

The Regional Performances of Agricultural Bank of China Applying GEE Method Multiple Linear Regression

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Abstract

This paper aims to assess the performance of China's banks by their geographical distribution of loans and deposits, with the application of Generalized Estimating Equation (GEE) method's multiple linear regression. We chose one of the four largest banks, Agriculture Bank of China, with data from 1990 to 2008 as the sample bank. We identified that branches' performances in the Yangtze River Delta ranked first and were followed by the Pearl River Delta. Different than that of the previous literature, the results further indicate that branches in economically well-developed regions were not necessarily better-performed. The empirical evidence also implies that distance impacts performances between branches and their headquarters. We emphasize that China's banks benefited greatly from the support of various government policies. The management efficiency of the ABC in the other four regions particularly the Bohai Sea and the Central regions with larger GDPs, needs to be strengthened with further deregulation of China's financial industry to domestic and international competition in the coming years. Overall the evidence provides insights into bank-specific management in efficient allocation of scarce resources and could contribute to inform government policy, as well as to improve managerial performance and research issues on this regard.

JEL classification numbers: D2, G2, L25, N25.

Keywords: China's banks; regional performances of commercial banks; Agriculture Bank of China; GEE method; Commercial bank management.

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1 Introduction

China's economy experienced outstanding growth rates of around 10% for nearly three decades since 1978 (source: *China Statistical Yearbook*). The total assets of China's banks grew at the annual rate of about 18%, which was almost twice of the growth rate of GDP since the late 1980s to 2011 (source: *Almanac of China's Finance and Banking*). The scale of China's banks has already dominated the lists of the top 1000 banks in the world since the 2000s, according to *The Banker* magazine. Recent studies related to China's economy have clearly shifted from manufacturing sectors to service industry- in particular the financial institutions. A lot of literature has examined China's banking efficiency or even further conducted international comparative studies in the past few years (such as Garcia-Herre0 et al. 2006, Liu et al. 2012, Liu et al. 2012, Lu et al. 2007, Wu et al. 2007, Wu and Chen 2010 and etc). However, there are few studies on the territorial features of this sector, and most of them written in Chinese (Lin and Yan 2006, 2007, Li et al 2006, Lin et al. 2007, Liu 2011).

In other words, the lack of research on geographical dimensions has been greatly ignored. The overall efficiency of the gigantic banks is composed of all regional branches. It is of interest to examine the efficiency of China's bank at the branch or regional level instead of assessing efficiency of the bank as a whole, given China's large population and territory, plus the fact that several tens of thousands of branches are all run by one of the four largest commercial banks. The four banks merged or closed 440,000 small branches from 1998 to 2001 (Liu and Wu 2008). The number of domestic branches of the ABC was down from 65,870 in 1996, to 23,461 in 2011. The number of employees was down from 538,780 in 1996, and down to 441,144 in 2009. The above numbers clearly indicate that the ABC has been going through operational restructure greatly. This motivates us to conduct this research on the regional and territorial features of China's bank.

This paper focuses only on the Agricultural Bank of China which is one of China's four largest commercial banks with geographical approach due to its historical geographical financial data is relatively much more complete for thirty years consistently from 1979 to 2008 in comparison with other three largest with merely nine-year geographical data available. However, the provincial or regional data on deposits and loans for the ABC is no longer released from 2009 onwards.

The Agricultural Bank of China (ABC) was resurrected to support rural economic development in 1979. These state-owned banks performed certain policy functions.

Since 2003, the government promoted three large commercial banks into share-holding corporations. The ABC was also later listed in 2011. The ABC became a more profit-oriented commercial bank and its policy-bank function was adopted by three newly established banks in 1994. The ABC is ranked 10th among the top 1000 world banks by capital, according to *The Banker* magazine (July 2012). Additionally, ABC is ranked No. 84 rising from No. 127 among the top 1000 world corporations, according to *The Fortune* magazine (9th July 2012).

We identified that branches' performances in the Yangtze River Delta ranked first and were followed by the Pearl River Delta. Different than that of the previous literature, results indicate that branches in economically well-developed regions were not necessarily better-performed during this period. The management efficiency in the other four regions particularly the Central and Bohai Sea regions needs to be strengthened. Furthermore, the empirical evidence implies that the distance between branches and their headquarters impacts performance. It also provides insights into bank-specific

management in efficient allocation of scarce resources and could contribute to inform government policy, as well as to improve managerial performance and research issues on this regard.

The remainder of the paper is structured as follows. Section 2 studies existing related literature. Section 3 discusses the data of variables adopted and explains the methodology applied. Section 4 presents and analyzes the results of the banks' performance in geographical space. Section 5 concludes the paper.

2 Literature Review

A growing body of analytical or empirical research has shed light on the efficiency and the effectiveness of the government's financial reform (Chen et al. 2005, Fu and Heffernan 2007, Ariff and Can 2008, and Sufian 2010). Lu et al. (2007) suggested that joint-share banks performed better than state-owned banks in 2004 and 2005. The empirical findings of Sufian (2010) further indicate that scale efficiency has greater influence in determining China's banking sector's total technical inefficiency. The results imply that China's banking sector has been inefficient in exploiting the economies of scale given the size of their operations. The city commercial banks exhibited higher efficiency than state-owned banks and joint-stock banks from 2000 to 2005.

On the other hand there are some studies on the territorial features of China's banking industry. Liu and Wu (2008) indicated that in 2006 it was quite outstanding that China's financial resources were distributed mostly in the coastal region. The shares of the state-run banks in terms of the branches location and assets allocated in the coastal region was 50.4% and 67.1% respectively of their total number of branches and assets, which were higher than that of the population and this regional GDP (61.8%). Liu and Wu (2008) also emphasized that the regional distribution of China's banks assets tends to be positively and highly correlated with the distribution of GDP, while that of bank branches has a closer relationship to the distribution of the population.

Though some missing and inconsistent values appear on the dataset, the study of Yin et al. (2008) provides some insights into the efficiency of China's state-owned commercial banks at the provincial level branches from 1998 to 2003. The empirical results applying Data Envelopment Analysis showed that provinces on the eastern coast and the major cities were associated with much higher technical input efficiency scores than those in the interior parts of China. In addition, Liu (2011) applied the spatial econometric model and identified technology innovation, human resource, and especially the level of economic development as influential factors in the regional financial development in mainland China with the dataset of twenty-nine provinces and municipalities from 2002 to 2009.

Conventional research on banking sectors with geospatial approach contributed to the banks' locations and performances with important implications on bank management and government policy. Some early studies document the economic linkage between the bank performance and its spatial dimension. The studies of Peterson and Rajan (2002), Degryse and Ongena (2005) focused on the borrower-lender distance and lending conditions. The study of Deng and Elyasiani (2008) emphasized that no prior study has examined how parent-branch distance affects firm value and risk in banking. Their empirical findings show that geographical diversification is associated with a significant value premium and a reduction in total risk. Additionally increased distance the branches and the headquarters is inversely related to the bank value and directly related to risk. Deng and Elyasiani

(2008) pointed out that a common weakness in most prior studies of geographic diversification was the failure to account for distance (e.g. Rivard and Thomas 1997, Denis et al. 2002). Geographic diversification may be associated with firm value enhancement because of scale and scope economies and cost reduction. Geographically diversified banks can achieve a lower cost of funds by enlarging their deposit bases, increasing their revenues through new investment opportunities and improving managerial efficiency by spreading their managerial expertise over a larger scale of operation (Lewellen 1971, and Boot and Schmeits, 2000). Some empirical research supports the above arguments. For example, Hughes et al. (1999) and Akhigbe and Whyte (2003) find that US interstate banking leads to a higher level of profitability and a lower level of earning volatility, insolvency risk, and market risk. On the other hand, geographical diversification may be associated with value loss, due to the lack of managerial skills or lack of information when entering new markets, and product structure, and hence intensified agency problem (Acharya et al. 2006 and Baele et al. 2007).

The farther away a branch is from its headquarters, the more difficult it is for the senior managers to monitor branch managers (Brickley et al. 2003). Furthermore, according to Berger et al. (2005), bank holding companies (BHCs) operating in narrower geographic markets have certain advantages over the more geographically dispersed banks.

Overall the efficiency and management of China's state-owned banks from the geospatial analysis is rare in literature. This paper attempts to fill the gap by providing empirical evidence on one of China's largest state-owned banks by employing the geographical approach.

3 Data and Methodology

Studies on China's banks (Liu and Wu 2008, Yin et al. 2008, and etc.) often claimed that the data were very rare and significantly limited in scope. Researchers constantly found that there were missing and inconsistent values on the dataset.

In this paper, we focused on only one of the four largest commercial banks: the Agricultural Bank of China (ABC) with more complete data from 1979 to 2008 in comparison with other three largest with merely nine-year geographical data available. However, the provincial or regional data on deposits and loans for the ABC is no longer released from 2009 onwards. (Data source: *Statistical Yearbook of Agricultural Bank of China, Almanac of China's Finance and Banking*). The data includes twenty-six provinces and nine municipalities. We further group the data into six regions referring to the national geography. The six regions are the Yangtze River Delta (Shanghai city, Ningbo city, and Jiangsu and Zhejiang provinces), Pearl River Delta (Xiamen city, Shenzhen city, and Fujian, Guangdong, Hainan, and Guangxi Provinces), Bohai Sea region (Beijing city, Tianjing city, Dalian city, Qingdao city, and Hebei and Shandong provinces), Central region (Shanxi, Anhui, Jiangxi, Henan, Hubei, and Hunan provinces), Western region (Chongqing city, and Guizhou, Sichuan, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, and Xingjiang provinces), and Northeast region (Inner Mongolia, Liaoning, Jilin, and Heilongjiang provinces). All the nominal variables have been transformed into real terms from 1990 to 2008 in this paper due to the fact that China's deflator index by regions has only been available since 1989. On the other hand, the provincial or regional data on deposits and loans for the ABC is no longer released from 2009 onwards.

There are two main approaches in analyzing service industry efficiency: the production approach and the intermediation approach. In light of the basic nature of the banking industry, the production approach treats banks as firms producing different deposit and loan accounts (Yao *et al.* 2007). A lot of literature followed the production approach, which adopted two outputs: namely deposits and loans (e.g. Sherman and Gold 1985, Vassiolglou and Giokas 1990, Tulkens 1993, Sherman and Ladino 1995, Athanassopoulos 1997, Schaffnit *et al.* 1997, Zenois *et al.* 1999, Soteriou and Zenios 1999).

The intermediation approach pioneered by Sealey and Lindley (1977) treats banks as financial intermediaries channeling funds between depositors and creditors. The value of bank lending and investment is considered to be output, while labor and deposit capital are treated as inputs. This approach is distinguished from the production approach by adding deposits to inputs, with consideration of both operating cost and interest cost. Neither the production approach nor the intermediation approach is perfect, the intermediation approach appears more appropriate when analyzing efficiency of entire financial institutions, while the production approach may be better for evaluating the efficiencies of branches of financial institutions. (Berger and Humphrey, 1997).

Therefore both deposits and loans are useful indicators in evaluating the performance of different branches. Furthermore, it is suggested that the larger the deposits or loans the better the performance of the branches. In this paper, we use loans and deposits as the proxy for the bank’s output to evaluate the efficiency and management of the banks in different regions.

The comparisons of these six regions’ performances were done by using the generalized estimating equation (GEE) method’s multiple linear regression (Liang and Zeger, 1986) with the application of regions. The Bohai Sea region (1, Reference), the Yangtze River Delta (2), the Pearl River Delta (3), the Central region (4), the Northeast (5), the Western region(6)) by year interaction terms. More specifically, the linear model can be shown as follows:

$$Y_{ijk} = \beta_1 + \sum_{i=2}^6 \beta_i \text{Region}_i + \sum_{j=2}^J \alpha_j \text{Year}_j + \sum_{i=2}^6 \sum_{j=2}^J \gamma_{ij} \text{Region}_i \times \text{Year}_j + \varepsilon_{ijk}$$

where:

β_i : the difference of *ith* Region effect - 1st Region effect (the Bohai Sea) in first study year,

α_j : the difference of *jth* Year effect - 1st Year effect in the Bohai Sea region,

γ_{ij} : the interaction effects between Regions and Years ,

$k = 1, \dots, n_{ij}; i = 2, \dots, 6; j = 2, \dots, J$ (Year_{*j*} = 2008),

n_{ij} : the number of provinces (or municipalities) in *ith* Region and *jth* Year.

The results of GEE models were analysed by the SPSS v19.0 (SPSS Inc., Chicago, IL, USA) with AR (autoregressive) (1) working correlation structure. All hypothesis tests were two-sided and conducted at $\alpha = 0.05$ significance level.

4 Empirical Results

The empirical results obtained by applying the multiple linear regression of GEE method are presented as follows. To be manageable, we only exhibited part of results in Table 1 and 2.

Regarding the regional performances of the ABC in terms of Reminbi Loans (100mn), the results are shown in Table 1 and the main findings are interpreted as follows.

- There were no significant differences in Renminbi loans among all the six regions in this study in 1990.
- The RMB loans in the Bohai Sea region began growing steadily in 1991. These growing momenta were significantly greater from 1992 to 2008 (all p-values < 0.000 with the exception of 1994, when p-value was 0.045).
- The Renminbi loans in the Yangtze River Delta in comparison to those in the Bohai Sea region expanded more from 1995 to 2008 with highly statistical significance (p-values < 0.001 from 1996 to 2005, p-values between 0.014 to 0.004 in year 1995 and from 2006 to 2008). The expansions were also larger in 1992 and 1994 but were statistically insignificant.
- The Renminbi loans in the Pearl River Delta, when compared to those in the Bohai Sea region, were fluctuated and statistically insignificant during the period of study.
- The expansions of Reminbi loans in the Western, Northeast, and Central regions were all less than those in the Bohai Sea region during the period of study, and reached the statistically significant level from 2003 to 2008 (p-values between 0.032 and < 0.001).

Regarding the regional performances of the ABC in terms of Reminbi Deposits (100mn), we similarly presented part of the results in Table 2. The main findings are interpreted as follows.

- There were no statistically significant differences in Renminbi (RMB) deposits among all regions in 1990.
- The RMB Deposits in the Bohai Sea region increased steadily and significantly during this study period with all p-values < 0.001.
- The increases of RMB deposits in the Yangtze River Delta were larger than those in the Bohai Sea region from 1992 to 2008 and reached statistical significance from 1993 to 2008 (p-values between 0.024 and < 0.001) with the exception of 1994 (p-values 0.902). The increases of RMB deposits in the Pearl River Delta were larger than those in the Bohai Sea region from 1992 to 2006, but became lesser in 2007 and 2008. All in all, the increased amounts of RMB deposits in the Pearl Delta River in comparison with those in the Bohai Sea region were statistically insignificant.
- The increases of RMB deposits in the Central, Northeast and Western regions were all lower than those in the Bohai Sea region, though most were statistically insignificant. The increases were significantly lower for the Northeast region from 2003 to 2007 with p-values between 0.029 and <0.001 and for the Western region from 1993 to 2008 with p-values between 0.047 and 0.005.

Earlier studies including Liu and Wu (2008) and Liu (2011) as aforementioned in Section 2 identified that the allocation and distribution of China's banks' branches and assets were highly correlated to the level of regional economic development. We therefore examine the above empirical results in light of the regional GDP. China's government has

been long biased toward industrial and urban development, which has led to the underdevelopment in the rural areas. The government only started implementing a series of measures that allows farmers to lease their contracted farmland or transfer their land-use rights to boost the scale of operation for farm production or to start new businesses in order to enhance income and consumption levels in the vast rural area and to balance urban and rural development and equalizing income distribution in Oct. 2008 (Liang 2010). Additionally the state-owned banks (such as the ABC) are normally reluctant to provide banking services to the small and medium enterprises because of the huge potential risks and missing information. (Lu et al. 2007).

The study of Liu and Wu (2008) demonstrate that since the late 1990s, the government promoted the establishment of the city commercial banks and the consolidation of city and rural cooperatives gradually formed useful local financial system in supporting regional, small-medium enterprises and consumers financing. At the same time the large state-owned commercial banks remained focusing mainly on infrastructure projects and industrial loans. Not until in the late 2000s China's government promoted the agriculture loans, the loans to farmers increased by 146.7% between 2007 and 2012. The farmers' loans to the agriculture related loans reached 21.3% and 5.4% to the total loans in March 2012. We therefore interpret the above empirical results in light of the regional real GDP instead of the GDP *per capita* in this paper.

With regard to the scale and growth of the real GDP in each region during the period in study, there is no significant difference among the six regions in late 1980s and the beginning of 1990s according to Figure 1. The Central region led the other regions from the mid-1990s to the end of 1990s while the GDP in the Yangtze River Delta and the Bohai Sea region were the second and the third. The Yangtze River Delta topped all other region from 2000 to 2008 with relatively significant gap with the second: the Bohai Sea region. However the gaps between the Yangtze River Delta and Central region gradually diminished towards the second-half of the 2000s. The Central region regained its top position in 2009. Meanwhile the Western region and Northwest region remained in the second lowest and the lowest position in the period.

We interpret the empirical results in light of the regional GDP growth from Figure 1. In terms of deposits and loans Renminbi, branches in the Yangtze River Delta topped all other regions thanks to the rapid economic development in this region and the efficient management though the regional GDP in the Central region was higher than that in Yangtze River Delta in quite a few years of this period. The performances of branches in the Yangtze River Delta were better than those in the Bohai Sea region in terms of deposits and loans. The headquarters of the ABC is located in the Bohai Sea region and economic growth rates in this region were also relatively higher than those in the Pearl River Delta according to Figure 1. However, growth rates of deposits and loans in the Bohai Sea region were not higher than those in the Pearl River Delta. It appears that the management of regional branches in the Bohai Sea region was more conservative than that of the Pearl River Delta. This could have led to the result that the performances of branches in the Bohai Sea region were not better than those in the Pearl River Delta. Meanwhile, the regional GDP growth in the Central region was generally higher than that of the Bohai Sea region during this period. The increased amounts of deposits and loans were lower than those in the Bohai Sea region, though some were statistically significant and some were statistically insignificant. Especially, in the second half of the 2000s regional GDPs in the Central region once again got stronger and closer to those in the Yangtze River Delta and surpassed all regions in 2008 according to Figure 1. In addition,

branches in the Pearl River Delta achieved better performance than those in the Bohai Sea and the Central regions, though regional GDP growth of the Pearl River Delta was consistently lower than that of the Bohai Sea and the Central regions. In other words, the efficiency and management of branches in the Central and Bohai Sea regions could be enhanced.

Overall the branches in the Yangtze River Delta were the best-performed both in loans and deposits, followed by the Pearl River Delta and the Bohai Sea region. Branches in the Bohai Sea region and the Central region could have performed better with appropriate management, because the regional GDPs of the Bohai Sea and the Central regions were higher than those of the Pearl River Delta in most of the years during this period. In particular, the branches in the Central region clearly underperformed. The performances of the Western and Northeast regions might provide some insight to the management of the ABC—whether it is necessary or how to restructure the branches in the two regions. Regarding loans and deposits performances of the ABC in different regions, we suggest that the large increase in loans and deposits of the branches in all regions did not fully result from the enhanced efficiency of the branches themselves over the observation period. These branches greatly benefited from the Open Policy promoted by the government, which led to the allurements of huge foreign direct investment and stimulation of international trade—especially in the coastal areas such as the Yangtze River Delta, the Pearl River Delta, and, to a lesser degree, the Bohai Sea region. The government should further open the inland regions to foreign investment and foster international trade to balance the inequality between coastal and inland regions in the future. At the same time the ABC would have to strengthen the management of the branches in inland regions to improve their performances.

The empirical findings in this paper are, to some extent, consistent with previous literature (such as Liu and Wu, 2008 and Yin *et al.* 2008), which highlighted the inequality of performances between branches in coastal and interior provinces in China. Interestingly, we identified that branches' performances in the Yangtze River Delta ranked first and were followed by the Pearl River Delta. The results further indicate that branches in economically well-developed regions were not necessarily better-performed during this period. The management efficiency in the other four regions particularly the Central and Bohai Sea regions needs to be strengthened.

The above results also provide some insights aforementioned in Section 2. The headquarter of the ABC is located in Beijing city. Beijing city is part of the Bohai Sea region. Also, the Yangtze River Delta is less distant from its headquarter than the four other regions are. Branches in the Yangtze River Delta and the Bohai Sea region performed better than most other regions. Thus the performances of branches with increased distance between headquarter and the branches are inversely related to the bank value and directly related to risks, as emphasized by Deng and Elyasiani (2008).

What it is of major concern from the empirical evidence is that loans and deposits of branches in each region were generally in a growing trend during the period due to the Open and Reform policy implemented by China's government. Also, to enhance the soundness and competitiveness of the banking industry after China's joining the WTO and to meet the requirement of Basel II, the government implemented a series of measures to reach the above goals. In other words, performances of the ABC during this period were strongly impacted by the government's policies. These policies mainly include:

First, the State Council of China implemented the "*Decision on Financial Institutional Reforms*" in 1993. It required the four state-owned commercial banks to close or merge

their small subsidiaries and branches. For example, all branches with savings below 0.5 million Reminbi per employee, and some between 0.5 million and 1.0 million Reminbi, were to be closed. The four banks merged or closed 440,000 small branches from 1998 to 2001 (Liu and Wu 2008). Yin et al. (2008) suggests that despite the substantial reduction in the number of branches and employees over the years, the problem of surplus branches and employees was still significant in 2003. China's largest commercial banks should direct further efforts at consolidating existing banking inputs (e.g. branches). Indeed, the number of domestic branches of the ABC was down from 65,870 in 1996, 44,417 in 2001 to 23,461 in 2011. The number of employees was down from 538,780 in 1996, 490,999 in 2001 and further down to 441,144 in 2009. The above numbers clearly indicate that the ABC has been going through operational restructure greatly. The number of domestic branches in 2011 has been largely reduced by about 60% of that in 1996.

Second, the introduction of *Commercial Banking Law* in 1995 regulates that commercial banks' lowest ratio of capital adequacy requirement is 8%, which was not seriously implemented by banks or monitored by the authorities. To meet the requirements of Basel II, in Feb. 2004 the authorities requested commercial banks' capital adequacy ratio to remain no lower than 8% by 1st Jan. 2007. China's commercial banks made great efforts to achieve the 8% capital adequacy ratio requirement.

Third and arguably most important, there were three steps of the recapitalization and the removal of NPLs implemented by China's government from 1998 to 2005. The average NPL ratio of China's banking sector was 34% in 1999 (Liang 2010). An estimated 20-24% of the 2004 GDP was injected into the banking system in these three waves. These came in the form of capital or as a substitute of NPLs. This amounts to over 110% of the all state-run commercial banks' capital in injections (Garcia-Herrero et al. 2006).

As a result, China's banks have become the most profitable banks in the world (*The Banker Magazine* 2011 and 2012). The current state of the ABC is relatively much better than of that in earlier years. Without the substantial resources and efforts deployed by the Chinese government to improve the efficiency of state-owned banks from the late 1990s to more than a decade, the ABC could have faced great difficulty in sustaining its operation. The inefficiency of state-owned banks is also confirmed by the previous studies mentioned in Section 2 (Lu et al. 2007, Sufian 2010). Finally the capability of self-oriented restructuring and the efficiency enhancement of the ABC, especially in the four regional branches: the Central, Bohai Sea, Western and Northeast, will be tested and proved with further deregulation of China's banking industry and financial markets to domestic and international competition in the near future. The regional pattern of branches' performances shows the significant differences over the years, and it is very important to enhance their management efficiency.

5 Figures and Tables

Table 1: Results of RMB loans (100mn) using the GEE method's multiple linear regression

Parameter	B	Std. Error	Wald Chi-Square	P-value
Yr 2008 vs. Yr 1990	1002.672	249.6685	16.128	< 0.001
Yr 2007 vs. Yr 1990	1016.367	154.6215	43.208	< 0.001
Yr 2006 vs. Yr 1990	948.540	150.6343	39.652	< 0.001
Yr 2005 vs. Yr 1990	823.385	128.8824	40.815	< 0.001
:	:	:	:	:
Yr 1993 vs. Yr 1990	72.822	12.1349	36.013	< 0.001
Yr 1992 vs. Yr 1990	25.770	3.5709	52.081	< 0.001
Region 6 * Yr 2008	-633.441	278.3101	5.180	0.023
Region 6 * Yr 2007	-587.066	197.7728	8.811	0.003
Region 6 * Yr 2006	-535.051	192.1181	7.756	0.005
Region 6 * Yr 2005	-438.159	171.1626	6.553	0.010
:	:	:	:	:
Region 6 * Yr 1993	-26.842	19.6856	1.859	0.173
Region 6 * Yr 1992	-8.147	7.2189	1.274	0.259
Region 5 * Yr 2008	-885.685	263.7030	11.281	0.001
Region 5 * Yr 2007	-694.760	179.7957	14.932	< 0.001
Region 5 * Yr 2006	-617.035	178.8635	11.901	0.001
Region 5 * Yr 2005	-499.715	162.6196	9.443	0.002
:	:	:	:	:
Region 5 * Yr 1993	22.145	18.4184	1.446	0.229
Region 5 * Yr 1992	11.318	7.0093	2.607	0.106
Region 4 * Yr 2008	-768.426	250.2934	9.426	0.002
Region 4 * Yr 2007	-582.781	160.5604	13.174	< 0.001
Region 4 * Yr 2006	-524.773	157.7938	11.060	0.001
Region 4 * Yr 2005	-423.972	139.3627	9.255	0.002
:	:	:	:	:
Region 4 * Yr 1993	5.324	16.5585	0.103	0.748
Region 4 * Yr 1992	1.315	5.7715	0.052	0.820
:	:	:	:	:
Region 2 * Yr 2008	1257.941	513.3121	6.006	0.014
Region 2 * Yr 2007	771.933	267.3260	8.338	0.004
Region 2 * Yr 2006	871.350	309.9189	7.905	0.005
Region 2 * Yr 2005	630.835	169.2079	13.899	< 0.001
:	:	:	:	:
Region 2 * Yr 1993	16.491	17.4692	0.891	0.345
Region 2 * Yr 1992	5.510	7.6838	0.514	0.473

Table 2: Results of RMB deposits (100mn) using the GEE method's multiple linear regression

Parameter	B	Std. Error	Wald Chi-Square	P-value
Yr 2008 vs. Yr 1990	1078.095	365.7279	8.690	0.003
Yr 2007 vs. Yr 1990	928.565	240.1200	14.954	< 0.001
Yr 2006 vs. Yr 1990	1343.780	137.3690	95.693	< 0.001
Yr 2005 vs. Yr 1990	1104.957	118.4467	87.025	< 0.001
:	:	:	:	:
Yr 1993 vs. Yr 1990	77.205	14.3344	29.009	< 0.001
Yr 1992 vs. Yr 1990	22.640	5.4475	17.273	< 0.001
Region 6 * Yr 2008	-749.199	377.1833	3.945	0.047
Region 6 * Yr 2007	-668.869	249.4104	7.192	0.007
Region 6 * Yr 2006	-664.542	240.2497	7.651	0.006
Region 6 * Yr 2005	-518.046	210.2509	6.071	0.014
:	:	:	:	:
Region 6 * Yr 1993	-55.177	19.5059	8.002	0.005
Region 6 * Yr 1992	-12.806	7.0932	3.260	0.071
Region 5 * Yr 2008	-702.767	389.9807	3.247	0.072
Region 5 * Yr 2007	-626.635	259.9301	5.812	0.016
Region 5 * Yr 2006	-712.152	187.0279	14.499	< 0.001
Region 5 * Yr 2005	-535.435	166.3464	10.361	.001
:	:	:	:	:
Region 5 * Yr 1993	-35.687	16.6536	4.592	0.032
Region 5 * Yr 1992	-5.170	7.3027	0.501	0.479
Region 4 * Yr 2008	-723.500	369.5126	3.834	0.050
Region 4 * Yr 2007	-585.825	256.5818	5.213	0.022
Region 4 * Yr 2006	-513.825	156.2352	10.816	0.001
Region 4 * Yr 2005	-377.367	138.2388	7.452	0.006
:	:	:	:	:
Region 4 * Yr 1993	-19.508	15.9344	1.499	0.221
Region 4 * Yr 1992	-3.508	6.0968	0.331	0.565
:	:	:	:	:
Region 2 * Yr 2008	1741.438	740.9192	5.524	0.019
Region 2 * Yr 2007	1144.822	424.7587	7.264	0.007
Region 2 * Yr 2006	1145.243	267.7529	18.295	< 0.001
Region 2 * Yr 2005	1029.379	226.8849	20.584	< 0.001
:	:	:	:	:
Region 2 * Yr 1993	42.132	18.6877	5.083	0.024
Region 2 * Yr 1992	19.483	10.5550	3.407	0.065

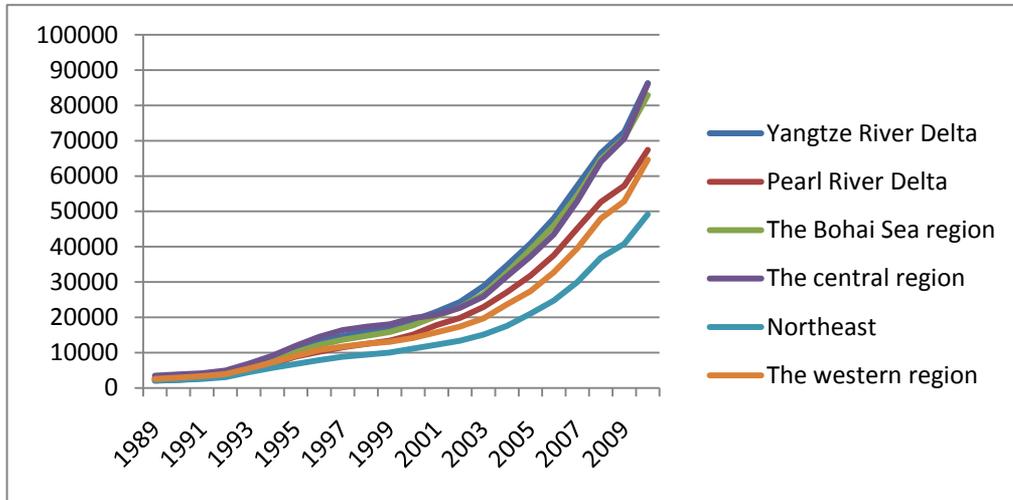


Figure 1: Regional Real GDP from 1989 to 2009

6 Conclusion

A lot of literature has examined China's banking efficiency or even further conducted international comparative studies in the past decade. However, there were only a few studies that have investigated China's bank management from the geospatial viewpoint. This paper assesses the performance of the ABC, one of the four largest commercial banks in China, by its spatial pattern and geographical distribution of loans and deposits, with the application of GEE method multiple linear regression and data from 1990 to 2008.

The empirical findings of this study contribute significantly to the existing knowledge on the regional pattern of branches' performances in China's banking industry. We identified that branches' performances in the Yangtze River Delta ranked first and were followed by the Pearl River Delta. The results further indicate that branches in economically well-developed regions were not necessarily better-performed during this period. The empirical evidence also implies that distance impacts performances between branches and their headquarters. We emphasize that China's banks benefited greatly from the support of various government policies. The management efficiency of the ABC in the other four regions particularly the Bohai Sea and the Central regions with the larger GDPs, needs to be strengthened with further deregulation of China's banking industry and financial markets to domestic and international competition in the coming years.

Overall the evidence provides insights into bank-specific management in efficient allocation of scarce resources and could contribute to inform government policy, as well as to improve managerial performance and research issues on this regard.

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