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https://doi.org/10.15017/21823

出版情報：経済論究. 142, pp.35-45, 2012-03. 九州大学大学院経済学会
バージョン：
権利関係：

The Effects of Capital Requirement on the Loan Behaviors of Banks

—The Case of China

Jianzhong Dai†

1. Introduction

In the early 1998, People's bank of China (PBC, the central bank of China) began to change the quantity control policy of bank loans. From then on till 2006, this policy was gradually substituted by capital adequacy ratio (CAR) management. This paper will try to check if this policy change has significant influence on the loan growth in China. Or put it another way: does the capital condition become a significant constraint of bank loan growth in China?

The CAR of a bank is the ratio of capitals divided by risk weighted total assets of the bank. Its definition and calculation is based on the Basle Accord published in 1988. By the year of 2006, the Accord was elevated to a new version called Basel II and a further version (Basel III) will begin in effect in many countries in 2013. The aim of the CAR regulation is to control the risk taking of banks so that the safety of bank system can be improved.

Ever since its publication in 1988, researchers were interested in analyzing the effects of the CAR regulation on the loan supplies of the banks. Various theoretical and empirical papers in this area have been published. Theories about the effects of CAR on loan supplies can generally be divided into two categories: "the capital crunch" school and the "risk shifting" school (Saunders, 2002). The "capital crunch" school predicts that with the tightening of the requirement of CAR, a bank's ability of loan supply will be up-bounded by their volume of capital. For those banks with CAR level above the minimum requirement, their loan growth will not be constrained by the CAR requirement. Their loan ability will be bounded by the volume of deposit. The old "deposit multiplier" school may be more suitable for explaining the loan behaviors of these banks (Kopecky and Vanhoose 2004). However, banks whose capital positions are less than the minimum level defined by CAR will be forced to reduce their loan supply in order to fulfill the requirement of the bank supervisors, unless they can find ways to get new capitals. Another school is called "the risk shifting" school (Saunders, 2002). This school argues that CAR implementation will stimulate banks to "shift" their assets to more risky categories within the same weight in order to earn more profits on the same capital basement. For a detailed literature

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survey in this field, see Dai (2011. 11)

The paper uses the supply approach with a panel database. Unlike other similar panel models which only use variable constant terms, we use a seemingly unrelated regression (SUR) model with both variable constant terms and coefficients, thus it is more like a system of cross sectional models with correlated errors terms across different equations. We believe this kind of model can much better catch the dynamics of the effects of CAR implementation on the loan growth. However, this kind of model is not without weakness. Compared with models with only varying constant term, it needs much more samples. This is especially problematical in the case of China since the sample size is small. For this reason we include less explanatory variables in our model than the other models. To suit the special case of China, our choice of explanatory variables also has some differences from the other related researches.

The structure of the paper is arranged as follows: Chapter 2 describes the panel data used in the model and the specification of the model; Chapter 3 gives the result of the regression and offers some explanations for the result; Chapter 4 concludes and make some policy recommendations.

2 . Description of the data and model specification

2.1 Data used in the analysis

The models in the paper use a panel database collected from the "Almanac of Chinese banking and finance." The time spread is from 1995-2004.

To make the regression results comparable we try to choose those banks that existed over the whole inspection period. This is a very tough work because the number of banks in China is not large and most of the new banks are only established after 1996. Some banks also have merged with other banks during the period. The time of the financial reporting of each bank is also different so that the availability of the latest data for each bank is not the same.

In order to extend the time length of the sample as longer as possible and keep it more balanced between the period before and after the adoption of the CAR implementation, in the end only 14 banks are chosen. The name of the banks and their index are: Agricultural Bank of China (abc), Bank of China (boc), China Construction Bank (ccb), Bank of Communications (bcomm), Industrial and Commercial Bank of China (icbc), China Everbright Bank (ceb), China Mingsheng Banking Corp. (cmbc), China Merchant Bank (cmb), Citic bank (citic), Guangdong Development Bank (gdb), China Industrial Bank Corp. (cib). Shengzhen Development Bank (sdb), Shanghai Pudong Development Bank (spdb). We divide the total sample into two groups: Group 1 include the first 4 banks which are state owned and also the biggest ones (normally called "Big Four".) Group 2 include the other banks normally called "Stock banks" in China, which have a mixed

structure of investors consisted of local government, large state owned corporations or private investors.

Though the number of sample is small, it includes most of the above medium size banks and only the "big four" alone account for above 80% loan activities in China.

2.2 The trend of nominal aggregate loan growth rate

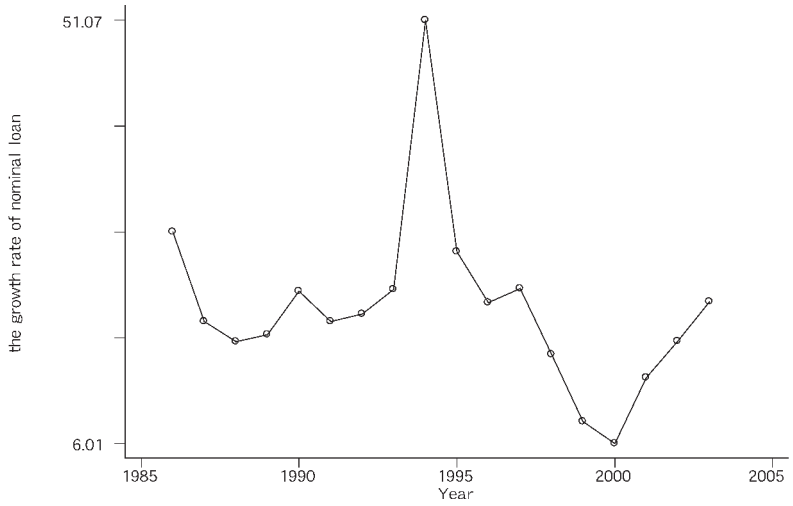
At start we check the trend of aggregate bank loan growth in China to get a general impression about the behavior of bank lending in China in that period.

We use nominal loan growth rate of total bank loan as the measure of bank loan growth. Some researchers use real growth rate of total bank loan as the measure of bank loan growth; however, as Bernanke and Lown (1991) have pointed out, price index may seriously distort the growth rate of loans. For example, in a severe deflation period, real bank loan growth rate may be high even though there is actually very little nominal loan growth; therefore we directly use the nominal growth rate.

The trend of nominal loan growth rate is showed in figure 1.

Figure 1, Nominal growth rate of bank Loan

Unit (%)



Source: Yearbooks of Statistics of China, National Bureau of Statistics of China.

From figure 1, we can see that nominal bank loan growth rate does show a significant decline from 1998 (the beginning year that the PBC canceled the quantity control of the bank loans and substitute it with the CAR management) to 2000. Although there were sharp decline in 1986-1988 and in 1995-1996, but these declines were from extraordinary high levels to more normal levels,

especially in the period 1995-1996. This seems to suit the "capital crunch" hypothesis, as most other countries that have experienced bank restructuring do. However, two things need emphasized here: one is that the absolute rate of loan growth still stays at a relative high level (6%) during the period 1998-2000. Second, and even more surprising, the loan growth rate rebound after 2002. This is contrary to the prediction of the "Capital Crunch" school.

2.3 The Specification of the model

We use a supply approach to analyze the relationship between bank loan behavior and bank capital conditions. The ideal method will be using a cross sectional model. However, when we need to estimate cross sectional models for several years, we can use a system of seemingly unrelated regression models (SUR). SUR will consider the serial correlations of the error terms between equations in each year. One advantage of SUR Model is that it get rid all of the macroeconomic factors that will influence both the demand and supply of the loans, since all banks faced these same factors[1)]. Another advantage of the method is that it will show the evolution of the model. Unlike most of the panel models which only allow variation in constant terms, in SUR models both the constant term and the coefficients of explanatory variables may be change over time. We can also check the changes of significances of the estimated coefficients (the t value) as well as the total fitness (the R square) of the model over time.

However, since the cross sectional sample we used here is too small, cross-sectional models suffer from the weakness of small sample size. Knowing this shortfall we use very few explanatory variables.

The model is defined as:

$$l_{it} = b_{0t} + b_{1t}\, CA_{it-1} + \mu_{it} \tag{1}$$

Where l_{it} is the nominal loan growth rate of bank i in year t. It is calculated using the equation:

$$l_{it} = \frac{L_{it} - L_{it-1}}{L_{it-1}}$$

Where l_{it} is the total nominal value of outstanding loan of bank i in year t.

CA_{it-1} is the capital/total asset ratio of bank i in year *t-1*. The best indicator of capital adequacy of a bank is the risk weighted Capital Adequacy Ratio (CAR) calculated according to the rule specified by the Basle Accord. Unfortunately this ratio is not available in the balance sheets of all the samples and the balance sheets are also not informative enough to calculate it by myself. So we use the capital/total asset ratio which has not been adjusted for risk. However, considering other assets (such as bond and other claims to the government) only

1) If the banks are located in different areas and the macro demand factors are significantly different between these areas, these conclusion can not be established. Since the banks we include in the panel database are all nation wide banks, we do not have to worry about this problem.

account for a minor proportion of total asset in Chinese banks, the two ratios are not much different. The capital used here only includes the item called "claims for owners," which is the only terms that can be collected or calculated through all samples and all sample years. It is similar to the term of "first tier capital" in Basle Accord's specification and CA_{it} is close to the term of core CAR in the definition of Basle Accord. The reason that we choose one year lagged CA as the explanatory variable is due to the consideration that the CA ratio is calculated at the end of each year, but the loan decision of a bank is most likely related to the CA ratio at the beginning of the year.

Our purpose is to check the coefficient of CA_{it-1} (b_{1t}) to see if its value and significance in the period of 1998-2004 is improved. If so, then we can say that the loan supplies of the Chinese banks are more significantly correlated with their capital capacities after the reform carried out in 1998. Conditional on the significance of the coefficient, if the coefficient is positive, it means banks with higher CAR will have higher loan growth rate, then we can say that the behavior of the Chinese banks follow the prediction of the "capital crunch" school; On the other hand, if the coefficient is negative, then it means banks with lower CAR will have higher loan growth rate. In this case, "risk shifting" will be more suitable for explaining the loan behaviors of the banks after CAR implementation.

We may also add deposit growth rate into the above model as a control variable and estimate the model:

$$l_{it} = b_{0t} + b_{1t}\, CA_{it-1} + b_{2t} d_{it} + \mu_{it} \tag{1'}$$

Where d_{it} is deposit growth rate of bank i in year t, it is calculated similarly as l_{it} by using the equation:

$$D_{it} = \frac{D_{it} - D_{it-1}}{D_{it-1}}$$

Where D_{it} is the total volume of deposit of bank i in year t.

If the coefficient of CA_{it-1} is insignificant but the coefficient of d_{it} (b_{2t}) is and it have the right sign (positive), then we can say that the value of deposit is the key factor that will determine a bank's loan growth rate. Thus the "deposit multiplier" school may be the better explanation of the behaviors for the Chinese banks after CAR implementation.

The loan growth rate can only measure the growth of absolute volume of loan. To testify the effects of CAR implementation on the relative importance of loan in total bank assets or bank's preference for loan, we can use the total loan/total asset ratio (lta_{it}) as the dependent variable and testify the model:

$$lta_{it} = b_{0t} + b_{1t}\, CA_{it-1} + \mu_{it} \tag{2}$$

Where lta_{it} is the total loan/total asset ratio of bank i in year t. If loan increased quicker than other items of bank asset, lta_{it} will increase. Thus this ratio will show the preference of banks

for loan assets relative to other sort of assets. If loans are the major risky assets of the banks, this ratio can also be used as an indicator of degree of risk taking of the banks.

The explanation of the model is the same as equation 1. If the significance of the coefficient of CA_{it-1} has improved then we can say that the loan/asset ratio of a bank is more significantly correlated with its capital capacities. If the coefficient is positive, we can say that the attitude towards loans of the Chinese banks follows the prediction of the "capital crunch" school; if the coefficient is negative, then "risk shifting" school will be more suitable for the explanation of the attitude towards loans of the banks after CAR implementation.

As in the models for loan growth, we add deposit growth rate into the above model and estimate the model:

$$lta_{it} = b_{0t} + b_{1t}\ CA_{it-1} + b_t d_{it} + \mu_{it} \quad \text{(equation 2')}$$

As in model 1, if the coefficient of CA_{it-1} is insignificant but d_{it} is and its coefficient have the right sign (positive), then we can say that the value of deposit is the factor that determines a bank's attitude towards loans.

3. The regression result and its explanations

To control for the possible serial correlation among residual terms amony different equations, we use e-view's pooled regression method with robust covariance matrix (period white) to estimate the panel data model. This method offered a simple way to estimate the SUR models.

3.1 The results for total sample

At first we use the total sample to estimate the model. Table 1 showed the regression results.

The first column shows the regression result of model 1. We can see that in model 1, where CA_{it-1} is the only explanatory variable, the coefficient of CA_{it-1} is significant in year 1997, 1999 and 2001 (all significant at 10% level). However, after 2001, the coefficient of CA_{it-1} again became insignificant. All the years before 1997 the coefficient are insignificant. Nevertheless, it is hard to explain why in 1998 and 2000 the coefficient is not significant at any traditionally acceptable level.

Column 2 shows the regression results of model 1', where the deposit growth rate is added into the model. Now the coefficient of CA_{it-1} is still significant in year 1997 and 1999. Furthermore, their significance is noticeably improved (Both significant now at 5% level). Although the coefficient in year 1998 is still insignificant, its significance also much improved. The coefficient in year 2001 now becomes insignificant.

On the whole, the results of model 1 and model 1'can be explained as weak evidence that the implementation of the CAR in 1998 only has a temporary dynamic effect on the loan growth.

Table 1: the panel data regression result with the total sample

Dependent Variables	L growth		L/TA	
	1	1′	2	2′
C	0.191792** (5.181705)	0.02904** (0.587062)	0.590269** (59.97321)	0.55993** (36.07441)
CA(t-1)-95	0.606435 (0.252929)	2.192349 (0.978359)	0.731415 (1.156943)	1.32858 (1.34608)
CA(t-1)-96	0.807371 (0.436017)	0.148724 (0.111247)	-0.3867 (-0.42266)	-0.04631 (-0.03807)
CA(t-1)-97	2.520697* (1.671291)	1.372324** (2.198532)	-1.70584** (-4.65866)	-0.80912 (-1.28598)
CA(t-1)-98	-1.77211 (-0.83687)	-2.9783 (-1.42543)	-1.6879** (-3.53803)	-1.17386* (-1.9348)
CA(t-1)-99	8.187931* (1.69411)	4.577377** (3.557067)	-0.38616 (-0.59557)	0.28747 (0.36995)
CA(t-1)-00	1.18606 (0.204535)	-5.094444 (-1.03795)	-0.29425 (-0.38056)	-0.60241 (-0.73932)
CA(t-1)-01	4.930055* (1.661898)	1.167427 (0.491804)	0.696483** (1.890054)	0.524778 (0.958594)
CA(t-1)-02	0.393269 (0.208998)	-2.07634 (-1.19174)	-0.0156 (-0.03015)	-0.12945 (-0.19078)
CA(t-1)-03	2.651518 (1.01328)	1.033891 (0.556601)	-0.74513 (-0.94937)	-0.23348 (-0.27594)
CA(t-1)-04	3.512503 (1.325063)	0.48156 (0.205845)	-1.44393 (-1.56841)	-0.86904 (-1.09521)
DGROWTH-95		0.855823** (3.556438)		-0.14958 (-1.50568)
DGROWTH-96		0.422476** (3.781143)		0.014619 (0.346172)
DGROWTH-97		0.359664** (8.0002)		-0.05603 (-1.60754)
DGROWTH-98		1.944318** (1.872019)		-0.056 {-0.30627}
DGROWTH-99		0.668888** (11.18744)		-0.02856 (-1.01602)
DGROWTH-00		1.529311** (7.257979)		0.081134 (1.317951)
DGROWTH-01		0.848708** (4.065364)		0.051594 (1.117399)
DGROWTH-02		0.756512** (2.524032)		0.059658 (1.085543)
DGROWTH-03		1.148793** (2.706899)		0.244449* (1.812454)
DGROWTH?-04		0.799405** (2.074408)		0.363440* (1.659672)
Adjusted R-squared	0.515459	0.740889	0.633669	0.658606
Sum squared resid	3.560608	1.719195	0.214043	0.044007

Note:
**: significant at 5% level
*: significant at 10% level

It is better not to explain the insignificance of CA_{it-1} coefficient after 2000 as evidence that implementation of CAR has been loosened after that year. It is more likely that since 1998, Chinese banks have gradually raised their CAR above the minimum requirement of 8% level by capital accumulation. As we pointed out at beginning, when a bank's CAR is above the minimum level, its loan growth will be unconstrained by its CAR.

In model 1 and 1′, in the years that the coefficient of CA_{it-1} is significant, the coefficients are all positive, which means that banks with higher CA ratio will have higher loan growth rate. This is in accordance with the prediction of "Capital Crunch" model. Also worth noting is that after 2001, the coefficients of CA_{it-1} are all negative in both models, though it is not significant. This fits the prediction of "risk shifting" model. This may partly explain the sharp increase of loan growth rate after 2002 (see graph 1).

From column 2 of table 1, we can see that the coefficient of deposit growth rate is highly significant in every sample year (significant at 5%). The coefficients are all positive, which means that banks with higher deposit growth rate will have higher loan growth rate. The results strongly imply that multiplier model may be a much better explanation for the loan growth in China.

Column 3 of table 1 shows the regression results of model 2, where total loan / total asset ratio (L/TA) is used as the dependent variable. We can see that when CA_{it-1} is the only explanatory variable, the results are similar as model 1. The coefficient of CA_{it-1} is highly significant in year 1997, and 1998 and 2001 (all significant at 5% level).

However, from column 4 of table 1, which presents the results of model 2′, we can see that when deposit growth rate is included in the model, the coefficient of CA (t-1) is only significant in 1998 (significant at a little more than 5% level). This means the CAR only has a temporary effect on the L/TA ratio in the year it is implemented.

On the whole, as in model 1 and model 1′, the results of model 2 and model 2′can be explained as weak evidence that the preference for loan and risk-taking attitude (roughly presented by the L/TA ratio) of the banks in China has only been temporary affected by the capital position around year that the CAR is implemented.

Both in model 2 and model 2′, the coefficient of CA_{it-1}, whether significant or not, are all negative except in year 2001, indicating that in these years banks with relative lower capital position are tend to be more preferable for loan supply. This fits the prediction of the "risk shifting" model. This is contrary to the results of model1 and 1′. Only in 2001, the coefficients of CA_{it-1} in both models are positive, (though in model 2′ it is insignificant), indicating that in this year banks with lower CAR take a more conservative attitude in loan supplying, which fits the prediction of "capital crunch" model.

In column 4, we can see that the coefficients of deposit growth rate are all insignificant except

in year 2003 and 2004 (significant only at 10% level). This shows that in most of the sample years, deposit growth rate are not related with the bank's attitude towards loan.

3.2 The result for the non-Big Fours:

Table 2 shows the regression results when only group 2 (Banks other than the "big four") is used in the regression.

We can see that for model 1 and 1′, the regression results are almost the same as in the case of total sample.

However, for model 2 and 2′, there are some difference between the total sample case and the group 2 case. Compared to the total sample case, we can see in model 2 now the coefficient of CA (t-1) is also significant in year 1995 (at 10% level). On the other hand, in model 2′ the coefficient of CA_{it-1} in year 1998 became insignificant so that the coefficients of CA_{it-1} in all the sample years are insignificant. Thus we conclude that for non-"Big Four" there are less evidences that the preference for loan of the banks has been affected by their capital position.

Compared to the total sample case, in column 4 we can see that now the coefficient for deposit growth in 2003 and 2004 also become insignificant so that the coefficients all become insignificant except in year 1997 (significant only at 10% level). Furthermore, in year 1997, the coefficient is negative, which is not what we are assumed. Thus, the conclusion is the same: compared to the case of total sample deposit growth rate are not related with the bank's attitude towards loan.

Except for these small differences, the conclusions we get are the same as the total sample case.

4. Conclusion and policy recommendations

From the regression results using the total sample we can conclude that the implementation of CAR requirement in 1998 has at most only temporary positive influence on the loan behavior of the banks in China (both on the growth of absolute value and its relative importance in the portfolio selections of the banks). Furthermore these evidences are sensitive to the regression model used. On the other hand, there are robust evidences that deposit is a key element in the determination of loan growth during the whole sample period (though there are only weak and sensitive evidences in its positive role in its relative importance in bank's portfolio.) This means the capital condition did not become a strong constraint on the Chinese bank's ability to supply loans after the adoption of CAR regulation and the traditional deposit multiplier model may be a better explanation of the bank loan growth in China -both before and after the policy change. This is in sharp contradiction with other countries which also have experienced bank restructuring.

Furthermore, when we only consider the "non-Big Four," it seems that there are even less

Table 2: the regression result of panel data model for group 2

Dependent Variables	L growth		LTA	
	1	1′	2	2′
C	0.236179** (7.457598)	0.021601 (0.332583)	0.552391** (35.91439)	0.550276** (37.24193)
CA(t-1)-95	2.194936 (0.463524)	3.268254 (1.418269)	1.705922* (1.620534)	1.938942 (0.988886)
CA(t-1)-96	2.193731 (0.918157)	-1.22652 (-0.4037)	0.097925 (0.144685)	0.637736 (0.63308)
CA(t-1)-97	4.128257** (3.149784)	1.798144** (2.3617)	-1.23271** (-2.68938)	-0.13393 (-0.19691)
CA(t-1)-98	0.861472 (0.356612)	-2.6921 (-0.846)	-0.74454 (-1.44482)	-0.31952 (-0.56052)
CA(t-1)-99	8.681477* (1.801781)	3.899646** (5.524762)	-0.34193 (-0.55843)	0.21268 (0.228592)
CA(t-1)-00	-1.00612 (-0.13599)	-4.13226 (-0.74531)	-0.66456 (-0.73246)	-0.88492 (-0.984)
CA(t-1)-01	7.092532** (1.973684)	0.541978 (0.142045)	0.83595** (2.064144)	1.02899 (1.008063)
CA(t-1)-02	-0.34646 (-0.04802)	-5.92905 (-1.02731)	0.349349 (0.30968)	0.448541 (0.316161)
CA(t-1)-03	0.843337 (0.128166)	0.34053 (0.055173)	-0.78154 (-0.87661)	-1.1402 (-0.9053)
CA(t-1)-04	0.341011 (0.056985)	0.752139 (0.185413)	2.263056 (1.206336)	1.343824 (0.823406)
DGROWTH-95		1.108445** (10.87338)		-0.18016 (-1.60299)
DGROWTH-96		0.431381** (3.623947)		-0.03294 (-0.98896)
DGROWTH-97		0.363143** (5.827422)		-0.08445** (-2.28851)
DGROWTH-98		1.981271** (1.648111)		-0.09856 (-0.61444)
DGROWTH-99		0.643263** (13.52687)		-0.03548 (-1.33589)
DGROWTH-00		1.702854** (4.253599)		0.060011 (0.897714)
DGROWTH-01		0.919914** (2.96055)		-0.01017 (-0.13847)
DGROWTH-02		0.929422** (2.529456)		-0.01455 (-0.25257)
DGROWTH-03		1.468731** (2.147846)		-0.09421 (-0.491093)
DGROWTH-04		1.14015** (2.605805)		0.17151 (0.75935)
Adjusted R-squared	0.366539	0.669317	0.672662	0.715766
Sum squared residual	3.20928	1.425277	0.102412	0.075654

strong evidence to support that the implementation of CAR in 1998 has affected the loan growth (whether measured in absolute term or in proportion to total assets) of the banks, there are also less strong connections between loan growth and deposit growth. It seems that neither "capital crunch," nor "risk shifting" nor deposit multiplier is good explanation for the loan behaviors of the "non-Big Four banks." It is reasonable to conclude that the loan supply in China have not been significantly influenced by the implementation of CAR. The finding is not surprising. We can find from figure 1 that there is no structural change for the nominal loan growth rate in 1998 or 1999.

However, we can not conclude that the CAR requirement has no effects on the Chinese banks at all. With the rapid growth of loan after 2000 and the gradual implementation of the CAR regulation, there are some signs that some Chinese banks begin to feel the capital constraint now. For example, in recent years, many listed banks, with its CAR ratio near the bottom line, are trying to issue new stock in the market, even though most of its current shareholders are against it. There is also a wave in the Chinese banks to go public.

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