The Impact of Macro-Economic Environment on Probability of Non-Performing Loans in Financial Institutions

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Abstract. The rise in mortgage defaults in the banking industry highlights the connections between financial and macroeconomic shocks as well as the risk of financial instability created by credit market friction. The percentage of non-performing loans in the banking industry is assessed in this study in connection to the effects of the global economy. In order to do a regression analysis, three American banks are chosen, and the variables GDP growth, unemployment rate, real interest rate, and CPI are taken into account. The study found a significant correlation between the percentage of non-performing loans and the unemployment rate (NPL). The results of Wells Fargo indicates that there is no obvious link between GDP and NPL. There is an association between GDP expansion and the percentage of non-performing loans for Citi Bank and Bank of America. Real interest rates and NPL do not significantly affect one another. Therefore, even though some factors might not affect such probabilities, changes in the economic climate may have an impact on banks' likelihood of non-performing loans.

Keywords: Non-performing loans, GDP, Unemployment rate, CPI, Real interest rate.

1. Introduction

In recent decades, the topic of non-performing loans (NPL) has garnered increased attention. The rise in mortgage and loan defaults draws attention to the rise in financial and macroeconomic shocks as well as the link between credit market friction and the risk of financial instability. Before the bankruptcy, banks still have a significant number of bad loans. The significance of bad debt, as revealed by the close association between NPL and banking crises, explains the financial vulnerability. As a result, a bank failure is frequently caused by the high number of subprime loans in the banking sector. One of the primary causes of the issues with economic stagnation is the NPL. The likelihood that a company may experience trouble and unprofitability increases with each impaired loan in the financial industry. Financial system shocks can be caused by macroeconomic imbalances or company-specific reasons. Research conducted in developed economies has generally shown that credit risk is influenced by macroeconomic factors. This study's first objective is to pinpoint the factors that affect a bank's loan quality, especially bad loans. These variables could include macroeconomic and bank-specific data.

Researchers have looked into several variables that may affect the likelihood of non-performing loans. Gao et al. estimated the factor that determines default in China for P2P lending using the Failure Prediction Model and Decomposition Methods. The reported transaction or financial data is the primary presumption at the foundation of the failure prediction model. On the other hand, the Decomposition Method searches for the underlying causes of problems from a range of sets of factors, including internal business processes and the external business environment. In addition to NPL-related and size-related characteristics, the study reveals that ownership and interest rate style components, popularity selection factors, and timing factors also have a bigger influence on P2P platform default (bond yield and loan maturity) [1]. Lin et al. used information from a well-known P2P database to analyze what impact default risk regarding borrower demographics. It initially performed nonparametric tests to see if the variables between loans with a good status and loans that have defaulted varied significantly. Then, binary logistic regression is used to model a loan applicant's default probability. It demonstrated that borrowers with minimal default risk tend to be female, young people, long-tenured employees, happily married, highly educated, employed by large corporations, with low monthly payments, modest borrowing amounts, low debt-to-income ratios, and no prior

defaults [2]. The financial data or reported transaction serves as the primary foundation for the failure prediction model. On the other hand, the Decomposition Method searches for the root causes of issues from a variety of sets of components, including internal business processes and the external business environment [3]. Yoon et al. carried out a correlation analysis and employed the normal and logistic distribution assumptions in their model. Platform default risk is closely connected with the platform's higher average rate of return and underpricing of borrower risks (average interest rate). It discovered proof that the macroenvironment, such as changes in speculative investment opportunities or stock market conditions, play significant roles in raising the platform default rate. It clarified the platforms' difficulties with default risk and validates important variables that affect their risky actions [4].

The COVID-19 pandemic might have a huge impact. The chance of loan nonperforming was forecasted by Nguyen et al. using data from Lending Club. A logistic regression model combines the significant connections between the likelihood of defaulted loans and the borrower, loan, and credit variables. The outcomes of the non-repaid loans demonstrate how the Covid-19 pandemic's existence in this peer-to-peer market has affected the market [5]. Nigmonov and Sham employed the data of loans from Mintos (Latvia). They utilized the logit regression approach. According to our findings, the possibility of default rises from 0.056 before the COVID-19 stage to 0.079 after COVID-19. The possibility of a default in May and June of 2020 has greatly increased as a result of the COVID-19 outbreak. It also discovered that the COVID-19 risk will be felt more keenly by borrowers with lower credit scores and nations with less developed FinTech industries. When there is a pandemic or when there is significant economic turmoil, there are risks linked with FinTech loans [6].

Data processing and investigation have been done using a variety of research techniques. Maggio and Yao used unique individual-level data from traditional and fintech lenders to study the personal credit market. The study looked at whether the risk of default for fintech loans 15 months after issuance is higher or lower. It started by comparing the cross-sectional outcomes of the different loans. In addition to the regression findings comparing the performance of loans made with and without fintech, it also published the results of a regression analysis comparing the ex-post performance of loans made with and without fintech in the sample. When comparing neighboring persons with the same qualities who borrow from traditional banking institutions to fintech borrowers, default rates are noticeably higher. Furthermore, they frequently see a temporary decrease in the cost of credit since, after loan origination, their level of debt increases faster than that of non-fintech borrowers [7]. Fuster et al. outlined the various prediction techniques used to calculate the likelihood that mortgages generated in our data set will default. To characterize the estimation techniques, the research utilized the terms observable qualities (x), and loan interest rate (R). Besides, conditional probability of default is also considered ($P(x,R)=Pr(Default|x,R)$). After that, it uses projected default probabilities to analyze how different statistical methods impact mortgage lending. The major conclusion of the study is that more dispersed statistical predictions with higher accuracy are obtained when the projected outcome variable is more closely matched (in our setting, the probability of mortgage default). [8]. Ginting and Nugroho put the Almant Z-Score and Equity Duration Models to the test. The outcome demonstrates that both approaches produced identical outcomes. The Altman Z-Score and Equity Duration results, which are supported by the validity of the data, show that the enterprises asking for a suspension of their debt payment obligations are primarily in trouble or have a long or negative duration [9]. Using county and state level data, Dettling and Lambie-Hanson created a straightforward multivariate regression model. They managed to examine the relationship between the likelihood of default and cases, governmental policy responses, and also economic circumstances. It investigated the connections between governmental activities, changing economic conditions, and borrowers' debt repayment behavior. It offers fresh proof that although the epidemic has adversely affected households' ability to pay their debts, many families have so far avoided default thanks to forbearance programs and government financial assistance [10].

This study will evaluate the impact of the macroeconomic environment on the probability of NPL in financial institutions. In section 2 Methodology, there will be a regression analysis of the rate of NPL and GDP growth, CPI, real interest rate, and unemployment rate. In section 3, the result will be

displayed. Financial ratios will be compared to understand the different financial situations of each bank. In section 4, this study will discuss the reason for the results. In section 5, the study will make a conclusion discussing the main findings and inspiration.

2. Methodology

2.1 Data Selection

The United States Census Bureau will provide the macroenvironment data used in this study. Three US banks are chosen to measure the rate of NPL from 2002 to 2021, including Bank of America, Wells Fargo & Co, and Citi Bank. The data are from each bank's annual reports.

Bank of America is one of the biggest banks in the country, providing a variety of banking services and goods, such as personal banking, international wealth and investment management, and worldwide banking. Wells Fargo & Co. is a diversified financial services corporation that provides three categories of services: personal, small business, and commercial. These services are provided through community banking, wholesale banking, wealth management, and investment management. With its headquarters in New York City, Citi Bank is a global investment bank and provider of financial services. Through Citi and Citi Holdings, Citi Bank offers financial goods and services to individuals, companies, governments, and organizations all over the world.

2.2 Model

The ratio of bad loans is measured by an allowance for loan losses on loans (ACLL) as a percentage of end-of-period loans. This study will use a regression model to measure the influence of the macro-environment on the ratio of a bad loan.

$$P_i = \beta_1 G_i + \beta_2 CPI_i + \beta_3 R_i + \beta_4 UN_i + \beta_0 \quad (1)$$

The bad loan rate is denoted by P. G represents the Consumer Price Index (CPI), UN is for the unemployment rate, and R stands for the real interest rate, which has been adjusted to account for inflation. β1, β2 and β3 respectively refer to the coefficients of variables.

3. Results

Table 1 lists the three banks' coefficients and accompanying t-values. The findings indicate a correlation between the ratio of problematic loans and the unemployment rate that is favorable. An incline in GDP leads to a decrease in the NPL of Citi Bank and Bank of America. There is no significant relationship between NPL and the real interest rate of CPI.

Table. 1 The coefficients of determinants of bad debt ratio

	Wells Fargo & Co		Citi Bank		Bank of America	
	Coefficient (10^{-3})	t-value	coefficient (10^{-3})	t-value	coefficient (10^{-3})	t-value
G	-0.337	-1.060	-1.628	-3.233	-2.680	-4.583
R	-0.002	-0.005	-1.085	-1.283	1.084	1.103
CPI	0.444	1.219	1.127	1.625	0.811	1.008
UN	3.294	10.005	7.616	12.735	4.027	5.801

Figure 1 and Figure 2 represent the financial ratios of the three banks.

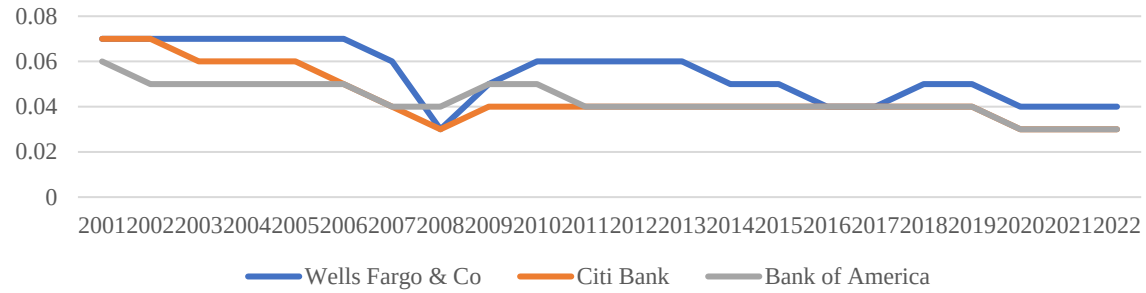

Fig. 1 The asset turnover ratio of three banks

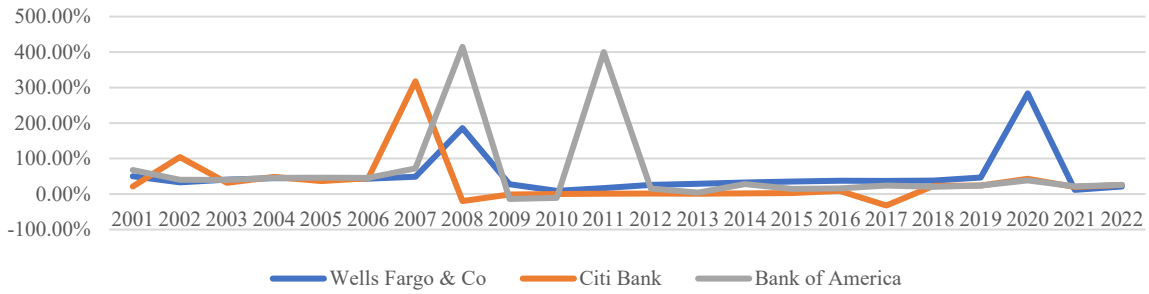

Fig. 2 The payout ratio of three banks

4. Discussion

For Citi Bank and Bank of America, the results discovered demonstrate a considerable and adverse association between the growth rate of GDP and NPL, which is quite compatible with the idea. The non-performing loan portfolios of commercial banks are declining as the actual economy improves. For Wells Fargo, the result is not significant. This may also represent the financial ratios of Wells Fargo, compared to Citi Bank and Bank of America. The asset turnover of Wells Fargo is relatively higher, which means it is more efficient when using its asset, including accounts receivables, to generate revenue. The special situation of Wells Fargo may be accounted for by its policies, compared to other banks. Wells Fargo diverged from other major U.S. commercial banks in the 1980s by choosing to hold firm and adhere to its traditional business model in contrast to JP Morgan Chase, Citibank, and other large banks that made investment banking a focus of their development and aggressively expanded their investment and brokerage businesses. Wells Fargo has always aimed to be "one of the top financial institutions on a global scale," so it's not like it lacks an ambitious internationalization objective. However, in actuality, Wells Fargo's ambitions are in stark contrast to the global expansion plans of significant banking organizations like Citi and HSBC, whose significant acquisitions have been undertaken domestically. Wells Fargo insisted on community banking as its primary business and decided to maintain its long-standing corporate position of commercial banking. Wells Fargo's core businesses have three lines, including community banking, wholesale banking, and wealth management. The largest portion of Wells Fargo's income comes from community banking. Offering complete and varied financial services to consumers and small businesses is its main goal.

This analysis discovers a strong and favorable correlation between the unemployment rate and the proportion of non-performing loans in all three banks. Clients without jobs frequently struggle to carry out their obligations and make their debt payments, which raises the number of non-performing loans. In this example, families, enterprises, and their ability to pay their loans all have a significant impact on the dynamics of the two variables (GDP growth rate and unemployment rate).

According to this study, the percentage of non-performing loans in each of the three banks and the unemployment rate are positively and significantly correlated. Unemployed customers typically

struggle to carry out their obligations and pay off debts, which raises the number of non-performing loans. Residents may still have enough money to pay their bills during an inflationary period because of household reserves or worries about their credit scores. The relationship between real interest rate and NPL is not significant in this study. A higher interest rate may connect to higher interest payments. On the other hand, when there is an economic recession, the bank would decrease its interest rate. However, clients' capacity to repay debt would also decrease.

5. Conclusion

This study mainly estimated the correlation between the macroeconomic environment and the rate of NPL. Three banks are conducted to make a regression analysis of GDP growth, unemployment rate, real interest rate, and CPI. The study found out there is a positive relationship between unemployment rates. This may suggest when clients face an unemployment crisis, they are more likely not to repay their loans. For GDP growth, Citi bank and Bank of America have a significant relationship while Wells Fargo does not. This difference may be explained by Wells Fargo's policy that it insists on traditional commercial banking. For real interest rate and CPI, there is no significant relationship found between them and NPL. Price and interest rate may be an indicator of the macro-economic environment but may not influence the ability of clients to cover their debts. Consequently, there is a correlation between the macro-environment and the rate of NPL. When there is an economic recession, the banks may need to promote corresponding policies to have a healthier capital structure, and operation environment, thus handling higher credit risk and a higher rate of non-performing loans.

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