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Non-Performing Loans and Banking Profitability

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Abstract

Aim: This article aimed to determine the effect of macroeconomic and specific variables on the ratio of non-performing loans, and study the recursive direction of bank profitability to NPLs in Tunisian banks.

Methodology: To formalise this phenomenon, the author proposed a panel data model that covers a sample of ten listed Tunisian banks over a period from 2007 to 2015.

Findings: The empirical results indicate the determining power of bank profitability measured by asset profitability, solvency ratio, credit growth rate, provision-based debt coverage rate, bank size, inflation and unemployment.

Implications: The effect of these variables veered between the preservative and destructive aspects of the quality of bank assets.

Originality/value: This study enabled not only to identify the explanatory factors of this phenomenon, but also to verify the existence of a simultaneous relation between NPLs and bank profitability.

Keywords: non-performing loans, bank profitability, Tunisian banks

1. Introduction

Banks aiming at the sustainable growth of their business are required to manage their credit risk, and this includes the monitoring of the ratio of non-performing loans. Following the banking and financial crises caused by the non-productive accumulation of debt, credit risk has attracted the attention of

several researchers, especially in relation to the study of the factors explaining this risk (macro-economic factors and bank-specific factors). Several studies have been conducted in this direction including those by Adebola Solarin et al. (2011), Klein (2013) and Konstantakis et al. (2016). Among the determinants of non-performing loans are bank returns measured by asset returns (ROA) and equity return (ROE), which according to several authors, such as Kolapo et al. (2012), negatively affect these cases, since profitability is seen as an indicator of performance and good management (management quality) of the bank, which can reflect risk-taking behaviour by managers. Thus, there is a negative relation between profitability and classified liabilities as poor management leads to more risky activities. Furthermore, since losses can be absorbed by equity, a high yield can recover equity so that the bank can cope with potential losses.

Tunisia is ranked among the countries with a relatively high credit risk, with a rate of 14.4% in 2016, the highest rate among the southern and eastern Mediterranean countries, and well above the global average which is below 5%. In addition, within the European Union and following the 2008 financial crisis, the level of non-performing loans increased from 1.8% on average in 2006 to 5.5% in 2016, whilst some countries have low rates that do not exceed 3% such as Qatar and Kuwait (1.7% and 2.4%, respectively) showing a better control of this risk. However, several authors, e.g. Raharjo et al. (2014) and Suandi (2017), indicated that non-performing loans also have a negative effect on ROA: "the higher the NPL ratio, the worse the credit quality, the lower the ROA, and hence the depreciation of the bank's financial performance." NPLs have a negative impact on the financing of the economy and are a barrier to the profitability of banks due to the costs they generate, and as a result not only is bank profitability one of the determinants of non-performing loans, but they can be among the definers of bank's profitability in terms of the costs they entail.

In this context, the study examined the recursive direction of bank profitability to NPLs in Tunisian banks by analysing the effect of these non-performing loans on variables that define profitability, such as ROE or ROA. In fact, if only NPLs affected banking profitability, it would be enough to improve that profitability by having fewer NPLs. However, if it is a vicious circle, the improvement in profitability does not result in a decrease in NPLs. As a result, relations between these variables seem to take a simultaneous and recursive form. Such interdependence makes the impact of calculations and the treatment of NPLs more complex. It is in this context that the subject of this research work was defined, aiming to two main objectives. The first concerns the investigation of the main determinants of non-performing loans in Tunisia, therefore the author reviewed financial literature on this topic. Knowing these specific and macroeconomic factors enables banks to have an idea of the elements of this risk in order to act more effectively. The second objective was to examine whether banking profitability, which is one of the determinants of NPLs, has been already affected by them, in which case, banks cannot intervene to lower NPLs by improving bank profitability, as this is a vicious circle that runs in both directions.

2. Determinants of Non-Performing Loans of Tunisian Banks

In order to understand the phenomenon of non-performing assets, this study employed an econometric analysis aimed at identifying the determinants of the poor quality of bank assets in the Tunisian context.

2.1. Varied Bi-Analysis

In financial literature, non-performing loans are explained by internal and external factors concerning the bank. Before proceeding to the econometric study, the author applied the bi-varied study of NPLs with each of the variables selected.

NPL and asset returns: asset profitability is a measure of performance and good banking management. This indicator illustrates the bank's managerial and operational efficiency as well as its ability to generate

profits. According to Abid et al. (2014), Rahadian & Permana (2021) and Berrak Koten (2021), the return on the asset is negatively correlated with the rate of unproductive receivables. For this purpose, high returns indicate good credit risk control and, of course, a reduced level of dubious receivables.

NPL and size: according to Pasha & Khemraj (2009), the effect of the bank's size on the rate of classified receivables is mixed. Yulianti & Aliamin (2018) and Asif Khan et al. (2020) found that bank size negatively affects non-performing loans, contrary to the results of Panta (2019).

NPL and inflation rate: according to Klein (2013), inflation has an ambiguous impact on NPLs. This leads to an erosion of the actual value of reimbursement. Khoirunisa & Karnasi (2023) found a positive association between NPLs and inflation rate contrary to the results of Mazreku et al. (2018).

NPL and GDP growth rate: in economic literature, several researchers, including Nusrat et al. (2019), Salas & Saurina (2002), and Fofack (2005), concluded that the rate of GDP growth negatively affects non-performing loans.

2.2. Multivariate Analysis

This section presents the sample on which this study was conducted, and then tries to specify the relation between NPLs and their determinants through a panel data model. Based on this modelling, the author defined the different variables used.

2.2.1. Model Specification

The empirical study aimed to determine the effect of macroeconomic and specific variables on the ratio of non-performing loans. To formalise this phenomenon, the author proposed a panel data model that covers a sample of ten listed Tunisian banks over a period from 2007 to 2015; namely, Amen Bank, ATB, Attijari Bank, BH, BIAT, BNA, BT, STB, UBCI and UIB. To determine this model, the author referred to the paper by Klein (2013), which focused on the study of NPL determinants for a sample of banks belonging to the European Economic and Social Committee (EESC) during the period from 1998 to 2011. Referring to this research, it was possible to express the equation of this model as follows:

$$\boldsymbol{NPLi,t} = \boldsymbol{\alpha} + \boldsymbol{\beta}1\boldsymbol{ROAi,t} + \boldsymbol{\beta}2\boldsymbol{SOLVi,t} + \boldsymbol{\beta}3\boldsymbol{TAILLEi,t} + \boldsymbol{\beta}4\text{TC\_}\boldsymbol{CREDi,t} + \boldsymbol{\beta}5\boldsymbol{PROVi,t} + \boldsymbol{\beta}6\text{TC\_PIB}\boldsymbol{i,t} + \boldsymbol{\beta}7\boldsymbol{CHOMi,t} + \boldsymbol{\beta}8\boldsymbol{DETTEi,t} + \boldsymbol{\beta}9\boldsymbol{INFi,t} + \mu\boldsymbol{i} + \boldsymbol{\varepsilon i,t},$$

where:
$\boldsymbol{i}$: the number of banks ranging from 1 to 10;
$\boldsymbol{t}$: the period from 2007 to 2015.

The variables specific to Tunisian banks are represented as follows:

$\boldsymbol{NPLi}$: non-performing loans ratio (at date *t*);
$\boldsymbol{ROAi}$: return on the assets of bank i during year *t*;
$\boldsymbol{SOLVi}$: bank's solvency ratio *i* during year *t*;
$\boldsymbol{TAILLEi}$: size of bank i during year *t*;
TC_$\boldsymbol{CREDi}$: growth rate of credit of bank i during year *t*;
$\boldsymbol{PROVi}$: rate of coverage of bank *i*'s classified claims during year *t*.

The macroeconomic variables are represented as follows:

TC_PIB$\boldsymbol{i}$: GDP growth rate of Tunisia in year *t*;
$\boldsymbol{CHOMi}$: unemployment rate in Tunisia in year *t*;
$\boldsymbol{DETTEi}$: debt rate of Tunisia in year *t*;
$\boldsymbol{INFi}$: inflation rate in Tunisia during year *t*;
$\boldsymbol{\beta 1, \beta 2, \beta 3, \beta 4, \beta 5, \beta 6, \beta 7, \beta 8}$ **:** coefficients associated with the explanatory variables;
$\boldsymbol{\mu i}$ **:** *random term;*
$\boldsymbol{\varepsilon i}$**:** *error terms.*

2.2.2. Presentation of Variables

Table 1. Summary table of variables

Variables	Calculation formulas	Sources
NPL	Non-performing loans ratio = Classified claims /Total liabilities	Activity reports of Tunisian banks
SOLV	Solvency ratio = Total Net Capital / Total Risk Weighted	Activity reports of Tunisian banks
ROA	Return on assets = Net profit / Total assets	Activity reports of Tunisian banks
Taille	Size = Bank *i*'s total assets for year *t* / Bank sampling assets of year *t*	Financial statements of Tunisian banks
TC_CRED	Credit growth rate = Credits granted by bank *i* at time *t* – Credits granted by bank *i* at time *t* / Credits granted by bank i at time t-1	Financial statements of Tunisian banks
PROV	The coverage ratio of classified receivables by provisions = provisions + reserved interests / doubtful and litigious receivables.	Activity reports of Tunisian banks
TC_PIB	Real GDP growth rate = (Real GDP t i real GDP t-1) * 100 / real GDP t-1	INS
CHOM	Unemployment rate = Number of unemployed individuals / Active population	INS
DETTE	Tunisia's debt-to-GDP ratio = Public debt / GDP	World Bank
INF	Inflation rate = (IPCt−IPCt−1)* 100 / IPC t−1	INS

Source: own work based on literature review.

Following this brief presentation of the variables used in the empirical study, and given that the applied methodology centered on the evolution of the set of banks over time, the author used panel data models.

2.3. Presentation of Panel Data Technique

Unlike time series observations, panel data combines two dimensions at once, namely the individual dimension and the chronological dimension. The peculiarity of these models is that they allow to study relations of economic behaviour over time, taking into account the heterogeneity of banks. Panel models provide cut and serial estimates, thus allowing the accumulation of a considerable amount of information on the evolution of the population studied. Two specifications can be envisaged in panel templates, in particular error templates consisting in fixed effects and random effects, as shown in the following:

$$NPLi,t = \alpha i + \Sigma^{k}_{k=1} \beta i\, Xit + \mu it \ (i = 1, 2\ldots, n\ ;\ t = 1, 2,\ldots, T),$$

where αi can be an unknown parameter to estimate or an error term for which the variance can be estimated.

The selection of the period 2005–2012 for this study was deliberate and served to provide a comprehensive analysis of the Tunisian banking sector within a significant economic context. The period encompasses the years leading up to, during, and following the global financial and economic crisis of 2008–2009, a pivotal time that had profound implications for financial institutions worldwide.

By extending the research period three years before and after the crisis, the study aimed to capture the full spectrum of the banking sector's performance and behaviour in response to economic fluctuations. This approach allowed for the assessment of how the Tunisian banking sector navigated through both prosperous and challenging times, shedding light on its resilience, vulnerabilities, and adaptive strategies.

Furthermore, the inclusion of key indicators such as the solvency ratio and credit growth ratio within this timeframe enabled a nuanced understanding of their dynamics and impact on the banking sector's

stability and lending practices. Analysing these indicators within the context of the pre-crisis boom, the crisis itself, and the subsequent recovery period, offered valuable insights into their significance and implications for financial stability.

Summarising, the choice of the 2005–2012 research period was made strategically to provide a holistic examination of the Tunisian banking sector's performance and to facilitate a deeper understanding of the factors influencing its solvency, credit growth, and overall resilience in the face of economic upheavals.

2.3.1. Fixed-Effect Templates

Fixed-effect panel models assume an identical relation between the endogenous variable and the exogenous variables for the entire population studied. These models are called fixed effects because heterogeneity is entered by different constants from one bank to another, and therefore the term 'error' alone is random. Therefore, individual specificities are represented by mute variables with:

αi = fixed effects;
NPLit = ratio of non-performing loans;
Xit = set of explanatory variables observed on banks over time;
μit = error term corresponding to the following characteristics:
***E*(*μit*)** = 0; V(μit) = σ²,
cov(*μit, μjp*) = 0 if $i \neq j$ or $t \neq p$.

Fixed-effect models assume observable heterogeneity, thus limiting the exploitation of the individual non-observable dimension. In case of random heterogeneity, the quality of the results provided by these models is considered insufficient, hence the use of random effects models.

2.3.2. Models with Random Effects

Unlike fixed-effect models, random-effects models (also called compound error models) assume a random heterogeneity. For this purpose, individual specificity includes a random term for controlling individual heterogeneity. The use of this type of model is justified by the presence of individual specificities that cannot be observed, where:

αi = a random term that takes into account non-observable individual heterogeneity and meets the following criteria:

***E*(*αi*)** = 0; ***E*(*μit*)** = 0,
V(αi) = $\sigma\alpha^2$; **V(*μit*)** = σ²,
Cov(*αi, αj*) =0; **Cov(*μit, μ js*)** = 0,
Cov(*αi, μ jt*) = 0 for everything *i*, for everything *j*.

The choice between fixed or random specification models was made using appropriate tests such as the Hausman test presented later in the paper.

2.4. Empirical Findings and Interpretations

The study identified the determinants of non-performing loans of Tunisian banks, including bank profitability, based on the empirical results of the applied econometric treatment. The empirical study of non-performing loans from listed Tunisian banks has allowed to specify a model of compound errors with random estimation.

Table 2. Model of compound errors with random estimation

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
ROA	-1.824134	0.365984	-4.984188	0.0000
INF(-1)	0.003242	0.005133	0.631474	0.5298
CHOM(-1)	-0.003735	0.002472	-1.510735	0.1354
TC_PIB	0.004594	0.002308	1.990710	0.0504
PROV	-8.564049	5.401806	-1.585405	0.1174
SOLV	2.578065	0.269548	9.564415	0.0000
TA	0.104573	0.032203	3.247302	0.0018
TC_CRD	0.025608	0.008343	3.069268	0.0031
DET(-1)	1.06E-05	8.64E-06	1.229830	0.2229
C	-1.774283	0.482175	-3.679750	0.0005
Effects Specification				
		S.D. Rho		
Cross-section random		0.050375	0.7425	
Idiosyncratic random		0.029664	0.2575	
Weighted Statistics				
R-squared	0.561875	Mean dependent var	0.032204	
Adjusted *R*-squared	0.505544	S.D. dependent var	0.055469	
S.E. of regression	0.039004	Sum squared resid	0.106494	
F-statistic	9.974619	Durbin-Watson stat	0.834649	
Prob(*F*-statistic)		0.000000		
Unweighted Statistics				
R-squared	-0.012935	Mean dependent var	0.158001	
Sum squared resid	0.892506	Durbin-Watson stat	0.099591	

Source: own work based on literature review.

2.4.1. The Hausman Test

Let us employ the Hausman test to identify the nature of heterogeneity through fixed or random effects. The test allows to judge whether or not there is a correlation between the specific effects and the explanatory variables of the model, which enables to choose between the fixed effect model and the random effect model Kpodar (2006). The Hausman test is based on the following assumptions:

$$E(Ui\ Xit) = 0\ E(Ui\ Xit) \neq 0.$$

Table 3. Cross-section random effects test comparisons

Variable	Fixed	Random	Var(Diff.)	Prob.
ROA	-1.034776	-1.824134	0.013264	0.0000
INF(-1)	0.010922	0.003242	0.000001	0.0000
CHOM(-1)	0.005872	-0.003735	0.000002	0.0000
TC_PIB	-0.001195	0.004594	0.000001	0.0000
PROV	2.309168	-8.564049	3.667722	0.0000
SOLV	-3.069114	2.578065	0.013133	0.0000
TA	-0.014529	0.104573	0.000490	0.0000
TC_CRD	-0.005622	0.025608	0.000030	0.0000
DET(-1)	0.000014	0.000011	0.000000	0.0162

Source: own work based on literature review.

At the end of the estimate by the compound error model, the author proceeded to the analysis of the determinants of non-performing loans in the Tunisian banking sector, and studied the relations between NPLs and each of the variables introduced in the previous model.

2.4.2. Discussion of the Results

NPL and asset profitability: according to financial literature, asset returns (ROA) are very significant and negatively correlated with the ratio of non-performing loans. Thus, a 18% increase in profitability contributes to a 10% decrease in non-productive receivables (coefficient -1.824 in the previous model). This relation was identified by several authors, including Abid et al. (2014) in the study on non-performing loans in the Tunisian banking sector. High returns result in good credit risk management and thus a reduced level of classified liabilities, and high profitability can recover equity so that the bank can cope with possible losses Kolapo et al. (2012) showed that the repercussions of bank profitability were negative on the level of non-performing loans ratio, and that the profitability measured by asset yield (ROA) negatively affects the default loans of financial institutions.

NPL and GDP growth rate: unlike described in the literature, GDP growth rate is positively associated with the rate of non-productive debt. Indeed, according to the above estimates, it is significant in the order of 5% and its increase of one unit contributes to the increase in the NPL rate of 0.45%. The positive association between the NPL rate and the GDP growth rate indicates that the quality of banking assets deteriorates during periods of economic expansion, and improves during economic slowdown. Such a contradiction is due to specific characteristics of the Tunisian banking sector. In fact, the credit market is characterised by increased competition and the competitiveness of the product offers. In times of growth، banks try to obtain new market shares by easing their credit policies، yet such a strategy only attracts bad payers. However, in a difficult economic environment, banks are becoming cautious and selective when it comes to lending; which then leads to a decline in granting loans.

There may be a delay in observing the reaction of banks to changes in the quality of their loan portfolios. In the short term, these adjustments may not be immediately apparent. This delay could be due to various factors, such as the time it takes for banks to assess the impact of changes in economic conditions or competition on their portfolios, or the lag in implementing new lending policies or risk management strategies.

Essentially, the question is how quickly banks in Tunisia respond to shifts in the quality of their loan portfolios compared to the pace of changes in the external factors influencing those portfolios. This implies that while adjustments may eventually occur, they might not be immediately visible, especially in the short term. This delay could have implications for understanding and predicting the behaviour of banks and the overall stability of the banking sector in Tunisia.

In this case, the rate of GDP growth is significant, making it a determinant of the poor quality of bank assets. However، the empirical findings of this study seem to be incompatible with those of Pasha & Khemraj (2009), which show that improved GDP is reflected in the real economy by a decrease in NPLs. In addition, Espinoza & Prasad (2010) found that the NPL ratio deteriorates as economic growth becomes weaker.

NPL and inflation rate: in this case, inflation seems significant, which suggests that it may explain bad loans; according to the literature, this shows that it affects NPLs positively and sometimes negatively. Indeed, this result can be explained by the endogeneity of bank profitability and the simultaneous relationship between NPL and the inflation rate. In this case, the results can be corrected after the application of the technique of instrumental variables, wherein the period analysed, the inflation rate in Tunisia was very low. In economics, some macroeconomic indicators naturally lose their impact when they assume low values.

NPL and debt: regarding the relationship between NPLs and public debt, it has been viewed as a positive relation by several authors, including Bofondi & Ropele (2011), who indicated that an increase in debt would lead to higher growth in non-performing loans. Nevertheless,، in this study public debt is not significant and therefore cannot determine the poor quality of bank assets.

NPL and unemployment rates: similarly, it was found that the impact of the unemployment rate is significant.

NPL and bank size: in its turn, the size is significant in the order of 1% and is positively associated with NPLs. In fact, if the size increases by 1%, the NPL rises by 10.45%. This is incompatible with Hu et al. (2004) and Salas & Saurina (2002), who indicated that large banks assess their credit risk much better, which explains the low level of their classified debt stocks. However, this author's findings can be supported by Pasha & Khemraj (2009), showing that the effect of a bank's size on the rate of classified receivables is mixed – which explains the positive relation between size and NPLs by indicating that big banks can take more risks, which increases the scale of non-performing loans.

NPL and NPL coverage rate by provisions: hence, the rate of coverage of NPLs by provisions does not appear to be significant in view of the causes already highlighted.

NPL and credit growth rate: with regard to the rate of credit growth, measured by the percentage change in each bank's credit portfolio, the results show that it is significant in the order of 1% and is positively linked to NPLs. The literature justifies this finding by indicating that rapid credit growth is often associated with dubious receivables, hence this increase in credit is explained by 'sheep-like' behaviour and agency problems that could incite bank executives to over- borrow during periods of crisis Pasha & Khemraj (2009).

NPL and solvency ratio: in this case, the solvency ratio is significant in the order of 1%, but is positively linked to NPLs, which seems incompatible with the literature. In fact, the negative relation found in previous studies is explained by the hypothesis of 'moral allure'. In order to finance risky projects, credit institutions and banks grant loans on a mass scale without following the mechanisms of control and supervision of operations or a selection of their clients,، causing an accumulation of NPLs (Greenidge et al. 2005; Pasha & Khemraj, 2009). However, the positive sign of the relation between NPLs and the solvency ratio may be caused by disruptions related to the endogeneity of profitability.

2.5. Profitability: An Endogenous Variable?

Ultimately, one can say that identifying the determinants of bad loans from Tunisian banks can help to understand the way to act on these factors in order to improve the quality of these loans. Thus, as already stated in the first chapter, bank profitability is one of the main determinants of non-performing loans since high profitability translates into good credit risk management and therefore a reduced level of classified liabilities and it can recover the capital so that the bank can cope with possible losses.Therefore, it seems that it is enough to improve bank profitability to reduce non-performing loans.

However, profitability does not appear to be exogenous because it is already influenced by other variables, including the ratio of non-performing loans. Therefore, the status of this variable should be checked. To do this, the fourth section is devoted to explaining the endogenous nature of profitability, and more specifically showing that it may even be caused by NPL.

2.6. Profitability and NPL a Reciprocal Relation

In order to reveal the precise role of profitability on NPLs, the study addressed the status of the profitability variable: is it exogenous as the previous results appear to suggest, or is it endogenic as was assumed? For this purpose, the author carried out a causality test on all data. This test was used by Granger in 1969, which became over time an important framework of thought, corresponding to the highlighting of econometric links.

2.7. Causality Test in the Granger Approach

This test allows us to show whether there is a close and reciprocal link between NPLs and bank profitability, thus one has to check whether only NPLs is caused by profitability. Indeed, this issue is important because it changes the status of profitability as an instrument variable held by the bank. More specifically, and in a synthetic way, a change in bank profitability can be considered "Granger-caused" if the ratio of non-performing loans is decisive in the estimation of profitability.

Table 4. Granger causality test

Null Hypothesis:	Obs	F-Statistic	Prob.
ROA does not Granger Cause NPL	60	2.72050	0.0536
NPL does not Granger Cause ROA	4.64767	0.0059	

Source: own work based on literature review

Indeed, the results obtained from the Granger causality test found from the EVIEWS software are detailed in the table above. There is causality when the probability value of accepting the zero hypothesis at the threshold of 0.05 (5%) is less than 0.05. Here، it is the banking profitability that causes – in the Granger sense – the rate of NPLs, considering the probability of 0.0536 which is less than 0.10, and also the NPL rate Granger-causing the profitability (0.0059, also less than 0.05). In view of this study of the causal relation between NPLs and bank profitability، the results revealed that when there is a change in the rate of NPLs, this leads to a variation in profitability and vice versa. Therefore, there is a retroactive loop in the behaviour of these variables. There is a strong and bi-directional relation between the two variables, but with a predominance of the effect of NPLs versus bank profitability (0.0059 < 0.0536). This result led to resuming the analysis of determinants.

2.8. The Endogeneity of Profitability (2SLS Method)

Given the endogenous nature of profitability on NPLs, demonstrated by the causality test, it is clear that it is not possible to act on the level of NPLs through profitability. The latter was even carried out regarding NPLs by authors such as Abd Karim et al. (2010), Raharjo et al. (2014) and Suandi (2017), who examined this simultaneity. Taking this into account, the study proceeded to the correction of that simultaneousness by the technique of instrumental variables. As a result, some variables may become significant and even the sign of their coefficients may change because of the correction of the effect of endogeneity of bank profitability. In fact, this method has been used to treat the problem of endogeneity and to identify and estimate causal relations between variables.

Table 5. Results of the 2SLS method

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
ROA	-4.881326	0.479069	-10.18920	0.0000
SOLV	-1.049493	0.305618	-3.434006	0.0009
TC_CRD	0.045914	0.009507	4.829541	0.0000
INF	-0.015829	0.010890	-1.585405	0.1122
PROV	23.97607	8.182419	2.930193	0.0044
CHOM	0.012011	0.004280	2.806544	0.0063
TA	0.103341	0.034914	2.959866	0.0040
C	-1.253113	0.538420	-2.327391	0.0224
R-squared	0.619408	Mean dependent var		0.165350
Adjusted *R*-squared	0.586918	S.D. dependent var		0.115619
S.E. of regression	0.074310	Sum squared resid		0.452805
F-statistic	19.06482	Durbin-Watson stat		0.829375
Prob(*F*-statistic)	0.000000	Second-Stage SSR		0.452805
Instrument rank	10	Prob(*J*-statistic)		0.797285

Source: own work based on literature review.

From the above estimates one can see that the significance of the ROA is greatly improved compared to the first results of the least square method, which proves that profitability is not an exogenous variable, as it is conditioned by other variables that have an impact on it. The following table summarises the main changes that followed the endogeneity effect correction after the application of the instrumental variable method.

Table 6. Summary table of results with and without endogeneity

Variable	Endogeneity	Without Endogeneity	Summary
ROA	S (-)	S(-)	Negatively linked to NPL with strong significance improvement
Prov	NS	S(+)	It becomes significant and positively linked to the NPL
Solv	S(+)	S(-)	It remains significant but with a change of the sign from positive to negative
Taille	S(+)	S(+)	It remains significant and positively linked to NPL
TC_CRED	S(+)	S(+)	Positively linked to NPL with improved significance
INF	NS	S(-)	It becomes significant and negatively linked to NPL
Chom	NS	S(+)	It becomes significant and positively linked to the NPL
TC_PIB	S (+)		Significantly and positively linked to NPL
Dette	NS		Relation non-significant

Source: own work based on literature review.

Next, examine the analysis of each of the variables whose performance was average due to the simultaneity of the relation between NPLs and bank profitability, which was corrected after the application of the instrumental variable method.

NPL and inflation rate: Inflation itself is negatively linked to the NPL rate. In fact, when the inflation rate increases by one unit, the rate of classified loans decreases by 1.58%, as the author's estimates showed, which seems a little inconsistent with the results of previous studies, cf. Tham et al. (2021), Nkusu (2011) and Klein (2013), which claim that this is instead a positive relation, explaining that the loans granted become expensive, and households may find it difficult to repay their principal and interest debts. However, the author's findings are supported by Klein (2013), showing that inflation has an ambiguous impact on NPLs by indicating that it leads to an erosion in the real value of repayment. On the one hand, inflation can make the loan agreement an easy task by reducing the real value of ongoing loans, but on the other, it can also reduce the real income of borrowers when wages are rigid.

NPL and unemployment rates: With regard to the unemployment rate, it is positively associated with the rate of unproductive receivables and is significant at the 1% threshold. According to the detailed estimates above, an increase in the unemployment rate of 0.12% results in an increase of the NPL rate of 10%, which appears to be consistent with the literature that indicates that being unemployed negatively affects people's ability to secure the repayment of their debt after their income decreases. After the application of the instrumental variable method, the NPL coverage rate by provisions becomes significant at about 1% and is positively linked to NPLs, which seems to be compatible with the literature and more specifically with Anwer et al. (1999). Their study revealed that credit losses provisions have a significant positive influence on NPLs. Consequently, an increase in credit loss provisions indicates an increased credit risk and a deterioration in the quality of loans, which consequently affects the performance of the bank.

NPL and solvency ratio: Finally, following the application of the instrumental variable method and the elimination of the effect of the endogeneity of profitability, the solvency ratio became negatively linked to the NPL, which confirmed the hypothesis of the 'moral gap'.

3. Conclusion

The empirical approach undertaken in the second section enabled to identify several peculiarities of the Tunisian banking sector in terms of non-performing loans. Although it was known in advance that the determinants of the poor quality of bank assets through the theoretical foundations of the first section, the second one also seems crucial to confirm the priorities on the issue and to assess the impact of each of the key variables. Moreover, the empirical application enabled an in-depth study of the asset characteristics of the Tunisian banking sector, and clarified the invisible side of this phenomenon so that it can be dealt with in time. The empirical findings indicated the determining

power of bank profitability measured by asset profitability, solvency ratio,‹ credit growth rate,‹ reserve-rated debt coverage rate, bank size,‹ inflation and unemployment. Indeed, the effect of these variables veers between a preservative and another, destructive aspect of the quality of bank assets. Furthermore, the presented study enabled not only to identify the explanatory factors of this phenomenon, but also to verify the existence of a simultaneous relation between NPLs and bank profitability. It was possible to identify a causality in both directions between these two variables, which proves that it is a retroactive loop in their behaviour, similarly to the results found by Abd Karim et al. (2010), Raharjo et al. (2014), and Suandi (2017). Therefore, increasing bank profitability in order to improve the quality of loans appears to be insufficient, given that profitability itself is already affected by the level of NPLs. More specifically, any treatment aimed at improving the performance of the bank must examine the genuinely exogenous variables, such as the solvency ratio, the rate of coverage of claims classified by the provisions, and the bank's size.

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Nieskuteczne pożyczki i rentowność banków

Streszczenie

Cel: Celem niniejszego artykułu jest określenie wpływu zmiennych makroekonomicznych i specyficznych na współczynnik kredytów oraz zbadanie rekurencyjnego kierunku rentowności banków w stosunku do NPL w bankach tunezyjskich.

Metodyka: Aby sformalizować to zjawisko, proponujemy model danych panelowych obejmujący próbę 10 notowanych banków tunezyjskich w okresie od 2007 do 2015 roku.

Wyniki: Nasze empiryczne wyniki wskazują na decydujący wpływ rentowności banków, mierzonej poprzez rentowność aktywów, stopę wypłacalności, szybkość wzrostu kredytowego, opartą na prowizjach stopę pokrycia zadłużenia, wielkość banku, inflację i bezrobocie.

Implikacje: W rzeczywistości efekt tych zmiennych różni się między konserwatywnym a innym destrukcyjnym aspektem jakości aktywów bankowych.

Oryginalność/wartość: Dzięki tej analizie udało nam się nie tylko zidentyfikować czynniki wyjaśniające to zjawisko, lecz także zweryfikować istnienie jednoczesnego związku między NPL a rentownością banku.

Słowa kluczowe: niewypłacalne pożyczki, rentowność banków, banki w Tunezji