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Bank branching deregulation and the credit risk of the regional banking sector: Evidence from city commercial banks in China☆

Chaochao Wang *, Yan Dong, Ran Ge

Research Institute of Economics and Management, Southwestern University of Finance and Economics, No. 555, Liutai Avenue, Chengdu 611130, China

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ABSTRACT

From 2006 to 2011, with the change in regulatory policies, most regions of China relaxed restrictions on the intercity branching of city commercial banks, which led to a significant increase in the number of nonlocal branches of city commercial banks. We assess the impact of this bank branching deregulation on the credit risk of the regional banking sector across 286 prefecture-level cities in China. We find that deregulation has increased the credit risk of the regional banking sector in host cities by intensifying competition and encouraging risk-taking behaviors such as "lowering lending criteria" and "attracting deposits with higher interest". Moreover, this effect becomes more pronounced in regions with a higher initial level of the loan-to-deposit ratio and regions with a higher initial level of competition in the banking sector.

1. Introduction

A large body of literature has examined the influence of the geographic diversification of banks on their own risks (e.g., Dick, 2006; Goetz et al., 2016; Berger et al., 2017). However, few studies have focused on how the overall credit risk of the local banking sector is affected when multiple banks expand into the region. Since the global financial crisis in 2008, countries around the world have paid much more attention to maintaining the stability of the financial system and guarding against major financial risks. At the same time, the geographic diversification of banks is becoming a more common phenomenon and brings new challenges to the stability of the regional financial market. Moreover, the geographic diversification of banks often follows branching deregulation. The main purpose of this paper is to understand how bank branching deregulation affects the overall credit risk in the regional banking sector in China and to explore possible measures to manage the risk. We focus on credit risk because it is the most important type of risk facing the banking sector.

We carry out this analysis with a sample of city commercial banks in China's banking sector. Before 2006, intercity branching by city commercial banks was not permitted by the China Banking Regulatory Commission (CBRC). After 2006, with the implementation of the *Measures for the Administration of Intercity Branching by City Commercial Banks* and the *Suggestions on Adjusting the Market Access Policy for Branches of Small and Medium-sized Commercial Banks*, this restriction has been gradually removed, forming a natural experiment that enables us to assess the effect of branching deregulation on the credit risk of the regional banking sector.

This branching deregulation may have two opposite effects on the risk of the regional banking sector. On the one hand, the arrival

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* Corresponding author.
E-mail addresses: ccw_norton@163.com (C. Wang), ydong@swufe.edu.cn (Y. Dong).

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of out-of-town banks may bring advanced risk management technology. The diffusion of such technology will benefit the banks of the whole region and reduce the credit risks. On the other hand, the arrival of out-of-town banks increases the intensity of competition in the banking sector, which tends to encourage banks to engage in more risk-taking behaviors, thus increasing the risk of the regional banking sector. It is difficult for theoretical analysis to give an exact answer about what the net effect is.

Motivated by theoretical uncertainty, in this paper, we assess the impact of the deregulation of city commercial banks' intercity branching on the credit risk of the regional banking sector, employing a difference-in-differences (DD) identification strategy. We obtain three main findings. First, on average, branching deregulation increases the credit risk of the regional banking sector in host cities. Second, this effect occurs because greater competition accompanying deregulation encourages the banking sector to take actions such as "lowering lending criteria" and "attracting deposits with higher interest". Third, among different types of local banks, the closer the bank's main business is to that of the out-of-town city commercial banks, the greater the impact on its credit risk will be. Moreover, the effect of branching deregulation is more pronounced in regions with a higher initial level of the loan-to-deposit ratio and regions with a higher initial level of competition in the banking sector.

Our work contributes to the literature in the following ways. First, we expand the research boundary of the geographic diversification of banks. Specifically, we focus on the impact of branching deregulation on the overall risk of the regional banking sector rather than the impact of an individual bank's geographic diversification on its own risk. Second, we study the mechanism of how competition affect the credit risk of the regional banking sector. It is found that the arrival of out-of-town banks will encourage risk-taking behaviors in the regional banking sector. We extract risk-taking information from administrative penalties on banking misconduct imposed by the CBRC. We use this information as a proxy for the change in risk-taking behaviors in the banking sector. This approach can provide a new reference for the study of banking risk. Third, we enrich the analysis of how credit risk is formed to a certain extent. We analyze the mechanisms of credit risk not only using the specific risk-taking behaviors of banks but also the fixed asset investments of industries with various default risks. Specifically, we establish relationships between the default risk of loans in certain industries and their corresponding fixed asset investments and use the changes in fixed asset investment in these industries to infer the change in credit risk in the regional banking sector.

The rest of the paper is organized as follows: Section 2 offers a brief overview of the market structure of China's banking sector, the deregulation of city commercial banks' intercity branching, and related studies. Section 3 describes the data and variables. Section 4 explains our empirical strategy. Section 5 presents and discusses the empirical findings, and Section 6 presents concluding thoughts.

2. Background and related literature

2.1. The market structure of China's banking sector

China's banking sector is composed of several types of banks, including state-owned commercial banks, joint-stock commercial banks, city commercial banks, rural financial institutions, foreign banks, and other banking financial institutions. Fig. 1 shows the market shares of various types of banks.[1]

There are five state-owned commercial banks in China, which are Industrial and Commercial Bank of China, Agricultural Bank of China, Bank of China, China Construction Bank, and Bank of Communications. State-owned commercial banks have branches all over the country. By the end of 2018, their total assets accounted for about 40.8% of the total assets of the banking sector.

There are a total of twelve joint-stock commercial banks in China, all of which were born in the process of China's reform and opening up. Since the joint-stock commercial banks adopted a modern enterprise system at the beginning of their birth and were allowed to conduct business nationwide, they have developed rapidly and by the end of 2018, their total assets accounted for 19.5% of the total assets of the banking sector. At present, the vast majority of joint-stock commercial banks have formed a nationwide business network, and nine joint-stock commercial banks are listed on A-shares.

For city commercial banks, their number currently reaches 128. The predecessor of city commercial banks was the city credit cooperatives that emerged in the mid-1980s. The city credit cooperatives are cooperative financial organizations established by urban residents, which provide financial services to urban collective enterprises, individual businesses and urban residents. City credit cooperatives developed rapidly. By the end of 1993, most cities and counties in the country had established city credit cooperatives, with a number of nearly 4800. However, many of them have problems on operation and risk management. In order to solve these problems, city credit cooperatives were restructured into city cooperative banks, and their total number was greatly reduced. City cooperative banks are generally owned by urban enterprises, residents and local governments, in which local governments play an important role. In March 1998, city cooperative banks changed their name to city commercial banks. Since then, city commercial banks have achieved leapfrog development by stripping non-performing assets, replenishing capital, and introducing strategic investors. Before 2006, city commercial banks could only conduct business in prefecture-level cities where their head offices were located. Since the CBRC allowed city commercial banks to set up branches in other prefecture-level cities in 2006, city commercial banks have undergone large-scale geographic expansion and their market share has increased significantly. Although the process of the geographic expansion was halted in 2011, the development process of city commercial banks has not been interrupted, and as of the end of 2018, their total assets accounted for about 14.2% of the total assets of the banking sector.

[1] Due to the changes in the statistical coverage of bank categories after 2019, we only report the market shares of various types of banks before 2019. In addition, due to the particularity of policy banks, the statistics of the total assets of the banking sector do not include the assets of policy banks.

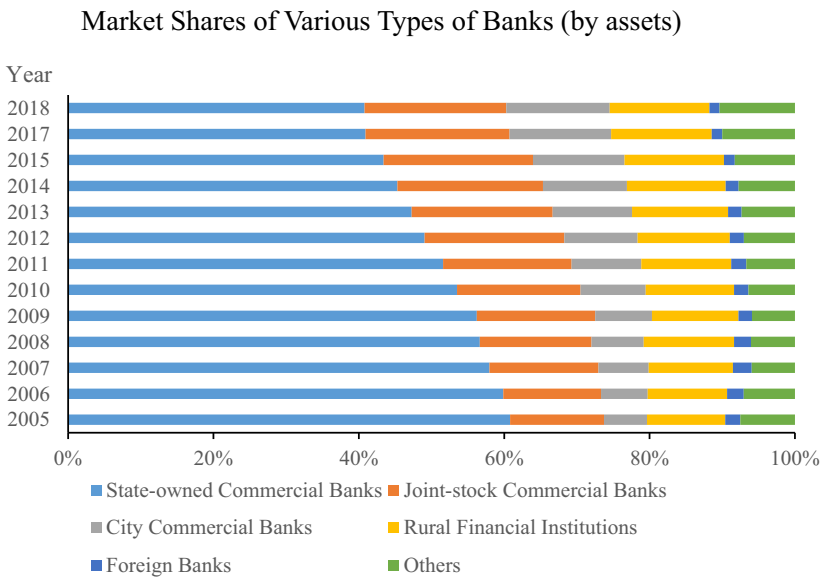

Fig. 1. Market Shares of Various Types of Banks (by assets).
Notes: Rural Financial Institutions include rural commercial banks, rural cooperative banks, and rural credit cooperatives. Others include Postal Savings Bank of China , private banks, and other credit institutions.
Data Source: The Almanac of China's Finance and Banking (2006–2019).

Rural financial institutions include rural commercial banks, rural cooperative banks, and rural credit cooperatives. At present, there are 1596 rural commercial banks in China. Rural commercial banks are restructured from rural credit cooperatives and are mainly located in counties and urban districts in China. A large part of the clients of rural commercial banks are small and medium-sized enterprises, farmers, and agriculture-related enterprises. By the end of 2018, their total assets accounted for 10.9% of the total assets of the banking sector.

Since 2001, when China joined the WTO and the banking sector opened wider to the outside world, foreign banks have been developing continuously in China. At present, there are a total of 41 foreign-funded legal-person banks and 115 branches of foreign banks and banks from Hong Kong, Macao and Taiwan in mainland China.

Other financial institutions include Postal Savings Bank of China, private banks, and other credit institutions.

2.2. The deregulation of intercity branching for city commercial banks

Before 2006, intercity branching[2] by city commercial banks was not permitted by the CBRC. City commercial banks could only conduct business in cities where their head office is located. After 2006, with the passage of the *Measures for the Administration of Intercity Branching by City Commercial Banks* and the *Suggestions on Adjusting the Market Access Policy for Branches of Small and Medium-sized Commercial Banks*, this restriction has been gradually relaxed. By the end of 2009, The CBRC had delegated much of its administrative licensing authority to provincial banking regulatory bureaus, which can independently examine and approve applications for cross-city operations by city commercial banks within the province. As a result, from 2006 to 2011, a total of 98 city commercial banks took the step of geographic expansion, accounting for 76.6% of the total number of city commercial banks at that time. In total, they established 1070 new nonlocal branches. As of December 2011, city commercial banks have expanded geographically to 175 prefecture-level cities, accounting for 52.7% of the total number of prefecture-level cities in China.

The growth in the number of branches has been accompanied by an increase in the size of assets and liabilities that has far exceeded the average level of the banking sector. According to the Almanac of China's Finance and Banking, in 2010, the total assets of city commercial banks grew by 38.3%, while those of state-owned commercial banks and joint-stock commercial banks grew by 14.9% and 26.1%, respectively. The total liabilities of city commercial banks grew by 38.5%, compared with 14.1% for state-owned commercial banks and 25.2% for joint-stock commercial banks. However, this process of city commercial bank expansion was halted by regulators in 2011 because of the sharp increase in risk.

2.3. Literature review

This study is related to four strands of the literature: the economic effects of banking deregulation, the role of individual bank's

[2] The “city” in “intercity” refers to a prefecture-level city.

geographic expansion on its risk, how competition intensity affects individual bank risk, and the specific risk-taking behaviors caused by increased competition in the banking sector.

The first strand of the literature investigates the economic effects of banking deregulation. Banking deregulation affects firstly credit supply (e.g., Chu, 2018; Keil and Müller, 2020), and secondly the activities of corporates such as cash holdings, investment, innovation, etc. (e.g., Chava et al., 2013; Francis et al., 2014; Braggion and Ongena, 2019). Further, at the micro level, changes in the activities of corporates will lead to changes in corporate risk (Jiang et al., 2020); at the macro level, changes in the activities of corporates may also affect some macro variables, such as income distribution (e.g., Beck et al., 2010). However, few studies investigate the impact of banking deregulation on the credit risk of the regional banking sector.

The second strand of the literature examines the effect of individual bank's geographic expansion on its own risk. However, there are no conclusive findings in the literature. Some studies have shown that geographic expansion increases bank risk (e.g., Dick, 2006; Acharya et al., 2006; Berger et al., 2017; Zamore et al., 2019). A Possible explanation is that the head office's ability to manage the branches has been weakened by geographic expansion (Brickley et al., 2003; Acharya et al., 2006); However, other studies have found that geographic expansion reduces bank risk (e.g., Akhigbe and Whyte, 2003; Deng and Elyasiani, 2008; Goetz et al., 2016), since banks can diversify risk by geographic expansion (Goetz et al., 2016). In addition, the existing literature mainly focuses on the banking sector in Europe and the United States(e.g., Huang, 2008; Cacciatore et al., 2015; Aguirregabiria et al., 2016; Meslier et al., 2016; Berger et al., 2020; Jiang et al., 2020), with little attention to the banking sector in developing countries.

The third strand of the literature examines how competition intensity affects individual bank risk, however, no clear conclusions have been drawn so far. A considerable number of studies have shown that increased competition intensity is associated with increased risk (e.g., Hellmann et al., 2000; Salas and Saurina, 2003; Allen and Gale, 2004), which supports the classic hypothesis that the erosion of monopoly rents by competition increases banks' appetite for risk-taking (Keeley, 1990). However, some studies have found the opposite effect (e.g., Beck et al., 2006; Schaeck et al., 2009; Goetz, 2018). Boyd and De Nicoló (2005) believe that this is because the lower loan interest rate caused by competition weakens the borrower's risk-taking incentive, thereby reducing the borrower's default risk. And Arping (2019) argues that the reduction of profits caused by increased competition means that the risk of bank failure increases, so banks will act more prudently. We believe that, in this paper, the deregulation of city commercial banks' intercity branching will inevitably lead to an increase in the competition intensity. But what is the exact effect, pure theoretical analysis cannot provide the answer, and well-designed empirical analysis is needed.

The final strand of the literature investigates the specific risk-taking behaviors caused by increased competition in the banking sector. These risk-taking behaviors include lowering lending criteria, attracting deposits with higher interest, reducing or deferring loan loss provisions, reducing monitoring, etc. (Bushman et al., 2016; Goetz, 2018; Dou et al., 2018). However, it is worth noting that many studies have found that it is difficult to quantitatively measure risk-taking behaviors. By using a unique dataset of penalties on banking misconduct, this paper is able to conduct relatively reliable statistics on banks' risk-taking behaviors, thus providing strong support for the empirical analysis of this paper.

The focus of this paper is different from the above studies. First, this paper examines the impact of branching deregulation on the overall risk of the regional banking sector, rather than the impact of an individual bank's geographic expansion on its own risk, and different empirical strategies are needed to address it. Second, the context of banking deregulation in China is different from that in other countries, so their conclusions cannot be simply extended to China' market. For example, in the United States, after restrictions on the geographic expansion of the banking sector were removed, a large number of mergers took place, while after the relaxation of the restrictions on the geographic expansion of the city commercial banks in China, only a few mergers took place, and most city commercial banks expand geographically by setting up new branches. Therefore, the impact and mechanism of deregulation of China's banks may be completely different, and it is worth a detailed study.

3. Data and variables

3.1. Data sources

In this study, we used four data sources. First, we collected information on branches of city commercial banks from the CBRC's financial license data. Second, the data on deposits, loans, and non-performing loans at the prefecture-level city level, as well as the data on loans and non-performing loans of various types of banks in each prefecture-level city are all from a dataset[3] of the CBRC. Third, we collected information on bank misconduct penalties relevant to lowering lending criteria and attracting deposits at higher interest rates from the database of administrative penalties imposed by the CBRC on banking misconduct. Fourth, we had data on the economic and demographic characteristics of the prefecture-level cities from the China City Statistical Yearbook. We matched the data above and finally obtained nonbalanced panel data on 286 prefecture-level cities from 2006 to 2011.

The reason the data in this paper only cover by 2011 is that the deregulation of intercity branching for city commercial banks started in 2006 but was discontinued in 2011. The CBRC halted the deregulation because city commercial banks had accumulated risks that could not be neglected during their rapid geographic expansion. Therefore, a study period from 2006 to 2011 allows us to accurately assess the impact of the branching deregulation on the credit risk of the regional banking sector.

[3] This dataset contains detailed information on deposits, loans, non-performing loans, SME loans, and farmer loans in China's provinces, prefecture-level cities, districts and counties, which has been used in some literature, for example, Dong and Wang (2021).

3.2. Variables and descriptive statistics

3.2.1. Dependent variables

We use *NPLR* as the dependent variable in the benchmark regression. *NPLR* is the overall nonperforming loan ratio of the banking sector within a prefecture-level city, which is a measure of the credit risk of the regional banking sector. We also use *Pena1* and *Pena2* as dependent variables in the mechanism analysis. *Pena1* and *Pena2* are the numbers of administrative penalties imposed by regulators on banks within the prefecture-level city for their misconduct relevant to "lowering lending criteria" and "attracting deposits with higher interest", respectively.

3.2.2. Independent variables

3.2.2.1. Branching deregulation. From 2006 to 2011, the CBRC gradually relaxed restrictions on city commercial banks setting up nonlocal branches. The CBRC has delegated much of its administrative licensing authority to provincial banking regulatory bureaus, which can independently examine and approve applications for cross-city operations by city commercial banks within the province. As a result, in some prefecture-level cities, out-of-town city commercial banks set up branches from the year the policy was issued, while in others, it was several years after the policy was issued, which means that different cities were actually affected by the policy at different times. For a certain prefecture-level city, we choose the year when city commercial banks from other cities set up the first branch within it as the year when the prefecture-level city actually deregulated. Therefore, we defined the "policy variable" *Deregulation* as a dummy variable, which equals one in the years after the first branch of out-of-town city commercial banks is set up in the city and equals zero otherwise.

3.2.2.2. Level of competition intensity in the local banking sector. In this paper, following Ye et al. (2019), we use the concentration level (Herfindahl-Hirschman Index) within the prefecture-level city to measure the level of competition intensity in the local banking sector, which is defined as follows:

$$HHI_{ct} = \sum_{k} \left(\frac{\#branch_{kct}}{\#branch_{ct}} \right)^2 \tag{1}$$

where $\#branch_{kct}$ is the total number of branches opened by bank k within city c in year t, and $\#branch_{ct}$ is the total number of bank branches within city c in year t.

3.2.2.3. Other variables. Based on related research, we choose *Rgdp, Ln_loan, Ln_employ* and other variables as the control variables. The definitions of all variables are listed in Table 1.

3.2.3. Descriptive statistics

Descriptive statistics of the variables are shown in Table 2.

4. Empirical strategy

We employ a difference-in-differences (DD) specification to estimate the average treatment effect of branching deregulation on the credit risk of the regional banking sector.

For a certain prefecture-level city, the deregulation of intercity branching for city commercial banks essentially means the entry of out-of-town city commercial banks. Therefore, when we study the impact of the branching deregulation on the credit risk of the regional banking sector, we are actually studying the impact of the entry of out-of-town city commercial banks on it.

Table 1
Definition of variables.

Variables	Definition
NPLR	The overall nonperforming loan ratio of the banking sector within a prefecture-level city.
Deregulation	A dummy variable representing branching deregulation.
Rgdp	The growth rate of the gross regional product of a prefecture-level city.
Ln_loan	The natural logarithm of the loan balance held by all banks within a prefecture-level city.
Ln_employ	The natural logarithm of the total number of banking employees in a prefecture-level city.
HHI	The banking concentration index within a prefecture-level city.
Ln_pop	The natural logarithm of the total population of a prefecture-level city.
Ln_area	The natural logarithm of the administrative area of a prefecture-level city.
Ln_firm	The natural logarithm of the number of industrial enterprises in a prefecture-level city.
Pena1	The number of administrative penalties imposed by the bank regulators on misconduct related to "lower lending criteria" in the banking sector within a prefecture-level city.
Pena2	The number of administrative penalties imposed by the bank regulators on misconduct related to "attracting deposits with higher interest" in the banking sector within a prefecture-level city.

Note: The values of the above variables are all measured at the end of each year.

Table 2
Descriptive statistics.

Variables	Obs.	Mean	Std. Dev.	Min.	Median	Max.
NPLR	1617	0.031	0.031	0.003	0.019	0.190
Deregulation	1617	0.260	0.439	0.000	0.000	1.000
Rgdp	1617	0.139	0.029	−0.012	0.138	0.329
Ln_loan	1617	14.804	3.497	12.664	15.279	19.737
Ln_employ	1617	8.574	1.969	6.741	8.915	12.603
HHI	1617	0.246	0.063	0.181	0.240	0.429
Ln_pop	1617	5.860	0.673	3.506	5.902	8.111
Ln_area	1617	9.344	0.821	7.016	9.397	12.443
Ln_firm	1617	6.484	1.149	2.996	6.428	9.841
Pena1	1617	0.352	1.244	0	0	23
Pena2	1617	0.067	0.526	0	0	16

In the deregulation of intercity branching for city commercial banks, the CBRC delegated much of its administrative licensing authority to provincial banking regulatory bureaus, which can independently examine and approve applications for cross-city operations by city commercial banks within the province. As a result, in some prefecture-level cities, out-of-town city commercial banks set up branches from the year the policy was issued, while in others, it was several years after the policy was issued, which means that different cities were actually affected by the policy at different times. This naturally resulted in the treatment group that was treated by the policy and the control group that was not treated by the policy, allowing us to estimate the effect of branching deregulation on the credit risk of the regional banking sector by means of a difference-in-differences (DD) specification.

The model is set as follows:

$$Risk_{c,t+1} = \alpha_0 + \alpha_1 Deregulation_{c,t} + \alpha_2 X_{c,t} + A_c + B_t + \varepsilon_{c,t}, c = 1, \ldots, 286, t = 2006, \ldots, 2011 \quad (2)$$

where $Risk_{c,\,t+1}$ is the credit risk of the regional banking sector in city c in year $t+1$, which is measured by the overall nonperforming loan ratio of the banking sector in the city. We choose to use one-year-ahead nonperforming loan ratio as the dependent variable, because it generally takes time from the bank's lending behavior being affected by the branching deregulation policy to the loan being turned into non-performing loan. The variable of interest is $Deregulation_{c,\,t}$, a dummy variable that equals one in the years after the first branch of an out-of-town city commercial bank is set up in city c and equals zero otherwise. The coefficient α_1 captures the average treatment effect of branching deregulation on the credit risk of the regional banking sector.

In addition, $X_{c,\,t}$ contains a vector of control variables describing the local conditions in city c in year t. Following the literature, we include the growth rate of the gross regional product (*Rgdp*), the natural logarithm of the loan balance held by all banks within city c (*Ln_loan*), the natural logarithm of the total number of banking employees (*Ln_employ*), the banking concentration index (*HHI*), and other variables as the control variables in Model (2). The city fixed effect A_c and the year fixed effect B_t are also included in the regression to capture a wide range of unobservable factors.

Moreover, to understand how branching deregulation influences the credit risk of the regional banking sector, we need to establish a direct connection between them. Therefore, we take the risk-taking behaviors of banks into account and propose the following empirical model:

$$Penai_{c,t} = \beta_0 + \beta_1 Deregulation_{c,t} + \beta_2 X_{c,t} + A_c + B_t + \varepsilon_{c,t} \quad (3)$$

where $Penai_{c,\,t}$ are two variables: $Pena1_{c,\,t}$ and $Pena2_{c,\,t}$, measuring the numbers of administrative penalties imposed by the bank regulators on the misconduct of "lowering lending criteria" and "attracting deposits with higher interest", respectively, in the banking sector within city c in year t. We choose these two variables because the risk-taking behaviors they represent are highly correlated with credit risk. Banks' lower lending criteria on the asset side will directly increase credit risk; on the liability side, deposits obtained by paying high interest often force banks to issue high-interest loans, which are highly correlated with borrowing firms' risky investments and thus increase credit risk. All other variables are the same as in Model (2).

To extend the analysis of the mechanism, we consider the fixed asset investments of various industries in the city, since many loans to enterprises are ultimately converted into fixed asset investments. Branching deregulation is accompanied by the geographic expansion of city commercial banks. If their geographic expansion leads to an increase in risk-taking behaviors in the local banking sector, such as lowering lending criteria and attracting deposits with higher interest, we can infer that this will encourage more loans flowing into industries with higher default risk and thus increase the investments in fixed assets in these industries. If we can prove that branching deregulation increases fixed asset investments in industries with higher default risk, we further verify the mechanism by which branching deregulation affects the credit risk of the regional banking sector by increasing risk-taking behaviors. Thus, we propose the following empirical model:

$$Inve_{j,c,t} = \gamma_0 + \gamma_1 Deregulation_{c,t} + \gamma_2 X_{c,t} + \delta_j + A_c + B_t + \varepsilon_{j,c,t} \quad (4)$$

where $Inve_{j,\,c,\,t}$ is a series of variables: $Inve_{1,\,c,\,t}$, $Inve_{2,\,c,\,t}$ …., $Inve_{5,\,c,\,t}$, which, respectively represent the fixed asset investments in the five industries with high default risk in city c in year t. $X_{c,\,t}$ is a set of control variables related to fixed asset investments in city c in year t. δ_j is an industry fixed effects term that controls for unobservable industry-specific factors. All other variables are the same as in Model

(2).

Furthermore, we consider the different effects on bank risk across different types of banks within the city. There are five major types of commercial banks in China, including state-owned commercial banks, joint-stock commercial banks, city commercial banks, rural commercial banks, and foreign banks. We believe each type of bank has its specific client group and operation strategy. The closer its main business is to the new competitor, the stronger the impact it will suffer, and more risk will be brought to the bank. As banks generally tend to "cherry-pick" when entering nonlocal markets (Wu et al., 2017), we expect city commercial banks to choose large enterprises as their main target clients during their geographic expansion. And in fact, state-owned commercial banks have the largest number of large enterprise clients in a region, followed by joint-stock commercial banks, we assume the risk of these two types of banks will be significantly affected by the arrival of out-of-town city commercial banks. In addition, since the intersection of the main business of city commercial banks and rural commercial banks is small, the risk of the latter will not be significantly affected. We test the above hypotheses using the following model:

$$Risk_{k,c,t+1} = \theta_0 + \theta_1 Deregulation_{c,t} + \theta_2 X_{c,t} + \delta_k + A_c + B_t + \varepsilon_{k,c,t} \tag{5}$$

where $Risk_{k,\ c,\ t+1}$ is a series of variables: $Risk_{1,\ c,\ t+1}$, $Risk_{2,\ c,\ t+1}$, $Risk_{3,\ c,\ t+1}$, $Risk_{4,\ c,\ t+1}$ represent the nonperforming loan ratio of state-owned commercial banks, joint-stock commercial banks, city commercial banks and rural commercial banks in city c in year $t+1$, respectively. δ_k is a fixed effects term that controls for unobservable banking-specific factors. All other variables are the same as in Model (2).

Finally, we explore the regional heterogeneity of branching deregulation in Model (2). We focus on the impact across cities with different initial levels of loan-to-deposit ratios and competition intensity. The loan-to-deposit ratio in the city measures how difficult it is for enterprises in the region to obtain loans from banks. For cities with a high initial level of loan-to-deposit ratio, the arrival of new city commercial banks from other regions will intensify competition, which will induce the banking sector to further reduce the lending criteria and eventually lead to an increase in credit risk in the city. However, for a city with a low initial level of loan-to-deposit ratio, the impact may not be so significant. In addition, if the initial level of competition intensity is already high, credit risk in the city may increase more significantly after the arrival of new city commercial banks from other regions. Therefore, we expect this effect to be more pronounced in regions (i) with a higher initial level of loan-to-deposit ratio and (ii) with a higher initial level of competition intensity in the banking sector. We test the above hypotheses using Model (6):

$$Risk_{c,t+1} = \lambda_0 + \lambda_1 Deregulation_{c,t} + \lambda_2 Deregulation_{c,t} \cdot IR_c + \lambda_3 X_{c,t} + A_c + B_t + \varepsilon_{c,t} \tag{6}$$

where IR_c is the initial level of loan-to-deposit ratio (or competition intensity) of a city. All other variables are the same as in Model (2).

Table 3
Baseline: Branching deregulation and the credit risk of the regional banking sector.

	NPLR		
	(1)	(2)	(3)
Deregulation	0.034***	0.013***	0.011***
	(0.003)	(0.003)	(0.003)
Rgdp			−0.225***
			(0.040)
Ln_loan			0.024***
			(0.008)
HHI			0.105***
			(0.040)
Ln_employ			−0.004
			(0.003)
Ln_pop			−0.022
			(0.043)
Ln_area			0.060*
			(0.033)
Ln_firm			−0.009
			(0.009)
City FE		Yes	Yes
Year FE		Yes	Yes
Observations	1266	1266	1266
Adj. R^2	0.077	0.672	0.702

Notes: This table reports the benchmark results regarding the impact of branching deregulation on the credit risk of the regional banking sector. *NPLR* is the overall nonperforming loan ratio of the banking sector within each prefecture-level city in year $t+1$. The branching deregulation indicator *Deregulation* equals one in the years after the first branch of out-of-town city commercial banks is set up in the prefecture-level city and equals zero otherwise. The control variables are the growth rate of the gross regional product (*Rgdp*), the banking concentration index (*HHI*), the loan balance held by all banks (*Ln_loan*), the total number of banking employees (*Ln_employ*), the total population (*Ln_pop*), the administrative area (*Ln_area*), and the number of industrial enterprises (*Ln_firm*) of each city. The last five variables are logarithmized. Standard errors are clustered at the prefecture-level city level and appear in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

In the empirical analysis, we consider two different proxies for IR_c: the loan-to-deposit ratio in city c (LDR_{high}) and the competition intensity in the banking sector in city c (IC_{high}). The coefficient of interest is λ_2, which captures the differential effects of branching deregulation in different regions.

5. Empirical results

5.1. Benchmark results

Table 3 presents the results from estimating Model (2). The dependent variable is *NPLR*, the overall nonperforming loan ratio of the banking sector within city *c* in year $t + 1$. We add the growth rate of the gross regional product (*Rgdp*), the natural logarithm of the loan balance held by all banks within city *c* (*Ln_loan*), the natural logarithm of the total number of banking employees (*Ln_employ*), the banking concentration index (*HHI*), and other variables as the control variables in our regressions.

Columns 2 and 3 show the estimation of the effect of branching deregulation with city fixed effects and year fixed effects, respectively. All errors are clustered by city. The results in Column 3 show that the variable *Deregulation* is positively correlated with *NPLR* and that the coefficient of *Deregulation* is significant at the 1% level. This means that the branching deregulation of city commercial banks has indeed increased the credit risk of the regional banking sector in host cities. Meanwhile, the coefficient of *Deregulation* is 0.011, indicating that, on average, branching deregulation increases the nonperforming loan ratio of the regional banking sector by 1.1%, which is an impact that cannot be ignored.

5.2. Mechanisms

Having established the positive effect of branching deregulation on the credit risk of the regional banking sector, this study now examines how this effect occurs from the perspective of banks' risk-taking behaviors. The specific risk-taking behaviors caused by increased competition in the banking sector include lowering lending criteria, attracting deposits with higher interest, reducing or deferring loan loss provisions, reducing monitoring, etc. (Bushman et al., 2016; Goetz, 2018; Dou et al., 2018). Among these, "lowering lending criteria" and "attracting deposits with higher interest" are highly related to the credit risk of the banking sector. Additionally, considering data availability, we choose these as the main objects of investigation. Lower lending criteria on the asset side will directly increase credit risk; on the liability side, deposits obtained by paying high interest often force banks to issue high-interest loans, which are highly correlated with borrowing firms' risky investments and thus increase credit risk.

The arrival of out-of-town banks enhances the competition intensity in the banking sector of the region, which tends to induce banks to engage in more risk-taking behaviors, thus increasing the credit risk of the local banking sector. Therefore, we conjecture that the impact of branching deregulation on the credit risk of the regional banking sector is realized by greater risk-taking behaviors such as lowering lending criteria and attracting deposits with higher interest within the region. Therefore, we adopted two proxy variables, $Pena1_{c,\ t}$ and $Pena2_{c,\ t}$, measuring the numbers of administrative penalties imposed by the bank regulators on the misconduct of "lowering lending criteria" and "attracting deposits with higher interest" in the banking sector, respectively, within the city. Due to the high cost of regulation, it is impossible for bank regulators to detect and penalize all misconduct. Therefore, the choice of such proxy variables will inevitably lead to the underestimation of corresponding risk-taking behaviors. However, as long as we can prove the correlation between branching deregulation and the proxy variables, we can at least partially explain the impact of branching deregulation on risk-taking behaviors.

We collected information on administrative penalties on bank misconduct relevant to lowering lending criteria and attracting deposits at higher interest rates from the database of administrative penalties imposed by the CBRC on banking misconduct. From 2006 to 2011, the CBRC penalized lending criteria changes and high-interest deposits 736 times and 438 times, respectively. We rearrange the penalty data according to the city and year in which they take place and generate the variables *Pena1* and *Pena2*.

We use Model (3) for empirical analysis. The regression results are reported in Table 4. Columns 1–4 show that branching deregulation significantly increases the number of penalties corresponding to those two kinds of risk-taking behaviors. The above results prove our conjecture that the effect of branching deregulation on the risk of the regional banking sector is realized by increasing amounts of risk-taking behaviors such as lowering lending criteria and attracting deposits with high interest.

To extend our analysis of the mechanism further, we examine the impact of branching deregulation on the fixed asset investments of various industries in the region. If we can prove that branching deregulation increases fixed asset investments in industries with high default risk, we further verify the mechanism by which branching deregulation affects credit risk by increasing the risk-taking behaviors of the regional banking sector.

According to the Almanac of China's Finance and Banking, the ranking of nonperforming loan ratios across various industries is very stable and changes slowly over time. For example, for many years, the nonperforming loan ratio of the industry of hotels and catering services was always high, while that of the industry of production and supply of electricity, gas and water was always low. We have listed the top five industries with the highest nonperforming loan ratios (NPLRs) in all 19 industries in 2006 and 2007 in Table 5, and it is shown that they are identical.

It is worth noting that since the average nonperforming loan ratios in different industries do not vary much across time, it is reasonable to expect banks to be aware of the default risk associated with an industry when they make lending decisions. If more fixed-asset investments are made in industries with a higher default risk, it may suggest that upon the arrival of out-of-town city commercial banks, banks have taken more risk-taking behaviors and provided more credit to these industries. Therefore, we use the fixed asset investments of the top five high-risk industries as the dependent variables of Model (4) to further verify the mechanism of branching

Table 4
Mechanisms: Branching deregulation and risk-taking behaviors in the regional banking sector.

	Pena1	*Pena1*	*Pena2*	*Pena2*
	(1)	(2)	(3)	(4)
Deregulation	0.102***	0.070**	0.105**	0.091**
	(0.029)	(0.034)	(0.044)	(0.044)
Controls		Yes		Yes
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	1617	1617	1617	1617
Adj. R^2	0.067	0.096	0.083	0.109

Notes: This table reports the results of the regressions to test the effect of branching deregulation on the risk-taking behaviors in the regional banking sector, in which the dependent variables are *Pena1* and *Pena2*, the numbers of administrative penalties imposed by the CBRC on the behaviors of "lowering lending criteria" and "attracting deposits with higher interest", respectively, in the banking sector of each prefecture-level city. The branching deregulation indicator *Deregulation* equals one in the years after the first branch of an out-of-town city commercial bank is set up in the prefecture-level city and equals zero otherwise. All models control for city and year fixed effects. Standard errors are clustered at the prefecture-level city level and appear in parentheses. The 1%, 5%, and 10% levels of significance are denoted by ***, **, and *, respectively.

Table 5
The top five industries with the highest nonperforming loan ratios in 2006 and 2007.

Serial Number	Industry	NPLR in 2006(%)	NPLR in 2007(%)
1	Agriculture, Forestry, Animal Husbandry, and Fishery	46.09	47.1
2	Hotels and Catering Services	19.55	16.11
3	Wholesale and Retail Trades	17.3	13.92
4	Culture, Sports and Entertainment	14.83	13.12
5	Scientific Research, Technical Services, and Geological Prospecting	13.6	11.16

Note: The data source is the Almanac of China's Finance and Banking (2007).

deregulation on the credit risk of the regional banking sector.

In addition, to avoid the obvious impact of China's 4 trillion yuan stimulus package implemented in 2008, we shorten our observation period to 2006–2007. From 2006 to 2007, a total of 26 prefecture-level cities across the country were affected by the branching deregulation of city commercial banks. We use these cities as the treatment group and other prefecture-level cities in the same province as the control group. Due to the absence of data for some prefecture-level cities, we obtain data on fixed-asset investments in those 5 industries for 43 prefecture-level cities from 2006 to 2007.

The results are summarized in Table 6. The dependent variables in Columns 1–5 are the fixed asset investments of industries 1–5 in city *c* in year *t*, and the measurement unit is 100 million yuan. The coefficients for *Deregulation* in Columns 2–4 are significantly positive, but in Columns 1 and 5, the coefficient for *Deregulation* is not significant. This indicates that the investments in fixed assets have increased significantly in three of those five industries after the arrival of the out-of-town city commercial banks. Therefore, we have further verified the mechanism of branching deregulation on credit risk to some extent.

Table 6
Mechanisms: Branching deregulation and fixed asset investments in industries with the highest default risk.

	$Inve_1$	$Inve_2$	$Inve_3$	$Inve_4$	$Inve_5$
	(1)	(2)	(3)	(4)	(5)
Deregulation	3.069	3.657**	6.651**	7.014***	−2.446
	(1.552)	(1.610)	(3.055)	(2.094)	(1.271)
Controls	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	80	81	84	83	70
Adj. R^2	0.154	0.318	0.313	0.577	0.227

Notes: This table reports the results of the regressions to test the effect of branching deregulation on the fixed asset investments in industries with the highest default risk. In these regressions, we reduce the observation period to 2006–2007 to avoid the obvious impact of China's 4 trillion yuan investment package implemented in 2008 on investments in various industries. Due to the absence of data for some prefecture-level cities, we obtain data on fixed-asset investments in 5 industries of 43 prefecture-level cities from 2006 to 2007. $Inve_1$ - $Inve_5$ are the fixed asset investments in the top five industries with the highest default risk within each prefecture-level city, and the measurement unit is 100 million yuan. The branching deregulation indicator *Deregulation* equals one in the years after the first branch of an out-of-town city commercial bank is set up in a prefecture-level city and equals zero otherwise. All models control for city and year fixed effects. Standard errors are clustered at the prefecture-level city level and appear in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

5.3. Heterogeneous effects

In this section, we further explore the heterogeneous effects of the branching deregulation of city commercial banks on the credit risk of the regional banking sector.

5.3.1. Types of banks and the impact of branching deregulation

In the benchmark regression, we analyzed the average treatment effect of branching deregulation on the credit risk of the regional banking sector. In this section, we examine whether this impact varies across different bank characteristics.

According to our analysis in Section 4, for a specific type of bank in the regional banking sector, the closer its main business is to the new competitor, the stronger an impact it will suffer, and more risk will be brought to the bank. In general, due to their undisputed market positions, state-owned commercial banks have the largest number of large enterprise clients in the region, followed by joint-stock commercial banks. At the same time, considering the general propensity of banks to "cherry-pick" when entering nonlocal markets (Wu et al., 2017), we expect city commercial banks to choose large enterprises as their main target clients in the process of their geographic expansion. In other words, the main businesses of these two types of banks are closer to those of out-of-town city commercial banks. Therefore, we assume that the credit risk of state-owned commercial banks and joint-stock commercial banks will increase significantly with the branching deregulation of city commercial banks. At the same time, rural commercial banks are less affected.

To verify our hypothesis, we use Model (5) for empirical analysis. The results are summarized in Table 7. The dependent variables of regressions in Columns 1–4 are the nonperforming loan ratios of state-owned commercial banks, joint-stock commercial banks, city commercial banks and rural commercial banks in city c in year $t + 1$, respectively. The coefficients for *Deregulation* in Columns 1–3 are significantly positive at the 1% level, but in Column 4, the coefficient for *Deregulation* is not significant. These results agree with our hypothesis.

5.3.2. Regional differences and the impact of branching deregulation

Enterprises have different levels of difficulty accessing bank loans across regions with different banking development. If enterprises in the region have easy access to bank loans, then the lending criteria of the banking sector in this region are generally low. Therefore, the arrival of new city commercial banks may intensify competition and induce the banking sector to further reduce the lending criteria, which eventually leads to an increase in the credit risk of the regional banking sector.

The loan-to-deposit ratio is a measure of how difficult it is for enterprises in the region to obtain loans from the banking system. The higher the loan-to-deposit ratio is, the less difficult it is for enterprises to obtain loans. Therefore, we assume that the impact of branching deregulation on banking risk is more pronounced in regions with a higher initial level of loan-to-deposit ratio.

We use a binary dummy variable LDR_{high} to represent the initial level of a city's loan-to-deposit ratio. Specifically, if the city's loan-to-deposit ratio was in the top 25th percentile in 2006, LDR_{high} takes the value of one, otherwise it takes the value of zero. We use Model (6) for empirical analysis. The results are summarized in Table 8. The coefficients for *Deregulation* $*LDR_{high}$ in Columns 1 and 2 are significantly positive at the 1% level. These results indicate that the impact of branching deregulation is more pronounced in regions with a higher initial level of loan-to-deposit ratio.

In addition, the initial level of competition intensity in the region may also affect our results. If the competition intensity in the banking sector is already high before the arrival of out-of-town banks, the arrival of new city commercial banks will inevitably further intensify the competition, which will induce more risk-taking behaviors and ultimately increase the credit risk of the banking sector in the region. Therefore, we expect that the impact of branching deregulation is more pronounced in regions with a higher level of competition intensity in the banking sector.

We use Model (6) for the empirical analysis. The results are summarized in Table 8. We create a binary dummy variable IC_{high} to represent the initial level of competition intensity in the city. If the city's *HHI* was in the bottom 25th percentile in 2006, IC_{high} is equal

Table 7
Heterogeneity: Types of banks and the impact of branching deregulation.

	NPLR_1	*NPLR_2*	*NPLR_3*	*NPLR_4*
	(1)	(2)	(3)	(4)
Deregulation	0.014***	0.007**	0.012***	0.003
	(0.004)	(0.003)	(0.004)	(0.007)
Controls	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	1266	633	906	190
Adj. R^2	0.637	0.134	0.273	0.541

Notes: This table reports the results of the regressions to examine whether the effect of branching deregulation varies across different types of banks. *NPLR_1 - NPLR_4* are the nonperforming loan ratios of state-owned commercial banks, joint-stock commercial banks, city commercial banks and rural commercial banks in each prefecture-level city in year $t + 1$, respectively. The branching deregulation indicator *Deregulation* equals one in the years after the first branch of an out-of-town city commercial bank is set up in the prefecture-level city and equals zero otherwise. All models control for city and year fixed effects. Standard errors are clustered at the prefecture-level city level and appear in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Table 8
Heterogeneity: Initial conditions of regions and the impact of branching deregulation.

	NPLR			
	(1)	(2)	(3)	(4)
Deregulation $*LDR_{high}$	0.021***	0.018***		
	(0.005)	(0.005)		
Deregulation $*IC_{high}$			0.017***	0.014***
			(0.003)	(0.003)
Controls		Yes		Yes
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	1266	1266	1266	1266
Adj. R^2	0.679	0.707	0.673	0.702

Notes: This table reports the results of the regressions to examine whether the effect of branching deregulation varies across different cities with different initial conditions. *NPLR* is the overall nonperforming loan ratio of the banking sector within each prefecture-level city in year $t + 1$. The branching deregulation indicator *Deregulation* equals one in the years after the first branch of out-of-town city commercial banks is set up in the prefecture-level city and equals zero otherwise. We construct a dummy variable LDR_{high} that equals one if the city's loan-to-deposit ratio was in the top 25th percentile and zero otherwise. IC_{high} is another dummy variable that equals one if the city's HHI was in the bottom 25th percentile and zero otherwise. Both are calculated using the value from the base year of 2006. All models control for city and year fixed effects. Standard errors are clustered at the prefecture-level city level and appear in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

to one, otherwise it is equal to zero. The coefficients for *Deregulation* * IC_{high} in Columns 3 and 4 are significantly positive at the 1% level. The results indicate that the impact of branching deregulation is more pronounced in regions with a higher level of competition intensity in the banking sector.

5.4. Robustness tests

In this section, we conduct additional robustness tests on the results of the benchmark regression.

5.4.1. Correlation test

The benchmark results of this paper is based on the assumption that the timing of deregulation of each prefecture-level city was not affected by the nonperforming loan ratio (*NPLR)* of the banking sector in the prefecture-level city. Following Beck et al. (2010), we test this assumption, and the results are shown in Fig. 2.

We define the year when a prefecture-level city accepts the entry of the first out-of-town city commercial bank as the "start year", or the timing of deregulation. Fig. 2 (A) shows the relationship between the "start year" and the average *NPLR* before the start year, and Fig. 2 (B) shows the relationship between the start year and the average change[4] of *NPLR* before the start year. As seen from the figure, the start year is not affected by these two variables. In the correlation analysis, the correlation coefficients between the start year and the average *NPLR* before the start year or the average change of *NPLR* before the start year are not statistically significant, and the t-statistics are −0.37 and − 1.63, respectively.

In summary, the timing of deregulation in each prefecture-level city is not affected by the nonperforming loan ratio of the banking sector in the prefecture-level city.

5.4.2. Parallel trend test

We replace the variable *Deregulation* in Model (2) with eight dummy variables to test the parallel trend assumption. The model is set as follows:

$$Risk_{ct} = \alpha_c + \alpha_t + \beta_1 E_{ct}^{-4} + \beta_2 E_{ct}^{-3} + \ldots + \beta_8 E_{ct}^{+4} + \gamma X_{ct} + \varepsilon_{ct} \quad (7)$$

where the j in E^j is the difference between the year represented by E^j and the "start year".[5] It should be noted that the "start year" is different in different cities. For an observation of a certain city, if the year of the observation is the same as the year represented by E^j, then E^j takes the value one, otherwise it takes the value zero. In Model (7), $j = -4, -3, -2, -1, 1, 2, 3, 4$, that is, we exclude the E^j corresponding to the "start year". Therefore, we can estimate the change in the effect relative to "start year". In addition, in Model (7), we do not use the one-year-ahead nonperforming loan ratio as the dependent variable as we did in Model (2), because the setting of Model (7) itself enables us to observe effects over multiple periods.

Fig. 3 plots the regression results of Model (7). The small circles in the figure represent the year-by-year treatment effects of branching deregulation on the credit risk of the regional banking sector, and the dashed lines represent the 95% confidence intervals, adjusted for prefecture-level city-level clustering. Fig. 3 shows that in the years before branching deregulation, the regression

[4] The "average change" is the average of the first difference of the values for each year.
[5] We define the year when a prefecture-level city accepts the entry of the first out-of-town city commercial bank as the "start year".

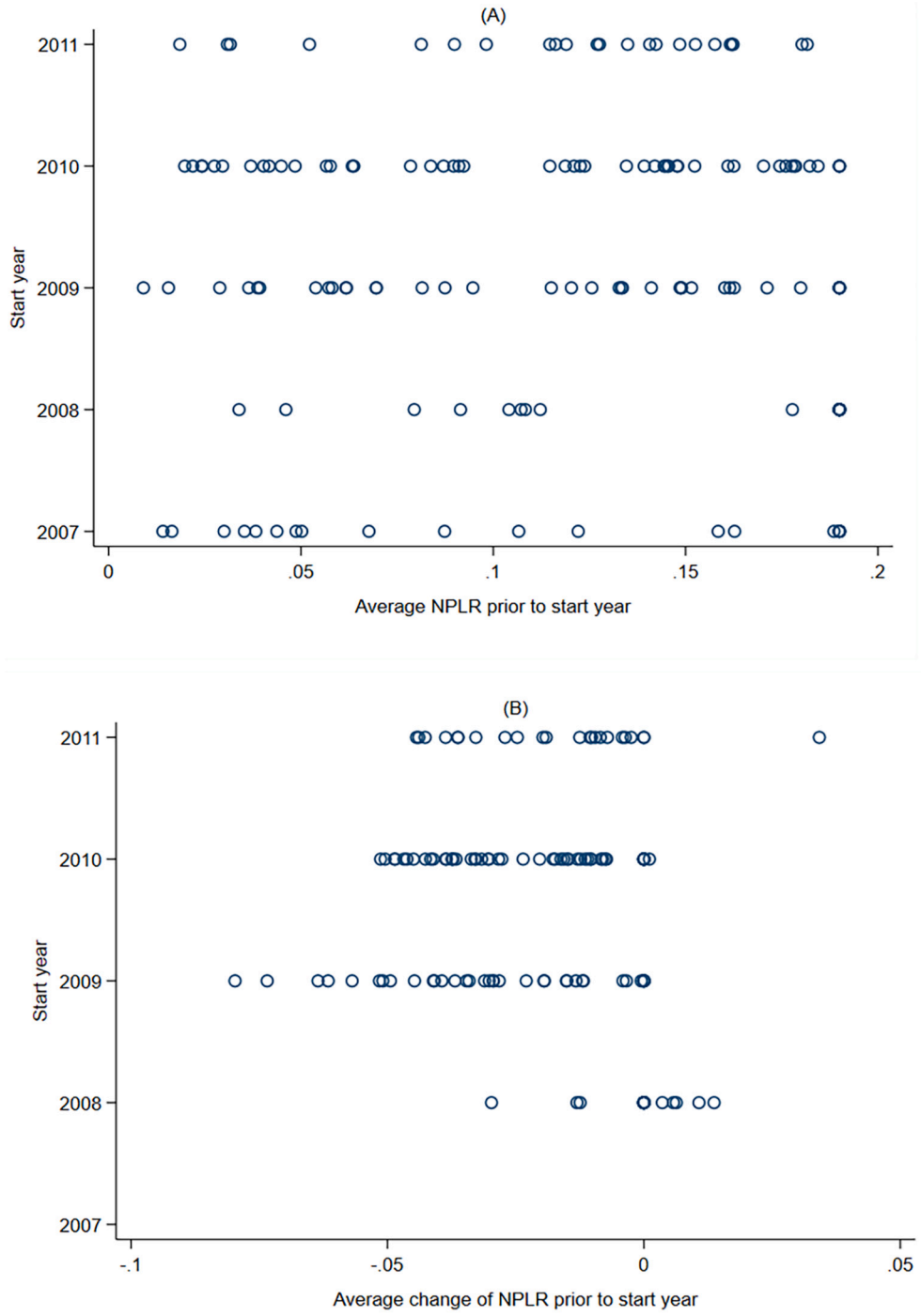

Fig. 2. Correlation test.

coefficients of the dummy variables were not significantly different from zero. This indicates that the variation trend of the variable *NPLR* in the treatment group and the control group was parallel before branching deregulation. After branching deregulation, the *NPLR* increased rapidly and significantly. The coefficients of E^{+1}, E^{+2} and E^{+3} were both positive and significant at the 5% level. Therefore, the parallel trend assumption is verified.

5.4.3. Instrumental variable analysis

In this section, we employ the 2SLS instrumental variable estimator to alleviate possible endogeneity problems.

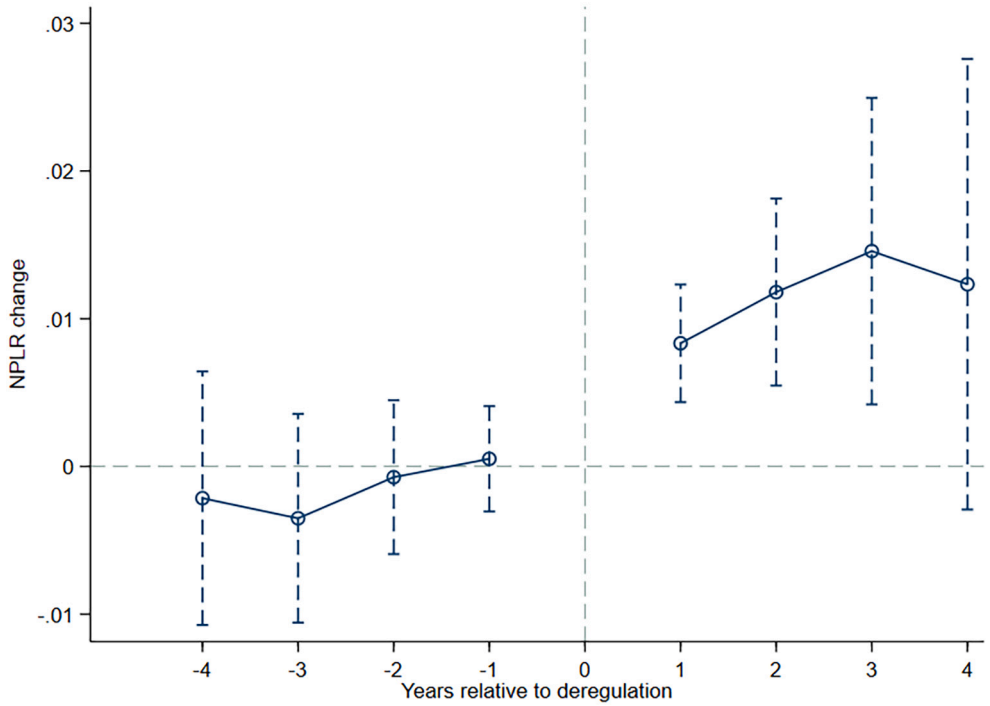

Fig. 3. Parallel trend test.

5.4.3.1. DD model with instrumental variable. The Model (2) of Section 4 for benchmark regression is a difference-in-differences model. We can treat Model (2) as an ordinary fixed effects model and use instrumental variable approach to alleviate the endogeneity problem.

We employ the 2SLS instrumental variable estimator to alleviate this problem, using the variable *A_Ratio* as the instrumental variable for the variable *Deregulation*. *A_Ratio* is the average "proportion of out-of-town city commercial banks" in neighboring

Table 9
The results of the instrumental variable regression for Model (2) as an ordinary fixed effects model.

	NPLR	
	IV	IV
	2nd stage	1st stage
	(1)	(2)
Deregulation	0.046**	
	(0.022)	
A_Ratio		1.931***
		(0.441)
Controls	Yes	Yes
City FE	Yes	Yes
Year FE	Yes	Yes
Observations	1266	1266
Adj. R^2	0.491	0.322
Durbin-Wu-Hausman test (*p*-value)	–	0.010
Cragg-Donald F-Statistic	–	33.797

Note: This table reports the results of the instrumental variable regression for Model (2) as an ordinary fixed effects model. *NPLR* is the overall nonperforming loan ratio of the banking sector within each prefecture-level city in year $t + 1$. The branching deregulation indicator *Deregulation* equals one in the years after the first branch of out-of-town city commercial banks is set up in the prefecture-level city and equals zero otherwise. We use the variable *A_Ratio* as the instrumental variable for the variable *Deregulation*. *A_Ratio* is the average "proportion of out-of-town city commercial banks" in neighboring prefecture-level cities within the same province. Durbin-Wu-Hausman test (*p*-value) is used to diagnose whether there is an endogeneity problem, and Cragg-Donald F-Statistic is used to diagnose whether the instrumental variable is a strong IV. Standard errors are clustered at the prefecture-level city level and appear in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

prefecture-level cities within the same province. The "proportion of out-of-town city commercial banks" refers to the proportion of out-of-town city commercial banks in the total number of banks in a prefecture-level city. We choose *A_Ratio* as the instrumental variable for the following reasons:

On the one hand, since two adjacent cities within the same province have certain similarities in terms of economic development level, business environment, etc., they have similar attractiveness to out-of-town city commercial banks. Therefore, the presence of out-of-town city commercial banks in a city is related to the "proportion of out-of-town city commercial banks" in neighboring cities. On the other hand, the overall credit risk of a city's banking sector is unlikely to be directly affected by the "proportion of out-of-town city commercial banks" in its neighboring cities.

Table 9 presents the results of the instrumental variable regression. The results in Column 1 show that the branching deregulation has indeed increased the credit risk of the regional banking sector. Column 2 shows the first-stage regression results. First, the variable *A_Ratio* is significantly positively correlated with the variable *Deregulation*. Second, the results of the Durbin-Wu-Hausman test show that potential endogeneity problem cannot be ruled out. In addition, the value of Cragg-Donald F-Statistic is greater than the critical value 16.38 (using the 10% significance level) constructed by Stock and Yogo (2005), rejecting the hypothesis of weak instrumental variable. In conclusion, the results in Table 9 are consistent with the results in Table 3 (the benchmark results).

5.4.3.2. Fixed effects model with instrumental variable. For a certain prefecture-level city, since the branching deregulation policy essentially corresponds to the entry of out-of-town city commercial banks, we consider the following fixed effects model:

$$Risk_{c,t+1} = \alpha_0 + \alpha_1 Ratio_{c,t} + \alpha_2 X_{c,t} + A_c + B_t + \varepsilon_{c,t} \tag{8}$$

where $Ratio_{c,\ t}$ is the "proportion of out-of-town city commercial banks" in city c in year t. The "proportion of out-of-town city commercial banks" refers to the proportion of out-of-town city commercial banks in the total number of banks in a prefecture-level city. We use $Ratio_{c,\ t}$ to represent the presence (entry) of out-of-town city commercial banks in (into) city c in year t. The other variables in Model (8) are defined exactly the same as in Model (2). We focus on the coefficient α_1 of variable $Ratio_{c,\ t}$, which captures the impact of the entry of out-of-town city commercial banks on the credit risk of the regional banking sector. Table 10 shows the regression results. The coefficient α_1 is significantly positive at the 1% level. This indicates that the entry of out-of-town city commercial banks has significantly increased the credit risk of the regional banking sector. This conclusion is consistent with that drawn from the benchmark regression.

Next, we employ the 2SLS instrumental variable estimator to alleviate the endogeneity problem that may exist under the setting of Model (8), and we still choose the variable *A_Ratio* as the instrumental variable for the variable *Ratio*.

Table 11 reports the results of the instrumental variable regression. The results in Column 1 show that the entry of out-of-town city commercial banks has significantly increased the credit risk of the regional banking sector. Column 2 shows the first-stage regression results. First, the variable *A_Ratio* is significantly positively correlated with the variable *Ratio*. Second, the results of the Durbin-Wu-Hausman test show that the endogeneity problem does exist, and it is reasonable for us to use the instrumental variable approach. In addition, the value of Cragg-Donald F-Statistic is significantly larger than the critical value 16.38 (using the 10% significance level) constructed by Stock and Yogo (2005), which suggests that the variable *A_Ratio* is a strong IV for the variable *Ratio*. To sum up, after employing IV analysis, we still find that the entry of out-of-town city commercial banks has significantly increased the credit risk of the regional banking sector. The results in Table 11 are consistent with the results in Tables 3 (the benchmark results).

5.4.4. Shortening the observation period and reducing the sample size

We shorten the observation period (SOP) from 2006–2011 to 2007–2010 and rerun the regression of Model (2). The results are shown in Column 1 of Table 12. The coefficient for the variable *Deregulation* is still significantly positive. In addition, to eliminate the interference of outliers, we rerun the regression of Model (2) using a reduced sample size (RSS), in which we exclude city banking

Table 10
Regression results of the fixed effects model.

	NPLR		
	(1)	(2)	(3)
Ratio	0.162***	0.075***	0.070***
	(0.019)	(0.016)	(0.015)
Controls			Yes
City FE		Yes	Yes
Year FE		Yes	Yes
Observations	1266	1266	1266
Adj. R^2	0.054	0.673	0.705

Notes: This table reports the regression results on Model (8). *NPLR* is the overall nonperforming loan ratio of the banking sector within each prefecture-level city in year $t + 1$. *Ratio* is the "proportion of out-of-town city commercial banks" in a prefecture-level city. We use *Ratio* to represent the presence (entry) of out-of-town city commercial banks in (into) the prefecture-level city. The other variables are set and defined the same as in Table 3. All regressions include city and year fixed effects. Standard errors are clustered at the prefecture-level city level and appear in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Table 11
The results of the instrumental variable regression for Model (8).

	NPLR	
	IV	IV
	2nd stage	1st stage
	(1)	(2)
Ratio	0.179***	
	(0.067)	
A_Ratio		0.591***
		(0.104)
Controls	Yes	Yes
City FE	Yes	Yes
Year FE	Yes	Yes
Observations	1266	1266
Adj. R^2	0.647	0.314
Durbin-Wu-Hausman test (p-value)	–	0.001
Cragg-Donald F-Statistic	–	94.486

Note: This table reports the results of the instrumental variable regression for Model (8). *NPLR* is the overall nonperforming loan ratio of the banking sector within each prefecture-level city in year $t + 1$. *Ratio* is the "proportion of out-of-town city commercial banks" in a prefecture-level city. We use the variable *A_Ratio* as the instrumental variable for the variable *Ratio*. *A_Ratio* is the average "proportion of out-of-town city commercial banks" in neighboring prefecture-level cities within the same province. Durbin-Wu-Hausman test (*p*-value) is used to diagnose whether there is an endogeneity problem, and Cragg-Donald F-Statistic is used to diagnose whether the instrumental variable is a strong IV. Standard errors are clustered at the prefecture-level city level and appear in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

sectors which had a dependent variable *NPLR* in the top 1% and the bottom 1%. The results are shown in Column 2 of Table 12. The coefficient for the variable *Deregulation* is still significantly positive. Moreover, the magnitude of these two coefficients is similar to that of the baseline regression.

In summary, the results of our study on the relationship between branching deregulation and the credit risk of the regional banking sector are robust.

6. Conclusion

There is a lack of literature on the impact of bank branching deregulation on the credit risk of the regional banking sector. The deregulation of the intercity branching of city commercial banks by China's regulatory authorities provides us with a quasi-natural experiment to analyze this problem.

In this paper, we assess the impact of the deregulation of city commercial banks' intercity branching on the credit risk of the regional banking sector, employing a difference-in-differences (DD) identification strategy. We find that, on average, branching deregulation increases the credit risk of the regional banking sector in host cities. Specifically, banks in treatment cities (i.e., prefecture-level cities where out-of-town city commercial banks have set up branches) have exhibited more risk-taking behaviors, including lowering lending criteria and attracting deposits with higher interest. In addition, if a type of bank has a similar business strategy to the newly arrived city commercial banks, it may experience more severe competition and thus higher risk. Further evidence shows that the impact of branching deregulation is more pronounced in regions with a higher initial level of the loan-to-deposit ratio and regions with a higher initial level of competition in the banking sector.

We draw two important implications from this paper. First, bank branching deregulation led to increased credit risk of the regional banking sector, due to the risk-taking behaviors that accompanied the geographic expansion of city commercial banks, which seriously violated the rules of prudent operation.

Second, the heterogeneity analysis in this paper shows that intense homogenous competition is an important reason for the rise in risk-taking behaviors. Therefore, how to guide banks to avoid homogeneous competition and to encourage staggered competition is an important issue that regulatory authorities must face when managing risks. As China accelerates the establishment of a unified domestic market, the extent of interregional operation of banks will be further deepened, which poses a greater challenge to the regulators. To meet this challenge, it is necessary to draw lessons from past branching deregulation of city commercial banks.

Data availability

Data will be made available on request.

Table 12
Robustness tests: Shortening the observation period (SOP) and reducing the sample size (RSS).

	NPLR	
	SOP	RSS
	(1)	(2)
Deregulation	0.012***	0.011***
	(0.003)	(0.003)
Controls	Yes	Yes
City FE	Yes	Yes
Year FE	Yes	Yes
Observations	1034	1244
Adj. R^2	0.706	0.705

Note: This table reports the results of robustness tests using reduced samples. *NPLR* is the overall nonperforming loan ratio of the banking sector within each prefecture-level city in year $t + 1$. Column 1 reports the results estimated using the sample that shortened the observation period (SOP) from 2006–2011 to 2007–2010. Column 2 reports the results estimated with a reduced sample size (RSS) in which we exclude cities with the value of the dependent variable *NPLR* in the top 1% and the bottom 1%. Definitions for other variables are reported in Table 3. All regressions include city and year fixed effects. Standard errors are clustered at the prefecture-level city level and appear in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

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