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# Bank leverage and profitability: Evidence from a sample of international banks

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ABSTRACT

We examine the relationship between leverage and residual income for a sample of international banks using an unbalanced panel over the period 2005–2011. Our GMM-based econometric model considers both bank-level and country-level variables to control for several other factors aside from equity capital and allows for endogeneity and unobservable heterogeneity. We document a significant positive non-monotonic link between the capital ratio and residual income for the international banking industry. These results are robust to a number of different model specifications.



## 1. Introduction

Following the 2008 financial crisis, much attention has been devoted to the balance sheets of banks. Large bailouts carried out with taxpayers' money have pushed regulators to take a more conservative approach to bank risk, forcing them to hold more equity and introducing new short run and long run liquidity ratios. The regulators' purpose is to reduce banks' bankruptcy probability and the associated disruptions with the real economy, among which are costly bailouts and financial distress to non-financial firms highly dependent on bank credit. However, while the negative externalities created by bank insolvency have been studied at length in the literature (especially after the 2008 financial crisis and in relation to the European sovereign crisis — e.g. Acharya, Drechsler, and Schnabl (2014) and Duchin and Sosyura (2014)) — there has been less attention to empirical estimates of the optimal capital structure for banks, with the notable exception of Miles, Yang, and Marcheggiano (2012). This is the topic under examination in this paper.

We ask the following question: what is the optimal leverage ratio for a bank from the perspective of shareholders? In order to answer this question, we study the empirical link between leverage and residual income (the difference between the rate of return on equity and the expected rate of return). The Ohlson (1990) model shows that the price of a stock can be interpreted as the sum of the book value and the present discounted value of expected residual income. Shareholder-friendly banks should therefore choose leverage, among other variables, to maximize residual income. We use data from a sample of international banks to estimate a regression model where residual income is explained by leverage and other bank- and country-specific characteristics, find results that favor a quadratic specification and use it to estimate the optimal leverage ratio. Our results are consistent with a large literature that assumes the existence of a bank-specific optimal leverage ratio. Here we try to empirically pin down the size of the optimal leverage ratio.

The topic is debated in practitioners and academic circles. Practitioners have complained about the negative impact of increasing capital requirements on profitability. The Institute of Institute for International Finance (2010) predicted an average annual decrease in bank *ROE* (over 2011–2020) of almost 2% for U.S. banks and 3.5% for European banks. Academics offer conflicting analyses and predictions about the relationship between leverage and bank value. Admati and Hellwig (2013) argue that leverage and value are independent in a pure Modigliani–Miller world where risk is determined by assets' risk. Others observe that a bank's financial structure may affect its production function: higher equity capital enhances value as it may increase management incentive to monitor loans, see Allen, Carletti, and Marquez (2011), but leverage is a key input for liquidity production by banks as shown by De Angelo and Stulz (2015) and may even provide a disciplinary role towards managers as noted by Diamond and Rajan (2001) and Dewatripont and Tirole (2012). Regarding risk, the theoretical consensus

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is that more equity reduces risk, also due to a negative impact on risk-taking see Freixas and Rochet (2008).

The banking literature has separately looked at the impact of leverage on various measures of profitability and on risk. The leverage–profitability relation is not univocal in the data. Demirguc-Kunt and Huizinga (2010) find a positive relation between bank equity and profitability, explained mainly by the reduction in the cost of funding, but also by cost efficiency, managerial incentives, and asset monitoring. Berger and Bouwman (2013) show that equity improves the performance of medium and large banks especially during banking crises. On the contrary, Berger and Bonaccorsi di Patti (2006) find that a lower equity ratio is associated with higher profit efficiency for a cross section of US commercial banks over the period 1990–1995, while Kisin and Manela (2015) find very little relation between capital requirements and profitability. Calem and Robb (1999) and Haq and Heaney (2012) find that capital deficits tend to be positively associated with future ROA whereas capital surpluses tend to be strongly negatively associated with future ROA. There are also several papers examining the relationship between equity and risk. Kashyap, Stein, and Hanson (2010) find evidence of a positive link between a bank's systematic risk and its leverage. Miles et al. (2012) use data on UK banks and find a positive relation between leverage and equity betas. Admati and Hellwig (2013) point out that if more equity reduces both bank risk and expected returns, then bank equity is not so expensive as advocated by practitioners. The results of Mehran and Thakor (2011) are consistent with this view, as they find that bank capital is cross-sectionally positively related to value. However, Baker and Wurgler (2013) find a negative association between equity ratios and betas, and, contrary to the theory, a negative relation between betas and stock market historical excess returns in a sample of U.S. banks. We differentiate ourselves from the literature as we study optimal leverage through the analysis of its impact on residual income rather than through a separate analysis of leverage on risk and return.

Our paper is also related to the literature that studies the effects of bank characteristics on their performance. Stiroh (2004) studies the relation between Z-scores and non-interest income of U.S. banks. Baele, De Jonghe, and Vander Vennet (2007) find that systematic risk increases with non-interest income share. Laeven and Levine (2008) show that corporate governance and national regulations affect the Z-score in a sample of international banks. Demirguc-Kunt and Huizinga (2010) observe that a bank's rate of return and risk increase with its fee income share, while wholesale funding lowers the rate of return on assets but also offers some risk reduction benefits. Beltratti and Stulz (2012) do not find a relation between liquid assets and stock price performance in a sample of international banks during the credit crisis, but show that low financial fragility and high equity capital have been important determinants of bank resilience. We also control for bank characteristics and study whether some of them contribute to the determination of optimal leverage by testing for the existence of an interaction with leverage in affecting residual income.

The remainder of the paper is organized as follows. Section 2 discusses the theoretical model, the econometric specification and the estimation methodology. Section 3 describes the data and our findings. Section 4 contains the robustness analysis. Section 5 concludes.

## 2. Theoretical and econometric model

Under the assumption of a constant required rate of return, Ohlson (1990) shows that according to clean surplus accounting the price of a stock is equal to the book value plus the present discounted value of expected residual income:

$$P_{it} = B_{it} + \sum_{j=1}^{\infty}\left(\frac{E_t(\pi_{i,t+j} - r_i \times B_{i,t-1+j})}{(1+r_i)^j}\right) \quad (1)$$

where $P$ is stock price, $B$ is book value per-share, $E_t r_i$ is the cost of equity capital or the total expected return on equity, and π is the level of profits. The market value of a company is larger than its book value when investors expect the average annual profit to be above the expected compensation for the equity invested. In our empirical work we look at the first term of the infinite sum that determines the market-to-book ratio of the bank. Understanding whether changes in leverage affect residual income in the following year is the first step in asking whether it can also affect market value. It is theoretically possible that increasing leverage has an opposite effect on short-run residual income and stock market valuation, but this requires that leverage drives short-run and long-run expected residual income in opposite directions.[2]

Residual income may also be interpreted as a risk-adjusted expected profit. The cost of equity capital in Eq. (1) is a required rate of return, which depends on the quantity of risk associated with the bank and on the risk-free rate.[3] The higher the level of systematic risk, the higher the required rate of return and the larger the risk-induced deduction to expected profits. Increasing leverage has a potential positive effect on both risk and expected return, and it is a priori unclear what is, if any, the optimal capital structure. Regulators have argued that increasing bank capital decreases risk, while practitioners claim that *ROE* falls as more capital does not have a sufficiently positive impact on profits. One way to better understand the issue is to consider the marginal impact of equity on residual income.

To operationally measure residual income we assume that the return on equity is proxied by the implied cost of capital *ICC* obtained from current market prices and analysts' earnings forecasts:

$$RI_{i,t} = \frac{\pi_{i,t}}{\left(\frac{B_{i,t} + B_{i,t-1}}{2}\right)} - ICC_{i,t-1} \quad (2)$$

where we normalize bank $i$ annual profit $\pi_{i,t}$ for year $t$ by the average book value $B$ between the end of years $t-1$ and $t$. This is useful to decrease measurement error associated with a bank increasing its equity during the year, with a potentially immediate effect on profits.

Following Lee, Mayers, and Swaminathan (1999), the implied cost of equity is the solution to the following non-linear equation:

$$P_t = B_t + \frac{(FROE_{t+1} - ICC)}{(1+ICC)}B_t + \frac{(FROE_{t+2} - ICC)}{(1+ICC)^2}B_{t+1} + \frac{(FROE_{t+3} - ICC)}{(1+ICC)^2 \times ICC}B_{t+2} \quad (3)$$

where *FROE* is forecasted *ROE*, computed as $FEPS_{t+i}/B_{t+i-1}$, $FEPS_{t+i}$ is the Thomson Reuters mean forecast earnings per share for the year $t+i$, $B_{t+i-1}$ is the book value per share at the end of the year $t+i-1$. It must be true that $B_{t+i} = B_{t+i-1} + FEPS_{t+i} - FDPS_{t+i}$ with $FDPS_{t+i}$ being the forecasted dividend per share for year $t+i$, estimated using the current dividend payout ratio $k$, that is $FDPS = k \times FEPS$.

We also consider alternative estimators for the implied cost of equity. We use the Gordon and Gordon (1997) finite horizon model (EPR) and the Easton (2004) abnormal growth model (with T = 2 and $FDPS_{t+1} = 0$) also known as the modified PEG ratio (MPEG). Thus *ICC* is the cost of capital that verifies the EPR equation $ICC_t = FEPS_{t+1}/P_t$ or alternatively the MPEG[4] equation $ICC_t = \sqrt{(FEPS_{t+2} - FEPS_{t+1})/P_t}$. EPR and MPEG have been chosen as they display potentially high correlations with a large variety of alternative methods of *ICC* estimation (see

[2] A differential impact would occur for example if investors believed that an increase in leverage may boost profits in the short run but may expose the bank to risks that can materialize in the long run, i.e. at a time of crisis. We cannot determine on the basis of our methodology if the data are consistent with this scenario. This would be very interesting but is clearly outside the scope of our paper.

[3] Based on long-run data, see e.g. Bodie, Kane, and Marcus (2014), the risk premium is on average six times larger than the risk-free rate for a stock with a unitary beta.

[4] The adoption of the MPEG metric produces a reduction of the sample size since any observation is discarded whenever when $FEPS_{t+1} < FEPS_{t+1}$.