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Analysis of Non-Performing Loan Losses In Lebanese Banks

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Abstract

This paper studies the determinants of the non-performing loans ratio in Lebanese banks during a hectic, critical, and crucial historical period, characterized by political instabilities, civil tension, imported terrorism, and straight wars with Israel. The literature suggests many variables, some of them that do not apply to Lebanon. Some factors peculiar to Lebanon are included in the analysis. The econometric procedure adopted is by panel least squares since we have annual data on 35 banks spread over more than a decade of time. Three variables explain significantly the loan loss ratio: return on assets (ROA), return on equity (ROE), and growth in total assets (GTA). However closer scrutiny shows that for the class composed of the largest banks, called alpha banks, there are no variables that are statistically significant, meaning that the loan loss ratio is unpredictable. As for non-alpha banks the analysis shows that ROA, ROE, and GTA and their squares are highly significant statistically. This quadratic relation stems from the fact that the behavior of banks for low values of these three determinants is negative while it is positive for high values. Additionally it is shown that short run impacts are smaller than long run impacts and this conforms to the theory that predicts persistence in loan losses.

Keywords: commercial banks, loan loss, unit roots, Granger causality, panel least squares, quadratic relation, Lebanon.
JEL Classification: **G21, C12, C33.**

1. Introduction

In developing countries banking operations revolve mostly about safekeeping deposits and granting loans. Basically, the process of paying depositors a small amount of money in exchange for keeping their deposits at the bank, while lending borrowers loans with higher rates creates the spread which determines the bank's gross profit margin.

Loans can be either long or short term. Long term loans usually finance the purchase, the improvement, and the expansion of plants, facilities, equipment or real estate. Short term loans are mainly used to raise cash for cyclical and seasonal needs such as inventory, accounts payable or any other item of the working capital. Loans can also be either secured or non-secured. Secured loans are loans guaranteed by enough collateral which is provided by the borrowers in the form of assets and/or other pledges. Non-secured loans are one category of long term loans for which the risk of default is high. Loans are either awarded to the private sector or to the public sector. In Lebanon a sizeable portion of the public debt is held by commercial banks. The main types of private loans granted by Lebanese banks are car loans, housing loans, personal loans, education loans and business loans. Personal loans typically include loans for travel, weddings and other personal matters such as the purchase of consumer goods like electronics and home appliances. Business or corporate loans are granted to small, medium and large companies and they are used mainly as a tool for financing the business.

Under certain circumstances, loans reach a point at which they become non-performing. According to the International Monetary Fund (IMF), non-performing loans are loans whose repayment in interest and/or principal is past due by 90 days or more, or interest payments equal to 90 days or more have been capitalized, refinanced, or delayed by agreement, or payments which are less than 90 days overdue, but there are other good reasons to doubt that payments will be made in full (Bloem and Freeman, 2005). This implies that the market value of loans is below par, because some bank customers will renege on their loan obligations. On the liability side debt has a market value at least equal to par because a bank cannot refrain from honoring fully its obligations. These market values assume no change in interest rates.

Because of sour loans banks keep a provision for such loans and start monitoring them closely in order to find ways to recover the loans or minimize the losses that might occur from defaulting. If a loan is considered absolutely uncollectible, it becomes bad debt and is written-off after a certain period of time, thus creating a loss expense.

The Middle Eastern region passed through difficult times prior to the global financial crisis of 2008-2009, and prior than the uprisings and conflicts that took place or are still taking place in a number of Arab states. Lebanon was not immune from the consequences of those events especially that it has experienced throughout the post-civil war era (1991/2016) numerous periods of political and security instability. The occupation and conflict in the South in the 1990's did not end with the Israeli withdrawal from most of the occupied territories in 2000, and Lebanon had to face once more the Israeli war machine in the summer of 2006 which had catastrophic consequences. On top of that, the assassination of former Prime Minister Rafik Hariri in 2005 and the subsequent political tension and internal armed conflicts caused further deterioration of the country's financial situation. Therefore, it would be worthwhile to take a closer look at how Lebanon's leading economic sector, the financial sector, represented mainly by the commercial banks, have coped with the above situation across the years.

The banking sector is an integral part of the Lebanese economy. As of the end of 2014, the banking sector held total assets almost 3.8 times and deposits over 3 times the Lebanese Gross Domestic Product (GDP). Lebanese Banks operate in a liberal economic system under the authority and scrutiny of the Central Bank, known as Banque du Liban (BDL), and they are obligated to apply the bank secrecy law which some believe to be more stringent than the Swiss bank secrecy code.

The study will try to figure out how different factors affect non-performing loans (NPL) in Lebanese Banks. Those factors are selected from the studies that were previously conducted about NPL in other countries, and which form the contents of the next section. From here on NPL denotes interchangeably either non-performing loans or non-performing loans over total loans or the provision for non-performing loans or the provision of non-performing loans over total loans. It is understood that these four variables co-vary closely and/or have the same determinants. The following section, section 3, enumerates the chosen factors used in our analysis with a discussion of their respective and likely impacts. Section 4 is the empirical part. In order to avoid spurious regressions all variables are tested for unit roots. In order to limit the bad effects of simultaneity bias the dependent variable, which is NPL, should be either Granger-caused by our selected factors, or should have a bi-directional Granger-causation, or, at the very least, no causality at all. If NPL Granger-causes some variables in a strict unidirectional way, then these variables are omitted from the analysis.

Wald hypothesis tests are applied on the regressions in order to identify the factors that explain significantly NPL from among those they do not. The marginal significance level is chosen to be a two-tailed 5%. Because of the low Durbin-Watson statistics, which measure the presence and the extent of serial correlation of the regression residuals, the lagged NPL is included in the regressions. This is a common procedure in the literature (Makri et al., 2014), and serves to measure persistence in bad loan reserves. As we will argue, such a procedure generates short run and long run relations that are distinguishable from each other. Furthermore the banks are classified into alpha and non-alpha banks, and the subsequent differential impacts are estimated. Alpha banks are the ones that command a much higher share of the banking market. Finally, as argued in many places in our paper, the well-specified relations are empirically found to be non-linear. Quadratic non-linearity allows a given factor to have a negative effect at low values, and a positive effect at high values. This approach is novel and unique in the extant literature and elevates the discussion to other and different frontiers of analysis. The final section summarizes and concludes.

2. Survey of the Literature

A survey of the recent literature on the subject follows. Poposka (2015) uses four variables that do not appear elsewhere in the literature: (1) foreign currency spreads between reference lending and deposit rates, (2) local currency spreads between reference lending and deposit rates, (3) personnel expenses over non-interest expenses, and (4) equity over total assets ratio. Popopska (2015) also uses GDP as an explanatory variable, but finds no significant relation while Khemraj and Pasha (2009) and Filip (2014) find a negative relation, and Vardar and Özgüler (2015) find a positive relation. Louzis et al. (2011) finds GDP growth to be the single most important determinant of NPL losses.

Poposka (2015) finds that the liquid assets over total assets ratio explains positively NPL while Kozaric and Žunić (2015) find it to be negatively related to NPL. Too much liquidity cuts into profitability, while too little liquidity can lead to a bank crisis. Polodoo et al. (2015) and Poposka (2015) use the non-interest expense over gross income ratio. The first author finds a positive relation while the second one finds a negative relation. Hence the sign of the association is uncertain.

Total loans (TL) are found to impact positively NPL by the four authors who included this variable: Khemraj and Pasha (2009), Filip (2014), Kosaric and Žunić (2015), and Vardar and Özgüler (2015). Cai and Huang (2014) find that the return on total assets (ROA) is negatively related to NPL while the return on equity (ROE) is positively related. This is the same result as in this paper. Cai and Huang (2014) use total assets (TA), and find these a negatively signed explanatory variable. Bank size has consistently a positive effect on NPL (Khemraj and Pasha, 2009; Ryskulov and Berhani, 2014; and Polodo et al., 2015). See, however Louzis et al. (2011).

Cai and Huang (2014) find interest rates (IR) as negatively related to NPL while both Filip (2014) and Anić et al. (2015) find a positive relation. The size of deposits is positively related to NPL (Khemraj and Pasha, 2009; Caig and Huang, 2014; Vardar and Özgüler, 2015). Polodoo et al. (2015) are the only one to use and to find that credit concentration (industry-specific) and cross-border loans are positively related to NPL. Vardar and Özgüler (2015) find that the Central Bank overnight lending rate, which is close in nature to a repo rate or a federal funds rate, is negatively related to NPL, while Kosaric and Žunić (2015) find that more risk-weighted assets increase NPL.

The effect of liquid assets to long-term liabilities on NPL is negative according to Kosaric and Žunić (2015) but positive according to Vardar and Özgüler (2015). The effect of lagging loans can be positive (Polodo et al., 2015), or negative (Vardar and Özgüler, 2015) or even uncertain (Khemraj and Pasha, 2009). Inflation (I) is in general detrimental (Ryskulov and Berhani 2014; Filip, 2014; Anić et al., 2015; Kozaric and Žunić, 2015; Polodo et al., 2015) except in Vardar and Özgüler (2015).

The real exchange rate has a definite negative effect (Anić et al., 2015; Kozaric and Žunić, 2015; and Polodoo et al., 2015). The unemployment rate is found to have a positive effect in general (Filip, 2014; Anić et al., 2015; Polodoo et al., 2015) except in Ryskulov and Berhani (2014).

Anić et al. (2015) are the only ones to study the effects of real wages and savings which turn out both to have a negative impact on NPL. Finally, Vardar and Özgüler (2015) study the current account deficit which is found to have a positive effect on NPL.

In the survey of literature of this study, the most recurring variables that were selected were GDP, total loans, interest rates, deposits, inflation, the real exchange rate, the unemployment rate and capital adequacy. GDP happened to be one variable where there was much variance in its effect on NPL. Large banks have better risk management strategies, which translate into a better quality of loans, and less NPL. A positive relation is rationalized as large banks tend to give larger and more complex loans, are more lenient in their credit policy, and take more risky endeavors (Polodoo et al., 2015).

Return on Assets (ROA) can have either a negative or positive relationship with NPL. It could be negative because it implies that there are more profits which are the results of lower NPL. On the other hand, higher ROA might be a sign of weakness due to lower assets compared with net income, and lower assets places the bank in danger. Finally ROA can be considered as the result of good management and has a negative relationship with NPL (Louzis et al. 2011). One way to capture this uncertainty in the association is by including ROA in a quadratic functional form. And this will be carried out subsequently.

Return on Equity (ROE) can have either a negative or positive relation with NPL. It could be negative because it implies that there are more profits which are the result of a lower NPL. On the other hand, higher ROE might be a sign of weakness due to low equity (which means higher liabilities) compared with net income, and higher liabilities increase financial leverage corrode profits, and place the bank in danger. One way to capture this indeterminacy of signs is by including ROE in a quadratic functional form. And this will be carried out subsequently.

The growth in bank size (GTA) is seen by one study as having a positive effect on NPL but a second study considered it as affecting NPL negatively (Cai and Huang, 2014). This can be captured by a quadratic functional form. And this will be carried out subsequently. A high growth rate may come from more economic activity which impacts negatively NPL. Or a high GTA may indicate to the bank that it has more than enough cushion against bad loans and the bank takes more risky exposures, because of moral hazard, which impact positively NPL. Finally a high GTA may indicate sustained favorable expansion of the activities of banks, and hence a lower NPL.

Total loans were agreed by all studies in which they were used as to have positive effects on NPL (Khemraj and Pasha, 2009; Filip, 2014; Kozaric and Žunić, 2015; Vardar and Özgüler, 2015). The more loans the higher the risky loans and therefore the higher is the required NPL. Deposits represent liabilities to banks. The more liabilities the more the negative impact on profitability, and NPL increases (Khemraj and Pasha, 2009; Cai and Huang, 2014; Vardar and Özgüler, 2015).

Interest rates were considered by two studies as having a positive relation while only one study saw it as having a negative relation on NPL. Inflation was considered by five studies as having a direct relationship with NPL while one study theorized that it is the opposite. The real exchange rate was seen by two studies as having an inverse relationship with NPL while one study supposed that it has a positive one. Four out of five studies agreed that the unemployment rate has a positive impact on NPL while only one study supposed the contrary. As for the capital adequacy ratio, three studies found support to a positive effect.

3. The Factors used in our Analysis

We have selected a number of the variables that were used by the papers in the above literature review which affect NPL along with the reasons and expected theoretical impacts behind those relationships. The null hypothesis for each variable will be that there would be no relationship between that variable and NPL, while the alternative hypothesis will be stated for each variable on its own. This list comprises variables that are specific to Lebanon, and hence allows testing hypotheses that are not encountered elsewhere. Variables are both bank specific or macroeconomic.

Growth in Gross Domestic Product (GGDP): It may have a positive, negative or no effect on NPL. The positive relationship between NPL and GDP is explained by the idea that when GDP grows more loans are lent to borrowers as a result of an expanding economy which leads eventually to more NPL. However, there is another suggestion that claims that when the economy falls down, borrowers with lower incomes find it harder to re-pay their loans and this increases NPL.

Capital Adequacy (CA): also known as Capital to Risk-Weighted Asset Ratio (RWA) which is the ratio of a bank's capital to its total risky assets. We expect that the higher the ratio is the less NPL would be. This is due to the fact that a bank with a higher CA is considered less risky.

Interest Rate (IR): This variable could play either a negative or a positive role when it comes to NPL. Interest rates have a negative effect on NPL due to the fact that higher interest rates can cause profits to grow. Yet, higher interest rates might result in borrowers failing to re-pay their loans and therefore leads to higher NPL.

Repurchase Agreement Rate (REPO): The repo rate is the loan rate on a collateralized instrument against a security, usually a T-bill or T-note. It is considered as the rate for very short term liquidity needs. A high REPO is a sign that individual banks and the banking system as a whole are liquidity strained, and are incurring high NPL.

Growth in the Coincident Indicator (GINCI): The coincident indicator is a measure of consumer and business confidence for the future, computed by the central bank of Lebanon. A high GINCI means that future prospects are rosy and hence the default rate is lower leading to less NPL.

Annual standard deviation of monthly GINCI (UCSCI): UCSCI is a measure of uncertainty in the economic outlook. More uncertainty is detrimental to banks and may generate high levels of NPL.

Loans to Deposits (LDR): Deposits have a positive relationship with NPL since it represents liabilities in banks, for which an increase will reflect negatively on profitability and therefore might increase NPL. Therefore, the alternative hypothesis is that NPL increases by the increase in deposits.

Inflation (I): Inflation affects NPL positively since rising inflation prevents more borrowers from re-paying their loans and as a result NPL increases. The alternative hypothesis will state that inflation and NPL have a direct relationship. It may be necessary to decompose inflation into expected and unexpected components which have a differential effect on debt repayment.

Growth in Total Assets (GTA): GTA can affect NPL either positively or negatively. The argument behind having a positive relationship with NPL is that high-growth banks are able to give out more loans which as a result lead to higher NPL. GTA can have a negative relationship with NPL. It could be negative due to the fact that owning more assets serves as a cushion to the bank and allows for more risk-taking through moral hazard. The alternative hypothesis is thus indeterminate.

Liquid Assets over Total Assets (LATA): This variable can have a negative relationship with NPL. It could be negative since having more liquid assets allows the bank to deal better with short-term liabilities. The alternative hypothesis will be as the aforementioned.

Return on Assets (ROA): This variable can have either a negative or positive relationship with NPL. It could be negative because it implies that there are more profits which are the results of lower NPL. On the other hand, higher ROA might be a sign of weakness due to lower assets compared with net income, and lower assets places the bank in danger. ROA can also be a measure of good bank management. The alternative hypothesis as such as that the ratio and NPL have an indeterminate relationship.

Return on Equity (ROE): This variable can have either a negative or positive relationship with NPL. It could be negative because it implies that there are more profits which are the results of lower NPL. On the other hand, higher ROE might be a sign of weakness due to low equity (which means higher liabilities and higher financial leverage) compared with net income, and higher leverage places the bank in danger. We will consider the alternative hypothesis as such as that the ratio and NPL have an indeterminate relationship.

Total Loans (TL): Total loans go hand in hand with NPL, where the relationship is positive. Logically, the more loans the bank gives to borrowers the higher the likelihood of incurring NPL. As a result, the alternative hypothesis is that the increase in loans granted will increase NPL.

From the above variables the following general equation is hypothesized:

$$NPL = \alpha_0 + \alpha_1 GGDP + \alpha_2 CA + \alpha_3 IR + \alpha_4 REPO + \alpha_5 GINCI + \alpha_6 UCSCI + \alpha_7 LDR + \alpha_8 I + \alpha_9 GTA + \alpha_{10} LATA + \alpha_{11} ROA + \alpha_{12} ROE + \alpha_{13} TL + \epsilon$$

However, and after screening the variables for unit roots, wrong Granger-causality, and Wald tests, the list will become slimmer. We will also consider doing a regression analysis where we categorize the banks into alpha banks and non-alpha banks, and see if there are any differential changes in the estimated regression coefficients. A short run and long run analyses, by including the lag of the dependent variable (NPL), will also be performed. The results conform to economic theory whereby long run effects are greater than short run effects, because adjustment to a given change is more apt to be completed in the long run.

4. Empirical Results

Data is collected from the Association of Banks in Lebanon and comprises information on 35 banks over a period of 11 years (2003-2013). In addition to the variables defined in the previous section, NPL is defined here as the ratio for non-performing loans over total loans.

First unit root tests are conducted. All variables should be integrated of order zero, i.e. be stationary in distribution, to avoid spurious regressions. Since we consider panel data then bank-specific variables should not have an individual unit root, and macroeconomic variables should not have a common unit root. Second Granger causality should be unidirectional from the independent variable to NPL, or, at the very least, bi-directional Granger causality can be allowed, but not unidirectional causality from NPL to the selected variable.

We use a unit root test with intercept and trend to test for a unit root. If we fail to reject the null hypothesis then the data is non-stationary and we differentiate the variable and test again for a unit root. If we reject the null hypothesis after differencing then the variable is now stationary. This indicates that the original data has a unit root, which means that the raw series is integrated of order 1. Table 1 reports the results. The two tests for a common unit root and the three tests for an individual unit root are all carried out using the EViews 9.5 statistical package. The actual p-values are compared to a marginal significance level of 5%. The last column in Table 2 lists the hypothesis for which there is enough evidence.

The variables shown above in Table 1 can be classified into macroeconomic variables and bank-specific variables. GGDP, IR, I, REPO, GINCI and UCSCI are the macroeconomic variables and NPL, CA, LDR, GTA, LQR, ROA, ROE and TL are the bank-specific variables. Stationarity of the macroeconomic variables will be decided upon looking at the common unit root, while the bank-specific variables will be tested for unit root using the individual unit root test. The variables for which the non-stationarity hypothesis fails to be rejected are CA, LDR and TL. Therefore, we have conducted on these variables the same test using the first difference of the log and the results came out that the variables become stationary. Thus, we will include these three variables in the first difference in the multiple regression equation.

Table 1: Actual p-values of panel unit root tests. The null hypothesis is one unit root (or non-stationarity). The marginal significance level is taken to be 5%. The tests include a constant and a trend

Variables	**Common Unit Root**		**Individual Unit Root**			**Conclusion**
	Levin, Lin & Chu t	**Breitung t-stat**	**Im, Pesaran and Shin W-stat**	**ADF –Fisher Chi-square**	**PP – Fisher Chi-square**	
NPL	0.0000	0.3931	0.0056	0.0001	0.0000	S
GGDP	0.0000	0.0000	0.8309	0.9989	1.0000	S
CA	0.0000	0.0406	0.3444	0.3402	0.1193	NS
ΔCA	0.0000	0.0000	0.0000	0.0000	0.0000	S
IR	0.0000	0.0071	0.0007	0.0000	0.9652	S
LDR	0.0074	0.9998	0.7669	0.8327	0.4956	NS
ΔLDR	0.0000	0.0000	0.0000	0.0000	0.0000	S
I	0.0000	0.0000	0.0000	0.0000	0.0000	S
GTA	0.0000	0.0000	0.0001	0.0000	0.0000	S
LATA	0.0000	0.0115	0.0080	0.0007	0.0000	S
ROA	0.0000	0.6416	0.0023	0.0000	0.0000	S
ROE	0.0000	0.0424	0.0000	0.0000	0.0000	S
GINCI	0.0000	0.0000	0.0035	0.0463	0.0463	S
UCSCI	0.0000	0.0000	0.0000	0.0000	1.0000	S
TL	0.3014	1.0000	0.9986	0.9650	0.7841	NS
ΔTL	0.0000	0.6930	0.0055	0.0000	0.0000	S
REPO	0.0000	0.0122	0.7581	0.9859	0.3702	S

Δ: First difference operator. S: Stationarity – Null Hypothesis rejected. NS: Non-stationarity –Null Hypothesis fails to be rejected. NPL: Ratio of loan losses over total loans. GGDP: Growth in gross domestic product. CA: Capital adequacy. IR: Interest rate represented by the annual 12-month T-Bill rate. LDR: Loan to deposit ratio. I: inflation rate. GTA: Growth in total assets. LATA: Liquidity ratio. ROA: Return on total assets. ROE: Return on Equity. GINCI: Growth in the coincident indicator. UCSCI: standard deviation of the monthly coincident indicator. TL: Total loans. REPO: Repurchase agreement rate.

Table 2 provides for the results of undertaking Granger causality. The latter, with a lag length of 3, relies on estimation of the following regression against an exogenous variable (X) and against itself:

$$Y_t = \gamma_{0+}\gamma_1 Y_{t-1} + \gamma_2 Y_{t-2} + \gamma_3 Y_{t-3} + \theta_1 X_{t-1} + \theta_2 X_{t-2} + \theta_3 X_{t-3} + \vartheta_t$$

where ϑ_t is the regression residual.

If $\theta_1 = \theta_2 = \theta_3 = 0$, then, X_t does not Granger-cause Y_t.

If $\theta_1 \neq 0 \; and/or \; \theta_2 \neq 0 \; and/or \; \theta_3 \neq 0$, then X_t Granger-causes Y_t.

Table 2 shows the results of the Granger causality test conducted for each variable and their relationship with NPL, using a lag of 3 years. The test results include whether the variables cause NPL, whether NPL causes the variables, whether there is bidirectional causality or whether there is no causality at all. Variables such as GGDP, ΔCA, IR, GTA, LQR, and ΔTL have no causality with NPL. As for I, GINCI, and UCSCI are to be ignored since the tests concluded that NPL causes them in a unidirectional way. ΔLDR, ROA and ROE all cause NPL. REPO is the only variable to have a two-way causality with NPL.

Table 2: Granger Causality tests – with respect to NPL. The null hypothesis is no Granger causality. The marginal significance level is taken to be 5%

	Variable does not Granger-cause NPL		**NPL does not Granger-cause variable**	
Variables	**P-Value**	**Null hypothesis**	**P-Value**	**Null Hypothesis**
GGDP	0.4452	A	0.7407	A
ΔCA	0.8233	A	0.7620	A
IR	0.1242	A	0.0578	A
ΔLDR	1.E-05	R	0.2620	A
I	0.5633	A	0.0309	R
GTA	0.1892	A	0.6932	A

	Variable does not Granger-cause NPL		NPL does not Granger-cause variable	
Variables	P-Value	Null hypothesis	P-Value	Null Hypothesis
LATA	0.3338	A	0.1075	A
ROA	0.0012	R	0.0541	A
ROE	0.0010	R	0.1555	A
GINCI	0.1346	A	0.0006	R
UCSCI	0.6602	A	0.0204	R
ΔTL	0.4234	A	0.9593	A
REPO	0.0461	R	0.0428	R

A: Null hypothesis fails to be rejected R: Null hypothesis rejected.

The variables that are only affected by NPL, and not the other way round, are excluded from any further consideration. This is due to the fact that NPL is considered to be the dependent variable. All other variables which cause NPL, have bidirectional effect or no effect in both ways are kept for further testing using the Panel Least Squares which is implemented in Table 3 below. In this table the statistic that is most relevant is the Durbin-Watson statistic which is too low, denoting the presence of positive serial correlation. Its value is 1.04980. Serial correlation keeps the estimators unbiased but overstates the standard errors of the coefficients. The result is that a variable can be seen wrongly to have an insignificant explanatory power. One way to correct for positive serial correlation is to include in the regression the lagged value of the dependent variable. This is carried out in Table 4.

Table 3: Panel least squares test with NPL as a dependent variable. Values in parentheses are negative

Variable	Coefficient	t-statistic	Probability
Constant	(0.012409)	(1.674908)	0.0949
GGDP	(0.038806)	(2.184038)	0.0297
ΔCA	0.000206	1.434057	0.1525
IR	0.002773	2.702288	0.0072
ΔLDR	0.000111	0.893859	0.3720
GTA	(0.021029)	(3.300947)	0.0011
LATA	0.021461	0.008676	0.0139
ROA	(0.626342)	(5.619905)	0.0000
ROE	0.015737	4.509554	0.0000
ΔTL	6.68E-10	0.216728	0.8286
REPO	0.000442	1.087830	0.2775
Adjusted R-squared: 0.236241			
Durbin-Watson statistic: 1.049800			

Hence Table 4 includes the same variables as in Table 3 with the exception that the panel least squares in Table 4 includes the first lag of the dependent variable as a regressor. Subsequent to this panel least squares of Table 4, we will examine the variables which have an actual two-tailed probability higher than 5% and, if so, they are considered insignificant, and as a result, we will use the Wald test to check whether those variables found insignificant individually are still insignificant when tested together and jointly. If the null hypothesis of the Wald test fails to be rejected, then these variables will be discarded from further consideration. The Wald tests are reproduced in Table 5. The result is that GGDP, ΔCA, IR, ΔLDR, LQR, ΔTL, and REPO will be omitted in all subsequent analysis because they are jointly insignificant (Table 5).

Table 4: Panel least squares test with NPL as a dependent variable, including the lag of the dependent variable as a regressor

Variable	Coefficient	t-Statistic	Probability
Constant	(0.000779)	(0.110917)	0.9118
GGDP	(0.020706)	(1.223398)	0.2221
ΔCA	0.000161	1.208754	0.2276

Variable	Coefficient	t-Statistic	Probability
IR	0.001741	1.806855	0.0717
ΔLDR	5.17E-05	0.447008	0.6552
GTA	(0.030975)	(3.900512)	0.0001
LQR	0.006933	0.800174	0.4242
ROA	(0.504411)	(4.742584)	0.0000
ROE	0.016119	4.969098	0.0000
ΔTL	1.98E-09	0.684197	0.4943
REPO	(5.15E-05)	(0.132631)	0.8946
NPL(-1)	0.347822	7.530031	0.0000
Adjusted R-squared: 0.353984 Durbin-Watson stat: 1.836171			

Table 5: Wald Test for removing GGDP, ΔCA, IR, ΔLDR, LQR, ΔTL and REPO from Table 4

Test Statistic	Value	Probability
F-statistic	0.847829	0.5484
Chi-square	5.934802	0.5474

The actual p-values of the Wald tests in Table 5 are around 0.55, failing to reject the null hypothesis that all seven variables GGDP, ΔCA, IR, ΔLDR, LQR, ΔTL and REPO do not enter significantly statistically. Hence the conclusion is strong: these variables need to be omitted from subsequent analysis.

Table 6 is based on a regression, which is denoted short run as will become apparent in a while, of the dependent variable (NPL) on GTA, ROA, and ROE, which are the three variables that were found to be significant statistically in Table 4. As expected all three variables have high statistical significance with very low actual p-values, less than 0.0001. The minimum absolute t-statistic is 4.787761 and the highest is 5.083521. It is noteworthy to remark that the lagged dependent variable carries a coefficient of 0.370276, which has a standard error of 0.04321, which implies a t-statistic of -14.575 for a t-test on difference from 1. Hence there is strong evidence that the residual is stationary. However what is striking in the results is that GTA and ROA have statistically significantly negative coefficients while ROE has a statistically significantly positive coefficient. What is expected is for the three variables to have the same sign of association with NPL because they measure essentially similar effects. As has been argued previously this finding implies that the true relation is non-linear and must include quadratic terms. This will be implemented later. Another striking result is the statistical significance of GTA because this variable did not Granger cause and was not Granger caused by NPL (see Table 2).

Table 6: Panel least squares test with NPL as a dependent variable

Variable	Coefficient	t-Statistic	Probability
C	0.010400	5.926234	0.0000
GTA	(0.034824)	(4.787761)	0.0000
ROA	(0.501208)	(4.885224)	0.0000
ROE	0.016338	5.083521	0.0000
NPL(-1)	0.370276	8.569913	0.0000
Adjusted R-squared: 0.356057 Durbin-Watson stat: 1.842365			

The derivation of the long run coefficients from the short run coefficients in Table 6 when the lag of the dependent variable is included as an independent variable is presented as follows. Assume we have the following multiple linear regression with two independent variables (X and Z) and the lag of the dependent variable as an additional independent variable:

$$Y_t = \beta_0 + \beta_1 X_t + \beta_2 Z_t + \beta_3 Y_{t-1} + \varepsilon_t$$

This equation can be rewritten as:
$Y_t - \beta_3 Y_{t-1} = \beta_0 + \beta_1 X_t + \beta_2 Z_t + \varepsilon_t$
In the steady state Y_{t-1} converges to Y_t, hence the above equation changes to:
$Y_t - \beta_3 Y_t = \beta_0 + \beta_1 X_t + \beta_2 Z_t + \varepsilon_t = Y_t(1-\beta_3)$
Dividing through by $(1-\beta_3)$ one gets:
$Y_t = \beta_0/(1-\beta_3) + (\beta_1/(1-\beta_3))X_t + (\beta_2/(1-\beta_3))Z_t$

The three new coefficients $\beta_0/(1-\beta_3)\,,(\beta_1/(1-\beta_3)), and\ (\beta_2/(1-\beta_3))$ are the long run coefficients, and the impact coefficients β_0, β_1, and β_2 are the short run coefficients. Since usually $0 < \beta_3 < +1$, then the long run coefficients are higher than the short run coefficients.

The lag multiplier, between the short run and the long run, is simply $(1/(1-\beta_3))$. From Table 6 the lag multiplier is 1.587997, and carries a t-statistic of 14.57475, and a very low actual p-value. The t-statistic that the lag multiplier is higher than +1, is 5.3967 and is highly significant statistically. Hence long run effects are stronger than the short ones, as expected. Table 7 shows the results of transforming the significant variables in the short-term in Table 6 to long-term. These values represent each the long-term effect. All long run values are highly significant statistically.

Table 7: Wald tests for the short run coefficients in Table 6 multiplied by the lag multiplier, i.e. Wald tests for the long run coefficients

	Value	Standard Error	t-statistic	Probability
GTA	(0.055300)	0.012041	(4.592732)	0.0000
ROA	(0.795917)	0.163838	(4.857941)	0.0000
ROE	0.025944	0.006424	4.783403	0.0000

Table 8: Panel least squares test with NPL as a dependent variable for GTA, ROA and ROE of both Alpha (AB) and Non-Alpha Banks (NAB)

Variable	Coefficient	t-Statistic	Probability
NAB	(0.011154)	(5.633643)	0.0000
AB	0.006669	1.328515	0.1849
NAB*GTA	(0.050991)	(5.429671)	0.0000
NAB*ROA	(0.481769)	(4.582666)	0.0000
NAB*ROE	0.016977	5.223555	0.0000
AB*GTA	(0.011298)	(0.946983)	0.3443
AB*ROA	(0.605169)	(1.073273)	0.2839
AB*ROE	(0.032660)	0.859971	0.3904
NPL(-1)	0.371582	8.595324	0.0000
Adjusted R-squared: 0.362799 Durbin-Watson stat: 1.827464			

The regression in Table 8 is for the short run, i.e. including the lagged dependent variable. The dummy variable AB is equal to 1 if the bank is an alpha bank, and zero otherwise. The dummy variable NAB equals 1 if it is a non-alpha bank and zero otherwise. Both dummies enter as intercept shifts and as interactive variables with the other independent variables. Table 8 shows that all the variables of the Alpha Banks are statistically insignificant since their p-values are much higher than 5 percent. Therefore, a Wald test on their joint significance will be performed for those variables. See Table 9.

In Table 9, a Wald test is performed for the variables pertaining to alpha banks to prove for the last time that they are collectively insignificant. The actual p-values are around 0.56, which is much higher than 5%, the adopted two-tailed marginal significance test.

Table 9: Wald Test for removing the variables of Alpha Banks from Table 8

Test Statistics	Value	Probability
F-statistic	0.690288	0.5585
Chi-square	2.070863	0.5578

From the tests in Table 9, it can be concluded that after performing the Wald test for the variables of GTA, ROA and ROE of Alpha Banks that their joint statistical insignificance is confirmed. Hence in Table 10 only non-alpha banks are considered. It is obvious that the three variables ROA ROE and GTA enter statistically with high significance.

Table 10: Panel least squares test with NPL as a dependent variable against GTA, ROA and ROE for Non-Alpha Banks

Variable	Coefficient	t-Statistic	Probability
Constant	0.011170	4.388019	0.0000
NAB*GTA	(0.050994)	(4.235114)	0.0000
NAB*ROA	(0.482146)	(3.575168)	0.0004
NAB*ROE	0.016975	4.073808	0.0001
NPL(-1)	0.370463	6.508444	0.0000
Adjusted R-squared: 0.361335			
Durbin-Watson stat: 1.828730			

Table 10 presents the results of the regression of NPL on the three significant variables, ROA, ROE, and GTA for non-alpha banks. The coefficients on GTA and ROA are negative and the coefficient on ROE is positive. This discrepancy prompted us to include quadratic terms. This is done in the regression reproduced in Table 11. As evident from the results all three variables with their squares are statistically significant. They all denote the presence of a minimum in the three marginal relations. Before the minimum the marginal effects are negative and after the minimum these marginal effects are positive. One can conclude that this econometric model is the best. In the short run profitability is low and NPL is high, creating inverse relations. In the long run high profitability allows the provision of a higher NPL, as a sizeable cushion for doubtful loans, and the marginal effects are positive.

Table 11: Panel least squares test with NPL as a dependent variable against GTA, ROA and ROE, and their squares, for Non-Alpha Banks

Variable	Coefficient	t-Statistic	Probability
constant	0.0003576	2.455714	0.0146
NAB	0.011944	4.847501	0.0000
NAB*GTA	(0.083909)	(5.841370)	0.0000
NAB*GTA^2	0.162788	3.757280	0.0002
NAB*ROA	(0.506397)	(4.201893)	0.0000
NAB*ROA^2	5.757961	2.361340	0.0188
NAB*ROE	(0.046466)	(3.571329)	0.0004
NAB*ROE^2	0.012192	3.618702	0.0003
NPL(-1)	0.367185	8.893127	0.0000
Adjusted R-squared: 0.425988			
Durbin-Watson stat: 1.965137			

In Table 11 the lag multiplier is equal to 1.580241. The two null hypotheses that this lag multiplier is equal to zero or is no greater than +1 are rejected with respective t-statistics of 15.3266 and 5.6277. Using the lag multiplier one can obtain the long run coefficients that are reproduced in Table 12 with their statistical significance.

Table 12: Wald Test for variables from short-term to long-term from Table 11

	Value	Standard Error	t-statistic	Probability
NAB*GASSETS	(0.132597)	0.023422	(5.661164)	0.0000
NAB*GASSETS^2	0.257244	0.068255	3.768877	0.0002
NAB*ROA	(0.800229)	0.187820	(4.260618)	0.0000
NAB*ROA^2	9.098967	3.856841	2.359176	0.0189
NAB*ROE	(0.073427)	0.021351	(3.439085)	0.0007
NAB*ROE^2	0.019266	0.005588	3.447908	0.0006

The regression analysis of the variables that were concluded as significant when tested for all banks over both the long and short terms were proven again to be significant for Non-Alpha Banks. The results are robust when the econometric procedure is changed. Table 13 provides for such an alternative procedure with fixed cross section effects. The only discrepancy is that the square of the ROA has a two-tailed p-value of 0.0929, which is not that highly significant. Finally, the Hausman test for correlated random effects rejects the model with random effects, and provides support to the model in Table 13 at a high marginal statistical significance (0.0000).

Table 13: Panel least squares test, with fixed cross-section dummy variables, with NPL as a dependent variable against GTA, ROA and ROE, and their squares, for Non-Alpha Banks

Variable	Coefficient	t-Statistic	Probability
constant	0.014795	9.407973	0.0000
NAB	-	-	-
NAB*GTA	(0.057329)	(3.918076)	0.0001
NAB*GTA^2	0.105056	2.395173	0.0172
NAB*ROA	(0.898745)	(5.817715)	0.0000
NAB*ROA^2	4.029965	1.685784	0.0929
NAB*ROE	(0.066535)	(2.892281)	0.0041
NAB*ROE^2	0.017326	3.178781	0.0016
NPL(-1)	0.230400	5.256410	0.0000
Adjusted R-squared: 0.515621 Durbin-Watson stat: 2.112068			

In Table 13 the lag multiplier is equal to 1.299377. The two null hypotheses that this lag multiplier is equal to zero or is no greater than +1 are rejected with respective t-statistics of 17.55786 and 4.04536. Using the lag multiplier one can obtain the long run coefficients that are reproduced in Table 14 with their statistical significance.

Table 14: Wald Test for variables from short-term to long-term from Table 13

	Value	Standard Error	t-statistic	Probability
NAB*GASSETS	(0.074492)	0.019549	(3.810574)	0.0002
NAB*GASSETS^2	0.136508	0.136508	2.378954	0.0180
NAB*ROA	(1.167808)	0.197381	(5.916515)	0.0000
NAB*ROA^2	5.236442	3.111021	1.683191	0.0934
NAB*ROE	(0.086455)	0.030913	(2.796670)	0.0055
NAB*ROE^2	0.022513	0.007378	3.051610	0.0025

The results are consistent when performing the regression analysis for the variables in the long and short terms as well as the testing them under Alpha and Non-Alpha banks. Six variables were determined to be significant as having an effect on the provision of non-performing loans which are the growth in total assets (GTA), return on assets (ROA) and return on equity (ROE), and their squares.

In the short run, GTA has a negative relationship because high growth in assets stems from high macroeconomic activity (in this sense, GDP) which results in a better credit outlook and thus lowers the probability of borrowers' bankruptcy all leading to requiring less loan loss provision. When GTA is too high banks are inclined to extend too much credit which translates into more loan loss provisions. This explains the positive relation of GTA with NPL.

Banks with low profitability or ROA are likely to have had a high NPL. That is why ROA has a negative relationship with NPL. Banks with high profitability are less motivated to generate income and therefore are less inclined to engage in risky activities such as granting risky loans, which leads to a lower NPL and a negative relation between ROA and NPL (Messai and Jouini, 2013). Hence, when ROA is small, inefficient, or unprofitable, banks are likely to grant credit, considered risky, and subsequently achieve high levels of impaired loans. However a high ROA will tend to boost the business self-confidence of bankers, and to reduce their risk aversion, and consequently more loans are generated, and NPL becomes elevated.

ROE equals ROA multiplied by total assets divided by total equity. In other words it is ROA multiplied by the equity multiplier. Since ROA is already included in the regression the impact of ROE is restricted to the impact of the equity multiplier. At low levels of ROE, the equity multiplier is relatively small, inciting banks to extend more credit and therefore to incur a higher NPL. As the equity multiplier increases, financial leverage grows larger which leads banks to take risky assets, a case of moral hazard. All of this ends up in increasing NPL. This explains why ROE and NPL have a positive relationship.

Two reasons explain why we did not find any of the variables significant for alpha banks. The first one is that alpha banks take higher risks when lending due to counting on larger deposit insurance, or on a too-big-to-fail prospect. Deposit insurance is a tool implemented to protect depositors from any losses caused by the failure of a bank's ability to pay its due obligations. The second reason which comes as a result of the first is that alpha banks are usually too big to fail, and their bankruptcy might produce systemic instability. Therefore, even if large banks engage in hazardous behavior by lending excessive amounts to borrowers, and thereby increasing NPL disproportionately, these banks benefit from protective measures which keep them from falling and bringing down with them the economy. Therefore, the variables in this study might not apply in their case.

5. Conclusion

During the period under study (2003/2013) the economic, social, and security outlook in Lebanon deteriorated noticeably. This has prompted us to find out the effect of this instability on the behavior of Lebanese banks. The account that will be most affected by the instability is undoubtedly that of non-performing loans, with their association to the defaulting on loans. The research on the topic has attracted many economists and there is a large body of literature, and a concomitant large array of factors, influencing default, factors that are both bank-specific and macroeconomic in nature. The empirical findings have discovered that only three factors have statistically significant impacts on the loan loss ratio for non-performing loans. These are the return on assets (ROA), the return on equity (ROE), and the growth in total assets (GTA). The impact of these factors is non-linear: at low levels the three factors have a negative impact, and at high levels the relation is positive. This pattern of effects is well captured by a quadratic specification whereby the variable and its square enter the regression. Nonetheless it is also discovered that very large banks have unpredictable and random loan losses, probably arising from the distortion due to the moral hazard emanating from deposit insurance and the fact that they are too big to fail, i.e. their bankruptcy has systemic and contagious repercussions on the financial markets and the real economy. Finally the fact that the growth in GDP was not a significant explanatory factor, may be because business cycles already show up in the fluctuations in ROA, ROE, and GTA. One strong conclusion, however, is that the loan loss ratio in a given bank responds only to bank-specific factors, and is immune from general and direct macroeconomic factors.

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