Capitalization and Credit Provision: Evidence from the United States

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Abstract

This article tries to study the relationship between capital ratios and lending patterns of banks. Using an unbalanced panel of around nine thousand commercial banks in the United States, from 1996:Q1 to 2010:Q4, we find a moderate relationship between loan growth rates and capital ratios. We use three different capital ratios to perform the analysis. The sensitivity is higher for banks with lower capital ratios. We also find a higher sensitivity, of lending to capital ratios, in the crisis period, compared to the pre crisis period.

1 Introduction

"The reason I raise the capital issue so often, is that, in a sense, it solves every problem."
- Alan Greenspan to the Financial Crisis Inquiry Commission

The recent financial crisis has been an eyeopener in many ways. It has thrown many challenges at us, economists. It is imperative that we develop a better understanding of these issues so that we do not witness a relapse of the crisis. One of the issues of paramount importance, is understanding the linkages between the real and financial sector. We live in a world where the various sectors are interconnected. Hence a stress in one sector can easily be transferred to another, if sound policies are not in place.

In this article, we ask one main question. How sensitive is bank lending to bank capital ratios? The effect of changes in bank capital on the provision of credit is a key determinant of the linkage between financial conditions and real activity. Quantifying this relation has therefore been one of the most important research questions post the recent financial crisis. When the Troubled Asset Relief Program (TARP) moved to inject capital into banks through the Capital Purchase Program (CPP), the impact of

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the program on real activity largely focused on the effect of these injections on bank lending. More recently, this question has re-emerged in light of proposals announced by the Basel Committee on Banking Supervision to raise banks capital requirements and limit leverage ratios, Berropside and Edge (2010).

The impact of capitalization on lending is expected to depend on the banks current capital position. If a bank is sufficiently capitalized, or has access to financial markets, then a reduction in capital does not have to be accomodated by a reduction in assets. The worsening of the capital position could come from (say) increased credit risk materialization. On the other hand, a bank that is not well capitalized and finds it difficult to raise fresh equity, will have to actively manage its assets. Such banks will often try to maintain a constant equity to asset ratio (leverage ratio) to avoid violating the capital requirements. For these banks, the impact of capital, on lending, is expected to be greater, than their well capitalized counterparts.

In this article, we are mainly concerned about the bank capital channel of how capital affects credit provision.[1] The bank capital channel is based on a few hypothesis and these are well summed up in Gambacorta and Mistrulli (2004). The primary hypothesis is that there has to be an imperfect market for bank equity. Secondly, there has to be a maturity mismatch, thereby exposing the bank to interest rate risk and thirdly, there has to be a direct impact of regulatory requirements on lending. The intuition is simple. When the economic scenario is adverse, banks often accumulate losses on its assets. Given maturity mismatch, the bank profits fall leading to a decline in bank equity. If the bank was well capitalized to begin with, then it will not have to adjust through a reduction in assets. However, if the bank equity is sufficiently low such that the regulatory constraint binds, the bank may have to reduce lending to boost the capital ratios. This theory obviously assumes that the market for bank equity has some imperfections.

2 Literature Review

There are not many recent estimates for the United States of the impact of bank capital on lending. Hancock and Wilcox (1993, 1994) estimated models relating changes in individual banks loan growth to measures of loan demand and bank capital. They measure the response of lending to excess/shortfall of capital from a target ratio. Berger and Udell (1994) specified an equation relating the growth rate of various bank assets to measures of bank capital. Finally, Bernanke and Lown (1991) developed equations linking bank loan growth to bank capital ratios and employment, for a single state (New Jersey). If we look beyond the United States, there are some studies that seek to quantify this relationship between bank equity and credit extension. Peek and Rosengren (1997), Puri, Rocholl and Steffen (2010) use loan applications from German Landes-

[1]The other channel is of course the bank lending channel. We, however, do not elaborate on this further as this is beyond the scope of this article. Refer Gambacorta and Mistrulli (2004) for a more detailed discussion on bank lending channel.

banks to examine the effect of shocks to capital on the supply of credit by comparing the performance of affected and unaffected banks. Gianetti and Simonov (2010) use Japanese data to perform a similar exercise concerning bank bailouts. These papers do find a relevant role for capital in determining loan volumes, although they do not explicitly compare the magnitudes of the effects they find with those implied by the constant leverage view.[2] Another group of papers use firm and bank loan-level data; these include Jimenez, Ongena, and Peydro (2010), who use Spanish data, and Albertazzi and Marchetti (2010), who use data on Italy. These papers find sizeable effects of low bank capitalization and scarce liquidity on credit supply. Also, Elliot (2010) uses simulation based techniques to find small effects of capital ratios on loan pricing and loan volumes for U.S. banks. De Nicolo and Lucchetta (2010) use aggregate data for the G-7 countries and conclude that credit demand shocks are the main drivers of bank lending cycles. Last but not least, Berropside and Edge (2010), use data on US bank holding companies and also find a subdued effect of bank capital and lending. We will undertake a similar exercise by using data for commercial banks in the United States. It must be noted that this is not an article about the impact of regulation. We simply wish to study the strength of the relationship between bank capital ratios and loan growth rates.

3 Data Description

The data mainly come from the call report database of the Federal Reserve Bank of Chicago. It is an unbalanced panel of around nine thousand commercial banks in the US. We cover sixty quarters, from 1996:Q1-2010:Q4. For the macro variables, the FRED database was used. Let us now look at some descriptive statistics. Figures 1-3, below show how the distribution of capital ratios has changed in our sample period. We use three different measures of capital ratios, namely the capital adequacy ratio (CAR), the tier 1 ratio (T1 Ratio) and the equity asset ratio (ETA). The capital adequacy ratio is the sum of tier 1 and tier 2 ratio divided by the risk weighted assets. It is computed as:

$$CAR = \frac{Tier1Capital + Tier2Capital}{RiskWeightedAssets}$$

Tier 1 capital is the core measure of a banks financial strength from a regulators point of view. It primarily consists of common stock and retained earnings. Tier 2 capital represents supplementary capital such as general loan-loss reserves and subordinated debt. The denominator is a risk adjusted measure of assets on the banks balance sheet. The tier 1 ratio is the tier 1 capital normalized by the risk weighted assets. It is computed as:

$$T1Ratio = \frac{Tier1Capital}{RiskWeightedAssets}$$

[2]Adrian and Shin (2010) show pictorally how commercial banks in the US might be actively managing assets to target a constant leverage ratio.

Lastly, the equity asset ratio (or the leverage ratio) is the total equity (computed by subtracting total liabilities from total assets) divided by total assets. Equity asset ratio is non risk adjusted while the other two are. It is computed as:

$$ETA = \frac{TotalEquity}{TotalAssets}$$

The figures show the distribution of capital ratios in the last quarter of 1996, 2002, 2006 and 2010. In other words, we see a snapshot at four different points in time. The x-axis shows the capital ratios while the y-axis shows the number of banks. From the figures[3], it is evident that there is a shift in the distribution across the time series. There seems to be more mass near the left tail of the distribution towards the end of the sample period i.e. 2010:Q4. In other words, more banks were reporting lower capital ratios and this holds true irrespective of which ratio we use.

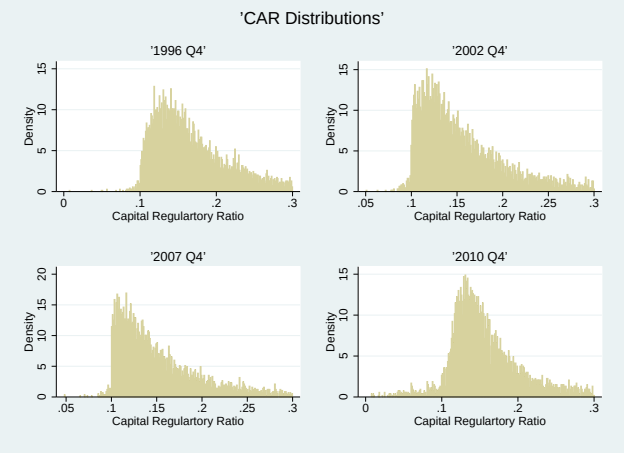

Figure 1: Capital Adequacy Ratio

[3]Source: Karmakar and Mok (2013)

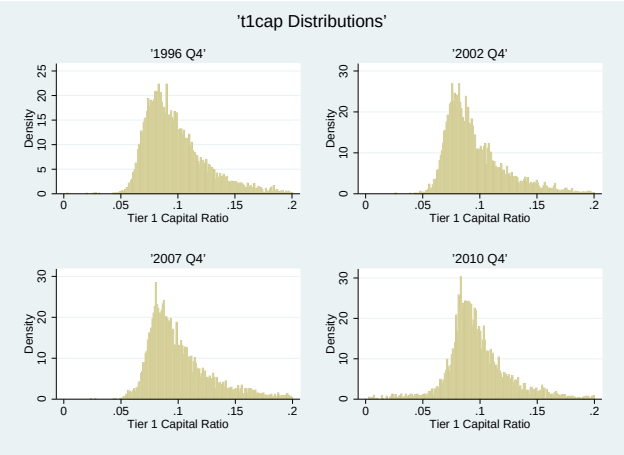

Figure 2: Tier 1 Ratio

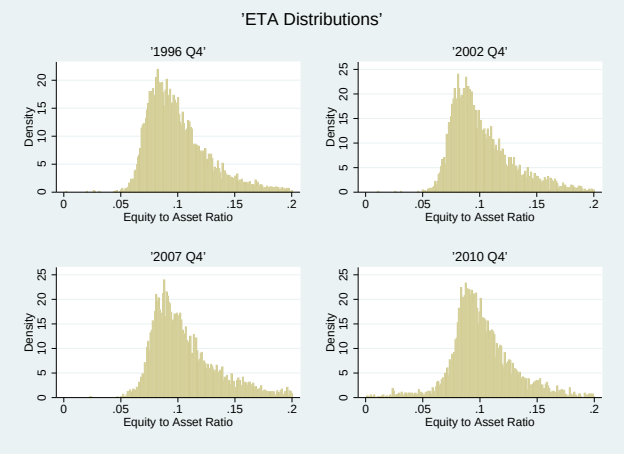

Figure 3: Equity Asset Ratio

Table 1: Summary Statistics

Variable	**Mean**	**Median**	**Std. Dev**	**Observations**
Loan_Gr	0.0225	0.0178	0.0631	331,048
CAR	0.1493	0.1416	0.0376	331,048
ETA	0.0974	0.0931	0.0238	331,048
T1 Ratio	0.0934	0.0892	0.0218	331,048
NPL	0.0028	0.0009	0.0067	293,832
Size	11.5884	11.5380	0.8212	331,048
FFR	3.46	4.33	2.0704	
GDP Gap	-0.0002	-0.0028	0.0127	

Data Source: Call Reports.

Table 1 gives a broad overview of the entire dataset. We drop the observations where the loan growth rate (Loan_Gr) exceeds 50% as this might be indicating a merger or an acquisition. We also drop the observations if the capital adequacy ratio (CAR) is above 25%. The rationale there is that at such high levels of capitalization, we do not expect to find a significant relationship between capital ratios and lending. Also banks that report very high capital ratios are typically very small banks. Dropping them does not alter our analysis. We have more than three hundred thousand observations. Looking at the simple mean, it looks like the average bank is well capitalized, irrespective of which ratio we look at. However, we need to remember that there is sufficient heterogeneity among banks in our sample, as is evident from the figures (1)-(3). The loan growth rate (Loan_Gr) has been around 2.25% on average, per quarter. The loans included are real estate loans, commercial and industrial loans, personal loans and agricultural loans. This is our dependent variable in the regression analysis. The fed funds rate (FFR) has been 3.46% on average. The mean non performing loan (NPL) is around 0.28% of total loans. The output gap (GDP Gap), is the HP filtered real GDP with smoothing parameter, $\lambda = 1600$. The variable size (Size) is the natural logarithm of total assets. FFR and GDP Gap are the macro control variables. They help us control for the factors that affect loan demand. NPL and SIZE are the bank specific control variables and have been widely used in other papers, in the literature.[4]

Now that we have a brief overview of the data, we can proceed to our empirical model to try to study the relationship between the capital ratios and lending. We will be using our various measures of capital ratios for this analysis. We will also try to see if the relationship is different for high vs low capitalized banks. Lastly, we will try to see if there are any differences in behaviour in the pre crisis and crisis periods.

[4]Refer Tabak et. al. (2011).

4 The Empirical Framework

We estimate an equation for loan growth rate on the bank capital ratios. As discussed earlier, we will be using three different measures of capital ratios, namely the capital adequacy ratio, the tier 1 ratio and the equity asset ratio. The model we estimate is as follows:

$$Loan\_Gr_{i,t} = \alpha K_{i,t-1} + \beta BSC_{i,t-1} + \gamma Macro_{t-1} + v_{i,t} \quad (1)$$

The left hand side is the quarterly growth rate of loans. The right hand side contains measures of bank capital ratios, some bank specific control variables and some additional macro controls. An issue here is that the bank typically decides on its retained earnings and lending simultaneously rather than sequentially. So there could be some endogeneity among banking variables. All the variables on the right hand side are lagged to mitigate this problem. $K_{i,t-1}$ is the capital ratio of bank i at time $t-1$. BSC consists of some bank specific variables. In this specification we will use the size and the ratio of non performing loans. Size is measured as the natural logarithm of total assets. The non performing loans, as a fraction of total loans, is simply a measure of the risk in the banks balance sheet.

The macro variables are included to control for the overall economic scenario. Since we are mainly concerned with a supply side analysis, the inclusion of the macro variables helps us control for the demand side factors. We use the fed funds rate and the output gap. The standard random error term is $v_{i,t}$. The model is estimated with fixed effects.

We will first estimate the equation (1) by using the three different capital measures. Next we will split up the sample at the median capital ratio[5] and try to see if there is a difference in behaviour between high and low capitalized banks, by estimating equation (1) separately for the two groups. This is an interesting exercise because the current level of capitalization should affect the way in which capital ratios affect lending.

To emphasize the last point more, we will do a third exercise. We will estimate equation (1) only for the lowest quartile of banks. The 25th percentile for T1 ratio is 7.8%, for CAR it is 12.1% while for ETA it is 8.1%. These are the banks for whom, the relationship between capital ratios and lending is expected to be particularly strong.

Lastly, we will also be doing a pre crisis vs crisis period analysis to see if the regression coefficients differ in the two sub samples. To this effect, we will split up the sample at the end of 2006. In other words, observations from 1996:Q1-2006:Q4 represent our pre crisis sub sample while observations from 2007:Q1-2010:Q4 represent our crisis period sub sample.

5 Results

The results are reported in tables (2)-(5). Table 2 reports the results of the fixed effects estimation using three different measures of capital. We find a moderate relationship

[5]This is done for CAR, T1 Ratio and ETA.

between capital ratios and loan growth rates. From the regressions, a one percentage point increase in the capital ratio is associated with a rise in loan growth rate between 0.12% and 0.19%. These magnitudes are moderate given that a one percentage point increase in capital ratio is quite substantial.

The signs on the respective variables are intuitive. With higher NPLs, it could be that the banks are willing to lend less. For bigger banks the loan growth rate seems to be lower. This could be because the big banks are sufficiently diversified and have other activities besides credit provision, like trading in securities.

In table 3, we see the results for high vs low capitalized banks. For this analysis, the sample was split at the median for the different measures of capital. The banks above the median are henceforth referred to as high capitalized banks and conversely. From the table, we observe that the coefficients for the lower capitalized banks are higher, for all measures of capital ratios. For a 1% increment in capital ratio, the loan growth rate increases by 0.13%-0.17% for high capitalized banks. This range, for the low capitalized banks, is 0.28%-0.45%. This is intuitive. Well capitalized banks will not have to adjust assets as much as their lower capitalized counterparts, in response to changes in capital.

Table 4 presents results obtained by estimating equation (1) but for the bottom quartile of banks, by capital ratios. Let us focus on the coefficients of capital ratios. The magnitudes are remarkably higher than those reported in tables 2 and 3 and are also significant at the 1% level. This endorses our initial hypothesis that the impact of capitalization on lending is indeed dependent on the capital position of banks. The banks in the lowest quartile are the closest to the minimum capital requirements. These banks could well be trying to maintain a constant level of equity asset ratio and remain compliant with the regulatory requirements. This theory could explain the large coefficients.

Table 5 presents results from our pre crisis vs crisis period analysis. It is worth reminding the reader that the years 1996-2006 are called pre crisis, while 2007-2010 are called crisis periods. From the table we observe that the sensitivity of lending to capital ratios has substantially increased, irrespective of which measure we look at. For the pre crisis period the regression coefficient ranges from $0.12\% - 0.19\%$. In the crisis period, the range is $0.35\% - 0.46\%$. This means that with increased capitalization, banks are now willing to extend more credit.

6 Conclusion

In this article we find a moderate relationship between bank capital ratios and credit provision, in the United States. For a 1% point increase in capital ratios, the growth rate of loans is less than 0.20%. This relationship is stronger for less capitalized banks. To emphasize this point a bit more, we find that banks in the lowest quartile report greater sensitivity of lending to capital ratios. Lastly, we find that the relationship between lending and capital ratios is stronger in the crisis periods (i.e. in recent years) when compared to the pre crisis period. It must, however, be mentioned that this

article exclusively focuses on the United States. It would not be suitable to extrapolate the results to other countries with different institutional frameworks.

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Table 2: Fixed Effects Estimation

	(1)	(2)	(3)
	Loan_Gr	Loan_Gr	Loan_Gr
VARIABLES	T1 Ratio	CAR	ETA
T1 Ratio	0.193***		
	(0.019)		
CAR		0.127***	
		(0.010)	
ETA			0.160***
			(0.016)
NPL	-1.388***	-1.403***	-1.395***
	(0.142)	(0.143)	(0.143)
SIZE	-0.022***	-0.021***	-0.023***
	(0.001)	(0.001)	(0.001)
FFR	0.001***	0.000***	0.001***
	(0.000)	(0.000)	(0.000)
GDP gap	0.173***	0.199***	0.184***
	(0.018)	(0.018)	(0.017)
Constant	0.258***	0.248***	0.270***
	(0.011)	(0.011)	(0.010)
Observations	293,832	293,832	293,832
F Statistic	776.46***	788.90***	769.54***
Number of banks	9,108	9,108	9,108

Robust standard errors in parentheses

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

(Std. Err. adjusted for 9108 clusters in id)

Table 3: High Vs Low Capitalized Banks

	(1)	(2)	(3)	(4)	(5)	(6)
	Loan_Gr	Loan_Gr	Loan_Gr	Loan_Gr	Loan_Gr	Loan_Gr
VARIABLES	T1 High	T1 Low	CAR High	CAR Low	ETA High	ETA Low
T1 Ratio	0.175***	0.452***				
	(0.021)	(0.061)				
CAR			0.134***	0.286***		
			(0.012)	(0.033)		
ETA					0.148***	0.309***
					(0.021)	(0.047)
NPL	-1.283***	-1.322***	-1.366***	-1.267***	-1.218***	-1.396***
	(0.208)	(0.093)	(0.102)	(0.210)	(0.170)	(0.168)
SIZE	-0.023***	-0.022***	-0.018***	-0.025***	-0.023***	-0.025***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
FFR	0.000***	0.000	0.001***	-0.000	0.000**	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP Gap	0.157***	0.240***	0.120***	0.317***	0.149***	0.284***
	(0.020)	(0.033)	(0.025)	(0.024)	(0.023)	(0.026)
Constant	0.265***	0.248***	0.205***	0.289***	0.269***	0.296***
	(0.013)	(0.018)	(0.019)	(0.013)	(0.016)	(0.014)
Observations	206,531	87,301	149,120	144,712	162,063	131,769
F Statistic	465.07***	292.39***	290.86***	505.70***	307.41***	425.16***
Number of banks	8,635	6,049	7,898	7,030	8,110	7,007

Robust standard errors in parentheses

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

Table 4: Bottom Quartile by Capital Ratios

	(1)	(2)	(3)
	Loan_Gr	Loan_Gr	Loan_Gr
VARIABLES	T1 Ratio	CAR	ETA
T1 Ratio	0.544***		
	(0.071)		
CAR		0.585***	
		(0.075)	
ETA			0.488***
			(0.059)
NPL	-1.220***	-1.126***	-1.384***
	(0.096)	(0.248)	(0.075)
SIZE	-0.022***	-0.028***	-0.026***
	(0.002)	(0.001)	(0.001)
FFR	0.000	-0.001***	-0.001*
	(0.000)	(0.000)	(0.000)
GDP Gap	0.266***	0.396***	0.341***
	(0.037)	(0.032)	(0.035)
Constant	0.247***	0.302***	0.302***
	(0.020)	(0.017)	(0.018)
Observations	73,518	74,354	75,400
F Statistic	248.21***	338.19***	352.23***
Number of banks	5,637	5,305	5,633

Robust standard errors in parentheses

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

Table 5: Pre Crisis Vs Crisis Period Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
	Loan_Gr	Loan_Gr	Loan_Gr	Loan_Gr	Loan_Gr	Loan_Gr
	T1 Ratio	T1 Ratio	CAR	CAR	ETA	ETA
VARIABLES	Pre Cri	Cri	Pre Cri	Cri	Pre Cri	Cri
T1 Ratio	0.194***	0.460***				
	(0.026)	(0.038)				
CAR			0.153***	0.350***		
			(0.013)	(0.024)		
ETA					0.127***	0.426***
					(0.021)	(0.031)
NPL	-1.492***	-0.745***	-1.499***	-0.793***	-1.506***	-0.748***
	(0.244)	(0.094)	(0.245)	(0.096)	(0.247)	(0.095)
SIZE	-0.020***	-0.047***	-0.018***	-0.052***	-0.021***	-0.050***
	(0.001)	(0.004)	(0.001)	(0.004)	(0.001)	(0.004)
FFR	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP Gap	0.091***	0.149***	0.122***	0.160***	0.121***	0.142***
	(0.032)	(0.017)	(0.031)	(0.017)	(0.031)	(0.017)
Constant	0.230***	0.531***	0.212***	0.579***	0.250***	0.572***
	(0.017)	(0.051)	(0.016)	(0.049)	(0.016)	(0.049)
Observations	217,991	75,841	217,991	75,841	217,991	75,841
F Statistic	239.01***	459.35***	256.84***	456.41***	223.67***	471.29***
Number of banks	8,524	6,028	8,524	6,028	8,524	6,028

Robust standard errors in parentheses

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