Macrothink Institute™

International Journal of Accounting and Financial Reporting
ISSN 2162-3082
2024, Vol. 14, No. 2

Financial Liberalization and Banking Risks in the Waemu Zone: Do Fintechs Matter?

PRAO Yao Séraphin

Associate Professor, Alassane Ouattara University (Bouaké)

LAMPE- Laboratory of Economic Policies' Analysis and Modeling, Ivory Coast

E-mail: praoseraph@gmail.com

https://orcid.org/0000-0002-7782-8442

Received: April 6, 2024 Accepted: May 5, 2024 Published: June 16, 2024

doi: 10.5296/ijafr.v14i2.21990 URL: https://doi.org/10.5296/ijafr.v14i2.21990

Abstract

This study aims to examine the role of fintech development in the relationship between financial liberalization and banking risks in WAEMU countries. To do this, we used macroeconomic data from WAEMU countries, except of Guinea Bissau, due to lack of data, over the period 2011-2021. Methodologically, we use the PCSE (Panel-Corrected Standard Error) method of Beck and Katz (1995). The results revealed that fintechs amplify the banking risk reduction effect of financial liberalization. In terms of economic policy implications, the study suggests that the authorities should step up the process of financial liberalization and pay particular attention to adequate regulation of fintechs.

Keywords: Financial liberalization, Fintech, Banking risks, WAEMU, PCSE

JEL Classification Numbers: G21, G23, G28; E44; O33

1. Introduction

The financial liberalization developed by McKinnon (1973) and Shaw (1973) in the 1970s is a replica of financial repression, in which state intervention was the major element in financial development. Indeed, financial repression can be defined as a situation in which the activities of commercial banks and financial institutions are closely supervised by public authorities. It takes the form of restrictive and regulatory measures, such as the administrative setting of interest rates or exchange controls. In contrast, financial liberalization is defined as the process of dismantling all forms of restrictive quantitative or qualitative regulatory control imposed by the state on financial structures, not only domestically but also internationally (Boyer, 2004). In practice, financial liberalization policies applied in

developing countries advocated the total abandonment of lax monetary policies, the removal of ceilings imposed by monetary authorities on interest rates, and the cessation of the policy of targeting credit to sectors determined by the state rather than the market. According to McKinnon (1973) and Shaw (1973), liberalization of the financial system promotes more efficient financial intermediation and a more optimal allocation of resources. Moreover, by allowing banks to set their interest rates freely, financial liberalization improves the performance of the financial system and contributes to economic development (Lensink & Hermes, 2004; Levine, 2001). From a theoretical standpoint, however, financial liberalization does not meet with unanimous approval in the literature. It exacerbates macroeconomic cyclical fluctuations and amplifies the fragility of financial institutions, thereby increasing the likelihood of a financial crisis (Cubillas and Gonz á lez, 2014; Hamdi et al., 2013). Indeed, internally, financial liberalization can foster increased competition between banks, which could exacerbate excessive risk-taking. Externally, financial liberalization promotes large and volatile capital flows, creating imbalances in domestic financial markets and increased exchange rate and interest rate volatility. In addition, financial liberalization leads to interconnection between financial markets, with all the advantages and disadvantages that this can bring. However, liberalization could open the door to technological advances and innovative practices that can improve risk management and reduce costs. A Fintech is a company that develops innovative digital technology to optimize a financial service.

Fintechs reduce transaction costs and increase accessibility to financial services. Authors such as Lapavitsas and Dos Santos (2008) and Oikonomou et al. (2023), argue that the development of fintechs can reduce traditional banks' information asymmetry, and banks' transaction friction costs, thus improving banks' level of risk management. Julapa and Kose (2018) suggest that fintechs can bring financial services to underserved areas. Furthermore, Chen et al. (2019) find that innovations hurt financial sectors when they involve disruptive technologies from non-financial startups. It thus appears that the link between financial liberalization, fintech development, and banking risks is a relevant research topic. Financial liberalization can promote market opening and economic integration, but it can also expose banks to significant risks. In light of these findings, the following research question can be posed: What is the role of fintechs in the relationship between financial liberalization and banking risks in the WAEMU zone? From this central question, three secondary questions follow:

- What is the effect of financial liberalization on banking risks?
- What is the effect of fintech development on banking risks?
- What influence does the development of fintech have on the relationship between financial liberalization and banking risk

Thus, the main objective of this study is to analyze the role of fintechs in the relationship between liberalization and banking risks in the WAEMU zone. Specifically, it aims to: (i) determine the effect of financial liberalization on banking risks, (ii) identify the effect of fintech development on banking risks, and (iii) examine the effect of fintech development in the relationship between financial liberalization and banking risks. In this research, we start

from the general hypothesis that fintechs accentuate the effect of liberalization on banking risks. The first secondary hypothesis is that financial liberalization reduces banking risk. The second is that the development of fintechs increases banking risks. The third is that the development of fintechs improves the effect of financial liberalization on banking risks.

At a time of exponential growth in financial technologies and artificial intelligence, it seems crucial to understand the effect of such innovations on banking risks in the WAEMU zone. To carry out our study, we mobilize the PCSE estimator of Beck and Katz (1995) for its advantages and its ability to correct standard errors, namely autocorrelation, and heteroscedasticity. In addition, the study is carried out on WAEMU countries, except Guinea-Bissau for lack of data, over the period 2011-2021.

The remainder of the paper is organized as follows. Section 2 presents the theoretical and empirical literature review on financial liberalization, fintech development and banking risks. Section 3 presents the methodology and a description of the variables used. The fourth section deals with data sources and descriptive analysis. The fifth presents the estimation results, and the sixth section is a conclusion.

2. Literature Review on Financial Liberalization, Fintech Development and Banking Risks

This section reviews theoretical and empirical contributions on the relationship between financial liberalization, fintech development, and banking risks.

2.1 Theoretical Contributions

We first look at the relationship between financial liberalization and banking risk, then at the link between fintech development and banking risk. About the theoretical relationship between financial liberalization and banking risk, two points of view are possible: a positive relationship and a negative one. For McKinnon (1973) and Shaw (1973), financial liberalization implies that increased competition between banks encourages financial development, by raising interest rates capable of attracting bank deposits, favorable to the distribution of credit (Denizer et al. 2007). It can reduce banking risks by promoting risk diversification and encouraging competition and innovation (Caprio and Honohan, 2001). In addition, risk diversification can enable banks to better withstand financial crises by limiting the impact of losses on their overall portfolio. With its corollary of relaxed financial regulation, financial liberalization enables banks to better meet the financing needs of the economy, thereby reducing the risk of financial crises (Calomiris and Haber, 2015). For his part, Levine (1997) argues that financial liberalization can reduce banking risk by encouraging banks to adopt more sophisticated risk management practices and diversify their loan portfolios. Indeed, liberalization encourages banks to lend to more productive sectors of the economy, thereby reducing banking risk while stimulating economic growth. However, while financial liberalization tends to reduce banking risks, it can also contribute to increasing them. Many authors believe that financial liberalization could increase banking risk. Financial liberalization increases banking risk insofar as it increases market risk due to deregulation. Claessens and Horen (2012) examine the impact of the presence of foreign banks on the stability of domestic countries. They find that the increase in the number of banks, facilitated by financial

liberalization, can increase banking risks and undermine financial stability, due to banking competition. Financial liberalization can increase banking risks due to greater capital flows and banks' exposure to exchange rate and interest rate risks (Ghosh et al. 2011). In addition, financial liberalization can lead to an increase in foreign currency debt, exposing banks to foreign exchange risks. According to Barth et al (1998), financial liberalization may encourage banks to take excessive risks to achieve high profits, which may also increase the risk of bank failure. For Dell'Ariccia and Marquez (2006), financial liberalization pushes banks to take greater risks and be less rigorous in their credit supply. Moreover, financial crises have multiplied in emerging countries that have implemented financial liberalization policies (Cartapanis and Gilles, 2003).

Regarding the theoretical link of the effects of fintech development on banking risks, it is possible to record both positive and negative effects. Philippon (2019) argues that fintechs can reduce banking risks by improving the efficiency and transparency of the financial sector. They can reduce the costs of providing financial services by using innovative technologies, such as automation and artificial intelligence. They can also improve the transparency of financial services by providing clearer, more accessible information to consumers. According to Yermack (2017), blockchain-based fintechs can reduce banking risks by improving the transparency and traceability of financial transactions. They can even play an important role in improving financial regulation, thanks to their ability to collect and analyze large amounts of financial data in real-time (Arner et al. 2015). Above all, fintechs can help strengthen market discipline, reducing the risks of moral behavior by financial institutions (Cecchetti and Schoenholtz 2016). Similarly Deng et al (2021) use annual report data from 155 small and medium-sized banks from 2011 to 2016, to analyze the relationship between Fintech and banks' risk-taking behavior. They find that the development of Fintech has significantly reduced banks' level of risk-taking. Muganyi et al (2022) examine the influence of fintech on the development of China's financial sector in 290 cities and 31 provinces between 2011 and 2018. The results establish a positive link between fintech and financial development. These results show that fintech supports financial sector development by improving access (lending), depth (deposits) and savings within Chinese financial institutions. Some authors have shown that the development of fintechs could entail several banking risks, by offering unregulated financial services (Beck et al. 2018).

2.2 Empirical Contributions

The relationship between financial liberalization and banking risk has been the subject of numerous empirical studies, in different parts of the world, with different contexts. The work of Wang and Luo (2019) examines the effect of financial liberalization on bank risk-taking, using banking data from 169 Chinese banks from 2000 to 2014. The results indicate that banking stability increases with the implementation of financial liberalization policies. Demirgüç-Kunt and Detragiache (1998) examined the determinants of banking crises, in 20 developed and 25 developing countries, over the period 1980-1994. Using a logistic regression model, the results show that financial liberalization increases banking risks due to greater capital flows and banks' exposure to exchange rate and interest rate risks. Using a sample of 4,333 banks from 83 countries over the period 1991-2007, Cubillas and González (2014) analyze the effect of financial liberalization on bank risk-taking, using a GMM model. The results indicate that

financial liberalization increases bank risk-taking, both in developed and developing countries, but through different channels. Exploring the relationship between financial liberalization and banking crises, using data from 73 banks in Greece, Malaysia, Mexico, Taiwan and Thailand, Klaus and Chenard (1998) indicate that financial liberalization increases the fragility of the banking system, thus accentuating the probability of bank failure. Similarly, Mehrez and Kaufmann (2000) study the effect of financial liberalization on the probability of a banking crisis in 56 developed and developing countries, over the period 1977-1997. The results indicate that the probability of a crisis is higher in the period following financial liberalization, particularly in countries with weak institutions.

On the link between the development of fintechs and banking risks, studies exist in both developed and developing countries. In the USA, Fuster et al. (2019) showed that Fintech companies process loan applications 20% faster than traditional banks. However, Buchak et al. (2018), for the case of the United States, conclude that Fintechs benefit banks in terms of convenience for borrowers and lower credit costs. Li et al. (2023) evaluate the impact of fintech on the Chinese banking sector between 2008 and 2017 and show the development of fintech improves the total factor productivity of Chinese commercial banks, reducing the operating costs of banks, and improving the efficiency of services. Additionally, Nguyen and Dang (2022) examine the impact of financial technology development on financial stability in an emerging market. Using data from 37 commercial banks in Vietnam, over the period 2010-2020, the study found that FinTech development hurt financial stability and that market discipline could mitigate this effect. Nevertheless, the negative effect of FinTech development on financial stability is stronger when the degree of financial stability is low, and the role of market discipline becomes more important in such a situation. Yudaruddin et al. (2023) used a sample of 141 banks in Indonesia, during the period 2004-2018, to study the impact of financial technology (FinTech) companies on banking stability. They note that FinTechs contribute to improving banking stability.

For the cases of China, India, Pakistan, and Bangladesh, over the period 2014 to 2021, Sajid et al. (2023) show that fintech products reduce banking risks by improving the operational efficiency of the bank.

Allen et al. (2014) examine the impact of fintech on financial inclusion and financial stability in sub-Saharan African countries. The results show that increased use of fintechs, including mobile banking, is associated with greater financial inclusion, but may also increase financial stability risks.

3. Study Methodology

We first present the study model and the definition of the variables. Secondly, the estimation method will be discussed, and thirdly, preliminary tests.

3.1 Specification of the Empirical Model and Description of the Variables

For this study, we draw inspiration from the work of Wang and Luo (2019) who examine the effect of financial liberalization on bank risk-taking, using banking data from 169 Chinese banks from 2000 to 2014. To study the role of financial liberalization on banking risks, the authors use the following model:

$$Risk_{i,t} = \gamma_0 + \gamma_1 \cdot FL_t + \gamma_2 \cdot BankChar_{i,t-1} + \gamma_3 \cdot Macro_t + Year_t + f_i + \epsilon_{i,t}. \quad (1)$$

In this expression, i and t represent bank i in year t. $\boldsymbol{Risk_{it}}$ represents the actions that banking risks take. $\boldsymbol{FL_t}$ reflects the process of financial liberalization. $\boldsymbol{BankChar}_{it}$ and $\boldsymbol{Macro}_t$ indicate the series of bank characteristics and macroeconomic variables. $\boldsymbol{Year_t}$ is a dummy year. The variable $\boldsymbol{fi}$ is the bank-specific effect, invariant over time. $\epsilon_{i,t}$ represents the idiosyncratic error. To alleviate the endogeneity problem, a one-year lag for each bank characteristic variable is used. The baseline model is estimated by a bank-specific fixed effects method, and robust standard errors clustered at the bank level are used.

In our research, we include fintechs to analyze the existing relationship between financial liberalization and banking risks, which leads us to add an interaction variable to the model. In addition, our study is carried out on the WAEMU banking sector as a whole and not on individual banks.

In its functional form, the equation to be estimated can be written as follows:

$$PNP = \mathit{f}(LIBFIN, FINTECH, LIBTECH, RLIQ, CAR, \text{SIZE}, POLMON) \quad (2)$$

In econometric form, the regression model is as follows:

$$PNP_{it} = \beta_i + \beta_1 LIBFIN_{it} + \beta_2 FINTECH_{it} + \beta_3 LIBTECH_{it} + \beta_4 RLIQ_{it} + \beta_5 \text{SIZE}_{it} + \beta_6 CAR_{it} + \beta_7 POLMON_{it} + \varepsilon_{it} \quad (3)$$

X_{it}: represents the value of the variable X of individual i observed on date t.

β: represents the coefficients of the exogenous variables for individual i.

β_i: captures individual specific effects.

ε_{it} represents the error term.

The variable $\boldsymbol{PNP_{it}}$ represents non-performing loans as a proxy for bank risk. This is the variable to be explained in our study. This ratio measures the proportion of the institution's loans for which there is a high risk of non-repayment or payment default. It is an indicator of the fragility of banks (Quagliariello, 2007). In our study, it was measured by dividing the value of provisions for risks and charges by customer receivables.

The variable $\boldsymbol{LIBFIN_{it}}$ represents the financial liberalization index. We use here the KOF globalization index, which is made up of different elements that reflect different aspects of the opening of financial markets and economic integration between countries, namely, foreign direct investments, portfolio investment, international debt, international reserves, and international income payments. According to McKinnon and Shaw (1973), financial liberalization policies aim to improve the efficiency of the financial system, reduce risks, and meet new financial needs. We can therefore expect a negative effect on non-performing loans.

The $\boldsymbol{FINTECH_{it}}$variable represents the usage rate of mobile banking services. In our study, we use the rate of use of mobile banking services as an indicator of fintechs. Mobile banking

services determine the level of development of fintechs as well as their frequency of use.

The $\boldsymbol{LIBTECH_{it}}$ variable represents the interaction between financial liberalization and fintechs. We include the interaction variable financial liberalization*fintechs (Lib*fintechs) in our study to examine how the interaction between these two factors influences banking risk. Thus, we can assess how these changes jointly affect banking risk.

Subsequently, we use four control variables, which are $\boldsymbol{RLIQ_{it}}$the liquidity ratio, $\boldsymbol{SIZE_{it}}$ the size of the bank, $\boldsymbol{CAR_{it}}$ the capitalization ratio, $\boldsymbol{POLMON_{it}}$ the monetary policy.

Regarding $\boldsymbol{RLIQ_{it}}$, which measures the liquidity of a bank, it is measured by the ratio of bank liquidity to total deposits, also known as the liquidity ratio. This indicator helps assess a bank's ability to ensure the availability of liquidity necessary to meet depositor withdrawals and to meet other financial obligations. The higher the ratio, the lower the level of banking risk (Vithessonthi, 2014).

The variable $\boldsymbol{SIZE_{it}}$, measures the size of the bank. Louzis et al. (2012) argue that larger banks face less risk. Several authors show the existence of a negative relationship between size and bank risk (Baselga-Pascual et al., 2015; Gul and Cho, 2019). Bank size is approximated by the logarithm of total bank assets.

The $\boldsymbol{CAR_{it}}$ variable is the capital adequacy ratio, dividing equity by the bank's total assets. The Basel Accords require banks to maintain a capital ratio of at least 8% of risk-weighted assets, which guarantees a minimum level of capital to cover their obligations in the event of bankruptcy. Vazquez and Federico (2015) found that banks with low capitalization and high leverage are mainly exposed to bankruptcy risk. In contrast, well-capitalized banks tend to have high returns on their assets, which helps ensure the stability of the banking system (Demirgüç-Kunt & Huizinga, 2010). A higher ratio indicates increased strength of the bank and should therefore reduce non-performing loans.

Finally, the variable $\boldsymbol{POLMON_{it}}$ measures monetary policy. In our study, we used the money supply as a percentage of GDP as an indicator of monetary policy because it reflects the amount of liquidity available in the economy. Indeed, when the central bank adopts an expansionary monetary policy, it aims to increase the quantity of money in circulation to stimulate economic activity. On the other hand, when it adopts a restrictive monetary policy, it seeks to reduce inflation or curb excessive growth in the economy. Thus, a rapid increase in the money supply can stimulate economic activity and reduce the proportion of non-performing loans. However, excessive money supply growth can lead to economic imbalances and increased credit risks, thereby promoting non-performing loans.

3.2 Estimation Method

To highlight the role of fintech development in the relationship between financial liberalization and banking risks in WAEMU countries, our study adopts the panel-corrected standard errors (PCSE) method. Indeed, the analysis of panel data is often faced with problems of heteroskedasticity and temporal and spatial dependence in the residuals. In an early attempt to account for heteroscedasticity as well as temporal and spatial dependence in

the residuals of panel models, Parks (1967) proposed a feasible algorithm based on generalized least squares (FGLS) which became more popular thanks to Kmenta (1986). However, Beck and Katz (1995) showed that the Parks-Kmenta method tends to produce unacceptably small standard error estimates. To alleviate this problem of the Parks-Kmenta method, Beck and Katz (1995) suggest relying on OLS coefficient estimates with panel-corrected standard errors (PCSEs). However, the PCSE estimators are not the best when the cross-sectional dimension N of the panel is large compared to the temporal dimension T. In our case, the temporal dimension being greater than the individual dimension, the PCSE method turns out to be the best suited to achieving our objective. The PCSEs thus correct the heteroskedasticity of the panel and the spatial correlation. When panel heteroscedasticity and spatial correlation are present, ordinary least squares estimates are inefficient and their standard errors are inaccurate. An accurate estimate of the variability of ordinary least squares estimates can only be obtained if the standard error is corrected. This correction takes into account spatial correlation and heteroskedasticity of panel errors, but any form of serial correlation must be taken into account before the specific panel-corrected errors are calculated.

Ultimately, the PCSE method retains the parameters estimated by ordinary least squares (OLS) while considering the standard errors as biased. Then, these biased standard errors are replaced by new standard errors (panel-corrected standard errors or PCSEs) obtained after taking into account the temporal and spatial autocorrelations.

3.3 Presentation of Preliminary Tests

As the study focuses on panel data, we will carry out a homogeneity test, a Breusch Pagan dependence test, and then a Hausman test.

● Fisher's Homogeneity Test

In the case of panel data, the choice of specification (homogeneity or heterogeneity) is of crucial importance. This test helps determine the panel structure, i.e. whether it is a panel structure where observations are linked to specific individuals or a stacked data structure where observations are simply stacked on top of each other. From an econometric point of view, this test aims to evaluate whether the coefficients of the model studied are equal in the individual dimension. On an economic level, it is a question of verifying whether we can assume that the theoretical model studied is identical for all countries (homogeneous panel) or whether there are particularities specific to each country (heterogeneous panel). Here we apply the Fisher test which consists of choosing between a homogeneous panel and a heterogeneous panel. Hypothesis H_0 is that the panel is homogeneous and Hypothesis H_1 the panel is heterogeneous. As a decision criterion, we reject the null hypothesis if the p-value is less than the threshold of 5% and we accept the Panel Heterogeneity Hypothesis.

● Hausman Test

The dependence test is used to choose the most appropriate unit root tests for our study model. To do this, we estimate both a fixed effects model and a random effects model. However, it should be noted that the dependence test is only applicable to heterogeneous panels with fixed

effects. Therefore, before performing the dependence test, we must first perform the Hausman (1978) test. This test compares the parameter estimates between the fixed effects model and the random effects model. The assumptions underlying this test are as follows. Hypothesis H_0 is that the model is random effects and hypothesis H_1 the model is fixed effects. As a decision criterion, if the calculated statistic is below the threshold of 5%, then the null hypothesis H_0 is rejected and we conclude that our model is a fixed effects model. On the other hand, if the calculated statistic is greater than the 5% threshold, then the null hypothesis cannot be rejected. In this case, we conclude that our model is random effects.

● Dependence Test

The interindividual dependence test makes it possible to choose the unit root tests best suited to our study model. We have two possibilities: the Breusch-Pagan interindividual dependence test (1980) and the Pesaran interindividual dependence test (2004). We choose the Breusch-Pagan (1980) interindividual dependence test when the panel has a temporal dimension greater than the individual dimension (T > N), otherwise, we choose the Pesaran test (2004). Given that our study period (T) is greater than the number of individuals (N), we will use the Breush-Pagan (1980) interindividual dependence test to test the hypothesis of non-dependence between individuals. The test hypotheses are as follows. Hypothesis H_0 is that there is interindividual independence and random effects and hypothesis H_1 is that there is interindividual dependence. To make the choice, if the p-value is lower than the threshold of 5%, then we reject the hypothesis H_0 and we accept the hypothesis of interindividual dependence.

4. Data Sources and Descriptive Analyses

This section presents firstly, the sources of the data and, secondly, the descriptive statistics.

4.1 Data Sources and Descriptive Analysis

The study uses annual data from the 7 WAEMU countries covering the period 2011-2021. The choice of this period and the number of countries is linked to data availability. We exclude Guinea Bissau due to insufficient data. Our data comes from the BCEAO (2023), the World Bank (2023), and the KOF Globalization Index (2023). Table 1 presents the description of the variables, their symbol, the unit of measurement the data sources, and the expected signs of the coefficients.

Table 1. Summary of variables, expected sign, and data sources

Variables	Description	Sources	Expected signs
Non-performing loans (NPLs)	The proportion of loans for which there is a high risk of non-repayment or payment default.	BCEAO (2023)	
Financial liberalization (LIBFIN)	The process of lifting restrictions and controls on financial activities and capital flows within an economy.	KOF (2023)	Negative (-)
Fintechs (FIN)	The rate of use of electronic money services	BCEAO (2023)	Negative (-)
Liberalization*fintechs (LIBTECH)	The interaction variable between liberalization and fintech	KOF and BCEAO (2023)	Positif (+)
Liquidity (RLIQ)	The ratio of liquid assets to total assets (%)	World Bank (2023)	Negative (-)
Bank size (SIZE)	Natural logarithm of total bank assets	BCEAO (2023)	Negative (-)
Capitalization (CAR)	The ratio of equity to total assets (%)	BCEAO (2023)	Negative (-)
Monetary Policy (POLMON)	The money supply in circulation (% GDP)	World Bank (2023)	Ambiguë (+/-)

Source: Author based on literature

4.2 Descriptive Analysis

Table 2 presents the descriptive statistics of the data. It presents the respective mean values and standard deviations as well as the minimum and maximum values of the variables used. The mean value shows the average value of the variable and the standard deviation shows how much it deviates from the mean value.

Table 2. Descriptive Statistics of Variables

Variables	Mean	Standard deviation	Min	Max	Observations
PNP	6.615	4.963	0.086	22.524	77
LIBFIN	55.353	11.548	30.905	78.497	77
FINTECH	40.564	35.282	0.12	99.11	77
RLIQ	9.905	3.837	4.490	22.893	77
SIZE	4.548	0.291	3.883	5.096	77
CAR	8.162	2.697	2.759	13.348	77
POLMON	31.096	8.702	14.261	51.028	77

Source: Author, based on data from BCEAO (2023), KOF (2023), WDI (2023)

The average non-performing loans (NPL) in the WAEMU zone during the period 2011-2021 is 6.61%, with a maximum value of 22.52% and a minimum value of 0.086%. Banks in the area therefore recorded a fairly low ratio of non-performing loans. The financial liberalization index (LIBFIN) has an average of 55.33% with a standard deviation of 11.54% and ranges from 30.90% to 78.49%. The standard deviation is lower than the average shows us that the proportions are relatively similar in all the countries in the region. Furthermore, fintechs (FINTECH) have an average of 40.56% with a minimum value of 0.12% and a maximum value of 99.11%. This high variation between the minimum and maximum value of fintechs indicates a large dispersion in the usage rates of electronic money services. Some individuals or entities may have very low utilization rates, while others may have very high utilization rates. In addition, the bank capital ratio (CAR) records an average of 8.16%, which is within the standards of 8% that Basel III proposes. This indicates that banks respect this threshold which allows them to cover themselves against possible risks. Furthermore, monetary policy (POLMON) has an average of 31.09% with a standard deviation of 8.70% and ranges between 14.26% and 51.02%. These data suggest a monetary policy that exhibits some volatility and diversity in the actions taken. This may reflect a need for frequent adjustment in response to economic developments or specific monetary policy objectives. The results of the correlation matrix of the respective variables are also presented in Table 3. This involves determining the degree of correlation between each of the explanatory variables and the explained variable. Additionally, we will seek to assess whether there is a strong or weak correlation between the explanatory variables themselves. The analysis of the results recorded in Table 3 allows us to determine whether or not there is a strong correlation between the variables studied.

Table 3. Correlation matrix between variables

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*
(1) PNP	*1.0000*						
(2) LIB_FIN	*-0.2040*	*1.0000*					
(3) FINTECH	*0.1978*	*0.2680**	*1.0000*				
(4) RLIQ	*-0.2298**	*-0.1355*	*-0.1135*	*1.0000*			
(5) TAILLE	*0.0065*	*0.3063**	*0.6685**	*0.0724*	*1.0000*		
(6) CAR	*-0.1306*	*-0.2825**	*-0.7544**	*0.3268**	*-0.5479**	*1.0000*	
(7) POL_MON	*0.0757*	*0.6639**	*0.6469**	*-0.2534**	*0.5471**	*-0.734**	*1.0000*

Source: Author, based on data from BCEAO (2023), KOF (2023), WDI (2023)

Note: * denotes the significance of the correlation at the 5% threshold.

Thus, the matrix shows us that the FINTECH, SIZE, and POLMON variables are positively correlated with non-performing loans, while the LIBFIN, RLIQ, and CAR variables are negatively correlated with non-performing loans. The majority of correlations are weak except of a few, in particular, that between CAR and FINTECH which turns out to be the highest, with a coefficient, in absolute value, of 0.7544. To prevent any spurious regression problems, we carry out the VIF (Variance Inflation Factor) test. The results of this test are presented in Table 4 below, aimed at determining whether there is a possible presence of multicollinearity between the variables. According to Guijarati et al. (2009), if the VIF value is greater than 10, then there is strong multicollinearity. The results in Table 4 indicate that none of the VIF values are greater than 10 and their mean is less than 5. This implies that multicollinearity is not a problem in this study if we use all variables in the regression.

Table 4. Multicollinearity Test (VIF)

Variables	**VIF**	**1/VIF**
POLMON	4.51	0.221
CAR	3.74	0.267
FINTECH	3.05	0.328
LIBFIN	2.16	0.462
SIZE	2.04	0.489
RLIQ	1.27	0.784
MEAN VIF	2.80	

Source: Author, based on data from BCEAO (2023), KOF (2023), WDI (2023)

5. Estimation Results

This section first presents the results of the econometric tests before moving on to those of the estimations.

5.1 Econometric Tests

We need to examine the results of the homogeneity test, the Hausman test, and the dependence test.

■ Homogeneity Test

We present here the result of the homogeneity test. The results of the test presented in Table 5 show that the p-value associated with the test statistic is less than 5%. We therefore reject the null hypothesis and conclude that the panel is heterogeneous at the 5% threshold. Thus, there is the presence of a specific effect.

Table 5. Results of the homogeneity test

F(6, 70) =	3.07
Prob > F =	0.0101

Source: Author, based on data from BCEAO (2023), KOF (2023), WDI (2023)

To determine whether it is a fixed or random effect, we perform the Hausman test, the results of which are recorded in Table 6.

■ Hausman Test

The results obtained following the completion of the Hausman test, recorded in Table 6, indicate that the probability associated with the test statistic is less than 1%. It follows that the null hypothesis of random effect cannot be retained, so we are in the presence of a fixed effect model.

Table 6. Hausman test results

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B) =	56.55
Prob > chi2 = 0.0000	

Source: Author, based on data from BCEAO (2023), KOF (2023), WDI (2023)

We can now apply Breusch Pagan's (1980) interindividual dependence test.

■ Breusch Pagan interindividual dependence test (1980)

Given that the study period (T) is greater than the number of individuals (N), we use the Breusch-Pagan (1980) dependence test to evaluate the hypothesis of non-dependence between individuals. Furthermore, this test only applies to fixed effects models, which is our case here, as confirmed by the Hausman test carried out previously. The results of the Breusch-Pagan (1980) Lagrange multiplier test (LM test) of interindividual independence are

presented in Table 7.

Table 7. Result of the Breusch Pagan (1980) dependence test

chi2(21) = 100.785
Pr = 0.0000

Source: Author, based on data from BCEAO (2023), KOF (2023), WDI (2023)

The p-value is lower than the critical threshold of 5%, we then reject the null hypothesis of absence of dependence. There is therefore dependence between the individuals present in the study sample.

5.2 Estimation Results and Discussion

We will successively carry out an econometric and economic interpretation of the results. Table 8 presents the results of the PCSE estimator

Table 8. PCSE estimator results

Variables	***Coef.***	***Std. Err.***	***P>|z|***
LIBFIN	***-0,160******	***0,053***	***0.003***
FINTECH	***0,236****	***0,107***	***0.028***
LIBTECH	***-0,003****	***0,001***	***0.056***
RLIQ	***-0.351****	***0,162***	***0.031***
SIZE	***-2.758***	***1,951***	***0.158***
CAR	***0,946****	***0,404***	***0.019***
POLMON	***0,392****	***0.180***	***0.030***
CONS	***9.584***	***9.134***	***0.294***

Note: (***), (**) and (*) represents the significance of the coefficient at the threshold of 1%, 5%, and 10%

Source: Author, based on data from BCEAO (2023), KOF (2023), WDI (2023)

The result shows that the coefficients of the variables LIBFIN, LIBTECH, and RLIQ are statistically significant but negative at the 5% threshold. This result indicates that these different variables negatively influence non-performing loans in the WAEMU zone. On the other hand, the coefficients of the FINTECH, CAR, and POLMON variables are statistically significant and positive at the 5% threshold, which indicates that these variables positively influence non-performing loans in the WAEMU zone.

In terms of interpretation of the results, it appears that financial liberalization negatively influences banking risk in the WAEMU zone over the study period. Indeed, the coefficient of financial liberalization is negative and significant at the 1% level. This indicates that increased financial liberalization leads to a reduction in non-performing loans. This could be explained by the fact that financial liberalization pushes banks to improve their risk management policy to compete.

The opening of financial markets and increased competition may encourage financial institutions to adopt more rigorous practices in terms of borrower assessment and loan monitoring. This result is consistent with those of Abiad et al. (2010) which indicate that, in the context of financial liberalization, banks become freer to choose credit elements, and lower default rates.

When fintechs are taken into account, we see that they amplify the effect of financial liberalization on banking risk. Indeed, the interaction between financial liberalization and banking risks has a negative and statistically significant effect on non-performing loans at the 10% threshold. It follows that fintechs amplify the negative effect of financial liberalization on banking risks. In other words, fintechs improve the effect of liberalization on bank credit risk. Fintechs can help banks reduce costs and improve the quality of borrower information when the system is liberalized.

Nevertheless, the intrinsic effect of fintechs on credit risk is positive. Indeed, fintechs have a positive and statistically significant influence at the 5% threshold on non-performing loans. This means that the development of fintechs is associated with an increase in non-performing loans. Such a result is contrary to those of Onay and Ozsoz (2013) who found that new online banking activities significantly increased bank deposits and loans and a decline in non-performing loans. However, our results could be explained by the increased risks linked to new technologies. Chen et al. (2019) believe that most financial technology innovations provide great value, however, when this technology is a “disruptive technology”, it hurts the financial industry.

Concerning bank liquidity, the liquidity ratio negatively influences bank risk. Indeed, the liquidity ratio has a negative and significant effect on non-performing loans at the 5% threshold. This means that the more liquid the bank is, the more it can reduce non-performing loans. A liquid bank means that it has sufficient resources to invest in risk assessment, which will result in the reduction of non-performing loans. Bordeleau and Graham (2010) found that banks can reduce their liquidity risk and probability of failure by holding more liquid assets. This is because banks with a higher amount of liquid assets tend to face lower funding costs and higher net income.

Capitalization positively influences credit risk. Indeed, the capital adequacy ratio has a positive and significant influence on non-performing loans at the 5% threshold. This means that the more highly capitalized the bank, the more non-performing loans it has. Strict capital requirements put additional pressure on asset returns, which may prompt banks to seek riskier opportunities. This is confirmed by Godlewski (2014) who states that there is a positive correlation between capital regulation in the banking sector and excessive risk-taking. This

tendency for banks to take more risks leads to an increase in credit risk and the rate of non-performing loans.

Concerning monetary policy, it positively influences credit risk. Indeed, monetary policy has a positive and significant impact on non-performing loans at the 5% threshold. The increase in the money supply, which reflects an expansionary monetary policy, increases banking risk to the extent that low rates can encourage customers to borrow more and take greater risks, which can increase the number of potentially insolvent customers. Additionally, low rates may encourage investors to seek higher returns, which may lead them to take greater risks in their investment choices. This may have an explanation in the excess of confidence which generates debt, then over-indebtedness and excessive risk-taking, which is commonly called the paradox of "tranquility" (Minsky, 1982).

In our study, three hypotheses were tested. The first hypothesis which states that financial liberalization reduces banking risks was accepted. The second, which states that the development of fintechs increases banking risks, was also accepted. As for the third which states that the development of fintechs improves the effect of financial liberalization on banking risks, it is also accepted.

6. Concluding Comments

This study aimed to examine the role of fintech development in the relationship between financial liberalization and banking risks in the WAEMU zone, except Guinea Bissau, over the period 2011-2022. The study data comes from the BCEAO (2023), the World Bank (2023), and the KOF Globalization Index (2023). Specifically, it was a question of determining firstly the effect of financial liberalization on banking risks, secondly the effect of the development of fintech on banking risks and finally what was the role of fintech in the relationship between financial liberalization and banking risks. On a methodological level, it used the PCSE method of Beck and Katz (1995) and at the end of the estimation, the results showed that financial liberalization, and banking liquidity reduce banking risks, that fintechs accentuate risks. Banking risks and that fintechs improve the effect of liberalization on banking risks. In addition, the capital adequacy ratio, fintechs and monetary policy have a positive impact on banking risks. Such results call for major lessons to be drawn from this study.

The first is that financial liberalization policies are favorable to reducing credit risks in the WAEMU zone. This policy promotes competition and leads to the adoption of new management methods as well as new opportunities for players in the financial sector.

The second lesson is that more liquid banks can manage risks and reduce non-performing loans. Basel 3 also requires banks to maintain a "good liquidity cousin".

The third lesson is that fintechs are prone to banking risks if the financial environment is not liberalized. Indeed, fintechs can help banks reduce their credit risks but in a liberalized system.

In light of the results, the economic policy implications are as follows. Firstly, the authorities

must continue the financial liberalization policies initiated since the 1990s, not only for the development of the financial sector but also for its capacity to reduce banking risks. Secondly, the authorities should pay particular attention to the situation of fintechs in the WAEMU zone, to put in place the regulatory measures and standards necessary to improve the effect of these technologies on banking risks.

Although this study analyzed the role of fintech development in the relationship between financial liberalization and banking risks, the study focused on credit risk, as the main indicator of banking risk, with data from the banking system in its entirety. A future study could deepen this research with individual bank data.

References

Abiad, A., Detragiache, E., & Tressel, T. (2010). A New Database of Financial Reforms. *IMF Staff Papers*, *57*(2), 281-302. https://doi.org/10.2139/ssrn.1316734

Allen, F., Carletti, E., Cull, R., Qian, J., Senbet, L., & Valenzuela, P. (2014). The African Financial Development and Financial Inclusion Gaps. *Journal of African Economies*, *23*(5), 614-642.

Arner, D. W., Barberis, J. N., & Buckley, R. P. (2015). The Evolution of Fintech: A New Post-Crisis Paradigm? (October 1, 2015). University of Hong Kong Faculty of Law Research Paper No. 2015/047, *UNSW Law Research Paper No. 2016-62.* https://doi.org/10.2139/ssrn.2676553

Barth, M. E., Beaver, W. H., & Landsman, W. R. (1998). Relative valuation roles of equity book value and net income as a function of financial health. *Journal of Accounting and Economics*, *25*(1), 1-34. https://doi.org/10.1016/S0165-4101(98)00017-2

Baselga-Pascual, L., Trujillo-Ponce, A., & Cardone-Riportella, C. (2015). Factors influencing bank risk in Europe: Evidence from the financial crisis. *The North American Journal of Economics and Finance*, *34*(C), 138-166. https://doi.org/10.1016/j.najef.2015.08.004

Beck, N., & Katz, J. N. (1995). What to do (and not to do) with time-series cross-section data. *American Political Science Review*, *89*(3), 634-647. https://doi.org/10.2307/2082979

Beck, T., Degryse, H., De Haas, R., & Horen, N.V. (2018). When arm's length is too far: Relationship banking over the credit cycle. *Journal of Financial Economics*, *127*(1), 174-196. https://doi.org/10.1016/j.jfineco.2017.11.007

Bordeleau, E., & Graham, C. (2010). The Impact of Liquidity on Bank Profitability. *Staff Working Papers 10-38,* Bank of Canada. RePEc:bca:bocawp:10-38.

Boyer, R. (2004). *Une théorie du capitalisme est-elle possible?*. Odile Jacob.

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange Multiplier Test and Its Application to Model Specification in Econometrics. *Review of Economic Studies*, *47*(1), 239-253. https://doi.org/10.2307/2297111

Buchak, G., Matvos, G., Piskorski, T., & Seru, A. (2018). Fintech, regulatory arbitrage, and the

rise of shadow banks. *Journal of Financial Economics*, *130*(3), 453-483. https://doi.org/10.1016/j.jfineco.2018.03.011

Calomiris, C. W., & Haber, S. (2015). *Fragile by design : The political origins of banking crises and scarce credit*. Princeton University Press.

Caprio, G., & Honohan, P. (2001). Finance for Growth: Policy Choices in a Volatile World. *MPRA Paper 9929*, University Library of Munich, Germany.

Cartapanis, A., & Gilles, P. (2001). Prévention et gestion des crises financières internationales : Une analyse rétrospective de H. Thornton. *Cahiers d'Economie Politique*, *45*(2), 175-210. https://doi.org/10.3917/cep.045.0175

Cecchetti, S., & Schoenholtz, K. (2016). *A primer on helicopter money*. VoxEU.

Chen, M. A., Wu, Q., & Yang, B. (2019). How Valuable Is FinTech Innovation?. *Review of Financial Studies*, *32*(5), 2062-2106. https://doi.org/10.1093/rfs/hhy130

Claessens, M. S., & Van Horen, N.V. (2012). Being a foreigner among domestic banks: Asset or liability?. *Journal of Banking & Finance*, *36*(5), 1276-1290. https://doi.org/10.1016/j.jbankfin.2011.11.020

Cubillas, E., & González, F. (2014). Financial liberalization and bank risk-taking : International evidence. *Journal of Financial Stability*, *11*, 32-48. https://doi.org/10.1016/j.jfs.2013.11.001

Dell'Ariccia, G., & Marquez, R. (2006). Lending Booms and Lending Standards. *The Journal of Finance*, *61*(5), 2511-2546. https://doi.org/10.1111/j.1540-6261.2006.01065.x

Demirgüç-Kunt, A., & Detragiache, E. (1998). *Financial liberalization and financial fragility*. World Bank Publications.

Demirguc-Kunt, A., & Detragiache, E. (1998). The Determinants of Banking Crises in Developing and Developed Countries. *Staff Papers - International Monetary Fund*, *45*(1), 81.

Demirguc-Kunt, A., & Huizinga, H. (2010). Bank activity and funding strategies: The impact on risk and returns. *Journal of Financial Economics*, *98*(3), 626-650. https://doi.org/10.1016/j.jfineco.2010.06.004

Deng, L., Yongbin, L., Ye L., & Yiwen, Z. (2021). Impact of Fintech on Bank Risk-Taking: Evidence from China. *Risks*, *9*(5), 1-27. https://doi.org/10.3390/risks9050099

Denizer, C. A., Dinc, M., & Tarimcilar, M. (2007). Financial liberalization and banking efficiency : Evidence from Turkey. *Journal of Productivity Analysis*, *27*(3), 177-195. https://doi.org/10.1007/s11123-007-0035-9

Fuster, A., Plosser, M., Schnabl, P., & Vickery, J. (1019). The role of technology in mortgage lending. *The Review of Financial Studies*, *32*(5), 1854-1899. https://doi.org/10.1093/rfs/hhz018

Ghosh A., Qureshi M., & Tsangarides C. (2011) Words vs. Deeds: What really matters?. *IMF*

Working Paper, n °11/112, Mai.

Godlewski, C. J. (2014). Bank loans and borrower value during the global financial crisis: Empirical evidence from France. *Journal of International Financial Markets, Institutions and Money, 28, 100-130.* https://doi.org/10.1016/j.intfin.2013.10.009

Gujarati, D. N., & Porter, D. C. (2009). *Basic Econometrics* (5th ed.). McGraw-Hill Education, New York.

Gul, S., & CHO, H.-R. (2019). Capital Structure and Default Risk: Evidence from Korean Stock Market. *Journal of Asian Finance Economics and Business*, *6*(2), 15-24. https://doi.org/10.13106/jafeb.2019.vol6.no2.15

Hamdi, H., Hakimi, A., & Djelassi, M. (2013). Did financial liberalization lead to bank fragility? Evidence from Tunisia. *The International Journal of Business and Finance Research*, *7*(5), 77-88. Handle: RePEc:ibf:ijbfre:v:7:y:2013:i:5:p:77-88.

Hausman, J. (1978) Specification Tests in Econometrics. *Econometrica, 46*(6), 1251-1271. https://doi.org/10.2307/1913827

Julapa J., & Kose, J. (2018). Fintech: The Impact on Consumers and Regulatory Responses. *Journal of Economics and Business, 100*, 1-6. https://doi.org/10.1016/j.jeconbus.2018.11.002

Kaminsky, G. L., & Reinhart, C. M. (1996). *The twin crises: The causes of banking and balance-of-payments problems*.

Klaus. F., & Chenard. M. (1998). Financial liberalization causes banking system fragility. *Working paper n °97 – 14*, Universit éLaval.

Kmenta, J. (1986). *Elements of Econometrics* (2nd ed.). Macmillan, New York.

Lapavitsas, C., & Dos Santos, P.-L. (2008). Globalization and Contemporary Banking: On the Impact of New Technology. *Contributions to Political Economy*, *27*(1), 31-56. RePEc:oup:copoec:v:27:y:2008:i:1:p:31-56.

Lensink, R., & Hermes, N. (2004). The short-term effects of foreign bank entry on domestic bank behaviour: Does economic development matter?. *Journal of Banking & Finance, 28,* 553-568. https://doi.org/10.1016/S0378-4266(02)00393-X

Levine, R. (1997). Financial development and economic growth : Views and agenda. *Journal of Economic Literature*, *35*(2), 688-726. Retrieved from http://www.jstor.org/stable/2729790

Levine, R. (2001). International financial liberalization and economic growth. *Review of International Economics*, *9*, 688-702. https://doi.org/10.1111/1467-9396.00307

Li, L., Gao, W., & Gu, W. (2023). Fintech, bank concentration and commercial bank profitability: Evidence from Chinese urban commercial banks. *Finance Research Letters, 57*, 104234. https://doi.org/10.1016/j.frl.2023.104234

Louzis, D. P., Vouldis, A. T., & Metaxas, V. L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business

and consumer loan portfolios. *Journal of Banking & Finance, 36*(4), 1012-1027. https://doi.org/10.1016/j.jbankfin.2011.10.012

McKinnon, R. (1973). *Money and capital economic development*. Brookmgs Instttutton, Washmgton, DC.

Mehrez, G., & Kaufmann, D. (2000). Transparency, liberalization, and banking crisis. *Policy Research Working Paper Series 2286*, The World Bank.

Minsky, H. (1982). The Financial Instability Hypothesis: Capitalist Process and the Behaviour of the Economy. In C. Kindelberger, & J. P. Lafargue (Eds.), *Financial crises.* Cambridge University Press.

Muganyi, T., Yan, L., Yin, Y., Sun, H., Gong, X., & Taghizadeh-Hesary, F. (2022). Fintech, regtech, and financial development: evidence from China. *Financial Innovation, 8*(1), 1-20. https://doi.org/10.1186/s40854-021-00313-6

Nguyen, Q. K., & Dang, V. C. (2022). The Effect of FinTech Development on Financial Stability in an Emerging Market: The Role of Market Discipline. *Research in Globalization*, *5*(4-5), 100-105. https://doi.org/10.1016/j.resglo.2022.100105

Oikonomou, M., Pierri, N., & Timmer, Y. (2023). IT Shields: Technology Adoption and Economic Resilience during the Covid-19 Pandemic. *Labour Economics*, *81*, 102-330. https://doi.org/10.1016/j.labeco.2023.102330

Onay, C., & Ozsoz, E. (2013). The Impact of Internet-Banking on Brick and Mortar Branches: The Case of Turkey. *Journal of Financial Services Research, 44*(2), 187-204. https://doi.org/10.1007/s10693-011-0124-9

Parks, R. W. (1967). Efficient estimation of a system of regression equations when disturbances are both serially and contemporaneously correlated. *Journal of the American Statistical Association, 62*, 500-509. Retrieved from https://www.jstor.org/stable/2283977?seq=1#metadata_info_tab_contents

Pesaran, M. H. (2004). Generam diagnostic tests for cross section dependence in panels. *Cambridge Working Papers in Economics* 0435, Faculty of Economics, University of Cambridge.

Philippon, T. (2019). On fintech and financial inclusion. National Bureau of Economic Research. *Working paper 2633*, 1-18. https://doi.org/10.3386/w26330

Quagliariello, M. (2007). Banks' riskiness over the business cycle: a panel analysis on Italian intermediaries. *Applied Financial Economics, 17*(2), 119-138.

Sajid, R., Ayub, H., Malik, B. F., & Ellahi, A. (2023). The Role of Fintech on Bank Risk-Taking: Mediating Role of Bank's Operating Efficiency. *Human Behavior and Emerging Technologies*, 2023, 1-11. https://doi.org/10.1155/2023/7059307

Shaw, E. S. (1973). *Financial deepening in economic development*. Oxford University Press, New York.

Vazquez, F., & Federico, P. (2015). Bank Funding Structures and Risk: Evidence from the Global Financial Crisis. *Journal of Banking & Finance, 61*(C), 1-14. https://doi.org/10.1016/j.jbankfin.2015.08.023

Vithessonthi, C. (2014). The effect of financial market development on bank risk: evidence from Southeast Asian countries. *International Review of Financial Analysis*, *35*(C), 249-260. https://doi.org/10.1016/j.irfa.2014.10.005

Wang, R., & Luo, H. (2019). Does financial liberalization affect bank risk-taking in China?. *Sage Open*, *9*(4), 1-15. https://doi.org/10.1177/2158244019887948

Yermack, D. (2017). Corporate governance and blockchains. *Review of Finance*, *21*(1), 7-31. https://doi.org/10.1093/rof/rfw074

Yudaruddin, R., Soedarmono, W., Nugroho, B. A., Fitrian, Z., Mardiany, M., Purnomo, A. H., & Santi, E. N. (2023). Financial technology and bank stability in an emerging market economy. *Heliyon*, *9*(5), e16183. https://doi.org/10.1016/j.heliyon.2023.e16183

Copyright Disclaimer