Do Strict Capital Requirements Raise the Cost of Capital? Bank Regulation, Capital Structure, and the Low Risk Anomaly

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The instability of banks in the financial crisis has led to stricter bank capital requirements, both globally through Basel III and in the U.S. through further constraints imposed by the Federal Reserve. Setting these requirements requires balancing many costs and benefits, both social and private. In this paper, we argue that an important cost has heretofore been neglected: All else equal, making banks *less* risky is likely to *raise* their cost of capital—with consequent implications for investment and growth.

How can this be? Making bank equity less risky brings a robust but underappreciated "low risk anomaly" into play. Within the stock market, historical returns and thus realized costs of equity are higher, not lower, for less risky equity (e.g., Ang, Hodrick, Ying, and Yang 2006; Baker, Bradley, and Wurgler 2011). Since any such anomaly is much weaker in the debt markets, the Modigliani-Miller capital structure irrelevance theorem breaks down and banks' weighted average cost of capital becomes inversely related to its leverage.[1]

After some background on the low risk anomaly and development of an analytical framework, we proceed with the empirical analysis in two stages. First, we use a large sample of US bank returns and capital structure data to demonstrate that bank equity risk will decrease with leverage. This is not surprising and is indeed the premise of capital regulation. Second and more interestingly, we show that the low risk anomaly previously documented in broad samples holds at least as strongly within banks.

[1] The discussion and evidence in this paper are specialized to banks. See Baker and Wurgler (2014) for a general treatment of the low risk anomaly's implications for capital structure, including how it can be used to generate a tradeoff theory of leverage.

We conclude with a calibration. In the benchmark case, history suggests that a binding 10 percent increase in Tier 1 capital to risk-weighted assets could triple banks' average risk premium over Treasury yields, from 40 to 125 basis points per year, but relaxing simplifying assumptions tempers this effect somewhat.

Any cost of capital increase due to the low risk anomaly would, in competitive lending markets, raise rates for borrowers to a similar extent and encourage a shadow banking sector that can dodge capital regulation. At the end of the day, however, when all social and private benefits and costs are tallied, stricter capital requirements may remain desirable. Our argument is simply that one cost has been neglected and may be large enough to add to the debate.

I. The Low Risk Anomaly

Multiple Nobel Prizes, hundreds of finance textbooks, thousands of academic papers, and millions of classroom hours have incorporated the notion that risk and expected returns are positively related. *Across asset classes*, this holds. In long-term US data, for example, it is well-known that stocks provided higher but more variable returns than long-term corporate bonds, which in turn provided higher but riskier returns than long-term Treasuries, and so on through intermediate-term Treasuries and T-bills.

The historical risk-return tradeoff *within the stock market* has been flat or inverted, however. The standard Capital Asset Pricing Model (CAPM) predicts that the expected return on a security is proportional to its systematic risk (beta), while diversifiable risk is not rewarded in equilibrium.

The low risk anomaly is that the CAPM measure of systematic risk succeeds in predicting risk but not returns: stocks with lower beta, or even idiosyncratic risk, have tended to earn *higher* returns. This is true whether returns are risk-adjusted or, in some cases, even if they are not. The pattern appears in long time series in the US market, each G7 country, and across 23 developed markets (Ang et al. 2009, Baker et al. 2014).

This paper and several others consider the possibility that the failure of the CAPM reflects inefficient asset pricing, not model misspecification of risk. Individual investors may have an overconfidence- or lottery-based preference for volatile or skewed investments (Cornell 2008; Kumar 2009; Bali, Cakici, and Whitelaw 2011; Barberis and Huang 2008). Leverage-constrained investors seeking high returns from beta risk may also have a special demand for high beta stocks (Frazzini and Pedersen 2014).

If rational arbitrageurs cannot accommodate these sources of investor demand, overpricing of high beta stocks will result, the observable implication of which is abnormally low future returns on high beta stocks. For firms, this means a low cost of equity relative to that of less risky, low beta issues.

For a variety of reasons, arbitrage forces of this sort are indeed likely to be limited. The most plausible "arbitrageurs" in practice, professional fund managers, may prefer high-beta stocks themselves because the inflows to performing well in rising markets exceed the outflows to performing poorly in falling markets (Karceski 2002). In addition, institutional fund manager performance is often defined as return relative to "the market" on a non-beta adjusted basis. This leads managers to avoid low beta stocks (Baker et al. 2011). More generally, the extra costs of shorting inhibit sophisticated investors' ability to exploit overpricing (Hong and Sraer 2014).

II. The Low Risk Anomaly and the Cost of Capital

A simple analytical framework illustrates how the low risk anomaly affects the overall cost of capital. We focus exclusively on beta as our measure of equity risk, although the evidence supports a separate idiosyncratic risk anomaly. As in the CAPM, beta is defined as the covariance of returns with the market risk premium, divided by the variance of the market risk premium.

We first review how equity risk will change with a change in leverage. Writing the definition of a bank's overall asset beta as a weighted average of equity and debt betas, with e being the ratio of equity to total assets and thus the inverse of e being a convenient measure of leverage, and rearranging, yields

(1) $\beta_e = \frac{1}{e}\beta_a - \left(\frac{1}{e} - 1\right)\beta_d.$

With approximately riskless debt, the last term drops out and the relationship between equity beta and leverage is linear with a slope equal to the asset beta.

We incorporate the low risk anomaly by supposing that the CAPM holds for stocks and bonds except that in the case of stocks, there is an anomaly in which higher beta equities underperform their CAPM benchmark and lower beta equities outperform it, as in

(2) $r_e = \gamma(\beta_e - 1) + r_f + \beta_e r_p$

where r_f is the risk free rate, r_p is the market risk premium, and α is the first term which is not present in the CAPM. The extent of the low risk anomaly, and a central parameter of interest, is $\gamma = d\alpha/d\beta_e < 0$.

We assume that debt is correctly priced by the CAPM as

(3) $r_d = r_f + \beta_d r_p$

so the weighted-average cost of capital is

(4) $WACC = er_e + (1-e)r_d = r_f + \beta_a r_p + \gamma\beta_a - \gamma[e + (1-e)\beta_d(e)]$

using Equation (1) to substitute out the equity beta.

We are interested in how *WACC* changes upon moving from a level of capital *e* to a new regulatory level of e*. The difference between Equation (4) evaluated at the new and old levels of capital leads to an increase of

(5) $\Delta WACC = \gamma[e - e^* + (1-e)\beta_d(e) + (1-e)\beta_d(e^*)]$.

A special case is when the debt is riskless in both capital regimes, i.e., debt betas are zero. Then the change in the cost of capital is simply $\gamma(e - e^*)$, which is greater than zero for increases in *e*. In general, riskless debt is a plausible approximation in this context. Estimates of asset beta are on the order of 0.10 for banks, so estimates of debt betas are by definition lower, and for a plausible change in leverage, the change in debt beta is lower still.

[Insert Table 1 Here]

The benchmark above is riskless debt, segmented equity and debt markets, and no government subsidy. Table 1 summarizes the effects of relaxing these assumptions. In particular, if there is an equally large low risk anomaly in corporate debt, leverage irrelevance is restored. Frazzini and Pedersen (2014) and Baker and Wurgler (2014), however, find that any such anomaly in debt is far smaller. Other cases that we consider are: when a smaller low risk anomaly exists in debt markets, with a new Equation (3) that mirrors Equation (2) with parameters γ_d and $\overline{\beta_d}$ in place of γ and 1; and when the government insures bank debt, so that the cost of debt in Equation (3) is simply $r_d = r_f$, regardless of risk. There are simplifying cases when $\gamma_d = \gamma$ and when $\gamma = -r_p$.

III. Data and Variable Construction

We require bank returns and capitalization data. Our main monthly returns sample includes 3,952 publicly traded banks or bank holding companies that make an appearance in the Center for Research on Security Prices (CRSP) returns database between February 1970 and December 2011. Before 1970, there are relatively few publicly traded banks, rendering the beta portfolios undiversified and highly volatile. There are 272,031 total bank-months represented in this sample.

We estimate equity betas by regressing a minimum of 24 months and a maximum of 60 months of holding period excess returns on the corresponding CRSP excess value-weighted market returns. For each bank we compute a forward or realized beta, based on future returns data, to study how leverage today translates into systematic risk. We also compute a backward or pre-ranking beta, based on past returns data.

An inspection reveals that bank betas are relatively low, with pre-ranking means and medians around 0.67. There is significant cross-sectional variation. The median pre-ranking beta among the bottom three deciles is 0.21 and the mean among the top three deciles is 1.27. Importantly, this pre-ranking spread leads to differences in realized portfolio betas of approximately 0.6.

For a subset of bank-months in the returns sample we can obtain leverage data from the Wharton Research Data Services (WRDS) Bank Regulatory database of quarterly Federal Reserve Bank call reports. The measure most closely watched by regulators is the Tier 1 ratio, defined as common stock plus retained earnings divided by risk-weighted assets. This subsample of 74,105 bank-months runs from March 1996, the first date where Tier 1 capital is available, through February 2011.

There is substantial variation in Tier 1 ratios across banks. An inspection shows that the median Tier 1 ratio in the bottom three deciles is 9.30 percent, versus 13.94 percent in the top three deciles and 17.26 in the top decile alone.

IV. Reducing Leverage Reduces Risk

Our first and unsurprising empirical result is the positive relationship between leverage and equity risk. Figure 1 fits a kernel regression of (forward) equity beta on the inverse Tier 1 ratio, our measure of $\frac{1}{e}$ in Equation (1). A linear regression with an intercept forced to zero, corresponding to the assumption of riskless debt, yields a slope and estimate of asset beta of 0.074. This parameter does not appear in Equation (5) but it will be useful in benchmarking the calibration results.

[Insert Figure 1 Here]

The relationship is linear over most of the range of leverage, but the inclusion of extreme levels of leverage generates a modest S-shape. There are at least two sources of this effect. First, at high levels of leverage, debt begins to share some of the risk of equity. Second, when banks differ in their asset betas, endogenous selection of leverage because of asset risk also contributes to an S-shape. Highly levered banks are likely to have less risky assets and vice-versa. It is also worth noting that from a regulatory perspective, the Tier 1 ratio is just one of several relevant measures of leverage, leading to a generic attenuation bias.

These effects tend to flatten the cross-sectional relationship between leverage and risk. We can thus view 0.074 as a plausible lower bound of the asset beta of a typical bank and thus a lower bound of the effect of an exogenous change in leverage on stock beta.

V. Reducing Risk Increases the Cost of Equity

The next and more surprising empirical result is the inverse relationship between risk and return. The low risk anomaly is present in U.S. banks, not just nonfinancial firms.

In Figure 2, we compute monthly returns on six portfolios: the top three, middle four, and bottom three pre-ranking CAPM beta portfolios, where the portfolio returns are either equal- or capitalization-weighted within groups. We then regress these portfolios' excess returns on market excess returns to compute and plot betas and alphas for each portfolio. We repeat the process using the Fama-French three-factor model, which controls for systematic comovement patterns associated with capitalization and book-to-market.

[Insert Figure 2 Here]

The figure allows us to estimate the strength of the low risk anomaly, $\gamma = d\alpha/d\beta_e$. The estimate is 68 basis points per month based on the CAPM beta and 75 basis points per month for Fama-French market beta. From an investor's perspective, this translates to large differences in mean annualized risk-adjusted returns of 8.5 percent and 9.8 percent, respectively; from a firm's perspective, this is a large difference in the cost of equity.

In one of several robustness checks, we examine the link between leverage and risk-adjusted returns directly, rather than through the two-step process illustrated in Figures 1 and 2.[2] This helps deal with the possibility that there is a genuine low risk anomaly but it is for some reason only relevant for variation in beta that does not come from leverage changes. We find a slightly larger, but statistically weaker effect, as expected given that the leverage time series allows us to use only about a third of the full returns series.

VI. Calibration

We now empirically estimate the change in the cost of capital that would result from a binding shift in capital requirements of ten percentage points, as also considered in Kashyap et al. (2010). Ten percentage points is a large change in the context of existing regulation. For example, among the changes from Basel II to Basel III was to raise the Tier 1 ratio from 8 percent to between 8.5 and 11 percent. On the other hand, our hypothetical

[2] These checks and extensions of the results behind Figures 1 and 2 are described in online materials.

shift is much smaller than the increase to 20 or 30 percent proposed by Admati and Hellwig (2013).

Given the low volatility anomaly in bank stocks, heightened capital requirements will increase the weighted average cost of capital for banks. In the benchmark case of riskless debt (in both capital regimes), segmented markets, and no government subsidy, the magnitude is simply the excess risk-adjusted performance per unit of beta times the percentage point increase in equity capital. Estimates of the former range from 68 to 75 basis points per month, so the midpoint of these implies an annualized 71 x 12 x 10 = 85 basis point increase in the annual weighted average cost of capital. In competitive lending markets, spreads over the riskless rate would increase by the same amount.

To put 85 basis points in perspective, recall that our asset beta estimate for banks was 0.074. With the historical market risk premium from Ken French's data library of 45 basis points per month over our returns sample period, this suggests a pre-tax weighted average cost of capital under the CAPM of an annualized 45 x 12 x 0.074 = 40 basis points per year above the risk-free rate. The presence of the low volatility anomaly in stocks thus implies large effects of significantly heightened capital, tripling regulated banks' pretax weighted average cost of capital from 40 to 125 basis points per year.

The simplifying assumptions behind this estimate suggest moderating this conclusion, however. If our estimate of asset beta is too low and debt is risky, their betas have further to fall. Although this effect is probably slight, the change in equity betas is mitigated by the extent to which debt was already sharing the risk with equity. Similarly, government insurance of debt implies that debt was already sharing risk with equity. In addition, and although the evidence in Baker and Wurgler (2014) cast doubt on a fully integrated low risk anomaly in corporate debt, to the extent it is present it also reduces the impact of changes in leverage. And, finally and most obviously, our estimate of the low risk anomaly may be too large to apply to policy decisions going forward. Despite plausible theoretical foundations, and its robustness across long sample periods and international markets, the anomaly's future may or may not follow its past. But to the extent that it does, it is a cost that needs to be included in debates about capital regulation.

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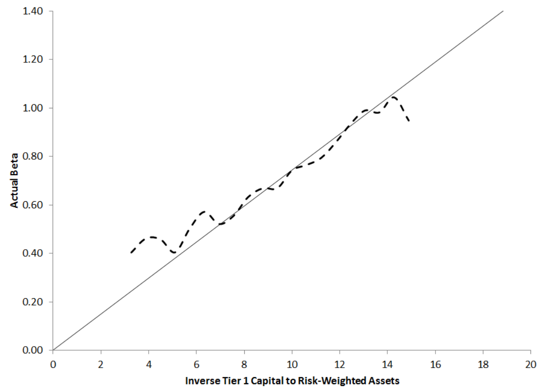

FIGURE 1. BETA AND BANK LEVERAGE

Note: The sample includes 74,105 bank-months of data from March 1996 to February 2011. The dependent variable is forward beta, computed by regressing a minimum of 24 months and a maximum of 60 months of future holding period returns on the corresponding bank's CRSP value-weighted market returns, both in excess of the riskless rate. The independent variable is the ratio of total risk-based capital to Tier 1 capital. The local polynomial regressions use a Epanechnikov kernel with 20 bins and smoothing interval of 0.1.

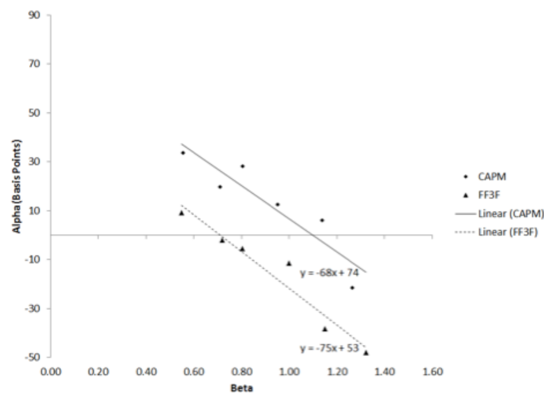

FIGURE 1. BETA AND THE COST OF EQUITY: THE LOW RISK ANOMALY IN BANKS

Note: The sample includes 486 months of portfolio returns from July 1971 to December 2011. The points are excess portfolio returns relative to CAPM or Fama-French three-factor model predictions. The six portfolios for each model are based on equal- and capitalization-weighted versions of the top three, middle four, and bottom three deciles according to pre-ranking beta.

TABLE 1—THEORETICAL DETERMINANTS OF CHANGES IN WACC.

Bank Debt				
Risk	Pricing	Integrated Markets	Government Subsidy	$\Delta WACC$
Risky	Correctly Priced	No	No	$\gamma\big(e - e^* + A(e, e^*)\big)$
Risk Free	Correctly Priced	No	No	$\gamma(e - e^*)$
Risky	Low Beta Anomaly	No	No	$\big(\gamma - \overline{\beta_d}\gamma_d\big)(e - e^*) + (\gamma - \gamma_d)A(e, e^*)$
Risky	Low Beta Anomaly $\gamma = \gamma_d$	No	No	$\gamma\big(1 - \overline{\beta_d}\big)(e - e^*)$
Risky or Risk Free	Low Beta Anomaly	Yes	No	0
Risky	Correctly Priced	No	Yes	$\gamma(e - e^*) + \big(\gamma + r_p\big)A(e, e^*)$
Risky	Correctly Priced	No	Yes $\gamma = -r_p$	$\gamma(e - e^*)$

Notes: $\overline{\beta_d}$ refers to the mean corporate debt beta and γ_d refers to the size of the low risk anomaly, playing the roles of γ and the mean equity beta of unity in Equation (2). Also, to simplify notation, we define $A(e, e^*) \equiv (1 - e)\beta_d(e) - (1 - e^*)\beta_d(e^*) \geq 0$.