Stability and economic performances in the banking industry: the case of China*

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Abstract

We estimate stability performances in the Chinese banking industry over the 2007–2017 period using four risk indicators under nonparametric modelling. We are the first to calculate the risk indicator shadow prices, and we use a new way of studying the relationship between stability and economic performance. In particular, we reexamine stability performances when banks achieve their best economic performances. This questions the existence of stability rents, which form a prime reason for the banking authority to consider economic performance. Finally, we verify whether ownership has an impact on our results and investigate the role of the interest rate liberalization reforms.

JEL codes: G21; C14; C67; B26; C12; C33.

Keywords: banking system; stability; shadow prices; economic performances; China.

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1 Introduction

The banking industry has played a crucial role in China's rapid and sustained economic growth. Economic activity gets a significant boost from the large amounts of credits provided to companies and firms in all economic sectors. The Chinese Banking Regulatory Commission shows that the assets held by the banking institutions increased steadily over the period 2007–2017 to reach RMB 252,404 billion in 2017, while the ratio of banking sector assets to GDP reached 307% by the end of 2017. The importance of the banking industry is still a recent phenomenon. According to the Central Bank of China, the banking industry increased the amount of credits granted to the economy by RMB 1.12 trillion in Nov. 2017 compared to Oct. 2017. Moreover, from Jan. 2017 to Nov. 2017, the total lending reached RMB 12.94 trillion in the Chinese banking industry compared to RMB 12.65 trillion for 2016 as a whole. Finally, according to Reuters calculations, there was a significant positive growth of corporate loans in 2017, e.g. from RMB 214.2 billion in Oct. 2017 to RMB 522.6 billion in Nov. 2017.

Given its crucial role, there has been ample investigation of the banking industry's economic performance. Different dimensions have been studied: profitability (Garcia-Herrero et al., 2009; Choi and Hasan, 2011; Tan and Floros, 2012; Tan, 2016; Aspergis, 2019; Fang et al., 2019; Tan, 2019), efficiency (Bos et al., 2009; Staub et al., 2010; Assaf et al., 2013; Barth et al., 2013; Konara et al., 2019); and productivity (Banker et al., 2010; Delis et al., 2011; Epure et al., 2011; Chen, 2012). When profitability is of interest, traditional accounting ratios (such as return on assets, return on equity, net interest margin and profit margin) can be used. Estimating efficiency or productivity behaviour requires more advanced techniques. Two main directions have been suggested: one, known as the parametric approach, specifies the bank production process and uses tailored regression tools (e.g. stochastic frontier analysis), while the other, known as the nonparametric estimation approach, avoids specifying bank production technology but lets the data speak from themselves by reconstructing the production process (e.g. data envelopment analysis). The main advantage of the parametric approach lies in considering the presence of noises explicitly, while its disadvantage lies in assuming a particular form of the production process that is typically unverifiable. The contrary applies in the case of the nonparametric estimation approach.

These different techniques have been used to study the performance of the Chinese banking industry. The parametric estimation approach has been used by, e.g. Berger et al., 2009; Fu and Heffernan, 2009; Berger et al., 2010; Sun and Chang, 2011; Jiang et al., 2013; Sun et al., 2013; Dong et al., 2016. These studies variously define efficiency (e.g. cost, profit, scale). The nonparametric estimation approach has been used, by e.g., Tan and Floros, 2013; Tan and Anchor, 2017; and Tan and Floros, 2018. Recent advancements include tailored models with heterogeneous bank production processes (Huang and Fu, 2013), connection between the production factors and the bank activities (Wang et al., 2014; Zha et al., 2016; Fukuyama and Matousek, 2017; Chen et al.,2018), the presence of undesirable outputs (An et al., 2015); the presence of uncertainty (Zhou et al., 2018); and robustness considerations (Du et al., 2018).

The Chinese government and the banking regulatory authority pay particular attention to the banking sector's stability through a series of banking reforms initiated in 1978. Examples include non-performing loan write-offs, capital injection, the establishment of the Chinese Banking Regulatory Commission, the attraction of foreign strategic investors, and improvement in bank governance and monitoring through an initial public offering. Moreover, it is well known that China experienced a real estate-driven credit boom, which may have exacerbated the problems with largely unoccupied towns (Glaeser et al., 2017; Liu and Xiong, 2018; Smith and Liang, 2019). In this context, assessing the systemic risk of Chinese banks is critically important (Engle, 2018). It stands to reason that financial stability plays a central role in understanding the risks of the financial intermediation sector in China.

While assessing the Chinese banking system's economic performance is the most popular research topic, particular attention has recently been given to risk level and stability: Fang et al. (2014) investigate the impact of institutional development on bank risk-taking behaviour; Fu et al. (2014) examine the impact of bank competition on bank risk; Chiaramonte et al. (2015) evaluate whether the existence of cooperative banks has any impact of bank stability; Sarmiento and Galan (2017) assess the impact of bank risk on efficiency; Tan and Anchor (2017) to use various accounting-based risk indicators to investigate the impact of competition on risk; and Tabak et al. (2012) and Tan (2018) proposed the stability inefficiency, estimated from a stability stochastic frontier, and further investigate the relationship between bank competition and bank risk.

Moreover, as highlighted in several studies, the specificities of the Chinese banking sector make performance evaluation exercises particularly relevant. Brunnermeier et al. (2022) delve into the intricate dynamics of intense government intervention within the Chinese financial sector, a policy framework meticulously crafted to uphold financial stability. This approach is paramount given China's evolving economic landscape and the interconnectedness of its financial institutions with global markets. Central to this discussion is the concept of implicit government guarantees, wherein financial institutions implicitly rely on the government's assurance to step in and prevent catastrophic failures. These guarantees profoundly influence various facets of bank performance, as elucidated by recent studies. Silva (2021) highlights the impact on banks' provisions, indicating that the perceived safety net provided by the government can lead to adjustments in the level of provisions set aside for potential losses. Furthermore, Dantas et al. (2023) shed light on the phenomenon of capital procyclicality, where the strength of implicit guarantees affects the cyclical behaviour of banks' capital buffers. Lastly, Gropp et al. (2014) underscore the crucial link between government guarantees and risk-taking behaviour among financial institutions, emphasizing how the perceived safety net may incentivize riskier strategies due to reduced perceived consequences of failure. This intricate interplay underscores the significance of government intervention in shaping the risk landscape and operational dynamics within China's financial ecosystem, with implications reverberating across both domestic and international markets.

In this paper, we investigate the stability and economic performances and their relationship with the Chinese banking system from 2007–2017. Our empirical exercise presents several unique features. The first one is that we adopt a nonparametric estimation method to measure both stability and economic performances and their relationship. In the absence of convincing arguments justifying a particular production process for the banks, adopting a nonparametric estimation approach is the safest way to proceed. Moreover, assuming a wrong parametric bank production process may create a bias in the estimation. While how to estimate economic performances nonparametrically is standard knowledge, this is not the case for stability performances. To do so, we adapt the technique used for economic performances.

A major advantage of our nonparametric approach is that we can compute the shadow prices of the risk indicators. In practice, such prices are not observed. Knowing their value represents valuable information for Chinese policy-makers and banking regulators. For example, it is theoretically easier to modify an indicator with a lower price. In other words, these prices can be used to better implement stability policy in the banking industry. To the best of our knowledge, few previous empirical studies have attempted to measure shadow prices in the banking sectors; and practically none has estimated the shadow prices of the risk indicators. Only Dong et al., (2016) have estimated the shadow price of equity capital when evaluating cost performances.

Next, our paper contributes to the empirical research on stability performances by considering a comprehensive aspect of the risk conditions in the banking industry. More specifically, we argue that banks face various risks that should all be considered when evaluating bank stability. In particular, we include four different types of risk: credit risk, measured by loan loss provision; liquidity risk, measured by liquid assets; capital risk, measured by equity capital; and insolvency risk, measured by the volatility of net income.

The last distinguishing feature of our empirical exercise is our questioning of the relationship between economic and stability performances, an aspect which has for far been neglected. Instead of using regression or econometric methods, we rather reexamine the stability performance when banks achieve their best economic performances. In other words, we verify the potential existence of stability rents. These rents form a prime reason for the banking authority to consider economic performance; which as yet may not have been done with all due seriousness.

The rest of our paper unfolds as follows. In Section 2, we formulate our empirical hypotheses. in Section 3, we present our empirical study. In Section 4, we provide some policy recommendations. Section 5 concludes.

2 Background and hypotheses

A particularity of the Chinese banking industry is the central role played by the Chinese authorities and the coexistence of several type of ownership (state, collective, private, and foreign). As a result, competition may not be strong enough and non-performer banks may survive in the industry (Chen et al., 2018). We, therefore, expect that there is still room to further improve economic performances, even though the Chinese authorities in 2015 underwent a process of interest rate liberalization to increase competition in the sector. There is empirical evidence indeed that competition improves economic performance in that industry (Yao et al., 2008; Fang et al., 2019). We therefore formulate our first two hypotheses as follows:

Hypothesis 1 *There is still room for economic performance improvements in the Chinese banking industry.*

Hypothesis 2 *Economic performance went down in 2015 due to the interest rate liberalization but picked up after that.*

The stability of the banking industry is considered crucial by the Chinese authorities, as attested by their series of reforms initiated in 1978. These initiatives include the write-off of non-performing loans, the establishment of four asset management companies, the establishment of the China Banking Regulatory Commission, as well as the attraction of foreign strategic investors (Berger et al., 2009; Liang et al., 2013). While few pieces of research have investigated the level of risk/stability in the Chinese banking industry, we have some results available. Using conditional value at risk, the marginal expected shortfall, the systemic impact index as well as the vulnerability index, Huang et al. (2019) examine the systemic risk in the Chinese banking industry and show that the risk level decreased after the global financial crisis but started to rise after 2014. Similar to Huang et al. (2019), Jiang et al. (2019) found that after 2010 and up to 2013, risk in the Chinese banking industry decreased. A possible explanation for this finding is that the Chinese banking industry had entered the final stage of interest rate liberalization in 2004 implying more competition. According to the competition-instability hypothesis (Allen and Gale, 2004)., this may lead to worse stability performances. We formulate our next two hypotheses as such:

Hypothesis 3 *Stability performances are overall high in the Chinese banking industry.*

Hypothesis 4 *Stability performances deteriorate after 2003 due to the final stage of interest rate liberalization.*

A particularity of our approach is its ability to compute shadow prices of the risk indicators. Being the first to compute such prices for all risk indicators, we have no a priori assumptions about the values of these prices. However, instead of expecting all shadow prices to either decrease or increase over time, we expect discontinuous variations. This is in line with Dong et al. (2016) who, by estimating the shadow price of equity capital, show that there is a level of volatility over the period. Our hypothesis is stated as follows:

Hypothesis 5 *The risk indicator shadow prices are volatile.*

The relationship between risk and economic performance is mainly documented in the bad management hypothesis (Berger and DeYoung, 1997), moral hazard hypothesis (Jeitschko and Jeung, 2005) and bad luck hypothesis (Berger and DeYoung, 1997). These hypotheses come to divergent conclusions: a decline in economic performance leads to an increase in the level of bank risk; banks with lower levels of economic performance tend to undertake a higher level of risk; and an increase in the level of bank risk precedes a decline in bank economic performance.

Several empirical works have been conducted on the relationship between economic performances and risk (e.g. Fiordelisi et al., 2011; Saeed and Izzeldin, 2016; Luo et al., 2016; Tan and Anchor, 2017; Tan and Floros, 2018; Korona et al., 2019). These papers have considered different risk conditions, empirical contexts, and methods. While a significant connection is often found between risk and economic performance, these papers do not come to any definite conclusion. We therefore expect a significant relationship between stability and economic performance without imposing the sign of this connection:

Hypothesis 6 *Stability and economic performance are significantly related.*

Finally, we check whether the bank ownership status has an impact on our findings. China is a peculiar economy with a large number of state- or collectively-owned firms, burgeoning private firms, and a restricted policy in terms of foreign investment. As mentioned in the Introduction, several scholars have investigated the connection between performances and ownership in China (Wei et al., 2002; Wei, 2007; Greenaway et al., 2014). As concerns the banking industry, previous works have pointed out the important role of state-owned banks in terms of economic performance (Berger et al., 2009, Lin and Zhang, 2009) and risk (Jia, 2009; Dong et al., 2014b). It is natural, therefore, to quantify the impact of the ownership status, if any, on our findings:

Hypothesis 7 *Ownership has a direct impact on economic and stability performances.*

3 Empirical investigation

We start by explaining how stability and economic bank production processes are modelled. Next, we compute economic and stability performances and assess their relationship by introducing the notion of stability rent. Finally, we quantify the impact of the bank ownership status on our findings.

A particularity of our approach is that we measure economic and stability performances using a non-parametric approach. To do so, we first define criteria to characterise best performers. Next, we can obtain the degree of potential improvements for the economic and stability performances using simple ratios. The ratios are estimated through linear programming using peers as the benchmarks. The non-parametric feature comes from the fact that it is not required to define the bank production processes formally; as is the case for a parametric approach (e.g. regressions). This represents a major advantage of our methodology. A second advantage is that the non-parametric estimation does not require price data; which is difficult to get in practice at the bank level. On the contrary, they will be estimated by linear programming. The estimated prices have a direct interpretation in terms of shadow prices

3.1 Bank processes

We assume that banks gain profits from interest and non-interest activities using three production factors: staff number, total deposits, and fixed assets. Activities are proxied by the income they generate. By adopting this approach, our framework aims to capture the multifaceted nature of banking activities, encompassing both traditional lending functions and broader financial services. Interest income, for instance, reflects not only the volume of loans originated but also the interest rates applied, providing a holistic measure of the financial intermediation services rendered by banks. Similarly, non-interest income captures the diverse revenue streams arising from ancillary services, offering insights into the breadth of services provided by banking institutions. Similar settings have been considered by Sealey and Lindley (1977), Asmild and Matthew (2012), and Wang et al. (2014). Indeed, Economic performance is about how banks combine their production factors to generate their activities. In particular, we consider banks as cost-minimizers. This represents a very natural behaviour for firms, and cost minimization is, by definition, a necessary condition for profit maximization.

There are four different approaches regarding the inputs and outputs selection for banks. First, the production approach argues that the bank's main aim is to produce deposits, loans and other services (Benston, 1965). Second, the intermediation approach posits that banks use deposits, labour and capital to generate loans and investments (Sealey and Lindley, 1977). Next, the profit-oriented approach assumes that the financial intermediation engaged by banks is to have monetary effects. They, therefore, use expenses as inputs and incomes as outputs (Kamecka, 2010). Finally, the value-added approach attempts to categorize factors that substantially contribute to value-added as outputs and those that do not as inputs (Berger et al., 1987). Our modelling of the bank's production process, therefore, is coherent with the intermediation approach.

Moreover, it is important to keep in mind that banking firms are different from non-financial firms in the production process, as reflected by the fact that the capital, which is also the source of funding for the banking firms, plays a dual role as a banking input (using which to provide financial services to different individuals and firms) as well as a banking output (one of the main businesses engaged in by banks is to attract banking deposits). The dual role played by deposits for banking firms has been discussed in the banking literature (Holod and Lewis, 2011; Floros et al., 2020). In contrast, for manufacturing firms, capital is only regarded as one of the inputs in the production process (Taymaz and Saatci, 1997; Chen et al., 2021). Although there has been a debate regarding whether deposits should be treated as an input or an output, it is a common practice to model deposits as an input to generate loans as the outputs in the banking context (recent references include Bayeh et al., 2021; Gulati, 2020; Antunes et al., 2024; Fukuyama et al., 2024).

Next, financial stability is also related to how banks use their production factors but in another fashion. According to the World Bank Financial Development Report, stability in the financial system should be reflected by four criteria: efficient allocation of resources; efficient assessment and management of financial risks; efficient maintenance of employment level to the economy's natural rate; and elimination of price movement of real and financial assets.[1] It is interesting to note that resources (i.e. inputs) are considered when defining stability.

In practice, risk has to be chosen to measure stability. For example, the Denmark's National Bank suggests using capital adequacy, asset quality, profitability, earnings and expenditure, liquidity reserves, and market risk; the Czeck National Bank points

[1]Global Financial Development Report 2015/2016 available at www.worldbank.org/en/publication/gfdr/gfdr-2016/background/financial-stability.

out capital adequacy, asset quality, profitability, liquidity, interest rate risk and foreign exchange risk; and for the International Monetary Funds the indicators are capital adequacy, assets quality, earnings and profitability, liquidity and exposure to foreign exchange risk. These indicators have been used by scholars (e.g. Rahman et al., 2004; Manu et al., 2011; Fatima, 2014; Swamy, 2014).

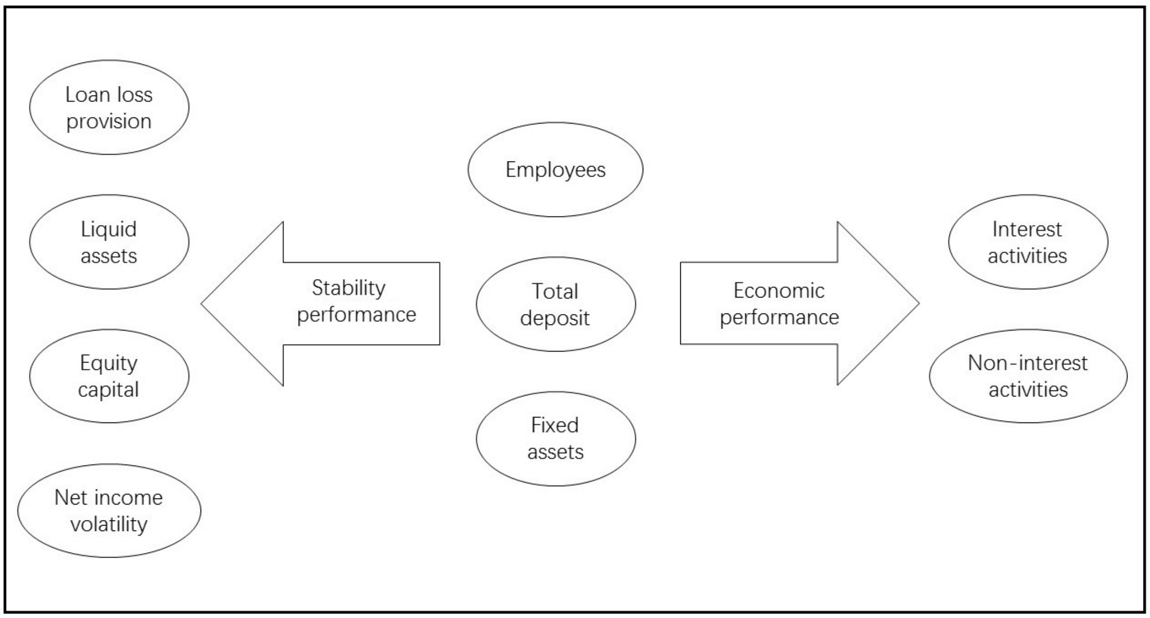
Surprisingly though, instead of a series of indicators, empirical research on financial stability has started with a single measure: the $Z-$scores (Laeven and Levine, 2009; Cihak and Hesse, 2010; Tan and Floros, 2013; Silva et al., 2016; IJtsma et al., 2017; Jin et al., 2017; Balasubramnian et al., 2019). This reflects the extent to which banks can absorb losses. The computation of the $Z-$scores mainly follows three steps: first, calculating the ratio of equity capital to total assets; second, adding return on assets (ROA); and third, dividing by the standard deviation of ROA. A practical reason for picking one indicator only is that econometric methods are generally designed to deal with one dependent variable, which, as we will show further on, does not apply to our case.

While the $Z-$scores are easy to deal with, several criticisms have been formed. For instance, Tabak et al., (2012) argue that $Z-$scores cannot accurately reflect the banks' stability position and propose a "stability inefficiency" measurement. Many studies have applied this stability inefficiency measurement in the context of the banking industry (Tan, 2018; Tan and Floros, 2018). Another issue with the $Z-$scores is that it is implicitly assumed that the returns on assets follow a normal distribution (which may be seen as a strong assumption). Also, the variation of the $Z-$scores may be important regarding the method used to calculate the empirical mean and the standard deviation of the returns on assets. Finally, they depend on the production function picked for the bank production process, which, when inappropriate, may lead to biased $Z-$scores.

We instead suggest using a large range of indicators to capture all the risk aspects for banks. We define financial stability as a bank's ability to use its production factors to minimize loan loss provision (credit risk) and net income volatility (solvency risk) and to maximize liquid assets (liquidity risk) and equity capital (capital risk). Putting this differently, we explicitly model a process to generate stability for banks. This also allows us to take the bank's relative size and structure into consideration. That is, stability is directly related to the bank profile and is not independent of their production process. This modelling makes clear that stability and economic performance are related through the production factors.

All in all, we have two processes in our context: one related to production, and the other is linked to stability. Each process can be used to measure a particular aspect of bank performance: economic and stability performances; and the relationship between both can be investigated when looking at the connection between the two processes. In particular, we are interested in the potential stability gains when banks look in their best light, i.e. when they produce at their best economic level. Figure 1 summarizes our modeling of the bank production process.

Figure 1: Bank processes



We take a nonparametric approach in what follows by explicitly recognizing that the two processes are unobserved. Indeed, we do not find convincing arguments to justify the choice of a particular functional form for the bank's production processes. Assuming a particular production function would directly impact the stability and economic performances. In the worst case, this may create a bias in the evaluation exercise. While how to estimate economic performances nonparametrically is standard knowledge, this is not the case for stability performances. To do so, we adapt the technique in the following. Finally, we point out that our nonparametric approach allows us to compute the (shadow) prices of the risk indicators.

We combine two main sources to obtain our data: FitchConnect (an alternative database providing comprehensive financial data for banks all over the world, following the closure of the original database Bankscope by the end of 2016), and the annual bank financial statements from their website.[2] We aim to select the largest number of banks and periods as possible. We end with 72 Chinese banks and a period from 2007 to 2017. In terms of ownership, we have six state-owned banks, nine joint-stock banks, and 57 city commercial banks.

While inputs and outputs are given as is in the datasets, this is not the case for prices. Capital price is measured by the ratio of non-interest expenses to fixed assets; funds price is calculated by the ratio of interest expenses to total deposits, and labour price is measured by the ratio of personal expenses to the number of employees. Three of our four risk indicators (loan loss provisions, equity capital and liquid assets) are directly retrieved from the datasets. Net income volatility is calculated in two steps: first, we calculate the average value of net income over the period (the average of the net income over the period is the sum up of the year-specific values divided by the number of years); second, we subtract the average value of net income from the net income value of a specific year.

We present descriptive statistics for the production factors and the activities in Table 1 and for the production factor prices in Table 2. While it may seem unusual for the unit to be RMB 10,000 in these Tables, it has been regarded as a convention in China when analyzing a company's financial statement (balance sheet and income statement).

Some important lessons can be drawn from these Tables. First, we observe that all inputs and outputs increase over the years, which bears out the increasing importance of the Chinese banking industry. The exceptions found in 2015 and 2016 could be attributed to the interest rate liberalization in 2015, which created important changes in the Chinese banking industry. Next, interest incomes are around ten times larger than non-interest income, while total deposits are around 70–80 times larger than fixed assets. Finally, we also notice that the price of funds is relatively much more stable than that of capital and labour; both are more volatile over the period.

The significant surge in fixed assets within the Chinese banking industry, outpacing the growth rate of deposits over the period from 2007 to 2017, raises intriguing questions about the underlying factors driving this trend. While the real estate bubble in China undoubtedly exerted substantial pressure on financial institutions to

[2] For example Industrial and Commercial Bank of China (http://www.icbc.com.cn/ICBCLtd/) and Bank of China (http://www.boc.cn/en/investor/ir3/)

Table 1: Descriptive statistics for the outputs and inputs

Year	Non-Interest Income (RMB 10,000)	Interest Income (RMB 10,000)	Fixed Assets (RMB 10,000)	Total Deposits (RMB 10,000)	Number of Employees (number)
2007	741,649	5,214,080	1,294,938	107,996,739	32,250
2008	833,358	5,734,285	1,513,725	119,995,469	32,876
2009	919,540	6,219,443	1,664,822	131,323,080	33,543
2010	1,021,562	6,629,985	1,853,014	144,570,527	34,395
2011	1,154,290	7,153,518	2,009,101	157,918,046	34,680
2012	1,302,718	8,737,005	2,304,663	176,465,231	36,848
2013	1,416,569	9,867,712	2,621,062	199,740,761	38,818
2014	1,622,182	11,359,315	2,898,863	214,151,520	39,529
2015	1,575,437	11,387,778	2,985,561	218,089,207	40,015
2016	1,152,678	10,131,033	3,060,356	226,598,971	39,936
2017	1,137,392	11,902,941	3,422,665	256,798,920	41,743

Table 2: Descriptive statistics for the input prices

Year	Capital Price	Funds Price	Labour Price
2007	1.49	0.06	46.96
2008	1.28	0.06	38.50
2009	1.83	0.05	42.87
2010	1.65	0.04	46.10
2011	1.47	0.04	47.32
2012	1.18	0.04	47.09
2013	1.05	0.04	56.18
2014	1.86	0.06	48.86
2015	1.99	0.10	48.85
2016	2.23	0.09	54.47
2017	1.52	0.09	51.09

expand their physical infrastructure to support lending activities and accommodate the burgeoning demand for credit, the situation is nuanced. Beyond the influence of the real estate market dynamics, Chinese banks may also have been spurred by a multitude of factors to over-invest in physical infrastructure. Rapid economic growth, coupled with ambitious government-led infrastructure projects, likely fueled a drive for expansion among banks, prompting investments in brick-and-mortar assets to bolster their operational capacities. Additionally, the regulatory landscape and internal strategic imperatives within Chinese banks could have played pivotal roles, as institutions may have perceived tangible assets as a means to enhance their competitive positioning and perceived stability. The confluence of these factors underscores the complex interplay between macroeconomic forces, regulatory frameworks, and institutional strategies shaping the trajectory of fixed asset accumulation within the Chinese banking sector.

The observed substantial drop in the price of capital, represented by fixed assets, and funds, reflected in deposits, within the Chinese banking industry around 2010–2014, bears the hallmarks of a complex interplay of global economic dynamics. The influence of rounds of quantitative easing implemented by the US Federal Reserve and other major central banks, such as the European Central Bank and the Bank of England, cannot be discounted. These expansive monetary policies aimed to stimulate economic growth and mitigate the effects of the global financial crisis, resulting in an excess supply of capital that cascaded into emerging markets, including China. Dedola, Georgiadis, Gräb, and Mehl (2020) highlight the spillover effects of such policies, which extended beyond domestic borders, shaping capital flows and liquidity conditions worldwide. In this context, the influx of capital into China could have exerted downward pressure on the prices of both fixed assets and deposits within the banking sector, as financial institutions competed to deploy surplus funds amid changing market dynamics. This underscores the intricate interconnectedness of global monetary policies and their ramifications on the pricing dynamics of capital and funding sources within emerging market economies like China.

Descriptive statistics for the risk indicators are provided in Table 3. At this point, we recall that banks aim at minimizing loan loss provision and net income volatility and maximizing liquid assets and equity capital.

Table 3 provides contrasted results in terms of financial stability. First, equity capital only increases between 2007–2017 implying a reduction of the capital risk.

Table 3: Descriptive statistics for the risk indicators

Year	Loan Loss Provision (10,000 CNY)	Equity Capital (10,000 CNY)	Liquid Assets (10,000 CNY)	Net income Volatility (10,000 CNY)
2007	624,063	9,786,974	47,778,189	-988,011
2008	656,892	10,947,961	43,793,249	-808,266
2009	682,887	11,750,195	30,769,884	-647,190
2010	614,976	12,722,146	32,679,570	-456,236
2011	642,330	13,764,562	34,052,003	-333,380
2012	689,868	16,078,728	36,797,029	56,173
2013	803,772	18,597,220	41,219,592	475,546
2014	1,167,539	22,009,261	44,064,487	708,930
2015	1,588,277	24,603,343	48,026,104	677,282
2016	1,688,012	25,959,482	53,660,392	506,771
2017	1,942,818	30,767,978	61,311,395	808,382

On the contrary, the continuous increase of loan loss provision implies more credit risk. Liquid assets decreased between 2007–2009 and increased between 2010–2017 resulting in a reduction of the liquidity risk. Finally, net income volatility increases over the period (except in 2015 and 2016) resulting in more insolvency risk. All in all, it is difficult to judge whether stability has improved in the Chinese banking industry at the aggregate level. This is the focus of Section 2.3. Before that, we examine economic performances in Section 2.2. The connection between both dimensions is the focus of Section 2.4.

3.2 Economic performances

We start our empirical investigation by evaluating the bank's economic performance. As explained earlier, we assume that banks seek to minimize their cost. Let us denote by $\mathbf{y}_t \in \mathbb{R}^Q_+$ the Q outputs measuring the bank activities at time t. The production factors are captured by $\mathbf{x}_t \in \mathbb{R}^P_+$ and their respective price by $\mathbf{w}_t \in \mathbb{R}^P_+$. Total cost at time t is given by $\mathbf{w}_t'\mathbf{x}_t$ ($\mathbf{w}_t'$ is the transpose vector of $\mathbf{w}_t$). We aim to quantify potential cost reduction. In particular, we want to quantify the banks' cost inefficiency degree.

We start by defining our cost evaluation criterion:

[**Criterion 1**]If bank i produces more outputs than bank j at time t,
bank i must use more costs than bank j at time t.

Criterion 1 is directly useful to define our notion of cost efficiency for every bank in our sample (denoted by S). In particular, if **Criterion 1** is met for bank j when comparing to all banks in the sample (i.e. for all $i \in S$), we declare bank j cost efficient. A natural index of cost (in)efficiency, suggested by Farrell (1957), is the ratio of minimal to actual costs. We obtain for each bank j at time t:

$$CE_t^j(\mathbf{w}_t^j, \mathbf{y}_t^j, \mathbf{x}_t^j) = \frac{C_t^j(\mathbf{w}_t^j, \mathbf{y}_t^j)}{\mathbf{w}_t^{j'} \mathbf{x}_t^j}. \tag{1}$$

When minimal cost, captured by $C_t^j(\mathbf{w}_t^j, \mathbf{y}_t^j)$, coincides with actual cost (i.e. $C_t^j(\mathbf{w}_t^j, \mathbf{y}_t^j) = \mathbf{w}_t^{'}\mathbf{x}_t$), we declare bank j cost efficient for period t. When it is not the case (i.e. $C_t^j(\mathbf{w}_t^j, \mathbf{y}_t^j) < \mathbf{w}_t^{'}\mathbf{x}_t$), bank j is seen as cost inefficient at time t (and we want to quantify potential cost reduction, see our discussion of (3) and (4)). Also, it is important to obtain a unit-free indicator for our empirical analysis. $CE_t^j(\mathbf{w}_t^j, \mathbf{y}_t^j, \mathbf{x}_t^j)$ is situated between 0 and 1 with 1 meaning that bank j generates outputs $\mathbf{y}_t^j$ efficiently, i.e. with minimal cost, at time t. Lower values reflect greater cost inefficiency and hence potential cost savings.

We can translate **Criterion 1** in simple linear programming. We evaluate cost efficiency for each bank j in our sample at time t as follows:

$$CE_t^j(\mathbf{w}_t^j, \mathbf{y}_t^j, \mathbf{x}_t^j) = \max_{C_t^j \in \mathbb{R}_+} \frac{C_t^j}{\mathbf{w}_t^{j'} \mathbf{x}_t^j}$$
$$\textbf{(C-1)} : C_t^j \leq \mathbf{w}_t^{j'} \mathbf{x}_t^i \text{ for all } i \in S : \mathbf{y}_t^i \geq \mathbf{y}_t^j. \tag{2}$$

In words, **(C-1)** picks minimal cost C_t^j when comparing the evaluated bank j to the dominating banks (i.e. those that produce more outputs than $\mathbf{y}_t^j$). Note that this kind of linear programming dates to Varian (1984). Also, it is nonparametric since no functional form has to be specified for the production function in (2). Instead, only available data are used.[3]

[3]At this point, it is fair to note that it is implicitly assumed that the inputs and outputs are

At this point, it is important to remark that the estimated cost efficiencies in (2) have to be interpreted in relative terms. Indeed, in (2) peers are used as the benchmarks (capured by for all $i \in S : \mathbf{y}_t^i \geq \mathbf{y}_t^j$). It turns out that when interpreting the cost (in)efficiencies, it is important to keep in mind what the peers used are. In the literature, it is common to use banks from the same country as the peers (e.g. Peng et al., 2017; Shamshur and Weill, 2019; George et al., 2023; Garcia and Gonzaga, 2024). The reason is simple to obtain a fair comparison peers have to share some common features such as the production process and the targeted market.

Boxplots per year are given in Figure 2 and results per bank are provided in Table 16, both in the Appendix. Note that we use the banks' acronyms for compactness (see Table 21 in Appendix). We start by disusing the results by showing the descriptive statistics of the cost efficiency scores provided in Table 4. A first observation is that there is room for cost reduction. Indeed, the overall cost efficiency score is 0.80 for the 2007–2017 period. This means that banks can reduce their cost by 20% on average. Hypothesis 1 is thus verified. Over this period, economic performances are getting better with a cost gain of almost 10% on average. Next, banks are becoming more homogeneous in terms of economic performance over time. This is indicated by a dwindling standard deviation (*std*).

These first two stylized facts are confirmed by more robust descriptive statistics which are the median and the interquartile range (*iqr*, defined as the difference between the third and first quartiles). Note that the medians are equal or very close to one for all years except 2007 and 2009 showing that the vast majority of banks are efficient. This is confirmed by the number of cost-efficient banks that moved from 41.67 % in 2007 to 58.33% in 2017. We could attribute part of this improvement to the completion of the process of interest rate liberalization in 2015 resulting in increasing competition in the bank industry. Hypothesis 2 is therefore verified.

While these findings are important, they are only based on descriptive statistics. To overcome this shortcoming, we use three statistical tests. Following the spirit of our empirical estimation method, we select nonparametric tests: the Wilcoxon rank test, the Kormogolov-Smirnov test, and an adapted version of Li's (1996) test by Simar and Zelenyuk (2006). We aim to verify that there is an improvement between the initial and final periods.[4] These tests do not require any distributional assumption which

freely disposable in (2). No convexity assumption is needed.

[4] H_0: 2007 and 2017 distributions are equal; H_1: 2017 distribution is greater than 2007 distribu-

Table 4: Descriptive statistics for the economic performances

year	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
average	0.76	0.81	0.78	0.79	0.80	0.79	0.78	0.82	0.78	0.83	0.84
std	0.28	0.26	0.27	0.28	0.27	0.27	0.28	0.26	0.29	0.25	0.24
median	0.89	0.99	0.91	1.00	1.00	0.98	0.99	1.00	1.00	1.00	1.00
iqr	0.49	0.42	0.46	0.39	0.45	0.42	0.50	0.38	0.48	0.33	0.24
% eff	41.67	48.61	43.06	51.39	52.78	48.61	50.00	52.78	54.17	59.72	58.33

is particularly attractive in our case. The $p-$values are displayed in Table 5. They are small enough and, in particular, smaller than 5% meaning that the distribution equality hypothesis can be rejected. This implies that all three tests confirm our initial observation of an economic performance improvement in the Chinese banking industry.[5]

Table 5: $p-$values for the economic performances

test	2017 > 2007
Wilcoxon rank test	0.041
Kormogolov-Smirnov test	0.024
Adapted Li test	0.011

When banks are not cost-efficient, we want to quantify potential cost reduction. Using our procedure enables us to find the cost-efficient input level and the minimal cost. The cost-efficient input levels will be particularly useful when defining our notion of stability rent in Section 2.4. They are given for bank j at time t:

$$\widehat{\mathbf{x}}_t^j = \left[1 - CE_t^j(\mathbf{w}_t^j, \mathbf{y}_t^j, \mathbf{x}_t^j)\right] \mathbf{x}_t^j. \tag{3}$$

$$C_t^j(\mathbf{w}_t^j, \mathbf{y}_t^j) = \mathbf{w}_t^{j'} \widehat{\mathbf{x}}_t^j = \mathbf{w}_t^{j'} \left[1 - CE_t^j(\mathbf{w}_t^j, \mathbf{y}_t^j, \mathbf{x}_t^j)\right] \mathbf{x}_t^j. \tag{4}$$

Building on the minimal cost, we can quantify the potential cost reduction by taking the difference between actual and minimal costs. Descriptive statistics for the potential cost reduction are displayed in Table 6 and potential cost reductions per bank in Tables 17 and 18 in Appendix.

tion.

[5]Note that the adapted version of Li's (1996) test by Simar and Zelenyuk (2006) is designed to test the difference between distributions. We can thus confirm that there is a difference between these two distributions using that test.

Table 6: Descriptive statistics for the cost reductions (10,000 CNY)

average	*2007*	*2008*	*2009*	*2010*	*2011*
	359,848	304,092	364,210	325,027	310,888
2012	*2013*	*2014*	*2015*	*2016*	*2017*
426,093	452,135	1,080,694	660,523	874,117	811,861
std	*2007*	*2008*	*2009*	*2010*	*2011*
	1,586,651	1,609,890	1,649,931	1,598,144	1,479,246
2012	*2013*	*2014*	*2015*	*2016*	*2017*
1,809,485	1,858,254	5,487,021	2,263,122	4,445,022	3,697,614
median	*2007*	*2008*	*2009*	*2010*	*2011*
	18,030	4,232	14,016	0	0
2012	*2013*	*2014*	*2015*	*2016*	*2017*
9,046	7,027	0	0	0	0
iqr	*2007*	*2008*	*2009*	*2010*	*2011*
	182,407	123,693	163,935	184,252	187,900
2012	*2013*	*2014*	*2015*	*2016*	*2017*
209,085	232,331	197,801	388,920	182,970	294,279

Table 6 shows that the average potential cost reduction increases over time. This seems to contrast our previous findings of more cost performers over time but it is easily explained by noticing that the bank inputs (and outputs) have increased importantly between 2007–2017 (see Table 1). A pick was found in 2014 with an average potential cost reduction of $1,080,694$ ten-thousands RMB. We attribute this finding to both non-performing loans and non-performing loan ratio improvements (China Banking Regulatory Commission). More specifically, by the end of 2014, the volumes of non-performing loans reached 842.6 billion RMB, i.e. an increase of 42.29% compared to 2013, while the non-performing loan ratio in 2014 was 1.25% with an increasing rate of 0.25 % point compared to the previous year. Next, the standard deviation increases over time showing us that there are more and more banks with large potential reductions. These banks have probably structural issues explaining why they cannot remove their cost-inefficient behaviour. Also, the median is zero in 2010–2011 and 2014–2017 and rather small (compared to the averages) for the other years. This once more shows that the majority of banks are efficient.

3.3 Stability performances

Our second and main focus is to evaluate Chinese banks' stability performances. Let us denote the indicators to capture risk for bank j at time t by the vector $\mathbf{z}_t^j \in \mathbb{R}_+^R$. Their respective prices are denoted as $\mathbf{p}_t^j \in \mathbb{R}_+^R$. These prices are generally unobserved. They are, however, of great interest for banks as demonstrated in what follows. We thus define the (unobserved) stability level of bank j at time t by $\mathbf{p}_t^{j'}\mathbf{z}_t^j$. We may see this as a linear aggregation of the risk indicators (where the weights are unknown) or as a total revenue (where the prices are unknown). Our measurement of stability considers how inputs are combined to generate stability. We define our stability criterion as:

[**Criterion 2**]If bank i uses more inputs than bank j at time t,
bank i must have larger risk indicators than bank j at time t.

Criterion 2 is directly useful to define our notion of stability efficiency for every bank in our sample. In particular, if **Criterion 2** is satisfied for bank j when compared to all banks in the sample (i.e. for all $i \in S$), we declare bank j stability efficient. In line with our cost efficiency measurement, we also use a Farrell-type ratio to capture the (in)efficient stability behaviour of the banks. It is given for bank j at time t by:

$$SE_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j, \mathbf{z}_t^j) = \frac{\mathbf{p}_t^{j'}\mathbf{z}_t^j}{S_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j)}. \tag{5}$$

$S_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j)$ represents the maximal (aggregated) stability level for bank j at time t. By construction, $S_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j) \geq \mathbf{p}_t^{j'}\mathbf{z}_t^j$ making the ratio smaller than unity. The smaller $SE_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j, \mathbf{z}_t^j)$ is, the larger the potential financial stability improvement is. We can translate **Criterion 2** in a simple programming. We evaluate stability efficiency for each bank j in our sample at time t:

$$\begin{aligned} SE_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j, \mathbf{z}_t^j) = &\max_{S_t^j \in \mathbb{R}_+, \mathbf{p}_t^j \in \mathbb{R}_+^R} \frac{\mathbf{p}_t^{j'}\mathbf{z}_t^j}{S_t^j} \\ &\textbf{(C-1)} : S_t^j \geq \mathbf{p}_t^{j'}\mathbf{z}_t^i \text{ for all } i \in S : \mathbf{x}_t^i \leq \mathbf{x}_t^j. \end{aligned} \tag{6}$$

Constraint **(C-1)** selects the maximal (aggregated) stability level when compared to banks using fewer production factors. Again, this program is nonparametric by construction since it does not need to specify a functional form for the stability process. This program is not directly useful as unknowns appear at both the numerator and the denominator of the objective function (neither prices nor maximal stability level are observed). In other words, the program is non-linear. Fortunately, we can make it linear by using a simple transformation as suggested by Charnes, Cooper, and Rhodes (1978) for nonparametric performance methods. In practice, we set the denominator equal to unity (here $S_t^j = 1$). We obtain the following:

$$
\begin{aligned}
SE_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j, \mathbf{z}_t^j) = & \max_{S_t^j \in \mathbb{R}_+, \mathbf{p}_t^j \in \mathbb{R}_+^R} \mathbf{p}_t^{j'} \mathbf{z}_t^j \\
& \textbf{(C-1)} : 1 \geq \mathbf{p}_t^{j'} \mathbf{z}_t^i \text{ for all } i \in S : \mathbf{x}_t^i \leq \mathbf{x}_t^j, \\
& \textbf{(C-2)} : S_t^j = 1.
\end{aligned} \tag{7}
$$

Constraint **(C-1)** is similar to the one of (6) while **(C-2)** captures our normalization procedure. At this point, we insist that the prices of the risk indicators are not observed before evaluating the stability performances of banks. They will be computed using (7). The obtained prices are interpreted as shadow prices. They are not estimated values of the unobserved prices of the risk indicators, they are interpreted, rather, in relative terms: they express the value of one commodity relative to that of other commodities (here the value of a specific stability indicator with respect to aggregated stability level). It also implies that the normalization constraint in **(C-2)** has no direct impact on the shadow prices, and more importantly, it does not mean losing the informational content of the corresponding (relative) shadow prices.

As for the economic performance results, we present descriptive statistics in Table 7 while boxplots per year are given in Figure 3 and results per bank are shown in Table 19 (in Appendix).

Table 7: Descriptive statistics for the stability performances

year	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
average	0.90	0.88	0.90	0.93	0.92	0.92	0.94	0.94	0.96	0.93	0.92
std	0.18	0.20	0.19	0.16	0.16	0.16	0.14	0.14	0.12	0.16	0.16
median	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
iqr	0.09	0.18	0.17	0.00	0.00	0.10	0.00	0.00	0.00	0.02	0.07
% eff	68.06	62.50	70.83	75.00	76.39	75.00	77.78	81.94	81.94	75.00	72.22

The picture is rather different than the one observed for the economic performances: the average is high (around 0.90) on the entire period, the median is always 1, the number of stability efficient banks is around 70%–80%, and homogeneity between banks is increasing over time. Hypothesis 3 is verified. We may see these results as the wish of the Chinese banking authority and regulations to have a very stable banking industry. Indeed, as said in the Introduction, the banking industry is crucial for China's economic development. Any issues with the banking industry will have huge negative consequences for the Chinese economy. This is also confirmed by noticing that stability performances are higher than economic performances. Finally, Hypothesis 4 is not verified. We do not find a significant impact of the final stage of the interest rate liberalization of the stability performances.

Having said this, the descriptive statistics also reveal that there is still potential stability improvement (around 10%) and that financial stability has been stable over the years. We continue by presenting $p-$values of the three nonparametric tests in Table 8. We cannot reject the null hypothesis for the three tests revealing that financial stability was stable from 2007–2017.

Table 8: $p-$values for stability performances

test	$2017 \neq 2007$
Wilcoxon rank test	0.548
Kormogolov-Smirnov test	0.478
Adapted Li test	0.686

Next, we also verify whether stability performance distribution is larger than economic performance distribution. For that purpose, we rely on Simar and Zelenyuk's adapted Li test. We give the $p-$values in Table 9, which confirms that stability and economic performance distributions are different.

Finally, we give the (average) shadow prices of the risk indicators in Table 10. We recall that these prices have to be interpreted in relative rather than absolute terms. Several lessons directly related to our previous observations based on Table 3 can be drawn. First, the cheapest stability indicator is liquid assets while the more expensive one is net income volatility. This is probably why net income volatility keeps increasing over the time period (resulting in more solvency risk). This also explains why liquid risk decreases over time (i.e. liquid assets increase). Interestingly, the shadow prices for risk indicators closely follow its change. A similar remark holds for loan loss provision: the prices decreased between 2007 and 2009, increased

Table 9: $p-$values for stability v.s. economic performances

year	$p-$value
2007	0.000
2008	0.009
2009	0.001
2010	0.005
2011	0.015
2012	0.015
2013	0.003
2014	0.009
2015	0.000
2016	0.009
2017	0.005
all	0.004

significantly in 2010, to decreased again in 2016. In 2017, the prices for that risk indicator increased again. This path closely follows the one for loan loss provision. Finally, the price of net income volatility is rather volatile for the period but it is always the most expensive risk indicator. All these findings support our Hypothesis 5. All in all, we see that liquidity risk is the easiest to reduce; it is reasonable to believe that credit and capital risks can be reduced in the future; but doubt can be raised concerning solvency risk. These findings are confirmed by the $p-$values of the statistical tests provided in Table 11.

Table 10: Average shadow prices for the risk indicators

	Loan loss provision	Equity capital	Liquid assets	Net income volatility
2007	5137.24	1055.41	17.75	992.81
2008	4740.61	869.76	15.74	982.85
2009	4648.49	546.34	23.49	1047.30
2010	3844.66	432.61	33.68	896.33
2011	3514.38	597.50	34.40	914.09
2012	4085.82	434.66	34.77	1109.43
2013	2423.84	446.78	14.11	1219.42
2014	1166.66	442.75	24.34	5196.42
2015	8908.78	472.96	44.75	6242.63
2016	2567.97	393.41	17.78	6687.26
2017	704.58	261.85	23.76	2544.59

Table 11: $p-$values for the shadow prices

Variable	Alternative hypothesis	Wilcoxon rank test	Kormogolov-Smirnov test	Adapted adapted Li test
Loan Loss Provision	2017 < 2007	0.000	0.000	0.000
Equity Capital	2017 < 2007	0.000	0.000	0.000
Liquid Assets	2017 > 2007	0.081	0.072	0.055
Net Income Volatility	2017 > 2007	0.000	0.000	0.000

3.4 Stability rents

In this Section, we propose a new way of investigating the connection between economic and stability performances. We check what happens to stability performances if banks remove their cost-inefficient behaviour. In other words, we evaluate stability performances using the cost-efficient production factor levels. If stability performances increase, they constitute a prime motivation to improve economic performance. This aspect may so far have been neglected by the Chinese banking authority. To compute such measurement, it suffices to adapt the linear programming to compute stability performances in (7). The only step is to replace the actual production factor levels with the optimal inputs (denoted as $\widehat{\mathbf{x}}$, see (3)). We obtain the following new linear programming for bank j at time t:

$$\begin{aligned} \widehat{SE}_t^j(\widehat{\mathbf{p}}_t^j, \widehat{\mathbf{x}}_t^j, \mathbf{z}_t^j) = & \max_{S_t^j \in \mathbb{R}_+, \widehat{\mathbf{p}}_t^j \in \mathbb{R}_+^R} \widehat{\mathbf{p}}_t^{j'} \mathbf{z}_t^j \\ & \textbf{(C-1)} : 1 \geq \widehat{\mathbf{p}}_t^{j'} \mathbf{z}_t^i \text{ for all } i \in S : \widehat{\mathbf{x}}_t^i \leq \widehat{\mathbf{x}}_t^j, \\ & \textbf{(C-2)} : \widehat{S}_t^j = 1. \end{aligned} \tag{8}$$

$\widehat{SE}_t^j(\widehat{\mathbf{p}}_t^j, \widehat{\mathbf{x}}_t^j, \mathbf{z}_t^j)$ has to be interpreted as $SE_t^j(p_t^j, \mathbf{x}_t^j, \mathbf{z}_t^j)$, but when production factors are at their cost-efficient level. It turns out that $\widehat{SE}_t^j(\widehat{\mathbf{p}}_t^j, \widehat{\mathbf{x}}_t^j, \mathbf{z}_t^j)$ is bounded from above by one. When it is equal to unity it reflects stability-efficient behaviour, when it is not the case it shows that stability can be improved. Next, a natural question is whether there is a natural ranking between $\widehat{SE}_t^j(\widehat{\mathbf{p}}_t^j, \widehat{\mathbf{x}}_t^j, \mathbf{z}_t^j)$ and $SE_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j, \mathbf{z}_t^j)$. The answer is no: when $\widehat{SE}_t^j(\widehat{\mathbf{p}}_t^j, \widehat{\mathbf{x}}_t^j, \mathbf{z}_t^j) > SE_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j, \mathbf{z}_t^j)$, this shows that improving the economic performances give a stability rent. In other words, there is a positive relationship between economic and stability performances. A contrario, when $\widehat{SE}_t^j(\widehat{\mathbf{p}}_t^j, \widehat{\mathbf{x}}_t^j, \mathbf{z}_t^j) < SE_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j, \mathbf{z}_t^j)$, it reveals that improving the cost efficiency behaviour deteriorates the stability performances. That is, there is a negative connection between economic and stability performances. In our case, we hope that the former will be observed. To capture the potential stability rent resulting when adopting a cost-efficient level for the production factors, we introduce the notion of stability rent. It is given for bank j at time t as follows:

$$SR_t^j(\mathbf{p}_t^j, \widehat{\mathbf{p}}_t^j, \mathbf{x}_t^j, \widehat{\mathbf{x}}_t^j, \mathbf{z}_t^j) = \frac{\widehat{SE}_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j, \mathbf{z}_t^j)}{SE_t^j(\widehat{\mathbf{p}}_t^j, \widehat{\mathbf{x}}_t^j, \mathbf{z}_t^j)}. \quad (9)$$

When there is indeed a positive relationship, $SR_t^j(\mathbf{p}_t^j, \widehat{\mathbf{p}}_t^j, \mathbf{x}_t^j, \widehat{\mathbf{x}}_t^j, \mathbf{z}_t^j)$ is larger than one. On the contrary, a value below one implies a negative connection. Finally, we point out that our notion of stability rent allows us to provide the following useful decomposition of stability efficiency:

$$\widehat{SE}_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j, \mathbf{z}_t^j) = SE_t^j(\mathbf{p}_t^j, \mathbf{x}_t^j, \mathbf{z}_t^j) \times SR_t^j(\mathbf{p}_t^j, \widehat{\mathbf{p}}_t^j, \mathbf{x}_t^j, \widehat{\mathbf{x}}_t^j, \mathbf{z}_t^j). \quad (10)$$

In words, stability efficiency when banks use the cost-efficient levels of inputs is decomposed into stability efficiency when banks do not use the optimal input levels times the effect of using optimal inputs. We give the descriptive statistics for the stability rents in Table 12 while boxplots per year are given in Figure 3 and the results per bank are given in Table 20 (in the Appendix).

Table 12: Descriptive statistics for the stability rents

year	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
average	1.11	1.08	1.09	1.10	1.11	1.08	1.05	1.04	1.03	1.04	1.05
std	0.28	0.33	0.35	0.50	0.51	0.39	0.21	0.21	0.15	0.20	0.16
median	1.01	1.00	1.01	1.00	1.01	1.01	1.01	1.00	1.00	1.00	1.00
iqr	0.07	0.06	0.07	0.07	0.06	0.07	0.07	0.06	0.06	0.06	0.06
% rent	59.72	45.83	50.00	44.44	55.56	52.78	50.00	44.44	47.22	47.22	48.61

These results support the positive relationship between economic and stability performances, i.e. Hypothesis 6 is true. On average, stability rents are larger than one over 2007–2017 period, which shows that a reduction of the cost-inefficient behaviour gives banks stability rent. The medians are close to one showing that the stability rents are important for some banks (as confirmed by the bank-level results in Table 20). Next, we see that the stability rents are decreasing over time. This is not surprising since the economic performances have also improved over time. which implies that the stability rent is getting less and less important, yet more than one in 2007. This is also confirmed by the number of banks with a positive rent: 60% in 2007 and a bit less than 50% in 2017. We verify the reduction of the stability rents by using our three nonparametric tests. Results are given in Table 13. The $p-$values confirm our findings (at 10%).

Table 13: Stability gains: $p-$values

test	*2007 > 2017*
Wilcoxon rank test	0.081
Kormogolov-Smirnov test	0.071
Adapted Li test	0.041

3.5 Ownership

Previous research has demonstrated that ownership has an important influence in China (Gunasekarage et al., 2007; Huang et al., 2011; Hu et al., 2018). Besides banking, this is true of many other industries such as manufacturing (Wei et al., 2002; Jin et al., 2018; He and Walheer, 2019), tourism (Qu et al., 2005; Mao and Yang, 2016; Walheer et al., 2019), and energy (Yang et al., 2017; Feng et al., 2018). In the context of the banking industry, we can mention, for example, Berger et al. (2009), Jia (2009), Lin and Zhang (2009), and Dong et al. (2014b). In this last Section, we verify whether ownership impacts our empirical analysis.

At this point, we wish to highlight that instead of assuming that different ownership types have access to different technologies (Chen et al., 2019; Lee and Huang, 2019), we consider ownership status as an external variable to categorize banks. While the technology heterogeneity is attractive, it is supported by strong economic arguments. Rather, we believe that there is a common bank process and that deviation from the best performances results in inefficiencies. Note that when technology heterogeneity is assumed there are still inefficiencies (to be precise, a part attributed to inefficiencies is instead labelled as a technology gap).

We start our investigation by presenting the averages of the economic and stability performances and the stability rents per ownership status in Table 14. First, we see that state-owned banks have the highest economic performance and city commercial banks have the lowest level of economic performance. This result is in line with the findings of Jiang et al. (2009) and Dong et al. (2014). Next, we find a slightly different ranking for the stability performances: state-owned banks are still leading, but the second place goes to city commercial banks. This result could be possibly explained by the perspective that state-owned commercial banks and city commercial banks are strongly supported by central and city-level governments (Fu and Heffernan, 2009; Tan, 2016), and also because a lower level of competition induces them to engage in a more prudential operation (Tan and Anchor, 2017). Finally, stability rents are larger than one for all ownership types, but the greatest for joint-owned banks. There are almost no stability rents for state-owned banks.

Table 14: Economic and stability performances per ownership status

average	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Economic performances											
State	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	1.00	0.87	0.91
Joint	0.83	0.83	0.79	0.85	0.86	0.76	0.81	0.87	0.80	0.78	0.85
City	0.73	0.78	0.75	0.76	0.77	0.77	0.75	0.81	0.75	0.83	0.83
Stability performances											
State	0.89	0.90	1.00	1.00	0.98	0.98	0.99	1.00	1.00	1.00	1.00
Joint	0.89	0.74	0.83	0.91	0.88	0.86	0.93	0.93	1.00	0.90	0.93
City	0.91	0.90	0.90	0.93	0.93	0.92	0.93	0.94	0.95	0.93	0.91
Stability rents											
State	0.98	1.00	1.01	0.98	1.00	1.01	1.02	1.00	1.01	1.01	1.00
Joint	1.17	1.26	1.24	1.41	1.43	1.32	1.00	0.99	0.99	1.15	1.06
City	1.11	1.06	1.08	1.06	1.07	1.04	1.06	1.05	1.03	1.03	1.05
percentage	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Economic performances											
State	100	100	100	100	100	100	100	83.33	100	83.33	83.33
Joint	70	70	60	80	80	40	50	60	40	50	70
City	30	30	30	40	40	40	40	40	40	50	60
Stability performances											
State	66.67	66.67	100	100	83.33	83.33	83.33	100	100	100	100
Joint	70	40	60	80	70	70	80	90	90	70	80
City	80	70	80	70	80	80	90	80	90	90	70
Stability rents											
State	66.67	50	33.33	83.33	66.67	33.33	33.33	50	33.33	66.67	83.33
Joint	20	50	80	50	40	50	50	60	50	30	50
City	50	60	70	50	30	40	70	50	70	70	50

Table 15 shows the average shadow prices for the risk indicators across different bank ownership types. Overall, our previous conclusions when not discriminating against banks to their ownership status (Table 10) hold. Additional findings are found when comparing ownership types. First, shadow prices of all risk factors except loan loss provision are smaller for state-owned banks. This may be directly related to their best performances observed previously. Also, city commercial banks have significantly higher levels of shadow prices for equity capital, loan loss provision and net income volatility. These findings are confirmed when using statistical tests. They are not given for compactness. Finally, joint-owned banks present the largest (shadow) prices for liquidity assets.

All in all, this last Section demonstrates that the bank ownership status indeed has a direct impact on our results (Hypothesis 7 is verified), which should be taken into account when designing policy implementations as discussed in the next Section.

4 Summary and policy recommendations

The stability of the banking system is critical for China as it plays a crucial role in boosting its economic development. Our empirical analysis consists in evaluating stability and economic performances, and their relationship, for 72 banks during the period 2007–2017. Our findings can be summed up in the following five main points:

- Stability performances are better than economic performances even though the latter show greater improvement over time. There is a potential average cost reduction of 10% over the period, while the vast majority of the banks are stability efficient. While credit and solvency risks have risen, we observe a reduction in capital and liquidity risks.

- The interest rate liberalization reforms have a signification impact on the economic performances, while no significant impacts have been found for the stability performances.

- The (shadow) prices of our risk indicators reveal that liquidity risk is the cheapest and solvency risk the most expensive one. Although credit and capital risks show non-constant paths, we think it is reasonable to predict potential reduction for these two dimensions.

- Stability and economic performances are positively related. We find strong evidence that Chinese policy-makers should take care of non-performing inputs.

Table 15: Average shadow prices for the risk indicators per ownership status

	Loan loss provision	Equity capital	Liquid assets	Net income volatility
year	*State*			
2007	865.48	6.33	0.50	52.78
2008	2596.44	6.57	5.79	224.31
2009	1410.82	7.39	7.09	109.34
2010	1366.69	3.79	8.35	116.23
2011	844.11	9.04	5.98	108.81
2012	590.88	13.14	0.49	343.85
2013	460.89	9.82	2.01	391.74
2014	490.35	21.52	4.23	783.82
2015	409.09	21.76	4.95	712.87
2016	206.54	8.69	3.65	591.57
2017	490.24	28.83	6.11	992.26
year	*Joint*			
2007	254.54	125.64	23.15	178.29
2008	218.09	107.80	43.50	38.22
2009	897.52	92.94	41.50	279.07
2010	1796.62	41.13	59.15	837.02
2011	1333.87	188.02	39.85	873.10
2012	1223.53	57.83	65.49	406.77
2013	208.79	66.85	20.12	1134.52
2014	329.46	112.18	33.70	2155.62
2015	406.22	223.83	21.10	1334.63
2016	230.02	65.42	19.14	419.90
2017	473.73	69.52	24.36	1132.84
year	*Private*			
2007	8430.58	1328.28	17.36	1549.54
2008	4164.08	990.39	14.56	1906.17
2009	8394.33	574.85	22.83	1432.31
2010	6637.86	472.34	39.02	1567.53
2011	3045.37	628.65	29.78	1452.71
2012	6732.01	522.20	45.56	929.97
2013	3297.71	506.26	15.90	821.81
2014	1402.07	476.50	19.99	2466.41
2015	6694.98	533.76	17.18	3929.31
2016	2583.04	386.68	18.97	2813.95
2017	497.36	294.80	21.10	1562.92

There exist stability rents when banks reduce their cost (without impacting their activities). While the stability rents have decreased over time, there is still room for new cost reductions leading to more stability.

- Bank ownership has a direct impact on our findings. State-owned banks are the uncontested leaders, while joint-owned banks are left behind. There are no stability rents for state-owned banks, while they are quite large for joint-owned banks and more moderate for commercial banks.

Our results have rich policy implications. First, while our empirical analysis has demonstrated that Chinese banks are using their inputs increasingly better over time, important cost savings are still possible. This seems to be directly related to the ownership status. Both internal and external solutions can be used. On the one hand, internal solutions include learning from the best performers and reviewing salary payments to management staff including the bank chairman and director (Tan, 2019). On the other hand, external solutions directly point out the role of the Chinese government and the regulatory authority. We may think that enhancing research and development will result in more innovation, and raise competition in the banking industry, the latter of which has proved to have a direct impact on the efficiency behaviour of the banks, as our empirical exercise shows.

Next, while Chinese banks perform quite well in terms of stability, the stability level remains fairly rather stable over the 2007–2017 period. The role of the Chinese government and the regulatory authority, therefore, is to further improve stability. Particular attention should be given to the credit and solvency risks. The (shadow) prices of the risk indicator can be used to better design the policy implementations: it is, theoretically, easier to expand a cheaper risk indicator.

Finally, our empirical analysis reveals that these two objectives, to some extent, can be achieved simultaneously. Indeed, we find that economic and stability performances are, generally, positively related. That is, banks can benefit from stability rents when using their production factors more cost-efficiently. This forms a primer reason to design policies taking both economic and stability performances into account.

5 Conclusion

The role of the banking industry in boosting economic development is crucial in China. In this paper, we investigate the stability and economic performances and their relationship with the Chinese banking system over the 2007–2017 period. Stability is recognized as an important target by the Chinese government and the banking regulatory authority, while economic performances have been studied by many scholars using different dimensions.

Our empirical exercise presents several unique features. First, we measure both stability and economic performance nonparametrically. Second, we compute the shadow prices of the risk indicators. While unobserved, their value represents valuable information for Chinese policymakers and banking regulators. Also, we consider a comprehensive aspect of the risk conditions in the banking industry. In particular, we include four different types of risk: credit risk, liquidity, capital, and insolvency risks. Next, we question the relationship between economic and stability performances by verifying the potential existence of stability rents. These rents form a prime reason for the banking authority to consider economic performances; which may not have been considered seriously enough until now. Finally, we check whether the bank ownership status has an impact on our findings.

Our findings indicate that Chinese banks have better results in terms of stability than economic performances in 2007–2017, but economic performances have improved over time. The (shadow) prices of the risk indicators show us that liquid assets are the cheapest risk factor while solvency risk is the most expensive. Next, we demonstrate the existence of stability rents revealing a positive connection between economic and stability performances. Also, bank ownership has a direct impact on performance: state-owned banks are leading in both dimensions. Finally, economic performances have been impacted by the interest rate liberalization reform, but this is not the case for the stability performances.

We end our paper by providing some ideas for further research. Although we have provided insights regarding the roles of ownership and interest rate liberalization reforms in the relationship between stability and economic performance, more can be done to better understand the determinants of economic performance and stability performance. Important factors would certainly include China's GDP growth, China's deficit as a fraction of GDP as well as the growth rate of the FED's balance sheet.

Another potential extension is to define indexes to better capture the performance change over time (for cost-based index, see e.g. Maniadakis Thanassoulis, 2004; Walhee, 2018). There is no index about stability performance for the moment in the literature.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Appendix

Figure 2: Cost efficiency boxplots

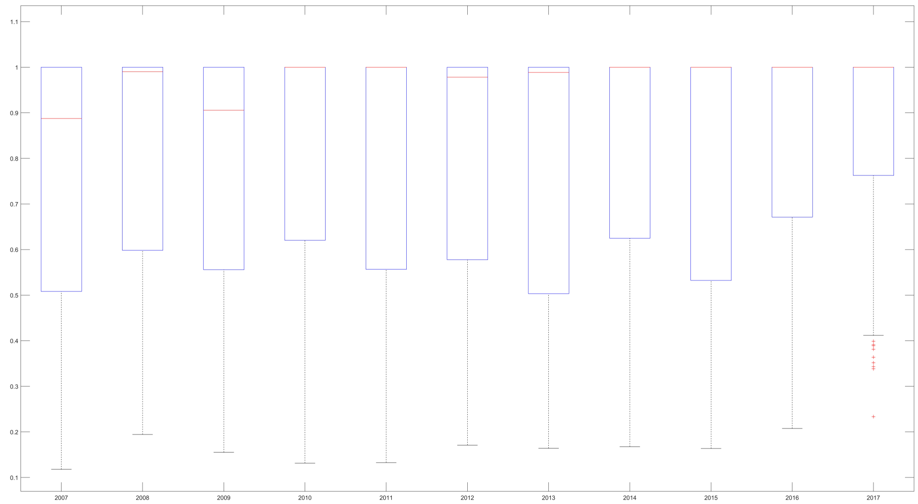

Figure 3: Stability efficiency boxplots

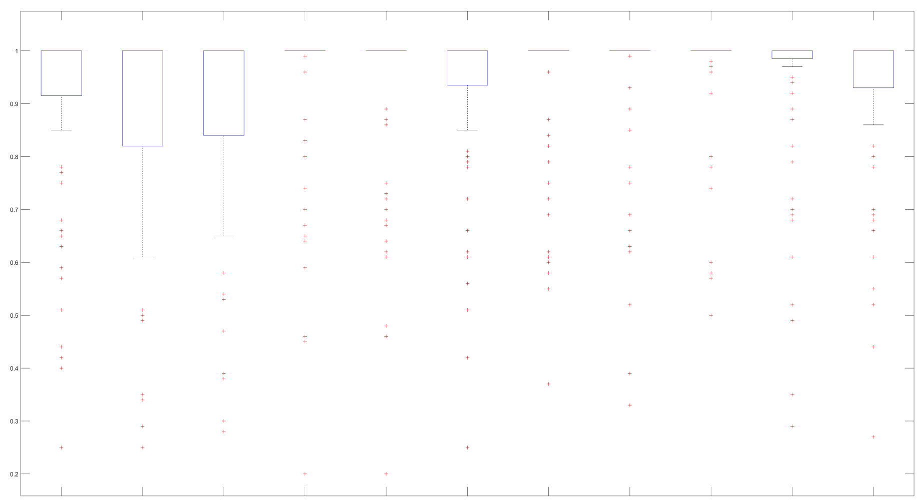

Figure 4: Stability rent boxplots

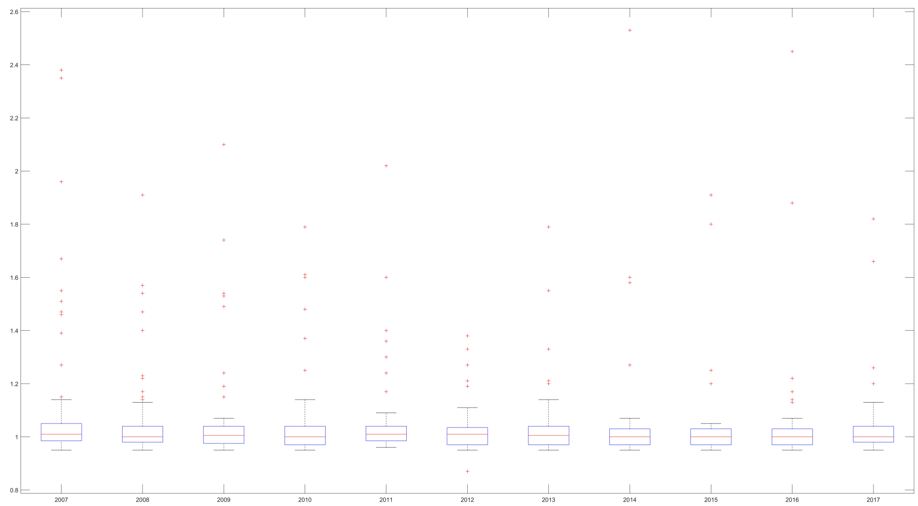

Table 16: Economic performances per bank and year

Bank	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	**Av.**
ICB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CCB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
ACL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.17	1.00	0.22	0.47	**0.81**
BCL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CCL	0.30	0.27	0.28	0.29	0.32	0.23	0.27	0.21	0.22	0.21	0.23	**0.26**
PSB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CMB	1.00	1.00	0.74	1.00	1.00	0.71	0.76	1.00	0.69	1.00	1.00	**0.90**
BCC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
SPD	0.70	1.00	1.00	1.00	1.00	0.88	0.92	0.86	0.86	0.92	1.00	**0.92**
CBC	0.83	0.90	0.72	0.69	0.72	0.83	0.84	0.81	1.00	1.00	0.90	**0.84**
CMB2	1.00	0.76	1.00	1.00	1.00	0.92	0.96	0.88	0.87	1.00	1.00	**0.95**
IBC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CFH	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.68	0.79	**0.95**
CEB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
FFH	0.47	0.47	0.48	0.44	0.46	0.45	0.50	0.61	0.62	0.73	0.77	**0.55**
CFH2	0.41	0.46	0.47	0.46	0.45	0.42	0.47	0.46	0.16	0.48	0.40	**0.42**

CHA	0.96	1.00	0.98	1.00	1.00	1.00	1.00	1.00	0.18	1.00	1.00	**0.92**
HXB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
SFH	0.70	0.84	0.73	1.00	1.00	1.00	0.66	0.72	0.28	0.91	0.94	**0.80**
BOB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CEC	0.27	0.26	0.27	0.26	0.26	0.28	0.16	1.00	1.00	0.31	0.35	**0.40**
BHK	0.43	0.50	0.52	0.52	0.50	0.53	0.54	0.55	0.39	0.52	0.53	**0.50**
CZB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BOJ	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BOS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
HSC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
HSB	0.89	1.00	1.00	0.71	0.70	1.00	1.00	1.00	1.00	1.00	1.00	**0.94**
BON	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BOA	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CRC	0.84	0.84	0.75	0.73	0.76	1.00	1.00	1.00	1.00	0.97	1.00	**0.90**
HBC	0.83	0.98	0.98	0.95	0.99	1.00	1.00	1.00	1.00	1.00	0.92	**0.97**
GSC	0.22	0.28	0.24	0.29	0.26	0.25	0.21	0.33	0.37	0.51	0.50	**0.32**
FEH	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.77	0.82	0.70	**0.94**
BOJ2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
HB	0.88	1.00	0.99	0.97	0.99	0.95	0.98	1.00	1.00	1.00	1.00	**0.98**
BOH	0.83	0.94	0.91	0.86	1.00	0.96	1.00	1.00	1.00	1.00	0.78	**0.93**
BEA	0.44	0.87	0.92	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00	**0.91**
GRC	0.74	0.76	0.83	0.76	0.83	0.79	0.84	0.98	1.00	1.00	1.00	**0.87**
CMS	0.12	0.53	0.16	0.56	0.54	0.58	0.51	0.62	1.00	1.00	1.00	**0.60**
MFH	0.51	1.00	1.00	1.00	1.00	1.00	0.37	0.63	0.38	0.42	0.39	**0.70**
ZBC	0.31	1.00	0.84	1.00	1.00	1.00	1.00	1.00	0.21	1.00	1.00	**0.85**
CIC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
FFH2	0.51	0.53	0.49	0.15	0.50	0.58	0.34	0.36	0.28	0.38	0.41	**0.41**
HKE	0.98	1.00	0.90	0.92	0.94	0.88	0.93	0.85	0.82	0.81	0.76	**0.89**
BOZ	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.68	0.78	1.00	**0.95**
TCF	0.28	0.38	0.21	0.20	0.24	0.24	0.28	0.33	0.29	0.33	0.34	**0.28**
BOC	0.94	0.98	0.90	0.91	0.89	0.94	0.92	1.00	0.40	1.00	1.00	**0.90**
SFH2	0.40	0.38	0.31	0.30	0.28	0.39	0.21	0.32	0.36	0.34	0.34	**0.33**
ESC	0.37	0.41	0.39	0.47	0.52	0.62	0.75	0.83	0.74	1.00	1.00	**0.64**
TFH	0.47	0.47	0.40	0.42	0.50	0.42	0.27	0.88	0.43	0.40	0.39	**0.46**

SFH3	0.19	0.79	0.82	0.76	0.72	0.38	0.42	0.19	0.28	0.38	0.44	**0.49**
CSC	0.31	0.31	0.30	0.31	0.29	0.77	0.95	1.00	1.00	1.00	1.00	**0.66**
ATC	1.00	1.00	1.00	1.00	1.00	0.39	0.45	0.92	1.00	1.00	1.00	**0.89**
BOQ	0.86	0.70	0.68	0.69	0.72	0.66	0.82	0.79	0.56	0.66	0.36	**0.68**
CRC2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
DSF	0.19	0.19	0.19	0.13	0.13	0.17	0.18	0.24	0.21	0.30	0.38	**0.21**
DSB	0.23	0.19	0.24	0.23	0.22	0.27	0.26	0.33	0.47	0.50	0.60	**0.32**
SHK	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	**0.99**
WSC	0.85	0.85	0.84	0.96	0.87	0.81	0.76	0.59	1.00	1.00	1.00	**0.87**
SSC	0.74	0.69	0.67	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.82	**0.90**
WRC	0.89	0.87	0.84	0.80	0.77	0.78	0.74	0.96	0.80	1.00	1.00	**0.86**
JWR	0.91	0.89	0.77	0.72	0.77	0.47	0.48	0.84	1.00	1.00	1.00	**0.80**
FEI	0.54	0.48	0.46	0.50	0.51	0.49	0.41	0.62	0.86	0.83	0.82	**0.59**
KTB	0.91	0.75	0.77	1.00	1.00	1.00	0.47	0.55	0.66	0.77	1.00	**0.81**
JSF	0.70	0.63	0.63	0.60	0.63	0.68	0.51	0.57	0.40	0.34	0.49	**0.56**
OCL	1.00	1.00	1.00	1.00	0.53	0.33	1.00	1.00	0.69	1.00	1.00	**0.87**
WFH	0.62	0.56	0.53	0.64	0.57	0.63	0.68	0.79	0.70	0.83	0.76	**0.67**
MSC	0.81	0.76	0.75	0.77	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**0.92**
ACS	1.00	1.00	0.58	1.00	1.00	0.62	1.00	0.77	0.68	0.58	0.95	**0.83**
BOK	0.61	0.49	0.31	0.32	0.48	0.47	0.46	0.49	0.51	0.66	0.84	**0.51**
CFS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CBF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**

Table 17: Cost reductions per bank 2007–2012

Bank	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
ICB	0	0	0	0	0	0
CCB	0	0	0	0	0	0
ACL	0	0	0	0	0	0
BCL	0	0	0	0	0	0
CCL	13,368,794	13,699,365	13,795,015	13,552,090	12,508,470	15,002,366
PSB	0	0	0	0	0	0
CMB	0	0	2,239,906	0	0	3,542,072
BCC	0	0	0	0	0	0

SPD	2,219,314	0	0	0	0	1,627,994
CBC	823,825	536,802	1,825,873	2,183,789	2,179,295	1,963,991
CMB2	0	1,744,307	0	0	0	1,151,269
IBC	0	0	0	0	0	0
CFH	0	0	0	0	0	0
CEB	0	0	0	0	0	0
FFH	251,803	327,651	390,370	508,994	538,446	608,447
CFH2	269,309	295,695	327,335	379,056	482,960	574,111
CHA	107,628	0	60,546	0	0	0
HXB	0	0	0	0	0	0
SFH	84,808	55,338	102,955	0	0	0
BOB	0	0	0	0	0	0
CEC	202,536	241,100	259,180	388,169	442,905	320,370
BHK	632,407	615,437	695,974	777,920	890,515	897,906
CZB	0	0	0	0	0	0
BOJ	0	0	0	0	0	0
BOS	0	0	0	0	0	0
HSC	0	0	0	0	0	0
HSB	71,741	0	0	315,626	371,750	0
BON	0	0	0	0	0	0
BOA	0	0	0	0	0	0
CRC	187,934	224,304	378,812	448,533	367,710	0
HBC	106,856	11,478	12,612	43,408	7,001	3,233
GSC	110,276	121,726	146,255	149,082	192,082	218,708
FEH	0	0	0	0	0	0
BOJ2	0	0	0	0	0	0
HB	52,922	0	4,220	26,144	5,791	78,419
BOH	131,793	59,949	98,133	179,724	0	59,071
BEA	970,682	253,412	176,938	253,163	299,394	0
GRC	292,039	306,817	251,266	411,639	350,291	388,490
CMS	1,454,849	884,597	2,213,228	307,726	206,095	203,310
MFH	336,517	0	0	0	0	0
ZBC	208,111	0	181,970	0	0	0
CIC	0	0	0	0	0	0

FFH2	589,355	198,982	232,255	511,379	315,374	263,364
HKE	8,497	684	38,373	39,559	33,795	63,361
BOZ	0	0	0	0	0	0
TCF	980,713	355,835	540,476	621,719	707,347	739,513
BOC	39,834	7,779	48,211	46,129	70,481	49,996
SFH2	485,646	280,220	327,972	335,735	404,709	374,649
ESC	727,974	410,629	371,919	185,762	166,583	144,806
TFH	332,197	338,324	404,942	503,886	464,353	634,210
SFH3	165,826	52,552	54,865	84,210	119,397	307,191
CSC	124,171	107,281	101,544	154,629	208,953	61,689
ATC	0	0	0	0	0	71,449
BOQ	48,912	132,993	169,828	199,950	189,748	246,766
CRC2	0	0	0	0	0	0
DSF	99,665	122,953	123,976	198,356	182,356	211,010
DSB	98,892	123,940	130,292	149,818	176,180	196,669
SHK	0	0	0	0	0	0
WSC	10,727	11,342	14,564	4,592	14,232	21,343
SSC	95,066	100,324	121,396	0	0	0
WRC	47,735	54,813	91,584	137,063	157,170	165,374
JWR	10,009	13,056	30,481	45,592	38,768	106,425
FEI	77,339	96,804	105,088	112,948	108,007	138,187
KTB	3,254	11,392	11,904	0	0	0
JSF	33,546	35,839	39,294	56,834	54,566	49,928
OCL	0	0	0	0	60,086	103,531
WFH	18,480	20,606	25,336	20,099	27,151	28,306
MSC	9,515	11,855	13,113	12,778	0	0
ACS	0	0	13,468	0	0	14,860
BOK	17,579	28,451	51,622	55,862	41,975	46,300
CFS	0	0	0	0	0	0
CBF	0	0	0	0	0	0

Table 18: Cost reductions per bank 2013–2017

Bank	*2013*	*2014*	*2015*	*2016*	*2017*	**Av.**
ICB	0	0	0	0	0	**0**
CCB	0	0	0	0	0	**0**
ACL	0	43,817,392	0	34,720,265	26,485,738	**9,547,581**
BCL	0	0	0	0	0	**0**
CCL	15,417,933	17,297,398	17,496,312	16,140,318	17,720,639	**15,090,791**
PSB	0	0	0	0	0	**0**
CMB	3,568,544	0	5,660,639	0	0	**1,364,651**
BCC	0	0	0	0	0	**0**
SPD	1,289,297	2,867,131	2,742,320	1,441,445	0	**1,107,955**
CBC	2,352,033	3,746,994	0	0	1,982,802	**1,599,582**
CMB2	726,122	2,529,913	2,775,351	0	0	**811,542**
IBC	0	0	0	0	0	**0**
CFH	0	0	0	405,560	283,695	**62,659**
CEB	0	0	0	0	0	**0**
FFH	527,097	562,813	575,974	390,729	379,486	**460,164**
CFH2	545,529	710,474	1,128,897	694,426	909,233	**574,275**
CHA	0	0	5,935,243	0	0	**554,856**
HXB	0	0	0	0	0	**0**
SFH	205,957	172,760	318,659	34,957	27,706	**91,195**
BOB	0	0	0	0	0	**0**
CEC	830,174	0	0	1,883,513	2,395,582	**633,048**
BHK	909,222	889,195	1,236,386	926,200	1,105,402	**870,597**
CZB	0	0	0	0	0	**0**
BOJ	0	0	0	0	0	**0**
BOS	0	0	0	0	0	**0**
HSC	0	0	0	0	0	**0**
HSB	0	0	0	0	0	**69,011**
BON	0	0	0	0	0	**0**
BOA	0	0	0	0	0	**0**
CRC	0	0	0	69,593	0	**152,444**
HBC	0	0	0	0	302,136	**44,248**
GSC	375,531	641,602	1,566,316	1,061,703	969,640	**504,811**

FEH	0	0	107,173	114,249	297,807	**47,203**
BOJ2	0	0	0	0	0	**0**
HB	41,147	0	0	0	0	**18,968**
BOH	0	0	0	0	660,251	**108,084**
BEA	0	0	0	0	0	**177,599**
GRC	304,349	37,464	0	0	0	**212,941**
CMS	241,122	211,009	0	0	0	**520,176**
MFH	1,024,269	739,092	1,176,095	1,276,889	1,026,750	**507,238**
ZBC	0	0	1,292,589	0	0	**152,970**
CIC	0	0	0	0	0	**0**
FFH2	407,296	425,879	488,188	423,729	474,393	**393,654**
HKE	52,122	113,143	158,919	199,814	257,341	**87,782**
BOZ	0	0	476,364	396,140	0	**79,319**
TCF	692,152	697,975	701,643	621,794	644,812	**663,998**
BOC	89,168	0	972,290	0	0	**120,354**
SFH2	481,650	499,466	481,328	594,652	716,316	**452,940**
ESC	112,525	130,175	355,922	0	0	**236,936**
TFH	712,807	131,687	437,280	460,035	518,295	**448,911**
SFH3	297,052	457,155	399,919	325,314	347,677	**237,378**
CSC	14,054	0	0	0	0	**70,211**
ATC	56,290	12,178	0	0	0	**12,720**
BOQ	156,898	218,942	237,723	174,113	331,224	**191,554**
CRC2	0	0	0	0	0	**0**
DSF	202,810	233,386	196,901	185,922	180,444	**176,162**
DSB	192,757	206,148	154,110	136,882	122,571	**153,478**
SHK	0	0	0	0	9,534	**867**
WSC	34,671	69,934	0	0	0	**16,491**
SSC	0	4,229	0	0	117,438	**39,859**
WRC	189,653	35,366	180,569	0	0	**96,302**
JWR	116,591	40,617	0	0	0	**36,504**
FEI	172,158	114,761	37,833	43,722	45,002	**95,622**
KTB	58,416	48,695	35,033	22,254	0	**17,359**
JSF	89,916	78,140	103,642	136,044	111,541	**71,754**
OCL	0	0	50,320	0	0	**19,449**

WFH	21,280	12,183	16,881	9,347	13,981	**19,423**
MSC	0	0	0	0	0	**4,296**
ACS	0	9,293	12,853	17,224	1,857	**6,323**
BOK	45,156	47,348	47,965	29,569	14,720	**38,777**
CFS	0	0	0	0	0	**0**
CBF	0	0	0	0	0	**0**

Table 19: Stability performances per bank and year

Bank	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	**Av.**
ICB	0.95	0.89	1.00	1.00	0.86	0.87	1.00	1.00	1.00	1.00	1.00	**0.96**
CCB	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	1.00	**1.00**
ACL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BCL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CCL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
PSB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CMB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BCC	0.42	0.51	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**0.90**
SPD	1.00	0.34	1.00	1.00	0.75	0.60	0.60	1.00	1.00	0.95	1.00	**0.84**
CBC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.94	1.00	**0.99**
CMB2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
IBC	1.00	0.50	0.53	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**0.91**
CFH	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CEB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.79	0.68	**0.95**
FFH	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CFH2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CHA	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	1.00	1.00	**0.99**
HXB	1.00	0.69	0.72	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**0.95**
SFH	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BOB	0.25	0.25	0.30	0.46	0.61	0.78	0.79	0.75	0.78	0.69	0.86	**0.59**
CEC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.33	1.00	0.69	1.00	**0.91**
BHK	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CZB	0.78	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**0.98**
BOJ	1.00	0.35	0.39	0.74	0.87	1.00	1.00	1.00	1.00	1.00	1.00	**0.85**

BOS	1.00	1.00	1.00	1.00	1.00	0.60	0.62	0.66	0.58	0.35	0.27	**0.73**
HSC	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**0.99**
HSB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BON	1.00	0.78	0.87	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	**0.97**
BOA	1.00	1.00	0.87	0.95	0.86	0.77	0.70	1.00	1.00	1.00	1.00	**0.92**
CRC	1.00	0.94	0.99	1.00	1.00	0.64	0.82	1.00	1.00	1.00	1.00	**0.94**
HBC	1.00	1.00	1.00	1.00	1.00	0.85	0.58	0.63	0.92	0.82	0.78	**0.87**
GSC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
FEH	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BOJ2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
HB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BOH	0.82	0.73	0.76	0.94	1.00	1.00	1.00	1.00	0.74	0.70	0.66	**0.85**
BEA	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.72	**0.97**
GRC	0.92	0.75	0.68	0.96	1.00	0.79	1.00	0.85	1.00	0.72	0.68	**0.85**
CMS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.82	1.00	0.53	0.44	**0.89**
MFH	1.00	0.84	0.38	0.45	0.46	0.51	1.00	1.00	1.00	1.00	1.00	**0.79**
ZBC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CIC	0.68	0.61	0.70	0.67	0.67	0.61	0.69	0.69	0.57	0.68	1.00	**0.69**
FFH2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
HKE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BOZ	0.64	0.67	0.81	0.87	0.86	0.86	0.75	1.00	1.00	1.00	1.00	**0.86**
TCF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BOC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
SFH2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
ESC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.61	0.70	**0.94**
TFH	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
SFH3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CSC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
ATC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BOQ	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	0.73	1.00	1.00	**0.96**
CRC2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
DSF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
DSB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
SHK	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	**1.00**

WSC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.52	**0.96**
SSC	1.00	1.00	1.00	1.00	1.00	0.90	0.83	1.00	1.00	1.00	1.00	**0.98**
WRC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	**1.00**
JWR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
FEI	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
KTB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
JSF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
OCL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
WFH	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
MSC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
ACS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
BOK	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
CFS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	1.00	**0.99**
CBF	1.00	0.88	0.87	0.83	0.72	0.85	1.00	1.00	1.00	1.00	1.00	**0.92**

Table 20: Stability rents per bank and year

Bank	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	**Av.**
ICB	0.99	0.98	1.01	0.96	0.96	1.05	1.02	1.01	1.04	0.97	0.99	**1.00**
CCB	0.95	1.04	0.99	1.00	0.98	1.04	1.04	0.96	0.97	1.02	0.99	**1.00**
ACL	0.95	1.02	1.02	0.95	1.02	0.95	1.05	1.04	1.04	1.00	1.00	**1.00**
BCL	0.96	0.97	0.95	0.95	1.05	1.03	0.96	1.05	0.95	0.99	1.05	**0.99**
CCL	1.02	1.03	0.97	1.04	1.01	0.99	1.05	1.03	1.01	1.01	0.97	**1.01**
PSB	1.02	1.02	1.05	0.98	0.99	0.95	1.05	0.98	1.03	1.05	0.98	**1.01**
CMB	1.15	1.03	0.96	0.95	1.00	0.99	0.95	0.96	0.96	0.96	0.95	**0.99**
BCC	1.01	0.98	1.04	1.02	0.99	1.05	0.97	0.97	1.01	1.00	0.98	**1.00**
SPD	1.01	1.05	0.98	1.05	1.03	1.21	1.04	0.97	1.01	1.00	1.02	**1.03**
CBC	1.05	1.04	1.03	0.96	1.02	1.03	1.20	1.07	0.99	1.03	1.02	**1.04**
CMB2	1.01	0.95	1.00	1.04	1.02	0.98	0.99	1.01	0.98	1.02	0.96	**1.00**
IBC	1.02	0.96	0.98	0.99	1.00	1.03	0.97	0.97	0.95	0.97	0.97	**0.98**
CFH	1.04	0.96	1.01	0.96	1.05	0.97	0.98	1.05	0.95	0.96	1.02	**1.00**
CEB	1.05	0.99	0.98	0.96	1.04	1.02	1.05	0.99	1.03	0.96	1.03	**1.01**
FFH	0.96	1.02	0.95	1.05	1.04	0.98	0.99	1.04	1.04	1.04	1.03	**1.01**
CFH2	0.96	1.00	1.04	0.99	0.98	1.00	1.00	0.96	1.01	0.99	1.04	**1.00**

CHA	0.97	1.17	1.53	1.25	2.02	2.27	2.55	2.53	1.80	0.96	1.05	**1.65**
HXB	0.99	1.04	1.07	1.02	0.98	0.96	0.95	1.04	0.98	1.05	1.00	**1.01**
SFH	0.95	0.98	0.97	0.99	0.96	1.05	0.98	1.04	1.03	1.01	0.99	**1.00**
BOB	0.97	0.95	0.95	1.04	0.98	1.02	0.98	1.05	0.98	1.00	0.97	**0.99**
CEC	2.38	3.57	3.49	5.14	5.17	4.02	0.96	0.95	1.05	2.45	1.66	**2.80**
BHK	0.98	0.99	1.03	1.00	0.99	0.96	1.04	1.05	0.95	0.96	0.97	**0.99**
CZB	0.98	1.02	1.03	1.03	0.98	0.98	0.97	0.95	0.98	0.97	1.05	**0.99**
BOJ	1.01	0.97	1.02	1.04	1.03	1.00	1.02	1.02	1.03	1.03	0.96	**1.01**
BOS	1.01	1.14	2.10	1.79	1.60	1.09	0.96	1.00	1.01	0.99	0.95	**1.24**
HSC	1.46	0.98	0.99	1.04	1.03	1.01	1.04	1.03	0.95	0.95	1.00	**1.04**
HSB	1.04	1.00	0.95	0.98	0.98	0.97	0.98	1.00	1.04	1.04	1.00	**1.00**
BON	1.51	1.13	1.15	0.98	1.00	1.11	0.96	0.99	0.97	0.99	0.99	**1.07**
BOA	1.02	0.95	1.24	1.37	1.24	1.19	1.02	0.96	1.05	1.04	0.99	**1.10**
CRC	2.35	1.91	1.74	1.61	1.36	0.87	0.96	0.99	1.01	1.00	0.95	**1.34**
HBC	0.95	0.98	0.96	0.96	1.09	1.11	1.05	0.95	0.96	0.95	0.97	**0.99**
GSC	1.02	1.22	0.98	0.96	0.97	1.01	1.02	1.04	0.95	1.02	0.97	**1.01**
FEH	0.99	0.95	1.05	1.02	1.00	1.00	1.02	0.95	0.97	1.02	1.03	**1.00**
BOJ2	1.00	1.00	1.04	0.98	1.05	0.96	1.00	1.00	0.99	0.99	0.98	**1.00**
HB	1.03	1.01	0.97	1.04	0.98	0.98	0.96	0.99	1.03	1.03	0.95	**1.00**
BOH	1.13	1.04	0.98	1.11	0.96	1.03	0.98	1.03	0.96	1.00	1.00	**1.02**
BEA	0.98	1.04	1.01	1.00	1.05	1.00	1.02	1.02	1.01	0.97	1.04	**1.01**
GRC	1.39	0.96	1.03	0.98	0.98	1.04	1.21	0.95	1.05	0.99	1.05	**1.06**
CMS	1.55	1.47	1.54	1.48	1.40	1.19	1.14	1.60	0.95	1.13	1.00	**1.31**
MFH	0.96	1.00	1.00	1.03	0.96	1.01	1.79	1.58	1.91	1.88	1.82	**1.36**
ZBC	1.03	1.02	1.00	1.01	1.05	0.97	0.99	0.99	0.97	0.99	1.02	**1.00**
CIC	1.05	0.99	1.00	0.98	1.01	0.96	0.96	0.95	0.99	1.04	1.13	**1.01**
FFH2	1.15	1.14	0.96	1.04	1.01	1.02	0.99	1.02	1.02	1.05	1.20	**1.05**
HKE	1.27	1.15	1.06	1.03	0.96	1.04	1.04	1.03	1.03	1.07	1.04	**1.07**
BOZ	1.14	1.00	0.97	0.96	0.99	1.03	1.02	1.05	0.95	1.04	1.04	**1.02**
TCF	0.95	1.01	1.03	1.03	1.00	0.97	1.03	1.03	0.96	0.96	0.95	**0.99**
BOC	1.04	1.40	1.01	0.99	1.03	0.95	0.95	1.03	1.00	0.95	0.97	**1.03**
SFH2	1.00	0.95	1.04	0.96	1.00	1.02	0.97	0.96	0.98	1.05	1.04	**1.00**
ESC	1.47	1.00	1.03	0.97	1.00	1.01	1.03	1.00	0.98	1.05	1.03	**1.05**
TFH	0.98	1.03	0.97	0.99	0.97	0.96	1.03	0.99	1.04	1.17	1.01	**1.01**

SFH3	1.04	1.04	1.01	0.99	1.05	1.05	0.98	0.95	1.01	1.14	1.02	**1.02**
CSC	0.99	0.96	1.05	1.04	1.03	0.96	1.02	0.99	1.00	0.95	0.97	**1.00**
ATC	1.03	0.98	0.95	0.97	1.04	0.97	1.01	0.97	1.00	0.97	0.95	**0.99**
BOQ	1.01	0.99	0.98	1.00	1.00	0.95	1.01	0.98	1.20	0.99	1.05	**1.01**
CRC2	1.02	0.97	0.99	0.96	1.04	1.02	1.04	1.00	1.05	1.02	1.02	**1.01**
DSF	0.99	0.99	0.99	0.96	1.04	0.99	0.97	0.96	1.03	0.96	1.04	**0.99**
DSB	1.04	0.95	1.04	1.04	1.00	1.01	0.95	0.98	0.96	0.98	0.98	**0.99**
SHK	1.01	1.03	0.99	0.96	1.01	0.96	1.04	1.05	0.96	1.01	1.26	**1.03**
WSC	1.00	0.98	1.02	0.97	1.03	0.97	1.05	0.99	1.00	1.01	1.03	**1.00**
SSC	1.96	1.54	1.74	1.60	1.60	1.38	1.33	1.02	1.01	1.01	1.82	**1.45**
WRC	1.03	0.99	1.01	0.95	0.96	1.04	0.98	0.96	1.05	0.96	1.00	**0.99**
JWR	1.00	1.13	1.05	0.98	1.00	1.01	0.98	1.00	0.95	1.00	1.00	**1.01**
FEI	0.99	0.95	1.00	0.98	1.05	0.96	1.03	0.98	0.95	0.97	1.11	**1.00**
KTB	1.05	0.98	0.97	1.02	1.01	0.96	0.97	0.99	1.01	1.02	0.98	**1.00**
JSF	0.96	0.99	1.04	0.96	1.01	1.02	0.99	1.03	1.02	0.98	0.98	**1.00**
OCL	1.67	0.95	1.00	1.00	1.05	0.98	0.99	1.01	0.96	0.98	1.05	**1.06**
WFH	1.08	1.23	1.19	1.01	1.30	1.33	1.20	1.27	1.25	1.22	1.20	**1.21**
MSC	0.99	1.00	0.95	0.98	1.04	1.01	1.01	0.98	0.99	0.99	1.00	**0.99**
ACS	0.96	0.97	0.99	0.98	1.01	1.00	1.04	0.95	1.01	1.03	1.04	**1.00**
BOK	1.01	1.05	0.96	1.03	0.97	1.05	0.97	0.97	1.00	1.03	1.03	**1.01**
CFS	1.04	1.01	0.97	1.03	1.03	0.99	0.97	1.03	0.98	0.99	0.96	**1.00**
CBF	0.95	0.98	0.96	1.03	0.96	1.03	0.96	1.03	0.97	0.96	1.01	**0.99**

Table 21: Bank acronyms

Full name	Acronym
Agriculral Bank of China	ACL
Ping An Bank	ACS
Ningbo tongshang Bank	ATC
Bank of Communication	BCC
Bank of China	BCL
bank of Baoding	BEA
Fujian Haixia Bank	BHK
Guangdong nan'ao bank	BOA

Bank of Yibin	BOB
Bank of Cangzhou	BOC
bank of Handan	BOH
Bank of Jinshang	BOJ
Bank of Jiujiang	BOJ2
Bank of Kunlun	BOK
Bank of Ningbo	BON
Bank of Qilu	BOQ
bank of Shangrao	BOS
China Zheshang Bank	BOZ
Bank of Chaoyang	CBC
Bank of Fuxin	CBF
China Construction Bank	CCB
China Citic Bank	CCL
China Everbright Bank	CEB
China Evergrowing Bank	CEC
Fujian Haixia bank	CFH
Bank of Hainan	CFH2
Bank of Fushun	CFS
Bank of Panzhihua	CHA
Bank of Xingtai	CIC
China Merchent Bank	CMB
China Minsheng Bank	CMB2
Bank of Inner Mogolia	CMS
Zhejiang Chouzhou bank	CRC
Huarong xiangjiang Bank	CRC2
Bank of Anshan	CSC
jiangsu changjiang bank	CZB
Bank of Dezhou	DSB
Guangfa Bank	DSF
Ordos Bank	ESC
Bank of Huzhou	FEH
Bank of Langfang	FEI
Bank of Fudian	FFH

Bank of Hami	FFH2
Bank of Ganzhou	GRC
Guangxi Beibuwan Bank	GSC
Bank of Hebei	HB
bank of Huishang	HBC
Bank of Harbin	HKE
Bank of Hubei	HSB
Bank of Hankou	HSC
Hua Xia Bank	HXB
Industial bank	IBC
Industrial and Commercial Bank of China	ICB
Bank of Jiangsu	JSF
Bank of Jinhua	JWR
Bank of Korla	KTB
Bank of Mianyang	MFH
zhejiang mintai bank	MSC
Bank of Changsha	OCL
Postal and Saving Bank of China	PSB
bank of Shengjing	SFH
bank of Huaxi	SFH2
Bank of Donghai	SFH3
Bank of Shanghai	SHK
Shanghai Pudong Bank	SPD
Bank of Shizuishan	SSC
Bank of Tianjin	TCF
Bank of Taizhou	TFH
Guangdong huaxing Bank	WFH
Bank of Huarun	WRC
China Citic Bank	WSC
Bank of Zhangjiakou	ZBC