BANK AGE AND FINANCIAL PERFORMANCE: IS THE RELATIONSHIP LINEAR OR NONLINEAR? EVIDENCE FROM LISTED AND UNLISTED COMMERCIAL BANKS IN CHINA[1]

BANKA YAŞI VE FİNANSAL PERFORMANS: İLİŞKİ DOĞRUSAL MI DEĞİL Mİ? ÇİN'DE BORSAYA KAYITLI VE KAYITLI OLMAYAN TİCARET BANKALARINDAN KANITLAR

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Öz

Bu çalışma, 2006-2019 dönemi için Çin bankacılık sektöründe faaliyet gösteren 51 ticari bankadan oluşan bir örneklem kullanarak banka yaşının banka finansal performansı üzerindeki etkisini ampirik olarak araştırmaktadır. Çalışmada dengesiz panel veri seti ve PCSE panel tahmincisi kullanılmıştır. Bankaya özgü, sektöre özgü ve makroekonomik göstergeler kontrol edildikten sonra, tahmin sonuçlarımız borsaya kote bankalar için ROA ve ROE modellerinde banka yaşı ile karlılık göstergeleri arasında pozitif ve doğrusal bir ilişki olduğunu göstermektedir. Ayrıca, bütün karlılık modellerinde (ROA, ROE ve NIM) banka yaşı ile borsa'ya kote olmayan bankaların finansal performansı arasında ters U-şeklinde bir ilişkinin varlığı belirlenmiştir. Sonuçlarımız banka yaşının finansal performans üzerindeki etkisinin bankaların borsa'ya kote olup olmama durumuna bağlı olarak değişkenlik gösterdiğine işaret etmektedir.

Anahtar Kelimeler: Çin ticari bankaları; banka yaşı; finansal performans, PCSE.

JEL Sınıflaması: C23, G21, G28

Abstract

This study empirically investigates the impact of bank age on bank financial performance using a sample of 51 commercial banks from the Chinese banking industry over the period 2006-2019. In the study, we employ an unbalanced panel data set and PCSE panel estimation procedure. After controlling for the bank-specific, industry-specific, and macroeconomic indicators, our estimation results demonstrate that there exists a positive and linear relationship between bank age and profitability indicators in ROA and ROE models for listed banks. Moreover, we specify a quadratic (inverted U-shaped) impact of bank age on unlisted banks' financial performance in all profitability models (i.e. ROA, ROE and NIM). Our findings indicate that the influence of bank age on financial performance varies depending on whether banks are listed on the stock exchange or not.

Keywords: Chinese commercial banks; bank age; financial performance, PCSE.

JEL Classification: C23, G21, G28

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1. Introduction

There are various factors influencing firm performance such as the quality of human resources, corporate culture, implementation of corporate governance, risk management, size, and liquidity. Age is also considered among the important factors that affect firm performance (Muslish and Marbun, 2020). According to D'Amato and Falivena (2020), age is an important demographic indicator or variable for firms. A firm's age influences its associations with stakeholders, its experience, its goodwill, its reputation, and its market share in the industry.

The use of age as an explanatory variable in some studies investigating the differences in firm performance in the existing literature has led to an increased interest in examining the age-performance linkage. Thus, theoretical and empirical literature researching the age-performance association has emerged (Rossi, 2016). Despite the theoretical and empirical studies investigating this relationship, the research area has not yet reached maturity (Akben Selcuk, 2016).

Older firms gain knowledge, skills and expertise over time and optimize their business processes, which contributes to reducing costs and improving performance (Arrow, 1962). This perspective supports the theory of liability of newness. According to the notion of the liability of newness, younger firms are disadvantaged in comparison to older firms. Because younger firms lack experience and external ties and face higher risks of failure (Stinchcombe, 1965; Majumdar, 1997; D'Amato and Falivena, 2020). Consistent with this hypothesis, Ujunwa (2012), Shehata et al. (2017), and Rahman and Yilun (2021) indicate that firm performance decreases with firm age. However, consistent with the life cycle hypothesis, firms, like people, are more likely to lose their ability to innovate and compete over time. Firm aging is frequently pertaining to organizational rigidity and the rent-seeking behavior by managers, which in turn leads to a decline in firm performance (Leonard-Barton, 1992; Isidro and Sobral, 2015). Consistent with this hypothesis, Leite and Carvalhal (2016), Kramaric et al. (2017) and Silva et al. (2019) and Mishra et al. (2021), and Arora (2022) suggest that firm performance increases with firm age. Therefore, in the light of these theoretical evaluations, non-linear inverted U-shaped relationship is likely to be expected between firm age and firm performance.

The aim of this study is to examine the effect of bank age on financial performance in the Chinese banking industry using non-linear models. The study covers 51 commercial banks and a period of 14 years (2006-2019). PCSE panel estimation procedure is employed in the analyses. The impact of bank age on the financial performance is investigated using three different financial performance indicators (ROA, ROE and NIM), both on the full sample and on the sub-samples which is banks listed and banks unlisted on the stock exchange. Our study contributes to the literature in three-fold. First, best of our knowledge, this is the first study which focuses on the non-linear effect of bank age in the Chinese banking industry. Second, we employ a PCSE panel estimator that allows us to control for potential heterogeneity, serial correlation, heteroskedasticity, and cross-sectional dependence and endogeneity. Finally, this study provides important insights for bank management and policymakers to improve banks' financial performance.

The remainder of this paper is organized as follows. Section 2 provides literature review. The data used in the study and the research methodology are explained in the Section 3. The findings obtained from the regression models are discussed in the Section 4. The results of the study and policy recommendations are included in the Section 5.

2. Related Literature

In the previous literature, there are many empirical studies focusing on the relationship between the age and firm performance. A brief summary of some of these studies is presented in Table 1.

Table 1. Literature Review

References	Study Area	Data Period	Methodology Used	Empirical Findings
Majumdar (1997)	1020 Indian firms	1988-1994	Regression analysis	Older firms are found to be more profitable and less productive.
King and Santor (2008)	613 Canadian firms	1998-2005	Random effects (RE)	Firm age is not a significant determinant of firm performance.
Kowalewski et al. (2010)	217 Polish companies	1997-2005	System generalized method of moments (GMM)	Profitability indicators are not influenced by firm age.
Shan and McIver (2011)	117 Chinese companies	2001-2005	Fixed effects (FE)	There exists a significant and negative linkage between firm age and profitability.

Ujunwa (2012)	122 quoted firms in Nigeria	1991-2008	FE and RE	Firm age is negatively linked with ROA.
Dezsö and Ross (2012)	the S&P 1,500 firms	1992-2006	GMM	Firm age significantly increases market performance of US firms.
Coad et al. (2013)	62,259 Spanish manufacturing firms	1998-2006	Median regressions	Firm age has a significantly negative (positive) impact on profitability (productivity).
Nguyen et al. (2014)	257 Singaporean companies	2008-2011	System GMM	Firm age appears to be significantly negatively correlated with market performance (i.e. Tobin's Q).
Mokni and Rachdi (2014)	15 conventional and 15 Islamic banks in the MENA region	2002-2009	System GMM	bank age does not influence accounting-based performance measures.
Nunes and Serrasqueiro (2015)	187 Portuguese KIBS	2002-2009	System GMM and LSDVC	ROA is positively and significantly affected by firm age.
Gill and Kaur (2015)	231 listed S&P BSE companies	2006-2010	The instrumental-variable-two-stage least-squares (IV-2SLS)	Firm age does not have a significant impact on firm financial performance.
Poutziouris et al. (2015)	141 listed UK companies	1998-2008	OLS and RE	Younger firms exhibit a significant and positive association with ROA
Nguyen et al. (2015a)	Vietnamese and Singaporean companies	2008-2011	System GMM	The coefficient of the firm age measure is significantly negative in the market performance model.
Nguyen et al. (2015b)	120 Vietnamese companies	2008-2011	System GMM	A significantly positive relationship between firm age and Tobin's Q ratio exists.
Ilaboya et al. (2016)	30 listed Nigerian companies	2006-2012	OLS, FE and RE	Firm age has a positive influence on financial performance.
Akben Selçuk (2016)	302 Turkish companies	2005-2014	FE	Firm age has a U-shaped effect on performance.
Nguyen et al. (2017)	Vietnamese companies	2008-2011	System GMM	The influence of firm age on three alternative performance indicators (ROA, ROE and Tobin's Q) is statistically insignificant.
Isik (2017a)	193 listed Turkish firms	2005-2012	Fixed Effects Vector Decomposition (FEVD)	Higher age is associated with lower Tobin Q value but higher ROA.
Haykir and Çelik (2018)	38 listed Turkish companies	2008-2016	OLS	Firm age-profitability linkage follows the U-shaped pattern.
Kramaric et al. (2017)	137 insurance companies from Croatia, Slovenia, Hungary and Poland	2010-2014	RE	Firm age positively and significantly affects profitability indicators (i.e. ROA and ROE)
Shehata et al. (2017)	34,798 small- and medium-sized enterprises (SMEs) in the U.K	2005-2013	FEVD	Firm age shows a significant negative relationship with ROA.

Pervan et al. (2017)	956 firms operating in Croatian food industry	2005-2014	GMM	There is strong evidence that higher firm age reduces profitability.
Sardo and Serrasqueiro (2018)	2.044 non-financial listed firms from 14 Western European countries	2004-2015	System GMM	According to the findings, there is a positive and significant relationship between firm age and ROA, but a negative and significant relationship with Tobin's Q.
Sardo et al. (2018)	934 Portuguese small and medium-sized hotels	2007-2015	System GMM	There exists a significant and positive linkage between firm age and ROA.
Adusei (2011)	17 banks in Ghana	2005-2009	Ordinary least square (OLS) estimator	The findings support the view that the firm age–profitability (i.e. ROE) nexus is positive.
Dietrich and Wanzenried (2011)	372 commercial banks in Switzerland	1999-2009	system GMM	In general, the effect of bank age on three alternative profitability indicators (i.e. ROAA, ROAE and NIM) is positive and significant.
Kassi et al. (2019)	31 non-financial Moroccan companies	2000-2016	system GMM	There is no significant relationship between firm age and performance indicators.
Pastore et al. (2020)	350 SMEs in southern Italy	2010-2017	RE	In the ROE model, the coefficient for firm age is negative and highly significant.
Szegedi et al. (2020)	20 listed Pakistani banks	2008-2018	OLS, FE and RE	The impacts of bank age on ROE and Tobin's Q are negative and positive, respectively..
Mishra et al. (2021)	325 Indian non-financial companies	2010-2018	System GMM	There exists positive linkage between firm age and Tobin's Q.
Işık (2021)	27 non-life insurers in Turkey	2014-2019	RE	As foreign insurance companies get older, their profitability declines significantly.
Rahman and Yilun (2021)	50 listed Chinese companies	2008-2018	FE	It seems that there is a significant negative relationship between firm age and profitability.
Srivastava and Bhatia (2022)	179 listed Indian companies	2011–2017	OLS	Firm age is positively related to accounting-based performance indicators, while it is negatively related to market-based performance indicator.
Arora (2022)	442 listed companies from India	2015-2019	System GMM	The firm age has a positive impact on profitability
Othmani (2022)	10 listed Tunisian banks	2005–2020	FE, RE, and System GMM	Bank age significantly affects neither market performance nor accounting performance.
Harb et al. (2022)	51 listed deposit banks from 10 MENA countries	2010–2018	OLS, FE, and FE with Driscoll-Kraay standard errors	The impact of bank age on financial performance is insignificant.

3. Data and Research Methodology

3.1. Data

Our sample is composed of 24 listed banks and 27 unlisted banks in the Chinese commercial banking system from 2006 to 2019. The period under research is selected depending on data availability. Commercial banks with missing data are dropped from the banking sample. The information of the banks included in the analysis is

presented in the Appendix. The data on bank-specific variables, industry-specific and macroeconomic variables are taken from the BankScope database, Global Financial Development (GFD) database, the International Monetary Fund's International Financial Statistics (IFS) database, and World bank's world development indicators (WDIs) database. Moreover, all variables have been winsorized at the 1% and 99% levels (except for industry-level and macroeconomic variables) to remove outliers.

Table 2. Definition of Variables

Variables	Abbreviation	Definition	Expected Impact	Data Sources
Dependent Variables				
Profitability	ROA	Net profit (loss)/total assets		BankScope
	ROE	Net profit (loss)/total equity		BankScope
	NIM	Net interest income/total assets		BankScope
Independent Variable				
Bank age	Ln(age)	Natural logarithm of the number of years of existence of the firm	+/-	Web page
Control Variables				
Size	Ln(assets)	The natural logarithm of total assets	+/-	BankScope
Efficiency	CIR	Cost-to-income ratio	-	BankScope
Credit Risk	NPL	Non-performing loans/total Loans		
Banking stability	Ln(zscore)	The natural logarithm of the sum of ROA and equity to assets ratio/the standard deviation of ROA	+	BankScope
Capitalization	CAR	Tier 1 capital + tier 2 capital/risk-weighted assets	+/-	BankScope
Growth	GRO	Yearly growth of assets	-	BankScope
Financial Inclusion	FINC	Number of deposit accounts with commercial banks per 1,000 adults		IFS
Stock market development	SMD	Stock market capitalization/GDP	+	GFD
Banking sector development	BSD	Domestic credit to private sector/GDP	+/-	GFD
Concentration ratio	CR3	The three largest banks' asset concentration ratio	+/-	GFD
Inflation rate	INF	Yearly percentage change in CPI	+	WDI
CRISIS	GFC	A dummy variable that takes the value of 1 during the 2007-2009 period	-	-

3.2. Econometric Model

The objective of this study is to investigate the impact of bank age on financial performance of commercial banks in China. Therefore, we specify a quadratic model denoted by the following regression equation to examine how bank age-profitability nexus vary across listed and unlisted commercial bank:

$$(FP)_{it} = \alpha + \beta_1 Ln(age)_{it-1} + \beta_2 Ln(age)^2_{it-1} + \text{control variables} + \varepsilon_{it} \tag{1}$$

where the subscript i refers to commercial bank and t refers to the time period; α is a constant term; FP_{it} is the dependent variable, and is measured with three alternative indicators such as ROA, ROE and NIM; $Ln(age)_{it}$ is bank age and $Ln(age)^2_{it}$ is the quadratic term of $Ln(age)_{it}$; control variables in the above equation include various control variables at bank level, industry level, country level, and the global financial crisis that took a value of 1 in 2007, 2008 and 2009; and ε_{it} is residual term. The independent and control variables included in the above equation are lagged one period to eliminate the possibility of any endogeneity that can arise due to the potential reverse causality.

3.3. Estimation Methodology

To examine the associations between all variables we employ panel-corrected standard errors (PCSE) as an estimation technique, which is beneficial in controlling potential serial correlation, heteroskedasticity, and cross-sectional dependence (Beck and Katz, 1995). This estimation technique is also suitable for unbalanced panel data (with small T and large N) (Marques and Fuinhas, 2012; Khan et al., 2022; Diaconaşu et al., 2022).

In addition to the observed variables that can be easily measured and modeled in an equation, bank financial performance could also be affected by some other bank-specific characteristics that are not easy to measure or determine in an equation, which may raise the problem of unobservable heterogeneity among banks operating in the same industry.

Unobservable factors such as short or long-term policies followed by banks in their deposit collection activities or lending, risk-taking tendencies, and attitudes and behaviors of the bank's senior management may be closely related to the bank's financial performance. Therefore, if the effect of such characteristics is not included in the model, some independent variables will be correlated with the error terms, which may cause the estimated coefficients of these variables to be biased. Therefore, PCSE estimations are carried out by including bank and time dummies to control for the problem of unobserved heterogeneity.

4. Results

4.1. Descriptive Statistics, Mean-Variance Analysis, and Correlations

Within the scope of the analysis, first of all, a comparison of various descriptive statistics (number of observations, minimum, mean, standard deviation, and maximum) for listed and unlisted commercial banks in China is given in Table 3. As seen in the last column of Table 3, we have also carried out the mean-variance analysis using the *t*-test and the *z*-test (i.e. Wilcoxon rank-sum) to test whether there are significant differences between the two groups regarding the means of bank-level variables. When profitability indicators are taken into account, the profitability levels of the listed banks are higher than their unlisted counterparts. The average age is 27.496 (25.268) ranging between 2(1) and 111(159) for listed (unlisted) commercial banks. These findings show that listed banks are older than unlisted ones. It appears that all bank-level variables except for the NPL variable are significantly different between the two groups. Also, Table 4 provides the summary of the descriptive statistics for the industry-specific and macroeconomic variables for the 2006 to 2019 period.

Table 3. Descriptive Statistics of Listed and Unlisted Commercial Banks in China

	Panel A – Listed Banks					Panel B – Unlisted Banks					*t*-test	z-test
	N	Min	Mean	SD	Max	N	Min	Mean	SD	Max		
ROA	357	.19	1.15	.43	2.87	372	.08	.74	.34	1.77	-14.30***	-14.07***
ROE	359	.95	16.18	4.51	26.64	373	.75	10.18	5.49	26.64	-16.10***	-14.5***
NIM	359	.29	2.63	.71	4.15	372	.29	2.37	.97	4.61	-4.05***	-5.31***
AGE	359	2	27.50	24.22	111	377	1	25.28	35.90	159	-5.85***	-7.44***
Ln(assets)	359	7.92	12.16	1.66	15.04	369	7.46	10.13	1.46	14.71	-17.53***	-15.22***
CIR	359	20.95	40.05	10.54	89.53	373	15.40	47.51	17.29	89.53	.02***	6.40***
NPL	345	.09	1.25	.62	4.51	359	.09	1.31	1.01	4.51	1.00	-2.43**
Ln(zscore)	357	2.07	4.75	1.24	7.58	368	2.07	4.45	1.19	7.58	-2.98***	-3.85***
CAR	329	9.06	12.63	1.67	26.05	336	6.9	15.60	7.81	57.36	6.75***	6.06***
GRO	359	-10.29	19.88	14.25	88.90	363	-17.27	16.14	17.97	88.90	-3.09***	-4.48***

This table compares the means of bank-level variables for the two subsamples: Comparison tests are carried out employing the *t*-test and *z*-test. Superscripts ***and ** denote that means are not equal at 1% and 5% levels, respectively.

Table 4. Descriptive Statistics of Industry-Specific and Macroeconomic Variables

	N	Min	Mean	SD	Max
FINC	14	11.714	1041.862	2407.924	6975.15
SMD	14	38.72	60.084	20.735	126.15
BSD	14	102	135.973	19.513	165.39
CR3	14	40.59	61.088	19.917	99.94
INF	14	-.73	2.634	1.658	5.93

Table 5 and 6 display pair-wise correlation coefficients of the variables for listed and unlisted banks, respectively. It is observed that the highest significant correlation coefficient value in Table 5 is found as 0.74, which is between the Ln(age) and Ln(assets) variables. As reported in Table 6, the largest significant correlation coefficient value among independent and control variables is -0.58, which is between the CR3 and BSD variables. According to Brooks (2008), the correlation values between −0.8 and +0.8 demonstrate no multicollinearity problems. The correlation coefficients reported in Tables 5 and 6 are between −0.8 and +0.8, indicating that multicollinearity is not a critical issue for analysis. In this context, all variables are included in the analysis. It should be noted here

that the GDP growth variable is also included in the data as a macroeconomic control variable. However, the high correlation of this variable with some other control variables caused this variable to be excluded from the analysis.

Table 5. Pair-Wise Correlation Matrix for Listed Commercial Banks

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)Ln(age)	1.00											
(2)Ln(assets)	**0.74** (0.00)	1.00										
(3)CIR	**-0.25** (0.00)	**-0.27** (0.00)	1.00									
(4)NPL	**0.32** (0.00)	**0.29** (0.00)	-0.06 (0.26)	1.00								
(5)Ln(zscore)	0.01 (0.90)	0.01 (0.87)	0.000 (0.98)	0.06 (0.25)	1.00							
(6)CAR	**0.11** (0.04)	0.06 (0.26)	**-0.21** (0.00)	-0.00 (0.95)	-0.04 (0.46)	1.00						
(7)GRO	**-0.46** (0.00)	**-0.46** (0.00)	**0.52** (0.000)	**-0.29** (0.00)	-0.07 (0.23)	**-0.11** (0.04)	1.00					
(8)FINC	**0.17** (0.00)	**0.18** (0.00)	**-0.45** (0.00)	**0.15** (0.01)	**0.14** (0.01)	**0.29** (0.00)	**-0.35** (0.00)	1.00				
(9)SMD	-0.05 (0.41)	-0.05 (0.40)	0.05 (0.40)	**0.14** (0.01)	**-0.16** (0.00)	0.08 (0.17)	**0.11** (0.06)	**-0.14** (0.01)	1.00			
(10)BSD	**0.26** (0.00)	**0.33** (0.00)	**-0.63** (0.00)	0.05 (0.40)	0.02 (0.79)	**0.24** (0.00)	**-0.44** (0.00)	**0.56** (0.00)	-0.07 (0.23)	1.00		
(11)CR3	**-0.15** (0.01)	**-0.18** (0.00)	**0.42** (0.00)	**-0.20** (0.00)	-0.01 (0.91)	**-0.18** (0.00)	**0.32** (0.00)	**-0.36** (0.00)	**-0.21** (0.00)	**-0.59** (0.00)	1.00	
(12) NF	**-0.10** (0.08)	**-0.12** (0.03)	**0.17** (0.00)	-0.06 (0.28)	0.07 (0.22)	0.04 (0.46)	**0.10** (0.08)	-0.05 (0.41)	-0.01 (0.85)	**-0.46** (0.00)	**0.13** (0.02)	1.00

This table reports the pair-wise correlation matrix for the control and independent variables used in the analysi. Bold values indicate significant correlations.

Table 6. Pair-Wise Correlation Matrix for Unlisted Commercial Banks

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)Ln(age)	1.00											
(2)Ln(assets)	0.05 (0.36)	1.00										
(3)CIR	**-0.10** (0.07)	**-0.45** (0.000)	1.00									
(4)NPL	**-0.14** (0.01)	**0.13** (0.02)	**-0.29** (0.00)	1.00								
(5)Ln(zscore)	-0.05 (0.33)	-0.07 (0.23)	0.04 (0.53)	-0.07 (0.23)	1.00							
(6)CAR	0.06 (0.27)	**-0.49** (0.00)	**0.42** (0.00)	**-0.26** (0.00)	0.05 (0.34)	1.00						
(7)GRO	**-0.11** (0.05)	0.03 (0.63)	**-0.23** (0.00)	-0.07 (0.21)	0.04 (0.50)	**-0.21** (0.00)	1.00					
(8)FINC	**0.15** (0.01)	**0.17** (0.00)	**-0.12** (0.03)	0.04 (0.54)	-0.00 (0.96)	0.07 (0.20)	**-0.26** (0.00)	1.00				
(9)SMD	-0.01 (0.93)	-0.03 (0.58)	0.01 (0.85)	0.09 (0.12)	-0.09 (0.10)	-0.00 (0.99)	-0.01 (0.83)	**-0.16** (0.00)	1.00			
(10)BSD	**0.18** (0.00)	**0.30** (0.00)	-0.09 (0.10)	-0.02 (0.73)	**-0.10** (0.07)	**0.16** (0.00)	**-0.34** (0.00)	**0.57** (0.00)	-0.04 (0.44)	1.00		
(11)CR3	**-0.13** (0.02)	**-0.17** (0.00)	0.10 (0.08)	-0.08 (0.156)	**0.13** (0.02)	**-0.10** (0.07)	**0.23** (0.00)	**-0.35** (0.00)	**-0.25** (0.00)	**-0.58** (0.00)	1.00	
(12) NF	-0.01 (0.93)	-0.07 (0.20)	-0.04 (0.44)	-0.04 (0.28)	-0.07 (0.23)	-0.08 (0.14)	**0.15** (0.01)	-0.02 (0.70)	-0.08 (0.13)	**-0.43** (0.00)	**0.12** (0.02)	1.00

This table reports the pair-wise correlation matrix for the control and independent variables used in the analysis. Bold values indicate significant correlations.

4.2. Regression Results

As mentioned above, we adopt the PCSE estimation technique to determine the effect of bank age on financial performance in terms of listed and unlisted banks in the Chinese commercial banking industry. Table 7 reports the estimation results. Columns 1, 2, and 3 present the estimation results of ROA model, while columns 4, 5, and 6 report the estimation results for the ROE model. The estimation results for NIM, the third alternative financial performance indicator, are given in columns 7, 8, and 9. Estimation results including all banks are reported in columns 1, 4 and 7. The estimation results for the listed banks are presented in columns 2, 5 and 8. estimation results presented in columns 3, 6 and 9 belong to unlisted banks.

When the results reported for the sample covering all banks in columns 1, 4, and 7 of Table 7 are examined, the estimated coefficient of the Ln(age) is positive and significant, indicating that older banks tend to outperform younger banks in terms of ROA. On the other hand, the estimated coefficient of Ln(age)^2 is negative and significant, which means that after a certain threshold value, as banks continue to age, they tend to perform worse. Thus, estimation results for two variables representing bank age confirm that there exists an inverted U-shaped relation between bank age and ROA. However, the non-linear correlation found in the ROA model for the full sample is valid for neither the ROE nor the NIM models.

Estimation results for the listed bank sample demonstrate that there exists a positive and linear relationship between Ln(age) and profitability indicators such as ROA and ROE. This means that ROA and ROE increase with bank age. Nevertheless, these findings are not valid for the NIM model. The positive and linear association between bank age and ROA and ROE supports the results of Dietrich and Wanzenried (2011) for commercial banks in Switzerland. However, our findings for bank age in ROA and ROE models are different from those of Mokni and Rachdi (2014), Szegedi et al. (2020), and Othmani (2022).

As seen in columns 3, 6 and 9 of Table 7, the estimated coefficients for Ln(age) and its square are found to be statistically significant in all models (i.e. ROA, ROE and NIM) for unlisted banks. These results suggest that age-profitability linkage follows the inverted U-shaped pattern for unlisted banks. This result contradicts the findings of Akben Selcuk (2016) and Haykir and Çelik (2018) for listed non-financial firms in Turkey.

As for the other bank-specific variables, regarding the influence of bank size (Ln(assets)) on Chinese banks' profitability indicators, we have observed mixed results. Mixed findings on the association between bank size and financial performance have also been reported in the previous banking literature. For example, while Xiazi and Shabir (2022) reported that the relationship between bank size and financial performance was positive for bank samples covering 85 countries, Aydemir and Guloglu (2017) provided evidence that this relationship was negative for Turkish banks. Apart from these findings, Isik (2017b) and Harb et al. (2022) reported that size-performance association follows the inverted U-shaped pattern for Turkish and MENA banks.

The results presented in Table 7 show that cost to income ratio (CIR) affects the profitability indicators of Chinese banks negatively and significantly. Our results for this variable are consistent with those of Kumar et al. (2022) and Alfadli and Rjoub (2020).

In line with our expectations, we found evidence that NPL has a negative effect on ROA and ROE. However, the association between NPL and NIM appears to be positive. Negative results for ROA and ROE models are in line with the results of Trujillo-Ponce (2013), Djalilov and Piesse (2016), Horobet et al. (2021), and Işık (2022). In addition, our positive results for NIM models support the findings of Fungáčová and Poghosyan (2011) and Raharjo et al. (2014). These two studies prove that NPL positively impacts financial performance for state-controlled banks in the Russian banking industry and commercial banks in Indonesia, respectively.

The coefficient on Ln(zscore) is significantly positively in relation to financial performance measured by ROA and ROE. These findings imply that more stable banks are more profitable. The earlier study by Isik (2017b) also reported similar results.

It can be observed from Table 7 that the coefficient of bank capital (CAR) is negative and significant in Models 4, 5, 6 and 9. This result indicates that the ROE and NIM ratios tend to be lower in commercial banks with higher capital. As a result, the negative influence of CAR is more pronounced for unlisted banks. Pak (2020) reported that bank capital is positively correlated with ROA and NIM models in her study covering the banking industries of Russia, Belarus and Kazakhstan.

The estimated coefficient of the GRO variable is found to be significant only in Model 2. This finding shows that growth in terms of total assets causes a decrease in ROA of listed banks. But, Pak (2020) reported that the impact of growth in total assets on NIM and ROA is positive for banks in Russia and Kazakhstan, except Belarus.

Table 7. Impact of Bank Age on Financial Performance

	ROA			ROE			NIM		
	All Banks	**Listed Banks**	**Unlisted Banks**	**All Banks**	**Listed Banks**	**Unlisted Banks**	**All Banks**	**Listed Banks**	**Unlisted Banks**
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**	**Model (7)**	**Model (8)**	**Model (9)**
L. Ln(age)	0.346**	0.318**	0.421**	6.615*	7.258*	7.164***	0.678	0.215	1.734**
	(0.146)	(0.145)	(0.155)	(3.453)	(3.396)	(1.986)	(0.450)	(0.619)	(0.645)
L. Ln(age)^2	-0.0717*	-0.0359	-0.0974**	-0.838	-0.840	-1.672**	-0.215	0.135	-0.639**
	(0.0382)	(0.0455)	(0.0435)	(1.109)	(1.326)	(0.602)	(0.149)	(0.137)	(0.212)
Bank-Specific Control Variables									
L.Ln(asstes)	0.0398***	-0.0402*	-0.00144	1.000***	-0.348**	0.432**	0.0315**	-0.0294	-0.108**
	(0.00794)	(0.0206)	(0.0158)	(0.112)	(0.170)	(0.175)	(0.0153)	(0.0284)	(0.0519)
L.CIR	-0.0038**	-0.0066***	-0.0048***	-0.0206	-0.0711**	-0.0274	-0.0017	-0.0082**	-0.0038*
	(0.0015)	(0.0012)	(0.0016)	(0.0177)	(0.0339)	(0.0199)	(0.0021)	(0.0041)	(0.0022)
L.NPL	-0.0531***	-0.0498***	-0.0395*	-0.534***	-0.179	-0.295	0.127***	0.165***	0.138***
	(0.0155)	(0.0160)	(0.0202)	(0.165)	(0.272)	(0.200)	(0.0288)	(0.0505)	(0.0362)
L. Ln(zscore)	.00006***	0.00004**	0.00007*	0.0010***	0.0008**	0.00007*	0.00004	0.00005	0.00002
	(0.00002)	(0.00002)	(0.00004)	(0.0002)	(0.0004)	(0.00004)	(0.0001)	(0.0001)	(0.0001)
L.CAR	-0.0021	0.0070	-0.0041	-0.126***	-0.368***	-0.123***	-0.0058	0.0120	-0.0154***
	(0.0030)	(0.0048)	(0.0030)	(0.0272)	(0.113)	(0.0300)	(0.0042)	(0.0154)	(0.0057)
L.GRO	-0.00003	-0.0018***	0.0003	0.0084	0.0094	0.0081	0.0007	-0.0005	-0.0003
	(0.0005)	(0.0004)	(0.0007)	(0.005)	(0.0144)	(0.0070)	(0.0012)	(0.0016)	(0.0016)
Industry-Specific Control Variables									
L.FINC	-0.0053***	0.0006	-0.0165***	-0.0325	-0.140***	-0.0230	0.0098	0.0131***	0.0031
	(0.0020)	(0.0008)	(0.0035)	(0.0264)	(0.0216)	(0.0546)	(0.0068)	(0.0035)	(0.006)
L.SMD	0.0009***	0.0010***	0.0005	0.0123***	0.0091***	0.0159*	0.0036***	0.0043***	0.0020**
	(0.0003)	(0.0001)	(0.0005)	(0.0035)	(0.0025)	(0.009)	(0.0005)	(0.0004)	(0.0008)
L.BSD	0.0010	0.0019*	0.0051***	-0.0665***	0.0402	-0.0167	-0.0006	-0.0003	0.0085**
	(0.001)	(0.001)	(0.001)	(0.013)	(0.027)	(0.020)	(0.002)	(0.004)	(0.004)
L.CR3	0.0045***	0.0065***	0.0045***	0.0608***	0.114***	0.0541***	0.0223***	0.0183***	0.0255***
	(0.0004)	(0.0005)	(0.0004)	(0.005)	(0.0100)	(0.006)	(0.0008)	(0.001)	(0.001)
Macroeconomic Variables									
L.INF	-0.0039	0.0196***	-0.0113	0.129	0.682***	-0.0776	0.0115	0.0644**	-0.0473
	(0.0056)	(0.0046)	(0.0068)	(0.114)	(0.130)	(0.108)	(0.0244)	(0.0212)	(0.0320)
Global Financial Crisis Control Variable									
GFC	0.153***	0.175***	0.266***	1.898***	4.231***	2.804***	0.275***	-0.0742	0.554***
	(0.0331)	(0.0359)	(0.0432)	(0.492)	(0.786)	(0.621)	(0.0577)	(0.130)	(0.0930)
Constant	0.0504**	0.0549***	0.00417	1.219***	0.183	1.354***	0.242***	0.0989	0.374***
	(0.0170)	(0.0133)	(0.0303)	(0.301)	(0.420)	(0.361)	(0.0554)	(0.0588)	(0.0928)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.6865	0.8233	0.6424	0.7679	0.7883	0.7014	0.7104	0.8188	0.6783
Wald χ2 (p-value)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of Groups	51	24	27	51	24	27	51	24	27

This table reports the regression results for the impact of bank age on financial performance. Robust standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Wald χ2 statistic tests the null hypothesis of non-significance of all coefficients of explanatory variables.

As for the other industry-specific variables, we have observed that an increase in FINC declines the financial performance of Chinese commercial banks in models 1, 3, and 5. These findings are consistent with the results of Kumar and Bird (2022) and Kanga et al. (2020). However, the influence of this variable on NIM is positive for listed banks in Model 8. The positive finding is similar to that of Vo and Nguyen (2021).

The estimated coefficients of the BSD variable, which indicates the contribution of the banking sector to the country's economy, are positive and significant in Models 2, 3 and 9. The finding also reveals that the development of the banking sector is negatively related to NIM for unlisted banks in Model 9. Regarding the impact of BSD, Yao et al. (2018) provided evidence for banks in Pakistan that BSD was negatively associated with NIM. However, Tan (2016) reported that the relations between BSD and profitability measures (i.e. ROA, ROE and NIM) are positive for banks in China.

The estimated coefficients of the SMD variable are positive and significant in all models except Model 3. This finding demonstrate that the financial performance of commercial banks tends to increase as the stock market development. These results coincide with the findings of Katsiampa et al. (2022). However, Sufian and Habibullah (2012) reported that the linkage between SMD and ROA is negative.

In all models, positive and highly significant relationships were determined between the CR3 variable and financial performance indicators, which indicates that as the concentration of the banking sector increases, its financial performance will increase. These findings are in line with those of Sufian and Habibullah (2012).

Regarding the effect of inflation rate (INF) on financial performance, it is observed that the coefficients of this variable were positive and significant in the listed banks. This suggests that increasing inflation rate contributes to financial performance. Lee and Lee (2019) has also found a positive association between inflation rate and financial performance. However, Xiazi and Shabir (2022) reported that the inflation rate has an adverse and highly significant association with profitability indicators.

Finally, it seems that there exist positive and highly significant correlations between the dummy variable representing the global financial crisis (GFC) and financial performance, except for model 8. These findings are not consistent with the results of Kumar and Bird (2022).

5. Conclusion

Our study focuses on a panel data of Chinese commercial banks to investigate the quadratic impact of bank age on financial performance over a period of 14 years (2006–2019). Our banking sample is an unbalanced panel data with 50 listed and unlisted commercial banks. In the present study, we use PCSE panel estimation procedure to investigate bank age-financial performance association.

Empirical findings from PCSE panel estimation procedure full sample allow us to conclude that: (i) there is an inverted U-shaped link between bank age and ROA; (ii) there exists a positive and linear association between the age of bank and ROE; and (iii) neither linear nor nonlinear relationship is found between bank age and NIM.

After examining the estimation results of the main sample, the sample consisting of commercial banks is divided into two sub-samples as listed and unlisted banks. The PCSE estimation results for the listed bank sample imply that there exists a positive and linear relationship between bank age and financial performance in ROA and ROE models. However, we found a quadratic (inverted U-shaped) impact of bank age on unlisted banks' financial performance in all three models (i.e. ROA, ROE and NIM). In summary, the results demonstrate that there is a non-linear linkage between financial performance and age in unlisted banks, but a linear relationship in listed banks except from NIM model.

These results indicate that the influence of bank age on financial performance varies according to the status of banks listed on the stock exchange, in other words, the listing status of commercial banks is a determining factor in the association between bank age and its financial performance. Therefore, it is thought that it would be beneficial to consider these results in future studies. Findings that bank age positively affects ROA and ROE in banks listed on stock exchange suggests that it may be useful for investors and finance analysts to consider the age variable in the analysis of banks' return on assets and return on equity.

In addition to our findings on the association between bank age and financial performance, bank-specific, industry-specific, and macroeconomic variables have significant effects on the financial performance of banks in the commercial banking industry in China. Empirical findings reveal that the global financial crisis also had positive effects on the financial performance of listed and unlisted commercial banks.

In this study we solely focus on the Chinese commercial banking sector. However, it would be interesting to see whether our findings can be extended to other emerging economies. Performing a cross-country analysis may shed further light on the age-performance relationship. Moreover, investigating the influence of bank age on financial performance for commercial banks in bank-based or market-based financial systems can also produce interesting results.

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Appendix.

Table 8. Chinese Commercial Banks

id	Chinese Commercial Banks	Founded year	Listing Status
1	INDUSTRIAL & COMMERCIAL BANK OF CHINA (THE) - ICBC	1984	Listed
2	LONGJIANG BANK CORPORATION LIMITED	2009	Unlisted
3	BANK OF LIAOYANG CO LTD	1996	Unlisted
4	SHANXI YAODU RURAL COMMERCIAL BANK CO LTD	2010	Unlisted
5	HUISHANG BANK CO LTD	1997	Listed
6	BNP PARIBAS (CHINA)	1992	Unlisted
7	CHINA EVERBRIGHT BANK COMPANY LIMITED	1992	Listed
8	SHANGHAI RURAL COMMERCIAL BANK	2005	Unlisted
9	BANK OF WEIFANG CO LTD	1997	Unlisted
10	BANK OF CHONGQING	1996	Listed
11	BANK OF RIZHAO	2000	Unlisted
12	BANK OF EAST ASIA (CHINA) LTD	2007	Unlisted
13	HANKOU BANK	1997	Unlisted
14	CHINA CONSTRUCTION BANK CO., LTD	1954	Listed
15	BANK OF MONTREAL (CHINA) CO LTD	2010	Unlisted
16	GUANGXI BEIBU GULF BANK CO LTD	1996	Unlisted
17	DALIAN RURAL COMMERCIAL BANK	1998	Unlisted
18	BANK OF CHANGSHA CO LTD	1997	Listed
19	BANK OF COMMUNICATIONS CO. LTD	1908	Listed
20	OCBC WING HANG BANK (CHINA) LTD	1937	Unlisted
21	CHINA MINSHENG BANKING CORPORATION	1996	Listed
22	CHINA CITIC BANK CORPORATION LIMITED	1987	Listed
23	CHINA MERCHANTS BANK CO LTD	1987	Listed
24	HSBC BANK (CHINA) CO LTD	2007	Unlisted
25	CHINA GUANGFA BANK CO LTD	1988	Unlisted
26	GUANGDONG SHUNDE RURAL COMMERCIAL BANK COMPANY LIMITED	1952	Unlisted
27	SHANGHAI PUDONG DEVELOPMENT BANK	1993	Listed
28	BANK OF NINGBO	1997	Listed
29	JP MORGAN CHASE BANK (CHINA) CO LTD	1921	Unlisted
30	HUA XIA BANK CO., LIMITED	1992	Listed
31	CITIBANK (CHINA) CO LTD	2007	Unlisted
32	CHINA BOHAI BANK	2005	Listed
33	MUFG BANK (CHINA), LTD	1958	Unlisted
34	CHONGQING RURAL COMMERCIAL BANK	1951	Listed
35	BANK OF BEIJING CO LTD	1996	Listed
36	INDUSTRIAL BANK CO LTD	1988	Listed
37	UNITED OVERSEAS BANK (CHINA) LIMITED	1984	Unlisted
38	BANK OF KUNLUN CO LTD	2002	Unlisted
39	BANK OF CHINA LIMITED	1912	Listed
40	BANK OF DALIAN	1998	Unlisted
41	DEUTSCHE BANK (CHINA) CO LTD	1872	Unlisted
42	MIZUHO BANK (CHINA) LTD	2007	Unlisted
43	QILU BANK CO LTD	1996	Unlisted
44	HARBIN BANK	1997	Listed
45	BANK OF CHENGDU CO LTD	1996	Listed
46	BANK OF NANJING	1996	Listed
47	BANK OF SHANGHAI	1996	Listed
48	PING AN BANK CO LTD	1987	Listed
49	BANK OF WENZHOU CO LTD	1998	Unlisted
50	AGRICULTURAL BANK OF CHINA LIMITED	1951	Listed
51	XIAMEN INTERNATIONAL BANK	1985	Unlisted