

# **Capital Adequacy, Financial Leverage and Cost of Funding in the banking system: how they may affect credit price?**

P. di Biase – E. D'Apolito

## **Abstract**

The new capital requirements proposed under Basel III increase the quantity - while improving the quality - of the regulatory capital. This study provides a methodology for mapping the impact of higher capital requirements – by which we mean equity – on banks' cost of funding and how this might affect the interest rate charged on loans.

Such a study is then useful to assess the effects of regulatory changes on the cost of credit for households and corporations.

By using both the Capital Asset Pricing Model (CAPM) and a Discounted Cash Flow (DCF) model, we map how changes in banks' capital structure affects the cost of common equity ( $r_e$ ) and the level of market capitalization. We then estimate the change in the average interest rate on loans necessary to preserve the market value of the bank. Our empirical evidence is based on the Italian banking sector.

According to our estimates, the long-run steady-state impact on loan rates is likely to be modest: in the worst scenario, our methodology suggests that each percentage point of increased capital can be recovered by raising lending rates by only 7 basis points. Therefore, we believe that the banking system should be able to adjust to higher capital requirements with no significant effect on bank loans pricing.

**JEL Classification: C3, C32, G12, G18, G21, G32.**

**Keywords: Capital Adequacy; Leverage; Credit Price; Banks.**

## Contents

|   |    |
|---|----|
| <b>1. Introduction</b> .....  | 3  |
| <b>2. Literature Review</b> .....   | 5  |
| <b>3. The Modigliani-Miller theorem implications</b> .....                | 7  |
| <b>4. the impact of higher capital requirement on lending rates</b> ..... | 15 |
| <b>4.1. The methodology</b> .....   | 15 |
| <b>4.2. The representative bank's financial statements</b> .....          | 19 |
| <b>5. Mapping higher capital to market value</b> .....                    | 22 |
| <b>6. Mapping higher capital to credit price</b> .....                    | 27 |
| <b>7. Conclusion and future research</b> .....                            | 31 |
| <b>References</b> .....   | 34 |

## 1. Introduction

In December 2009 the Basel Committee on Banking Supervision (BCBS) has proposed two consultative documents – the Basel III reform – that include three crucial areas of intervention: increase of minimum capital ratios<sup>1</sup>, higher quality of regulatory capital, and new liquidity requirements, namely a short-term requirement called the Liquidity Coverage Ratio (LCR) and a long-term requirement called the Net Stable Funding Ratio (NSFR) (BCBS, 2009a, b).

This paper focuses on the first area of the proposed reform – related to the new bank capital requirements – and it is fully consistent with researches on the long-term economic impact of stronger capital ratios (Angelini et al. (2011), BCBS (2010), King (2010), Schantz (2010)).

This higher quantity and quality of capital is calibrated as to better absorb the losses associated with crises like the most recent ones.

The new standards will take effect on 1st January 2013 and for the most part it will become fully effective by January 2019.

The hypothesis underlying this study is that the increase in capital requirements can involve a lower level of leverage, as equity replaces debt, and higher funding costs, given the equity funding is costly. Specifically, we assume that as leverage falls, the market value of shareholders' equity might decrease, and such effects could be expected to be offset by increasing the average interest rate charged to those who borrow from banks.

Our research question covers two different levels. First, we aim at assessing to what extent the Modigliani-Miller (M-M) theorem holds for banks. This is a key question, since

---

<sup>1</sup> The raising of minimum capital requirements, notably includes: *i*) a minimum of 4.5% of Risk Weighted Assets (RWA) in tangible Common Equity, instead of the 2% under Basel II; *ii*) a Capital Conservation Buffer (CCB) to absorb losses and set the extent of 2.5% of RWA, which means that banks will need to maintain a 7% common equity ratio; *iii*) the increase from 4% to 6% of the minimum requirement for Tier 1, consisting of Common Equity and other equity instruments that will comply with more stringent criteria than those set by the laws and regulations in force; *iv*) a buffer-cyclical capital in varying degrees between zero and 2.5% of RWA, which is defined at individual country level according to the expansions of the credit cycle and that can be constituted either by means of Common Equity or other types of capital capable of absorbing full loss (i.e. the Contingent Capital).

the mechanism underlying the M-M model affects the sensitivity of a bank's overall cost of funds to different levels of capital requirements.

Second, we aim to evaluate the effects on market capitalization coming from higher levels of loss-absorbing capital, and how banks could easily neutralize these effects by raising interest rates on loans.

To evaluate to what degree the basic mechanism underlying the M-M model operates for banks we performed a linear regression model (Ordinary Least Squares - OLS) so to evaluate the correlation level between leverage and the systematic risk of bank equity (i.e. beta of equity).

To estimate loan price implications of the higher capital requirements proposed under Basel III, we implemented a particular financial-based model to predict the impact on lending spreads associated with raising new external equity finance.

The underlying hypothesis is that there is a positive relationship between bank's leverage level and its cost of funding. Specifically, higher capital requirements, by impacting bank return on equity (ROE) and expect growth rate in both earnings and dividends, could lead to a lower market value of shareholders' equity (i.e. market capitalization of the bank).

We will finally map the rise in lending rates required to neutralize the potential loss in equity market value associated with a structural change in leverage, so as to hold bank market capitalization unchanged.

In this study banks are assumed to meet the higher capital adequacy ratio by increasing common equity and reducing debt funding by an off-setting amount, so that the bank's total assets remain unchanged. We also assume that any higher cost of funding is fully recovered exclusively by raising loan rates, with no change in other sources of income and no reduction in operating expenses.

This study refers to the Italian banking system. Indeed, our estimates come from a representative bank's financial statement, obtained collecting from Bankscope database accounting and market data for Italian commercial banks and bank-holding companies publically traded on Milan Stock Exchange.

The plan of this paper is this: in section 3 we evaluate to what extent the M-M model operates for Italian banks; in section 4 we assess the assumptions underlying our empirical model and we construct a representative bank's financial statement; in section

5 we calibrate the effects of increased capital requirements on banks' market value; in section 6 we provide estimates of the shift in the average rates on loans required to keep safe the market value of banks' equity.

## **2. Literature Review**

This study aims to contribute to the empirical evidence on the long-run impact of the higher bank capital requirements under Basel III (Angelini et al. (2011), Berrospide, Edge (2010), Hannoun (2010), King (2010), Memmel, Raupach (2010), Slovik, Cournede, (2011)).

In the last twenty years many economists provided overviews of the literature on bank capital (Berger, Herring and Szego (1995), Inderst and Mueller (2008), Maccario, Sironi, Zazzara (2002), Marcus (1983), Morrison, White (2005), Santos (2001) and VanHoose (2007)), as well as many researches analyze the role of capital requirements and their potential impact on financial crisis (Acharya et al. (2009), Berger, Bouwman (2009, 2010), BIS (2008, 2009), Gropp, Heider (2010), King (2009), Koziol, Lawrenz (2009), Masera (2009), Mehran, Thakor (2011), Meh, Moran (2010), Resti, Iannotta (2010)).

One strand of literature reviews some of the significant benefits associated with better capitalized banks. In the recent financial crisis important parts of the financial sector had become very highly leveraged. Admati et al. (2010) find that U.S and U.K banks, especially the investment banks, have done business with a very high level of financial leverage, as reflected by the ratio of equity to total balance sheet assets. The authors argues that capital requirements based on higher equity ratios, lowering leverage of banks, are important in banks ability to survive financial crises. Other studies arrive to the same conclusions. For example, BSBC (2010) estimates that if the capital ratios increase of 2%, the probability of a financial crisis will reduce by 2,9%.

Another strand of literature points out that increased capital requirements are costly. Angelini et al. (2011) find that there could be significant costs in implementing a regime with higher capital requirements. According to the authors, each percentage point of

increased equity raises the weighted average cost of capital (WACC) and hence loan rates.

Many authors (Brealey (2006), King (1990), French et al. (2010), Miller (1995) and Titman (2002)), find that the Modigliani-Miller Theorem (Modigliani and Miller (1958)) must be the starting point of any discussion on capital regulation.

Cosimano and Hakura (2011) estimates that higher capital requirements will increase banks' pricing of loans if - contrary to the Modigliani-Miller Theorem - the marginal cost of capital is greater than the marginal cost of deposits and therefore a higher cost of equity leads banks to raise the price of their loans. The authors, using the same structural model of bank behavior adopted by Chami and Cosimano (2010) and Barajas et al. (2010), estimate that the 100 largest banks in the world would raise by 16 basis points the loan rate given an increase of 1,3 percentage point in their equity-to asset ratio, required to achieve the new Basel regulation.

Several studies, including Repullo, Suarez (2004) and Ruthenberg, Landskroner (2008), have been conducted for examine the loan pricing implications under Basel II reform. Specifically, Repullo and Suarez (2004) and Ruthenberg and Landskroner (2008) highlight the impact of the methodologies introduced for calculating the capital requirements for loans with different risk characteristics by employing a perfect (Repullo and Suarez (2004)) and imperfect (Ruthenberg and Landskroner (2008)) competition model for bank loans. Both papers conclude that high quality firms and retail customers will enjoy a reduction in loan interest rates if banks will adopt the internal ratings-based approach. This estimate is in line with recent studies measuring the long-term effects of higher capital requirements under Basel III on banks' lending spreads.

Elliot (2010) and Kashyap et al. (2010) identify the impact of an increase in the equity to asset ratio in particular for the US banks.

Elliott's analysis (2010) suggests that these effects on loan rates does not seem likely to be dramatic, especially if banks are able to offset any possible increase in their funding costs by other means (for example managing their return on equity). The author estimates that, if the equity capital level rises from 6% to 8% of the loan value, banks need to increase loan spreads by 39 basis points to maintain a target ROE of 15%. The required increase will drop by 9 basis points if the ROE is allowed to fall to 14.5%.

Kashyap et al. (2010) find that there is no relationship between bank's capital ratios and lending rates, apart from one depending on tax factors. More specifically, they regress the equity-assets ratio finding no significant relationship with some proxies of lending spreads (i.e. those involving the net interest margin and the loan yield minus the deposit rate). The authors estimate that a 1 point increase in the ratio of equity-to-assets is associated with a 28 basis point increase in the cost of loans. Thus, consistent with the small effects of the Modigliani-Miller calibration model, a simple historical analysis reveals no tendency for higher capital ratios to be associated with higher loan spreads.

BCBS (2010) estimate that a one per cent increase in Tier 1 capital turns into 13 basis point long-term increase in lending spreads. King (2010) provides estimates of slightly more than 15 basis points. Angelini et al. (2011) and Slovik and Cournede (2011) also reported similar results.

Complementing the studies mentioned above, this paper aim to provide a contribution to the existing literature. By using a particular financial model and a representative bank financial statement, we will map how shifts in banks' capital structure affect the cost of loans for banks' borrowers. We believe a financial model might better represent the effect of structural changes in a firm's leverage than pure accounting models.

A second novelty lies in the attempt to analyze the effects of increasing capital requirements for the Italian banking sector, while most of the empirical literature refers to an Anglo-Saxon context.

### **3. The Modigliani-Miller theorem implications**

The Modigliani and Miller (M-M) theorem states that, under idealized conditions, the market value of a firm is determined by its earning power and the risk of its underlying assets, and is unaffected by how that firm is financed. In other words, the mix of debt and equity (debt-equity ratio) does not affect a company's overall cost of funds (WACC - Weighted Average Cost of Capital) as well as its market value ("Capital structure irrelevance principle").

Under the M-M framework, if a bank raises equity capital by issuing stock and/or selling debt, the increase in the proportion of equity, which is more expensive than debt, is offset by a decrease in the required rate of return on both debt and equity, because of the lower risk premium investors demand. This happens in such a way that the overall impact of higher equity capital (and less debt) on the funding cost is zero.

Therefore, if the Modigliani–Miller theorem were fully applicable to banks, there would be no need for our research, because requiring banks to use more equity and less debt would have no effect on the Weighted Average Cost of Capital (WACC) and therefore it would not affect the price of loans, since banks would not need to charge higher funding costs on loans.

However, there are a number of important reasons for presuming that the classic M-M theorem does not entirely hold for banks. Some of those reasons are common to both financial and non-financial companies.

The most evident one is the tax treatment of equity and debt. In their classical model, Modigliani and Miller assumed that the tax treatment of equity is equivalent to the tax treatment of debt. In practice, interest payments are tax-deductible for companies while dividends are not. As a result of their different tax treatment, an higher proportion of equity reduces the tax shields on debt, thereby increasing funding costs (WACC) for banks. Some empirical studies confirm that tax distortions have a significant influence on financial structure, for non-financial firms (A.J. Auerbach (2002), Cheng and Green (2008), Graham (2003)), as well as for banks (Elliott, 2010), which is one of the reasons why banks raise as much debt as they can, consistent with their risk management strategy.

Regarding banks' capital structures, an additional departure from the M-M theorem stems from the government guarantees on deposits and debt. In the case of deposits, there exists an explicit guarantee in the form of the deposit insurance system. In addition, banks' non-deposit debt liabilities benefit from an implicit government guarantee, since investors assume that the government will not let the banks default on their debt. These government guarantees, either explicit or implicit, make bank's cost of debt far less sensitive to the creditworthiness of the bank than was assumed by M-M. The relative insensitivity of bank's debt costs to the riskiness of the institution makes the

cost of debt fall relative to equity, thus providing banks with an incentive to substitute equity funding with debt funding.

Academic literature has observed a number of other factors that could have an impact on capital structure choices, causing a misalignment from the M-M model. Those factors include information asymmetries and conflicts of interest between managers and investors (Leland and Pyle D.H. (1977), Calomiris and Kahn (1991), Froot and Stein (1998). Despite the existence of those distortions, part of the academic research suggests that the Modigliani-Miller theorem is a good approximation of the relationship between banks' required return on equity and their leverage (Kashyap, Stein, and Hansen (2010), Admati., DeMarzo, Hellwig and Pfleiderer (2010)).

The key question seems to be to what degree the basic mechanism underlying the M-M model (i.e. equity is more risky the higher is leverage) operate for banks and what is the sensitivity of banks' overall cost of funds to different levels of capital requirements.

To answer this question, we tested to what extent the M-M theorem is true for Italian banks. For this purpose, we formed a sample of publicly-traded banking firms over the period 2005-2010. Once collected the daily closing prices for the entire period, we first estimated daily stock returns for each bank in the sample; we then estimated equity betas by regressing daily stock returns on the daily returns of the FTSE MIB index over discrete periods of twelve months. We finally regressed these estimates of individual banks' annual equity betas on the banks' leverage ratio at the beginning of each period. We define leverage as the book value of equity over the book value of total assets. We also controlled for other plausible determinants of equity betas, such as accounting ratios and annual macroeconomic data.

Using a backward-elimination procedure to find the significant variables, we derived the following regression model:

$$\beta_{i,t} = \alpha_i + b \cdot BV_{i,t-1} + c \cdot \left( \frac{BV_{i,t-1}}{MV_{i,t-1}} \right) + d \cdot \left( \frac{BV_{i,t-1}}{TA_{i,t-1}} \right) + \varepsilon_{i,t} \quad (1)$$

for banks ( $i$ ) = 1, 2 ..... N      and time periods ( $t$ ) = 1, 2 ..... T

Here,  $BV_{i,t-1}$  is the book value of equity (in billions of euro),  $(BV_{i,t-1} / MV_{i,t-1})$  is the book-to-market equity ratio, and  $(BV_{i,t-1} / TA_{i,t-1})$  is the ratio of book equity to book total assets (i.e. leverage).

To limit the impact of reporting errors or outliers, we excluded observations where  $\beta_{i,t}$  is below the 5<sup>th</sup> or above the 95<sup>th</sup> percentile. Performing a multiple linear regression (Ordinary Least Squares - OLS), we obtained the following estimated regression equation:

$$\beta_{i,t} = 0,732 + 0,013 \cdot BV_{i,t-1} - 0,019 \cdot \left( \frac{BV_{i,t-1}}{MV_{i,t-1}} \right) - 0,398 \cdot \left( \frac{BV_{i,t-1}}{TA_{i,t-1}} \right) + \varepsilon_{i,t} \quad (2)$$

Table 1 shows in detail the regression results.

**Table 1. Bank equity beta: multiple linear regression (OLS)**

| Variable                     | Parameter | S.D.  | T-STAT<br>(H0: parameter = 0) | 2-tail p-value | 1-tail p-value |
|------------------------------|-----------|-------|-------------------------------|----------------|----------------|
| INTERCEPT                    | 0,732     | 0,038 | 19,139                        | 0              | 0              |
| BV                           | 0,013     | 0,003 | 5,214                         | 1.00E-06       | 0              |
| BV/MV                        | -0,019    | 0,008 | -2,322                        | 0,022          | 0,011          |
| BV/TA                        | -0,398    | 0,197 | -2,025                        | 0,045          | 0,023          |
| <b>Regression Statistics</b> |           |       |                               |                |                |
| Multiple R                   |           |       | 0,512                         |                |                |
| R-squared                    |           |       | 0,262                         |                |                |
| Adjusted R-squared           |           |       | 0,242                         |                |                |
| F-TEST (value)               |           |       | 13,156                        |                |                |
| p-value                      |           |       | 2,06E-07                      |                |                |

All the explanatory variables are statistically significant, and the equation explain around the 50% of the variability in betas. BV coefficient indicates that the larger size banks are bearing higher cost of equity.

In order to focus on the link between leverage and systematic risk of equity ( $\beta_e = 0$ ), we tested the same regression model using  $(BV / TA)$  as only independent variable. We obtained the following regression equation:

$$\beta_{i,t} = 0,772 - 0,5 \cdot \left( \frac{BV_{i,t-1}}{TA_{i,t-1}} \right) + \varepsilon_{i,t} \quad (3)$$

Table 2 shows statistical parameters of the regression.

**Table 2. Bank equity beta and leverage: linear regression (OLS)**

| Variable                     | Parameter | S.D.  | T-STAT<br>(H0: parameter = 0) | 2-tail p-value | 1-tail p-value |
|------------------------------|-----------|-------|-------------------------------|----------------|----------------|
| INTERCEPT                    | 0,772     | 0,037 | 20,6434                       | 0              | 0              |
| BV/TA                        | -0,500    | 0,220 | -2,265                        | 0,025          | 0,012          |
| <b>Regression Statistics</b> |           |       |                               |                |                |
| Multiple R                   |           |       | 0,208                         |                |                |
| R-squared                    |           |       | 0,043                         |                |                |
| Adjusted R-squared           |           |       | 0,034                         |                |                |
| F-TEST (value)               |           |       | 5,130                         |                |                |
| p-value                      |           |       | 0,025                         |                |                |

Also for the second model the explanatory variables are statistically significant, but the equation explain only the 20% of the variability in betas.

We can now compare the estimated relationship between banks' leverage and equity betas to the one predicted based on the M-M principle.

In the widely-used Capital Asset Pricing Model (CAPM), temporarily ignoring corporate taxes, the systematic risk of bank assets - that is the "asset beta" or "unlevered beta" ( $\beta_a$ ) - can be decomposed into the risks borne by shareholders ( $\beta_e$ ) and by debt holders ( $\beta_d$ ), as follows:

$$\beta_a = \beta_e \cdot \frac{MV}{EV} + \beta_d \cdot \frac{D}{EV} \quad (4)$$

where  $MV$  is the market value of bank's equity,  $D^2$  its debt and  $EV$  the enterprise value of the firm ( $MV+D$ ). Assuming that debt is free of systematic risk ( $\beta_d = 0$ ), we get the following expressions:

$$\beta_a = \beta_e \cdot \frac{MV}{EV} \quad (5a)$$

$$\beta_e = \beta_a \cdot \frac{EV}{MV} \quad (5b)$$

where  $EV/MV$ , that is the ratio of the enterprise value to the market value of equity, is a leverage measure.

If the market value of equity is assumed to match with its book value, and we express leverage by the ratio of book equity to book total assets (as in the above regression models), equation (5b) turns out to be the following:

$$\beta_e = \frac{\beta_a}{Lev} \quad (6)$$

where  $Lev$  is the leverage, expressed by the book value of equity over the book value of total assets ( $Lev = BV / TA$ ). Equations (5b) and (6) show the link between the CAPM and the M-M theorem. Indeed, they states that if bank debt is free of systematic risk, the systematic risk of equity, as well as the risk premium to shareholders, should move linearly with leverage.

---

<sup>2</sup> In this study we use the book value of debt as proxy of its market value.

The CAPM also states that, in a capital markets equilibrium context, the required return on equity ( $r_e$ ) is a function of the equity market risk premium (MRP) and the (bank specific) equity beta:

$$r_e = r_f + \beta_e (r_m - r_f) = r_f + \beta_e \cdot MRP \quad (7)$$

where  $r_e$  is the required return on equity (i.e. firm's cost of equity),  $r_f$  is the risk-free rate of interest (such as interest arising from government bonds),  $r_m$  is the expected return of the market portfolio (i.e. the overall stock market return) and MRP is the market risk premium (i.e. the difference between the expected return on the equity market portfolio and the risk-free rate).

In equation (7), the risk-free rate ( $r_f$ ) represents the time value of money, while the second half of the formula represents the amount of compensation an investor needs for taking on additional risk.

On the basis of estimates that will be presented in the following paragraphs, the equity beta for our representative bank is close to 1,2, while the equity-to-assets ratio is about 7,5%. If we assume BV=MV, the unlevered beta of the bank is 0,09 (i.e.  $1,2 \cdot 0,075$ ).

Given a risk free rate of about 4% and a market equity risk premium close to 3,5%, the risk premium (i.e. the excess return over the risk free rate) on bank's equity is roughly 4,2% (since  $1,2 \cdot 0,035 = 0,042$ ) and the required return on equity is about 8,2% (i.e.  $0,04 + 0,042$ ).

According to the M-M theory, if the equity ratio doubles from 7,5% to 15%, both the beta of equity and the risk premium on that equity should fall by half, to 0,6 (equity beta) and 2,1% (equity risk premium), while the bank's cost of equity should fall from 8,2% to 6,1% (i.e.  $0,04 + 0,021$ ). Indeed, when a bank halves its leverage, each unit of equity should bear half as much assets' risk as before, and equity beta should then fall by half. This would also imply an equal decrease in the risk premium on that equity.

Looking now at our second regression model, we find a coefficient on the leverage ratio of roughly - 0,5. This value implies that if the equity ratio doubles (+7,5%), beta will fall by 0,0375 (since  $\Delta\beta = - 0,5 \cdot \Delta\text{Lev} = - 0,5 \cdot 0,075 = - 0,0375$ ) to 1,162 (i.e.  $1,2 - 0,0375$ ).

Accordingly, the equity risk premium decreases to 4% (since  $1,162 \cdot 0,035 = 0,04$ ) and the required return on equity would fall to 8% (i.e.  $0,04 + 0,04$ ).

Synthesizing, according to the M-M principle, the equity beta (as well as equity risk premium) should fall in half (- 50%) and the return on equity should decrease by 25% (from 8,2% to 6,1%). Instead, our estimations suggest a very small decrease both in the equity beta and in the equity risk premium (-3%), while the cost of equity would fall by only 1,6%. In other words, the empirical magnitudes are very far from what is predicted by the M-M conservation-of-risk principle. Table 3 synthesizes our results.

**Table 3. The impact of leverage on risk and required return of equity\***

| <b>Variable</b>            | <b>Baseline Scenario</b> | <b>M-M Theory</b><br>(assuming equity ratio doubles) | <b>Model Estimates</b><br>(assuming equity ratio doubles) |
|----------------------------|--------------------------|--|---|
| <b>Equity beta</b>         | 1,2                      | 0,6 (- 50%)  | 1,162 (-3%)   |
| <b>Equity risk premium</b> | 4,2%                     | 0,021(- 50%)   | 4% (-3%)  |
| <b>Return on equity</b>    | 8,2%                     | 6,1% (-25%)  | 8% (-1,6%)  |

\* Estimates are based on the hypothesis explained in the text.

Of course, we cannot say that the M-M principle did not hold at all, since changes in leverage have an impact on the required return on equity. Nevertheless, according to our model, the impact of leverage on the beta of equity is very small and the required rate of return on that equity is far higher than what it would be if M-M theorem held exactly. For this reason, in the baseline scenario of our model, the M-M principle is expected not to hold for banks.

Certainly, one has to be careful in interpreting our results given the strong assumptions behind them. For example, we have assumed that bank debt is free of systematic risk. We have also ignored tax and the effect of the tax shield on debt.

In addition, our regression model is based on a limited number of observations, since we considered only data for Italian banks publicly traded over the period 2005-2010. Given the characteristics of the domestic equity market, we could collect data for a few number of banks, resulting in a final data set made of only 130 year-bank observations.

## 4. The impact of higher capital requirement on lending rates

### 4.1. The methodology

The methodology developed aim to estimate loan price implications of higher capital requirements proposed under Basel III. We provide a particular financial-based model to predict the impact on lending rates associated with raising new external equity finance.

The underlying hypothesis is that there is a positive relationship between bank's equity ratio and it's total cost of funding. Consequently, higher capital requirements, by raising banks' cost of funding, could lead to a lower market value of equity, all else equal.

As in King (2010), our empirical model relies on some key assumptions. First, we define the capital ratio (CR) as the ratio of equity to RWAs (i.e.  $CR = BV / RWAs$ ). This ratio is assumed as a proxy for the TIER 1 capital ratio. We are not interested in the TIER 2 capital since our intention is to analyze the effects coming from a shift in the capital provided by ordinary shareholders.

We also assume that banks meet the higher capital adequacy ratio by increasing shareholders' equity relative to RWAs:

$$BV_{t+1} = BV_t + \Delta CR \cdot RWAs \quad (9a)$$

where  $BV_t$  is the current book value of equity,  $BV_{t+1}$  is the book value of equity in the long-run steady-state,  $\Delta CR$  is the increase in capital ratio requirement, and  $RWAs$  is the risk-weighted value of bank assets. Equation (9) may be rewrite as follows:

$$\Delta BV = \Delta CR \cdot RWAs \quad (9b)$$

where  $\Delta BV$  is the change in the book value of equity. Equation (9b) states that the required increase in shareholders' equity is positively correlated with both the increment of capital requirements and the value of risk-weighted assets. All else equals, the higher is the change in the capital ratio (or in the RWAs), the higher is the growth in the book value of equity needed to fulfill the new capital requirement.

We also assume that the increase in equity is accompanied by a corresponding decrease in the quantity of liabilities, so that total assets are unchanged:

$$\Delta D = -\Delta BV = -\Delta CR \cdot RWAs \quad (10)$$

where  $\Delta D$  is the change in the book value of debt.

The change in capital structure leads to a decrease in the bank's interest expenses, resulting in a higher net income, all else equal. Although net income rises, the return on equity (ROE) should fall, since the relative increase in net income (the numerator of the ratio) is usually lower than the rise in common shareholders' equity (the denominator of the ratio)<sup>3</sup>.

Holding the payout ratio ( $\rho$ ) - i.e. the percentage of net income that is paid out as dividends to common shareholders - unchanged, the fall in ROE leads to a decrease in the expected growth rate ( $g$ ) in both earnings and dividends. This assumption relies on the following accounting relationship between the return on equity and the growth rate:

$$g = ROE \cdot (1 - \rho) \quad (11)$$

where  $(1 - \rho)$  is the earnings retention rate (plowback ratio). The above expression shows that the sustainable growth rate ( $g$ ), is positively correlated with bank's ROE and retention rate. Hence, if ROE falls the growth rate decreases proportionally. According to Damodaran (2001) equation (11) works very well for financial firms, since in a regulatory framework based on risk-based capital requirements, the plowback ratio is a reliable proxy of how much the bank can grow in the long run.

Summarizing, the final effect of higher capital requirements results in an increase of the annual earnings and a related decrease in the return on equity (ROE) and in the expected growth rate ( $g$ ). To get a single measure of those changes, we might ask how they affect the market value of equity, that is market capitalization of the bank. Answering this

---

<sup>3</sup> This happens as long as the average cost of debt ( $r_d$ ) is lower than the cost of equity ( $r_e$ ).

question allow us to evaluate if the additional equity funding creates or destroys value for bank's shareholders.

By using a Discounted Cash Flow model (DCF) based on accounting magnitudes, we will map how shifts in bank's capital structure affect market capitalization of the same bank. Our basic choice falls on the Gordon-Shapiro model, which may be expressed as follows<sup>4</sup>:

$$MV_t = \frac{DIV_{t+1}}{r_e - g} \quad (12)$$

where  $MV_t$  is the market value of equity at time  $t$ ,  $DIV_{t+1}$  are the expected dividends one year from now,  $r_e$  is the required rate of return for equity investors, and  $g$  is the annual growth rate in earnings and dividends (expected to be constant for perpetuity).

Assuming that  $DIV_t$  is the current value of dividends,  $E_t$  is the current value of earnings, and remembering the meaning of the payout ratio ( $\rho$ ), we may reword the model as follows<sup>5</sup>:

$$MV_t = \frac{DIV_t \cdot (1 + g)}{r_e - g} \quad (13a)$$

$$MV_t = \frac{\rho \cdot E_t \cdot (1 + g)}{r_e - g} \quad (13b)$$

$$MV_t = \frac{\rho \cdot E_t \cdot [1 + ROE \cdot (1 - \rho)]}{r_e - ROE \cdot (1 - \rho)} \quad (13c)$$

Equations from (13a) to (13c) show that, all else being equal, the lower is the increase in bank's earnings and/or the higher is the decrease in the return on equity (ROE), the

---

<sup>4</sup> The Gordon model assumes that the required rate of return for equity investors (i.e. the cost of equity for the company) remains constant at a level  $r_e > g$ .

<sup>5</sup> In the model, the payout ratio ( $\rho$ ) is assumed to remain constant, as well as the return on equity (ROE) should be constant over time (i.e. the ROE in the long-run steady-state).

higher is the falling in the market value of the company. However, the final change in equity market value coming from a change in the capital structure depends on the link between leverage and cost of equity capital.

As observed, according to the classical theory (i.e. M-M theorem), as banks reduce leverage shareholders should expect a lower return on their investment, thus decreasing the cost of equity funding ( $r_e$ ). To the extent that the M-M model holds for banks, the decline in the cost of capital should offset the lower return on equity (ROE), keeping the market capitalization of banks unchanged.

However, our empirical estimates do not support the theoretical predictions about the effects of changing in capital structure on the cost of funding. Therefore, the base case in this study supposes that the expected return on equity is unchanged despite the reduction in leverage

Given this assumption, If banks wishes to avoid the fall in market capitalization, they should find a way to generate more net income from existing assets. We will then outline a model to estimate the rise in lending rates required to offset the effects of the higher equity funding, keeping unchanged banks' market value.

In this study, other income sources and operating expenses are expected to remain unchanged, as well as there will be no change in either the bank managers' behaviour or in the bank's assets structure. In other words, we assume that banks will presumably pass on any additional costs resulting from the introduction of Basel III only by raising the average interest rate faced by bank borrowers.

Finally, we focus on the long-run steady-state effects of higher capital requirements on lending activity, without considering the transition period to the steady state. We therefore assume two steady states: the first one without considering the proposed regulatory reform; the second one assuming banks have completed the transition to Basel III.

## 4.2. The representative bank's financial statements

For our purposes, we constructed a representative bank's financial statements (balance sheet and income statement) collecting from Bankscope Database accounting and market data of the last six-years (2005-2010) for Italian commercial banks and bank-holding companies which were listed on the Milan Stock Exchange at the end of 2010. Our final sample consists of 24 companies and 146 bank-year observations.

Special care has been taken to remove the survivorship bias intrinsic in the Bankscope Database. Indeed, Bankscope deletes historical information on banks that no longer exist in the latest update of the database, but did exist in previous years. We dealt with the problem by reassembling the panel data set by collecting missing data from financial statement released by banks on their official websites.

The representative bank's financial statement is derived by a process based on a two-step median calculation. We first calculated, for each bank included in the reference sample, an average balance sheet and income statement based on the arithmetic mean of their annual accounting values over the period 2005-2010. In this way we aim to normalize accounting data and isolate possible errors in data reporting.

In a second step, the representative bank's financial statement is obtained by computing a weighted average of the median accounting values derived in the first step. The weights are based on market capitalization of banks at the end of 2010.

Table 4 shows the stylized financial statement for the representative bank. All items are shown both in million of euro and as a percentage of total assets. We believe they provide a good estimate of the steady-state.

Loans are close to 60% of bank total assets, followed by trading assets (25,4%) and interbank loans (8,3%). Bank assets are funded primarily by deposits (37,2%) and wholesale funding & trading liabilities (36,1%), followed by interbank funding (13,2%). Shareholders' equity represents 7,5% of total assets.

Looking at the income statement of our representative bank, net interest income is 1,6% of total assets, while non-interest income is 0,98%. In other words, non-interest income is about 61% of interest income (i.e.  $0,98\% / 1,6\%$ ), which confirms the preference of Italian banks for traditional forms of intermediation. Total operating expenses amount to

2 % of total assets, with personnel expenses representing about half of total operating expenses (since 0,94% / 2% = 47%). Net income (or ROA) is 0,53 %, and the average return on equity (ROE) is around 7%.

**Table 4: Representative balance sheet and income statement, 2005-2010**

| Balance sheet                           | Euro (million) | % of Total Assets | Income statement                             | Euro (million) | % of Total Assets |
|---|----------------|-------------------|--|----------------|-------------------|
| Cash and cash equivalent                | 6.511          | 1,26              | 1. Interest income                           | 18.908         | 3,66              |
| Loans to Banks                          | 43.108         | 8,34              | 2. Interest expenses                         | 10.604         | 2,05              |
| Net Loans                               | 300.138        | 58,10             | A. Net interest income (1 - 2)               | 8.304          | 1,61              |
| Total Securities                        | 131.153        | 25,39             | 3. Trading income                            | 378            | 0,07              |
| Fixed Assets                            | 5.391          | 1,04              | 4. Fees and commissions                      | 4.617          | 0,89              |
| Intangible Assets                       | 15.213         | 2,94              | 5. Other non-interest income-expenses        | 79             | 0,02              |
| Other Assets                            | 15.100         | 2,92              | B. Total non-interest income (3 + 4 + 5)     | 5.074          | 0,98              |
| <b>TOTAL ASSETS</b>                     | <b>516.614</b> | <b>100</b>        | C. Total Revenues (A + B)                    | 13.378         | 2,59              |
| Interbank funding                       | 68.143         | 13,19             | 6. Personnel Expenses                        | 4.863          | 0,94              |
| Deposits                                | 192.413        | 37,24             | 7. Other Administrative Expenses             | 5.608          | 1,09              |
| Wholesale funding & Trading liabilities | 186.739        | 36,15             | D. Total Operating Expenses (6 + 7)          | 10.472         | 2,03              |
| Other Liabilities                       | 30.357         | 5,88              | E. Operating Profit (C - D)                  | 2.906          | 0,56              |
| <b>TOTAL LIABILITIES</b>                | <b>477.651</b> | <b>92,46</b>      | 8. Non-operating income and expenses         | 299            | 0,06              |
| <b>TOTAL EQUITY</b>                     | <b>38.963</b>  | <b>7,54</b>       | F. Pre-tax profit (E +/- 8)                  | 3.206          | 0,62              |
| <b>TOTAL LIABILITIES AND EQUITY</b>     | <b>516.614</b> | <b>100</b>        | 9. Tax expense                               | 808            | 0,16              |
| Market Capitalisation                   | 29.509         | 5,71              | 10. Profit/Loss from Discontinued Operations | 329            | 0,06              |
|   |                |                   | G. Net income (F -9 +/- 10)                  | 2.727          | 0,53              |
| <i>RWAs</i>                             | <i>241.690</i> | <i>46,78</i>      |  |                |                   |
| <i>TIER 1 capital</i>                   | <i>18.766</i>  | <i>3,63</i>       |  |                |                   |
| <i>TIER 1 ratio (%)</i>                 | <i>7,7%</i>    |                   |  |                |                   |
| <i>Total Capital</i>                    | <i>28.195</i>  | <i>5,46</i>       |  |                |                   |
| <i>Total Capital Ratio (%)</i>          | <i>11,6%</i>   |                   |  |                |                   |

Risk weighted assets (RWAs) are less than half of total assets (46,8%). Looking at capital ratios, we see a TIER 1 capital ratio at 7,7% and a Total Capital Ratio at 11,6%. Then, both ratios are about 3,5 percentage points above their minimum level. This is not surprisingly considering that banks tend to hold more capital than the minimum regulatory requirements. Indeed, as observed by Berger et al. (1995) and Maccario et al. (2002), the effective regulatory capital requirement is the minimum explicit regulatory capital

requirement plus an implicit requirement. The implicit requirement consists of an additional capital buffer that banks hold either as a result of the implicit pressures from the national supervisory authority or to avoid the costs associated with a fall of the capital ratios below their explicit requirement.

Hence, if banks want to keep their actual capital buffers (the implicit requirement), they should react to an increase in the capital requirement – the explicit one – by raising proportionally the capital buffer – the implicit requirement –.

Table 5 reports accounting ratios and market data for our representative bank.

**Table 5: Market data and accounting ratios for the representative bank, 2005-2010**

| <b>Indicator</b>                             | <b>Value</b> | <b>%</b>  |
|--|--------------|-----------|
| <b>Market Capitalization (MV)</b>            | 29.509 (2)   | 5,71% (1) |
| <b>ROE (Return on equity)</b>                |              | 7%        |
| <b>Leverage (Book value / Total assets)</b>  |              | 7,5%      |
| <b>P/B (Book-to-Market Ratio)</b>            | 1,32         |           |
| <b>P/E (Price-Earnings Ratio)</b>            | 10,8         |           |
| <b>Payout ratio (<math>\rho</math>)</b>      |              | 48,8%     |
| <b>Plowback ratio (<math>1-\rho</math>)</b>  |              | 51,2%     |
| <b>Growth rate (<math>g</math>)</b>          |              | 3,5%      |
| <b>Beta of equity (<math>\beta_e</math>)</b> | 1,21         |           |

(1) percentage of total assets; (2) millions of euro.

Market capitalization, the payout ratio and the plowback ratio are obtained by the same double-step mean calculation used for the accounting data. The systematic risk of equity for the representative bank ( $\beta_e$ ) is the weighted average of the 5-Year Betas of each bank in the sample. Banks' equity betas are obtained by regressing the daily stock returns on

the daily returns of the FTSE MIB index over a period of five years<sup>6</sup>, while the weights refer to the market capitalization of each bank at the end of 2010. Finally, key accounting ratios and market multiples are obtained from the available accounting and market data.

## 5. Mapping higher capital to market value

As observed, the final aim of our study is to assess at what level banks should set the loan rate so to offsets the cost of having banks use more equity and less debt. For this purpose, we need an estimate of the change in the required return on equity ( $r_e$ ) associated with shifts in the capital structure.

To evaluate the cost of equity capital funding for our representative bank, we use the Gordon-Shapiro model as above described. From the equations (13a) - (13c) we may obtain the value of the required return on equity which is implicit in the market capitalization:

$$r_e = \frac{DIV_t \cdot (1 + g)}{MV_t} + g = \frac{\rho \cdot E_t \cdot [1 + ROE \cdot (1 - \rho)]}{MV_t} + ROE \cdot (1 - \rho) \quad (14)$$

Applying equation (14), we find that the implicit value of the cost of equity for our representative bank is 8,25% [i.e.  $48,8\% \cdot 2.727 \cdot (1 + 3,5\%) / 29.509 + 3,5\%$ ]. Here we implicitly assume that the different classes of shares bear the same cost. This is a conservative assumption which move the cost of shareholders' equity upwards.

Given the value of the cost of equity (8,25%), we are able to find the market risk premium underlying the Capital Asset Pricing Model. Indeed, equation (7) may be rewrite as follows:

$$MRP = (r_m - r_f) = \frac{r_e - r_f}{\beta_e} \quad (15)$$

---

<sup>6</sup> In a few cases we couldn't calculate 5-Year Betas, since stock price data were available for a period shorter than five years.

As a proxy for the risk-free rate we use the Treasury security rate. On the basis of the gross yield of Italian Government Bond (10 YEAR BTP) issued in the year 2010, we obtain an average risk-free rate of about 4 percent. This value, together with the values of  $\beta_e$  (1,21) and  $r_e$  (8,25%), give us an estimate for the market risk premium of about 3,5% (i.e.  $8,25\% - 4\% / 1,21$ ), which implies an expected return for the market portfolio of 7,5% (i.e.  $3,5\% + 4\%$ ). Those values are not surprisingly when one looks at performance of the equity markets in the last few years.

To test our model, we can estimate the effects on bank's equity value coming from an increase in the capital ratio of 1 percentage point. According to our assumptions, bank reacts to the higher capital requirement by increasing common equity. Applying equation (9b), we estimate the book value of equity increases of 2.416,90 (i.e.  $241.690 \cdot 0,01$ ), to the value of 41.380 (i.e.  $38.963 + 2.416,90$ ). At the same time, from equation (10), we see that the book value of debt falls from 477.651 to 475.234 (since  $477.651 - 2.416,90 = 475.234,10$ ).

As bank reduces debt funding, its interest expenses decreases and the net income raises. The final effect on firm's earnings may be expressed as follows:

$$\Delta E = \Delta I_{exp} \cdot (1 - t) = -r_d \cdot \Delta D \cdot (1 - t) \quad (16)$$

where  $\Delta E$  is the change in earnings,  $\Delta I_{exp}$  is the reduction in the interest expenses,  $t$  is the average tax rate and  $r_d$  is the average cost of debt. Equation (16) states that, all else being equal, the higher is the cost of bank's debt and the decrease of debt funding, the higher is the increase in bank's earnings. By multiplying by one minus the tax rate we are including the effect coming from the partial loss of the tax shield on debt, while the use of an average cost of debt ( $r_d$ ) implies a proportional reduction of the various sources of funding (interbank funding, trading liabilities, deposits, and wholesale funding). Of course, It's reasonable to assume that banks would prefer to replace with equity the most expensive form of liabilities, that is long-term debt. Nevertheless, our assumption aim to capture, at least in part, the combined effects of a change in both capital and liquidity requirements.

For our representative bank, the cost of debt ( $r_d$ ) is estimated to be close to 2,2%, which is obtained as the ratio of interest expense to total liabilities, while the average effective tax rate (25,2%) is estimated relating tax expense to the pre-tax profit.

Applying those values to equation (16) we obtain an increase of bank's earnings of 39,7 [i.e.  $2,2\% \cdot 2.416,90 \cdot (1 - 25,2\%)$ ], from 2.727 to 2.766,7. While net income rises, the return on equity (ROE) falls from 7% to 6,68% (i.e.  $2.766,7 / 41.380$ ). Given an earnings retention rate (plowback ratio) of 51,2%, and referring to the relationship between ROE and  $g$  (equation 11), the decrease in the return on equity leads to a small reduction in the expected growth rate, from 3,5% to 3,4% (i.e.  $6,68\% \cdot 51,2\% = 3,4\%$ ).

In order to apply the Gordon-Shapiro model, so to evaluate the market value of the bank after the shift in leverage, we refer to different scenarios about how the cost of equity capital ( $r_e$ ) reacts to a lower leverage level.

In the baseline scenario, we assume the M-M principle doesn't hold at all for banks. Under this hypothesis, the both the beta of equity (1,21) and the required return on equity (8,25%) are unchanged, despite the lower leverage level.

In an alternative, less aggressive calibration, we assume that as bank raises the equity-ratio the cost of equity capital ( $r_e$ ) falls accordingly with the M-M principle. Incorporating income taxes in the M-M model, equation (4) become as follows:

$$\beta_a = \beta_e \frac{MV}{EV} + \beta_D (1 - t) \frac{D}{EV} \quad (17)$$

where  $t$  is the average tax rate, and the enterprise value (EV) is now equity plus debt minus the value of tax shields due to interest payments ( $MV + D - t D$ ).

In this study banks' debt is assumed to be free of systematic risk ( $\beta_d = 0$ ). This is a reliable hypothesis if one considers the explicit and implicit guarantee on banks' debt, which leads the cost of debt funding close to riskless rates.

As the beta of bank debt is close to zero, equation (17) may be rewrite as follows:

$$\beta_a = \beta_e \frac{MV}{EV} = \frac{\beta_e}{1 + (1-t) \frac{D}{MV}} \quad (18a)$$

from which:

$$\beta_e = \beta_a \left[ 1 + (1-t) \frac{D}{MV} \right] \quad (18b)$$

Applying equation (18a) to our representative bank, we find that assets' beta in the steady-state is 0,092 [i.e. 1,21 / (1+(1- 0,252)\* 477.651 / 29.509)].

Of course, when bank reduces debt funding by an off-setting amount of common equity, the debt/equity ratio decreases.

As bank's management aim to keep safe the market value of shareholders' equity, the minimum target level after the change in leverage may be assumed to be 31.925 - that is the market capitalization in the steady-state (29.509) plus the new equity funding (2.416) -, while the new ratio of debt to equity would fall from 16,2 (i.e. 477.651 / 29.509) to 14,9 (i.e. 475.234 / 31.925).

Under the above assumptions, the new beta of equity may be obtained by applying equation (18b): 0,092 \* (1+(1- 0,252)\* 14,9) = 1,12.

Consequently, with a M-M calibration, the cost of equity should decrease from 8,25% to 7,94% (i.e. 4% + 1,12\*3,5%).

We can now evaluate the new value of bank's equity by applying the model of Gordon-Shapiro as expressed in equation (13c). In the baseline scenario, the market value of equity would be:

$$MV = \frac{48,8\% \cdot 2.767 \cdot [1 + 6,69\% \cdot 51,2\%]}{8,25\% - 6,69\% \cdot 51,2\%} = 28.909 \quad (19)$$

while according to the second calibration (M-M effect), bank's market capitalization would be:

$$MV = \frac{48,8\% \cdot 2.767 \cdot [1 + 6,69\% \cdot 51,2\%]}{7,94\% - 6,69\% \cdot 51,2\%} = 30.926 \quad (20)$$

In the first and worst scenario (No M-M effect), our representative bank raises 2.416 of new equity capital without any improvement effect on market capitalization, the value of which falls from 29.509 to 28.909. Considering the value of the new equity funding, the total loss in market capitalization is 3.016 (i.e. 29.509 + 2.416 – 28.909).

In the alternative calibration, bank's market capitalization raises of 1.417, from 29.509 to 30.926, which means that not all the new equity funding turns into new market value. The final effect corresponds to a loss in market capitalization close to 1.000 (i.e. 29.509 + 2.416 – 30.926).

Table 6 synthesizes the effects of higher capital requirement on the representative bank's market value. Looking at column three, we observe a loss in market capitalization (999) despite the full assumption of the Modigliani-Miller theory. One could have expected that, to the extent that the M-M model holds for banks, the fall in the cost of capital would have offset the lower ROE, keeping safe the market capitalization of bank. This is not the case for the following two reasons, First, in a world with taxes, we have a negative effect associated with a decrease in leverage coming from the lost tax shields on debt. Then, assuming the M-M plus taxes approach, higher equity requirements are costly, in part, as they reduce the benefits resulting from tax deductibility of interest payments.

Second, in the traditional M-M model, as leverage falls is likely to have a reduction in the required return on both equity and debt, while in our calibration we have assumed no

effect on the cost of debt. Although this is likely to be the case of banks, this way we nullify one of the routes through which the M-M model acts, potentially understating the fall in funding costs coming from a lower leverage level.

**Table 6: Impact of higher capital requirements\* on market capitalization (representative bank, 2005-2010)**

| Indicator                                    | Actual steady-state | Long-run steady-state effects |            |
|--|---------------------|-------------------------------|------------|
|  |                     | No M-M effect                 | M-M effect |
| <b>New equity funding</b>                    | -                   | 2.416                         | 2.416      |
| <b>Book value of equity (BV)</b>             | 38.963              | 41.380                        | 41.380     |
| <b>Book value of debt</b>                    | 477.651             | 475.234                       | 475.234    |
| <b>Leverage (BV / TA)</b>                    | 7,5%                | 8%                            | 8%         |
| <b>Net Income</b>                            | 2.727               | 2.767                         | 2.767      |
| <b>ROE (Return on equity)</b>                | 7%                  | 6,7%                          | 6,7%       |
| <b>Payout ratio (<math>\rho</math>)</b>      | 48,8%               | 48,8%                         | 48,8%      |
| <b>Plowback ratio (1-<math>\rho</math>)</b>  | 51,2%               | 51,2%                         | 51,2%      |
| <b>Growth rate (g)</b>                       | 3,5%                | 3,4%                          | 3,4%       |
| <b>Beta of equity (<math>\beta_e</math>)</b> | 1,21                | 1,21                          | 1,12       |
| <b>Beta of assets (<math>\beta_a</math>)</b> | 0,092               | 0,092                         | 0,092      |
| <b>Cost of capital (<math>r_e</math>)</b>    | 8,25%               | 8,25%                         | 7,49%      |
| <b>Market Capitalization</b>                 | 29.509              | 28.909                        | 30.926     |
| <b>Loss in Market Capitalization</b>         | -                   | 3.016                         | 999        |

\* Assuming an increase in the capital ratio of 1 percentage point.

## 6. Mapping higher capital to credit price

As already observed, the hypothesis underlying this study is that banks respond to a change in capital requirements by raising the interest rates on loans, so as to offset the effects coming from a reduction in the debt to equity ratio.

Indeed, by increasing net income, a raise in loan pricing could be able to push up bank's ROE, neutralizing the potential loss in equity market value associated with an higher shareholders' equity funding.

Although the ability of banks to increase rates on loans depends on many factors, in assessing the change in credit price required to keep safe bank's market capitalization, the supply of bank credit is assumed to be an exogenous variable. That is, we did not consider the elasticity of loan demand and the degree of banking competition.

As lending rates cannot be directly observed, the effect of an increase in credit price is modelled as an increase in the average interest rate charged by a bank on its entire loan portfolio, so that the impact on the bank's earnings may be expressed as follows:

$$\Delta E = \Delta IL \cdot (1 - t) = \alpha \cdot NL \cdot (1 - t) \quad (21)$$

where  $\Delta E$  is the change in bank's earnings,  $\Delta IL$  is the change in the interest income on loans,  $NL$  is the total amount of loans ("net loans" in bank's balance sheet),  $t$  is the tax rate and  $\alpha$  is the increment in the average interest rate charged on loans.

In order to calibrate the size of the required increase in earnings ( $\Delta E$ ), and then in  $\alpha$ , we have to solve the equation (13c) replacing the market value (MV) with the target market value (TMV), and setting earnings as dependent variable. In other words, we have to find the value of  $\Delta E$  which solve the following equation:

$$TMV = \frac{E_{t+1} \cdot \rho \cdot \left[ 1 + \frac{E_{t+1}}{BV_{t+1}} \cdot (1 - \rho) \right]}{r_e - \frac{E_{t+1}}{BV_{t+1}} \cdot (1 - \rho)} = \frac{(E_t + \Delta E) \cdot \rho \cdot \left[ 1 + \frac{E_t + \Delta E}{BV_t + \Delta BV} \cdot (1 - \rho) \right]}{r_e - \frac{E_t + \Delta E}{BV_t + \Delta BV} \cdot (1 - \rho)} \quad (22)$$

Where TMV is the target market value of equity, that is 31.925 (i.e. 29.509 + 2.416),  $E_{t+1}$  (the dependent variable) is the value of bank's earnings after the increase of interest rate on loans,  $BV_{t+1}$  is the book value of equity after the new equity funding, that is 41.380 (i.e. 38.963 + 2.416,90).

Recalling equations (9b), (10), (16) and (21), the equation (22) may be written as follows:

$$TMV = \frac{\rho \cdot [E_t + (\alpha NL + r_d \Delta BV)(1-t)] \cdot \left[ 1 + \frac{E_t + (\alpha NL + r_d \Delta BV)(1-t)}{BV_t + \Delta BV} \cdot (1-\rho) \right]}{r_e - \frac{E_t + (\alpha NL + r_d \Delta BV)(1-t)}{BV_t + \Delta BV} \cdot (1-\rho)} \quad (23)$$

Then, for our representative bank, in the first scenario (No M-M effect), the required change in credit price may be obtained solving the following equation:

$$\frac{48,8\% \cdot [2.767 + \alpha \cdot 300.138 \cdot (1 - 25,2\%)] \cdot \left[ 1 + \frac{2.767 + \alpha \cdot 300.138 \cdot (1 - 25,2\%)}{41.380} \cdot 51,2\% \right]}{8,25\% - \frac{2.767 + \alpha \cdot 300.138 \cdot (1 - 25,2\%)}{41.380} \cdot 51,2\%} = 31.925 \quad (24)$$

In the alternative calibration (M-M effect), the equation we have to solve is the same, with the only difference being that the required return on equity falls from 8,25% to 7,49%:

$$\frac{48,8\% \cdot [2.767 + \alpha \cdot 300.138 \cdot (1 - 25,2\%)] \cdot \left[ 1 + \frac{2.767 + \alpha \cdot 300.138 \cdot (1 - 25,2\%)}{41.380} \cdot 51,2\% \right]}{7,49\% - \frac{2.767 + \alpha \cdot 300.138 \cdot (1 - 25,2\%)}{41.380} \cdot 51,2\%} = 31.925 \quad (25)$$

Solving both equations we find that in the first hypothesis (No M-M effect), we need to increase the average interest rate on loans by 0,071%, while in the second calibration (M-M effect) the required change in the cost of credit is 0,022%.

We made the same exercise assuming a progressive increase of 1 pp (percentage point) in the capital ratio. Results of our test are shown in table 7.

**Table 7: Impact of higher capital requirements on lending rates (representative bank, 2005-2010)**

| Increase in capital ratio (percentage points) | No M-M effect | M-M effect |
|---|---------------|------------|
| 0   | 0             | 0          |
| +1  | 0,071%        | 0,022%     |
| +2  | 0,141%        | 0,044%     |
| +3  | 0,212%        | 0,067%     |
| +4  | 0,282%        | 0,090%     |
| +5  | 0,352%        | 0,114%     |
| +6  | 0,422%        | 0,137%     |

The above table provides a measure of the change in lending rates required to offset the fall in bank's market value associated with different assumptions of growth in the capital ratio.

As long as debt is replaced by new shareholders' equity and the cost of debt is unchanged, the increase in credit price rises linearly with the increase in the capital ratio. Column two in table seven shows that for each percentage point of increase in the capital ratio, our representative bank would need to rise the average interest rate on loans by roughly 0,07 percentage point. Assuming the M-M effect (column three), bank is required to increase the cost of loans by about 0,02 pp for each percentage point of increase in the capital ratio. This means that, to the extent that the M-M model holds for banks, the change in lending rates associated with an increase in the capital ratio is about 30% as large as it would be if M-M did not hold at all. So the effect of increased capital requirements on lending rates is clearly stronger in the first scenario, though still small in absolute terms.

In our analysis we assumed that banks react to any additional costs associated with the regulatory reform by only raising the interest rate on a loan to end-customers. However, banks have a number of options to increase net income, such as increasing non-interest income and/or reducing personnel expenses or other administrative expenses.

**Table 8: Role of non-interest income and expenses under higher capital requirements (representative bank, 2005-2010)**

| Increase in capital ratio (percentage points) | Offsetting change* (%) |                    |                               |
|---|------------------------|--------------------|-------------------------------|
|   | Fees and commissions   | Personnel Expenses | Other Administrative Expenses |
| 0   | 0                      | 0                  | 0                             |
| +1  | 4,6%                   | -2,2%              | -3,8%                         |
| +2  | 9,2%                   | -4,5%              | -7,6%                         |
| +3  | 13,8%                  | -6,7%              | -11,3%                        |
| +4  | 18,3%                  | -9,1%              | -15,1%                        |
| +5  | 22,9%                  | -11,5%             | -18,8%                        |
| +6  | 27,4%                  | -14%               | -22,6%                        |

\* Assuming the worst scenario (No M-M effect).

Table 8 shows how our representative bank could recover the loss of market value coming from increased capital ratio, by increasing non-interest income (fees and commission) or by reducing operating expenses (personnel expenses or other administrative expenses), holding interest rates on loans unchanged.

## 7. Conclusions and future research

This study provided a methodology for mapping the impact of higher capital requirements on bank lending rates. Such a study is useful to assess the effects of regulatory changes on the cost of credit for households and corporations.

According to our estimates, considerably higher capital requirements are likely to have only a modest impact on the average interest rate charged on loans. In the worst scenario, each percentage point increase in capital can be recovered by raising lending rates by 7 basis points for a representative bank. Thus, even relatively large changes in capital requirements are expected to lead to a small long-term impact on the interest rates faced by borrowers. For example, a five-percentage-point increase in required

capital requirement can be offset by an increase in the cost of credit of only 35 basis points.

Our calibration assumes the bank's accounting and market magnitudes in the two steady-states - the actual one and the long-run steady-state - are the same except for leverage. If the cost of banks' debt is expected to decrease as leverage falls and/or we allow positive changes in non-interest sources of income and/or expenses, the impact on lending rates is even lower.

Therefore, based on our analysis, we believe that the Italian banking system will be able to adjust to higher capital requirements through a combination of strategic and commercial actions, with no significant effect on loan prices.

Our results appear to be in line with previous research (Kashyap et al. (2010), King (2010)). Nevertheless, we believe this study is original for two aspects at least: first, it is specific of Italian banking sector, while most of the empirical literature refers to an Anglo-Saxon context; second, it is based on a financial model, which we believe may better represent the effect of structural changes in a firm's leverage than pure accounting models

Also, the model it's flexible, as it can be managed to estimate the effects resulting from a change in banks' capital structure, in the composition of assets and/or in the different sources of income and expenses.

Of course, our approach has its limitations. First, setting apart the assumptions on which our calibrations relies, the present study does not provide estimates based on an optimization process linked to a general equilibrium setting.

Second, while the BCBS proposals outline changes both in capital and liquidity requirements, this study focuses just on the effects on loan policy of the new capital requirements. Short (Liquidity Coverage Ratio - LCR) and long-term (Net Stable Funding Ratio - NSFR) liquidity requirements can have direct cost implication for banks, such as higher interest expense - associated with the extension of the maturity of debt - and lower interest income - as banks are required to hold more liquid, less-risky assets.

Future research could further investigate the impact on lending policies of the Basel III requirements as a whole, to fully evaluate the potential synergies between the new

capital and liquidity requirements and how they will affect the general economics of banks, their operating margins, financial capacity and balance sheet structure.

## References

- Acharya V. V., Gujral I., Shin H. S. (2009), "Dividends and Bank Capital in the Financial Crisis of 2007-2009", available at SSRN: <http://ssrn.com/abstract=1362299>.
- Admati A. R., DeMarzo, P.M, Hellwig M.F. & Pfleiderer P. (2010), "Fallacies, Irrelevant Facts, and Myths in the Discussion of Capital Regulation: Why Bank Equity is Not Expensive", The Rock Center for Corporate Governance at Stanford University, Working Paper Series No. 86, October 2010.
- Angelini P., Clerc L., Cúrdia V., Gambacorta L., Gerali A., Locarno A., Motto R., Roeger W., Van den Heuvel S. and Vlček J. (2011), "BASEL III: Long-term Impact on Economic Performance and Fluctuations", *BIS Working Papers*, No. 338 and Bank of Italy Occasional Paper, No. 87.
- Auerbach A. (2002), "Taxation and Corporate Financial Policy", *American Economic Review*, Vol. 92, pp 67-178.
- Bank for International Settlements (BIS, 2008), "78th Annual Report", Basel, Switzerland.
- Bank for International Settlements (BIS, 2009), "79th Annual Report", Basel, Switzerland.
- Barajas A., Chami R., Cosimano T., Hakura D. (2010), "U.S. Bank Behavior in the Wake of the 2007–2009 Financial Crisis", *IMF Working Paper*, No. 10/131.
- Basel Committee on Banking Supervision (BCBS, 2009a), "Strengthening the resilience of the banking sector", Consultative Document (December).
- Basel Committee on Banking Supervision (BCBS, 2009b), "International framework for liquidity risk measurement, standards and monitoring", Consultative Document (December).
- Basel Committee on Banking Supervision (BCBS, 2010), "An assessment of the long-term economic impact of stronger capital and liquidity requirements" (August).
- Berger A. N., Herring R., Szego G. P. (1995), "The Role of Capital in Financial Institutions", *Journal of Banking and Finance*, Vol. 19, pp. 393-430.
- Berger A. N., Bouwman C. H. S. (2009), "Bank Capital, Survival, and Performance around Financial Crises", working paper, The Wharton Financial Institutions Center.

- Berger A. N., Bouwman C. H. S. (2010), "How Does Capital Affect Bank Performance During Financial Crises?", working paper, The Wharton Financial Institutions Center.
- Berrospide J. M., Edge R. M. (2010), "The effects of bank capital on lending: What do we know? and, what does it all mean?", *Finance and Economics Discussion Series*, No. 44.
- Brealey R. A. (2006), "Basel II: The Route Ahead or Col-de-sac?" *Journal of Applied Corporate Finance*, vol. 18.
- Calomiris C, Kahn C. (1991), "The Role of Demandable Debt in Structuring Optimal Banking Arrangements", *The American Economic Review*, Vol. 81, No 3.
- Chami R., Cosimano T. F. (2001), "Monetary Policy with a Touch of Basel", *IMF Working Paper*, No. 01/151.
- Cheng Y., Green C. (2008), "Taxes and Capital Structure: A Study of European Companies", *The Manchester School*, Vol. 76 (S1), pp. 85-115.
- Cosimano T. F., Hakura D. S. (2011), "Bank Behavior in Response to Basel III: A Cross-Country Analysis", *IMF Working Paper*, No. 11/119.
- Damodaran A. (2001), *Investment Valuation*, John Wiley & Sons.
- Elliott D.J. (2010), "Quantifying the Effects on Lending of Increased Capital Requirements", The Brookings Institutions, 21 September.
- Fernandez P., del Campo J. (2011), "Market Risk Premium used in 2010 by Analysts and Companies: a survey with 2,400 answers", *IESE Business School-University of Navarra, Working Paper*, No. 912, March.
- French K. R., Baily M. N., Campbell J. Y., Cochrane J. H., Diamond D. W., Duffie D., Kashyap A. K., Mishkin F. S., Rajan R. G., Scharfstein D. S., Shiller R. J., Shin H. S., Slaughter M. J., Stein J. C., Stulz R. M., 2010, *The Squam Lake Report: Fixing the Financial System*, Princeton University Press.
- Froot K. A., Stein J. C. (1998), "Risk Management, Capital Budgeting, and Capital Structure Policy for Financial Institutions: An Integrated Approach," *Journal of Financial Economics*, Vol. 47, No. 1, pp. 55-82.
- Graham J. (2003), "Taxes and Corporate Finance: A Review", *Review of Financial Studies*, Vol. 16, pp. 1075-1129.
- Gropp R., Heider F. (2010), "The determinants of bank capital structure," *Review of Finance*, vol. 14.

- Hannoun H. (2010), "The Basel III Capital Framework: A Decisive Breakthrough", BoJ-BIS High Level Seminar on Financial Regulatory Reform: Implications for Asia and the Pacific, Hong Kong SAR, November.
- Inderst R., Mueller H. M. (2008), "Bank capital structure and credit decisions", *Journal Financial Intermediation*, Vol. 17, Issue 3, pp. 295-314.
- Kashyap K., Stein J., Hanson S. (2010), "An Analysis of the Impact of 'Substantially Heightened' Capital Requirements on Large Financial Institutions," *Working Paper*.
- King M. R. (1990), "International Harmonisation of the Regulation of Capital Markets: An Introduction" *European Economic Review*, Vol. 34.
- King M R. (2009), "The cost of equity for global banks: a CAPM perspective from 1990 to 2009", *BIS Quarterly Review*, September.
- King M.R. (2010) "Mapping capital and liquidity requirements to bank lending spreads", *BIS Working Paper*, No 324, November.
- Koziol C., Lawrenz J. (2009), "What Makes a Bank Risky? Insights from the optimal capital structure of banks", *Journal of Banking and Finance*, Vol. 33, Issue 5.
- Leland H.E., Pyle D.H. (1977), "Informational asymmetries, financial structure, and financial intermediation", *The Journal of Finance*, Vol. 32, N. 2, May.
- Maccario A., Sironi A., Zazzara C (2002), "Is Banks' Cost of Equity Capital Different Across Countries? Evidence from the G10 Countries Major Banks", *SDA Bocconi Research Division Working Paper*, No 02-77.
- Macroeconomic Assessment Group (MAG 2010a), "Assessing the Macroeconomic Impact of the Transition to Stronger Capital and Liquidity Requirements", Group established Financial Stability Board and the Basel Committee on Banking Supervision, August.
- Macroeconomic Assessment Group (MAG 2010b), "Assessing the Macroeconomic Impact of the Transition to Stronger Capital and Liquidity Requirements – Final Report", Basel Committee on Banking Supervision, December.
- Masera R. (2009), *The Great Financial Crisis*, Banca Editrice.
- Marcus A. J. (1983), "The bank capital decision: a time series cross-section analysis", *Journal of Finance*, vol. 38.

- Meh C., Moran K. (2010), "The role of bank capital in the propagation of shocks", *Journal of Economic Dynamics and Control*, Vol. 34, Issue 3, pages 555-576.
- Memmel C., Raupach P. (2010), "How do banks adjust their capital ratios?", *Journal of Financial Intermediation*, Vol. 19, Issue 4, Pages 509-528.
- Mehran H., Thakor A. (2011), "Bank capital and value in the cross section", *Review of Financial Studies*, vol. 24, Issue 4, pp. 1019-1067.
- Miles D., Yang J., Marcheggiano G. (2011), "Optimal bank capital", *Bank of England, Discussion Paper*, No. 31, January.
- Miller M. (1995), "Do the M&M propositions apply to banks?", *Journal of Banking and Finance*, vol. 19.
- Modigliani F., Miller M. (1958), "The cost of capital, corporation finance and the theory of investment", *The American Economic Review*, vol. 48.
- Morrison A. D., White L. (2005), "Crises and Capital Requirements in Banking", *American Economic Review*, vol. 95, Issue 5, pp. 1548–1572.
- Repullo R., Suarez J. (2004), "Loan pricing under Basel capital requirements" *Journal of Financial Intermediation*, vol. 13. No. 4, pp. 496-521.
- Resti A., Iannotta G. (2010), "Bank Capital under Basel 3: Open Issues and Foreseeable Effects", *Carefin Working Paper*, No 21.
- Ruthenberg D., Landskroner Y. (2008), "Loan pricing under Basel II in an imperfectly competitive banking market", *Journal of Banking and Finance*, vol. 32, pp. 2725-2733.
- Santos J.A.C. (2001), "Bank capital regulation in contemporary banking theory: A review of the literature", *Financial Markets, Institutions & Instruments*, vol. 10, No. 2, pp. 41-84.
- Slovik P., Courne de B., (2011), "Macroeconomic Impact of Basel III", *OECD Economics Department Working Papers*, No. 844.
- Titman S. (2002), "The Modigliani and Miller theorem and the Integration of Financial Markets", *Financial Management*, vol. 31, No. 1.
- VanHoose D. (2007) "Theories of bank behaviour under capital regulation", *Journal of Banking and Finance*, vol. 31, pp. 3680-3697.