Bank Capital and Value in the Cross-Section

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We develop a dynamic model of bank capital structure in an acquisitions context which predicts: (i) total bank value and the bank's equity capital are positively correlated in the cross-section, and (ii) the various components of bank value are also positively cross-sectionally related to bank capital. Our empirical tests provide strong support for these predictions. The results are robust to a variety of alternative explanations—growth prospects, desire to acquire toe-hold positions, desire of capital-starved acquirers to buy capital-rich targets, market timing, pecking order, the effect of banks with binding capital requirements, Too Big To Fail, target profitability, risk, and mechanical effects. (*JEL* G21, G28, G32, G34)

> The banker sitting next to me was lamenting the profitable lending opportunities being passed up by capital-constrained banks, when I broke in to ask: "Then, why don't they raise more capital?" "They can't," he said. "It's too expensive. Their stock is selling for only 50 percent of book value." "Book values have nothing to do with the cost of equity capital," I replied. "That's just the market's way of saying: We gave those guys a dollar and they managed to turn it into 50 cents." ... In a capital market left to its own devices, then, it's hard to see anything about demand securities so special as to rule out application of the M&M proposition to the banking industry. (Miller 1995)

Because financial intermediaries arise to resolve informational and other frictions, it is widely presumed that the Modigliani and Miller (M&M, 1958) leverage indifference theorem does not apply to banks. However, in a 1995 paper, Merton Miller challenged this presumption. The gauntlet thrown by Miller (1995) comes in the form of the question: Are bank capital and value largely unrelated in the cross-section, or does each bank have an optimal capital

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structure, with cross-sectional heterogeneity that leads to a systematic cross-sectional relationship between bank capital and value? This question is so fundamental that it seems odd to even mention it. Surely, one might think, this must have been settled a long time ago. The fact is, it has not. This is surprising because of the pivotal role of capital in banking, including its role in bank regulation. There is a large literature on bank capital that analyzes its role in regulation (e.g., Bhattacharya, Boot, and Thakor 1998; Hellmann, Murdoch, and Stiglitz 2001; Barth, Caprio, and Levine 2004; Dangl and Lehar 2004; DeCamps, Rochet, and Roger 2004; Morrison and White 2005) and examines how bank capital affects how banks compete and provide intermediation services (e.g., Berger, Herring, and Szego 1995; Thakor 1996; Boot and Marinc 2007).[1] But, it is only recently that the question of optimal bank capital structure has begun to be addressed (Diamond and Rajan 2000). One purpose of this article is to theoretically and empirically examine how bank capital affects bank value in the cross-section.

If capital does affect bank value, then an interesting question is: How does capital affect components of bank value—the stand-alone values of the bank's assets and liabilities and the synergies among them? This question is interesting, because banks differ significantly from nonfinancial firms. For example, banks specialize in screening borrowers (e.g., Ramakrishnan and Thakor 1984; Allen 1990) in certain industries/sectors, as well as in monitoring and collecting repayments from borrowers in specific sectors (e.g., Diamond and Rajan 2001), so there are synergies or economies of specialization in lending in those sectors. This implies that the value of a loan as part of the bank's portfolio, which reflects the bank's specialization/synergies in making the loan, may be quite different from its "fair market value" if it were sold as a stand-alone asset that does not fully preserve these specialization benefits. In a different setting, Kashyap, Rajan, and Stein (2002) argue that there are liquidity synergies for banks in taking deposits and making loan commitments, suggesting that a bank's portfolio synergies may be adversely affected if deposits are replaced by capital.[2] However, these are merely hints about how capital may affect the components of value for a bank; the question itself has not been directly tackled. A second purpose of our article is to theoretically and empirically address this question.

[1] As a practical matter, the issue of how bank capital affects value is also of great importance, as evidenced by the spate of lawsuits by thrifts and banks against the U.S. government for breach of contract involving the elimination of goodwill as part of regulatory capital with the passage of the FIRREA legislation into law in 1989. Under the "Winstar" umbrella of lawsuits, the plaintiffs asserted, in part, that being required to replace goodwill with tangible capital diminished the values of these institutions. That is, many of these lawsuits were based on the assertion that bank capital and value are negatively related.

[2] Alternatively, these synergies could be related to the matching of core deposits with relationship loans (as in Song and Thakor 2007), and the values of the relationship loans may be increasing in the bank manager's effort (e.g., Boot and Thakor 2000). Capital, by protecting lazy managers, could cause this effort supply to be curtailed. Yet another possibility is that by reducing the probability that the bank will be shut down due to its capital being too low, higher capital may actually strengthen managerial effort-provision incentives. Thus, the issue of how bank capital may affect bank value is far from settled, even theoretically.

On the issue of how capital affects bank value, there are two viewpoints. One is that of Miller (1995), who suggested that the M&M leverage indifference theorem could be extended to banks, even in the presence of agency and informational frictions.[3] The other is that capital adversely affects bank value for a variety of reasons. This point of view has been put forth recently, for example, by Diamond and Rajan (2001), whose model predicts that capital reduces liquidity creation by banks and diminishes the value of the bank's loan portfolio. We consider each of these two viewpoints in turn.

If Miller (1995) is right and capital is value irrelevant, then there should be no systematic relationship between bank capital and value in the cross-section. The typical banker would dispute Miller's (1995) claim, based on the following: the cost of (insured) deposits is lower than the cost of equity capital for the bank, so any increase in capital, holding the size of the bank's asset portfolio fixed, represents a replacement of deposits with more costly equity and hurts the value of the bank. This intuition, however, is not correct, as the following illustration shows. Consider two banks, A and B, each with a $100 loan portfolio, an unlevered equity cost of capital of 10%, and a cost of deposits of 5%. There are no taxes. Let bank A be financed with $10 in equity and $90 in deposits and bank B be financed with $20 in equity and $80 in deposits. Assume that each bank earns 10% per year on its loans, and this is also the appropriate risk-adjusted discount rate for the loan cash flows. Assuming perpetual cash flows, straightforward calculations show that the levered costs of equity capital for banks A and B are 55% and 30%, respectively, and assuming all the parameters here are common knowledge, the market values of equity for banks A and B are $10 and $20, respectively.[4] Thus, the net present value (NPV) to the bank's shareholders, measured as the market value of equity minus the book value of equity (invested capital), is $10−$10 = $0 for bank A and $20−$20 = 0 for B. Moreover, the total value of the bank in each case is $100. Shareholders are indifferent to the different levels of equity in the two banks.[5] This is a standard M&M analysis, of course, but it makes one simple yet important point—the fact that bank equity has a cost of capital greater than the cost of deposits does not by itself imply that higher levels of capital hurt the value of the bank, because capital replaces "cheaper" deposits.[6]

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[3] Miller (1995) does not present a formal model.

[4] We are using the standard formula for the relationship between the levered equity cost of capital and the unlevered cost: $K_e = K_u + [K_u - K_d]\,[1 - T]\,[D/V_s]$ with $T = 0$ (K_e and K_u are the levered and unlevered equity costs of capital, respectively; K_d is the cost of debt; D is the market value of debt; and V_s is the market value of equity).

[5] The banker's error is in not recognizing that even though equity costs more than deposits, an infusion of equity lowers the costs of all uninsured sources of financing, leaving total bank value unchanged. One might wonder if it matters that we have made the assumption that the unlevered equity cost of capital for the bank is the same as the yield on loans. It does not. To see this, assume that the loan yield is 15% for both banks, and all other data are unchanged. The market values of equity are now $60 and $70 for banks A and B, respectively, and the NPVs for the shareholders are $50 in both cases. The total value of the bank is $150 in both cases. Again, the different levels of equity capital in the two banks make no difference to the banks' shareholders.

[6] Miller (1995) makes a similar point, albeit a bit more colorfully: "An essential message of the M&M Propositions as applied to banking, in sum, is that you cannot hope to lever up a sow's ear into a silk purse."

In this example, although deposits are cheaper than equity, there are no deposit subsidies/rents. It has been suggested that deposit subsidies could make total bank value increase when deposit financing replaces equity. Miller (1995) provides an extensive discussion to dismiss this argument, but its essence is that nonbanks can also issue instruments similar to demand deposits, and insured deposits for banks are not really subsidized when one considers noninterest expenditures by banks to attract deposits and the combined cost of insurance premia and the regulation accompanying deposit insurance that banks absorb (see also Thakor and Beltz 1994). Miller (1995) also discusses the role of taxes, agency costs, and other frictions in tilting the firm's capital structure away from indifference. But, he notes that these factors have been studied in corporate finance for over three decades, and yet, no coherent "tilting principles" have emerged that predict a clear pattern of capital structures across firms. Moreover, even within banking, there are substantial cross-sectional differences in operating and financial risk that preclude sweeping generalizations about predicted leverage ratios based on these tilting factors.

We turn now to the second viewpoint on the effect of capital—it adversely affects value in the cross-section. According to this viewpoint, the M&M leverage indifference theorem breaks down in banking for reasons that are familiar in corporate finance. For example, the Ross (1977) debt signaling model suggests a negative correlation between bank capital and value in the cross-section, and Myers and Majluf's (1984) lemons model yields a similar implication. Agency models imply an ex ante preference for "hard" claims like debt that constrain management (e.g., Stulz 1990; Hart 1993; Hart and Moore 1995), which also suggests that higher capital may be correlated with lower bank values in the cross-section. Similarly, capital could also affect the resolution of an agency problem between the bank's manager and shareholders. A manager less willing to subject himself to capital market discipline may pay lower dividends to accumulate more capital, and he may also make poorer loans. That is, capital may hurt bank value by acting as a protective cushion for lazy or incompetent managers. Numerous additional arguments further reinforce the idea that capital could be deleterious to bank value.[7] The common presumption is that bank capital imposes a value-relevant cost (e.g.,Thakor 1996; Kashyap, Rajan, and Stein 2002; Dell'Ariccia and Marquez 2006; Repullo and Suarez 2007; Allen,

[7] For example, Besanko and Kanatas (1996) argue that the equity value of an impaired bank may increase or decrease when it is forced to meet a capital standard and that the bank's stock price will fall in response to a forced recapitalization. An important regulatory goal of capital standards is to control bank risk. Empirical evidence on whether bank capital leads to more or less risk taking is not clear cut but is generally supportive of the idea that more capital leads to less risk. Keeley (1990) shows that higher bank charter values lead to less risk taking by banks but do not directly indicate how capital affects risk taking. Hellmann, Murdoch, and Stiglitz (2001) show that higher capital requirements may induce banks to take more prudent portfolio risk on the one hand but may also reduce charter values and thereby encourage more gambling behavior on the other hand. Barth, Caprio, and Levine (2004) show that more stringent capital regulation reduces nonperforming loans. Berger and Udell (1994) and Thakor (1996) show that higher or more risk-sensitive capital requirements have sometimes induced banks to switch from loans to lower-yielding securities, with potential value implications. Berger (1995) examines how capital affects the bank's return on equity (ROE), whereas Berger and Bouwman (2009) document that, for large banks, capital positively affects liquidity creation.

Carletti, and Marquez 2009). That is, banks hold capital because of regulatory capital requirements that are motivated by industry-wide safety concerns,[8] but these requirements cause value dissipation for individual banks. In fact, this seems to be the standard "textbook view" of bank capital (Mishkin 2000). [9]

Diamond and Rajan (2001) provide another perspective on how bank capital can reduce bank value. They argue that the value of the bank's loan portfolio depends on the bank's willingness to collect repayments from borrowers. So, there is a hold-up problem, because the bank can threaten its financiers to withhold use of its collection technology, which is unique by assumption. Bank deposits can resolve this hold-up problem, because depositors can threaten in turn to withdraw their deposits on demand. Equity capital lacks this feature, so substituting equity for deposits can impede such a resolution. This can result in reduced liquidity creation. Diamond and Rajan (2000) suggest that banks may use capital despite this disadvantage, because they face bankruptcy costs with leverage. The authors do not examine the cross-sectional relationship between bank capital and value, so the inference one draws about this relationship depends on what one assumes about the cross-sectional heterogeneity in the observable and unobservable variables in their model. If one assumes that bankruptcy cost varies in the cross-section of banks but the assets with which they create liquidity do not, then their model would imply that banks that face higher bankruptcy costs would keep more capital, create less liquidity, and be worth less, implying a negative cross-sectional correlation between bank capital and value. If, conversely, one assumes that bankruptcy costs are invariant across banks but riskier assets allow banks to create more liquidity, then banks that create more liquidity will face higher expected bankruptcy costs, keep more capital, and also be worth more due to their higher liquidity creation. Capital and value are also positively related if the bankruptcy cost for a bank is the loss of future profits, which would be higher for a more profitable bank; more highly valued banks will then keep more capital.

With these starkly different views about bank capital as the backdrop, we theoretically and empirically confront the two questions raised earlier: (i) Is there an optimal capital structure for each bank, and if so, what does it imply about how bank capital and value are related in the cross-section? And, (ii) how does bank capital affect the stand-alone and synergy components of the bank's value? The empirical task is complicated by a couple of issues. First, neither the bank's market value nor the values typically recorded on its balance sheet permit us to delineate the stand-alone components of value from the synergy

8 Regulators are concerned about using capital requirements to limit risk taking at the individual bank level, which would also reduce the risk of financial crises through contagion effects. For research on banking crises, see Allen and Gale (2000, 2004).

9 Mishkin (2000, p. 227) states: "Banks hold capital because they are required to do so by regulatory authorities. Because of the high costs of holding capital for the reasons just described, bank managers often want to hold less bank capital than is required by regulatory authorities. In this case, the amount of bank capital is determined by the bank capital requirements."

components. Second, book value measurements are plagued by historical cost accounting distortions.

We take an approach to circumvent these roadblocks. We develop a theory in which the impact of bank capital on value is examined in an acquisitions context, and the predictions are then empirically tested. Our theory predicts that bank capital and total bank value are positively correlated in the cross-section. Moreover, both the synergy component of bank value and the NPV to the bank's shareholders from investing equity capital are also positively cross-sectionally related to capital. Our extensive empirical tests provide strong support for these predictions. Our analysis proceeds in an acquisitions context, because we believe that examining acquisitions, particularly those involving purchase accounting, offers several advantages. First, since acquisitions using purchase accounting separate out goodwill from the rest of the purchase price, we are able to empirically examine the impact of bank capital separately on the portion of the bank value that represents the stand-alone values of the bank's assets and liabilities (fair market value) and the portion that represents the synergies between them ("goodwill").[10] Indeed, it is difficult to reliably separate synergies from stand-alone values outside a purchase–accounting–acquisition setting in which the financial-reporting requirement ensures that the total price paid in the acquisition is decomposed into components with interesting economic interpretation. Second, because the bank's assets, liabilities, and off–balance sheet items are marked to market in order to compute fair market value in an acquisition involving purchase accounting, the usual accounting distortions in the measurement of various values are minimized.[11]

Our choice of bank acquisitions data is in contrast to the usual approach in empirical capital structure studies, which is to exclude acquisitions. The rationale in those studies is that an acquisition is a special kind of investment, and the way it is financed may have capital structure connotations that do not reflect the acquiring firm's equilibrium capital structure. Our exercise is sub-

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10 Under purchase accounting, the acquirer is required to record the fair market value of the target's assets and liabilities, including intangible assets, which is essentially the value at which each asset and liability can be sold on a stand-alone basis (i.e., its liquidation value). The Financial Accounting Standards Board (FASB) defines "fair value" as "...the price at which an asset or liability could be exchanged in a current transaction between knowledgeable, unrelated willing parties," (see Landsman 2006 for a discussion of the implications for bank regulation). Goodwill is then the difference between the purchase price and the fair market value and hence approximates synergies. There are various sources for the definition of goodwill. For example, AllBusiness.com states: "Goodwill equals the purchase price less the book value of the acquired company's net assets less the amount by which the acquired company's depreciable assets are written up to their fair market value." See SFAS 141 and 142. In practice, of course, establishing the fair market values of nonmarketable assets and liabilities of the bank, including off–balance sheet items, is often challenging (e.g., Barth 1994). Nonetheless, there is evidence about the market relevance of the information contained in fair-value disclosures, as well as the level of bank capital (Beaver and Venkatachalam 1999; Bishop and Lys 2001).

11 Goodwill includes both the synergies among the individual items on the target bank's balance sheet and also the portion of the synergy between the acquirer and the target that is reflected in the purchase price. However, this does not affect our analysis as long as the latter synergy is not correlated with the target's capital. In our theory, there is no such correlation.

stantially different, however, in that we are not examining the determinants of the acquiring bank's optimal capital structure. Rather, we study how the preacquisition capital structure choice of the target affects the different components of the target's value.

Apart from this article, there has been limited theoretical recognition that bank capital may contribute positively to value. Holmstrom and Tirole (1997) develop a model in which capital induces the bank to monitor borrowers and also thereby improves borrowers' access to credit both from banks and the capital market. Allen, Carletti, and Marquez (2009) develop a one-period model in which a monopoly bank holds capital, because it strengthens its monitoring incentive, increases the borrower's success probability, and increases the surplus extracted by the bank. When the credit market is competitive, borrowers capture the surplus, so higher bank capital benefits borrowers. The competitive outcome involves banks keeping more capital than they would as monopolists. The key differences between these papers and ours are as follows. First, in contrast to these static models, our model is dynamic, so an important role of capital in our model is that it increases the future survival probability of the bank, which in turn enhances the bank's monitoring incentive. So, bank capital has both a direct positive effect on monitoring incentives and a reinforcing indirect effect via an elevated survival probability. The acquisitions context of our analysis makes the dynamic structure of our model essential. An acquirer pays more for a bank with more capital as an ongoing concern, because this bank monitored more in the past and thus has a more valuable loan portfolio with a higher expected future payoff. Second, our model focuses not only on the effect of bank capital on bank value but also on the various components of value in an acquisitions context. This allows us to generate a variety of novel results, such as the multiples (purchase price/book equity) in acquisitions being decreasing in bank capital. Third, in addition to developing a theory of bank capital, we also provide supporting empirical evidence.

The rest of the article is organized as follows. Section 1 provides an overview of the details of the model and our key results. Section 2 develops the model. Section 3 contains the analysis. The empirical analysis appears in Section 4, and Section 5 concludes. All proofs are in the Appendix.

1. Overview of Model and Key Results

This section provides a detailed overview of our theoretical model, its specific predictions, and our empirical tests. The model has a bank that faces both costs and benefits associated with equity capital. As in many other models, the cost is dissipative and is simply exogenously specified as increasing and convex in the amount of equity capital, E, the bank keeps. The benefit is both direct and indirect. The direct benefit is that the bank invests more in monitoring its relationship borrowers and earns higher rents (Holmstrom and Tirole 1997; Allen, Carletti, and Marquez 2009). The indirect benefit is that higher capital reduces the probability of the bank being closed at an interim point in time. The bank's ex ante choice of capital balances the marginal costs and benefits of equity. We then allow the bank to possibly be acquired at an interim point in time in a competitive corporate control market. The price, P, paid by the acquirer, has two components: (i) the fair market value of the bank's equity (E_m), which is simply the difference between the fair market values of the assets and liabilities, and (ii) goodwill (G), that is, $P = E_m + G$. As mentioned earlier, the convention of purchase accounting in bank acquisitions is such that E_m is essentially the "liquidation value" of the bank's equity, that is, it is the value if each asset and liability were sold separately in the market. Thus, G captures the acquirer's prospective assessment of the "synergy value" or "growth value" of the bank's portfolio that is not reflected in the stand-alone market values of individual assets and liabilities.

The main result is that there is an optimal capital structure for each bank, and it is such that, in the cross-section of banks, value is increasing in capital, regardless of how value is measured. The intuition is as follows. For a particular bank, capital has both costs and benefits. The cost, which varies cross-sectionally, could capture familiar factors like adverse selection and agency costs. The benefits come in two forms. The first is a direct benefit: higher capital leads to a higher endogenously determined survival probability for the bank at the interim point in time. This, in turn, increases the marginal benefit of monitoring loans in the first period, because the elevated survival probability means higher odds of harvesting the gains from first-period monitoring. Banks with higher capital therefore monitor more. The second is an indirect benefit: the greater loan monitoring induced by higher capital enhances the value of the relationship loan portfolio. A key to our result that the value of the bank is cross-sectionally increasing in capital is that bank monitoring and capital are positively related in the cross-section. This positive relationship does not obtain without the first beneficial effect of capital in enhancing the bank's survival probability. Without this effect, banks with lower monitoring costs would monitor more, but the cross-sectional link between monitoring and capital would be severed. Banks can capture the indirect second benefit of capital simply by choosing to monitor more and not by keeping more capital to do so. Given both effects, however, each bank chooses a privately optimal capital level. An unconstrained value-maximizing bank, call it bank i, with a higher marginal benefit and/or a lower marginal cost of capital keeps more capital in equilibrium and monitors more. Since such a bank could have chosen to keep the lower capital kept by a bank with a lower marginal benefit or higher marginal cost of capital, say bank j, the value of bank i will be higher at its own privately optimal capital level than at the lower capital level of bank j. Controlling for other factors then, we obtain a positive association between equilibrium levels of capital and bank values in the cross-section, with nonbinding capital requirements.[12] We further find that all components of bank value are positively correlated with bank capital in the cross-section.

Specifically, the model has four predictions related to the measurement of the value of bank capital. First, as long as banks are choosing optimally, the purchase price, P, is an increasing function of the target bank's equity capital, E. Second, goodwill, G, is increasing in the equity capital, E, of the target bank due to the beneficial indirect effect of bank capital in eliciting greater value-enhancing bank monitoring of its relationship loans. Third, the NPV to the target bank's shareholders, measured as the acquisition price minus the book equity capital of the target, is increasing in its equity capital.[13] Fourth, the total value of the target bank is increasing in its equity capital.

We then take our theory to the data. Our empirical results strongly support the main predictions of the theory: total bank value and its components (the purchase price and goodwill in an acquisition, as well as the NPV to the shareholders of the target bank) are all increasing in the equity capital of the target. Moreover, the fair market value of the target bank's capital is also increasing in its capital. These results, which are both statistically and economically significant, obtain even while controlling for acquirer size, acquirer asset return volatility, acquirer capital, acquirer risk, market power, the banking sector's stock index returns, acquirer stock returns, target stock returns, the size of the target relative to that of the acquirer, percentage of target shares acquired, and the location of the target relative to the acquirer. We thus provide what we believe is the first empirical test of whether the M&M leverage indifference theorem holds for banks, as well as of the popular belief that capital adversely affects bank value cross-sectionally, and conclude that neither viewpoint is supported by the data.

In addition to testing the model's predictions, we also examine endogeneity issues and alternative stories for our results. One endogeneity problem lies in the possible simultaneous determination of target capital and goodwill. That is, riskier and more growth-oriented targets may choose to keep more capital simply to absorb their higher risk and support their higher growth prospects and receive higher goodwill in the purchase price due to this. We find that our results survive even after accounting for this possibility. Further, the acquirer's capital ratio does not have a statistically significant effect on the

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[12] This argument does not work if capital requirements are binding, because then banks hold levels of capital that are not privately optimal for them. Since banks' privately optimal capital choices are unobservable, our tests can also be viewed as an empirical examination of whether capital requirements are binding in a value-dissipating sense. A number of theoretical papers have provided reasons for why banks may hold equity in excess of regulatory requirements (e.g., Blum and Hellwig 1995; Bolton and Freixas 2006; Peura and Keppo 2006; Repullo and Suarez 2007; Van den Heuvel 2008). Gropp and Heider (2007) provide evidence that capital requirements do not appear to have constrained the capital ratios of U.S. and European banks. Flannery and Rangan (2008) reach a similar empirical conclusion for U.S. banks.

[13] The idea behind this prediction is that the target bank's book equity capital represents, on a historical cost basis, what the bank's shareholders invested in the bank, and the acquisition price represents the present value of the cash flows to shareholders made possible by that investment, so that the difference between the acquisition price and book value is the NPV to shareholders.

purchase price paid by the acquirer, which rules out the possibility that our findings are explained by the incentives of "capital-starved" acquirers to pay more for "capital-surplus" targets. We also explore other possible explanations for our results by checking whether acquirers are paying more for certain targets, because these targets give their acquirers "toe-hold" positions in some markets or generate additional market power. We conclude that our results are qualitatively unaffected by these factors.

We also examine two reverse causality stories. One is that banks that were overvalued prior to being acquired may have raised equity to time the market (e.g., Baker and Wurgler 2002). Such target banks would thus have higher capital due to preacquisition equity issuances and higher market values due to overvaluation. Since an acquirer would have to pay some premium over market value to purchase the bank, our empirical finding about bank capital and value being positively related in the cross-section may be merely an artifact of market timing. We explicitly test for this possibility and find that it is ruled out by the data. An additional reverse causality story is related to Myers and Majluf's 1984 pecking order. More profitable banks can finance more easily out of retained earnings, which they would prefer to do before turning to borrowing, and would therefore end up with more capital due to higher earnings retentions. They are also more valuable, because they are more profitable. We introduce target bank profitability as a control variable to explicitly account for this possibility in a way that addresses the endogeneity problem inherent in the simultaneous determination of bank capital and bank profitability. We also perform an additional robustness check that orthogonalizes capital with respect to profitability. Our results suggest that this reverse causality is not driving our results.

Further, we also conduct additional tests to gain deeper insights into the relationship between bank capital and value. First, we examine whether our results are driven by banks with binding capital requirements by dropping target banks that operate with a buffer of less than 1% above Basel I's "adequately capitalized" capital cutoff. Our results continue to hold. Second, we examine what happens if we drop the largest target banks from our sample, because they may be considered Too Big To Fail (TBTF); the results still hold. Third, we check to see if the results are just driven by a mechanical relationship between purchase prices and book equity values. We find that this is not what is going on. Fourth, we examine the impact of the target bank's (book) equity capital on the fair market value of the target bank's equity, E_m. We find that, controlling for all of the factors mentioned previously, E_m is increasing in E.

We conclude, therefore, that bank capital positively affects total bank value, as well as the components of this value in the cross-section of banks, at least within an acquisitions context. This finding represents a joint statement about the existence of a privately optimal capital structure at the individual bank level, as well as systematic cross-sectional differences among banks in their private optima. However, our analysis does not account for any potential externalities or other social welfare considerations in a general equilibrium context that may affect regulatory decisions about where to set capital requirements. Thus, our analysis is not meant to be prescriptive in terms of regulatory policy.

2. The Model

In this section, we develop the model. We first describe the sequence of events, then the bank's choices of capital and level of borrower monitoring, and finally the regulator's decision of whether or not to close the bank at the end of the first period. The model establishes an endogenous reason for the bank to choose capital, when capital affects bank value both directly through its effect on the bank's monitoring and hence the value of its loan portfolio, and also indirectly through its impact on the regulator's interim closure decision. The model attempts to capture all of the commonly attributed costs and benefits of bank capital. The costs are represented by the equity cost of capital, which is increasing in the amount of capital. The benefits are the direct and indirect benefits mentioned earlier.

2.1 Sequence of events

The economy has universal risk neutrality and three dates. At $t = 0$, the bank starts with a fixed asset size of $\$N$ and makes two decisions: (i) the mix of deposits (D) and equity (E) to finance its loans with and (ii) how much loan monitoring (m) to do. The bank's choice of m affects the value of its relationship loans. At $t = 1$, it becomes known what fraction of the bank's loans will default at $t = 2$ and what fraction will repay. Let γ represent an exogenous random variable that represents the repayment fraction, with $f(\gamma)$ as the density function and $F(\cdot)$ the associated cumulative distribution function. Moreover, at $t = 1$, the bank makes a second monitoring decision that involves a choice of effort $e \in \{0, 1\}$ and affects the value of the bank's loans at $t = 2$ that are known at $t = 1$ to not be in default. This second monitoring decision also influences the regulator's (subgame perfect) bank closure decision at $t = 1$. All payoffs are observed at $t = 2$. At that time, borrowers repay the bank, and the bank repays depositors. There is complete deposit insurance, zero insurance premium, and a zero riskless rate. Thus, the deposit interest rate is zero.

2.2 The bank's capital and monitoring choices

The bank starts out with retained earnings on hand of $\$B$, which are kept as cash-asset reserves to absorb the costs of monitoring and the dissipative cost of equity (discussed below) and not invested in loans. The bank makes $\$N$ in relationship loans at $t = 0$. Think of these as N relationship loans, each \$1. The bank takes this size as given and decides at $t = 0$ how much equity capital to raise, with the rest coming from deposits. The dissipative cost associated with \$$E$ in equity is $k(E)$, where $k' > 0, k'' > 0$, and the Inada conditions $k'(0) = 0, \lim_{E \to N} k'(E) = \infty$. We assume that $k'(E)$ varies in the cross-section among banks for any fixed E. This specification is meant to broadly capture the ubiquitous assumption in banking models that bank equity is costly, and it is general enough to capture different ways in which equity capital could impose a cost on the bank.[14]

The bank's monitoring of its relationship loans is $m \in [0, \overline{m}]$, with cost $W(m)$, where $W' > 0$, $W'' > 0$, $W''' = 0$, and $W(\cdot)$ satisfies the Inada conditions $W'(0) = 0$, $W'(\overline{m}) = \infty$. Bank monitoring enhances the value of the bank's relationship loans (e.g., Holmstrom and Tirole 1997; Boot and Thakor 2000; Allen, Carletti, and Marquez 2009) by increasing the payoff the bank receives on each relationship loan that is repaid.[15] This payoff is $R(m)$ per dollar of loans, so that on a \$1 relationship loan that repays, the bank collects $[1 + R(m)]$. We assume $R(0) = 0$, $R' > 0$, $R'' < 0$, and $R''' \geq 0$. The bank chooses m, taking a level of equity capital, E, as given.

Then, taking m as a function of E, the bank solves for its optimal E. We assume that the relationship loan value enhancement, $R(m)$, is an "illiquid asset" in the sense that it is bank-specific and hence partially lost if the asset portfolio were liquidated and the N loans sold on a piecemeal basis, or if the bank were closed. Specifically, if the loans are sold on a piecemeal basis, only a fraction $\alpha \in (0, 1)$ of the $R(m)$ can be captured. The relationship loan value enhancement is preserved in its entirety if the bank is acquired by another bank and maintained as an ongoing entity with $e = 1$ being chosen.[16]

In addition to the decisions about m and E at $t = 0$, the bank makes a second monitoring decision at $t = 1$ after observing the fraction γ of its loan portfolio that will repay at $t = 2$. This monitoring effort is $e \in \{0, 1\}$ with a cost

[14] The fact that the cost of equity is dissipative means that it represents a deadweight loss for the set of players identified in our model and is not a transfer payment from the bank to some other player (e.g., borrower, depositor, or regulator). The exogenous dissipative cost makes the specification general enough to include a variety of costs discussed in the literature—agency costs, adverse selection costs, transaction costs, liquidity reduction costs, etc.—without tying the results to a particular specification of costs.

[15] Our analysis assumes that monitoring is done by only one bank, thereby abstracting from the multiple-bank monitoring issues examined in Carletti, Cerasi, and Daltung (2007). We also assume that each relationship loan matures at $t = 2$, so there is no examination of the effect of relationship lending on the length of the bank–borrower relationship, as in Brick and Palia (2007). Our setup is general enough to accommodate a variety of assumptions about interbank competition, and we do know that competition does not eliminate relationship lending (e.g., Degryse and Ongena 2007).

[16] In the subsequent analysis, we will show that m is positively affected by E. So, one can view $R(m)$ as a benefit of equity capital. One should interpret $1 + R(m)$ as simply the value of the loan portfolio. The idea is that greater bank monitoring in a relationship loan means that the bank is providing more advisory services of value to the borrower (e.g., cash management, business planning, investing, etc.) and getting more involved in the business, in addition to more intensely monitoring the borrower's financial ratios and compliance with loan covenants. Consequently, higher monitoring permits the bank to create more value, develop a deeper relationship, charge more in fees, and earn higher rents. This aspect of monitoring in relationship lending is similar to that in Boot and Thakor (2000) and is consistent with the idea that greater interbank competition induces banks to seek enhancement in or preservation of profit margins by reorienting more toward relationship banking (Boot and Thakor 1997; Degryse and Ongena 2007).

$V(e)$, and $V(1) > V(0) = 0$. The effort e should be viewed as "maintenance monitoring" to preserve the value of the relationship loans between $t = 1$ and $t = 2$.

In particular, conditional on learning at $t = 1$ that a relationship loan will pay off at $t = 2$, the bank assesses the value of a \$1 relationship loan at $t = 2$ as $1 + R(m)$ if $e = 1$, and as having an expected value of less than 1 if $e = 0$. Conditional on $e = 0$, there is a probability $\xi \in (0, 1)$ that the loan will be worth $\Delta > 1$ and a probability $1 - \xi$ that it will be worth 0 such that $\xi\Delta < 1$. That is, not expending maintenance monitoring e at $t = 1$ results in a loss of the bank-specific value enhancement in relationship loans that was generated by the initial monitoring of m at $t = 0$. The bank's choices of m and e are privately observable to the bank but not to the regulator and hence cannot be contracted upon. The bank makes all its choices to maximize the expected wealth of its shareholders at $t = 2$.

2.3 Regulatory closure policy

At $t = 1$, we assume that the regulator is also able to observe γ (a proxy for the quality of the bank's loan portfolio) and decide whether to close the bank or let it continue. There is a small regulatory cost $c > 0$ involved in keeping the bank open another period that is absorbed by the regulator, so the regulator will keep the bank open only if the value of its equity at $t = 1$ exceeds c. The idea here is that γ determines the economic value of the bank's equity at $t = 1$; if this is sufficiently low, the regulator closes the bank. A summary of events is provided in figure 1.

3. The Analysis

In this section, we analyze the model and derive the key predictions. We determine the bank's incentive to provide maintenance monitoring at $t = 1$, as a

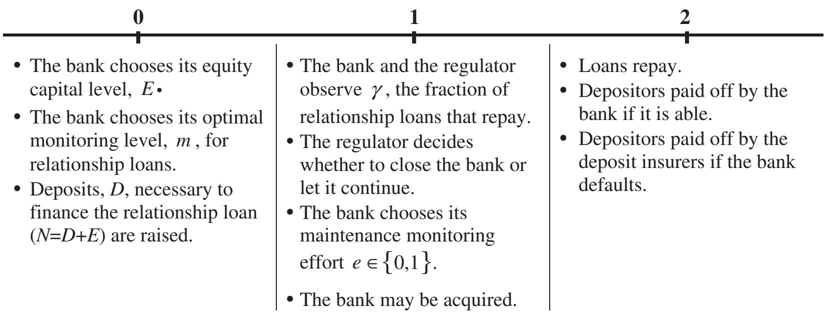

Figure 1
Sequence of events

function of the fraction of loans in default at that time and its equity capital. We also solve for the regulator's decision to either close the bank or allow it to continue at $t = 1$. This decision hinges on the regulator's perception of the bank's incentive to provide maintenance monitoring at $t = 1$, and the decision ends up therefore depending on two observable variables: the fraction of loans in default and the bank's equity capital. We then examine the simultaneous determination of the bank's equity capital, E, and monitoring level, m, at $t = 0$. This generates predictions about the link between the bank's equity capital and the different components of its value, namely the stand-alone values of its assets and the synergies among them. We will use the usual backward induction approach, starting with events at $t = 1$ and then moving back to $t = 0$.

3.1 Events at t =1

We now determine the bank's incentive to choose $e = 1$. Given a fraction γ of loans that repay, the expectation at $t = 1$ of the bank's shareholders' wealth at $t = 2$ is:

$$\begin{cases} \gamma N\big[1 + R(m)\big] - D - V(1) \text{ if } e = 1 \\ \text{Max}\big\{0, \gamma N\Delta - D\big\} w.p.\xi \text{ and 0 w.p.} 1 - \xi \text{ if } e = 0, \end{cases} \tag{1}$$

where "w.p." means "with probability," and we recognize that $V(0) = 0$ and that the bank's shareholders enjoy limited liability. Now define $A_1 \equiv \gamma N[1 + R(m)] - D - V(1)$, $A_2 \equiv \gamma N\Delta - D$, and $\bar{\gamma} \equiv \dfrac{D}{N\Delta}$. Note that since $\xi\Delta < 1$, the expected value of loans is less than $D + E$ with $e = 0$, so there is no reason for the bank to continue in the second period for any γ if $e = 0$. However, the bank will wish to continue for $\gamma > \bar{\gamma}$, because limited liability creates a positive value for equity in this case, and for all $\gamma \leq \bar{\gamma}$, the bank is indifferent between continuing and not continuing, because the value of equity is zero in this case due to limited liability. Thus, the bank has no preference to voluntarily shut down for any γ if it chooses $e = 0$. We now have the following lemma.

Lemma 1. Given an amount of equity, E, chosen at $t = 0$ and loans, N, made at $t = 0$, there is a repayment fraction cutoff, γ^0, such that the bank's participation constraint with $e = 1$ (nonnegative equity value at $t = 1$ with $e = 1$) is satisfied at $t = 1$ if $\gamma \geq \gamma^0$, where

$$\gamma^0 = \frac{V(1) + N - E}{\big[1 + R\big(m^*(E)\big)\big]N}, \tag{2}$$

and $m^*(E)$ is the optimal level of first-stage monitoring chosen by the bank at $t = 0$, given E.

We shall assume henceforth that

$$\Delta > \frac{\left[1 + R(\bar{m})\right]D}{V(1) + D}. \tag{3}$$

This assumption is merely a sufficiency condition to ensure a specific relationship between the various loan quality cutoffs and is not essential for the subsequent analysis. □

Lemma 2. Given (2) and a specific equity level, E, there is a repayment fraction cutoff, $\hat{\gamma}$, such that the bank is indifferent between choosing $e = 0$ and $e = 1$, and any $\gamma > \hat{\gamma}$ is incentive compatible in the sense that the bank strictly prefers $e = 1$ to $e = 0$, where

$$\hat{\gamma} = \frac{V\left(1\right) + \left[1 - \xi\right]\left[N - E\right]}{N\left[1 + R\left(m^*(E)\right) - \xi\,\Delta\right]}, \tag{4}$$

and $m^*\left(E\right)$ is the optimal level of first-stage monitoring chosen by the bank at $t = 0$ given E. Moreover, $\gamma^0 > \hat{\gamma} > \bar{\gamma}$. □

Lemma 2 implies that for any equity capital level, E, the loan repayment cutoff $\hat{\gamma}$ at which incentive compatibility of second-stage monitoring is achieved is below the cutoff, γ^0, at which the bank is willing to participate with $e = 1$. Thus, satisfaction of the bank's participation constraint also guarantees incentive compatibility. Further, since $\gamma^0 > \hat{\gamma} > \bar{\gamma}$, it also means that there is an interval of repayment fractions, $\left[\bar{\gamma}, \gamma^0\right]$, such that the bank would be willing to continue in the second period with $e = 0$, even though it would be unwilling to continue with $e = 1$ for $\gamma \in \left[\bar{\gamma}, \gamma^0\right]$.

Lemma 2 establishes a threshold for the fraction of loans that repay, such that the bank will wish to voluntarily continue for another period at $t = 1$ and also wish to provide maintenance monitoring as long as the actual fraction of repaying loans exceeds this threshold, γ^0. Note that the direct effect of E on γ^0 is to decrease it. Moreover, we will show later than m^* is increasing in E. Thus, this threshold, γ^0, is decreasing in the bank's equity, E. This means that loan-portfolio quality and bank capital are substitutes in inducing the bank to monitor at $t = 1$ and to wish to continue for a second period. For any given E, the bank's inclination to monitor and continue becomes weaker as its loan-portfolio quality at $t = 1$ gets worse. However, a higher level of equity induces the bank to be willing to provide maintenance monitoring and continue with a lower-quality loan portfolio.

Now, consider the regulator's problem. The regulator knows that second-period continuation of the bank requires $e = 1$, since the value of the equity of the bank with $e = 0$ is $\text{Max}\{\xi\,\Delta N\gamma - D, 0\}$ if the bank is closed down at $t = 1$, and it is $\text{Max}\{\xi\,\Delta N\gamma - D - c, 0\}$ if it is continued. For the regulator's continuation decision to be subgame perfect, we need[17]:

$$\gamma N\left[1+R\left(m\right)\right]-D-V\left(1\right)>c. \tag{5}$$

Thus, the cutoff γ from the regulator's standpoint, say γ_c, such that the bank is continued if $\gamma \geq \gamma_c$ and closed if $\gamma < \gamma_c$, is given by the value of γ for which (5) holds as an equality. This leads to:

Lemma 3. In a Nash equilibrium, the regulator permits the bank to continue if $\gamma \geq \gamma_c$ and closes it if $\gamma < \gamma_c$, where

$$\gamma_c = \frac{V\left(1\right)+N-E+c}{\left[1+R\left(m^{*}(E)\right)\right]N}, \tag{6}$$

where $m^{*}(E)$ is the regulator's belief about the bank's monitoring choice at $t=0$ as a function of its equity, E (which must be equal to the bank's actual choice in equilibrium). Moreover, $\gamma^{c} > \gamma^{o}$. □

The regulator's closure policy here depends on the regulator's observation about the bank's asset quality at $t=1$ (via γ) and the regulator's belief about the bank's equilibrium choice of $m^{*}(E)$.

In practice, regulators typically have a predetermined book equity cutoff (like 2% for U.S. banks) such that the bank is closed if its capital falls below that cutoff. Our analysis is robust to such a cutoff, as long as the cutoff is based on the bank's equity capital. Since $\gamma_c > \gamma^{o} > \hat{\gamma}$, whenever the regulator allows the bank to continue, the bank is willing to continue and choose $e=1$.

3.2 Events at t =0

The bank first solves for m, taking E as a given. That is, the bank solves:

$$\max_{m\in[o,\overline{m}]} \int_{\gamma_c}^{1} \left\{\gamma N\left[1+R\left(m\right)\right]-D-V\left(1\right)\right\} f\left(\gamma\right)\mathrm{d}\gamma + B - k\left(E\right) - W\left(m\right). \tag{7}$$

The bank chooses $e=1$ only if the realized γ is such that the bank is not closed. This leads to:

Proposition 1. There exists a unique, interior optimal level of monitoring, $m^{*}\left(E\right)$, chosen at $t=0$ that is a function of the equity level E, such that

[17] Mailath and Mester (1994) provide an analysis of the time-consistency problem in bank closure decisions. Boot and Thakor (1993) explain regulatory reluctance to close troubled banks.

$\mathrm{d}m^*/\mathrm{d}E > 0$. In equilibrium, this $m^*(E)$ is equal to the regulator's belief at $t = 1$ about the monitoring level the bank chose at $t = 0$. □

Proposition 1 establishes that banks that keep higher equity capital monitor more. The intuition is clear. Because γ_c is decreasing in E, a bank that keeps a higher E faces a lower probability of being closed at $t = 1$ and hence a higher probability of retaining its relationship banking rents, which are increasing in monitoring m. Hence, a higher E increases the marginal benefit of monitoring. Because banks never have a strict preference for voluntarily shutting down at the end of the first period, the regulator's closure policy is critical for the result that greater capital leads to higher monitoring.

Although the result that more bank capital leads to more bank monitoring is also encountered elsewhere (e.g., Allen, Carletti, and Marquez 2009; Dell'Ariccia and Marquez (2006)), it is the opposite of Diamond and Rajan's (2001) result that bank capital, by reducing financial fragility, can retard the bank's incentive to monitor its loans and create liquidity. The reason for this difference is that capital serves different roles in the two models. In our model, capital enhances the bank's continuation probability at $t = 1$, which in turn increases the marginal return to the bank's monitoring effort and elicits higher monitoring. In Diamond and Rajan (2001), capital protects the bank against the adverse consequence of deposit withdrawals stemming from depositors' actions in response to a curtailing of bank monitoring of loans, so in effect capital diminishes the marginal cost of avoiding monitoring.[18] Thus, even though in both models capital reduces the bank's financial fragility, the effect of reduced fragility on the marginal value of bank monitoring differs across the two models. We now turn to the optimal solution for E. The bank chooses E to maximize the expected value of $P - E$, where the expected value of P is given in (7), taking $m^*(E)$ as a given (from Proposition 1). That is, the bank chooses E to solve:

$$\max_{E\in[o,N]} \int_{\gamma_c}^{1} \{\gamma N[+R(m^*(E))]-N-E-V(1)\} f(\gamma)\mathrm{d}\gamma + B - k(E) - E - W(m^*(E)), \tag{8}$$

where we have substituted $D = N - E$ in the expression above. This leads to:

Proposition 2. Assume $f'(\gamma_c) \geq 0$. There exists a unique optimal bank capital level, E^*, chosen at $t = 0$, that is decreasing in the marginal cost of equity, $k'(E)$. □

The intuition behind this proposition is straightforward. While the marginal benefit of equity identified in Proposition 1 is the same for all banks, the marginal cost of equity is not, so equity is less attractive to banks with

18 Capital also serves to reduce liquidity creation in Diamond and Rajan (2000), but in that article, the bank's optimal capital structure trades off the effects of bank capital on liquidity creation, the expected costs of bank distress, and the ease of forcing borrower repayment.

higher marginal cost of equity.[19] Proposition 2 has the important implication that banks choose to keep capital voluntarily (i.e., in the absence of capital requirements).

We indicated earlier that to deal with the empirical challenges in measuring the impact of capital on the value of the bank, we would look at bank acquisitions for our tests. Thus, it is important to incorporate this approach into our theory as well, which we do now. Suppose the bank can be acquired at $t = 1$ in a competitive market for corporate control. Since a solvent target will not accept a price lower than its expected value under continuation if it were not acquired, an acquirer would have to pay the target (at least) $P = \gamma N \left[1 + R(m^*)\right] - D + B - k(E^*) - W(m^*)$ at $t = 1$, where γ is the realized fraction of repaying loans at $t = 1$. At the time of the acquisition, the goodwill recorded in the acquisition will be the acquisition price, P, minus the fair market value of the bank's equity. Computing this fair market value of equity requires assessing the fair market value of each individual asset and liability. This, in turn, requires essentially marking every individual asset and liability to market, which means calculating how much the bank's assets and liabilities would be worth if they were sold piecemeal as individual loans and deposits.[20] In our model, the fair market value of the bank's equity is:

$$E_m = \gamma N + \gamma\alpha N R(m^*) - D + B - k\left(E^*\right) - W\left(m^*\right),$$

since only a fraction α of $R(m^*)$ is captured if loans are sold piecemeal. Thus, goodwill is:[21]

$$G = \gamma N R\left(m^*\right)[1 - \alpha]. \tag{9}$$

Since $k'(E)$ varies in the cross-section of banks, suppose for two banks, i and j, $k_i'(E) < k_j'(E)\, \forall E \in (0, N)$. Then, Proposition 2 implies that $E_i^* > E_j^*$, ce-

19 The condition $f'(\gamma_c) \geq 0$ is merely a technical condition that is sufficient but not necessary for the second-order condition for a unique E^* to be satisfied. It is trivially satisfied for the uniform distribution and will hold for many other distributions for r_c low enough.

20 This is merely a standard bank acquisition purchase accounting technique, and its description can be found in the FASB rules governing purchasing accounting. It is important to not confuse the fair market value of equity, E_m, with the market value of equity (stock price × # of shares). E_m is merely the difference between the marked-to-market values of the bank's assets and liabilities, where the marking to market is done at the time of the acquisition.

21 Observe that the purchase price, P, decomposes into E_m, which is indirectly a function of E, and G, which is not directly affected by E.

teris paribus. In this case, it follows from (8) that $G_i > G_j$, since $\mathrm{d}m^* \big/ \mathrm{d}E > 0$ and $R'(m^*) > 0$. This leads to:

Proposition 3. Among banks of equal size, ceteris paribus banks that have higher levels of book equity capital will be acquired at prices that result in more goodwill being recorded by the acquirer, assuming that regulatory capital requirements are not binding. □

The intuition is that higher capital induces the bank to monitor its relationship loan more, and a part of the value created by this monitoring is reflected in the goodwill component of the bank's value. Holding fixed the fair market values of the bank's assets and liabilities, higher goodwill is indicative of higher synergies among the individual assets and liabilities of the target bank and thus a higher price.

Proposition 4. Among banks of equal size, ceteris paribus banks that have higher levels of book equity capital will be acquired at higher prices. □

The intuition is as follows. A bank endogenously chooses higher capital when the marginal cost of this capital is lower. This leads to more bank monitoring and a higher-valued loan portfolio and higher bank value. The only exception to Propositions 3 and 4 will be if regulatory capital requirements are above the privately optimal levels of equity for banks and thus binding. In this case, it is possible, although not necessarily true, that banks with higher capital levels will be associated with lower levels of goodwill and possibly lower purchase prices. In our empirical tests, we will examine whether higher capital levels are associated with lower or higher goodwill and purchase prices. Moreover, we also account for the possibility of binding capital requirements by conducting a robustness check in which we exclude target banks within 1% of minimum capital requirements.

While our analysis clearly predicts that goodwill should be increasing in the target bank's equity capital, assuming that capital requirements are not binding, it does not make an unambiguous prediction about the fair market value of equity, E_m. Empirically, we will examine the relationship between E_m and book equity, E. We recognize that book equity capital, E, may be distorted by accounting practices, and we make the assumption that the "true" book equity capital, which accurately represents the historically invested capital by the bank's shareholders, is a monotonically increasing function of the reported book equity capital; we do not need the two to be equal. The following corollary now emerges:

Corollary 1. The NPV to the target bank's shareholders, $P - E$, where P is the acquisition price and E is the book equity capital of the target, is cross-sectionally increasing in E. □

The intuition is that the banks with lower marginal costs of equity choose higher equity levels and receive higher prices in acquisitions (Propositions 2 and 4), leading to a higher NPV. Next, we turn to the M&M leverage indifference theorem: is the total value of the bank unaffected by its leverage?

Proposition 5. The total value (debt plus equity) of the target bank in an acquisition is increasing in its optimally chosen book equity capital. □

The intuition is straightforward. By Corollary 1, $P - E$ is cross-sectionally increasing in E. Moreover, deposits provide zero NPV financing for the bank. So, the total bank value, measured by the purchase price, P, plus the value of debt, D, must be higher for banks choosing higher capital ratios.

This proposition implies not only that the M&M leverage indifference result does not hold for banks but also that the popular view that bank capital lowers bank value in the cross-section is not correct. In equilibrium, banks that optimally choose higher equity-to-debt ratios enjoy higher total values. The reason for this result is related to the fact that banks differ in two important respects from other firms. First, banks add value in relationship lending through their monitoring, m, and this monitoring enhances loan cash flows (Holmstrom and Tirole 1997). Because monitoring incentives are strengthened by capital, the fundamental separation between capital structure and asset cash flows that is a bedrock M&M assumption is violated in the case of banks. Although bank capital is assumed to be dissipatively costly for all banks, banks with lower marginal costs of capital keep more capital in equilibrium and harvest higher monitoring benefits. Second, capital also serves to enhance the probability the bank will not be shut down by regulators. Recall that the threshold loan repayment fraction, γ_c, above which the bank is allowed to continue in the second period is decreasing in its equity capital, E. This enhanced continuation probability increases the marginal benefit of first-period monitoring, m, so banks that keep more capital end up monitoring more. Indeed, the positive equilibrium relationship between the bank's continuation probability and equity capital plays a central role in generating a positive relationship between monitoring (m) and capital (E). Since cross-sectional differences in the marginal costs of equity capital lead to different equity levels across banks, we get different banks also choosing different monitoring levels due to the link between m and E and hence experiencing different total values.

One could argue that our theoretical result that the acquirer pays a higher price for a target with higher capital is similar to the practitioner's intuition that prices in acquisitions are set as multiples of book value—say $P = ME$ with the constant multiple $M > 1$. One might then find that P is increasing in E and so is the NPV to the target shareholders, $P - E = [M - I]$. Of course, there still remains the theoretical challenge of proving that this "rule of thumb" is optimal for the acquirer. Nonetheless, it would be good to know if all that is going on is that acquirers are "mechanically" buying banks at price-to-book multiples exceeding 1. To this end, we examine what our theory has to say about the multiple $M = P\big/E$. A mechanical rule of setting $M > 1$ would imply no relationship *per se* between M and E.

Proposition 6. Given the equilibrium capital choices, E^*, of the target banks, the multiple $M = P\big/E^*$ is cross-sectionally decreasing in E^*. □

The intuition is that the marginal return on capital diminishes as capital increases. The effect of the bank's capital on its monitoring, as well as the effect of monitoring on its return on the loan, exhibits diminishing returns to scale. So, as capital increases in the cross-section in response to a lower marginal cost of equity capital, the marginal benefit of the additional capital decreases across banks.

3.3 Discussion of various model elements and results

We now briefly discuss why we need all of the key elements in our model: (i) relationship loan value as a function of first-period bank monitoring, (ii) equity cost of capital that varies cross-sectionally, (iii) a regulatory closure decision at the end of the first period, (iv) second-period "maintenance monitoring," and (v) the two-period structure.

Based on the preceding discussions, the reason for including (i) and (ii) is clear. The positive impact of bank monitoring on loan portfolio value generates a marginal benefit for bank monitoring whose level can be linked to bank equity capital, whereas having an equity cost of capital varying cross-sectionally is one reason why the privately optimal capital levels of banks vary in the cross-section. As for (iii), a regulatory closure decision at the end of the first period creates an incentive for the bank to keep more capital in the first period in order to reduce the probability of closure. This is a crucial link for creating a dependence of the optimal level of first-period bank monitoring on the bank's equity capital, since the optimality condition for monitoring does not depend directly on the cost or level of equity but rather depends on equity only indirectly through the survival probability (see the proof of Proposition 1). Moreover, the effect of capital on goodwill (Proposition 3) arises from the fact that higher capital increases the bank's continuation probability and reduces the need for the bank to sell off its assets on a piecemeal basis. As for (iv), we include the second-period maintenance monitoring to make it subgame perfect for the regulator to close a bank with sufficiently high first-period loan defaults. That is, the regulator would not close the bank unless it believed that the bank would hold back on maintenance monitoring in the second period, and the bank's incentive to provide maintenance monitoring depends on the value of the loan portfolio at $t = 1$, which in turn depends on the fraction of delinquent loans. Finally, the two-period structure is necessitated by the acquisitions context of our analysis. The bank is potentially acquired at t=1, and at that time, another period is needed for the acquirer to attach value to the bank as an ongoing concern. Moreover, the acquirer pays more for a bank with more capital at $t = 1$, because such a bank monitored more in the past (at $t = 0$) and thus has a more valuable loan portfolio.

We pause now for a few remarks on our results. With these results, we have three possible stories about how bank capital affects bank value: (i) Total value is unaffected by bank capital (Miller 1995), (ii) total value is adversely affected by bank capital (e.g., in one interpretation of Diamond and Rajan 2000; Mishkin 2000), and (iii) total value is positively affected by bank capital (our model). If (i) is right, then capital does not generate any value *per se*, and an acquirer should never pay more than a dollar for a dollar of target capital. Arguments that say that an acquirer is willing to pay more for a target with more capital because that target has greater potential to grow before hitting the constraints imposed by regulatory capital requirements make no sense. After all, an acquirer can always infuse an additional dollar of capital in the target after acquiring it, whether to relax a capital constraint or for some other reason, so there is no reason for the acquirer to pay more than a dollar for a dollar of equity capital in the target, unless of course the equity capital had other value-enhancing effects, which are absent in this world. The total value of the bank, as well as the NPV to target shareholders, should be unaffected by capital.

If (ii) is correct, then an acquirer should be willing to pay less than a dollar for an additional dollar of equity capital in the target. Holding the total size of the bank fixed, a bank with \$21 in book capital may still fetch a higher price than one with \$20 in book capital, but increasing capital from \$20 to \$21 may raise the price by only \$0.70. Thus, total bank value and NPV to the target shareholders will be decreasing in target capital. Finally, if our story is right and equity capital does have other value-enhancing effects, then in the cross-section, going from \$20 to \$21 in capital will raise the price by more than a dollar. That is, total bank value and NPV to target shareholders will go up with capital.

4. Data, Methodology, and Empirical Results

In this section, we describe our data and methodology and then discuss our empirical results.

4.1 Data

Our primary source of data on M&A is SDC Platinum. We start by collecting data on announcement dates, completion dates, transaction values, and methods of payment of all completed M&A deals in the banking industry[22]

[22] Defined as SDC industry sector code DA: Commercial Banks, Bank Holding Companies.

announced in the period January 1989 to December 2007.[23] We focus on acquisitions where both the acquirer and target are public firms. We exclude deals with an acquisition price below one million dollars, as well as acquisitions of less than or equal to 50% of the target bank. We obtain financial data for the acquirer and target banks from the Federal Reserve Banks' Y-9C and Call reports and from Compustat's Industrial Quarterly database. We collect monthly and daily stock return data from The Center of Research in Security Prices (CRSP) for the five and three years prior to the announcement date of each acquisition, respectively, for both the acquirer and the target. From SNL Financial, we obtain monthly returns on the SNL Financial bank total return index over the twelve months prior to the announcement date of each acquisition. Multiple acquisitions by one bank in the same quarter are removed.[24] The final sample consists of 244 deals, with announcement dates ranging from June 1989 to April 2007.

Table 1 provides descriptive statistics for the acquirer and the target firms, as well as deal characteristics. As Panel A shows, the average acquisition price is \$1.3 billion and the median is \$172 million, and the mean (median) target asset size is \$6.46 billion (\$0.82 billion). Targets on average have 8.8% capital/assets with a median of 8.5%. Panel B shows acquirer characteristics. The average acquirer is 5.7 times larger in terms of book value of assets than the average target. Acquirers on average have capital/assets of 9.1% and a median of 8.5%. Panel C describes deal characteristics. The price paid for targets is on average (median) about 27.5% (16.1%) of the acquirer's market value. The variable Goodwill/assets for the target firm is about 6.8% on average, with a median of 4.2%. The target's equity fair market value/book value of assets is on average 14.7%, with a median of 11.8%. The total acquisition price/book value of assets of the target firm is on average 21.5%, with a median of 20.7%.

In what follows, we test the five predictions emerging from our theoretical analysis: those generated by Propositions 3, 4, 5, and 6 and Corollary 1. Throughout the analysis, we use robust standard errors clustered by acquirer in order to deal with heteroscedasticity and the possibility of correlated errors when the same bank or bank holding company acted as an acquirer in multiple acquisitions.

4.2 Methodology for testing Proposition 3: higher target capital leads to higher goodwill

The main regression equation we wish to estimate in testing Proposition 3 is:

$$(GW/TA)_i = \beta_0 + \beta_1 (E/TA)_i + X_i B, \tag{10}$$

[23] Starting the sample period before 1989 was infeasible, because some of the Y-9C variables needed for our study were not available before 1989.

[24] All acquisitions by that bank in the quarter are dropped from the sample.

Table 1
Summary statistics for 244 acquisitions

Panel A: Target characteristics

Variables	Mean	Median	Min	Max
Acquisition price	1,293	172	4	58,761
Assets	6,461	822	50	326,563
Capital/assets (%)	8.78	8.54	3.95	20.68
Stock returns (%)	1.96	2.06	−8.26	15.36
Asset return volatility (%)	4.93	4.58	0.89	15.81

Panel B: Acquirer characteristics

Variables	Mean	Median	Min	Max
Market value of equity	6,682	1,672	19	178,765
Assets	36,960	9,499	164	1,213,691
Capital/assets (%)	9.05	8.45	5.04	20.41
Stock returns (%)	1.74	1.61	−2.89	7.09
Asset return volatility (%)	4.49	4.35	0.92	13.73

Panel C: Deal characteristics

Variables	Mean	Median	Min	Max
Relative size of target (%)	27.49	16.08	0.52	135.68
Goodwill	555	21	−110	32,159
Goodwill/assets (%)	6.81	4.24	−3.79	33.34
Fair market value of equity/assets (%)	14.73	11.83	0.43	39.93
Acquisition price/assets (%)	21.54	20.71	3.33	62.59

The acquisitions were announced between June 1989 and April 2007. Acquisition price is the price paid by the acquirer for the target's equity. Assets are the book value of assets as of the quarter prior to the announcement date. The variable Capital/assets is defined as the book value of equity divided by the book value of the assets in the quarter prior to the acquisition announcement. The variable Stock returns is defined as the average monthly stock returns for twelve months prior to acquisition announcement. Asset return volatility is the product of the standard deviation of daily stock returns times the ratio of the market value of equity to the market value of assets each quarter, averaged over the twelve quarters prior to acquisition announcement, and multiplied by the square root of 250. Market value of equity is the number of shares outstanding times the share price four weeks prior to the acquisition announcement. Relative size of target is the acquisition price/market value of equity of the acquirer four weeks prior to acquisition announcement. Fair market value of equity is the difference between the values of the bank's assets and liabilities after they have been marked to market. Goodwill is the acquisition price less the fair market value of equity. All values are in millions of $US unless otherwise indicated.

where $(GW/TA)_i$ is the ratio of goodwill to total assets for target firm i, TA is the total assets of the target as of the end of the quarter prior to the acquisition announcement, β_0 is a scalar intercept, β_1 is the regression coefficient on $(E/TA)_i$, which is the ratio of book equity capital to total assets for target firm i measured as of the end of the quarter prior to the acquisition announcement, X_i is a vector of control variables, and B is a vector of regression coefficients for these control variables. The control variables we use in our main multivariate regressions are the log of the acquirer's assets (measured at the end of the quarter prior to the acquisition announcement), the acquirer's asset return volatility (measured over the twelve quarters prior to the acquisition announcement), the ratio of the acquirer's book equity capital to total assets, the SNL bank stock index, the acquirer's and the target's average monthly stock returns (calculated over twelve months prior to the acquisition announcement), the size of the target relative to the acquirer, the percentage of shares acquired, location and year dummies, and the average ROE of the target for the three years prior to the acquisition announcement.

We discuss briefly the definition of each variable and the rationale for the control variables. Goodwill is defined as the acquisition price minus the difference between the fair market values of the target's assets and liabilities as assessed during the acquisition. We observe an acquiring bank's recorded goodwill at the end of the quarter before and after an acquisition completion and attribute the difference to the acquisition transaction.[25] That is, we take the goodwill that is recorded by the acquirer on its books after the acquisition. This measurement has to be approved by a certified auditor, so we use the number embedded in audited financial statements. $\left(E/TA\right)_i$ is the ratio of the target bank's book equity capital divided by the book value of its total assets for the quarter ending prior to the acquisition announcement.

As for the control variables, the log of the acquirer's assets in the quarter ending prior to the acquisition announcement is included, because the size of the acquirer may affect the price it is willing to offer the target and hence the goodwill in the deal. The acquirer's stock returns are measured as the average monthly stock returns for twelve months prior to the acquisition announcement. The idea here is that the price the acquirer is willing to pay for the target may depend on the acquirer's stock returns prior to the acquisition. For example, stock return dynamics seem to significantly influence equity issuance decisions and capital structure dynamics (e.g., Baker and Wurgler 2002; Welch 2004; Dittmar and Thakor 2007), so stock return dynamics may also influence prices in acquisitions. Moreover, to capture the potential effect of the riskiness of the acquirer on the price it is willing to pay for a target, we also include the acquirer's asset return volatility, calculated as Flannery and Rangan (2008).[26] We first compute the acquirer's stock return volatility as the standard deviation of daily returns and multiply it by the ratio of market value of equity to the market value of assets each quarter and take the average value over the twelve quarters before the acquisition announcement. We multiply this number by the square root of two hundred fifty to obtain the acquirer's (annualized) asset return volatility.

The ratio of the acquirer's book equity capital to total assets in the quarter prior to the acquisition announcement is included, because the acquirer's ability to make a bid for certain types of targets may be predicated on how well

[25] Most variables used in this article are defined relative to the acquisition announcement date. However, for computing goodwill, G, and the fair market value of the target bank's equity, E_m, we have to look at acquisition completion dates, because these data are generated only after the acquisition completion.

[26] Our results are unaffected if we use the standard deviation of stock returns instead of asset return volatility.

capitalized the acquirer is at the time of the acquisition announcement, particularly because regulatory approval of the deal depends in part on the acquirer's capital. The bank stock index is the average return on the SNL Financial bank total return index over the twelve months prior to the acquisition announcement. We include this control variable, because the state of the overall market for bank stocks may also affect the price paid in an acquisition, given the existing empirical evidence that mergers tend to come in waves and tend to be a bull market phenomenon (e.g., Jovanovic and Rousseau 2002; Shleifer and Vishny 2003). The target's average monthly stock return, measured over the twelve months prior to the announcement, is included as a control variable, because the stock return dynamics of the target could also influence the price paid for it in an acquisition. The relative size of the target is the ratio of the acquisition price to the market value of equity of the acquirer four weeks prior to acquisition announcement, with the data taken from CRSP. The rationale for this control variable is that the acquisition price could be affected by how large the target is relative to the size of the acquirer. The percentage of shares acquired is restricted to exceed 50%. We include this control variable, because the acquisition price is expected to increase in the size of the equity stake purchased in the target. Finally, the location dummy is set equal to 1 if the acquirer and target banks are headquartered in the same Federal Reserve region of the country[27] and 0 otherwise, which is meant to capture a possible "home bias" in acquisitions that may affect prices (e.g., Herrero-Garcia and Vasquez 2006 document a home bias in international bank expansion strategies, whereas Danthine, Giavazzi, and von Thadden 2001 document a home bias in European acquisitions). Year dummies for the year the acquisition is announced are included to account for year fixed effects since the environment for M&A may affect prices.

Finally, target ROE is included to deal with the possibility that our results are driven by a reverse causality story generated by the pecking order argument that internal finance is preferred to external finance (Myers and Majluf 1984). Ceteris paribus more profitable banks are more able to meet their financing needs through retained earnings and thus end up with higher capital ratios. They would, the argument goes, also sell at higher prices with more goodwill embedded in these prices, because they are more profitable rather than because of their higher capital. To account for this potential omitted variable bias, we include the target ROE as a control variable. Note that our theory predicts that capital (contemporaneously) positively affects ROE, whereas the pecking-order argument reverses that causality. To avoid the obvious endogeneity problem and ensure that we capture the pecking-order effect, we lag ROE relative to target capital (which is measured as of the quarter prior to the

[27] We define five regions based on Federal Reserve districts: Northeast (1, 2, 3, and 4), Midwest (7, 8, 9, and 10), Southeast (5 and 6), Texas (11), and West (12).

announcement) and define ROE as the average annual net income/equity for the three years prior to the acquisition announcement year.

4.3 Empirical results on testing Proposition 3: higher target capital leads to higher goodwill

Regression results for the estimation of Equation (10) appear in table 2. The estimates are presented in four size cohorts based on restrictions for acquisition price/market value of the acquirer.[28] The coefficient on target capital/assets is positive and significant in all four regressions. Thus, these results provide strong empirical support for the prediction of Proposition 3 that goodwill recorded in an acquisition will be increasing in target capital.

Table 3 provides the economic significance of our estimated coefficient on target capital/assets and shows that our result is not just statistically significant but also economically significant. Focusing on the specification where the relative size of the target to the acquirer is at least 3%, the coefficient on target capital/assets is 0.557. The median target in this restricted sample has a capital/assets ratio of 8.54%, so the estimated contribution of such a target's capital/assets to goodwill/assets is 4.76%. Now, consider an identical bank, but with a 10% greater capital/assets ratio of 9.39%. Table 3 shows that the contribution of target capital/assets to goodwill/assets jumps from 4.76% to 5.23%, an increase of 0.47%. Using the median goodwill/assets ratio for the restricted sample of 2.49% as the benchmark, this 0.47% increase represents an 18.88% increase in the premium paid for a target bank[29] that has a 10% higher capital/assets ratio at the time of the acquisition. Thus, the positive effect of target book capital on the goodwill paid for the target in an acquisition is economically significant.

Note that these findings also help to address a possible bias issue.[30] Since there is discretion in the determination of fair market values (e.g., Beaver and Venkatachalam 1999), it is possible that an acquirer that is paying a high purchase price for a target with high book equity may inflate its estimation of the fair market value of the target equity in order to reduce the recorded goodwill. This can provide a "protective shield" to the acquiring management against criticism that it overpaid, because management can defend the purchase price on the grounds that it was justified by the higher fair market value of the target rather than by the estimated value of the more-difficult-to-justify intangible asset called goodwill. In our analysis, $P(E) = E_m(E) + G(E)$, where P is the purchase price, E is book equity of the target, $E_m(E)$ is fair market value,

[28] We create these size cohorts, because our theory stipulates that the acquirer exercises complete diligence and prices the acquisition using all available information accurately. To the extent that acquiring managers may shirk in exercising due diligence, it is more likely to happen with smaller acquisitions where the cost of valuation errors to the acquirer is relatively low.

[29] This is 0.47% divided by 2.49%.

[30] We thank an anonymous referee for raising this issue.

Table 2
Goodwill/assets is increasing in target capital/assets

Dependent variable: Goodwill/assets

	Relative size of target restriction			
Independent variables	(>1%)	(>3%)	(>5%)	(>10%)
Target capital/assets	0.520**	0.557***	0.479**	0.504**
	(2.53)	(2.62)	(2.35)	(2.22)
Log(acquirer assets)	0.00316	0.000953	−0.000915	0.00119
	(1.11)	(0.33)	(−0.39)	(0.53)
Acquirer asset return volatility	−0.208	−0.202	−0.238	−0.223
	(−0.69)	(−0.67)	(−0.97)	(−1.00)
Acquirer capital/assets	−0.00832	0.00474	−0.0395	0.0664
	(−0.048)	(0.025)	(−0.26)	(0.40)
Bank stock index	0.00176	0.000362	0.000589	−0.000292
	(0.52)	(0.094)	(0.17)	(−0.094)
Acquirer stock returns	−0.480	−0.656**	−0.407	−0.316
	(−1.56)	(−2.21)	(−1.51)	(−1.34)
Target stock returns	0.395**	0.352**	0.259*	0.226
	(2.09)	(2.11)	(1.79)	(1.63)
Relative size of target	−0.0359***	−0.0306***	−0.0198*	−0.00748
	(−2.96)	(−2.72)	(−1.85)	(−0.67)
Percentage of shares acquired	0.00199***	0.00212***	0.00202***	0.00190**
	(3.12)	(3.11)	(2.84)	(2.52)
Location dummy	0.00189	−0.00352	−0.00756	−0.00283
	(0.18)	(−0.32)	(−0.69)	(−0.30)
Target ROE	0.0814**	0.0583	0.0619*	0.0315
	(2.03)	(1.64)	(1.98)	(0.90)
Intercept	−0.262***	−0.242**	−0.195**	−0.239**
	(−2.79)	(−2.36)	(−2.06)	(−2.46)
Year dummies	Yes	Yes	Yes	Yes
Adj. R-squared	0.50	0.59	0.71	0.80
Number of obs.	237	215	188	148

Goodwill is the acquisition price less the difference between the fair market values of the target's assets and liabilities. Capital/assets is the book value of equity divided by the book value of assets in the quarter prior to the acquisition announcement. Target and acquirer assets are from the quarter prior to acquisition announcement. Asset return volatility is the product of the standard deviation of daily stock returns times the ratio of the market value of equity to the market value of assets each quarter, average over the twelve quarters prior to the acquisition announcement, and multiplied by the square root of 250. Bank stock index is the average monthly return on the SNL Financial bank total return index over the twelve months prior to acquisition announcement. Stock returns is the average monthly stock return for twelve months prior to acquisition announcement. Relative size of target is the acquisition price/market value of the acquirer four weeks prior to acquisition announcement. Percentage of shares acquired is the size of the ownership stake purchased by the acquirer (restricted to be greater than 50%). Location dummy is set to 1 if the acquirer and target banks are headquartered in the same region of the country. ROE is the average net income/book value of equity for the three years prior to acquisition announcement. All regressions include year fixed effects. Standard errors are robust and clustered by acquirer. t-Statistics appear below estimated parameters. Significance levels: ***1%, **5%, and *10%.

and $G(E)$ is goodwill. Given that $P(E)$ is determined by competitive forces in the market for corporate control, elevating $E_m(E)$ reduces $G(E)$ for a fixed $P(E)$. While we cannot rule out the existence of such a bias, it qualitatively affects our results only if it leads to $\partial G(E)/\partial E < 0$ (i.e., if goodwill is decreasing in the target's book equity). In this case, our model may be correct in predicting that goodwill increases in the target's book equity, $\partial G(E)/\partial E > 0$, but management bias could negate that effect in the data. However, since we find empirically that $\partial G(E)/\partial E > 0$, we conclude that the bias is not large enough to qualitatively affect our results.

Table 3
The estimated coefficient on target capital/assets is economically significant

		Estimated coefficient on target capital/assets	Contribution of target capital/assets to goodwill/assets
Median target capital/assets	8.54%	0.557	4.76%
Target with 10% greater capital/assets	9.39%		5.23%
			+0.47%
Median goodwill/assets paid	2.49%		
Increase in goodwill/assets paid for a target with 10% greater capital/assets	0.47%		
The estimated premium paid for a higher capital bank relative to the median goodwill/assets in our sample	**18.88%**		

Notes: Estimated coefficient is from table 2 from the specification with a relative size of target restriction of (>3%). Median target capital/assets and goodwill/assets is for our sample of banks with the same (>3%) restriction.

4.4 Endogeneity issues related to Proposition 3

There is a potential endogeneity problem associated with goodwill and target capital—they may be simultaneously determined, so that capital may not be truly an exogenous variable. Specifically, higher-growth banks or riskier banks may endogenously keep more capital to support their higher growth or absorb more risk, and such banks may also exhibit greater synergies among their assets that would generate higher goodwill. We address these potential endogeneity issues in table 4. In Specification 1, we regress goodwill/assets on an intercept, target capital/assets, and the same control variables included in table 2.[31] In Specifications 2–4, we introduce various proxies for growth as independent variables: earnings per share growth, the market-to-book ratio, and asset growth. In Specification 5, we use the volatility of the target bank's Return on Assets (ROA) over the twelve quarters prior to the merger announcement as a proxy for target risk.[32] Despite including these growth and risk proxies, there is no reduction in the significance of capital/assets, nor is the size of the estimated coefficient affected very much.

In Specification 6, we directly investigate the effect of target risk on target capital/assets and find it to be insignificant in determining the level of capital for the target firm. We extract the residual capital/assets from this specification, which is the part of the capital/assets ratio that is orthogonal to target risk, and use this residual in Specification 7 to reestimate the original goodwill/assets

[31] Specification 1 shown in this table is identical to the specification used in column 2 in table 2. The coefficients are slightly different, and the number of observations is lower here, because we impose the restriction that not just the original control variables are available but also the additional controls used in any of the specifications presented in table 4 are available.

[32] We use the volatility of the target's ROA rather than the target's asset return volatility as a risk measure to ameliorate multicollinearity concerns. Asset return volatility includes in its definition the ratio of the market value of equity to that of assets, which is correlated with target capital/assets, as shown elsewhere in this article.

Table 4
Endogeneity tests

	Dependent variable: Goodwill/assets					Dependent variables	
						Target capital/assets	Goodwill/assets
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Target capital/assets	0.594***	0.607***	0.675***	0.586***	0.594***		
	(2.62)	(2.71)	(2.89)	(2.68)	(2.61)		
Residual target capital/assets							0.599***
							(2.66)
Target EPS growth		−0.00112					
		(−0.37)					
Target market-to-book			0.0200				
			(1.57)				
Target asset growth				0.0234			
				(0.61)			
Target ROA volatility					−0.0246	−0.0111	
					(−0.62)	(−0.90)	
Log(target assets)						0.000659	
						(0.46)	
Log(acquirer assets)	0.0000956	0.000177	−0.000129	−0.00000523	0.0000891		0.000455
	(0.027)	(0.049)	(−0.037)	(−0.0015)	(0.025)		(0.13)
Acquirer asset return volatility	−0.313	−0.302	−0.392	−0.345	−0.313		−0.312
	(−0.94)	(−0.89)	(−1.18)	(−1.12)	(−0.94)		(−1.04)
Acquirer capital/assets	0.0418	0.0310	0.0759	0.0646	0.0434		0.0434
	(0.21)	(0.16)	(0.40)	(0.33)	(0.22)		(0.25)
Bank stock index	−0.000146	−0.00000699	−0.000714	−0.0000327	−0.000172		−0.000147
	(−0.025)	(−0.0012)	(−0.12)	(−0.0055)	(−0.030)		(−0.025)
Acquirer stock returns	−0.661*	−0.655*	−0.789**	−0.643*	−0.672*		−0.656**
	(−1.96)	(−1.94)	(−2.35)	(−1.93)	(−1.97)		(−2.01)
Target stock returns	0.422*	0.442*	0.320	0.422*	0.424*		0.421*
	(1.76)	(1.80)	(1.29)	(1.72)	(1.76)		(1.87)
Relative size of target	−0.0310**	−0.0317**	−0.0293**	−0.0302**	−0.0311**		−0.0300***
	(−2.57)	(−2.59)	(−2.49)	(−2.50)	(−2.57)		(−2.63)

Table 4
(continued)

Percentage of shares acquired	0.00208***	0.00208***	0.00197***	0.00212***	0.00208***		0.00208***
	(3.44)	(3.40)	(3.13)	(3.57)	(3.44)		(3.46)
Location dummy	−0.00751	−0.00708	−0.0103	−0.00692	−0.00756		−0.00754
	(−0.64)	(−0.60)	(−0.87)	(−0.61)	(−0.64)		(−0.59)
Target ROE	0.111*	0.118*	0.0420	0.110*	0.111*	−0.00431	0.109*
	(1.71)	(1.82)	(0.52)	(1.70)	(1.71)	(−0.15)	(1.77)
Intercept	−0.236**	−0.239**	−0.239**	−0.243**	−0.236**	0.0497**	−0.207**
	(−2.15)	(−2.16)	(−2.11)	(−2.18)	(−2.15)	(2.13)	(−2.03)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.59	0.59	0.60	0.59	0.59	0.05	0.59
Number of obs.	195	195	195	195	195	195	195

Goodwill is the acquisition price less the difference between the fair market values of assets and liabilities. Capital/assets are the book value of equity divided by the book value of the assets in the quarter prior to the acquisition announcement. Residual target capital/assets are the residual from regression (6). EPS growth is earnings per share growth over the year prior to that of acquisition announcement. Market-to-book ratio is stock price times shares outstanding divided by book value of equity in the quarter prior to acquisition announcement. Asset growth is the average annual growth in assets over the three years prior to acquisition announcement. ROA volatility is the standard deviation of quarterly net income/assets over the twelve quarters prior to the acquisition announcement. Asset return volatility is the product of the standard deviation of daily stock returns times the ratio of the market value of equity to the market value of assets each quarter, averaged over the twelve quarters prior to the acquisition announcement, and multiplied by the square root of 250. Bank stock index is the average monthly return on the SNL Financial bank total return index over the twelve months prior to acquisition announcement. Stock returns is the average monthly stock return for twelve months prior to the acquisition announcement. Relative size of target is the acquisition price/market value of the acquirer four weeks prior to acquisition announcement. Percentage of shares acquired is the size of the ownership stake purchased by the acquirer (restricted to be greater than 50%). Location dummy is set to 1 if the acquirer and target banks are headquartered in the same region of the country. ROE is the average net income/book value of equity for the three years prior to acquisition announcement. All regressions include year fixed effects. Relative size restriction imposed: >3%. Standard errors are robust and clustered by acquirer. t-Statistics appear below estimated parameters. Significance levels: ***1%, **5%, and *10%.

regression. The coefficient on the residual of the target capital/assets is still significant and almost unchanged, suggesting that the variable defined as target capital/assets is truly a determinant of goodwill/assets, even independently of the impact of target risk on target capital/assets. To further check the robustness of our estimates, we conducted a Hausman test for the endogeneity of target risk. The test rejects the hypothesis that using the volatility of ROA as an instrument for target risk is necessary to produce consistent estimators in our original specification. In sum, after controlling for numerous factors, the empirical evidence strongly supports Proposition 3: banks with higher capital command higher goodwill premia in acquisitions.

4.5 Exploring alternative reasons why higher target capital leads to higher goodwill

The existence of goodwill in the purchase price means that the acquirer estimates synergies over and above the liquidation values of assets and liabilities that it is willing to pay for. In our model, this happens because bank capital enhances monitoring and generates portfolio synergies. But, in practice, there may be other sources of synergy as well.[33] One is that the acquirer may be expecting to gain a toe-hold in other local banking markets to expand geographically. This could be for efficiency reasons (to spread the influence of the acquirer's good management) or it could be a consequence of managerial hubris (Roll 1986). Berger et al. (2007) examine which of these two hypotheses is empirically dominant in the context of consolidation driven by technological advances and conclude that the efficiency hypothesis dominates. The toe-hold motivation for acquisition synergies in our analysis is to some extent accounted for by our location dummy. However, as a further robustness check, we replace that location dummy with a new control variable called "market overlap," which is a dummy that takes a value of 1 if the acquirer and the target are active in the same local banking markets. We define this as the acquirer and target each having a branch in the same core-based statistical area (CBSA) in the year prior to the acquisition announcement. Even if the acquirers and targets operate in multiple CBSAs, the dummy is 1 so long as both have a branch in at least one mutual CBSA. Yet, another reason for an acquirer to be willing to pay goodwill is to gain power in local banking markets (Hannan and Prager 2004). So, we now introduce the change in market power as an additional control variable. The change in market power is calculated as the bank-level Herfindahl index after the acquisition minus the weighted average Herfindahl index of the acquirer and target combined before the acquisition, using their respective deposit shares as weights. The results appear in table 5. The first column is the original specification (from column 2 in table 2), which is provided for comparative purposes. Our results about the impact of

33 We thank an anonymous referee for this suggestion.

Table 5
Robustness tests Goodwill/assets is increasing in target capital/assets

Dependent variable: Goodwill/assets

Independent variables	Original	Market overlap	HHI	Binding capital	TBTF
Target capital/assets	0.557***	0.633**	0.635**	0.607***	0.279*
	(2.62)	(2.12)	(2.15)	(2.78)	(1.70)
Log(acquirer assets)	0.000953	−0.00326	−0.00269	0.00126	−0.00218
	(0.33)	(−0.95)	(−0.72)	(0.41)	(−0.63)
Acquirer asset return volatility	−0.202	−0.472	−0.484	−0.164	−0.391
	(−0.67)	(−1.48)	(−1.40)	(−0.53)	(−1.40)
Acquirer capital/assets	0.00474	−0.000809	0.00710	−0.0220	0.0297
	(0.025)	(−0.0029)	(0.025)	(−0.12)	(0.15)
Bank stock index	0.000362	−0.403	−0.461	0.00419	0.00218
	(0.094)	(−0.91)	(−1.02)	(0.71)	(0.83)
Acquirer stock returns	−0.656**	−0.709*	−0.736*	−0.665**	−0.504*
	(−2.21)	(−1.80)	(−1.83)	(−2.18)	(−1.68)
Target stock returns	0.352**	0.343	0.378*	0.457**	0.372**
	(2.11)	(1.62)	(1.73)	(2.37)	(2.08)
Relative size of target	−0.0306***	−0.0279**	−0.0291**	−0.0305***	−0.0284**
	(−2.72)	(−2.16)	(−2.30)	(−2.69)	(−2.42)
Percentage of shares acquired	0.00212***	0.000647	0.000776	0.00221***	0.00228***
	(3.11)	(0.36)	(0.37)	(3.31)	(4.62)
Location dummy	−0.00352		−0.00135	−0.000491	0.00492
	(−0.32)		(−0.11)	(−0.043)	(0.42)
Local market dummy		0.00948			
		(1.29)			
Change in HHI index			0.0189**		
			(2.46)		
Target ROE	0.0583	0.106*	0.115*	0.0831*	0.0797**
	(1.64)	(1.71)	(1.78)	(1.93)	(2.44)
Intercept	−0.242**	0.0991	0.0863	−0.275***	−0.192*
	(−2.36)	(0.60)	(0.46)	(−2.89)	(−1.89)
Year dummies	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.59	0.62	0.61	0.59	0.59
Number of obs.	215	154	154	205	202

Goodwill is the acquisition price less the difference between the fair market values of assets and liabilities. Capital/assets are the book value of equity divided by the book value of assets in the quarter prior to the acquisition announcement. Target and acquirer assets are from the quarter prior to the acquisition announcement. Asset return volatility is the product of the standard deviation of daily stock returns times the ratio of the market value of equity to the market value of assets each quarter, averaged over the twelve quarters prior to acquisition, and multiplied by the square root of 250. Bank stock index is the average monthly return on the SNL Financial bank total return index over the twelve months prior to acquisition announcement. Stock returns is the average monthly stock return for twelve months prior to acquisition announcement. Relative size of target is the acquisition price/market value of the acquirer four weeks prior to the acquisition announcement. Percentage of shares acquired is the size of the ownership stake purchased by the acquirer (restricted to be greater than 50%). ROE is the average net income/book value of equity for the three years prior to acquisition announcement. Market overlap adds a local market dummy variable, which is 1 if the target and acquirer have any branches in the same CBSAs in the year prior to acquisition announcement. HHI, the change in market power, is the acquirer's Herfindahl–Hirschman index (HHI) after the acquisition minus the weighted average HHI of acquirer and target combined, calculated using each bank's deposits before the acquisition as weights, expressed as a % of the preacquisition HHI. "Too Big To Fail" (TBTF) eliminates targets and acquirers that ranked among the top 20 BHCs the year before the acquisition announcement. Binding capital drops targets operating with a buffer of less than 1% above any of Basel I's adequately capitalized capital cutoffs. Location dummy is set to 1 if the acquirer and target banks are headquartered in the same region of the country. All regressions include year fixed effects. Relative size restriction imposed: $> 3\%$. Standard errors are robust and clustered by acquirer. t-Statistics appear below estimated parameters. Significance levels: ***1%, **5%, and *10%.
Note: Column 1 above ("Original") is the same as table 2, column 2.

capital on goodwill, while introducing market overlap and the change in market power as additional control variables, are presented in columns 2 and 3 in table 5. As is evident, the coefficient on target capital/assets remains positive and significant, confirming the robustness of our results.

4.6 Additional robustness checks related to Proposition 3

We now perform two additional robustness checks related to Proposition 3. As we noted earlier, our theoretical model is predicated on the assumption that regulatory capital requirements are not binding. To check whether our results continue to hold when we exclude the banks that are likely to have binding capital requirements and thus would not conform to this assumption, we rerun our main test of Proposition 3 by dropping all target banks that do not have at least a 1% cushion above any of Basel I's three capital cutoffs to be adequately capitalized. These three cutoffs are (i) Tier 1 capital of at least 4% of unweighted total assets (the leverage ratio), (ii) Tier 1 capital of at least 4% of risk-weighted assets, and (iii) total regulatory capital (Tier 1 plus Tier 2) of at least 8% of risk-weighted assets (e.g., Berger et al. 2008).

A second robustness check has to do with the fact that we implicitly assume that regulators do not treat the institution as TBTF, because anticipation of TBTF treatment would negate the positive closure-avoidance benefit capital has in our model. So, we rerun our test of Proposition 3 by excluding targets and acquirers that belonged to the top twenty Bank Holding Companies (BHCs) in the year before the acquisition announcement. The results of these two robustness checks are reported in the last two columns in table 5. As is evident, Proposition 3 continues to be supported by the data even after dropping targets with "binding" capital requirements and after eliminating acquirers and targets that may be TBTF.

4.7 Results on testing Proposition 4: targets with higher capital fetch higher prices

We now confront Proposition 4 with the data and estimate the following equation:

$$\left(P/TA\right)_i = \beta_0 + \beta_1 \left(E/TA\right)_i + X_i B, \tag{11}$$

where P is the acquisition price, TA is the total assets of the target as of the end of the quarter prior to the acquisition announcement, β_0 is a scalar intercept, β_1 is the regression coefficient on $(E/TA)_i$, which is the ratio of book equity capital to total assets for target firm i measured as of the end of the quarter prior to the acquisition announcement, X_i is a vector of control variables, and B is a vector of regression coefficients for these control variables.

Table 6 presents the results related to estimating Equation (11). This specification is identical to Equation (10), except that we have replaced goodwill/

target assets with total acquisition price/target assets as the dependent variable. The estimates are presented for the same four size cohorts based on relative size restrictions, that is, restrictions for acquisition price/market value of the acquirer, as in the previous analysis. For all four size cohorts, the estimated coefficient on target capital/assets is positive and significant at the 1% level. Thus, these results provide strong empirical support for Proposition 4, that banks with higher capital ratios are acquired at higher prices. Moreover, note that the acquirer's capital ratio is not statistically significant in explaining the price paid by the acquirer for the target. This is important, because it rules out the possibility that the acquirer is paying more for higher-capital targets, because an acquirer with relatively low capital is effectively using the acquisition to put more capital on its own balance sheet. That is, a "scarcity" of capital for the acquirer cannot explain our findings.

4.8 Results on testing Corollary 1: NPV to the target bank's shareholders is increasing in target capital

Next, we test the prediction generated by Corollary 1 by examining whether higher target equity capital increases the NPV to the target bank's shareholders. We estimate the following equation:

$$((P - E)/TA)_i = \beta_0 + \beta_1 (E/TA)_i + X_i B, \tag{12}$$

where $(P - E)/TA$ is the difference between the acquisition price and the book equity capital in the target divided by the total assets in the target,[34] measured as of the end of the quarter prior to the acquisition announcement, X_i is the same vector of control variables as before, and B is a vector of regression coefficients for the control variables. The results are presented in table 7. As is apparent, the regression coefficient on $(E/TA)_i$ is positive in all cases and statistically significant when we impose a 1% or a 3% relative size cutoff. Thus, the target bank's equity capital appears to positively affect the NPV to the target bank's shareholders in an acquisition, supporting Corollary 1.[35]

4.9 Results on testing Proposition 5: total value of the target bank is increasing in capital

We now test Proposition 5 by estimating the following equation:

$$((P + D)/TA)_i = \beta_0 + \beta_1 (E/TA)_i + X_i B, \tag{13}$$

[34] Note that $(P - E)$ is the NPV to the shareholders. Dividing by *TA* normalizes the NPV for bank size.

[35] This test of the prediction of Corollary 1 may cause one to wonder whether the argument that multiples are above 1 would by itself suggest that capital is value increasing and that if so, then that is all one would need. However, this prediction and the way we test have nothing to do with book multiples being above 1 *per se*. There is no prediction of the model that multiples have to be greater than one. The only prediction is that the NPV has to be increasing in book equity, which is possible even if all multiples are in reality less than 1. Conversely, even if all multiples exceeded 1, the NPV could be cross-sectionally decreasing in capital, which would contradict the model. Thus, the model's predictions may be validated by the data even if all multiples are less than 1, and they may not be supported by the data even if all multiples exceed 1.

Table 6
Acquisition price/assets is increasing in target capital/assets

Dependent variable: Acquisition price/assets

	Relative size of target restriction			
Independent variables	(>1%)	(>3%)	(>5%)	(>10%)
Target capital/assets	1.486***	1.614***	1.433***	1.385***
	(6.13)	(5.73)	(4.94)	(4.22)
Log(acquirer assets)	0.00501	0.00556	0.00359	0.00171
	(1.38)	(1.38)	(0.89)	(0.39)
Acquirer asset return volatility	0.459	0.391	0.345	0.128
	(1.44)	(1.10)	(1.01)	(0.37)
Acquirer capital/assets	0.0714	0.0793	−0.0767	0.0458
	(0.34)	(0.34)	(−0.41)	(0.19)
Bank stock index	0.0101	0.00585	0.00563	0.00942
	(1.55)	(0.89)	(0.83)	(1.43)
Acquirer stock returns	0.488	0.436	0.266	0.867**
	(1.48)	(1.18)	(0.69)	(2.51)
Target stock returns	0.369*	0.368*	0.382*	0.359
	(1.85)	(1.77)	(1.69)	(1.26)
Relative size of target	−0.00155	−0.00657	−0.000665	−0.00408
	(−0.079)	(−0.32)	(−0.033)	(−0.19)
Percentage of shares acquired	0.00383***	0.00376***	0.00357***	0.00286***
	(5.48)	(4.81)	(4.69)	(4.47)
Location dummy	−0.00313	−0.00237	−0.0152	−0.00666
	(−0.28)	(−0.18)	(−1.20)	(−0.51)
Target ROE	0.216***	0.202***	0.214***	0.273***
	(4.07)	(3.87)	(3.89)	(3.73)
Intercept	−0.431***	−0.474***	−0.389***	−0.292**
	(−3.75)	(−3.78)	(−3.21)	(−2.44)
Year dummies	Yes	Yes	Yes	Yes
Adj. R-squared	0.49	0.49	0.57	0.62
Number of obs.	237	215	188	148

Acquisition price is the price paid by the acquirer for the target bank's equity, and acquisition price/assets is the ratio of this price to the total book value of the target bank's assets in the quarter prior to the acquisition announcement. We define the variable Capital/assets as the book value of equity divided by the book value of assets in the quarter prior to the acquisition announcement. Target and acquirer assets are from the quarter prior to the acquisition announcement. Asset return volatility is the product of the standard deviation of daily stock returns times the ratio of the market value of equity to the market value of assets each quarter, averaged over the twelve quarters prior to acquisition, and multiplied by the square root of 250. Bank stock index is the average monthly return on the SNL Financial bank total return index over the twelve months prior to acquisition announcement. Stock returns are the average monthly stock return for twelve months prior to acquisition announcement. Relative size of target is the acquisition price/market value of the acquirer four weeks prior to the acquisition announcement. Percentage of shares acquired is the size of the ownership stake purchased by the acquirer (restricted to be greater than 50%). ROE is the average net income/book value of equity for the three years prior to acquisition announcement. Location dummy is set to 1 if the acquirer and target banks are headquartered in the same region of the country. All regressions include year fixed effects. Standard errors are robust and clustered by acquirer. t-Statistics appear below estimated parameters. Significance levels: ***1%, **5%, and *10%.

where $P + D$ is the acquisition price (P) plus debt (D) of the target bank in the quarter prior to the acquisition announcement,[36] TA is the target bank's total assets in the quarter prior to the acquisition announcement, X_i is the same

[36] We use the market value of debt rather than the book value, which is defined as $(TA - E)$ plus the difference between the book value and market value of outstanding public debt one-quarter prior to the announcement date. However, using Bloomberg, we found public debt data for only eleven of the target banks one-quarter prior to the announcement date. Whenever the market value of outstanding public debt was not available, we used the book value instead. Only two of the target banks recorded differences between market value and book value of outstanding public debt one quarter prior to the announcement date. We also used SDC Platinum for data on the target banks' debt issuances twelve quarters prior to the announcement date. Twenty of the target banks issued debt, three target banks issued both public and private debt, while three made private placements only.

Table 7
The NPV to target bank's shareholders as measured by (acquisition price−target capital)/assets is increasing in target capital/assets

Dependent variable: The NPV to the target bank's shareholders

	Relative size of target restriction			
Independent variables	(>1%)	(>3%)	(>5%)	(>10%)
Target capital/assets	0.486**	0.614**	0.433	0.385
	(2.00)	(2.18)	(1.49)	(1.17)
Log(acquirer assets)	0.00501	0.00556	0.00359	0.00171
	(1.38)	(1.38)	(0.89)	(0.39)
Acquirer asset return volatility	0.459	0.391	0.345	0.128
	(1.44)	(1.10)	(1.01)	(0.37)
Acquirer capital/assets	0.0714	0.0793	−0.0767	0.0458
	(0.34)	(0.34)	(−0.41)	(0.19)
Bank stock index	0.0101	0.00585	0.00563	0.00942
	(1.55)	(0.89)	(0.83)	(1.43)
Acquirer stock returns	0.488	0.436	0.266	0.867**
	(1.48)	(1.18)	(0.69)	(2.51)
Target stock returns	0.369*	0.368*	0.382*	0.359
	(1.85)	(1.77)	(1.69)	(1.26)
Relative size of target	−0.00155	−0.00657	−0.000665	−0.00408
	(−0.079)	(−0.32)	(−0.033)	(−0.19)
Percentage of shares acquired	0.00383***	0.00376***	0.00357***	0.00286***
	(5.48)	(4.81)	(4.69)	(4.47)
Location dummy	−0.00313	−0.00237	−0.0152	−0.00666
	(−0.28)	(−0.18)	(−1.20)	(−0.51)
Target ROE	0.216***	0.202***	0.214***	0.273***
	(4.07)	(3.87)	(3.89)	(3.73)
Intercept	−0.431***	−0.474***	−0.389***	−0.292**
	(−3.75)	(−3.78)	(−3.21)	(−2.44)
Year dummies	Yes	Yes	Yes	Yes
Adj. R-squared	0.36	0.35	0.44	0.49
Number of obs.	237	215	188	148

The NPV to the target bank's shareholders is defined as the acquisition price minus the book value of the target bank's equity in the quarter prior to the acquisition announcement, and this difference is then normalized by the book value of the target bank's assets in the quarter prior to the acquisition announcement. Capital/assets are the book value of equity divided by the book value of assets in the quarter prior to the acquisition announcement. Target and acquirer assets are from the quarter prior to the acquisition announcement. Asset return volatility is the product of the standard deviation of daily stock returns times the ratio of the market value of equity to the market value of assets each quarter, averaged over the twelve quarters prior to acquisition, and multiplied by the square root of 250. Bank stock index is the average monthly return on the SNL Financial bank total return index over the twelve months prior to acquisition announcement. Stock returns is a variable that is defined as the average monthly stock return for twelve months prior to acquisition announcement. Relative size of target is the acquisition price/market value of the acquirer four weeks prior to the acquisition announcement. Percentage of shares acquired is the size of the ownership stake purchased by the acquirer (restricted to be greater than 50%). ROE is the average net income/book value of equity for the three years prior to acquisition announcement. Location dummy is set to 1 if the acquirer and target banks are headquartered in the same region of the country. All regressions include year fixed effects. Standard errors are robust and clustered by acquirer. t-Statistics appear below estimated parameters. Significance levels: ***1%, **5%, and *10%.

vector of control variables as before, and B is the related vector of regression coefficients. The results of this estimation are presented in table 8. The total value of the bank is increasing in its book equity capital in all cases and statistically significant when we impose a 1% or a 3% relative size cutoff. This provides support for Proposition 5.

Although we have included target bank profitability as a control variable in all our regressions to deal with a possible reverse causality generated by the

Table 8
The target's total value/assets is increasing in target capital/assets

Dependent variable: Total value/assets of the target bank

	Relative size of target restriction			
Independent variables	(>1%)	(>3%)	(>5%)	(>10%)
Target capital/assets	0.525**	0.651**	0.480	0.435
	(2.15)	(2.29)	(1.63)	(1.30)
Log(acquirer assets)	0.00520	0.00589	0.00400	0.00243
	(1.41)	(1.43)	(0.97)	(0.54)
Acquirer asset return volatility	0.475	0.417	0.379	0.160
	(1.46)	(1.16)	(1.08)	(0.44)
Acquirer capital/assets	0.0808	0.0927	−0.0658	0.0767
	(0.38)	(0.39)	(−0.34)	(0.31)
Bank stock index	0.00966	0.00540	0.00511	0.00880
	(1.47)	(0.81)	(0.74)	(1.32)
Acquirer stock returns	0.486	0.434	0.265	0.861**
	(1.45)	(1.16)	(0.67)	(2.44)
Target stock returns	0.340*	0.341*	0.351	0.334
	(1.74)	(1.67)	(1.57)	(1.21)
Relative size of target	−0.00215	−0.00677	−0.000688	−0.00212
	(−0.11)	(−0.33)	(−0.033)	(−0.100)
Percentage of shares acquired	0.00375***	0.00367***	0.00345***	0.00267***
	(5.59)	(4.94)	(4.70)	(4.07)
Location dummy	−0.00290	−0.00243	−0.0150	−0.00644
	(−0.26)	(−0.18)	(−1.16)	(−0.47)
Target ROE	0.207***	0.194***	0.206***	0.261***
	(3.94)	(3.72)	(3.73)	(3.59)
Intercept	0.570***	0.525***	0.610***	0.708***
	(4.98)	(4.22)	(5.04)	(5.87)
Year dummies	Yes	Yes	Yes	Yes
Adj. R-squared	0.35	0.33	0.42	0.47
Number of obs.	237	215	188	148

The total value/assets of the target bank is defined as the acquisition price plus the adjusted book value of the target bank's total liabilities divided by the target's assets in the quarter prior to the acquisition announcement. We adjust the book value of the target bank's total liabilities by adding the difference between the book value and market value of outstanding public debt one quarter prior to the announcement date. Capital/assets is a variable that is defined as the book value of equity divided by the book value of assets in the quarter prior to the acquisition announcement. Target and acquirer assets are from the quarter prior to the acquisition announcement. Asset return volatility is the product of the standard deviation of daily stock returns times the ratio of the market value of equity to the market value of assets each quarter, averaged over the twelve quarters prior to acquisition, and multiplied by the square root of 250. Bank stock index is the average monthly return on the SNL Financial bank total return index over the twelve months prior to acquisition announcement. The variable Stock returns is defined as the average monthly stock return for twelve months prior to acquisition announcement. Relative size of target is the acquisition price/market value of the acquirer four weeks prior to the acquisition announcement. Percentage of shares acquired is the size of the ownership stake purchased by the acquirer (restricted to be greater than 50%). ROE is the average net income/book value of equity for the three years prior to acquisition announcement. Location dummy is set to 1 if the acquirer and target banks are headquartered in the same region of the country. All regressions include year fixed effects. Standard errors are robust and clustered by acquirer. t-Statistics appear below estimated parameters. Significance levels: ***1%, **5%, and *10%.

pecking order hypothesis, we now conduct a robustness test on this issue in the context of Proposition 5. We run a two-stage regression. In Stage 1, we regress target capital/assets for the quarter prior to the acquisition announcement against target ROE for year $t-2$ (where t is the year of the acquisition announcement). In other words, ROE is lagged relative to capital. We extract the residual target capital/assets as the portion of capital not explained by prior target profitability. This residual is then used as an independent variable in

Table 9
Checking whether the results are driven by the pecking order hypothesis

	Dependent variables	
	Target capital/assets	Target total value/assets
Independent variables	(1)	(2)
Intercept	0.0585***	0.602***
	(45.1)	(4.86)
Residual target capital/assets		0.635**
		(2.16)
Log(acquirer assets)		0.00694*
		(1.73)
Acquirer asset return volatility		0.172
		(0.48)
Acquirer capital/assets		0.216
		(0.84)
Bank stock index		0.00651
		(1.04)
Acquirer stock returns		0.716**
		(1.99)
Target stock returns		0.279
		(1.31)
Relative size of target		−0.00199
		(−0.094)
Percentage of shares acquired		0.00319***
		(4.07)
Location dummy		0.000294
		(0.022)
Lag(Target ROE)	0.0104	0.0843***
	(1.62)	(2.89)
Year dummies	Yes	Yes
Adj. R-squared	0.09	0.30
Number of obs.	211	211

The total value/assets of the target bank is defined as the acquisition price plus the adjusted book value of the target bank's total liabilities divided by the target's assets in the quarter prior to the acquisition announcement. We adjust the book value of the target bank's total liabilities by adding the difference between the book value and market value of outstanding public debt one quarter prior to the announcement date. The variable Capital/assets is defined as the book value of equity divided by the book value of assets in the quarter prior to the acquisition announcement. Target assets are from the quarter prior to the acquisition announcement. Asset return volatility is the product of the standard deviation of daily stock returns times the ratio of the market value of equity to the market value of assets each quarter, averaged over the twelve quarters prior to acquisition, and multiplied by the square root of 250. Bank stock index is the average monthly return on the SNL Financial bank total return index over the twelve months prior to acquisition announcement. The variable Stock returns is defined as the average monthly stock return for twelve months prior to acquisition announcement. Relative size of target is the acquisition price/market value of the acquirer four weeks prior to the acquisition announcement. Percentage of shares acquired is the size of the ownership stake purchased by the acquirer (restricted to be greater than 50%). Location dummy is set to 1 if the acquirer and target banks are headquartered in the same region of the country. Lagged ROE is net income/book value of equity from two years prior to the acquisition announcement. All regressions include year fixed effects. Standard errors are robust and clustered by acquirer. t-Statistics appear below estimated parameters. Significance levels: ***1%, **5%, and *10%.

Stage 2 along with all of our control variables and with the total value of the target as the dependent variable. These results are shown in table 9. It is clear that the variable defined as residual target capital/assets, which is orthogonal to the target bank's prior profitability, is still highly significantly positively related to the total value of the target.

A possible criticism of our tests is that we have debt market values for very few banks. Note, however, that we can prove formally that the use of debt book values rather than market values biases against finding our results. To see this, note that our model implies (using the subscript m to denote market values and the lack of subscript to denote book):

$$\frac{\partial\left[E_m + D_m - [E + D]\right]}{\partial E} > 0 \text{ or } \frac{\partial\left[E_m - E\right]}{\partial E} + \frac{\partial\left[D_m - D\right]}{\partial E} > 0. \quad (14)$$

We have already shown that $\frac{\partial[E_m - E]}{\partial E} > 0$. Now, we can show formally that $\frac{\partial[D_m - D]}{\partial E} > 0$. The intuition is that replacing \$1 of debt with \$1 of equity must increase bondholders' returns (or equivalently, $\frac{D_m - D}{D}$ decreases as D increases). Thus, replacing D_m with D means that the second term in (14) drops out. Empirically, therefore, if one finds that total bank value is increasing in equity capital, holding fixed the size of the bank (as we do), when one uses debt book values, then the theory implies that the empirical relationship would be even stronger if we used debt market values. Having said that, in our sample, the difference between the market and book values of debt, when market values are available, is minimal; the ratio of debt market to book values is close to 1.

4.10 Reverse causality issue in testing Proposition 5

There is an alternative reverse causality story to be examined. It could be that some banks were overvalued prior to being acquired, and exploited this market timing opportunity by issuing more equity. These overvalued banks would thus end up with high levels of capital. Since acquirers would need to pay premia over the preacquisition market values of these banks in purchase transactions, we would end up with capital and value being positively cross-sectionally related solely due to market timing reasons. To examine the empirical validity of this alternative explanation, we divide our sample of target banks based on their capitalization, $\left(E/TA\right)_i$. Specifically, we split the targets into banks with high or low preacquisition capital ratios, using the median capital ratio across the sample as a cutoff. We then measure the equity issuance behavior of high- and low-capital targets over the three years prior to the acquisition announcement and perform a t-test on the difference in mean equity issuance across these two groups. We look at both total dollar proceeds and proceeds divided by the preacquisition market value of equity. These results are presented in table 10. Low-capital banks had mean proceeds from equity issuance of \$19.5 million (0.0201 when deflated by the market value of equity), while the high capital banks had \$11.2 million (0.0206 when deflated by the market value of equity). The t-tests reject the null hypothesis that the difference in mean equity issuance behavior across the high- and low-capital groups is statistically significant based on either measure.[37]

[37] We performed a similar test comparing equity issuance between high- and low-capital-listed BHCs for the entire universe of listed BHCs, excluding the targets in our sample, and again found no statistical difference.

Table 10
Equity issuance is not significantly different between low- and high-capital targets

		Total proceeds ($Millions)		Proceeds/market value of equity	
Capital ratio	*N*	Mean	Std Dev	Mean	Std Dev
Low	122	19.512	105.31	0.0201	0.0672
High	122	11.231	99.763	0.0206	0.0789
t-Tests		*t*-Value		*t*-Value	
Equal variance		0.63		−0.05	
Unequal variance		0.63		−0.05	

Target banks' equity issuance is computed over the three years prior to the acquisition announcement.

4.11 Test of Proposition 6: the purchase price/capital multiple is decreasing in capital

To conduct this test, we estimate:

$$[P/E]_i = \beta_0 + \beta_1 (E/TA)_i + X_i B, \tag{15}$$

where $[P/E]_i$ is the price-to-book multiple paid for the target in acquisitions, $[E/TA]_i$ is the book value of the target divided by total assets of the target, with TA measured as of the end of the quarter prior to the acquisition announcement, X_i is the same vector of control variables, and B is a vector of regression coefficients for the control variables. If our earlier results are merely driven by the "mechanical effect" of acquirers simply pricing acquisitions at a constant multiple of the target's book equity, then β_1 will be statistically insignificant. If Proposition 6 holds, β_1 should be negative and statistically significant.

The results of this estimation are presented in table 11. As with our goodwill analysis, we ran our main equation for four size cohorts based on the ratio of the acquisition price to the market value of equity of the acquirer being greater than 1%, 3%, 5%, and 10%. The estimated coefficient of the target's capital over its assets, $(E/TA)_i$, is significant and negative at the 1% level for each size cohort. These results support the predictions of our theory and rule out mechanical effects.

4.12 Ancillary test: effect of target bank capital on the fair market value of equity in acquisitions

Having tested the five main predictions of our model, we now turn to an additional test. Although our theory does not make an unambiguous prediction about the effect of target bank capital, E, on the fair market value of the target bank's equity, E_m, we can empirically check how E impacts E_m. We use the same set of control variables from Equation (10) to estimate the following equation:

$$(E_m/TA)_i = \beta_0 + \beta_1 (E/TA)_i + X_i B, \tag{16}$$

Table 11
The purchase price/capital multiple is decreasing in target capital/assets

Dependent variable: Purchase price/capital multiple

	Relative size of target restriction			
Independent variables	(>1%)	(>3%)	(>5%)	(>10%)
Target capital/assets	−8.504***	−7.989***	−9.693***	−9.062***
	(−4.63)	(−3.73)	(−4.74)	(−4.36)
Log(acquirer assets)	0.0239	0.0317	0.0136	−0.00335
	(0.58)	(0.69)	(0.3)	(−0.068)
Acquirer asset return volatility	6.334*	5.799	5.713*	3.295
	(1.81)	(1.57)	(1.68)	(0.98)
Acquirer capital/assets	−1.059	−0.793	−2.516	−1.784
	(−0.48)	(−0.32)	(−1.22)	(−0.69)
Bank stock index	0.144	0.0767	0.0758	0.11
	(1.42)	(0.75)	(0.72)	(1.07)
Acquirer stock returns	5.083	4.488	2.401	8.584**
	(1.39)	(1.1)	(0.56)	(2.05)
Target stock returns	5.675**	5.621**	5.901**	5.637*
	(2.41)	(2.29)	(2.22)	(1.66)
Relative size of target	−0.116	−0.142	−0.0933	−0.0896
	(−0.54)	(−0.63)	(−0.41)	(−0.40)
Percentage of shares acquired	0.0427***	0.0425***	0.0405***	0.0304***
	(5.36)	(4.95)	(4.71)	(4.39)
Location dummy	0.00931	0.00889	−0.15	−0.0848
	(0.071)	(0.057)	(−1.04)	(−0.57)
Target ROE	2.746***	2.647***	2.757***	3.077***
	(4.4)	(4.17)	(4.14)	(3.76)
Intercept	−1.922	−2.643*	−1.771	−0.538
	(−1.44)	(−1.88)	(−1.32)	(−0.40)
Year dummies	Yes	Yes	Yes	Yes
Adj. R-squared	0.39	0.37	0.47	0.49
Number of obs.	237	215	188	148

Purchase price/capital is the ratio of the acquisition price to the book value of the target bank's equity in the quarter prior to the acquisition announcement. The variable Capital/assets is defined as the book value of equity divided by the book value of assets in the quarter prior to the acquisition announcement. Target and acquirer assets are from the quarter prior to the acquisition announcement. Asset return volatility is the product of the standard deviation of daily stock returns times the ratio of the market value of equity to the market value of assets each quarter, averaged over the twelve quarters prior to acquisition, and multiplied by the square root of 250. Bank stock index is the average monthly return on the SNL Financial bank total return index over the twelve months prior to acquisition announcement. The variable Stock returns is defined as the average monthly stock return for twelve months prior to acquisition announcement. Relative size of target is the acquisition price/market value of the acquirer four weeks prior to the acquisition announcement. Percentage of shares acquired is the size of the ownership stake purchased by the acquirer (restricted to be greater than 50%). ROE is the average net income/book value of equity for the three years prior to acquisition announcement. Location dummy is set to 1 if the acquirer and target banks are headquartered in the same region of the country. All regressions include year fixed effects. Standard errors are robust and clustered by acquirer. t-Statistics appear below estimated parameters. Significance levels: ***1%, **5%, and *10%.

where $\left(E_m/TA\right)_i$ is the ratio of the fair market value of the equity of target i divided by the total assets (TA) of target i, with TA measured as of the end of the quarter prior to the acquisition announcement. X_i is the same vector of control variables used before, and C is a vector of regression coefficients for the control variables. The results are presented in table 12. As with our goodwill analysis, we ran our main equation for four relative size cohorts based on the ratio of the acquisition price to the market value of equity of the acquirer. The estimated coefficient on the target's capital over its assets, $\left(E/TA\right)_i$, is significant at the 1% level for each size cohort. These empirical results indicate

Table 12
The fair market value/assets is increasing in target capital/assets

Dependent variable: Fair market value/assets

	Relative size of target restriction			
Independent variables	(>1%)	(>3%)	(>5%)	(>10%)
Target capital/assets	0.965***	1.057***	0.954***	0.881***
	(4.10)	(5.10)	(4.72)	(4.11)
Log(acquirer assets)	0.00185	0.00461	0.00451	0.000521
	(0.47)	(1.08)	(1.08)	(0.13)
Acquirer asset return volatility	0.667*	0.593	0.583*	0.351
	(1.79)	(1.55)	(1.68)	(0.99)
Acquirer capital/assets	0.0797	0.0745	−0.0372	−0.0206
	(0.40)	(0.35)	(−0.19)	(−0.083)
Bank stock index	0.00835	0.00549	0.00504	0.00971
	(1.00)	(0.62)	(0.57)	(1.20)
Acquirer stock returns	0.968**	1.092***	0.673	1.184***
	(2.53)	(2.74)	(1.57)	(2.91)
Target stock returns	−0.0266	0.0162	0.123	0.133
	(−0.12)	(0.078)	(0.57)	(0.50)
Relative size of target	0.0343	0.0240	0.0191	0.00340
	(1.62)	(1.16)	(0.89)	(0.17)
Percentage of shares acquired	0.00185***	0.00164***	0.00155***	0.000962
	(3.29)	(3.10)	(2.80)	(1.56)
Location dummy	−0.00502	0.00115	−0.00760	−0.00383
	(−0.38)	(0.075)	(−0.46)	(−0.29)
Target ROE	0.134**	0.143***	0.152***	0.242***
	(2.55)	(2.74)	(3.09)	(3.43)
Intercept	−0.169	−0.233*	−0.195	−0.0525
	(−1.41)	(−1.86)	(−1.53)	(−0.44)
Year dummies	Yes	Yes	Yes	Yes
Adj. R-squared	0.44	0.51	0.55	0.65
Number of obs.	237	215	188	148

Fair market value/assets is the ratio of fair market value, the acquisition price minus the goodwill recorded in the transaction, to the book value of the target bank's assets in the quarter prior to the acquisition announcement. Goodwill is the acquisition price less the difference between the fair market values of assets and liabilities. The variable Capital/assets is defined as the book value of equity divided by the book value of assets in the quarter prior to the acquisition announcement. Target and acquirer assets are from the quarter prior to the acquisition announcement. Asset return volatility is the product of the standard deviation of daily stock returns times the ratio of the market value of equity to the market value of assets each quarter, averaged over the twelve quarters prior to acquisition, and multiplied by the square root of 250. Bank stock index is the average monthly return on the SNL Financial bank total return index over the twelve months prior to acquisition announcement. Stock returns are the average monthly stock return for twelve months prior to acquisition announcement. Relative size of target is the acquisition price/market value of the acquirer four weeks prior to the acquisition announcement. Percentage of shares acquired is the size of the ownership stake purchased by the acquirer (restricted to be greater than 50%). ROE is the average net income/book value of equity for the three years prior to acquisition announcement. Location dummy is set to 1 if the acquirer and target banks are headquartered in the same region of the country. All regressions include year fixed effects. Standard errors are robust and clustered by acquirer. t-Statistics appear below estimated parameters. Significance levels: ***1%, **5%, and *10%.

that the fair market value of a target bank's equity is significantly increasing in the target's capital.

5. Conclusion

How does bank capital affect bank value? There are two existing viewpoints on this. One is that of Miller (1995), who argued that bank capital has no value relevance. The more popular view is that bank capital adversely affects value (e.g., Mishkin 2000). We have developed a model that tells an entirely different story. It predicts that total bank value, as well as various components of bank value, is positively correlated with bank capital in the cross-section. We test this prediction using data on bank acquisitions. Our empirical results strongly support the predictions of the model.

Our analysis obviously does not imply that piling up huge amounts of capital or requiring banks to do so would necessarily be good for banks. In our theory, banks choose capital in a privately optimal manner, and at these private optima, value and capital are positively related in the cross-section. That is by no means a prescription for unfettered capital accumulation.

Can our findings be generalized to all banks rather than just those that were acquired? We believe that our results are likely to be encountered for a broader sample of banks, although it will not be possible to examine how capital impacts the different components of value in that case.

Appendix: Proofs of Lemmas, Propositions, and Corollary

Proof of Lemma 1. Note first that $\partial A_1/\partial\gamma > 0$. Now γ^0 is determined by: ν

$$\gamma^0 N\left[1 + R\left(m^*(E)\right)\right] - D - V(1) = 0.$$

Rearranging and substituting $D = N - E$ yields (2). ■

Since $\partial A_1/\partial\gamma > 0$, it follows that the bank's participation constraint is satisfied for all $\gamma \geq \gamma^o$.

Proof of Lemma 2. The bank's equity value with $e = 0$ is given by:

$$\xi\,[\gamma \mathrm{N}\Delta - \mathrm{D}] \tag{A1}$$

and with $e = 1$ is given by:

$$\gamma N\left[1 + R\left(m^*(E)\right)\right] - D - V(1). \tag{A2}$$

For incentive compatibility, we need:

$$\gamma N\left[1 + R\left(m^*(E)\right)\right] - D - V(1) \geq \xi\,[\gamma N\Delta - D] \tag{A3}$$

and $\hat{\gamma}$ is the value of γ for which A3 holds as an equality. It follows from this that $\hat{\gamma}$ is the expression given in (4). Note that $\partial\hat{\gamma}/\partial\xi < 0$. Moreover, $\hat{\gamma} = \gamma^0$ at $\xi = 0$. Thus, $\gamma^o > \hat{\gamma}$. It is easy to show that, given (3), $\hat{\gamma} > \bar{\gamma}$ also holds. ■

Proof of Lemma 3. Obvious from the discussion preceding Lemma 3. ■

Proof of Proposition 1. The first-order condition for an optimum is:

$$\int_{\gamma_c}^{1} \left\{\gamma N R'\left(m^*\right)\right\} f(\gamma)\,\mathrm{d}\gamma - W'\left(m^*\right) = 0, \tag{A4}$$

where we do not differentiate γ_c with respect to m, because γ_c is based on the regulator's belief about the bank's choice of $m^*(E)$ and is not affected by the bank's actual choice of m. ■

The second-order condition is:

$$SOC \equiv \int_{\gamma_c}^{1} \left\{\gamma N R''\left(m^*\right)\right\} f(\gamma)\,\mathrm{d}\gamma - W''\left(m^*\right) < 0, \tag{A5}$$

which is satisfied since $R''\left(m^*\right) < 0$ and $W''\left(m^*\right) > 0$.

Thus, m^* is a unique maximum. Further, it is also an interior maximum due to the Inada condition on $W(m)$.

Totally differentiating A4 yields:

$$\frac{\mathrm{d}m^*}{\mathrm{d}E} = \left[\frac{\left[\gamma_c N R'\left(m^*\right) f(\gamma_c)\left[\mathrm{d}\gamma_c/\mathrm{d}E\right]\right]}{SOC}\right]. \tag{A6}$$

We know from (6) that $\partial\gamma_c/\partial E < 0$, and we also know that the terms multiplying $\partial\gamma_c/\partial E$ in the numerator of the right-hand side of A6 are strictly positive. Since $SOC < 0$ (see A5), we have $\mathrm{d}m^*/\mathrm{d}E > 0$. ■

Proof of Proposition 2. Using the Envelope Theorem, the first-order condition for E^* corresponding to (8) can be written as:

$$-\left[\gamma_c N\left[1 + R\left(m^*\right)\right] - \left[N - E^*\right] - V(1)\right] f(\gamma_c)\left[\mathrm{d}\gamma_c/\mathrm{d}E\right] + \left[1 - F(\gamma_c)\right] - 1 - k'\left(E^*\right) = 0. \tag{A7}$$

Given the linearity of γ_c in E (see (6)), the second-order condition is $-k''\left(E^*\right) < 0$, which is satisfied since $R'(\bullet) > 0$, $\mathrm{d}m^*/\mathrm{d}E > 0$, $\mathrm{d}\gamma_c/\mathrm{d}E < 0$, $f'(\gamma_c) \geq 0$, and $k''\left(E^*\right) > 0$.Further, E^* is an interior maximum because of the Inada conditions on $k(\cdot)$. ■

From A7, we know that:

$$1 + k'\left(E^*\right) = -\left[\gamma_c N\left[1 + R(m*)\right] - \left[N - E^*\right] - V(1)\right] f(\gamma_c)\left[\mathrm{d}\gamma_c/\mathrm{d}E\right] + \left[1 - F(\gamma_c)\right]. \tag{A8}$$

The right-hand side of A8 is a positive constant for a fixed E. Consider two banks i and j, with $k_i'(E) > k_j'(E)$ for any fixed $E \in (0, N)$. Then, the right-hand side of A8 is the same for both banks i and j, which means that to make the left-hand side equal for both banks, we need $E_i^* < E_j^*$, because $k(\cdot)$ is convex and increasing in E.

Proof of Proposition 3. Obvious given the above discussion, preceding Proposition 3. ■

Proof of Proposition 4. Consider banks i and j with $k_i'(E) < k_j'(E)\forall E$. Then, from Proposition 2, we know that $E_i^* > E_j^*$. Now consider the price for bank i with equity capital E_j^*. This will be:

$$P_i(E_j^*) = \gamma N\left[1 + R(m_j^*(i))\right] - \left[N - E_j^*\right] + B - k_i(E_j^*) - W(m_j^*(i)), \tag{A9}$$

where $m_j^*(i)$ is the monitoring level chosen by bank i when it chooses capital E_j^*. By Proposition 1, we know that $\mathrm{d}m^*/\mathrm{d}E > 0$, and from the proof of Proposition 1, we also know that m^* does not depend directly on $k(E)$; the dependence of m^* on $k(E)$ is only through the dependence of m^* on E. Thus, $m_j^*(i) = m_j^*(j)$ and $W\left(m_j^*(i)\right) = W\left(m_j^*(j)\right)$. This means we can rewrite A9 as:

$$\begin{aligned} P_i(E_j^*) &= \gamma N\left[1 + R(m_j^*(j))\right] - \left[N - E_j^*\right] + B - k_i(E_j^*) - W(m_j^*(j)) \\ &> P_j(E_j^*) \text{ since } k_i(E_j^*) < k_j(E_j^*). \end{aligned}$$

Since each bank chooses its optimal equity capital to maximize its $P - E$, we know that $P_i(E_i^*) - E_i^* > P_i(E_j^*) - E_j^*$, where E_i^* maximizes $P_i - E_i$ for bank i and

$$P_i(E_i^*) = \gamma N\left[1 + R(m_i^*)\right] - \left[N - E_i^*\right] + B - k_i(E_i^*) - W(m_i^*). \quad \text{(A10)}$$

Thus, $P_i(E_i^*) > P_i(E_j^*) > P_j(E_j^*)$. ■

Proof of Corollary 1. Consider two banks i and j with $k_i'(E) < k_j'(E) \forall E$. Then, we know from Proposition 2 that $E_i^* > E_j^*$. Moreover, $P_i(E_i^*) - E_i^* > P_i(E_j^*) - E_j^* > P_j(E_j^*) - E_j^*$, since $k_i(E_j^*) < k_j(E_j^*)$. ■

Proof of Proposition 5. Consider again two banks i and j with $k_i'(E) < k_j'(E) \forall E$. Then, the total value of bank i in equilibrium is $P_i(E_i^*) + D_i$, and the total value of bank j is $P_j(E_j^*) + D_j$. Then,

$$\begin{aligned} P_i(E_i^*) + D_i &= P_i(E_i^*) + N - E_i^* \\ &> P_j(E_j^*) + N - E_j^* \text{ (from Corollary 1)} \\ &= P_j(E_j^*) + D_j \end{aligned}$$ ■

Proof of Proposition 6. Let m^* and E^* be the equilibrium values of m and E, respectively. Totally differentiating the expression in A6 yields:

$$d^2 m^* \big/ dE^{*2} = \frac{\left\{ \begin{array}{l} SOC\left\{\gamma_c N R''\left(m^*\right)\left[\mathrm{d}m^*/\mathrm{d}E^*\right]\mathrm{d}\gamma_c/\mathrm{d}E^*\right\} \\ -\left[\gamma_c N R'\left(m^*\right)\right] f\left(\gamma_c\right)\left[\mathrm{d}\gamma_c/\mathrm{d}E\right]\left[\partial SOC/\partial E^*\right] \end{array}\right\}}{[SOC]^2}.$$

It can be verified that $\partial SOC/\partial E^* \geq 0$. Given that $\mathrm{d}m^*/\mathrm{d}E^* > 0$, $R''\left(m^*\right) < 0$, and $\mathrm{d}\gamma_c/\mathrm{d}E^* < 0$, we see that $\mathrm{d}^2 m^* \big/ \mathrm{d}E^{*2} < 0$.

Next, we will prove that $R\left(m^*\left(E^*\right)\right)$ is concave cross-sectionally in E^*. Consider two different equilibrium levels of capital, E_1^* and E_2^*, with $E^* \equiv \lambda E_1^* + [1 - \lambda] E_2^*$, with $\lambda \in (0, 1)$. Then, $R\left(m^*\left(E^*\right)\right) > \lambda R\left(m^*\left(E_1^*\right)\right) + [1 - \lambda] R\left(m^*\left(E_2^*\right)\right)$, since m^* is increasing and concave in E^*, and R is concave in m^*. Thus, R is cross-sectionally concave in E^*. Next, we will prove $P\left(E^*\right)$ is concave in E^* as E^* varies in the cross-section. Note that $P\left(E^*\right)$ is given by A9. We now see that, given the cross-sectional concavity of R in E^*, we have:

$$\begin{aligned} &\gamma N\left[1 + R\left(m^*\left(E^*\right)\right)\right] - \left[N - E^*\right] + B - k\left(E^*\right) - W\left(m^*\left(E^*\right)\right) \\ &\quad > \lambda\left\{\gamma N\left[1 + R\left(m^*\left(E_1^*\right)\right)\right] - \left[N - E_1^*\right] + B - k\left(E_1^*\right) - W\left(m^*\left(E_1^*\right)\right)\right\} \\ &\quad + [1 - \lambda]\left\{\gamma N\left[1 + R\left(m^*\left(E_2^*\right)\right)\right] - \left[N - E_2^*\right] + B - k\left(E_2^*\right) - W\left(m^*\left(E_2^*\right)\right)\right\}. \end{aligned}$$

Thus, $P\left(E^*\right)$ is concave in E^*. Now,

$$\mathrm{d}\left(P/E^*\right)/\mathrm{d}E^* = \frac{E^*\left[\partial P/\partial E^*\right] - P\left(E^*\right)}{\left[E^*\right]^2} < 0,$$

since the numerator above is negative for all E^* because the numerator is negative for $E = \varepsilon > 0$ arbitrarily small (note $\partial P/\partial E^*$ is bounded everywhere and $P(0) > 0$ for continuing/solvent banks) and it is decreasing in E (for $E > 0$) due to the concavity of P in E^*. ■

References

Allen, F. 1990. The Market for Information and the Origin of Financial Intermediation. *Journal of Financial Intermediation* 1:3–30.

Allen, F., E. Carletti, and R. Marquez. 2009. Credit Market Competition and Capital Regulation. *Review of Financial Studies.* Advance Access published November 23, 2009, 10.1093/rfs/hhp089.

Allen, F., and D. Gale. 2000. Financial Contagion. *Journal of Political Economy* 108:1–33.

———. 2004. Competition and Financial Stability. *Journal of Money, Credit and Banking* 36:433–80.

Baker, M., and J. Wurgler. 2002. Market Timing and Capital Structure. *Journal of Finance* 57:1–32.

Barth, J. R., Gerard Caprio Jr., and R. Levine. 2004. Bank Regulation and Supervision: What Works Best? *Journal of Financial Intermediation* 13:205–48.

Barth, M. E. 1994. Fair Value Accounting: Evidence from Investment Securities and the Market Valuation of Banks. *Accounting Review* 69:1–25.

Beaver, W., and M. Venkatachalam. 1999. Differential Pricing of Discretionary, Nondiscretionary and Noise Components of Loan Fair Values. Working Paper, Stanford University.

Berger, A. N. 1995. The Relationship between Capital and Earnings in Banking. *Journal of Money, Credit and Banking* 27:432–56.

Berger, A. N., and C. H. S. Bouwman. 2009. Bank Liquidity Creation. *Review of Financial Studies* 22:3779–837.

Berger, A. N., R. DeYoung, M. J. Flannery, D. Lee, and O. Oztekin. 2008. How Do Large Banking Organizations Manage Their Capital Ratios? *Journal of Financial Services Research* 34:123–49.

Berger, A., A. A. Dick, L. G. Goldberg, and L. J. White. 2007. Competition from Large, Multimarket Firms and the Performance of Small, Single-Market Firms: Evidence from the Banking Industry. *Journal of Money, Credit and Banking* 39:331–68.

Berger, A. N., R. J. Herring, and G. P. Szego. 1995. The Role of Capital in Financial Institutions. *Journal of Banking and Finance* 19:393–430.

Berger, A. N., and G. F. Udell. 1994. Did Risk-Based Capital Allocate Bank Credit and Cause a "Credit Crunch" in the United States? *Journal of Money, Credit and Banking* 26:586–627.

Besanko, D., and G. Kanatas. 1996. The Regulation of Bank Capital: Do Capital Standards Promote Bank Safety? *Journal of Financial Intermediation* 5:160–83.

Bhattacharya, S., A. W. A. Boot, and A. V. Thakor. 1998. The Economics of Bank Regulation. *Journal of Money, Credit and Banking* 30:745–70.

Bishop, M. L., and T. Z. Lys. 2001. Inferring Accounting Information from Corporate Financing Choices: An Examination of Security Issuances in the Banking Industry. *Contemporary Accounting Research* (Fall):397–423.

Blum, J., and M. Hellwig. 1995. The Macroeconomic Implications of Capital Adequacy Requirements for Banks. *European Economic Review* 39:739–49.

Bolton, P., and X. Freixas. 2006. Corporate Finance and the Monetary Transmission Mechanism. *Review of Financial Studies* 19:829–70.

Boot, A. W. A., and M. Marinc. 2007. Competition and Entry in Banking: Implications for Capital Regulation. Working Paper, University of Amsterdam.

Boot, A. W. A., and A. V. Thakor. 1993. Self-Interested Bank Regulation. *American Economic Review* 83:206–12.

———. 1997. Banking Scope and Financial Innovation. *Review of Financial Studies* 10:1099–131.

———. 2000. Can Relationship Banking Survive Competition? *Journal of Finance* 55.

Brick, I. E., and D. Palia. 2007. Evidence of Jointness in the Terms of Relationship Lending. *Journal of Financial Intermediation* 16:452–76.

Carletti, E., V. Cerasi, and S. Daltung. 2007. Multiple-Bank Lending: Diversification and Free Riding in Monitoring. *Journal of Financial Intermediation* 16:425–51.

Dangl, T., and A. Lehar. 2004. Value-at-Risk vs. Building Block Regulation in Banking. *Journal of Financial Intermediation* 13:96–131.

Danthine, J.-P., F. Giavazzi, and E.-L. von Thadden. 2001. The Effect of EMU on Financial Markets: A First Assessment. In C. Wyplosz (ed.), *The Impact of EMU on Europe and the Developing Countries*, Chapter 9. London: Oxford University Press.

DeCamps, J.-P., J.-C. Rochet, and B. Roger. 2004. The Three Pillars of Basel II: Optimizing the Mix. *Journal of Financial Intermediation* 13:132–55.

Degryse, H., and S. Ongena. 2007. The Impact of Competition on Bank Orientation. *Journal of Financial Intermediation* 16:452–76.

Dell'Ariccia, G., and R. Marquez. 2006. Competition among Regulators and Credit Market Integration. *Journal of Financial Economics* 79:401–30.

Diamond, D., and R. Rajan. 2000. A Theory of Bank Capital. *Journal of Finance* 55:2431–65.

———. 2001. Liquidity Risk, Liquidity Creation and Financial Fragility. *Journal of Political Economy* 109:287–327.

Dittmar, A., and A. V. Thakor. 2007. Why Do Firms Issue Equity? *Journal of Finance* 62:1–54.

Flannery, M. J., and K. P. Rangan. 2008. What Caused the Bank Capital Build-Up of the 1990s? *Review of Finance* 12:391–429.

Gropp, R., and F. Heider. 2007. What Can Corporate Finance Say about Banks' Capital Structures? Working Paper, European Central Bank.

Hannan, T. H., and R. A. Prager. 2004. The Competitive Implications of Multimarket Bank Branching. *Journal of Banking and Finance* 28:1889–914.

Hart, O. 1993. Theories of Optimal Capital Structure: A Managerial Discretion Perspective. In Margaret Blair (ed), *The Deal Decade: What Takeover and Leveraged Buyouts Mean for Corporate Governance*. Washington: The Brookings Institution.

Hart, O., and J. Moore. 1995. Debt and Seniority: An Analysis of the Role of Hard Claims in Constraining Management. *American Economic Review* 85:567–85.

Hellmann, T. F., K. C. Murdoch, and J. E. Stiglitz. 2001. Liberalization, Moral Hazard in Banking and Prudential Regulation: Are Capital Requirements Enough? *American Economic Review* 90:147–65.

Herrero-Garcia, A., and F. Vasquez. 2006. International Diversification Gains and Home Bias in Banking. Working Paper, BIS and IMF.

Holmstrom, B., and J. Tirole. 1997. Financial Intermediation, Loanable Funds, and the Real Sector. *Quarterly Journal of Economics* 112:663–91.

Jovanovic, B., and P. L. Rousseau. 2002. The Q-Theory of Mergers. *American Economic Review* 92:198–204.

Kashyap, A., R. Rajan, and J. C. Stein. 2002. Banks as Liquidity Providers: An Explanation for the Co-existence of Lending and Deposit-Taking. *Journal of Finance* 57:33–73.

Keeley, M. C. 1990. Deposit Insurance, Risk, and Market Power in Banking. *American Economic Review* 80:305–60.

Landsman, W. 2006. Fair Value Accounting for Financial Instruments: Some Implications for Bank Regulation. Working Paper, BIS.

Mailath, G. J., and L. J. Mester. 1994. A Positive Analysis of Bank Closure. *Journal of Financial Intermediation* 3:272–99.

Miller, M. 1995. Do the M&M Propositions Apply to Banks? *Journal of Banking and Finance* 19:483–9.

Mishkin, F. 2000. *The Economics of Money, Banking and Financial Markets*. New York: Addison Wesley.

Modigliani, F., and M. H. Miller. 1958. The Cost of Capital, Corporate Finance and the Theory of Investment. *American Economic Review* 48:261–97.

Morrison, A. D., and L. White. 2005. Crises and Capital Requirements in Banking. *American Economic Review* 95:1548–72.

Myers, S. C., and N. S. Majluf. 1984. Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have. *Journal of Financial Economics* 13:187–221.

Peura, S., and J. Keppo. 2006. Optimal Bank Capital with Costly Recapitalization. *Journal of Business* 79:2163–201.

Ramakrishnan, R. T. S., and A. V. Thakor. 1984. Information Reliability and a Theory of Financial Intermediation. *Review of Economic Studies* 51:415–32.

Repullo, R. 2004. Capital Requirements, Market Power, and Risk Taking in Banking. *Journal of Financial Intermediation* 13:156–82.

Repullo, R., and J. Suarez. 2007. The Procyclical Effects of Basel II. Working Paper, CEMFI.

Roll, R. 1986. The Hubris Hypothesis of Corporate Takeovers. *Journal of Business* 59:197–216.

Ross, S. 1977. The Determination of Financial Structure: The Incentive Signaling Approach. *Bell Journal of Economics* 8:23–40.

Shleifer, A., and R. W. Vishny. 2003. Stock Market Driven Acquisition. *Journal of Financial Economics* 70:295–311.

Song, F., and A. V. Thakor. 2007. Relationship Banking, Fragility, and the Asset–Liability Matching Problem. *Review of Financial Studies* 20:2129–77.

Stulz, R. 1990. Managerial Discretion and Optimal Financial Policies. *Journal of Financial Economics* 26:3–27.

Thakor, A. V. 1996. Capital Requirements, Monetary Policy, and Aggregate Bank Lending: Theory and Empirical Evidence. *Journal of Finance* 51:279–324.

Thakor, A. V., and J. Beltz. 1994. A “Barter” Theory of Bank Regulation and Credit Allocation. *Journal of Money, Credit and Banking* 26:679–705.

Van den Heuvel, S. 2008. The Welfare Cost of Bank Capital Requirements. *Journal of Monetary Economics* 55:298–320.

Welch, I. 2004. Capital Structure and Stock Returns. *Journal of Political Economy* 112:106–31.