentage fee model	Probit model	Percentage fee model
Bind	0.412 (2.883)	0.165 (1.694)	0.555 (3.349)	0.014 (3.353)	-3.185 (-0.728)	0.001 (0.259)
log (Total assets _{<i>t-1</i>})	0.054 (1.135)	-0.008 (-6.757)	0.312 (4.793)	-0.002 (-1.087)	0.321 (7.072)	-0.007 (-3.783)
Lag (Additions to capital/loans)	15.28 (2.965)	-0.375 (-2.226)	4.422 (0.701)	-0.096 (-0.533)	13.47 (2.723)	-0.384 (-2.421)
(Securities/total assets) _{<i>t-1</i>}	-1.148 (-1.324)	0.046 (1.957)	-0.867 (-0.682)	-0.079 (-2.289)	-1.393 (-1.645)	0.001 (0.059)
Market-to-book	-0.392 (-0.396)	-0.038 (-1.852)	-9.538 (-2.763)	-0.432 (-3.434)	-1.729 (-0.825)	0.004 (0.075)
Risk	-4.999 (-0.713)	0.453 (1.504)	-0.412 (-0.073)	0.001 (0.005)	0.412 (0.090)	0.223 (1.357)
3 month avg stock price/ 36 month avg stock price	12.46 (2.681)		12.32 (2.212)		1.673 (0.351)	
Inverse mills ratio		-0.014 (-2.045)		0.021 (8.825)		-0.001 (-0.132)
Chi-squared (<i>p</i> -value)		44.54 (0.001)		127.03 (0.000)		133.13 (0.000)

for holding companies that have been performing well, as measured by the lagged cash flow measure. We also find that holding companies that face a binding capital requirement pay significantly higher underwriting fees, after controlling for other factors.

The estimated fee equations, reported in Table 10, also include dummy variables, whose estimated coefficients are unreported, for each holding company and for each year of the sample period. From these estimates, we can calculate the predicted underwriting fee for each holding company, taking into account the year and type of securities being issued. Holding companies were then classified as having high fees if their predicted fees are greater than the median predicted fee that year for a particular type of security issue in our sample.

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