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An Empirical Analysis of Non-Interest Income's Effect on Commercial Bank Performance

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Abstract

The share of non-interest income in commercial banks' operating revenue has steadily risen, dramatically affecting their overall operational performance. Using panel data for sixteen Chinese listed commercial banks from 2007 to 2013, variable intercept and variable coefficient models were constructed, accounting for variables including macroeconomic growth rate. The impact of non-interest revenue on the performance of commercial banks was empirically investigated, together with the quantity of bank assets and the cost-to-income ratio. The study results indicate a sizeable negative association with operational costs and a substantial positive correlation with total bank assets, macroeconomic growth, and commercial bank performance. However, the effect of non-interest income on performance differs depending on the kind of commercial bank. Central state-owned commercial banks' non-interest revenue and performance are favorably correlated; nevertheless, urban commercial banks' non-interest revenue and performance are negatively correlated. Therefore, it is recommended that Chinese commercial banks formulate differentiated development strategies based on their characteristics to enhance overall profitability.

Keywords: commercial banks, non-interest income, bank performance, panel data, variable coefficient models.

1. Introduction

Commercial banks in affluent Western nations have actively encouraged non-interest income business innovation since the 1980s, progressively transforming it into a primary enterprise alongside asset and liability activities (Minh and Thanh 2020). Innovating non-interest income business has become a strategic focus for the international banking industry in the 21st century. For instance, non-interest income makes up between 40% and 50% of a Western bank's

overall earnings; some can reach as high as 70% (Isshaq, Amoah, and Appiah-Gyamerah 2019; Huang and Chen 2006; Atellu 2016). Due to ongoing financial system reforms and growing economic sector openness in China, commercial bank operating environments are changing in ways never seen before. The fast advancement of interest rate liberalization and financial disintermediation has presented significant challenges for Chinese commercial banks that have hitherto relied on interest rate spreads, particularly the emergence of Internet finance and the launch of five private banks' pilot programs that were approved by the State Council (Al-Slehat and Al Tameemi 2021). Due to differences in the regulatory landscape, market dynamics, and customer preferences, the non-interest revenue structure of Chinese commercial banks may differ from that of international banks. While Western banks offer services based on target markets and client categories, Chinese banks reflect local consumer demands with fee-based services and income sources. In 2014, the People's Bank of China implemented asymmetric interest rate cuts and policies allowing deposit interest rates to float, further squeezing the profit space for interest rate spread business in banks. In the meantime, banks experiencing deposit losses are under tremendous strain due to the effects of Internet finance and interest rate liberalization. The deposit balances of sixteen listed commercial banks in China fell by about 1.5 trillion yuan, or nearly 2%, according to the third-quarter report of 2014. In 2014, the growth rate of commercial banks dropped by 4.8 percentage points despite an overall 9.7% year-over-year gain in profitability (Lee, Yang, and Chang 2014; Hahm 2008; Okello and Muturi 2018). The average return on equity has been on a declining trend for three consecutive years. Commercial banks look to be required to pursue the expansion of their non-interest revenue business actively, and variations in the share of non-interest income to operating income will unavoidably affect the way commercial banks function.

The positive impacts of non-interest income on bank performance have been studied. Numerous empirical techniques, including regression analysis, event study analysis, SEM, DEA, and time-series analysis, are used to examine the effect of non-interest revenue on the performance of commercial banks. These techniques analyze the connection between non-interest revenue and bank performance measures by accounting for additional variables, examining intricate linkages, gauging effectiveness, and recognizing dynamic patterns. Bian, Wang, and Sun (2015) suggests that due to the sensitivity of a bank's net interest income to fluctuations in interest rates and economic cycles, non-interest income, primarily derived from fee income, provides diversified revenue sources, thereby favoring the maintenance of relatively stable bank profits. Through revenue generation, enhanced profitability, improved asset-liability management, decreased credit risk, heightened investor trust, regulatory compliance, and long-term sustainability, stable interest income lowers bank risk. It also enhances banks' financial standing, reducing the risk of loan default. For example, using option pricing theory, Emongor, Musau, and Mwasiaji (2020) estimated the volatility of return on assets for 62 non-bank financial organizations and 123 bank-holding corporations. The findings suggested that creating nonbanking enterprises contributes to lowering bank risk. Based on data from 14 listed commercial banks between 2008 and 2020, regression analysis showed a significant positive correlation between the banks' asset returns and non-interest income (Mehzabin, Shahriar, Hoque, Wanke, and Azad 2023). Increasing the percentage of non-interest income can improve the performance of banks. Noor and Siddiqui (2019) discovered that non-interest revenue is more volatile than interest income and has a notably positive effect on bank asset returns, particularly for small and medium-sized banks. Using financial data from 16 Chinese listed commercial banks between 2008 and 2018, Lepetit, Nys, Rous, and Tarazi (2008) investigated the relationship between bank operating performance and non-interest income as a percentage of total revenue. The study's results indicated that the proportion of non-interest revenue and return on equity were positively correlated, indicating that increasing this percentage can improve bank profitability and performance.

Diverging viewpoints are presented in multiple research regarding the detrimental effect of non-interest income on bank performance. Weerasuriya, Rathnayake, and Fernando (2021) contends that despite the diversified revenue achieved by U.S. banks in developing non-interest

income businesses, the associated higher risks exacerbate income volatility, offsetting the benefits of diversified revenue. The risk-adjusted yield does not necessarily increase due to business diversification. Using data samples from 755 small banks in Europe between 2010 and 2020, Alhassan and Tetteh (2017) finds that the growth of non-interest revenue industries is counterproductive to banks' efforts to enhance their performance. Mutuma and Mungatu (2016) argues that developing fee-based businesses constitutes a diversification decision, which may not always be optimal for commercial banks. The current focus for Chinese commercial banks should be more than fee-based businesses; instead, it should involve exploring new areas and enhancing the quality and efficiency of existing operations. Ali and Khattak (2020) employ an empirical analysis based on portfolio theory with sample data from 12 commercial banks between 2009 and 2016, it discovers that a rise in non-interest revenue lowers banks' profitability. Zhou, Peng, and Latief (2021) Using bank industry data from 2010 to 2018, It was found that, despite certain risk diversification benefits, non-interest income growth has substantial cyclicality and high volatility, which reduces the marginal benefits of this diversification as its proportion rises. Zhou, Sun, Zhang, and Lin (2023d) by creating a panel data model and using data from 14 commercial banks from 2009 to 2018, the study examined the connection between bank risk and the percentage of non-interest revenue. The results imply that bank risk and income structure diversity do not correlate statistically. The principal cause of bank risk reduction is the lower interest income fluctuation risk. However, the risk of its swings increases along with the percentage of non-interest income, making the total risk higher.

Despite much research on the subject, different studies have produced varying conclusions about how non-interest revenue affects commercial banks' performance. This variation results from the use of different study designs and data sets. Commercial banks could find it difficult to reconcile these divergent conclusions when making strategic decisions. Strategic decisions may be difficult because of a lack of resources, competing priorities, and abundant information. Decision-makers must negotiate complexity, minimize biases, balance conflicting interests, communicate clearly, and use resources wisely to overcome these obstacles. Examples of strategies include open communication, a range of viewpoints, thorough analysis, reaching an agreement, and flexibility. There is debate over whether commercial banks should increase the share of non-interest income to achieve diversified operations or control the amount of non-interest income to promote operational efficiency and quality. There are significant differences because there are several different sorts of banks, especially in the Chinese commercial banking industry: large state-owned banks, joint-stock commercial banks, and city commercial banks. There are significant differences between these institutions' operational procedures. Previous research needs to include the fact that different types of banks may experience varied manifestations of the impact of non-interest income on performance. Based on recent changes in non-interest income for 16 listed commercial banks in China, this study aims to empirically assess the impact of non-interest revenue on the operational performance of these banks using a panel data model. The goal is to provide necessary guidance and a point of reference for the operational reform of China's commercial banks. The research highlights investor expectations, regulatory framework, competitive challenges, and risk management by examining the impact of non-interest income on bank performance. Many banks rely less on erratic interest-based earnings by generating a sizable portion of their revenue from non-interest income, such as fees from banking services. Policymakers, regulators, shareholders, and banks must comprehend this influence to evaluate the stability and resilience of the industry. It also aids banks in controlling risks, including operational and market risks. The rest of the paper is organized as follows: Section 2 describes the non-interest revenue business of commercial banks; Section 3 discusses the empirical research; and Section 4.

2. The non-interest revenue business of commercial banks

The operational revenue produced by commercial banks—which does not include interest rate

differentials—is referred to as non-interest income. Net income from intermediary services, fees and commissions, gains from investments, adjustments to fair value, gains or losses on exchanges, and other income from the firm are the main components of this income. Unlike commercial banks, Chinese commercial banks face restrictions on segmented operations and a lower level of marketization, resulting in many businesses not needing development. Table 1 displays the various non-interest revenue to operating income ratios for China's biggest listed commercial banks. In central state-owned banks, where non-interest revenue makes up a comparatively large amount of overall operating income, the development of non-interest revenue businesses could be more balanced simultaneously. Nine publicly traded commercial banks' non-interest revenue operations are developing in response to regulatory conditions, product offerings, customer segmentation, market positioning, innovation capabilities, and geographic reach. Sophistic wealth management and investment banking activities might possess a competitive advantage. Banks may have competitive disadvantages, more volatility, higher customer demands, risk management, regulatory scrutiny, and negative investor impression due to the unequal expansion of their non-interest earning activities. While banks with diverse revenue streams may be under regulatory pressure, those that rely primarily on interest income may see higher volatility. Banks have to analyze their income mix and adjust to changing market conditions. Take China Construction Bank as an example; its non-interest income ratio has consistently remained at the forefront among significant banks, stabilizing at around 30% from 2013 to 2016. The Industrial and Commercial Bank of China (ICBC) and Bank of China had excellent non-interest income ratios in 2016, at 28.58% and 24.66%, respectively. However, there is a notable difference in the development level of non-interest revenue businesses among the nine listed joint-stock commercial banks. Several variables, including organizational culture, market positioning, product offers, client base, and legislative and technical developments, impact the non-interest revenue activities of nine listed commercial banks. Banks that prioritize fee-based services, cutting-edge digital platforms, and inventive offers generate more non-interest revenue. Some joint-stock banks, like Minsheng Bank, have consistently outperformed others in recent years, producing substantial non-interest income. The key factors contributing to Minsheng Bank's success in China include its creative business plan, emphasis on microfinance and SMEs, robust risk management procedures, and tactical alliances. Its creative strategy, which uses fintech solutions and digital technology, has enhanced customer experiences and operational effectiveness while cultivating a devoted clientele. See Figure 1.

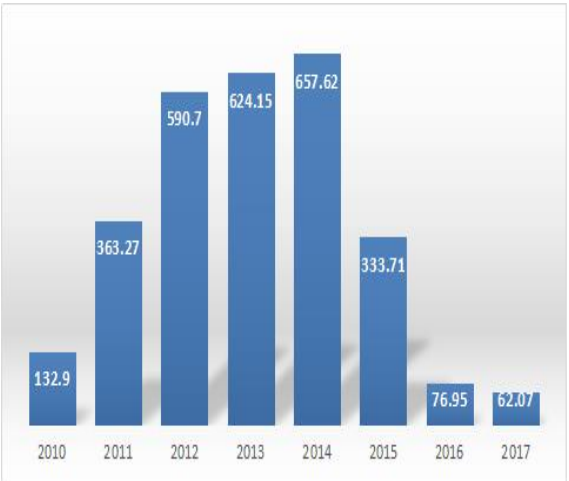

Figure 1: Displays the percentage of net fee and commission income for non-interest revenue for listed banks between 2010 and 2016

When examining the internal structure of the non-interest revenue business, one discovers that

Table 1: Displays the operating income percentage of non-interest revenue for sixteen listed commercial banks between 2010 and 2016

	2010	2011	2012	2013	2014	2015	2016
China Commercial and Industrial Bank	22.56%	25.58%	21.56%	21.25%	24.66%	28.58%	24.98%
Construction Bank	15.26%	25.98%	23.17%	25.25%	25.68%	24.35%	24.87%
Bank of China	25.46%	38.95%	42.25%	39.58%	36.23%	38.59%	38.98%
Agricultural bank	22.25%	18.35%	28.28%	26.62%	28.78%	39.85%	35.24%
Bank of Communications	23.78%	27.89%	27.78%	28.64%	29.81%	28.45%	26.55%
Bank of Beijing	15.89%	19.88%	17.98%	17.54%	19.85%	21.46%	24.26%
BANK OF NINGBO	18.12%	25.62%	24.88%	23.56%	24.25%	20.68%	21.56%
Bank of Nanjing	2.32%	29.56%	22.75%	23.86%	22.78%	25.75%	23.28%
China Merchants Bank	27.86%	25.62%	26.55%	25.62%	28.98%	32.89%	35.42%
Minsheng bank	20.75%	23.85%	33.26%	26.58%	31.52%	35.28%	38.98%
China CITIC Bank	15.89%	20.15%	21.85%	23.68%	25.65%	28.23%	32.45%
EVERBRIGHT BANK	21.35%	19.85%	29.85%	24.85%	35.21%	26.28%	32.24%
Shanghai Pudong Development Bank	16.52%	18.87%	18.86%	19.35%	19.45%	12.65%	24.85%

fees and commissions account for a substantial portion of non-interest revenue. This situation contrasts sharply with foreign commercial banks, where non-interest income tends to have higher added value and can generate significant profits. China Construction Bank has the lowest net fee and commission income percentage in non-interest income among several listed commercial banks, although it still surpasses 60%. This percentage often approaches 80% for banks, indicating that the main non-interest revenue streams are fees and commissions (Zhou, Zhang, and Zhang 2023e; Zhou, Liu, Jiang, Ren, Lam, and Zhang 2023b).

3. Empirical research

3.1. Model specification and variable selection

Two primary components can be identified in the revenue structure of commercial banks based on the asset portfolio theory put forward by Zhou, Pang, and Zhang (2023c): non-interest income and interest income. Commercial banks generally rely on interest income from the interest charged on loans and other assets that generate interest. Conversely, non-interest revenue consists of fees and commissions from offering clients financial goods and banking services. Within this theoretical framework, the entire commercial bank can be viewed as an asset portfolio consisting of two assets: one producing interest revenue and the other growing

Table 2: List and description of each variable used in this paper

Variable	Name	Unit	Illustrate
	ROE	%	After-tax net profit and net assets
	NON	%	Noninterest net income from operating income
Explained Variable	RGDP	%	GDP growth rate
	ASSET	Mo	Million yuan
	COST	%	Operating expenses/revenue

non-interest income in a fixed ratio. The asset portfolio mean formula can be used to get:

$$E\left(R_i\right) = \omega E\left(R_N\right) + (1-\omega) E\left(R_I\right) \tag{1}$$

Treating Equation (1) as an estimation equation, it can be rewritten as:

$$\mathrm{R_{it}} = \beta_1 \omega_{\mathrm{it}} + \beta_2 \left(1 - \omega_{\mathrm{it}}\right) + \varepsilon_{\mathrm{it}} \tag{2}$$

Where: The portion of earnings other than interest is ω_{it}, the portion of interest income that is $(1-\omega_{it})$, and the rate of return for commercial bank I in year t is R_{it}. One variable must be excluded in Equation (2) to avoid complete multicollinearity. For clarity, the percentage of interest income is excluded from the analysis, and the proportion of non-interest income is selected as the explanatory variable. Removing one variable from a regression analysis might enhance model performance by reducing the linear dependency between predictors. This can be done based on theoretical considerations, domain expertise, or statistical parameters such as correlation coefficients or variance inflation factors. Considering other explanatory variables, from an internal perspective of describing the bank, the bank's total assets are employed as an explanatory variable, as used in [12], to measure the bank's size effect. The cost-to-income ratio is another explanatory variable to illustrate the bank's operating costs. The "cost-to-income ratio" is a financial indicator used to examine banks' cost structure and operational effectiveness. It explains fluctuations in operating costs and provides an example of the bank's operational costs. Total operational expenses are divided by income to get the ratio; more excellent ratios indicate higher costs about income, while lower ratios show more effective cost control. The macroeconomic growth rate (RGDP) is chosen as an explanatory variable when characterizing the bank from the outside. One of the most important economic indicators is the Real Gross Domestic Product (RGDP) growth rate, which measures a nation's business cycle, financial market influence, and the connection of other factors. Strong growth rates may indicate inflation or boost economic activity, affecting financial markets, policy choices, and prediction of economic conditions. An essential external explanatory factor for the performance of commercial banks is the macroeconomic growth rate (RGDP), which affects monetary policy and interest rates set by central banks, as well as aggregate demand, investment levels, consumer spending, and corporate activity. This decision was reached because shifts in the macroeconomic environment significantly impact a bank's performance (Zhou, Li, Zhang, Yuan, Zhang, and Cai 2023a; Ali, Shan, Gul, and Roh 2023b; Ali, Jhaveri, Alswailim, and Roh 2023a).

To define bank performance, the dependent variable is the net return on equity (ROE), considering that contemporary listed commercial banks often prioritize maximizing shareholder value as their ultimate goal. The study investigates the relationship between non-interest revenue and the performance of commercial banks of different kinds. Retail banks serve individual customers and companies, whereas universal banks offer various financial services. Trade finance, cash management, lending, and treasury services are all provided by commercial banks. The macroeconomic growth rate is An explanatory variable affecting loan demand, interest rates, asset quality, and investment prospects. Table 2 presents the exact details for each variable.

Factors such as data quality, sample size, model assumptions, endogeneity, complexity, temporal dynamics, and data availability affect the validity and generalizability of statistical investigations. Small sample sizes reduce model power, biased data can induce overfitting and misspecification, and complicated models can cause these issues. Data availability and temporal dynamics may be constrained, particularly in longitudinal research or in-depth individual-level data. Panel data from multiple listed commercial banks for the years 2008 to 2019 were selected for the model setup:

$$\mathrm{ROE}_{\mathrm{it}} = \alpha_{\mathrm{i}} + \mathrm{C} + \beta_1 \mathrm{NON}_{\mathrm{it}} + \gamma_{\mathrm{ii}} \mathrm{RGDP}_{\mathrm{it}} + \gamma_{2\mathrm{i}} \mathrm{COST}_{\mathrm{it}} + \gamma_{\mathrm{ii}} \ln \mathrm{ASSET}_{\mathrm{it}} + \mu_{\mathrm{it}} \tag{3}$$

The "China Financial Yearbook" for the years 2008 through 2013 and each bank's annual report for the year 2013 were the sources of the data. A trustworthy source of detailed financial information about China's financial industry, including commercial banks, is the "China Financial Yearbook ."Researchers and analysts researching the Chinese banking sector will find it helpful since it offers aggregated data, key performance indicators, and industry-wide trends. The strength and credibility of the study are increased by the comprehensive financial statements, performance indicators, and strategic insights provided by annual reports from commercial banks for a particular fiscal year. Eviews 6.0 was the program utilized to establish the model.

3.2. Statistical description of variables

First, a statistical study of the factors of various commercial bank types was carried out; the findings are displayed in Table 3. Since non-interest income is becoming increasingly important, this research looks at the relationship between it and the performance of commercial banks. This relationship is crucial because it helps determine how stable and diversified a bank's revenue streams are and how to make strategic decisions in the banking sector. The statistical features of the variables show that the average Return on Equity (ROE) for multiple listed commercial banks is 29.87% with a standard deviation of 4.19%. This implies that the current profitability level of the Chinese banking industry is within a reasonable range. With an overall performance of 25.86%, the joint-stock commercial banks outperform the four central state-owned and urban commercial banks by a small margin. The average value of the percentage of non-interest income (NON) is marginally below the level of the Western banking sector. The standard deviation data reveals notable variations in the rate of non-interest income across different institutions. The four largest state-owned commercial banks have an average non-interest revenue percentage of 25.54%, substantially more significant than the percentage of joint-stock commercial banks. According to the discussion in the first section of the article, urban commercial banks have the lowest rate of non-interest income (Ren, Ahmed, and Liu 2023; Nazeer, Sultana, and Bonyah 2023; Zeng and Chu 2023; Guo 2023; Luo, Zhang, and Bai 2023). In the banking sector, there are three types of banks: state-owned, urban commercial, and joint-stock commercial. While urban commercial banks concentrate on retail banking, state-owned banks provide various services. State-owned banks deal with credit risk and regulatory compliance, whereas joint-stock banks have strong corporate governance and risk management systems. In terms of total asset size (ASSET), the nine listed joint-stock commercial banks have an average asset size of approximately CNY 2.06 trillion, the three listed urban commercial banks have an average total asset size of approximately CNY 0.42 trillion, and the four large state-owned banks have an average asset size of approximately CNY 11.2 trillion. The overall asset sizes of the various kinds of banks fluctuate significantly. The cost-to-income ratio's statistical features indicate that listed commercial banks in China have a generally consistent cost-to-income ratio between 33% and 36%, which is lower than that of foreign banks like Citigroup, HSBC, and Standard Chartered. The cost-to-income ratios of these banks often exceed 50% and sometimes even surpass 60%.

3.3. Selection of panel data models

The panel data model can be divided into three categories of constant coefficient models according to the variations in the intercept term and the pre-regression coefficients of each explanatory variable in the model (3):

$$\alpha_i = \alpha, \beta_i = \beta, \gamma_{1i} = \gamma_1, \gamma_{2i} = \gamma_2, \gamma_{3i} = \gamma_3 \tag{4}$$

The variable intercept model (VIM) and variational coefficient model are necessary to represent heterogeneity and dynamic relationships in panel data. While VCM expands it to capture dynamic changes, VIM allows for differences in intercept terms between groups, accounting for individual-specific features and unobserved variables. Varying Intercept Model (VIM)

$$\alpha_{\mathrm{i}} \neq \alpha, \beta_1 = \beta, \gamma_{1\mathrm{ii}} = \gamma_1, \gamma_{2\mathrm{i}} = \gamma_2, \gamma_{3\mathrm{i}} = \gamma_3 \tag{5}$$

Variational coefficient model

$$\alpha_{\mathrm{i}} \neq \alpha, \beta_1 \neq \beta, \gamma_{1\mathrm{i}} \neq \gamma_1, \gamma_{2\mathrm{i}} \neq \gamma_2, \gamma_{3\mathrm{i}} \neq \gamma \tag{6}$$

When considering that the cross-sectional coefficients of a particular variable differ, and there are no structural changes in the remaining variables, the research methodology proposed by [15] allows us to rewrite Equation (6) in the form of Equation (7):

$$\alpha_{\mathrm{i}} \neq \alpha, \beta_1 \neq \beta, \gamma_{\mathrm{ii}} = \gamma_1, \gamma_{2\mathrm{i}} = \gamma_2, \gamma_{3\mathrm{i}} = \gamma_3 \tag{7}$$

It facilitates the choice between variable coefficients, varying intercepts, and constant-coefficient models. While the changing intercept model permits coefficient fluctuations among entities, the continual coefficient model assumes constant coefficients across entities and periods. The F-test determines if the model's fit is substantially better with variable intercepts than continuous coefficients. For the selection of different types of panel data, an F-test is required to determine this:

If the test results support H_1 this, a constant coefficient model is warranted. If H_1 is rejected, a test for H_2 is necessary. If H_2 is supported, the adoption of a varying intercept model is recommended. If it H_2 is left, an unstable coefficient model should be employed. Throughout this process, it is essential to compute two F-statistics:

The test statistic for H_1 :

$$\mathrm{F}_1 = \frac{\left(\mathrm{SSE}_3 - \mathrm{SSE}_1\right) / [(\mathrm{n}-1)(\mathrm{k}+1)]}{\mathrm{SSE}_1 / [(\mathrm{nT} - \mathrm{n}(\mathrm{k}+1)]} \tag{8}$$

The critical values at a given 1% level of significance are :

$$\mathrm{F}_{0.01}[(\mathrm{n}-1)(\mathrm{k}+1), \mathrm{n}(\mathrm{T}-\mathrm{k}-1)] \tag{9}$$

Testing the statistics of H_2 :

$$\mathrm{F}_2 = \frac{\left(\mathrm{SSE}_2 - \mathrm{SSE}_1\right) / [(\mathrm{n}-1)\mathrm{k}]}{\mathrm{SSE}_1 / [(\mathrm{nT} - \mathrm{n}(\mathrm{k}+1)]} \tag{10}$$

The critical value at a given 1% level of significance is :

$$\mathrm{F}_{0.01}[(\mathrm{n}-1)\mathrm{k}, \mathrm{n}(\mathrm{T}-\mathrm{k}-1)], \tag{11}$$

where the constant coefficient model, variable intercept model, and variable coefficient model's residual sums are, respectively, $\mathrm{SSE}_1, \mathrm{SSE}_2$ and SSE_3. The sample duration is denoted by $\mathrm{t} = 7$, the number of people is represented by $\mathrm{n} = 16$, and the number of explanatory variables is indicated by $\mathrm{k} = 4$.

Computed, $F_1 = 3.43$, $F_2 = 2.38$ at 1 % significance level, $F_{0.01}(75, 32) = 2.05, F_{0.01}(60, 32) = 2.10$

According to the F-test, the panel data in this study should, therefore, be considered with variable coefficients. In panel data analysis, the F-test is a statistical tool used to analyze how well-nested models fit together and assess if adding more variables increases the model's explanatory power. Researchers may choose models confidently thanks to their assistance with model comparison, variable selection, specification, and estimating efficiency. Furthermore, the random effect model is rejected by Hausman's test. Therefore, this paper should develop a unique fixed effect model (Wang, Liu, and Zhang 2023; Liang, Cheng, Zhang, Wang, Yan, and Chen 2023; Anbar and Alper 2011; Meyappan, Yusof, and Mazlan 2019).

3.4. Model results

Generalized least squares (GLS) estimates can create a variable coefficient model for the share of non-interest income, as per model form (7). Using GLS estimates, a variable coefficient model is constructed in panel data analysis that accommodates changes in the coefficients of explanatory variables across time or between entities. This method improves flexibility and resilience by addressing heteroscedasticity, serial correlation, and entity- or time-specific effects.

$$\begin{aligned} &\mathrm{ROE_{it}} = \alpha_\mathrm{i} - 16.99 + \beta_\mathrm{i}\mathrm{NON_i} + 0.4929\mathrm{RGDP_{it}} \\ &- 0.1246\mathrm{COST_{it}} + 2.622 \ln \mathrm{ASSET_{it}} \begin{pmatrix} -1.8983^{*}\,(2.9994^{***}) \\ (-1.7073^{*})\,(5.3478^{***}) \end{pmatrix}. \end{aligned} \tag{12}$$

$$\begin{aligned} &\mathrm{i} = 1, 2, \cdots, 16; \mathrm{t} = 1, 2, \cdots, 7 \\ &\overline{\mathrm{R}^2} = 0.8012, F = 14.16, \mathrm{DW} = 2.369 \end{aligned}$$

(1) Overall, the regression equation exhibits a good fit, as the F-test indicates, demonstrating that the model accurately reflects the operational patterns of listed commercial banks in China. Regarding specific model parameters, COST passes the t-test at the 10% significance level, whereas RGDP and lnASSET pass at the 1% level. The t-test is an essential tool for evaluating the validity, robustness, and dependability of results since it helps with interpretation, validates model parameters, and determines the relevance of variables. The robustness of findings is increased due to its assistance in identifying significant contributors, improving statistical inference reliability, and bolstering trust in the stability and dependability of estimated parameters.

(2) Banks' net return on assets demonstrates a significant positive correlation with the macroeconomic growth rate at the 1% significance level, passing the t-test with a correlation value of 0.4929. The macroeconomic growth rate is an important explanatory factor for market mood, financial performance, and economic health. It is closely related to financial performance, particularly in the banking industry. Growth rates are influenced by government policy, which might indicate advantageous business settings or reduce market volatility. This implies that, after excluding the influence of other factors, the net return on assets for banks increases by about 0.49% for every 1% increase in the macroeconomic growth rate. Macroeconomic swings significantly impact the overall performance of the Chinese banking sector, and substantial economic fundamentals are the primary factor boosting bank performance. Economic fundamentals drive loan demand, enhance asset quality, and lower default rates, all of which substantially impact bank performance. Rising interest rates, growing deposits, and demand for fee-based services produce non-interest revenue. Advantageous market circumstances and a supportive regulatory framework also improve efficiency. Macroeconomic variations substantially impact the Chinese banking industry, impacting asset liability management, profitability, regulatory environment, capital adequacy, credit quality, and liquidity management. Resilience largely depends on monetary policy changes, liquidity management, and regulatory emphasis on innovation and credit growth by central banks.

(3) Banks' net return on assets exhibits a significant positive correlation with the logarithm of total asset size at the 1% significance level, passing the t-test with a correlation value of 2.622. This suggests that, without considering the influence of other factors, a 1% increase in total asset size leads to an approximately 2.6% increase in net return on assets. Chinese banks may increase the amount of money they make from non-interest sources by investing in technology, developing strategic alliances, focusing on high-value clients, expanding their fee-based service offerings, cross-selling, upselling, and maintaining regulatory compliance. Providing brokerage services, insurance products, financial advice services, and wealth management might attract new clients. This is mainly because Chinese banks have long benefited from statutory interest rate differentials for loans and deposits. Rate controls enable banks to maintain a relatively stable interest spread income. For banks to keep consistent interest spread revenue, competitive lending rates, manage deposit rates, limit interest rate risk, adhere to regulatory requirements, and react to market changes, rate controls are essential. They support the long-term sustainability of net interest margins and the overall financial success of banks. Risks that banks that depend on their conventional deposit and loan interest spread business must deal with include interest rate risk, small profit margins, sensitivity to economic cycles, low revenue diversification, competition, limited regulatory flexibility, and investor expectations. These elements may cause volatility in the market, profits, and margins. Therefore, the profitability model of banks is still highly dependent on traditional deposit and loan interest spread business.

(4) The cost-to-income ratio passes the t-test at the 10% significance level, demonstrating a strong and negative association with banks' net return on assets (correlation coefficient of -0.1246). Under the condition of other factors remaining constant, a 1% rise in the cost-to-income ratio causes the net return on assets to drop by about 0.12%. Efficiency, productivity, cost savings, quality assurance, adaptability, compliance, risk management, and customer happiness are all enhanced by standardizing management procedures. They provide workers with clear directions, optimize resource allocation, and simplify procedures. These procedures help companies function more efficiently and competitively in today's fast-paced commercial world. This indicates that implementing refined and standardized management, effectively reducing operational costs such as funding and operating expenses, is crucial for improving bank performance.

4. Conclusion

Panel data from different Chinese listed commercial banks covering the years 2008–2020 were used in this study, constructing variable intercept and variable coefficient models. The impact of non-interest revenue on the performance of commercial banks was empirically examined by adjusting for variables such as the cost-to-income ratio, bank asset size, and macroeconomic growth rate. Large state-owned banks set themselves apart from small and medium-sized joint-stock and urban commercial banks by initiating non-interest business operations early on. They possessed extensive networks, a broad selection of corporate services, and a substantial clientele comprising companies in numerous industries. The primary clientele of large state-owned commercial banks consists of medium to large enterprises; companies participate in significant transaction volumes in corporate services and are less sensitive to fee-based elements such as fees and commissions. On the other hand, they give substantial state-owned commercial banks' institutional strength, operational prowess, and reputation a top priority. Take the Industrial and Commercial Bank of China (ICBC) as an example; its annual business volume in settlement alone can account for over 50% of China's financial industry. China Bank boasts numerous overseas branches with a leading position in the foreign exchange business, demonstrating a significant advantage in non-interest business areas such as overseas remittances, foreign currency wealth management, and international settlement. Large state-owned banks, the backbone of China's banking sector, offer a broad range of non-interest revenue industries and effectively boost their profitability by attracting a sizable customer

base[12]. Urban credit cooperatives, which were first formed in the 1980s to offer services for the growth of small and medium-sized businesses and local economies, are the source of urban commercial banks. Despite significant development in recent years, their scale remains relatively small, and their profit model still heavily relies on traditional interest-based operations. Non-interest business development is still in its infancy in China, despite a steady increase in recent years, with fees and commissions dominating. Compared to traditional lending and deposit operations, these businesses have lower customer conversion costs and higher customer liquidity. However, an excess of fee-based services may lead to the loss of customer resources. In the face of external difficulties and increased interbank rivalry, raising the amount of non-interest income may result in variations in bank performance. At the same time, expanding non-interest businesses will incur various management costs. A turning point in revenue can only be reached when the scale of non-interest enterprises comes to a particular level and the fixed expenses related to staff, hardware investment, advertising, and promotion are diluted. However, reaching this point may take time and effort for shorter urban commercial banks. Additionally, non-interest income businesses are not without risks; for example, guarantee-based, financing-based, and financial derivative-based businesses may involve or generate liabilities, potentially causing losses for the bank. In the current context of narrowing interest rate spreads and the likelihood of maintaining loose monetary policies, it is crucial for many joint-stock commercial banks, considering their unique characteristics, to identify the strategic direction of development. Take China Merchants Bank, for example; it has consistently aimed to become the "best retail bank." Minimizing fees and commissions on customer services enhances its comprehensive service capabilities, successfully maintaining a stable retail customer base. With robust retail customer deposits and loan growth, it has achieved excellent overall profitability. As a result, the percentage of non-interest income and the bank's performance level are negatively correlated[16]. The strategic posture of Minsheng Bank, on the other hand, is to support private, small, and micro-enterprises. It focuses on growing and developing non-interest revenue businesses appropriate for these firms. Diverse non-interest income services are the main focus of financial services provided to small and micro-enterprises and the private sector. As a result, non-interest revenue makes up a more significant percentage of overall operating income, which indicates a strong positive association with the bank's performance level. Furthermore, CITIC Bank is actively integrating Internet finance by working with Baidu to launch "Baixin Bank," which promotes the expansion of Internet-based businesses that generate non-interest income. With the help of this creative partnership model, the bank can better serve the needs of contemporary customers, raise the percentage of non-interest income, and establish a positive relationship with its performance level. Therefore, facing intensified challenges within and outside the banking industry, formulating differentiated development strategies, maintaining the advantages of traditional businesses, and expanding different types of non-interest companies will be the optimal strategy for Chinese commercial banks to enhance profitability in the foreseeable future.

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