



Article

Non-Performing Loans and Net Interest Margin in the MENA Region: Linear and Non-Linear Analyses

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Abstract: This paper analyzes the linear and non-linear relationship between non-performing loans and bank profitability measured by the Net Interest Margin for a sample of 74 Middle Eastern and North African banks over the period of 2005–2020. We used the System Generalized Method of Moments (SGMM) as a linear approach and the Panel Smooth Transition Regression (PSTR) model as a non-linear approach. The empirical results of the SGMM approach indicated that the ratio of NPLs negatively affects bank profitability. The findings of the non-linear relationship based on the PSTR model confirmed the existence of a threshold effect. We found that below the threshold of 4.42%, the effect of NPLs is negative but not significant, while after surpassing this threshold, the effect becomes negative and significant. As for bank specifics, we revealed that bank size is positively and significantly associated with bank profitability. For industry factors, we found that more bank concentration decreases bank profitability. Regarding the financial environment, we concluded that the global financial crisis exerted a negative impact on bank profitability. Moreover, we revealed a positive and significant impact of GDP on bank profitability as well as a negative impact of inflation on bank profitability. This study has some limitations regarding the social, economic, and financial differences of the whole sample, which includes banks from the Middle East and others from North Africa. Hence, decomposing the whole sample into two sub-samples could improve the results of this paper.



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1. Introduction

The banking sectors in the Middle Eastern and North African (MENA *henceforth*) countries have gone through a fundamental transformation in the past 30 years. Foreign-owned banks have begun to increasingly dominate the MENA banking market. At the same time, financial systems in MENA countries have remained bank-dominated, and banks have become the main source of external financing for the private sector.

Bank profitability and bank stability are the most important targets of bankers and policymakers, particularly in some emerging economies where the stability of the whole economy is nearly dependent on the stability of the banking sector. A well-functioning banking sector is essential for sustainable growth and development in this political and economic part of the world (Olson and Zoubi 2011). Currently, many banks can utilize social media to access and share information with stakeholders at a minimum cost to improve bank performance (Ballouk et al. 2022). According to the financial intermediation theory, banking institutions play an intermediary role between savers and borrowers in the economy. Moreover, Yüksel et al. (2018) proved the vital role of banks as a catalyst for economic growth. According to Boubaker et al. (2022b), the global banking sector must maintain and improve its efficiency during difficult times.

Banks face multiple and complex risks. One of the most serious bank risks is credit risk. Non-performing loans (NPLs *henceforth*) are considered financial pollution and exert harmful effects on the level of bank profitability and bank stability. Increasing the level of NPLs poses a great risk to banks, the financial system, and the economy as a whole. Additionally, an increase in loan loss provision is also considered a significant determinant of credit risk (Kolapo et al. 2012). Moreover, the credit risk that might arise by increasing the level of NPLs on the bank's balance sheet reveals the occurrence of the banking crisis (Goswami 2022). The difficulties that borrowers might face due to the unwillingness to pay back their loans led to a progressive deterioration in credit quality and, thus, a significant increase in credit risk (Orlando and Pelosi 2020).

To the best of our knowledge, banking literature on the NPLs–profitability relationship is abundant. Several empirical studies concluded that the high-level ratio of NPLs significantly affects the level of bank profitability (Flamini et al. 2009; Messai and Jouini 2013; Ozurumba 2016; Apergis 2014). A significant part of the literature supports the negative relationship between NPLs and bank profitability (Manz 2019; Kjosovski et al. 2019; Panta 2018). NPLs represent a major challenge for the banking sector, as they reduce the profitability of banks and prevent them from lending to businesses and individuals. Nevertheless, less abundant studies support the negative association or the absence of a significant effect (Lata 2014).

When reviewing the literature on this topic, we noted that most of the prior studies are based on linear approaches using OLS regression, fixed effect models, random effect models, and dynamic panel data models (Vithessonthi 2016; Tölö and Virén 2021; Kumar et al. 2020). Only a few empirical studies are focused on the possible non-linear relationship (Bolarinwa et al. 2021; Merhbene 2021). Although the banking literature on the NPLs–profitability relationship (linear relationship) is well documented, most prior works supported the negative association. However, studies on the level at which the NPL ratio can affect bank profitability are less abundant. To date, no study has investigated both the linear and non-linear relationship between NPLs and bank profitability.

This paper aims to explore the effect of NPLs on bank profitability using a sample of MENA banks over the period from 2005 to 2020. The first step consists of checking the effect of NPLs on bank profitability using the system generalized method of moments (SGMM *henceforth*) approach. The second step refers to defining an optimal threshold for NPLs using the panel smooth transition regression (PSTR *henceforth*) model developed by González et al. (2005). The MENA region can be considered an appropriate case study for several reasons. The financial system of this region is a bank-centric financial system, despite the numerous reforms undertaken to establish a market-based financial system. Banks still play a dominant role in financing economic activities. They continue to collect their resources in the form of deposits and grant credit to their clients. However, these traditional activities carry risks that can destabilize banks. Consequently, the government budget deficit in the MENA region expanded to 10.1% of the region's GDP in 2020, compared to 3.8% in 2009 (IMF 2021).

North African banks operate in a highly concentrated banking sector market with a low level of profitability and a high level of NPLs, but they continue to show strong resilience. For example, in 2016, the level of NPLs in Algeria increased to 11.4% due to the fall in hydrocarbon prices, resulting in deterioration for public-sector enterprises. In Tunisia, the level of NPLs is still high, with around 50% of NPLs concerned with the industrial and tourism sectors. However, some North African countries made improvements in the provisioning of credit risk. For example, the loan loss provision rate in Egypt was close to 100% (Azzabi et al. 2018). The banking sector in the MENA region comprises two categories of banks, conventional and Islamic banks. Islamic banks dominate in GCC countries, while most banks in North African countries are conventional. The banking sector in GCC countries is more stable and developed. Thus, the levels of NPLs in GCC countries are lower than in North African countries (Hakimi et al. 2020).

Since there are a few studies that investigated the NPLs–profitability non-linear relationship, this paper comes to fill this gap. Firstly, it investigates the effect of NPLs on bank profitability. Secondly, it defines the optimal threshold of NPLs that affects bank profitability in the MENA region.

This paper contributes to the existing literature in several ways. First, to the best of our knowledge, this is the first paper that simultaneously investigates the linear and non-linear relationship between NPLs and bank profitability in the MENA region. Prior studies have focused on a linear relationship using either the OLS method or GMM regression. In the current study, we investigate both linear and non-linear relationships between NPLs and profitability. Furthermore, defining an optimal threshold of NPLs that affect bank profitability will be very useful for policymakers and bankers to develop appropriate strategies to hedge and manage credit risk. Second, it focuses on a region where banks still play a dominant role in financing economic activities. Additionally, the financial system of this region is a bank-centric financial system, and banks in some countries operate in a highly concentrated banking sector market with a low level of profitability and a high level of NPLs. Hence, defining the threshold of NPLs that might affect bank profitability could be of great importance for banks and policymakers to improve their decision-making and manage their credit risks.

The remainder of this paper is structured as follows: The literature review is given in Section 2. Section 3 describes the sample and the empirical strategy. Section 4 discusses the empirical findings, while Section 5 concludes and addresses some policy recommendations.

2. Literature Review and Hypotheses Development

There are some early investigations of the determinants of bank profitability (Short 1979; Bourke 1989; Molyneux and Thornton 1992). The existing literature provides the key determinants of profitability, which can be categorized into internal and external determinants. The internal determinants comprise return on assets (ROA) and return on equity (ROE), depending on the bank specifics, such as bank size, liquidity risk, credit risk, capital adequacy, and non-interest income. However, the external determinants of profitability are macroeconomic factors, such as the inflation rate, GDP, and money supply, as well as the financial environment, such as the global financial crisis. Many scholars have established evidence from both developed and developing countries (Onofrei et al. 2018; Mirzaei et al. 2013). Firm-level, industry-level, and macroeconomic determinants have been considered in prior studies as the main determinants of bank performance (Pasiouras and Kosmidou 2007; Natsir et al. 2019; Beck et al. 2015). Based on previous literature, bank size, capitalization, NPLs, growth of deposits, and efficiency are the major variables (Bolarinwa et al. 2019; Garcia and Guerreiro 2016; Dietrich and Wanzenried 2011). One of the important factors in banking literature is NPL, which is widely used as one of the determinants of bank profitability. While most of the empirical studies on the NPLs–profitability relationship focused on linear approaches (Aker and Roy 2017; Serrano 2021; Thornton and Di Tommaso 2021; Ugoani 2016; Rosenkranz and Lee 2019), a few studies investigated the possible non-linear relationship (Alqahtani et al. 2022; Neves et al. 2020; Kusi et al. 2020). Boubaker et al. (2022a) examined the role of bank affiliation in bank efficiency using a fuzzy approach, including bank NPLs as one of the relevant control variables that might affect bank stability.

2.1. The Linear Relationship between NPLs and Bank Profitability

NPLs represent a standard measure for the quality of assets and can be used to mark the onset of a banking crisis (Reinhart and Rogoff 2011). The higher level of NPLs adversely affects provisioning for doubtful debts and written-off loans that will distress bank profitability. Moreover, NPLs affect banks' profitability by decreasing revenues and eroding retained earnings (Kithinji 2010).

The extant literature found a negative effect of NPLs on bank profitability (Altunbas et al. 2000; Fan and Shaffer 2004; Girardone et al. 2004). These findings support the

hypothesis proposed by Berger and DeYoung (1997) that efficient banks are better at managing their credit risk. In European countries, there is extensive literature regarding NPLs and bank profitability. For example, in the Republic of North Macedonia, Kjosovski et al. (2019) found a negative relationship between NPLs and profitability and confirmed the empirical results of Louzis et al. (2012). Similarly, Athanasoglou et al. (2005) used a dynamic panel data model to examine the impact of credit risk on the profitability of Greek banks. The results revealed a negative and significant impact of credit risk on a bank's profitability. Çollaku and Aliu (2021) studied the impact of NPLs on banks' profitability in Kosovo over the period 2010–2019 by using multiple linear regression. The results showed that the effect of NPLs on profitability is significant and negative. Godlewski (2005) used ROA as a performance indicator to study the impact of NPLs on bank profitability in Spain and found that there is a negative relationship between ROA and NPLs. Louzis et al. (2012) formulated the bad management hypothesis, demonstrating the negative relation between a bank's profitability and NPLs.

In the USA, Ghosh (2015) studied 50 banks over the period of 1984–2013 and confirmed the negative impact of NPLs on the level of banks' profitability. In Asia, Swandewi and Purnawati (2021) examined the impact of NPLs on ROA and the capital adequacy ratios for 24 Indonesian banks. The authors found that both ROA and the capital adequacy ratio have a significant and negative relationship with NPLs. Moreover, Kaaya and Pastory (2013) investigated the relationship between credit risk and bank performance (measured by ROA) and found a negative relationship. Banker et al. (2010), by using a panel dataset for 14 Korean commercial banks, found that NPLs have a negative impact on bank profitability. Vinh (2017) examined the impact of NPLs on the profitability of 34 Vietnamese commercial banks; the results suggested that NPLs exert a negative effect on banks' profitability. Recently, Naili and Lahrichi (2022) examined the determinants of NPLs for 53 banks in the MENA region over the period of 2000–2019 and found that bank performance is more sensitive to an increase in NPLs. The results confirm the bad management hypothesis, which suggests that low profitability indicates poor management skills concerning lending strategies. Thus, increasing their risk exposure which may be achieved, at the expense of higher future NPLs. Foos et al. (2010) described credit growth in their study as the most critical driver of bank profitability and found a negative correlation between credit growth and both interest income and risk-adjusted interest income. Concerning NPLs, the expectation is that higher NPLs are associated with lower bank profitability because, when loan losses materialize, banks will lose the interest income associated with the loan category. Based on the prior literature we propose the hypotheses as follows:

H1. *A higher level of NPLs is associated with a lower level of bank profitability.*

2.2. *The Non-Linear Relationship between NPLs and Bank Profitability*

While prior studies on the NPLs–profitability nexus were dedicated to the bank performance, many studies examined the relationship between NPLs and profitability in emerging markets based on a linear approach (Albulescu 2015; Laryea et al. 2016; Kumar et al. 2018; Kohlscheen et al. 2018; Koju et al. 2018), but only a few examined the non-linear relationship. For instance, Bolarinwa et al. (2021) examined the threshold effect on NPLs–profitability within the Nigerian banking sector using a dynamic panel threshold adopted by Seo et al. (2019). Their findings showed that there is a threshold for NPLs of 3.5% and 5% for ROA and ROE, respectively. Rahbar and Soufiani (2021) used the PSTR model to test the impact of bank-specific factors on NPLs for 10 Iranian banks. The sample banks were categorized as bad banks if the interest spread was below 1% and good banks if the interest spread exceeded 1%. Pop et al. (2018) used a non-linear PSTR model to investigate the level of liquidity risk that affects the level of the NPL ratio in seven emerging European countries. They determined the threshold for liquidity of 94.98% for both low-liquid banks and high-liquid banks. Ben Ali et al. (2020) documented the effect of corruption on the occurrence of a banking crisis by using a threshold regression

approach. The results reveal that corruption negatively affects the banks' lending through excessive risk rather than through their profitability. Elekdag et al. (2020) explored the determinants of profitability across large Euro-area banks by using an approach based on conditional probability distributions. Interestingly, they found that the most reliable determinant of bank profitability is real GDP growth and NPLs. As explained by the scenario with higher growth and lower NPLs, the joint materialization of higher growth and lower NPLs reduces the probability of ROE falling below 8% more than these shocks reflecting nonlinear interaction. The theoretical framework of the non-linear relationship between NPLs and bank profitability is based on the study of Seo et al. (2019), which found that the relationship between NPLs and bank profitability is non-linear, and they defined an optimal threshold. Therefore, we propose hypothesis 2 as follows:

H2. *There is a threshold effect in the NPLs–profitability relationship.*

3. Data and Empirical Strategy

In this section, we provide information about the construction of the sample used in this study and describe the empirical strategy we followed.

3.1. The Sample

To investigate the effect of the NPLs on the profitability of banks, we used a sample of conventional banks in the MENA region observed during the period of 2005–2020. Initially, the sample covered 123 banks. Due to the problem of continuity of data for the same variables, especially the NPLs ratio, some banks were excluded and the final sample was made up of 74 banks. The number of banks by country is given in Table 1.

Table 1. Number of banks by country.

Middle East and North Africa	
Countries	Number of Banks
Bahrain	4
Jordan	13
Kuwait	5
Lebanon	4
Oman	4
Qatar	4
Saudi Arabia	8
United Arab Emirates	14
Egypt	4
Morocco	4
Tunisia	10
Number of banks	74

In this study, bank profitability is measured by the net interest margin (NIM). We have used the NIM to measure the profitability of the MENA banks for the following reason. Banks activities in this region, especially in North Africa, are based on traditional activities (collection of deposits and grant of credit). Hence, the profitability of these banks is based on the interest income proxied by the interest margin (interest revenue (credit) – interest expenses (deposit)). In some cases, NPLs lead to a loss of the principal of credit and the interest; hence, we used the NIM instead of the ROA and ROE. Several prior studies have used the NIM as a measure of bank profitability (Hakimi and Zaghoudi 2017; Hakimi and Boukaira 2020; Ben Naceur and Goaid 2008). The ratio of NPLs is used as a proxy for credit risk (Castro 2013; Dimitrios et al. 2016; Fainstein and Novikov 2011). To explain a change in the level of bank profitability, we introduce four groups of variables in the econometric model. Liquidity risk (LTD), bank size (BS), and capital adequacy ratio (CAR) refer to the main bank specifics (Maudos and Solís 2009; Cruz-García et al. 2019). Bank concentration

(CONC) is included in the model as a proxy for industry specifics. The international financial environment is represented by the global financial crisis (CRISIS). The growth rate of GDP (GDPG), inflation rate (INF), and unemployment rate (UNEM) are introduced to control the macroeconomic conditions (Islam and Nishiyama 2016; López-Espinosa et al. 2011). Furthermore, we consider the variable of control of corruption (CCOR) as a proxy for the institutional quality in this region (Ben Naceur and Omran 2011). Accounting and financial variables are collected from the annual reports of each bank, i.e., the Refinitiv Eikon database. Country-level data that reflect industry specifics and macroeconomic conditions are collected from the World Bank Indicators Database.

3.2. Empirical Strategy and Model Specification

To study the effect of NPLs on the profitability of MENA banks, we followed an empirical strategy based on two steps. In the first one, we used the two-stage SGMM to investigate the NPLs–profitability relationship. This method deals with the problem of endogeneity and provides robust and more efficient results (Zhou 2014; Teixeira and Queirós 2016; Danisman and Tarazi 2020; Hakimi et al. 2020).

Since previous studies on the NPLs–profitability relationship were limited to a linear approach (Laryea et al. 2016; Panta 2018; Kosmidou 2008; Flamini et al. 2009), in the second step, we define the threshold of NPLs that affect bank profitability. For that reason, we perform a non-linear approach that uses the PSTR model developed by González et al. (2005). The PSTR model is considered an extension of the panel threshold model (PTR) of Hansen (1999). It allows defining an optimal threshold for the transition variable and makes it possible to discuss the results within at least two regimes—below and above this threshold. The econometric model to be tested is given in Equation (1):

$$NIM_{i,t} = \beta_0 + \beta_1 NIM_{i,t-1} + \beta_2 NPLs_{i,t} + \beta_3 LTD_{i,t} + \beta_4 BS_{i,t} + \beta_5 CAR_{i,t} + \beta_6 CONC_{i,t} + \beta_7 CRISIS_t + \beta_8 GDPG_{i,t} + \beta_9 INF_{i,t} + \beta_{10} UNEM_{i,t} \tag{1}$$

All variable definitions are given in Table 2.

Table 2. Variables, definitions, and measurement.

Variables	Definitions	Measurement
		Dependent variables (NIM)
NIM	Net interest margin ratio	Net interest income/total assets (%)
		Bank specifics
NPLs	Non-performing loans	Bank non-performing loans to gross loans (%)
BS	Bank size	Natural logarithm of total assets
CAR	Capital adequacy ratio	Bank capital to total assets (%)
LTD	Liquidity risk	Loans to deposits ratio (%)
		Industry specifics
CONC	Bank concentration	Assets of the three largest banks as a share of total banking assets (%)
	Financial environment and macroeconomic conditions and institutional quality	
CRISIS	The Global Financial Crisis of 2008	The dummy variable takes 0 before the crisis of 2008 and 1 after
GDPG	The growth rate of GDP	The annual growth rate of GDP (%)
INF	The inflation rate	Consumer price index (%)
UNEM	Unemployment rate	Total unemployment rate (%)
CCOR	The control of corruption	The score of the World Bank ranges between −2.5 and 2.5

3.3. Summary Statistics and Correlation Matrix

This sub-section gives summary statistics regarding the data used in this study and checks for the multicollinearity problem between independent variables. Table 3 summarizes the descriptive statistics for all variables.

Table 3. Descriptive statistics.

Variable	Mean	Std. Dev.	Min.	Max.
NIM	2.78	2.77	−2.95	48.00
NPLs	8.10	7.60	0.01	58.13
LTD	81.92	27.62	1.43	215.32
BS	9.84	2.60	5.04	18.08
CAR	14.97	5.09	1.25	40.35
CONC	68.85	19.14	40.21	100.00
CRISIS	0.81	0.39	0.00	1.00
GDPG	3.25	4.39	−21.46	26.17
INF	3.83	6.24	−4.86	84.86
UNEM	7.63	5.45	0.11	18.50
CCOR	0.18	0.58	−1.14	1.56

The statistics displayed in Table 3 indicate that the mean value of the NIM is 2.78%, with a maximum of 48% and a minimum value of −2.95%. The average mean of NPLs is 8.1%, with a maximum value of 58.13% and a minimum value of 0.01%.

As bank specifics, the loans-to-deposits ratio (LTD), a proxy of liquidity risk, records an average ratio of 81.92%, with a maximum value of 215.32%. The mean value of bank size is 9.84, with a minimum value of 5.05 and a maximum value of 18.08. Banks in the MENA region registered an average capital adequacy ratio of 14.97%, with a maximum level of 40.35% and 1.25% as a minimum value. Based on these statistics, we can conclude that banks in the MENA region on average are well capitalized, except for some banks that recorded low and negative capital ratios.

Concerning the macroeconomic environment, the highest growth rate is 26.17%, against −21.46% as the weakest rate. The average value of the inflation rate is 3.83%, with a maximum value of 84.86% and a minimum value of −4.86%. Statistics indicate that the mean value of unemployment in the selected MENA countries is 7.63%, with a maximum rate of 18.5% and a minimum rate of 5.45%. These statistics point to an unstable macroeconomic environment in this region during the observed period of 2005–2020.

The correlation between all independent variables is given in Table 4. From this table, we can note that this correlation is very weak among all independent variables included in the econometric model. Thus, we confirm that there is no significant problem with multicollinearity.

Table 4. Correlation matrix.

	NPLs	LTD	BS	CAR	CONC	GDPG	INF	UNEM	CCOR
NPLs	1.0000								
LTD	0.2012 *	1.0000							
BS	−0.2606 *	−0.3108 *	1.0000						
CAR	−0.2165 *	−0.2327 *	−0.0168	1.0000					
CONC	−0.0440	−0.1100 *	−0.2007 *	0.0720 *	1.0000				
GDPG	−0.0568	−0.0604	−0.0866 *	0.0233	0.0102	1.0000			
INF	0.1579 *	−0.1887 *	0.0856 *	−0.0928 *	0.1158 *	−0.1087 *	1.0000		
UNEM	0.2711 *	0.0575	−0.3204 *	−0.2395 *	−0.1103 *	−0.1434 *	0.0977 *	1.0000	
CCOR	−0.1858 *	0.2317 *	−0.2042 *	0.2631 *	0.0690 *	0.1523 *	−0.2633 *	−0.4814 *	1.0000

***, ** and * indicate the level of significance at 1%, 5%, and 10%, respectively.

4. Empirical Findings

As explained in the empirical strategy, firstly, this paper investigates the effect of NPLs on bank profitability using the SGMM approach. Secondly, it explores the non-linear relationship between the two variables to define the threshold of NPLs that affects the profitability of banks in the MENA region. Hence, we discuss the empirical results of the SGMM approach in the first sub-section, while the second sub-section discusses the results of the PSTR model.

4.1. Findings of the SGMM Regression

The empirical findings of the SGMM regression are displayed in Table 5. The diagnostic tests of Sargan and serial correlation tests do not reject the null hypothesis of the validity of over-identifying restrictions and the absence of correlation. Both the p -values of the Sargan test and the AR (2) test of Arellano and Bond were greater than 5% (Arellano and Bond 1991).

Table 5. Results of the SGMM regression.

NIM	Coef.	Std. Errs.	Z	$p > z$
NIM (−1)	0.245	0.057	4.310	0.000 ***
NPLs	−0.028	0.006	−4.610	0.000 ***
LTD	0.006	0.001	5.330	0.000 ***
BS	0.298	0.044	6.730	0.000 ***
CAR	0.014	0.009	1.510	0.131
CONC	−0.009	0.001	−10.080	0.000 ***
CRISIS	−0.912	0.132	−6.900	0.000 ***
GDPG	0.028	0.006	4.740	0.000 ***
INF	−0.020	0.007	−2.810	0.005 ***
UNEM	0.016	0.013	1.230	0.217
CCOR	−0.191	0.209	−0.920	0.360
_cons	−0.935	0.354	−2.640	0.008 ***
AR (1)		−1.610		
Prob > z		0.107		
AR (2)		0.528		
Prob > z		0.597		
Sargan test		22.122		
Prob > chi2		0.985		
Obs		924		

***, ** and * indicate the level of significance at 1%, 5%, and 10%, respectively.

Results displayed in Table 5 indicate that the lagged variable of bank performance is positively and significantly correlated to the dependent variable. This result implies that bank profitability in the present year is positively dependent on the level of profitability in the previous year.

The findings indicate that the level of NPLs significantly decreases bank profitability in the MENA region. An increase of 1 percentage point in NPLs decreases bank profitability by 0.028 percentage points. Since interest income from bank assets is an important component of banks' net income, poor asset quality adversely affects bank profitability. Hence, we accept hypothesis H1. This result is in line with Makri et al. (2014), Khan et al. (2020), and Gulati et al. (2019). Moreover, bank size is found to be positively and significantly associated with the net interest margin. A 1 percentage point increase in the bank size leads to an increase in bank profitability by 0.29 percentage points. This result indicates that large banks can generate a high NIM through bank diversification. This finding confirms the results of Gupta and Mahakud (2020) and Nguyen et al. (2020).

The coefficient of bank concentration is negative and significant. An increase of 1 percentage point in bank concentration decreases the level of bank profitability by 0.009 percentage points. In other words, a more concentrated banking section is less profitable. The

efficient-structure hypothesis suggests that higher concentration does not necessarily imply market power. These results are in line with both (Berger 1995; Ben Naceur 2003; Grubišić et al. 2022; Le and Ngo 2020).

Table 5 shows that the effect of the global financial crisis on bank profitability is negative and significant at the level of 1%. The global financial crisis had a negative impact on banks' business environment, which points to the fact that it developed from a subprime crisis to a financial crisis in the banking system all over the world, including the region investigated in this research. This result is convergent with the findings of Horobet et al. (2021) and Ozgur and Gorus (2016).

The effect of the macroeconomic conditions is not spurious. We found that GDP growth exerts a positive and significant effect, while the inflation rate significantly decreases the bank's net interest margin. A 1 percentage point increase in the growth rate of GDP increases the net interest margin by 0.028, while an increase of 1 percentage point in the inflation rate decreases bank profitability by 0.02 percentage point. Rapid economic growth increases bank profitability. Therefore, bank profitability can support economic growth by enhancing financial stability (Demirgüç-Kunt and Huizinga 1999; Claeyns and Schoors 2007; Klein and Weill 2022). However, the effect of the inflation rate on profitability depends on whether it can be anticipated or not. Moreover, if the inflation rate is an unanticipated change in the interest rate, then it should be a negative relationship (Noman et al. 2015; Ariyadasa et al. 2017).

4.2. Findings of the PSTR Regression

In this sub-section, we discuss the results of the non-linear relationship between NPLs and bank profitability. Firstly, we start with the results of the *pre-tests*, such as the test of linearity, the number of regimes, and the threshold value. Secondly, we discuss the results of the PSTR model.

4.2.1. The Pre-Tests of the PSTR Approach

Before testing the PSTR model, the non-linearity hypothesis should be confirmed. If this condition is confirmed, then we test the number of regimes of the transition variable and define the threshold value. The results of these three tests are given in Tables 6–8.

Table 6. Test of linearity.

Transition Variables	NPLs → NIM	
	Statistics	<i>p</i> -Value
Lagrange Multiplier Wald Test	29.451	0.000 ***
Lagrange Multiplier F-Test	2.788	0.000 ***
Likelihood-ratio Test	31.403	0.000 ***

*** Indicates the level of significance at 1%.

Table 6 shows that the null hypothesis is rejected at the 1% level for the three tests: Lagrange Multiplier (Wald test), Lagrange Multiplier (F-test), and the Likelihood-ratio test (LR). The statistics of the three tests confirm the non-linearity between credit risk (NPLs) and bank performance (NIM) in the MENA countries. Hence, hypothesis H2 is accepted. Once the non-linearity hypothesis is checked, the second step consists of testing the number of regimes. The results for the number of regimes are given in Table 7.

Table 7. Test of the number of regimes.

Transition Variables		NPLs → NIM	
Hypotheses	Tests	Statistics	p-Value
(1) $H_0: r = 0; H_1: r = 1$	LRT	35.080	0.003 ***
	F	3.168	0.000 ***
(2) $H_0: r = 1; H_1: r = 2$	LRT	59.972	0.001 ***
	F	3.665	0.000 ***

*** Indicates the level of significance at 1%.

The test of the number of the regime is used to check if the PSTR model has one function of transition ($m = 1$) (null hypothesis) or if it has at least two functions of transition ($m = 2$) (alternative hypothesis). From Table 7, we note that both the hypothesis without a threshold ($r = 0$) and the hypothesis with at least two thresholds ($r = 2$) are rejected at the 1% significance level for the two tests. Hence, we reject the null hypothesis, and we admit that there exist at least two functions of transition and that the model has one threshold.

The third step consists of defining the optimal threshold of the transition variable (NPLs) that can affect the dependent variable (NIM). The results of the threshold value are given in Table 8.

Table 8. Results of threshold values.

	NPLs → NIM
γ	0.200
	4.42%
AIC	−1.134
BIC	−0.846

From Table 8, we note that the threshold of NPLs that affects bank performance (NIM) in the MENA region is 4.42%. Regarding descriptive statistics, this threshold is lower than the mean value of 8.10%. Therefore, banks in MENA countries are invited to well manage their credit risk and reduce the level of NPLs.

4.2.2. Results of the PSTR Approach

The results of the PSTR model are given in Table 9. The findings of the PSTR estimation indicate that below the threshold of 4.42%, the effect of NPLs is negative but insignificant. However, on surpassing this threshold, the effect of the NPLs ratio becomes negative and significant. To attain optimal profitability without a stability trade-off, it is recommended for banks operating in the MENA region to reach a ratio of NPLs below the threshold of 4.42%.

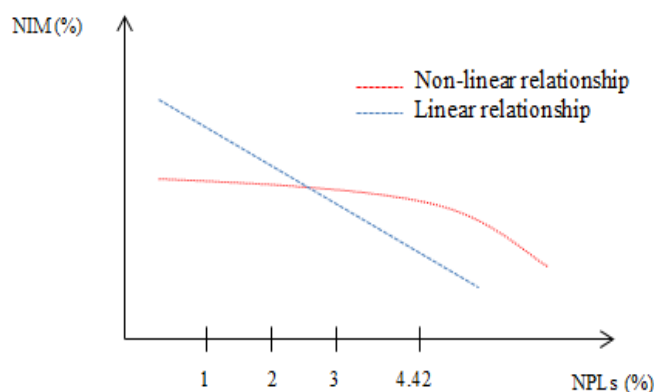
Similar to the results of the SGMM approach, the findings of the PSTR model indicate that the coefficient of bank size is positive and significant. This means that large banks are more profitable. Increasing bank size can increase profitability by allowing banks to realize economies of scale. Moreover, increasing banks' assets can reduce risk by diversifying operations across regions. Thus, lower risk can promote profitability by reducing losses. This result confirms the work of [Alhassan et al. \(2014\)](#) and [Louzis et al. \(2012\)](#).

Table 9. Results of the PSTR regression.

Variable	Coeff	Std Error	T-Stat	Signif
LTD	0.019	0.004	4.327	0.000 ***
BS	0.324	0.194	1.672	0.096 *
CAR	0.002	0.037	0.050	0.960
CONC	−0.023	0.008	−3.056	0.003 ***
CRISIS	−3.566	0.522	−6.838	0.000 ***
GDPG	0.080	0.033	2.403	0.017 **
INF	0.033	0.044	0.746	0.457
UNEM	−0.110	0.039	−2.836	0.005 ***
CCOR	0.274	0.436	0.629	0.530
NPLs < 4.42%	−0.096	0.088	−1.089	0.277
NPLs > 4.42%	−0.177	0.064	−2.760	0.006 ***
Y		0.200		
C		4.42%		
AIC		−1.134		
BIC		−0.846		
Obs		926		

***, ** and * indicate the level of significance at 1%, 5%, and 10%, respectively.

Figure 1 shows both linear and non-linear relationships between NPLs and bank profitability based on the defined threshold of 4.42%.

**Figure 1.** Linear and non-linear relationship between NPLs and bank profitability.

We also found that bank concentration significantly decreases bank profitability. An increase of 1 percentage point in bank concentration decreases the NIM by 0.023 percentage points. This result means that concentration is less beneficial in terms of profitability in our sample than in that of the competition. It also indicates that higher concentration leads to lower profitability due to the monopolistic position of banks in this region. This finding is in line with [Tan and Floros \(2012\)](#), [Yao et al. \(2018\)](#), and [Osugwu \(2014\)](#).

Results of the PSTR model confirm the positive effect of GDP growth on bank profitability. The coefficient of the GDPG is positive and significant at the level of 5%. An increase of 1 percentage point in the GDPG increases the NIM by 0.008 percentage points. Higher economic efficiency can be associated with economic growth, thus leading to better profitability. This is following the well-documented literature on the association between GDP growth and bank profitability ([Neely and Wheelock 1997](#); [Bikker and Hu 2002](#); [Dietrich and Wanzenried 2011](#); [Al-Harbi 2019](#)). However, we find that the inflation rate is without any significant effect.

Concerning the effect of the unemployment rate, findings of the PSTR model also indicate that the coefficient of this variable is negative and significant at the 1% level. An increase of 1 percentage point in the unemployment rate decreases the NIM by 0.11 percentage points. A higher unemployment rate can increase the aggregate credit risk faced by banks

and their risk aversion. Moreover, unemployment can worsen business conditions, and thus the probability of borrower default due to economic instability and uncertainty will erode bank income. Our findings are in line with [Angori et al. \(2019\)](#) and [López-Espinosa et al. \(2011\)](#).

5. Concluding Remarks and Policy Recommendations

This study aims to investigate both linear and non-linear relationships between NPLs and bank profitability across the MENA region. The study uses a sample of 74 banks located in 11 MENA countries over the 2005–2020 period, with an empirical strategy based on the SGMM regression and PSTR model.

Overall, the empirical findings of SGMM regression reveal that the level of NPLs is significantly and negatively associated with bank profitability. Regarding the effect of bank size, we found a positive and significant relationship with bank profitability. Moreover, for industry specifications, we found that the effect of the bank concentration in the MENA countries is negative and significant. Regarding the effect of the macroeconomic and financial environment, we found that the effect of the global financial crisis is negative and significant. Not surprisingly, the relationship between GDP and bank profitability is positive and significant, while the inflation rate exerts a negative impact on bank profitability.

The empirical findings of a non-linear relationship based on the PSTR model confirm the existence of a threshold effect. We found that below the threshold of 4.42%, the effect of NPLs is negative but insignificant, while on surpassing this threshold, the effect becomes negative and significant. Like the SGMM results, we found that the effect of bank size is positive and significant, while bank concentration decreases bank profitability. For the effect of macroeconomic conditions, only GDP growth exerts a significant effect. The inflation rate was found to be without any significant impact.

The findings of this research have substantial implications. Firstly, by identifying these thresholds, policymakers and bankers will address appropriate interventions to adjust their credit policies. To improve their profitability, banks in this region are invited to maintain their ratios of NPLs below the defined threshold of 4.42%. Secondly, economic and fiscal policies should be directed toward creating an environment that will empower economic growth. Hence, the main factors that increase NPLs are liquidity risk and bank size as internal factors and GDP growth, inflation, and unemployment as external factors. Therefore, the regulators should pay more attention to stabilizing macroeconomic conditions. Finally, central banks are also invited to monitor banks in this region, especially large banks with high liquidity risk.

This study has some limitations regarding the regression of the whole sample, which includes banks from the Middle East and North Africa. There are several social, economic, and financial differences between the two groups of countries. In addition, to measure bank profitability, this study used the NIM. While NIM is a common measure of financial performance, especially for banks that make money from the spread between loans and deposits, it does not capture the impact on profitability from provisions to loan-loss reserves.

In future research, decomposing the whole sample into two sub-samples could improve the results of this paper. We check whether the threshold of NPLs affecting bank profitability differs across the two groups of countries or whether it remains equal to 4.42% for both banks in the Middle East and North Africa. Additionally, instead of the NIM, we will use broader measures of profitability such as ROE and ROA that seem more appropriate measures of profitability given the research questions.

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