Estimating Bank Market Power

Meng Yang

Project for Structural Estimation

Abstract

This project estimates change of bank market power in China over the past five years by combining a homogenous coefficient logit model and first order condition of bank lending interest rate competition. In according with the evidence from decreasing ROE and net profit, the increasing competition in the banking due to new entrant and liberalization of lending interest rate led to decreasing bank market power over 2014-2018.
Keywords: markup, bank, homogenous logit

1 Introduction

Competition in the banking industry in China has been strengthened in the past few years due to new entrants including foreign banks and city banks, liberalization of lending as well as deposit interest rate. As the number of players in the industry increases, profitability and lending interest rate decrease over time. We expect that market power, measured by markup, will also decline as a results.

Rich literature of estimating markup offers several approaches, the key idea is to estimate elasticity then back out marginal cost, which is unobservable to economists. The first approach to estimate production function to obtain supply elasticity, then with FOC of firm competition in the supply market, markup can be backed out, this approach is suitable for manufacture firms, since production function estimation is viable. The second approach is to estimate demand function, either homogenous coefficient logit or random coefficient logit, to get demand elasticity, this approach is common in the case of a centerred and clear defined demand side. In case of financial sectors, the demand function approach is commonly chosen to estimate either deposit demand of lending demand. Another approach use the accounting data to calculate margianl cost, usually with a trans-log cost function, this approach avoid structurel estimation.

To test this hypothesis, I use a discrete choice choice logit demand to estimate demand in the bank lending market, combined with the first order condition of banks competition, I calculate the markup of 32 listed bank from 2014 to 2018. The results confirmed out expectation, the average markup of banking industry decline from 1.44 in 2014 to 1.13 in 2018. The most evident drop is from 2014 to 2015.

The declining market power of banks brings many desired results. Borrowers with relatively high risk and lack of mortgage, such as SMEs and individual consumers, are underserved without the competition since

large state-owned national banks tend to give loan to huge state-owned enterprise, who enjoy implicit government credit endorsement. With the deposit (usually low) and lending interest rate set by central banks, banks is slack about risk management and absorbing deposit. Depositors also enjoy more choice and better service.

However, even with the decline market power, banks still service as the major source of financing in China and listed banks takes up around 40% of the total profit among all listed firms. Increasing competition also give rise to undesirable consequences such as increasing shadow banking and excess risk-taking, which adds to systematic risk in the financial sector.

2 Banking Industry: an overview

The Chinese banking industry underwent changes in both the market structure and regulation in the past 10 years. Bank sector is the major source of external financing, which takes up 66.01% of total social financing in 2019. Profits from listed banks takes up 39.01% of the total profits from all the listed companies. After the liberalization of lending interest rate on Jun 20, 2013, banks gained their autonomy of deciding on their own lending interest rate. As the entrance of foreign banks and city banks, the competition in the banking industry has been decreasing as a result. While profitability measured by ROE, ROA and net profit has been decreasing since 2011, we still want to know if the competition has weakened market power of banking industry.

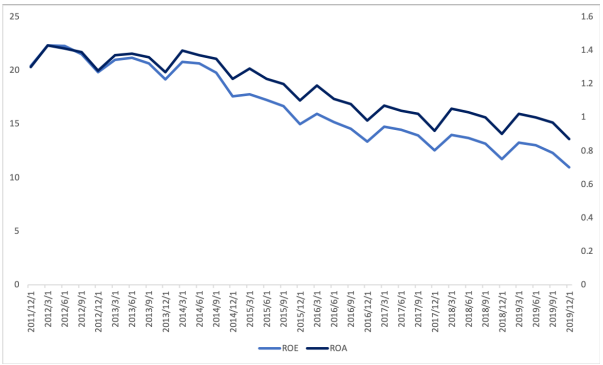

Figure 1: change of profit

There are six types of banks: policy banks, national bank ("bigfive"), city banks, rural Credit Cooperatives, Postal Savings Bank of China and foreign banks. Three policy banks implement agricultural, export and import policies, and support infrastructural project. National banks have branches nationally and is state owned corporations. City banks mainly operate regionally. Up to the end of 2019, there are 40 listed banks in China.

Absorb deposits and make loans is the major business of banking, apart from that banks also involved in inter-bank lending, and deposit in central bank account to meet the capital reservation requirement. As banks competes in the deposits as well as lending market, the interest rate of both are expected to decrease. However, since banks set their interest rate according to base deposit rate set by central bank,

they cannot compete on deposit market by playing a differentiated product game by setting different interest rates. So we will measure the market power of bank j in the lending market.

3 Data

The major data source of this research is Wind Financial Terminal, combined with annual report in case of incomplete data. I included 32 of the 40 listed banks in my sample, and the dataset spans from 2014 to 2018. Loan, deposit and interest income are in billion RMB.

Table 1 - Data Descrption

Variables	descriptoin	mean	sd	max	min
r_{jt}	lending interest rate	5.72	1.36	10.62	3.86
L_{jt}	loan increment in during year t	2436.20	3210.61	12718.92	14.65
s_{jt}	market share of bank j in year t	0.03	0.04	0.16	0.0002
CAR_{jt}	capital adequacy ratio	12.82	1.53	17.19	8.99
$default_{jt}$	default rate	1.32	0.46	2.90	0.39
$deposit$	deposit of bank j in t	31521.77	49437.29	214089.34	519.18
in_{cb}	interest rate from deposit in central bank	81.36	131.20	492.46	1.23
$in_{interbank}$	interest rate from interbank lending	63.41	119.76	632.81	0.15

I use yearly increment of loan balance of each bank as measure of L_{jt} to capture the demand of newly loan for each year. For robustness check, I used loan balance in the appendix. For interest rate, due to various term structure which complicate the explanation, I calculate the comprehensive interest rate as a single measurement of interest rate of bank j in year t, which is the interest income from loans divided by the receivable loan balance $r^l_{jt} = \frac{R_{jt}}{(1-f_{jt})L_{jt}}$. The mean r_{jt} is 5.72 with standard deviation of 1.36. which are close to base lending interest rate set by central bank.

While total loan of banking sector has been increasing, the market share of each banks in the sample is relatively stable, with average market share of 3%, and highest market share of 16%. Sampled banks takes up 95.53% of the total loan of listed banks in 2018.

Capital adequacy ratio (CAR) is the ratio of equity and risky assets, measuring the liquidity and anti-risk ability. According to the minimum CAR requirement of Basel III, the tier 1 core CAR, tier 1 CAR, and CAR are 5%, 6%, and 8%, respectively. The Tier 1 core CAR and Tier 1 CAR of commercial banks in China are around 10%, and CAR is above 12%, exceeding the requirements of Basel III. Average CAR is 12.82%, and increasing over years. I include CAR in discrete choice model assuming that borrowers can get positive marginal utility from borrowing from a bank with more core assets, thus higher risk management ability and liquidity.

As banks provide credit to riskier borrowers in face of competition, default rate increased from 0.95% to 1.49%. The speed of total deposit increase slowed down since 2014. $in_{cb}, in_{interbank}$ are interest rate from deposit in the central bank and interest rate from interbank lending respectively. Absorbed deposit can be used to supply credit to firms, lend to other banks, or deposit in central bank account, depending on relative interest rates. The last three variables will be used as supply shifter when estmate demand model.

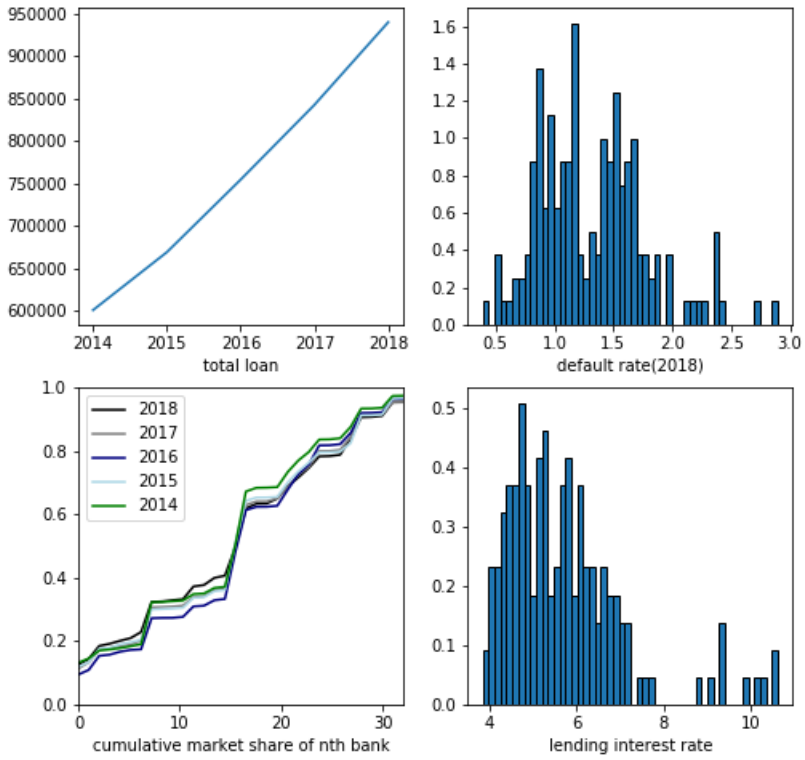

Figure 2: descriptive statistics

4 Model

The NEIO approach to estimate markup is by combining FOC of firm competition and demand model to back out marginal cost, which is unobservable. There are to approach to get the elasticity: from production function or demand function. In the case of bank sector, researchers tend to estimate demand since production function of financial sector is hard to define. Some literature choose to estimate demand in the deposit market (Egan, Hortacsu, Matvos, 2017), which is relatively easy to implement since deposit market is a retail market and deposit interest rate is open data whereas lending interest rate is negotiated between borrowers and banks privately, where mortgage is also taken into consider. Other literature, including Crawford (2018), choose to estimate lending demand, they estimate a structural model of credit demand, loan use, pricing and firm default using matched firm-bank data from Italy. Since the deposit interest rate is strictly control by central bank, following strictly with the base deposit interest rate, banks can hardly compete on deposit interest rate. Even if the upper bound of deposit interest rate has been cancelled in 24th October 2015, banks still follows the base deposit interest rate closely. Banks not only compete to absorb deposit, they also compete on lending banking on lending interest rate, while keep the default rate within control and regulation.

4.1 Bank Competition

Firm competition: banks compete for loan by playing a differentiated product Bertrand-Nash lending interest rate setting game. Timing: (1) bank j choose lending interest rate r_{jt} to maximize profit taking competitors' actions as given. (2) firms choose which bank to lend capital from. Bank j in year t decide on its lending interest rate r_{jt} to maximize expected profit, which is marginal profit from lending multiplied by L_{jt}. I use default rate of bank j in the last year as expecte default rate.

$$\max_{r^L} \pi_{jt} = (r^L_{jt}(1 - E(F_{jt})) - mc_{jt})L_{jt}$$

First order condition gives the expression of marginal cost. The semi-elasticity on the right-hand-side will be estimated by a discrete choice demand function. The expected default rate $E(F_{jt})$ equals the default rate of last year.

$$mc_{jt} = (1 - E(F_{jt}))(r^L_{jt} + (\underbrace{\frac{\partial L_{jt}}{L_{jt}\partial r^L_{jt}}}_{\text{semi-elasticity}})^{-1})$$

4.2 Discrete Choice Demand

Lending demand function of banks is estimated using a discrete choice homogenous coefficient logit model. Assume the utility of individual borrowing from bank j is the function of x_{jt}, r_{jt} and ξ_{jt}. x_{jt} are characteristics of banks, including capital adequacy ratio, and dummy varibales indicating whether it is among the largest five banks measured by total capital. ξ_{jt} is unobserved attributes of bank j observed only by consumers.ε_{ij} is idiosyncratic utility shock of consumer i from bank j with type 1 extreme value distribution. The utility function can be written as mean utility δ_{jt} plus random utility ε_{ijt}

$$\begin{aligned} u_{ijt} &= x'_{jt}\beta_t + r_{jt}\alpha_t + \xi_{jt} + \varepsilon_{ijt} \\ &= \delta_{jt} + \varepsilon_{ijt} \end{aligned}$$

Market share or demand of bank j equals the probability that it offers the highest utility. Given the distribution of random utility, the probability of borrowing from bank j is

$$pr(i \to j) = \frac{exp(\alpha_i p_j + x'_j\beta_i + \xi_j)}{1 + \sum_{k \in \mathcal{J}/j} exp(\alpha_i p_k + x'_k\beta_i + \xi_k)}$$

Assume homogenous consumer, we can aggregate discrete choice to get estimated market share

$$s_{jt} = \frac{exp(\delta_{jt})}{\sum_{k \neq j \in J} exp(\delta_{kt} + 1)}$$

By contraction mapping we can calculate mean utility δ_{jt}. Endogeneity problem due to simultaneity of supply and demand can be solved by finding price instruments and estimate the following moment condition with GMM

$$\begin{aligned} E[Z\xi] = 0 \\ E[Z(\delta_j - x'_j\beta_i + p_j\alpha_i)] = 0 \end{aligned}$$

The parameters to be estimated are: α_t: marginal disutility of lending interest rate for borrowers; β_{1t}: marginal utility from bank's CAR; β_{2t}: marginal utility of borrowing from bigfive; β_{3t}: year fixed effect.

Once we get parameters of demand function, we can calculate semi-elasticity with

$$\eta_{jt} = \frac{\partial s_{jt}}{\partial r_{jt} s_{jt}} = -\alpha (1 - s_{jt})$$

With the FOC above, the markup of bank j in t can be backed out by $\lambda_{jt} = \frac{r^L_{jt}}{mc_{jt}}$

The reason why we use markup instead of net interest margin or lending interest rate itself is that as banks competing in absorbing deposit and provide credit to borrowers, their marginal cost, including managing risk, better service, increases. Besides, competition motivates banks to take excessive risk, lending default rate to increasing and banks actual interest rate income can be declining. These facts can hardly be captured by interest margin of interest rate itself.

5 Estimation

Main steps of estimation are included in Appendix. Since $cov(p_j, \xi_j) \neq 0$, we need price instruments, which need to be supply shifter and do not influence demand. Formally, I use value of collected deposits, interst income from central bank deposit and interest income from inter-bank lending as IV, since deposit will positively affect credit supply, and inter-bank lending and central bank deposit are alternative ways of utilize deposit, thus negatively affect credit supply. These variables shift lending supply of banks unilateral while do not change demand.

Table 1 - Demand Estimates

	(2014)	(2015)	(2016)	(2017)	(2018)
r_{jt}	-1.4435	-1.5134	-1.6610	-1.4630	-1.4292
CAR_{jt}	0.6969	0.6578	0.5948	0.4940	0.4867
$bigfive_{jt}$	0.6309	0.6203	0.6788	0.5583	0.5718
intercept	-0.0088	-0.0075	-0.0108	-0.0263	-0.0356
iteration	175	112	125	125	125

r_{jt} is marginal disutility of lending interest rate for borrower, which are negative values as expected and it first increased in absolute term from 2014-2016 then decreased. Coefficients of capital adequacy rate has been decreasing over the past year which implies that the marginal utility from borrowing from a bank with high CAR has been decreasing. The coefficient of dummy 'bigfive' increase over time, indicating that the extra utility from borrowing from the largest five banks has been increasing.

I estimate the demand function year by year to in order to capture the change of marginal utility from lending interest rate, CAR, this will also give us different elasticity parameters for markup estimation.

6 Results

The markup of each bank in each year is shown in appendix. Figure 2 shows the evolve of markup of each bank from 2014 to 2018. The declining trend is evident, especially from 2014 to 2015. Average markup of banking sector change from 1.44 to 1.13. While Agricultural Bank of China has highest markup in 2014, the index drop to 1.11 in 2018.

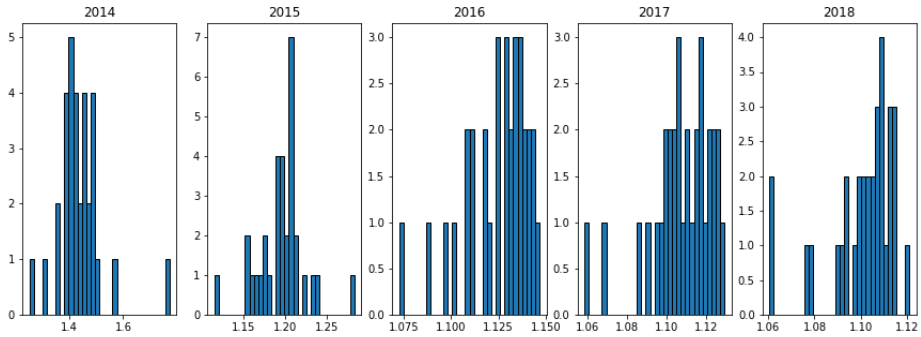

Figure 3: distribution of markup: 2014-2018

Figure 4 show the evolve of market power from 2014 to 2018 of each banks, the banks with the highest markup in 2014 is Agricultural bank of China (ABC), second highest is Bank of Shanghai, with markup of 1.59. Although markups of all banks have been decreasing steadily over time but market struture remains constant, 'bigfive', including Agricultural Bank of China, Bank of Communications; Bank of China; Industrial and Commercial Bank of China; China Construction Bank, are still have relatively high markup compared to other banks in the industry.

As the main business of banking sector, absorbing deposits and provide credit to borrowers are not only the major source of profits for bank themselves, but also the process of monetary policy transmission. The declining of market power in the lending market happens in parallel with the emergence of shadow banking, within the banking sector and outside of banking sector. Online platform and other shadow banking sectors provides borrowers, especially small and middle enterprise, regional infrastructure projects, who have relatively higher risk and thus under-served by the banking sector, who prefer lending to state-owned corporations who enjoys implicit credit endorsement and have sufficient cash flow. Meanwhile, banks also compete with online platforms, trust companies and MMF for deposit. Although the deposit interest rate are regulated so banks can hardly compete directly through offering higher deposit interest rate, their cost of absorbing deposit increasing with better service intended to attract depositors like longer working hours and better service. So, as banking sectors losing market power in the lending market, their profits and lending interest rate have been declining, which motivates banks to undertake other business, among which shadow banking is most popular one. Declining market power in the banking sector improves social welfare in the sense that the transaction cost of borrowing and lending has been decreasing and more credit is available, this will also motivate banks to improve their risk management ability.

7 Conclusion

Employing the method of combining the first order condition of competition and demand to estimate markup, this paper find the markup of banking sector in China has been decreasing from 2014 to 2018 as a consequence of the increasing competition in the banking sector, which is due to the new entrance of new banks and liberalization of lending interest rate.

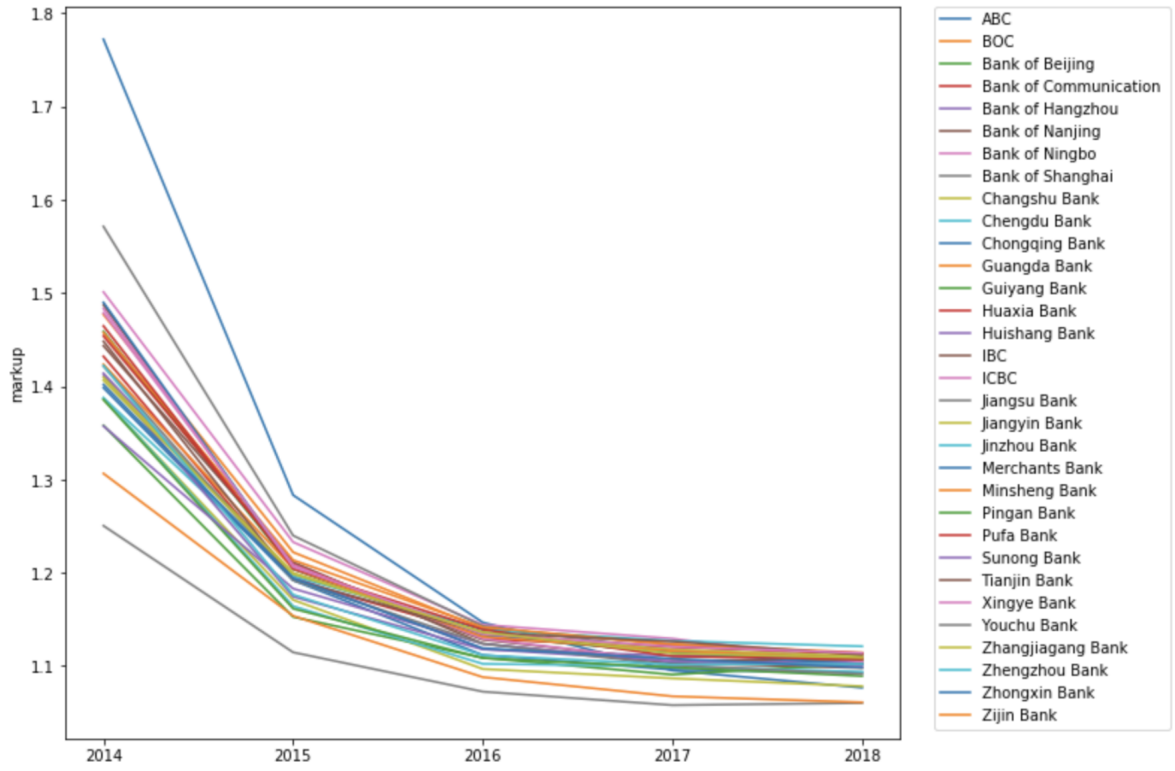

Figure 4: markup of banks (2014-2018)

Due to data limitation, this paper only samples 32 listed banks. However, city banks are playing a vital role in offering credit to local credit demand and thus should be analyzed further. Besides, although the liberalization of lending interest rate is implemented since Oct, 2013. There lending interest rate data is still very limited especially for the city banks. For robustness check, modelling the demand in the deposit market might be more accurate since it is a centered retail market.

The change of market power in banking industry affects the transaction cost of borrowing and lending, and can affect monetary policy transmission. It also bring welfare consequences in terms of availability of credit for small and middle corporations.

Reference

Crawford, G. S., Pavanini, N., Schivardi, F. (2018). Asymmetric information and imperfect competition in lending markets. American Economic Review, 108(7), 1659-1701.

Egan, M., Hortaçsu, A., Matvos, G. (2017). Deposit competition and financial fragility: Evidence from the us banking sector. American Economic Review, 107(1), 169-216.

Elliott, D., Kroeber, A., Qiao, Y. (2015). Shadow banking in China: A primer. Economic Studies at Brookings, 3(2015), 1-7.

Fungáčová, Zuzana, Pierre Pessarossi, and Laurent Weill. "Is bank competition detrimental to efficiency? Evidence from China." China Economic Review 27 (2013): 121-134.

Li, J., Hsu, S., Qin, Y. (2014). Shadow banking in China: institutional risks. China Economic Review, 31, 119-129.

Rousseas, S. (1985). A markup theory of bank loan rates. Journal of Post Keynesian Economics, 8(1), 135-144.

Ryan, Robert M., Conor M. O'Toole, and Fergal McCann. "Does bank market power affect SME financing constraints?." Journal of Banking Finance 49 (2014): 495-505.

Soedarmono, Wahyoe, Fouad Machrouh, and Amine Tarazi. "Bank market power, economic growth and financial stability: Evidence from Asian banks." Journal of Asian Economics 22, no. 6 (2011): 460-470.

Xu, Bing, Adrian Rixtel, and Michiel van Leuvensteijn. "Measuring bank competition in China: a comparison of new versus conventional approaches applied to loan markets." (2014).

Yuping, YANG Tianyu ZHONG. "On the Concentration, Competition and Risk of China's Banking Industry [J]." Journal of Financial Research 1 (2013): 012.

Appendix

1. Algorithm

1. calculate estimated market share
$$s_{jt} = \frac{exp(\delta_{jt})}{\sum_{k \neq j \in J} exp(\delta_{kt})}$$
2. contraction mapping on $s_{jt} = s_{jt}(\delta_t)$ for δ_{jt}, $s_j^{data} = s_j^{model}(\delta_j) \rightarrow \delta_j$, update with rule $\delta_t^{h+1} = \delta_t^h + lns_{jt} - lns_{jt}(\delta_t^h)$
3. GMM:
$$\min[\delta_{jt} - x'_{jt}\beta_t - r_{jt}\alpha_t]' ZWZ' [\delta_{jt} - x'_{jt}\beta_t - r_{jt}\alpha_t]$$
4. calculate semi-elasticity
$$\eta_{jt} = \frac{\partial s_{jt}}{\partial r_{jt} s_{jt}} = -\alpha_t (1 - s_{jt})$$
5. calculate marginal cost and markup
$$mc_{jt} = (1 - E(F_{jt}))(r_{jt}^L + {\eta_{jt}}^{-1})$$

2. Robustness

This part will measure L_{jt} as loan balance instead of loan increment as a robustness check of the demand estimation.

Table 1 - Demand Estimates

	(2014)	(2015)	(2016)	(2017)	(2018)
r_{jt}	-0.4356	-0.5108	-0.5771	-0.6219	-0.5978
CAR_{jt}	0.2971	0.2949	0.2727	0.2713	0.2440
$bigfive_{jt}$	0.2343	0.3203	0.4433	0.6567	0.5780
intercept	-0.0382	-0.0458	-0.0689	-0.0718	-0.0768
iteration	295	265	236	200	170

3. Markup Estimation

Full data of markup of 32 listed banks from 2014 to 2018.

	2014	2015	2016	2017	2018
ABC	1.7722	1.2834	1.1468	1.0953	1.0768
BOC	1.4771	1.2222	1.1404	1.1232	1.1122
Bank of Beijing	1.4588	1.2045	1.1326	1.1144	1.1062
Bank of Communication	1.4322	1.1927	1.1334	1.121	1.113
Bank of Hangzhou	1.414	1.1961	1.1183	1.1055	1.1044
Bank of Nanjing	1.4435	1.2114	1.1242	1.1031	1.0981
Bank of Ningbo	1.5012	1.233	1.1444	1.1295	1.1045
Bank of Shanghai	1.5714	1.24	1.143	1.1169	1.1092
Changshu Bank	1.3863	1.171	1.0969	1.0869	1.0784
Chengdu Bank	1.3877	1.1965	1.1391	1.1271	1.1212
Chongqing Bank	1.3985	1.192	1.1119	1.0962	1.093
Guangda Bank	1.4575	1.2137	1.1418	1.1236	1.1144
Guiyang Bank	1.3581	1.1528	1.1089	1.0909	1.1027
Huaxia Bank	1.4539	1.2092	1.1291	1.1205	1.1138
Huishang Bank	1.4123	1.1744	1.1179	1.1112	1.1085
IBC	1.4874	1.204	1.1284	1.1059	1.1074
ICBC	1.4788	1.2085	1.1294	1.1054	1.0994
Jiangsu Bank	1.2505	1.1148	1.0726	1.0581	1.0605
Jiangyin Bank	1.4097	1.1999	1.136	1.1177	1.1107
Jinzhou Bank	1.3873	1.1643	1.1024	1.0996	1.094
Merchants Bank	1.49	1.2048	1.1331	1.1148	1.1014
Minsheng Bank	1.4236	1.2046	1.1316	1.1162	1.1082
Pingan Bank	1.3858	1.1616	1.1086	1.0987	1.0894
Pufa Bank	1.4647	1.2049	1.1392	1.1105	1.1074
Sunong Bank	1.3574	1.1831	1.124	1.1046	1.1021
Tianjin Bank	1.4483	1.1931	1.1357	1.1264	1.1122
Xingye Bank	1.4833	1.2063	1.1344	1.1208	1.1141
Youchu Bank	1.4216	1.1921	1.124	1.101	1.0916
Zhangjiagang Bank	1.4066	1.1987	1.1362	1.1136	1.109
Zhengzhou Bank	1.4221	1.1766	1.1116	1.1018	1.1023
Zhongxin Bank	1.4019	1.194	1.1192	1.108	1.0985
Zijin Bank	1.3066	1.1539	1.0882	1.0676	1.0612