

The Impact of Capital and Liquidity Regulation: Evidence from European Banks

Armen Arakelyan^a
CUNEF

Artashes Karapetyan^b
Norges Bank

This version: October 2014

Abstract

Under the assumption of efficient and perfect capital markets, lower leverage leads to lower equity risk and hence lower required return on it, leaving weighted average cost of capital unchanged. We test this using data from listed European banks. We find that lower leverage (as well as higher liquidity) decrease equity risk. However, low risk banks offer higher or the same risk-adjusted stock returns in excess of risk-free rate. Under the assumption of riskless debt, calibration results show that a 10 percentage point increase in capital requirements brings about a 45 basis point increase in the weighted average cost of capital.

JEL classification: G01, G12, G21, G28

Keywords: Bank regulation, cost of capital, liquidity, low risk anomaly

^aA. Arakelyan is from Department of Finance, University College of Financial Studies (CUNEF), c/Leonardo Prieto Casto, 2, 28040 Madrid, Spain. Tel: +34 91 448 08 92, email: armen@cunef.edu. ^bA. Karapetyan is from Norges Bank Research, Bankplassen 2, P.O. Box 1179 Sentrum, Norway. Tel: + 47 22 31 62 52, e-mail: Artashes.Karapetyan@norges-bank.no. We thank G. Rubio, E. Duca, L. Swinkels, seminar participants at CUNEF, Norges Bank, EFMA 2014, and the 2014 Conference on Econometric Methods for Banking and Finance (Banco de Portugal) for valuable comments and suggestions. The views expressed in the paper do not represent those of Norges Bank. All remaining errors are ours.

1 Introduction

Highly leveraged financial institutions create negative externalities: a small decrease in the asset value of a highly leveraged bank can lead to distress and potential insolvency. In an interconnected financial system, this can cause the system to freeze, and may lead to severe repercussions for the rest of the economy. Governments often spend large amounts on bailouts and recovery efforts to minimize social damage. Whereas avoiding such systemic risk and its social costs is a major objective of financial regulation, market participants act in their own interests and pay little attention to systemic concerns: the role of financial regulation is to safeguard the well functioning of the financial industry.

After the experience of the recent financial crisis policy makers and academics have been actively debating whether banks should reduce their leverage. The purpose of using relatively more equity funding is to avoid that variations in asset values lead to distress and insolvency. Most bankers, however, consider equity as a costly source of bank finance: since equity is more costly than debt, then more of it will increase the weighted average cost of capital.

A number of recent studies, on the other hand, have argued that the overall cost of capital will remain unchanged despite changes in capital structure. Admati et al. (2011) consider arguments of expensive equity as fallacy and bring up the classical example of Modigliani-Miller: since the increase in capital provides further protection to shareholders reducing their risk, they will require lower rates of return in the more capitalized bank.

Thus whether or not higher capital requirements affect banks' overall cost of capital (and therefore lending rates and economic activity) is an empirical concern. In this paper we address this concern by using comprehensive data from listed European Banks. Our main objective is to evaluate the capital requirements and the risk-return relationship in the banking stock market.

Similar to Baker and Wurgler (2014), our methodology proceeds in two steps. First, we estimate, the impact of leverage on bank equity risk and, second, the relation between equity risk and

cost of bank equity or the overall cost of capital. In addition we estimate the impact of liquidity regulation on bank equity risk. Empirical evidence on the risk return relationship is mixed. Our motivation stems particularly from the potential interaction between capital requirements and the low risk anomaly within the stock market. That is, while stocks have on average earned higher returns than less risky asset classes (such as corporate bonds, which in turn have earned higher returns than government bonds or other riskless assets) the risk-return relationship within the stock market has historically been flat or even inverted.

Fama and French (1992), Baker et al. (2011) find a flat or negative relationship between a stock's systematic risk, as measured by its stock market beta, and its subsequent returns. Similar patterns of negative relationship have also been documented between idiosyncratic risk and returns in the U.S. as well as many international stock markets (see, for instance, Ang et al. (2009)). These studies suggest that there is a low risk anomaly on average within the stock market. Therefore, a relevant question for bank capital regulation is whether this holds within banks specifically. Indeed, the low risk anomaly might not be present in banks at all. All of these studies suggest that risk is not necessarily rewarded, and the relevant question is whether or not this is the case for the banking stocks in Europe. Does the cost of equity fall with capital requirements as the Modigliani-Miller logic predicts? Or does it not fall by enough, or actually increase, as bankers and the low risk anomaly would imply? Baker and Wurgler (2014) bring evidence supporting low risk anomaly from the U.S.. We conclude the same from banks across major Western European economies in the period from 1990 to 2014, and to the best of our knowledge this is the first attempt to do so.

The choice of capital is endogenous to the riskiness of banks' assets: highly leveraged financial institutions would not opt for very risky investments fearing bankruptcy, while those with high capital would have more appetite for risk. To address this, we follow Baker and Wurgler (2014) and proceed in two steps in the regression analysis: the first step is to relate bank equity risk

estimated from markets to capital ratios from annual accounting data. In the second step, we regress realized returns on equity to bank equity betas. Our most important finding is that while the expected relationship in the first step is confirmed, we see no positive, or even negative, relationship between risk and excess return in the second one.

The two steps together also allow us to calibrate the effect of increased capital requirements on the cost of equity as well as on weighted average cost of capital, under some assumptions made about the riskiness of debt. As a benchmark case, under the assumption of riskless debt, we find that a 10 percentage point increase in capital requirement bring about a 45 percentage point increases in WACC. Finally, in some of the analysis we also look at idiosyncratic risk in addition to beta. The key insight from the procedure is that the established link in the first step is an attenuated one: absent endogeneity, increases in capital ratios would have translated to more pronounced decreases in equity betas. In the second step, this would have resulted in at least as much an increase in excess return, yielding WACC even higher.

Since we are studying international stocks, we make certain assumption about the extent of integration of asset markets across countries. There may be problems if there is absence of integrated asset pricing in the region we cover. Even in the case when we have the correct asset pricing model, let's assume for instance CAPM, (and suppose we have integrates asset pricing), betas with respect to the whole region's market portfolio explain expected returns on all assets, but then local version of CAPM should not work. For example, betas with respect to the U.K. market portfolio should not explain expected returns on all U.K. assets. On the other hand if pricing is not regionally integrated, the international CAPM should fail if a local CAPM prices assets in each market. Following Fama and French (2012), we will assume that the European region is integrated enough and can be treated as one market.

Banking literature typically studies loan portfolios of banks, where the prices of loans are hard to measure on a market basis on a high enough frequency. In this regard, our paper is different

from the typical banking literature, and in terms of methodology closer to asset pricing literature of mainly non-financial firms, as well as the few recent studies on banking equity. From the latter group, perhaps closest to our paper is Baker and Wurgler (2014) and Kashyap et al. (2010), who did similar analysis for the U.S..¹

2 Betas, capital, and return

Standard theory of the firm predicts that lower leverage reduces risk and therefore cost of equity, under the assumptions of perfect and efficient capital markets.² In this paper, we confirm the first part of the theory, namely that the risk of bank goes down as leverage decreases. Our measures of capitalization show that the most capitalized banks have the lowest equity betas.³ Interestingly, these differences are affected (i.e., attenuated) by two factors. First, they would be more pronounced if banks with riskier assets did not choose to have larger capital; because riskier assets increase bankruptcy probability, banks will want to increase their capital cushion. Thus, such a move is endogenous, and reduces the slope between capital ratios and beta.

Second, from some point on part of the asset risk is eventually borne by debtholders. This is true for highly leveraged banks; if a highly leveraged bank further increases its leverage, it is likely to increase its bankruptcy probability and therefore the risk for debtholders. But because debt risk rises, beta of debt will rise too, thus giving room for a more attenuated rise in equity's beta, thereby flattening the relationship between beta and capital ratios.

According to the second part of the theoretical argument, a reduction of equity beta should be reflected in a reduction of the cost of equity. We however show that this is not the case.

The reduction of beta is generally invariant to returns, in line with empirical evidence on the

¹ King (2009) estimates cost of equity in a single factor CAPM model, while Maccario et al. (2002) estimate banks' cost of equity using analyst earnings' forecast.

²Modigliani-Miller irrelevance predicts that the overall cost of capital is unchanged

³In fact, this is also true for idiosyncratic risk measures.

low risk anomaly. While in efficient capital markets banks with higher capital ratios should have lower equity returns, capital structure is endogenous due to risk aversion and bankruptcy costs, rendering the cross-sectional analysis of capital ratios and beta erroneous.

To understand the causal effect of an increase in (exogenous) capital requirements we take into account the endogenous choice of (risky) banks for (high) capital, similar to Baker and Wurgler (2014). These effects will tend to reduce the effect of higher capital (as caused by regulation) on equity beta. But if one ignores the latter and still finds the expected relationship between capital and empirical equity betas, then it means that the exogenous effects will be at least as large.

The main arguments in the discussion of whether increased equity ratios will make the cost of capital higher, may be summarised by looking at the equation relating cost of assets to the cost of equity, the cost of debt and the equity ratio

$$\beta_{Asset} = \frac{E}{D + E}\beta_{Equity} + \frac{D}{D + E}\beta_{Debt}.$$

In this equation the cost of equity is typically higher than the cost of debt. What is often referred to as the Miller and Modigliani (MM) argument, is that the left hand side of this equation does not change if the equity ratio changes. If the equity share is increased, the volatility of equity is reduced and so is the cost of equity. The cost of debt, on the other hand, will either remain unchanged or decrease. Even though the individual elements of the right hand side of the equations will (or may, in case of debt) change, the sum of the elements will not change. What seems to be banks' argument is that the left hand side of the equation does change when the equity share is increased. In other words, the cost of capital is not fixed. Increasing the equity ratio will make the cost of capital higher because "cheap" debt is replaced by "expensive" equity. Even though the cost of equity is reduced, this reduction will not be large enough to avoid that an increase in the cost of capital. Bankers use this line of reasoning when arguing against stricter capital regulation and against stricter capital regulation in one country than another. Note that

the above yields

$$\beta_{Equity} = \frac{D + E}{E} \beta_{Asset} - \frac{D}{E} \beta_{Debt} \quad (1)$$

In the two step analysis of the impact of heightened capital regulation on cost of capital, the estimation of the above relationship will be the first step. The relationship between leverage and equity beta is linear whenever debt is riskless, and the slope is equal to the asset beta. As mentioned before, whenever leverage is very high and debt is no longer riskless, further increase in leverage will be accompanied by increases in debt beta, and therefore equity beta will not increase at the same pace: the increase in asset risk is now partially borne by debtholders. Such effect is in addition, and amplifies the attenuating effect of endogenous capital selection.

2.1 Liquidity requirements in Basel III Regulation

In December 2009 the Basel committee introduced new rules to the existing Basel II regulation, known as Basel III. In addition to revised capital adequacy requirements, Basel III proposed two new liquidity requirements: the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR). Essentially, banks are required to hold sufficient amount of high quality liquid assets (HQLA) to meet their net cash requirements until day 30 of the stress scenario (see BCBS (2014) for details of NSFR and BCBS (2013) for detailed definition of HQLA and LCR).⁴ Holding liquid instruments such as cash or government bonds can reduce asset beta, the overall risk of the bank, and equity beta. With the low risk anomaly, this may then increase the cost of bank equity.

The calculation of the cost to meet the NSFR is not trivial and will depend on definition of the

⁴The aim of LCR is ensure that banks can withstand a 30-day liquidity stress scenario. The NSFR is a longer-term liquidity ratio designed to address maturity mismatches between banks' assets and liabilities over one-year horizon. It provides incentives for banks to use stable sources of funding, such as stable deposits, equity and long-term liabilities. The banks are set to report new ratios from 2015. The implementation of the new Basel III regulations will be carried out gradually until 2019. Particularly, by the beginning of 2019 the banks should have reached 100% level for LCR. See Appendix A for the timing and implementation of Basel III requirements.

ratio. It requires assumptions about the composition of banks assets and liabilities, and estimates of the returns on different assets and the costs of different liabilities. This detailed information is not disclosed in a banks financial statements, but is being collected by the Basel Committee on banking Supervision (BCBS) through the Quantitative Impact Study (QIS). Below we follow King (2009), where the estimates are based on the December 2009 proposal of the NSFR, which was modified in July 2010 with the implementation date moved out to 2018.

3 Data and Summary Statistics

We use all European companies classified as banks by Industry classification Benchmark (ICB) from Bloomberg. More specifically, our broad sample includes both active and non-active banks domiciled in 43 European countries.⁵ The data are from January 1990 to September 2014. We mostly carry out our analysis for banks from Eurozone that joined the monetary union before 2001, the U.K., Switzerland and Scandinavia, except Iceland. We use the full sample with Central European countries in robustness checks.

Our market data for banks include end-of-month observations for closing share prices, market capitalization, and monthly total holding period returns.⁶ Share prices and holding period returns are for one outstanding share class of a bank, as identified by the Primary Security Ticker in Bloomberg. Our accounting data for banks include major items from Balance Sheet, Income, and Cash Flow statements, and information on notes to those financial statements. The accounting data are available on a quarterly basis from 1997 Q1.⁷ All variables from market and accounting

⁵Active banks are publicly traded banks as of now, and non-active banks are those that were once active.

⁶Holding period returns include gross dividends, and represent month-end-day to month-end-day total return values. See Appendix B for detailed variable definitions.

⁷In the earlier version of this paper entitled “Impact of Higher Capital Requirements on Cost of Capital: Evidence from European Banks”, we take our banking and accounting data from Worldscope/Datastream, where accounting variables were only annual. Results are similar to the ones reported in this paper for the effects of capital requirements and are available upon request.

samples are denominated in USD. The reason for using a single currency is to ease the comparison among banks from various countries with i) different currencies and ii) currencies that have changed over our sample period.

Returns on portfolios of Fama-French 3 factors for Europe are taken from Kenneth French's data library. All factor returns are in US dollars. Risk free rates are the yields from one-month US Treasury bills, taken from Kenneth French. Additionally, we also obtain the total return series for EURO STOXX 50 and STOXX Europe 600 indexes and time series of EURIBOR for one and three month maturities. Whenever available, we use gross total returns for the indexes.

We proceed by merging accounting data with market returns. Similar to Fama and French (1992), we ensure that the accounting variables are known prior to the returns that they are used to explain. To this end, we match the accounting data for all fiscal quarter-ends in month t with the market returns for months $t + 1$ to $t + 3$. We allow one month gap between quarter-end month and the returns because quarterly filings made by public companies follow the end of each quarter (with delay). Most companies file in January, April, July and October.

For capital adequacy analysis we consider the following measures: i) Total common equity to Total assets, ii) Tangible Equity to Total Assets iii) Total Risk-Based Capital to Total Assets, iv) Tier 1 capital to Risk Weighted Assets (RWA), and v) Total Risk-Based Capital to RWA.⁸

As for the liquidity requirements, we consider i) Cash and near cash items divided by Short-Term Debt as a proxy for LCR and ii) a proxy for NSFR, following King (2010). We recall that LCR and NSFR are not directly observable as the constituents used to calculate these measures are not available on financial statements.

⁸Regulatory capital consists of other elements than equity. Basel III uses the categories Tier 1 and Tier 2 capital for regulatory capital. Tier 1 consists of Common Equity Tier 1 and Additional Tier 1 (AT1) capital. AT1 capital is hybrid capital with "equity-like" characteristics. The minimum regulatory capital requirements are expressed as a minimum level of the ratio of regulatory capital to risk weighted assets. Banks may therefore improve their regulatory capital ratios by increasing the regulatory capital or by reducing risk weighted assets. There is therefore not a one-to-one relationship between higher regulatory capital requirements and higher equity ratios. Basel III, however, does imply that most banks have to increase their equity levels. In addition, Basel III introduces a minimum requirement for the equity ratio.

3.1 Summary Statistics

Table 1 shows the number of banks in each period and each country. Our primary sample includes bank-months for which we can calculate a valid beta, with at least 24 monthly holding period return observations, a valid market capitalization, and at least one holding period return following a valid beta.

Table 2 provides summary statistics by pre-ranking betas, from July 1990 to October 2013. Pre-ranking beta is computed by regressing a minimum of 24 months and a maximum of 60 months of trailing holding period returns on the European market return, in excess of the one month US Treasury bill. The market return for the European region is taken from Kenneth French's data library. In some of the analysis we also look at idiosyncratic risk in addition to beta. We take the root mean square error (RMSE) from pre-ranking beta regressions as our measure of idiosyncratic risk. In the first panel, we report means and medians by dividing the sample within each month into low (bottom 33.3%), medium (middle 33.3%), and high (top 33.3%) portfolios according to pre-ranking beta. The second panel reports means and medians of RMSE for the same portfolios. The pre-ranking betas are 0.28 and 1.29 in the bottom and top pre-ranking beta percentiles, respectively. Unlike non-financial firms, there is a positive relationship between bank size and risk; market capitalization increases with beta. Big banks might have other units, such as investment banking, brokerage, and asset management. The investment carried out by these units tend to produce returns that co-move with the overall stock market returns.

Figure 1 plots the time series of average betas (both equal and value weighted) for each pre-ranking beta percentile. There is an upward trend in the time series of pre-ranking betas. Pre-ranking betas also seem to increase during financial crisis. In particular, there is a noticeable increase in betas after mid 1997 and 2007, respectively. The former is due to the Asian financial crisis of 2007, and subsequent Russian crisis of 1998, while the latter is associated with the subprime crisis that originated in the U.S. in mid 2007.

Table 3 provides the summary statistics of post-ranking portfolio betas by capital and liquidity ratio percentiles. The sample is divided within each month into five percentile portfolios according to capital or liquidity. We follow Fama and French (1992) to calculate post-ranking betas. In particular, we first calculate monthly returns in excess of risk-free rate on different portfolios for each month and capital/liquidity ratio. Portfolio returns in each percentile of each capital or liquidity ratio are either equal or value weighted. Second, we regress the full sample of post-ranking portfolio excess returns on the market excess return to obtain post-ranking portfolio betas.

In all specifications for capital adequacy ratios higher capital is associated with lower post-ranking portfolio betas. As already highlighted in Section 2, the difference between portfolio betas of top and bottom percentiles of capital adequacy ratios is likely to be attenuated because of the endogenous choice of bank capital. This difference is also smaller for value weighted post-ranking betas as compared to the difference for equal-weighted post-ranking betas. Banks with higher capital adequacy ratio (e.g. in the 5th percentile) can still have high betas as riskier banks a priori might prefer to hold higher capital to avoid bankruptcy or high bankruptcy costs in the future. On the other hand, higher beta banks tend to have higher market capitalization. Due to those two observations, the value weights, which are based on the market capitalization, “inflate” the realized betas in the higher capital ratio percentiles (e.g. in the 5th percentile). Therefore, the observed difference in top and bottom value-weighted betas is smaller.

Higher liquidity is also associated with lower post-ranking betas. Similar to the capital adequacy ratios, the observed difference between top and bottom realized betas within liquidity ratio percentiles is smaller for value-weighted specification.

4 Empirical Analysis

4.1 Equity beta and capital ratio

Table 4 shows Fama-MacBeth regression results of forward beta and idiosyncratic risk on inverse equity capital, the specification suggested by equation (1), for all banks. Additionally, we run Fama-MacBeth regressions of forward beta and idiosyncratic risk on liquidity measures. Forward beta is the pre-ranking beta taken with a 24 month lead. Forward RMSE is defined in a similar fashion. In panels A1 and A2 the dependent variable is the forward beta, and in Panels B1 and B2 the dependent variable is the forward RMSE. We use the Fama and MacBeth (1973) procedure, which gives equal weight to each cross section in the estimation.

If capital choice were exogenous and debt were riskless, we would expect the intercepts in the regressions of forward betas on inverse capital ratios to be zero, and the slopes to be equal to the average bank asset betas. Consistent with the endogenous choice of capital, we observe that the intercepts are greater than zero and statistically significant in all specifications for capital adequacy. The slope coefficients are lower than what we would have obtained if the leverage choice were not endogenous. We find similar qualitative results for the idiosyncratic risk, measured by RMSE. Overall, the results of Table 4 confirm the hypothesis that higher leverage increases equity risk.

Panel A2 of Table 4 reveals that the regression slopes in the regression of forward betas on liquidity measures are negative and statistically significant. We tentatively conclude that heightened liquidity requirements decrease equity risk for banks.

4.2 Returns and cost of equity

Should lower betas reduce bank cost of equity as the argument of MM indicates? To address this question, we assign banks to three portfolio groups according to pre-ranking beta. Afterwards,

we run a series of OLS regressions, controlling for common risk factors, such as the overall market factor (CAPM), and factors related to firm size, and book-to-market equity (Fama-French 3-factor model). Table 5 provides the results of the OLS regressions. Under the CAPM model, the realized betas (equal weighted) increase from 0.32 to 1.10 for bottom and top beta portfolios, respectively. However, the risk-adjusted monthly returns in excess of the riskless rate (alphas) decline from low beta to high beta portfolios. The difference between top and bottom portfolio alphas is -59 basis points, and this difference is statistically significant. The alphas also decline relative to Fama-French 3-factor model. These results indicate that the security market line is flat relative to the CAPM model. Low beta banks particularly seem to be underpriced; the point estimates of alphas of the lowest beta portfolios are positive and significant in all specifications. Similar pattern can be discerned for value-weighted portfolios, albeit the statistical significance is weak.⁹

Therefore, theory does not match the data on stock returns for banks. We indeed document that less leverage does reduce equity risk and equity beta, but we are unable to see that lower beta translates into lower risk adjusted returns. The evidence above suggests that lower risk banks have the same or higher risk adjusted excess returns than higher risk banks.

4.3 Calibration

Following Baker and Wurgler (2014) we suppose that the CAPM holds but with a low risk anomaly (i.e. higher beta equities underperform their CAPM benchmark and lower beta equities outperform them), and returns can be explained by $r_i = (\beta_i - 1)\gamma + r_f + \beta_i r_p$, where $\gamma = \frac{\partial \alpha}{\partial \beta}$ measures the extent of the low risk anomaly. Indeed, as our Table 5 and 6 show, higher betas are related with lower alphas. This can be better seen in Figure 2 where we plot the equal weighted and value weighted alpha-beta relationships for CAPM regressions (see Table 5).

With the above returns equation in mind and assuming that debt is correctly priced by

⁹Appendix C provides the regression results of the CAPM and Fama-French 3-factor model for 5 and 10 beta-sorted portfolios. The results are qualitatively similar to the ones of 3 beta-sorted portfolios.

CAPM, WACC can be expressed by $WACC = e(\beta_e - 1)\gamma + r_f + \beta_a r_p$. To see the effect of higher capital requirements, we need to difference the above equation, which will yield $\Delta WACC = e^*(\beta_{e^*} - 1)\gamma - e(\beta_e - 1)\gamma = \gamma(e - e^* + (1 - e)\beta_d - (1 - e^*)\beta_{d^*})$. Assuming that debt is riskless means that the change in average cost of capital is equal to $\gamma(e - e^*)$, an assumption which is not far from being innocuous as the effects of changing debt beta are rather small. Indeed, means of capital ratios are between 5.6 and 13 percent for tangible equity ratio and risk-based capital to risk-weighted assets ratio, respectively, and average bank beta is 0.73 in our sample. This means that β_a are quite small. Using Table 5 we can get an estimate of the low risk anomaly: the linear regression of alpha and beta provides an estimate of $\gamma = 0.38$. With riskless debt, a 10 percentage point increase in capital requirements will bring about around 45 basis points ($= 38 \times 12 \times 0.1$) increase in cost of capital.

5 Discussion and concluding remarks

There are a number of reasons for regulatory increase in minimum capital requirements: agency problems in banks, asymmetric information, international coordination, bank governance, tax benefits of debt, government subsidies, shadow banking, and so on. Despite the costly frictions, there is a pervasive view underlying most discussions of capital regulation that equity is expensive, and that equity requirements, while having substantial benefits in mitigating problems causing instability, impose costs on the financial system and possibly on the economy. Bankers, policy makers and regulators are particularly concerned by assertions that increased equity requirements would restrict bank lending and would impede economic growth. Possibly as a result of such pressure, the proposed Basel III requirements, while moving in the direction of increasing capital, still allow banks to remain very highly leveraged.

However, the view on the impact of capital requirements on cost of capital is two-faceted.

Many economists still maintain that weighted average cost of capital will remain unchanged. Following Modigliani and Miller, Admati et al. (2011) claim that because the increase in capital provides downside protection that reduces shareholders' risk, shareholders will require a lower expected return to invest in a better capitalized bank.

We find that this theory does not match the data on stock returns for banks. While the evidence does show that less leverage reduces equity risk, there is still a role for the low risk anomaly in European bank equities: we document that lower risk banks have the same or higher risk adjusted excess returns than higher risk banks. The evidence contained in European market data suggests that increasing capital requirements by around 10 percent may be associated with 45 basis point increase in average cost of capital.

References

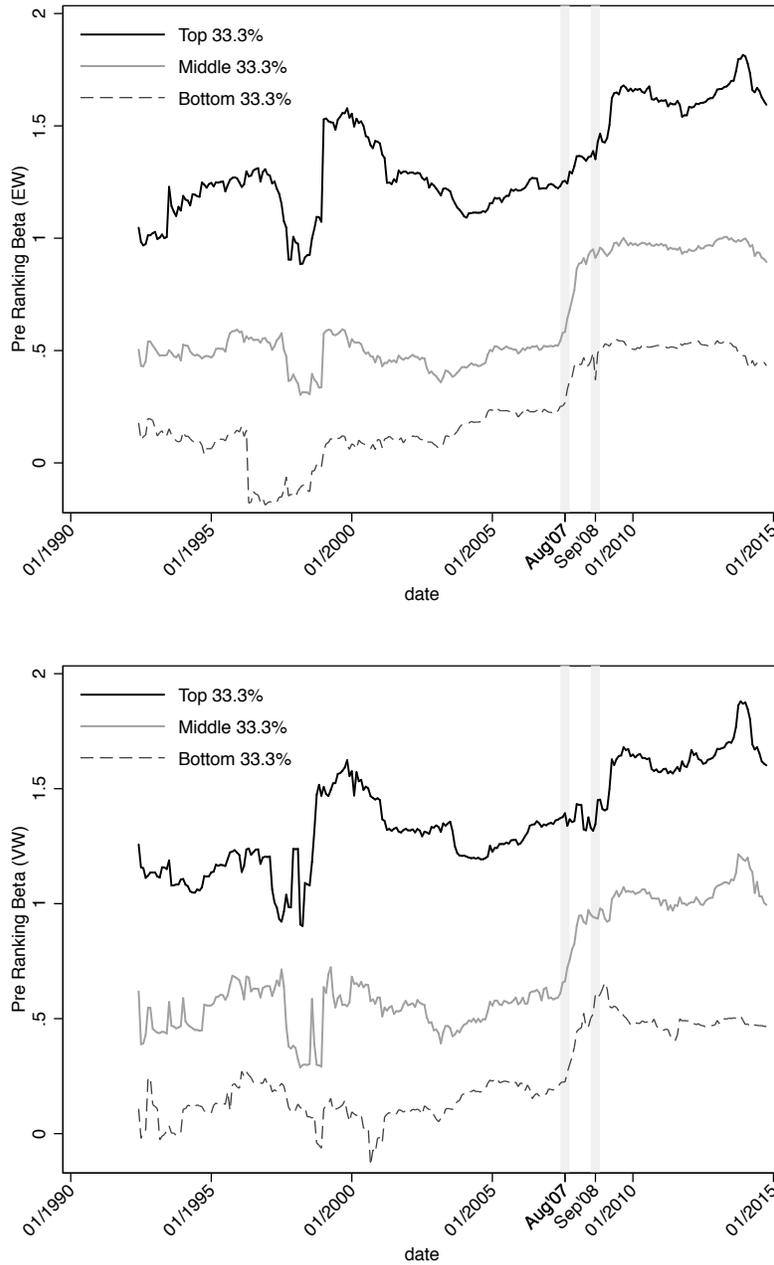
- Admati, A., P. DeMarzo, M. Hellwig, and P. Pfleiderer (2011). Fallacies, Irrelevant Facts, and Myths in the Discussion of Capital Regulation: Why Bank Equity is Not Expensive. Stanford University, Working Paper.
- Ang, A., R. J. Hodrick, Y. Xing, and X. Zhang (2009). High Idiosyncratic Volatility and Low Returns: International and Further U.S. Evidence. *Journal of Financial Economics* 91(1), 1–23.
- Baker, M., J. Bradley, and J. Wurgler (2011). Benchmarks as Limits to Arbitrage: Understanding the Low-Volatility Anomaly. *Financial Analysts Journal* 67(1), 1–15.
- Baker, M. and J. Wurgler (2014). Do Strict Capital Requirements raise the Cost of Capital: Banking Regulation and The Low Risk Anomaly. Harvard University, Working Paper.
- BCBS (2013). Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools. BIS.
- BCBS (2014). Basel III: The Net Stable Funding Ratio. Consultative Document (January).
- Fama, E. and K. French (1992). The Cross Section of Expected Stock Returns. *Journal of Finance* 47(2), 427–465.
- Fama, E. and K. French (2012). Size, Value, and Momentum in International Stock Returns. *Journal of Financial Economics* 105(3), 457–472.
- Fama, E. and J. D. MacBeth (1973). Risk, Return, and Equilibrium: Empirical Tests. *Journal of Political Economy* 81(3), 607–636.
- Kashyap, A. K., J. C. Stein, and S. G. Hanson (2010). An Analysis of the Impact of of ‘Substantially Heightened’ Capital Requirements on Large Financial Institutions. Harvard University, Working Paper.

King, M. (2009). The cost of equity for global banks: a CAPM perspective from 1990 to 2009. BIS Quarterly Review.

King, M. (2010). Mapping capital and liquidity requirements to bank lending spreads. Bank for International Settlements, Working Paper No. 324.

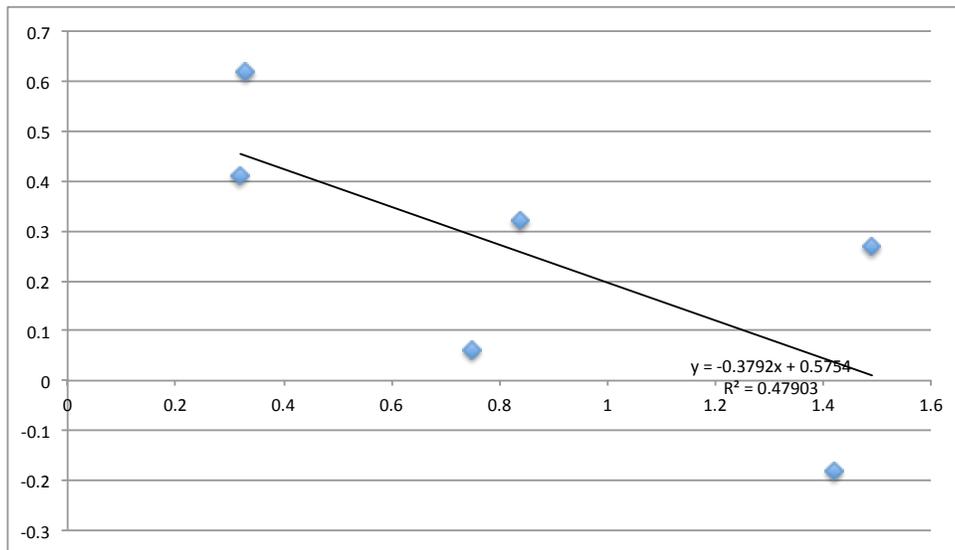
Maccario, A., A. Sironi, and C. Zazzara (2002). Is banks' cost of equity capital different across countries? Evidence from the G10 countries major banks. Libera Università Internazionale degli Studi Sociali (LUISS) Guido Carli, working paper.

Figure 1: Pre-Ranking Betas



The top and bottom panels plot the time series of equal- and value-weighted pre-ranking betas, respectively. Observations are from July 1992 to September 2014. The sample is divided into three equal parts based on pre-ranking beta sorts, top, middle, and bottom, market weighted. Included banks are all the banks classified as such by ICB in Bloomberg. The sample includes banks for which we can calculate a valid beta, with at least 24 observations of monthly holding period return, a valid market capitalization, and at least one holding period return following a valid beta. Pre-ranking beta is computed by regressing a minimum of 24 months and a maximum of 60 months of trailing holding period returns on the European market return in excess of the one month US Treasury bill.

Figure 2: Low risk anomaly



This figure plots portfolio betas and alphas from CAPM regressions of Table 5. The black line indicates the regression fit to the data.

Table 1: Banks by Country and Year

	1990 - 1994	1995 - 1999	2000 - 2004	2005 - 2009	2010 - 2014	Total
Austria	1	9	11	11	8	14
Belgium	0	4	5	5	5	6
Denmark	42	47	48	42	37	53
Finland	0	3	4	2	3	5
France	1	12	33	26	19	38
Germany	1	15	19	14	11	23
Greece	1	9	17	13	13	19
Ireland	0	3	4	4	2	4
Italy	4	36	44	31	22	52
Luxembourg	0	3	2	2	1	4
Netherlands	0	2	4	3	2	4
Norway	9	22	30	27	23	35
Portugal	0	10	10	5	5	11
Spain	2	22	19	16	12	27
Sweden	1	4	4	4	4	7
Switzerland	11	21	25	25	45	49
United Kingdom	6	14	18	9	7	24
Total	79	236	297	239	219	375

Number of banks in each country by five-year time periods and overall, from July 1992 to September 2014. Included banks are all the banks classified as such by ICB from Bloomberg. The sample includes banks for which we can calculate a valid beta, with at least 24 observations of monthly holding period returns, a valid market capitalization, and at least one holding period return following a valid beta.

Table 2: Summary Statistics

Summary statistics by pre-ranking betas, from July 1992 to September 2014. Included banks are all the banks listed as such by IBC in Bloomberg. The sample includes banks for which we can calculate a valid beta, with at least 24 observations of monthly holding period returns, a valid market capitalization, and at least one holding period return following a valid beta. Pre-ranking beta is computed by regressing a minimum of 24 months and a maximum of 60 months of trailing holding period returns on the European market return (in USD) in excess of the one month US Treasury bill. Pre-ranking Root Mean Squared Errors (RMSE) are calculated based on the residuals from these regressions. In the first panel, we report means and medians by dividing the sample within each month into low (bottom 33.3%), medium (middle 33.3%), and high (top 33.3%) portfolios according to pre-ranking beta. The second panel reports means and medians of RMSE for the same portfolios. RWA denotes Total Risk-Weighted Assets. In Europe Bank of International Settlement in Basel requires a Tier 1 ratio of 4.4% and Total risk-based capital ratio of 8%.

Panel A: Pre-Ranking Beta Sorts

	Bottom 33.3%			Middle 33.3%			Top 33.3%		
	N	mean	med	N	mean	med	N	mean	med
Pre-Ranking Beta	14873	0.25	0.22	14784	0.65	0.60	14974	1.37	1.31
Pre-Ranking RMSE	14873	6.02	4.99	14784	6.98	6.44	14974	10.28	8.40
Book-to-Market Ratio	3620	2.43	1.51	5544	1.71	1.20	8207	1.19	0.83
Market Cap	14873	683.54	106.47	14784	2496.65	362.64	14974	13796.82	4062.57
<u>Capital Adequacy:</u>									
Common Equity to Assets	3825	8.32	7.58	5717	7.40	6.61	8181	5.50	5.06
Tangible Equity to Assets	2423	7.37	6.96	3709	6.20	5.87	6589	4.61	4.28
Risk-Based Capital to Assets	1785	8.88	8.73	1999	7.72	7.48	3764	6.15	6.03
Tier 1 Capital to RWA	2565	11.65	11.76	4417	10.29	9.25	6493	9.87	9.20
Risk-Based Capital to RWA	3106	14.47	14.21	4714	12.85	11.91	6425	12.69	12.08
<u>Liquidity:</u>									
Cash to Short-Term Debt	3750	0.51	0.14	5282	0.35	0.10	7367	0.22	0.07
Net Stable Funding (Proxy)	3668	98.05	100.21	5399	93.63	95.34	8018	86.02	88.09

Panel B: Pre-Ranking RMSE Sorts

	Bottom 33.3%			Middle 33.3%			Top 33.3%		
	N	mean	med	N	mean	med	N	mean	med
Pre-Ranking Beta	14873	0.46	0.36	14784	0.75	0.69	14974	1.07	1.05
Pre-Ranking RMSE	14873	4.50	4.45	14784	6.58	6.40	14974	12.18	9.78
Book-to-Market Ratio	4247	1.80	1.13	6594	1.62	1.02	6530	1.48	1.00
Market Cap	14873	4576.79	340.64	14784	6744.57	587.39	14974	5735.81	605.72
<u>Capital Adequacy:</u>									
Common Equity to Assets	4351	7.28	6.83	6825	6.91	6.15	6547	6.15	5.90
Tangible Equity to Assets	3132	6.17	5.88	4854	5.72	5.29	4735	5.09	4.85
Risk-Based Capital to Assets	2092	7.80	7.80	3039	7.21	6.95	2417	6.70	6.40
Tier 1 Capital to RWA	3293	10.58	9.51	5491	10.40	9.50	4691	10.11	9.53
Risk-Based Capital to RWA	3530	13.45	12.60	5977	13.04	12.20	4738	13.02	12.30
<u>Liquidity:</u>									
Cash to Short-Term Debt	4232	0.31	0.10	6174	0.32	0.09	5993	0.34	0.09
Net Stable Funding (Proxy)	4233	93.93	96.28	6408	91.78	93.00	6444	88.32	90.06

Table 3: Post-Ranking Beta, Bank Capital Adequacy and Liquidity

Post-ranking betas by the percentiles of capital adequacy and liquidity ratios. The sample is divided within each month into 5 percentile portfolios according to capital or liquidity ratios. Both equal-weighted and value-weighted monthly returns in excess of risk-free rate on the resulting 5 portfolios are then calculated for each month and ratio. The full sample of post-ranking portfolio excess returns is regressed on the market excess return to obtain post-ranking portfolio betas. Therefore, for each ratio we obtain 5 post-ranking betas per weighting method. The sample runs from 1997 for Equity ratio, Total Risk-Based Capital Ratio and Cash to Short-Term Debt Ratio, and from 1998 for Tier 1 Capital Ratio.

Panel A: Capital Adequacy:

	<u>Common Equity</u> <u>Total Assets</u>		<u>Tangible Com. Equity</u> <u>Total Assets</u>		<u>Risk-Based Capital</u> <u>Total Assets</u>		<u>Tier 1 Capital</u> <u>Risk-Weighted Assets</u>		<u>Risk-Based Capital</u> <u>Risk-Weighted Assets</u>	
	EW	VW	EW	VW	EW	VW	EW	VW	EW	VW
1	1.28	1.35	1.39	1.39	1.43	1.42	1.19	1.41	1.12	1.29
2	1.14	1.30	1.28	1.34	1.35	1.53	1.14	1.37	1.09	1.34
3	0.93	1.27	1.07	1.26	1.15	1.37	1.11	1.32	1.09	1.41
4	0.95	1.30	0.94	1.20	0.97	1.23	1.05	1.35	0.95	1.30
5	0.77	0.92	0.87	0.94	0.96	1.38	0.83	1.11	0.89	1.23

Panel B: Liquidity:

	<u>Cash & Near Cash</u> <u>Short-Term Debt</u>		<u>NSFR (proxy)</u>	
	EW	VW	EW	VW
1	1.16	1.43	1.31	1.40
2	1.11	1.35	1.08	1.27
3	0.96	1.27	0.96	1.27
4	0.99	1.33	0.88	1.18
5	0.80	1.13	0.78	1.09

Table 4: Bank Capital, Liquidity, Forward Beta and Idiosyncratic Risk

This table reports regression results of future (forward) beta and forward RMSE on measures of bank capital and liquidity. Future beta is the same as pre-ranking beta, but taken with a 24-month lead. Forward RMSE is defined in a similar fashion. Independent variables in Panel A1 and A2 are inverse capital adequacy ratios, and the ones for Panel B1 and B2 are liquidity measures. t-statistics in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel A1: Fama-MacBeth, Dependent Variable is Forward Beta

	<u>Common Equity</u> Total Assets		<u>Tangible Com. Equity</u> Total Assets		<u>Risk-Based Capital</u> Total Assets		<u>Tier 1 Capital</u> Risk-Weighted Assets		<u>Risk-Based Capital</u> Risk-Weighted Assets	
Inverse Capital Ratio	2.20***	(23.34)	1.03***	(12.11)	1.90***	(10.80)	5.16***	(12.08)	6.30***	(20.25)
Intercept	0.55***	(22.78)	0.81***	(32.72)	0.76***	(21.19)	0.39***	(6.49)	0.44***	(16.65)
N	15298		10471		5751		11449		12162	
T	187		166		118		187		187	
R-Squared	0.111		0.083		0.007		0.006		0.015	

Panel A2: Fama-MacBeth, Dependent Variable is Forward Beta

	<u>Cash & Near Cash</u> Short-Term Debt		NSFR (proxy)	
Liquidity Ratio	-0.30***	(-6.96)	-0.01***	(-19.95)
Intercept	1.01***	(106.80)	1.87***	(41.33)
N	13937		14753	
T	187		187	
R-Squared	0.016		0.070	

Panel B1: Fama-MacBeth, Dependent Variable is Forward RMSE

	<u>Common Equity</u> Total Assets		<u>Tangible Com. Equity</u> Total Assets		<u>Risk-Based Capital</u> Total Assets		<u>Tier 1 Capital</u> Risk-Weighted Assets		<u>Risk-Based Capital</u> Risk-Weighted Assets	
Inverse Capital Ratio	6.04***	(14.76)	3.23***	(11.65)	4.73***	(6.94)	22.68***	(12.80)	37.75***	(11.92)
Intercept	6.56***	(64.18)	7.04***	(65.54)	6.77***	(40.59)	4.96***	(24.29)	4.37***	(20.84)
N	15298		10471		5751		11449		12162	
T	187		166		118		187		187	
R-Squared	0.012		0.014		0.000		0.007		0.000	

Panel B2: Fama-MacBeth, Dependent Variable is Forward RMSE

	<u>Cash & Near Cash</u> Short-Term Debt		NSFR (proxy)	
Liquidity Ratio	-0.06	(-0.30)	-0.05***	(-3.55)
Intercept	7.74***	(69.17)	12.79***	(11.34)
N	13937		14753	
T	187		187	
R-Squared	0.000		0.004	

Table 5: Realized Returns and Risk: Beta Portfolios

This table reports regression of portfolio returns on market excess returns and the Fama-French factors, SMB and HML, using equal weights for computing portfolio total return in excess of the riskless rate. The sample is divided each month into low (bottom 33%), medium (middle 33%) and high (top 33%) portfolios according to pre ranking beta.

Panel A: Equal Weights

	Bottom 33.3%		Middle 33.3%		Top 33.3%		Top-Bottom	
<u>Excess Return:</u>								
	0.59***	(3.07)	0.49	(1.59)	0.62	(1.25)	0.04	(0.09)
<u>CAPM:</u>								
Market	0.32***	(9.73)	0.75***	(18.54)	1.42***	(28.78)	1.10***	(21.21)
Intercept	0.41**	(2.44)	0.06	(0.28)	-0.18	(-0.74)	-0.59**	(-2.26)
T	268		268		268		268	
R-Squared	0.262		0.564		0.757		0.628	
<u>FF 4-Factor Reg.:</u>								
Market	0.32***	(10.51)	0.74***	(22.49)	1.37***	(32.45)	1.05***	(20.55)
SMB	0.43***	(6.66)	0.67***	(9.47)	0.47***	(5.16)	0.04	(0.33)
HML	0.34***	(5.59)	0.61***	(9.14)	0.84***	(9.92)	0.50***	(4.89)
Intercept	0.26*	(1.70)	-0.21	(-1.28)	-0.54**	(-2.58)	-0.80***	(-3.13)
T	268		268		268		268	
R-Squared	0.421		0.732		0.833		0.659	

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel B: Value Weights

	Bottom 33.3%		Middle 33.3%		Top 33.3%		Top-Bottom	
<u>Excess Return:</u>								
	0.81***	(3.18)	0.79**	(2.22)	1.11**	(2.13)	0.30	(0.64)
<u>CAPM:</u>								
Market	0.33***	(7.16)	0.84***	(16.68)	1.49***	(29.14)	1.16***	(17.99)
Intercept	0.62***	(2.63)	0.32	(1.26)	0.27	(1.03)	-0.36	(-1.09)
T	268		268		268		268	
R-Squared	0.161		0.511		0.761		0.549	
<u>FF 4-Factor Reg.:</u>								
Market	0.31***	(6.99)	0.77***	(17.97)	1.41***	(29.70)	1.09***	(17.21)
SMB	0.38***	(3.96)	0.30***	(3.30)	-0.24**	(-2.38)	-0.63***	(-4.57)
HML	0.49***	(5.47)	0.93***	(10.80)	0.73***	(7.61)	0.23*	(1.82)
Intercept	0.41*	(1.83)	-0.07	(-0.33)	-0.02	(-0.10)	-0.43	(-1.37)
T	268		268		268		268	
R-Squared	0.280		0.668		0.809		0.588	

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Realized Returns and Risk: RMSE Portfolios

This table reports regression of portfolio returns on market excess returns and the Fama-French factors, SMB and HML, using value weights for computing portfolio total return in excess of the riskless rate. The sample is divided each month into low (bottom 33%), medium (middle 33%) and high (top 33%) portfolios according to pre ranking root mean squared error.

Panel A: Equal Weights

	Bottom 33.3%		Middle 33.3%		Top 33.3%		Top-Bottom	
<u>Excess Return:</u>								
	0.49**	(2.15)	0.54*	(1.74)	0.68	(1.63)	0.19	(0.68)
<u>CAPM:</u>								
Market	0.57***	(19.44)	0.86***	(25.55)	1.07***	(20.59)	0.49***	(10.72)
Intercept	0.17	(1.11)	0.05	(0.31)	0.07	(0.27)	-0.09	(-0.40)
T	268		268		268		268	
R-Squared	0.587		0.710		0.615		0.302	
<u>FF 4-Factor Reg.:</u>								
Market	0.56***	(22.06)	0.83***	(30.97)	1.04***	(23.53)	0.48***	(10.56)
SMB	0.40***	(7.31)	0.46***	(7.89)	0.71***	(7.41)	0.31***	(3.13)
HML	0.43***	(8.36)	0.60***	(11.10)	0.76***	(8.55)	0.34***	(3.64)
Intercept	-0.02	(-0.16)	-0.21	(-1.54)	-0.26	(-1.18)	-0.24	(-1.05)
T	268		268		268		268	
R-Squared	0.714		0.827		0.736		0.355	

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel B: Value Weights

	Bottom 33.3%		Middle 33.3%		Top 33.3%		Top-Bottom	
<u>Excess Return:</u>								
	0.77**	(2.15)	0.97**	(2.10)	1.37**	(2.55)	0.60	(1.62)
<u>CAPM:</u>								
Market	0.94***	(21.36)	1.32***	(28.70)	1.39***	(20.89)	0.45***	(6.57)
Intercept	0.24	(1.10)	0.22	(0.96)	0.58*	(1.74)	0.34	(0.99)
T	268		268		268		268	
R-Squared	0.632		0.756		0.621		0.140	
<u>FF 4-Factor Reg.:</u>								
Market	0.87***	(21.78)	1.24***	(29.68)	1.31***	(21.04)	0.43***	(6.16)
SMB	0.03	(0.30)	-0.27***	(-2.95)	0.14	(1.04)	0.11	(0.75)
HML	0.69***	(8.62)	0.69***	(8.27)	0.96***	(7.64)	0.26*	(1.84)
Intercept	-0.04	(-0.21)	-0.05	(-0.25)	0.19	(0.62)	0.23	(0.66)
T	268		268		268		268	
R-Squared	0.713		0.813		0.690		0.152	

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

A Implementation Timing of Basel III requirements

Basel III phase-in arrangements

(All dates are as of 1 January)



Basel Committee on Banking Supervision

BANK FOR INTERNATIONAL SETTLEMENTS

Phases		2013	2014	2015	2016	2017	2018	2019
Capital	Leverage Ratio		Parallel run 1 Jan 2013 – 1 Jan 2017 Disclosure starts 1 Jan 2015				Migration to Pillar 1	
	Minimum Common Equity Capital Ratio	3.5%	4.0%	4.5%				4.5%
	Capital Conservation Buffer				0.625%	1.25%	1.875%	2.5%
	Minimum common equity plus capital conservation buffer	3.5%	4.0%	4.5%	5.125%	5.75%	6.375%	7.0%
	Phase-in of deductions from CET1*		20%	40%	60%	80%	100%	100%
	Minimum Tier 1 Capital	4.5%	5.5%	6.0%				6.0%
	Minimum Total Capital		8.0%					8.0%
	Minimum Total Capital plus conservation buffer		8.0%		8.625%	9.25%	9.875%	10.5%
	Capital instruments that no longer qualify as non-core Tier 1 capital or Tier 2 capital		Phased out over 10 year horizon beginning 2013					
Liquidity	Liquidity coverage ratio – minimum requirement			60%	70%	80%	90%	100%
	Net stable funding ratio						Introduce minimum standard	

* Including amounts exceeding the limit for deferred tax assets (DTAs), mortgage servicing rights (MSRs) and financials.

-- transition periods

B Variable Definitions (Bloomberg)

B.1 Id and Market variables

Primary security. Primary security refers to the security trading in the class/line's primary market.

Country of domicile. The country where the company's senior management is located

Market Capitalization Mnemonic: CUR_MKT_CAP

Total current market value of all of a company's outstanding shares stated in the pricing currency.

NON MULTIPLE-SHARE COMPANIES:

Current market capitalization is calculated as: Current Shares Outstanding x Last Price

MULTIPLE-SHARE COMPANIES:

Current market cap is the sum of the the market capitalization of all classes of common stock. If only one class is listed, the price of the listed-class is applied to any unlisted shares to determine the total market value. If there are two or more listed classes and one or more unlisted classes, the average price of the listed classes is applied to the unlisted shares to compute the total market value.

Total Return. Mnemonic: DAY_TO_DAY_TOT_RETURN_GROSS_DVDS

One day total return as of today. The start date is one day prior to the end date (as of date). Historically, this is a series of day to day total return values for daily periodicity. Applicable periodicity values are daily, weekly, monthly, quarterly, semi-annually and annually. Gross dividends are used.

B.2 Capital Adequacy Ratios:

Tier 1 Capital Ratio. Mnemonic: BS_TIER1_CAP_RATIO

The ratio of Tier 1 capital to risk-weighted assets.

Tier 1 capital generally includes Common Stockholders' Equity, qualifying Preferred Stock and Minority Interest less Goodwill and other adjustments.

Total Risk-Based Capital Ratio. Mnemonic: BS_TOT_CAP_TO_RISK_BASE_CAP

The ratio of total risk-based capital to risk-weighted assets.

The total risk-based capital is the total of the core capital ratio and supplementary capital ratio.

Supplementary ratio for commercial banks is:

Perpetual preferred stock ineligible for Tier 1

Perpetual debt and mandatory convertible securities

Qualifying senior and subordinated debt

Limited life preferred stock

Qualifying allowance for credit losses

C Realized risk and returns: beta Portfolios

Table 7: Realized Returns and Risk: 20th Percentile Beta Portfolios

This table reports regression of portfolio returns on market excess returns and the Fama-French factors, SMB and HML, using equal weights for computing portfolio total return in excess of the riskless rate. The sample is divided each month into 5 portfolios according to pre-ranking beta. P1 and P5 are the portfolios with the lowest and highest beta, respectively.

Panel A: Equal Weights

	P1	P2	P3	P4	P5	P5-P1
Excess Return:						
	0.61*** (3.13)	0.46* (1.90)	0.62** (1.98)	0.44 (1.18)	0.72 (1.22)	0.11 (0.21)
CAPM:						
Market	0.23*** (6.40)	0.51*** (13.81)	0.75*** (17.90)	1.02*** (24.87)	1.64*** (26.58)	1.41*** (20.90)
Intercept	0.47*** (2.61)	0.17 (0.90)	0.19 (0.90)	-0.14 (-0.69)	-0.22 (-0.70)	-0.69** (-2.03)
T	268	268	268	268	268	268
R-Squared	0.134	0.418	0.546	0.699	0.726	0.621
Fama-French:						
Market	0.23*** (6.67)	0.50*** (15.50)	0.75*** (20.96)	0.98*** (29.94)	1.58*** (28.23)	1.36*** (20.14)
SMB	0.41*** (5.65)	0.54*** (7.72)	0.67*** (8.72)	0.53*** (7.53)	0.46*** (3.83)	0.05 (0.35)
HML	0.33*** (4.87)	0.42*** (6.49)	0.57*** (7.92)	0.74*** (11.19)	0.91*** (8.07)	0.58*** (4.27)
Intercept	0.33* (1.93)	-0.02 (-0.13)	-0.06 (-0.34)	-0.46*** (-2.81)	-0.60** (-2.17)	-0.93*** (-2.78)
T	268	268	268	268	268	268
R-Squared	0.278	0.574	0.698	0.819	0.788	0.646

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel B: Value Weights

	P1	P2	P3	P4	P5	P5-P1
Excess Return:						
	0.89*** (3.28)	0.42 (1.48)	0.69* (1.88)	0.68 (1.59)	1.26** (2.19)	0.38 (0.65)
CAPM:						
Market	0.24*** (4.66)	0.49*** (10.40)	0.80*** (14.85)	1.12*** (21.98)	1.62*** (27.61)	1.38*** (17.55)
Intercept	0.75*** (2.85)	0.13 (0.56)	0.23 (0.84)	0.04 (0.15)	0.34 (1.15)	-0.41 (-1.03)
T	268	268	268	268	268	268
R-Squared	0.076	0.289	0.453	0.645	0.741	0.537
Fama-French:						
Market	0.24*** (4.68)	0.45*** (9.99)	0.73*** (15.71)	1.03*** (22.16)	1.53*** (27.55)	1.29*** (16.67)
SMB	0.46*** (4.14)	0.21** (2.20)	0.31*** (3.05)	-0.21** (-2.08)	-0.22* (-1.86)	-0.68*** (-4.06)
HML	0.36*** (3.47)	0.63*** (6.99)	0.99*** (10.62)	0.77*** (8.17)	0.74*** (6.63)	0.39** (2.46)
Intercept	0.59** (2.32)	-0.13 (-0.58)	-0.18 (-0.80)	-0.27 (-1.15)	0.04 (0.15)	-0.55 (-1.42)
T	268	268	268	268	268	268
R-Squared	0.164	0.407	0.623	0.722	0.782	0.575

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Realized Returns and Risk: Beta Decile Portfolios

This table reports regression of portfolio returns on market excess returns and the Fama-French factors, SMB and HML, using equal weights for computing portfolio total return in excess of the riskless rate. The sample is divided each month into 10 portfolios according to pre-ranking beta. P1 and P10 are the portfolios with the lowest and highest beta, respectively.

Panel A: Equal Weights

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1
Excess Return:											
	0.75*** (3.21)	0.45** (2.20)	0.55** (2.24)	0.38 (1.41)	0.57* (1.88)	0.68* (1.96)	0.51 (1.41)	0.36 (0.88)	0.65 (1.33)	0.78 (1.08)	0.03 (0.04)
CAPM:											
Market	0.12*** (2.66)	0.34*** (9.72)	0.47*** (11.79)	0.55*** (12.94)	0.65*** (14.17)	0.86*** (18.96)	0.93*** (20.66)	1.11*** (24.07)	1.35*** (25.51)	1.93*** (23.68)	1.80*** (20.02)
Intercept	0.68*** (2.93)	0.25 (1.44)	0.28 (1.41)	0.07 (0.32)	0.20 (0.86)	0.19 (0.84)	-0.02 (-0.08)	-0.27 (-1.18)	-0.12 (-0.45)	-0.32 (-0.78)	-1.00** (-2.21)
T	268	268	268	268	268	268	268	268	268	268	268
R-Squared	0.026	0.262	0.343	0.386	0.430	0.575	0.616	0.685	0.710	0.678	0.601
Fama-French:											
Market	0.11** (2.54)	0.34*** (10.36)	0.47*** (12.52)	0.54*** (14.45)	0.64*** (15.78)	0.85*** (21.77)	0.90*** (23.94)	1.06*** (26.81)	1.30*** (27.09)	1.86*** (24.30)	1.75*** (19.26)
SMB	0.40*** (4.06)	0.43*** (6.13)	0.49*** (5.99)	0.60*** (7.52)	0.63*** (7.28)	0.71*** (8.34)	0.60*** (7.43)	0.46*** (5.34)	0.41*** (3.94)	0.52*** (3.14)	0.12 (0.63)
HML	0.37*** (4.04)	0.30*** (4.55)	0.33*** (4.34)	0.52*** (6.99)	0.59*** (7.26)	0.55*** (6.92)	0.72*** (9.49)	0.76*** (9.47)	0.78*** (8.03)	1.05*** (6.79)	0.68*** (3.72)
Intercept	0.52** (2.32)	0.12 (0.73)	0.13 (0.72)	-0.16 (-0.88)	-0.06 (-0.29)	-0.05 (-0.26)	-0.33* (-1.76)	-0.60*** (-3.01)	-0.45* (-1.87)	-0.76** (-2.01)	-1.29*** (-2.85)
T	268	268	268	268	268	268	268	268	268	268	268
R-Squared	0.129	0.390	0.452	0.555	0.588	0.701	0.748	0.780	0.775	0.733	0.621

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel B: Value Weights

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1
Excess Return:											
	0.94*** (3.14)	0.24 (0.95)	0.42 (1.46)	0.48 (1.46)	0.56 (1.61)	0.51 (1.27)	0.74* (1.71)	0.55 (1.20)	1.26** (2.46)	1.20* (1.80)	0.26 (0.38)
CAPM:											
Market	0.18*** (3.10)	0.33*** (7.20)	0.47*** (9.53)	0.56*** (9.91)	0.59*** (9.77)	0.93*** (16.26)	1.03*** (17.46)	1.18*** (20.89)	1.40*** (25.25)	1.82*** (24.88)	1.64*** (17.46)
Intercept	0.84*** (2.82)	0.05 (0.21)	0.15 (0.60)	0.16 (0.58)	0.23 (0.75)	-0.02 (-0.06)	0.15 (0.50)	-0.12 (-0.44)	0.46 (1.64)	0.16 (0.44)	-0.68 (-1.43)
T	268	268	268	268	268	268	268	268	268	268	268
R-Squared	0.035	0.163	0.254	0.270	0.264	0.498	0.534	0.621	0.706	0.700	0.534
Fama-French:											
Market	0.18*** (3.15)	0.33*** (7.17)	0.46*** (9.64)	0.50*** (9.43)	0.52*** (9.50)	0.87*** (16.77)	0.95*** (17.29)	1.09*** (20.57)	1.31*** (25.39)	1.75*** (24.24)	1.56*** (16.50)
SMB	0.52*** (4.13)	0.36*** (3.64)	0.45*** (4.41)	0.23** (2.02)	0.31*** (2.64)	0.37*** (3.29)	0.04 (0.36)	-0.16 (-1.39)	-0.26** (-2.35)	-0.07 (-0.46)	-0.59*** (-2.89)
HML	0.36*** (3.09)	0.30*** (3.22)	0.42*** (4.38)	0.76*** (7.12)	0.93*** (8.49)	0.87*** (8.30)	0.86*** (7.75)	0.75*** (7.01)	0.77*** (7.39)	0.75*** (5.18)	0.39** (2.04)
Intercept	0.68** (2.33)	-0.08 (-0.36)	-0.03 (-0.15)	-0.15 (-0.58)	-0.16 (-0.60)	-0.38 (-1.48)	-0.20 (-0.74)	-0.43 (-1.61)	0.15 (0.59)	-0.14 (-0.40)	-0.82* (-1.74)
T	268	268	268	268	268	268	268	268	268	268	268
R-Squared	0.120	0.229	0.346	0.393	0.430	0.612	0.621	0.684	0.762	0.728	0.556

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$