

# Impact of supply side structural reform on credit concentration risk of commercial banks

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## Abstract

**the report of the 19th National Congress of the Communist Party of China focused on the supply side structural reform, clearly pointed out to promote the upgrading of financial supervision and hold the bottom line of no systemic risk. The effect of supply side structural reform on credit concentration risk of commercial banks has attracted extensive attention of domestic scholars. Based on the data of 30 Chinese commercial banks from 2012 to 2019, firstly, this paper uses the exposure ratio method and Herfindal index method to calculate the credit concentration of commercial banks; Secondly, it uses the double difference method (did) to empirically analyze the net effect of the supply side structural reform on the credit concentration risk of commercial banks; Finally, the editorial dynamic test method is used to investigate the impact trend of the net effect of supply side structural reform. It is found that the implementation of supply side structural reform will reduce the credit concentration risk of commercial banks through the coordination of name credit concentration, industry credit concentration and regional credit concentration. In addition, the article also found that the net effect of supply side structural reform showed a U-shaped trend, showing that the negative effect first increased and then weakened, and the impact reached the deepest in 2018, and has crossed the bottom at present. Therefore, the supply side structural reform has so far reduced the credit concentration risk of commercial banks.**

## Keywords

**Commercial Bank; the structural reform of supply-side; Credit concentration; DID.**

## 1. Introduction

The subprime mortgage crisis, which began in the United States in 2008 and finally spread all over the world, has had a great impact on the global financial and economic order, and its negative effect of systemic financial risk has not been completely eliminated. The report of the 19th National Congress of the Communist Party of China pointed out that we must deepen the supply side structural reform, comprehensively use new technologies and new models to promote the upgrading of the financial supervision system, and hold the bottom line of no systemic financial risk. This shows that preventing and resolving financial risks and improving China's financial supervision system are a crucial part of the "financial stability" policy. They are to maintain China's financial stability, promote the stable development and sustainable prosperity of the socialist market economy, improve people's living standards and quality of life, enhance people's happiness, and build a high-quality modern economic society An important way to achieve high-quality economic growth. Since the supply side structural reform was proposed in 2015, China's banking industry has actively responded to the policy call, issued a series of regulatory policies, improved the financial risk quantification and early warning system, strengthened the financial risk supervision and management of commercial banks, and formed a more sound risk control system. China is a country dominated by the

banking industry. The operation status, resource allocation and risk prevention and control of the banking industry have a great impact on the national economic development, the improvement of national living standards and the long-term stability of society. To comply with the supply side structural reform, banks need to balance social responsibility and their own profits. Up to now, the supply side structural reform has been implemented for six years. Has it really dispersed the credit concentration risk of commercial banks? Can commercial banks obtain a win-win situation of social responsibility and self-profit from the supply side structural reform?

Taking 30 commercial banks in China as the research object, this paper tests the impact of supply side structural reform on credit concentration risk of commercial banks. It is found that the supply side structural reform has a negative impact on the credit concentration cost of commercial banks, and this impact presents a "U" shape. At present, it has crossed the bottom, and the overall negative impact is gradually decreasing. The follow-up arrangement of this paper is as follows: the second part is literature review and hypothesis proposal; The third part is the research design and data source; The fourth part is the empirical results and analysis; The last part is the research conclusion and policy suggestions of this paper.

## 2. Literature review and hypothesis

### (1) Literature review

So far, many scholars have done a lot of research on supply side structural reform and credit concentration risk of commercial banks. The existing research mainly focuses on the significance of supply side institutional reform, reform background and the necessity of supply side structural reform for the problem of credit concentration of commercial banks, It has important reference value for understanding the reform policy and credit concentration risk.

Does the supply side structural reform promote or inhibit the development of commercial banks? Domestic scholars are still inconclusive. Most scholars believe that the supply side structural reform has a positive effect on the development of commercial banks. Firstly, this is determined by the basis for the implementation of the supply side structural reform. Liu Yaofei and Shen Jie (2016) believe that the basis for the implementation of the reform is the problems in China's supply system, mainly due to the prominent supply side contradictions, the weak foreign demand caused by the world economic downturn, the difficulty in stimulating domestic demand and the constraints of the "middle-income trap". Secondly, these problems are manifested in "three imbalances" in finance, and the combination of external input risk and internal high leverage poses a threat to financial security. Therefore, the supply side structural reform should bear an important responsibility. It is the best choice in line with the internal logic of the current reform, a good medicine to deal with the current complex international and domestic economic situation, and the only way for China's financial development and financial reform (Gu fengjuan and Deng Fang, 2019). Lu Minfeng and Yang Liang (2016) believe that the supply side structural reform is an opportunity for banks to adjust their credit structure. Banks can reduce credit risk by supporting the development of green economy, relaxing the total amount of loans to emerging industries and other measures and policies. Jiang Xiangcheng, Kong Wei and Qiao Yingying (2017) analyzed the credit concentration risk of commercial banks from an industry perspective and believed that the adjustment direction of bank credit allocation was basically consistent with the reform direction of supply side policies. However, some scholars believe that the supply side structural reform not only promotes the development of commercial banks, but also brings great challenges. Cao Guohua and Liu Ruifan (2016) pointed out that supply side reform is both a challenge and an opportunity for commercial banks, which is conducive to stabilizing the quality of credit assets of commercial banks while bearing the pressure of credit risk exposure. Tian Guowen (2021) believes that in

the process of interest rate marketization, the implementation of supply side structural reform is not only a valuable development opportunity for commercial banks, but also brings challenges in financial product system and structure, risk control mechanism, income and risk tolerance.

In terms of credit concentration risk of commercial banks, Christian Bluhm and Ludger Overbeck (2003) proposed that there are systematic risk and non systematic risk in the credit portfolio, and the general systematic risk is universal and usually unavoidable; However, unsystematic risk has its particularity. Generally speaking, it comes from the concentration of loan portfolio, so credit concentration will increase the overall unsystematic risk of credit portfolio. Kay Giesecke and Stefan Weber (2004) pointed out that when default may occur, excessive concentration of loans by banks to interrelated enterprises or industries with important joint and several effects on each other will aggravate the risk of credit concentration. Tobia E. rotherli (2000) analyzed the relevant credit data of the three major Swiss banks from 1987 to 1996, found that banks not only imitate the third party to a certain extent in loan decision-making, but also determine their own loan decision-making through mutual imitation behavior, and defined this phenomenon as the "herding effect" of the credit market. Demsetz et al. (1997) believe that the credit concentration of smaller banks is higher than that of large banks, and although the risk dispersion effect of credit portfolio of large banks is better, the risk reduction degree is not obvious. Relevant domestic studies have summarized the following views: Hu Xintian (2003) based on the view of game theory, assuming that the basis of credit decision is information asymmetry, it is concluded that the loan decision is based on the maximization of individual interests, but it will lead to credit concentration. Chen Guoli (2006) pointed out that China's private banks have developed rapidly in recent years, which has alleviated the problem of credit concentration of commercial banks to a certain extent. However, due to the "Stickiness" characteristics of bank customers and the inherent concept of "state-owned", credit resources are still more concentrated in state-owned banks. As an important means of financing for various industries and enterprises, loan is a major power source to promote the stable and sustainable growth of China's economy, and credit concentration will hinder the development of non-monopoly industries and enterprises, and then have an adverse impact on China's economy. The research of Zhou Mei, Xue Xiaodan and Yang Yang (2020) shows that compared with private enterprises, state-owned enterprises have easier access to credit funds, so the phenomenon of credit concentration is more common. Chen Hongyan (2007) pointed out that the credit concentration of China's commercial banks mainly comes from three mechanisms: micro, meso and macro. The macro mechanism includes the inducement of national policy orientation, weak financial supervision, lack of centralized credit supervision system, restriction of credit supply environment, etc; The meso mechanism is manifested in the restriction of bank enterprise relationship environment, the "lemon market" of credit for small and medium-sized enterprises, the intensification of banking competition and so on; The micro mechanism is manifested in the restriction of commercial banks' own credit management system, the internal credit assessment mechanism, the business philosophy of intensifying credit concentration, intensive operation and avoiding risk, herding effect and so on. Sun Qinyue (2008) points out that credit concentration will trigger systemic financial risks, lead to economic bubbles, reduce the efficiency of capital use, and deteriorate the regional financial ecological environment, which will add negative effects to economic growth. Li Fangfang (2016) used variable autoregressive model to prove herding effect from an empirical point of view and support the above view. Domestic scholars hold different views on the impact of credit concentration on the risk of commercial banks, and there is no unified conclusion. Wang Li (2013) pointed out through empirical research that the increase of loan concentration of China's commercial banks had a negative impact on the non-performing loan rate, resulting in an increase in the operational risk of commercial banks; Ren qiuxiao and Wang Yiming (2016)

used the data of 16 banks and based on the fixed effect model, concluded that industry concentration had a negative impact on the asset safety of commercial banks, while customer concentration reduced the risk. However, some scholars believe that credit concentration is conducive to the improvement of business efficiency of commercial banks. Wang Fuhua and Jiang Shanshan (2012) pointed out from an empirical perspective that there is no significant relationship between regional and industrial concentration and the operational risk of commercial banks.

To sum up, first of all, the existing literature on the impact of supply side structural reform on commercial bank credit concentration mostly studies the impact mechanism and means of supply side structural reform on commercial bank credit concentration from a qualitative perspective, while few scholars analyze the impact relationship between the two as a whole and deeply describe it based on China's local sample data combined with theory and demonstration; Secondly, the relevant literature on credit concentration of commercial banks mainly starts from the causes of credit concentration, credit resource allocation, loan portfolio, non-performing loans and other factors, and does not comprehensively consider the background of supply side structural reform and the business challenges and social factors that commercial banks need to face under this background. Based on the background of supply side structural reform, this paper comprehensively considers all kinds of banks including urban commercial banks, and makes an empirical study on whether their supply side structural reform can reduce credit concentration.

## (2) Hypothesis proposal

In the context of the supply side structural reform strategy, the response policy reform of commercial banks mainly affects the bank credit concentration risk through the following three perspectives: name credit concentration risk, industry credit concentration risk and regional credit concentration risk.

First, the name credit concentration risk refers to the risk contained in the ratio of the loan balance of commercial banks to the group's major customers to the bank's net capital, which is mostly measured by the concentration of the first major customers and the concentration of the top ten customers. The higher the credit concentration of the name, it shows that commercial banks tend to large customers when allocating loan flows, which leads to that the operating efficiency and results of banks are closely related to the use of loan funds of large customers. Wang Haixia (2009) obtained the concentration of the largest customer and the top ten customers based on the exposure ratio method, established a multiple regression model to measure the correlation between bank income and customer loan concentration, and concluded that loan concentration is one of the main reasons for aggravating the vulnerability of urban commercial banks.

Secondly, industry credit concentration risk refers to the possibility that commercial banks' credit funds are concentrated in monopoly industries, resulting in their business crisis. So far, China's supervision of the concentration of commercial bank credit industry is still in the initial stage, lack of clear quantitative supervision indicators and relatively complete supervision system. Herfindahl index method avoids the concentration calculation error caused by the number and scale distribution of banks by weighting. It is the most mainstream calculation concentration method in today's academic circles. Shi Gaofeng (2013), Liu Chunzhi and fan Yaorong (2015) all used this method to calculate the industry concentration, while Wang Fuhua (2012) used the modified Herfindal index method. However, other scholars use other methods to calculate the industry concentration, such as Wu Dan (2012) using the random frontier analysis method, he Xiaoying (2015) using the loan logarithm of various industries, and pan Xinmin (2008) drawing Lorenz curve fitting and geometric method.

Finally, regional credit concentration refers to that commercial banks tend to regional economically developed areas and relatively ignore economically underdeveloped areas in the allocation of credit funds. Similar to the industrial credit concentration, the supervision of regional credit concentration is also in the initial stage, and there are deficiencies in the quantitative indicators and policy system of financial supervision. Although the state has proposed to support the development of the central and western regions in policies in recent years, commercial banks are considering the profit-making goal and are more inclined to invest credit funds in economically developed regions that can bring stable and high returns, resulting in obvious regional credit concentration. Similar to industry concentration, most scholars use HHI index to calculate regional concentration.

This paper holds that under the background of supply side structural reform, commercial banks continue to adjust the allocation of credit funds and promote the balance of industry and regional credit opportunities. In this process, by investigating the changes of commercial bank name credit concentration, industry credit concentration and regional credit concentration, this paper studies and analyzes the impact of supply side structural reform on commercial bank credit concentration risk. Based on the above analysis, the following assumptions are put forward:

H1: supply side structural reform to reduce the concentration risk of name credit of commercial banks

H2: supply side structural reform reduces credit concentration risk in commercial banking industry

H3: supply side structural reform reduces regional credit concentration risk of commercial banks

### 3. Study design and data sources

In recent years, the double difference model has been widely used to test the policy effect (Athey and imbens, 2006). The advantage is to test the different effects of things with the same trend after the policy occurs, so as to alleviate the endogenous problems caused by missing variables, reverse causality, statistical data deviation and so on. At the same time, the model can alleviate the possible impact of individual unobservable heterogeneity on explanatory variables.

Chen Lin and Wu Haijun (2015) proposed that the model should be applied under the premise of random grouping natural experiment after summarizing and analyzing the past policy evaluation using double difference model. Secondly, the double difference model should have a control group and an experimental group, the control group should not be affected by the policy, on the contrary, the experimental group should be impacted by the policy, so as to judge the effect of policy implementation. China's supply side structural reform was put forward in November 2015. As an important bank in China's system, the five major banks play a benchmarking role in their operation and development to alleviate the credit risk of China's financial and banking industry. However, national joint-stock banks and urban commercial banks adhere to the business principle of taking profit as the main purpose and taking into account liquidity and safety, and credit concentration risk is less considered. Based on this feature, this paper adopts the double difference model (did) to measure the impact effect of the supply side structural reform on the credit concentration risk of commercial banks, so as to overcome the endogenous and heterogeneous problems of credit financing of commercial banks. Another assumption of the double difference model is that there is a parallel trend in events, so this paper first carries out the parallel trend test. As shown in the figure, before 2015, the control group and the experimental group have the same development trend, and the

average loan ratio of the top ten loan customers in the experimental group is much higher than that in the control group, which meets the parallel trend test.

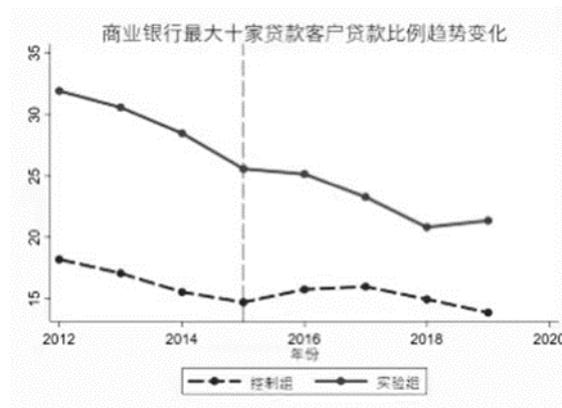


Figure 1 Trend of loan proportion of the top ten loan customers of commercial banks

(1) Econometric model

China's systemically important banks were taken as the control group and other non systemically important banks as the experimental group. According to the release of the supply side structural reform in November 2015, 2015 and beyond are set as the test year, and the previous is the control year. Analyze the concentration risk of supply side structural reform on the credit name of commercial banks, and the estimation model is shown in formula (1):

$$Ttdra_{it} = \alpha_0 + \alpha_1 DID_{it} + \alpha_2 Nplra_{it} + \alpha_3 Liquidity_{it} + \alpha_4 Ebit_{it} + \alpha_5 Loanr_{it} + \alpha_6 Tdr_{it} + \alpha_7 Car_{it} + \alpha_8 Treated_{it} + \alpha_9 Post_{it} + \varepsilon_{it} \quad (1)$$

Where *ttdra* is the dependent variable of loan name concentration; *Treated* is the dummy variable of bank disposal effect, which is used to indicate whether it is a systemically important bank. If the sample is a systemically important bank, it is 0, and if it is a non systemically important bank, it is 1; *Post* is a virtual variable for policy release and implementation, which is used to indicate whether the dependent variable is affected by the policy. The value is 0 before policy implementation and 1 after policy implementation. The *treated* variable measures the difference of credit concentration risk between non systematic important banks and systematic important banks, and *post* measures the change of credit concentration risk of commercial banks before and after the release of policies. *Did* is the multiplication term of two dummy variables, i.e. double difference partial coefficient  $\alpha$  It is used to indicate the impact of the implementation of supply side structural reform on the credit concentration risk of commercial banks. According to the characteristics of the double difference model, this paper estimates that on the basis of control time and bank type, the heterogeneity of individual variables is alleviated, and the industry disposal effect and policy time variables are absorbed by the model. Therefore, this paper mainly evaluates the policy by measuring the interaction of virtual variables. Other variables are the control variables of commercial banks, including non-performing loan ratio, liquidity ratio, asset profit margin, relative loan scale, asset liability ratio and capital adequacy ratio. See table for definitions and descriptions 1.

Table 1 A definitions and descriptions of the variables

	variable	symbol	The variable definition
The variable being interpreted	Commercial banks' maximum ten loan concentration	$Ttdra_{it}$	Bank i Total loans / total loans to the top ten Group customers in the t-period
	Concentration in the lending industry	$Chd$	Bank i in the t-period to each industry loan ratio square sum

	The concentration of the loan area	Ghd	Bank i in the t-period to the region of the proportion of square
Explain the variable	Process variables	Treated <sub>it</sub>	The processing group is 1 and the control group is 0
	The time variable	Post <sub>it</sub>	Supply-side structural reforms were 0 before and 1 after reform
	Net effect of supply-side structural reform	DID	The net effect of the policy represented by the Post-Treated cross item
Control variables	Non-performing loan rate	Nplra <sub>it</sub>	Bank i Non-performing Loan Balance / Total Loan Balance in Period t
	Liquidity ratio	Liquidity <sub>it</sub>	Bank i current assets / current liabilities in the t-period
	Asset margin	Ebta <sub>it</sub>	Bank i EBITDA balance / total asset balance for period t
	The relative size of the loan	Loanr <sub>it</sub>	Bank i Net loan / total asset balance in t-period
	Asset-liability ratio	Tdr <sub>it</sub>	Bank i Total liability balance / total asset balance in t-period
	Capital adequacy ratio	Car <sub>it</sub>	Bank i loan loss provision / total loan balance in the t-period

In order to further analyze the impact of supply-side structural reform on the risk of credit concentration of commercial banks, the credit concentration risk of commercial banks is divided into different parts according to different standards. According to the BCBS classification, it can also be measured by credit sector concentration, which generally includes credit asset industry concentration and regional concentration. In examining the impact on the credit asset industry, the estimation model (1) in the dependent variables commercial banks the maximum ten loan concentration to the loan industry concentration Chd, the meaning of other variables remains unchanged, the estimation model as shown in formula(2). In examining the impact of supply-side structural reform on the regional credit concentration of commercial banks, the maximum ten loan concentrations of the dependent commercial banks in the estimation model (1) were replaced by the maximum ten loan concentrations of the commercial banks in the model (1) with the concentration of the loan areas Ghd, while the other variables remained unchanged, as shown in the model (3).

$$Chd_{it} = \alpha_0 + \alpha_1 DID_{it} + \alpha_2 Nplra_{it} + \alpha_3 Liquidity_{it} + \alpha_4 Ebit_{it} + \alpha_5 Loanr_{it} + \alpha_6 Tdr_{it} + \alpha_7 Car_{it} + \alpha_8 Treated_{it} + \alpha_9 Post_{it} + \varepsilon_{it} \quad (2)$$

$$Ghd_{it} = \alpha_0 + \alpha_1 DID_{it} + \alpha_2 Nplra_{it} + \alpha_3 Liquidity_{it} + \alpha_4 Ebit_{it} + \alpha_5 Loanr_{it} + \alpha_6 Tdr_{it} + \alpha_7 Car_{it} + \alpha_8 Treated_{it} + \alpha_9 Post_{it} + \varepsilon_{it} \quad (3)$$

Now the supply-side structural reform has been proposed for six years, in order to assess the effect of the implementation of the policy, and further determine the impact of china's commercial banks credit concentration risk trend. This article refers to the model of He Jing (2016), sets the time virtual variable ye2015-ye2019 on the basis of the model (1) and introduces Treated×2015, Treated×2016, Treated×2017, Treated×2018withTreated×2019, establishing the following dynamic marginal effect models:

$$Ttdra_{it} = \alpha_0 + \alpha_1 Treated_{it} + \alpha_2 ye2015 + \alpha_3 ye2016 + \alpha_4 ye2017 + \alpha_5 ye2018 + \alpha_6 ye2019 + \alpha_7 * Treated * 2015 + \alpha_8 * Treated * 2016 + \alpha_9 * Treated * 2017 + \alpha_{10} * Treated * 2018 + \alpha_{11} * Treated * 2019 + \alpha_{12} Nplra_{it} + \alpha_{13} Liquidity_{it} + \alpha_{14} Ebit_{it} + \alpha_{15} Loanr_{it} + \alpha_{16} Tdr_{it} + \alpha_{17} Car_{it} + \varepsilon_{it} \tag{4}$$

$$Chd_{it} = \alpha_0 + \alpha_1 Treated_{it} + \alpha_2 ye2015 + \alpha_3 ye2016 + \alpha_4 ye2017 + \alpha_5 ye2018 + \alpha_6 ye2019 + \alpha_7 * Treated * 2015 + \alpha_8 * Treated * 2016 + \alpha_9 * Treated * 2017 + \alpha_{10} * Treated * 2018 + \alpha_{11} * Treated * 2019 + \alpha_{12} Nplra_{it} + \alpha_{13} Liquidity_{it} + \alpha_{14} Ebit_{it} + \alpha_{15} Loanr_{it} + \alpha_{16} Tdr_{it} + \alpha_{17} Car_{it} + \varepsilon_{it} \tag{5}$$

$$Ghd_{it} = \alpha_0 + \alpha_1 Treated_{it} + \alpha_2 ye2015 + \alpha_3 ye2016 + \alpha_4 ye2017 + \alpha_5 ye2018 + \alpha_6 ye2019 + \alpha_7 * Treated * 2015 + \alpha_8 * Treated * 2016 + \alpha_9 * Treated * 2017 + \alpha_{10} * Treated * 2018 + \alpha_{11} * Treated * 2019 + \alpha_{12} Nplra_{it} + \alpha_{13} Liquidity_{it} + \alpha_{14} Ebit_{it} + \alpha_{15} Loanr_{it} + \alpha_{16} Tdr_{it} + \alpha_{17} Car_{it} + \varepsilon_{it} \tag{6}$$

Adding time margin to the model can evaluate the changing trend in the process of policy implementation and study the dynamic marginal treatment effect of supply-side structural reform on the risk of credit concentration of commercial banks. "In 2015, for example, the policy effect of the treatment group was  $\alpha_0 + \alpha_1 + \alpha_2 + \alpha_7$ , while the effect in the control group was  $\alpha_0 + \alpha_2$ , and the dynamic marginal effect was  $\alpha_1 + \alpha_7$ , and so on, the dynamic marginal effect for each year can be obtained." However, it can be seen that all marginal effects have a common coefficient of  $\alpha_1$ , so this paper focuses on the interaction items  $Treated \times 2015, Treated \times 2016, Treated \times 2017, Treated \times 2018$  and  $Treated$  when examining the risk of credit concentration on commercial banks. The coefficients for  $Treated \times 2019, \alpha_7, \alpha_8, \alpha_9, \alpha_{10}, \alpha_{11}$ .

(2) The source of the data sample

The data are used by 30 commercial banks as a sample of the study, including large commercial banks, national joint-stock banks, and urban commercial banks. Refer to the study of Fan Xiaoyun et al. (2012) and Xiao Wei et al. (2012), which included five large commercial banks, nine national joint-stock commercial banks, and 16 listed city commercial banks. According to the requirements of the double differential model, whether it is a systematic and important bank is used as the basis for distinguishing the treatment group and the control group. Since the policy was implemented in 2015, we set the sample data time interval to three years before and after the policy was implemented, i.e. using the 2012-2019 annual data. In the process of sample screening, interpolation is used to complete the missing data. The data for this article is derived from the CSMAR database and the WIND database. A statistical description of the variable is shown in the table

Table 2 A statistical description of the variables

variable	Observations	mean	standard deviation	minimum	maximum
Tdra	240	21.16	9.363	7.040	49.65
Chd	240	0.164	0.086	0.100	0.822
Ghd	112	0.215	0.073	0.131	0.432
Nplra	240	1.304	0.414	0.430	2.750
Liquidity	240	51.10	12.96	28.91	97.49
Ebta	240	0.0337	0.00491	0.0198	0.0484
Tdr	240	0.930	0.0129	0.828	0.954
Loanr	240	0.451	0.0895	0.00291	0.608
Car	240	0.00605	0.00304	-0.000291	0.0179

Source: Processed by Stata15.0 Software.

### 4. Empirical results and analysis

(1) The impact of supply-side structural reform on the concentration risk of credit in commercial banks' names

The overall impact of the implementation of supply-side structural reform on the concentration risk of credit concentration in commercial banks' names can be estimated by the table double differential variable DID, and the supply-side structural reform will generally reduce the proportion of commercial banks' loans to the top ten group customers, that is, the policy reduces the risk of credit concentration in commercial banks' name. The regression result of the control variable is reasonable, and the whole sample policy effect result is -5.163, which indicates that the supply-side structural reform reduces the risk of credit concentration in the name of commercial banks under the condition of 10% confidence. The policy effect decreased, but the impact was more significant, when the full sample was added to the indicators that took into account the liquidity, profitability, safety and size of banks. The estimates of Nplra and Liquidity are 6.228 and 0.116 respectively, indicating that these two factors have a positive impact on the increased risk of credit concentration in commercial banks, and that the non-performing loan ratio has a significant impact, but the policy response is not strong. The negative effect of asset profit margin (Ebta) of -484.6 indicates that the more profitable banks are, the more controlled the credit risk, the less risk they have. The negative effects of loan relative size (Loanr) and asset-liability ratio (Tdr) were -26.59 and -14.51, respectively, indicating that the more capable commercial banks were, the less risky they were to concentrate credit. The negative capital adequacy ratio (Car) effect of -780.1 indicates that the fuller the bank's credit risk assessment, the less risk it is.

After sub-sample, it is found that both joint-stock banks and urban commercial banks are affected by supply-side structural reforms. Compared with joint-stock banks, the policy impact on city firms is more significant. Prior to the addition of the control variable, the policy effects of joint-stock banks and city firms were -2.386 and -6.725 respectively, and the stability of the policy evaluation of the city banks was more significant, while the policy impact on both banks declined to -1.863 and -3.011, respectively, after the control variables were added. There are two possible reasons for this, one is that the city's small lending customer base, for profit purposes, the majority of loans to a specific customer group, resulting in excessive risk of credit concentration. After the implementation of the policy, the city firm optimizes the loan strategy and greatly reduces the risk of credit concentration. The other is that joint-stock banks have a wide range of target customers and are themselves capable of mitigating the risk of credit concentration and are therefore less affected by policy.

Table 3 Fixed Effect Panel Model: Double Differential Estimation

variable	Full sample		Joint-stock banks		City business	
	Ttdra	Ttdra	Ttdra	Ttdra	Ttdra	Ttdra
Post	-0.349	-5.391***	-0.349	4.188***	-0.349	-4.552***
	(2.803)	(1.337)	(1.250)	(1.487)	(2.749)	(1.549)
Treated	11.24***	12.03***	3.463***	0.340	15.61***	16.88***
	(2.428)	(1.597)	(1.232)	(1.257)	(2.490)	(2.053)
DID	-5.163*	-4.320***	-2.386	-1.863	-6.725**	-3.011
	(3.071)	(1.655)	(1.559)	(1.340)	(3.149)	(2.113)
Nplra		6.228***		-5.454***		8.170***
		(1.557)		(1.649)		(1.559)
Liquidity		0.116***		-0.0282		0.104***
		(0.0412)		(0.0357)		(0.0392)

Ebta		-484.6***		-117.9		-339.5**
		(137.8)		(111.7)		(157.5)
Loanr		-26.59***		16.77*		-10.82
		(7.091)		(9.853)		(8.760)
Tdr		-14.51***		307.9***		-81.91
		(3.679)		(73.71)		(56.71)
Car		-780.1***		282.8		-1,672***
		(261.8)		(194.5)		(398.6)
The number of samples	240	240	112	112	168	168
R^2	0.170	0.363	0.126	0.385	0.320	0.487

Note: The value in parentheses is the test t value; The s,s,ands are represented at the 10%,5%,and1% levels, respectively.

(2) The impact of supply-side structural reforms on the risk of credit concentration in the commercial banking industry

The overall impact of the implementation of supply-side structural reform on credit concentration risk in commercial banking industry can be obtained by the table double differential variable DID estimate, and supply-side structural reform will reduce credit concentration in commercial banking industry in general, that is, the policy reduces the risk of credit concentration in commercial bank industry. The regression results of the control variable are reasonable, with a policy effect of -0.0320 at the 5% confidence level for the entire sample. After considering the various control variable indicators, the policy effect decreased slightly and was raised to -0.0256,and the non-performing loan ratio and asset-liability ratio had a significant impact on the risk of credit concentration, indicating that the measures taken by banks to grasp the scale of non-performing loans and control assets had a significant impact on reducing the risk of credit concentration in the banking industry.

After the sample found that both joint-stock banks and urban commercial banks are also affected by supply-side structural reforms, and the policy impact of urban commercial banks than joint-stock banks slightly higher. After adding various control variable indicators, the policy effect of joint-stock banks and city commercial banks decreased, indicating that banks will have a partial offset effect on the policy effect after considering their own operating factors. Before and after the addition of control variables, the policy impact(-0.0397 and -0.0360)washigher than the full sample mean and joint-stock banks, which on the one hand indicated that the city commercial banks in the supply-side structural reform before the higher risk of industry credit concentration, on the other hand, it also shows that the major city firms actively participate in supply-side structural reform, and strive to reduce the commercial banking industry credit concentration risk objectives.

Table 4 validates H2 estimates

variable	Full sample		Joint-stock banks		City business	
	Chd	Chd	Chd	Chd	Chd	Chd
Post	-0.00922	-0.0252*	-0.00922	-0.00733	-0.00922	-0.0158
	(0.00584)	(0.0145)	(0.00589)	(0.00772)	(0.00586)	(0.0179)
Treated	0.0569***	0.0730***	0.0150**	0.0158**	0.0804***	0.101***
	(0.0128)	(0.0193)	(0.00610)	(0.00714)	(0.0185)	(0.0287)
DID	-0.0320**	-0.0256*	-0.0183**	-0.0114*	-0.0397**	-0.0360*
	(0.0141)	(0.0139)	(0.00736)	(0.00679)	(0.0199)	(0.0209)

Nplra		-0.0367**		-0.0184***		-0.0461**
		(0.0155)		(0.00531)		(0.0210)
Liquidity		0.000236		0.000165		-5.96e-05
		(0.000316)		(0.000159)		(0.000349)
Ebta		-1.590		-1.394**		-0.166
		(2.073)		(0.607)		(2.471)
Loanr		0.105		0.0587		0.263**
		(0.0667)		(0.0355)		(0.104)
Tdr		-1.538***		0.641*		-1.232***
		(0.505)		(0.346)		(0.378)
Car		0.309		-0.907		4.251
		(2.290)		(0.661)		(4.647)
The number of samples	240	240	112	112	168	168
R <sup>2</sup>	0.080	0.140	0.290	0.427	0.115	0.198

Note: The value in parentheses is the test t value; The s,s,ands are represented at the 10%,5%,and1% levels, respectively.

(3) The impact of supply-side structural reforms on the risk of regional credit concentration of commercial banks

The overall impact of the implementation of supply-side structural reform on the regional credit concentration risk of commercial banks can be obtained by the table double differential variable DID estimate, and the supply-side structural reform will reduce the regional credit concentration of commercial banks in general, that is, the policy reduces the regional credit concentration risk of commercial banks. The regression result of the control variable is reasonable and has the policy effect of -0.00961 for the whole sample. After considering the indicators of various control variables, the policy effect was positive and raised to 0.0175, and the non-performing loan ratio and asset-liability ratio had a significant impact on the risk of credit concentration, which was -0.0442 and 2.977, respectively.

Table 5 validates H3 estimates

variable	Full sample	
	Ghd	Ghd
Post	-0.00828	0.0547**
	(0.0167)	(0.0268)
Treated	0.0328*	-0.0445**
	(0.0188)	(0.0216)
DID	-0.00961	0.0175
	(0.0253)	(0.0246)
Nplra		-0.0442*
		(0.0254)
Liquidity		0.000110
		(0.000611)
Ebta		3.825*
		(2.187)
Loanr		-0.211

		(0.151)
Tdr		2.977**
		(1.210)
Car		1.496
		(2.483)
The number of samples	112	112
R <sup>2</sup>	0.045	0.285

Note: The value in parentheses is the test t value; The s,s,ands are represented at the 10%,5%,and1% levels, respectively.

(4) Marginal dynamic testing and predictive analysis

The marginal dynamic test of the model(1)is carried out in the trend development article to examine the net effect of supply-side structural reform(see table). The year2015, year2016,year2017, year2018,andyear2019 variables are introduced with values of 1 in 2015-2019, 0in other years, and interactwith the grouping variable Treated, as shown in the table. Overall, the marginal dynamic negative effect of supply-side structural reforms was significant, rising from -3.453 to -7.094 and then dropping to -6.308 indicating that the negative negative effects of supply-side structural reforms in 2015-2019 were first enhanced and then weakened, and the most significant impact was in 2018. After adding the control variable, the effect changes to -2.631 and then decreases to -5.553, and the policy effect of supply-side structural reform increases and weakens, which is basically consistent with the above results. "In terms of both industry credit concentration and regional credit concentration, although the results are mostly negative, the marginal effect is not significant, with the marginal dynamic effect of industry credit peaking at -0.0424 in 2019and the maximum value occurring in 2017 after the inclusion of control variables." -0.0397;for regional credit marginal dynamics, which peak at -0.0163 in 2018, the maximum value appears in 2018 at -0.0210 after the control variable is added.

Combined with the above results, it can be seen that after the introduction of supply-side structural reform policy, compared with the control group, the credit concentration risk of the experimental group banks decreased significantly, and dynamically, the reduced effect of supply-side structural reform on credit concentration risk showed a tendency to strengthen first and then weaken.

Table 6 The dynamic marginal effect test of green credit policies

	(1)	(2)	(3)	(4)	(5)	(6)
variable	Ttdra	Ttdra	Chd	Chd	Ghd	Ghd
DID_2015	-3.453	-2.631	-0.0295	-0.0314	0.00313	0.00814
	(2.421)	(2.473)	(0.0287)	(0.0284)	(0.0128)	(0.0137)
DID_2016	-3.159	-2.697	-0.0381	-0.0384	-0.00485	-0.00343
	(2.421)	(2.486)	(0.0287)	(0.0286)	(0.0128)	(0.0145)
DID_2017	-5.800**	-6.128**	-0.0374	-0.0397	1.24e-05	-1.22e-05
	(2.421)	(2.423)	(0.0287)	(0.0279)	(0.0128)	(0.0139)
DID_2018	-7.094***	-7.056***	-0.0395	-0.0343	-0.0163	-0.0210
	(2.421)	(2.442)	(0.0287)	(0.0281)	(0.0128)	(0.0153)
DID_2019	-6.308***	-5.553**	-0.0424	-0.0377	-0.0141	-0.0185
	(2.421)	(2.440)	(0.0287)	(0.0281)	(0.0128)	(0.0156)
Nplra		0.539		0.0337*		0.00940
		(1.574)		(0.0181)		(0.0164)

Liquidity		-0.0798**		0.000919**		-0.000556
		(0.0368)		(0.000423)		(0.000336)
Ebta		222.3*		-0.288		-0.374
		(122.1)		(1.404)		(1.578)
Loanr		-9.454		-0.173**		0.151
		(6.149)		(0.0707)		(0.119)
Tdr		16.89		0.693*		0.942
		(34.22)		(0.394)		(0.714)
Car		34.71		-4.914***		-0.849
		(160.1)		(1.841)		(0.894)
The number of samples	240	240	240	240	112	112
R <sup>2</sup>	0.337	0.368	0.204	0.288	0.262	0.308

Note: The value in parentheses is the test t value; The \*, \*\*, and \*\*\* are represented at the 10%, 5%, and 1% levels, respectively.

(5) Robustness inspection

In order to ensure the robustness of the empirical results, this paper further tests:

(1) One of the prerequisites for using the double differential method is to require the experimental group and the control group to have a basic parallel time trend before the implementation of the policy. Figure 1 shows that the experimental group and the control group had the same decreasing trend before the introduction of the supply-side structural reform policy, which initially satisfied the parallel trend assumption. On this basis, this paper further uses the event test method, takes the year before the policy occurs as the base period, introduces the interaction between the year virtual variable and the processing group virtual variable, and observes the coefficient, and finds that it is not significant. This conclusion can be seen visually in Figure 2.

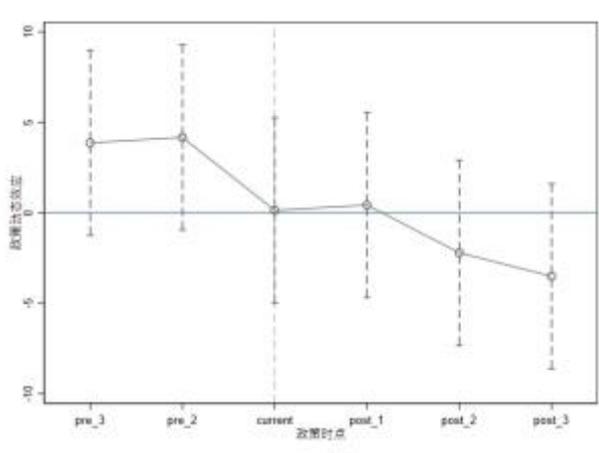


Figure 3 The time trend is parallel to that of the control group

(2) Exclude interference from other events. This paper carries on the counter-fact test, selects the variable that the commercial bank is not affected by the policy in the supply-side structural reform, that is, the commercial bank deposit growth rate, and carries on the double differential test again. If the double difference is not significant, the test results are robust. Between the same control group and the control group experiment, the explanatory variables did not produce significant changes, and it can be inferred that the changes in the relevant variables were caused by the impact of supply-side structural reform policies. In this paper, the growth rate of commercial banks' deposits is chosen as the explanatory variable of the placebo test,

mainly because the policy objectives of supply-side structural reform are mainly for commercial banks and do not have a policy impact on deposit groups. After empirical examination, it can be found that the double differential effect of deposit growth rate is -0.033, which has not changed significantly, indicating that this paper has a certain degree of robustness.

Table 7 Placebo test results

variable	Dgr
Post	-0.00439 (0.0270)
Treated	0.0848*** (0.0234)
DID	-0.0330 (0.0296)
The number of samples	240
R <sup>2</sup>	0.112

Note: The value in parentheses is the test t value; The s,s,ands are represented at the 10%,5%,and1% levels, respectively.

## 5. Research conclusions and policy recommendations

China's supply-side structural reform is the focus and main line of our policy reform in recent years, and the credit concentration risk of commercial banks is the first problem to prevent China's financial risk. The report of the 19th National Congress points out that we should resolutely fight the battle to prevent and resolve major risks, improve the financial supervision system, and keep the bottom line from systemic financial risks. However, because the supply-side structural reform is generally aimed at all the banks in China, and the different bank size will have an impact on the bank credit concentration risk, there is endogenous, making it difficult to analyze the effect of the supply-side structural reform policy. Based on the requirements of Basel III, the banking system-critical banks and non-systemically important banks are set up as control groups, and the impact of supply-side structural reform is comprehensively estimated using the double differential method based on the data of 30 banks in China from 2012-2019 as a research sample.

This paper finds that after implementing the supply-side structural reform policy for non-systematic and important banks, the loan ratio of the top ten group loan customers of China's commercial banks has decreased significantly, and the policy has a significant negative effect. For joint-stock banks and urban commercial banks, the supply-side structural reform policy of urban commercial banks has greater effect, and after commercial banks consider the profit, liquidity and security factors of their own operations, the policy effect of supply-side structural reform is obviously reduced. By estimating the dynamic marginal effect of supply-side structural reform policies on the risk of credit concentration in commercial banks' names, the results show that their negative effects are first enhanced and then weakened, with the greatest impact in 2018, with a U-shaped profile, and gradually diminishing by 2019. Thus, in the long run, the implementation of supply-side structural reform policy will gradually reduce the risk of credit concentration in China.

According to the above conclusion, although the government's moderate intervention in market economic development, that is, supply-side structural reform has played a role in reducing the risk of credit concentration in China's commercial banks in general, but this paper

believes that only through more reasonable and effective intervention can improve the government's credit concentration risk reduction effect, based on the supply-side structural reform of the core needs and the characteristics of China's commercial banks credit concentration risk, it is urgent to adjust and optimize from the following three aspects:

First, respect the basic laws of economic operation, respect the market's own trends, grasp the timing and mode of policy intervention. According to the deployment and need of supply-side structural reform, based on the basic characteristics of credit of commercial banks in China, intervention in a reasonable area on the road of standardization and legalization.

Second, the government regulatory authorities guide and supervise the downward risk of commercial bank credit concentration by establishing and perfecting a more perfect risk control policy support system. Focus on long-term and short-term regulatory policies in parallel, through the development of scientific and detailed regulatory indicators, innovative regulatory means and methods, to establish a more efficient and sound dynamic risk supervision system.

Third, commercial banks themselves should grasp the inherent requirements of improving credit quality, maintaining their own business development and promoting economic development. Rising to the height of national strategic development to clarify the important impact of self-management on China's economic development, in the current economic environment, commercial banks are china's economic development and economic policy is an important benchmark, reduce the risk of credit concentration in this level is very important.

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