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Empirical Determinants of the Non-Performing Loans in the Cypriot Banking System

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Abstract

High levels of nonperforming loans (NPLs) weigh heavily on private investment and the ability of banks to meet their basic financing role in society. Using linear regression, the paper examines the factors that affect the level of credit risk of the Cypriot commercial banks as expressed by the percentage of non-performing loans. Like similar studies in the international literature, macroeconomic and institutional/microeconomic factors were utilized to construct and test an appropriate predictive model for NPLs. This empirical study spans the start of the global financial crisis in the fourth quarter of 2008 and the resulting recession of the economy in the second quarter of 2014. All macroeconomic indicators used in the creation and testing of five prediction models were found to affect NPLs significantly, with public debt as a percentage of GDP being the most significant factor.

JEL classification numbers: E32, E44, E51, E52, G10, G21
Keywords: Banks, nonperforming loans, business fluctuations, financial stability

1 Introduction

Since the start of the global economic crisis in 2008, the level of bank non-performing loans (NPLs) to total gross loans in Cyprus has increased significantly. Despite strenuous efforts to control and reduce NPLs they remain excessively high and remains in the spotlight for both regulators, supervisory authorities and banks, and are associated with bank failures and financial crises

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(Makri et al, 2014). A high percentage of NPLs is the cause for economic instability with a negative impact on borrowers, the banks and the economy at large.

Given the economic, budgetary and financial implications of the increased percentage of NPLs in banks' loan portfolios, it is imperative to be able to predict and control their development. It is therefore very useful to know the factors that affect their magnitude. In this context, the present study examines the factors which determine the rate of NPLs in commercial banks in Cyprus. The main causes of NPLs in Cyprus do not seem to have been the subject of existing literature, despite the fact that according to the latest reports from the International Monetary Fund (IMF), the percentage of non-performing loans in commercial banks in Cyprus in the second quarter of 2014 reached to 41.3%, showing an upward trend since the fourth quarter of 2008 (date before which there no official published aggregate statistics were found), and averaged 47.748% in the year 2015 and 46.952% in the year 2016.[2]

The purpose of this study is to investigate the effect of various factors on the percentage of NPLs in commercial banks in Cyprus by estimating the significance level of each such factor and also develop statistical forecasting models. Predictive models can help assess the level of NPLs on the basis of possible changes of various factors in the macroeconomic environment (GDP change, unemployment, public debt, etc.), thus providing the Central Bank and other relevant institutions with valuable information. The research concerns the commercial banks in Cyprus in the period of economic recession beginning in the fourth quarter of 2008 until the second quarter of 2014 using aggregate data.

The paper is organized as follows. Section 2 reviews the literature and develops the conceptual framework for the analysis. Section 3 presents the various statistical methods that would be used for the data analysis and shows the empirical findings. Section 4 presents our concluding remarks and discusses the implications of our findings.

2 Literature Review and Conceptual Framework

2.1 Recent Developments in the Cyprus economy and Cyprus Banking System

Soon after the beginning of the financial crisis, in May 2011 (Zenios, 2013), the country was excluded from international debt markets. A year later, in June 2012 Cyprus becomes the fifth eurozone country applying to the European Commission, the European Central Bank (ECB) and International Monetary Fund (IMF) (Troika)

[2] The Central Bank of Cyprus (CBC) started releasing data on NPLs of both commercial and cooperative banks in June 2013. Ever since, NPLs as a percentage of total credit facilities continue to rise.

(IMF, 2014) for an economic rescue package. In March 2013, the authorities conclude an agreement with international lenders to recapitalize the largest commercial banking institution, Bank of Cyprus, through a bail-in, making use of uninsured deposits, let the second largest commercial bank, Laiki Bank, declare bankruptcy and bail out the co-operative banking sector with the injection of €1,5 billion. The "haircut" of more than €5 billion of deposits was accompanied with severe capital controls aimed at preventing the massive outflow of funds and bankruptcy. Cyprus requested a total of €17 billion. The agreement included a loan of €10 billion and €5.8 million deposit haircut on Cypriot troubled banks (Zenios, 2013). Under this Agreement Laiki Bank is dissolved and all deposits of less than €100.000 are transferred to the Bank of Cyprus (Cyprus's "good bank"). All NPLs of Laiki Bank as well as deposits of more than €100.000 are classified as toxic assets and are transferred to the "bad" bank for timely liquidation. Bondholders and shareholders are also set to lose. From April 2013, the Bank of Cyprus (BOC) continued to operate but underwent restructuring and significant reduction in its activities, initially by disposing branches in Greece and later disposing branches in other Eastern European countries. Depositors of BOC also suffered a "haircut" of nearly 50% of their deposits in excess of €100.000. It is worth noting that this bail-in recapitalization method of banks (CUT deposit / bail-in) was the first of its kind in the eurozone (Zenios, 2013). The size of the banking sector declined from 700% to 350% of GDP within a few weeks with a significant impact on the financial system and other sectors of the economy.

2.2 A Road Map to the Banking Crisis

The crisis of the banking system in Cyprus followed the global banking crisis that erupted in 2007 due to the US mortgage market problems and later transferred to Europe through the toxic derivatives that created a financial crisis in the eurozone (Orphanides & Syrichas, 2012). Cypriot banks were never directly affected as they were not exposed to toxic financial derivatives in contrast to other European banks (Orphanides & Syrichas, 2012). However, there were indirect effects that had to do with the recession in Europe and particularly in the United Kingdom that led to a significant drop in the demand for holiday homes in Cyprus by British citizens. This drop led to a crisis in the construction and real estate sector, the main recipient sectors of bank loans on the island. The large drop in demand was followed by a decline in property prices and a reduction in the construction sector activities (Orphanides & Syrichas, 2012).

The impact of the global economic crisis of 2008 on the Cypriot economy was preceded by a "boom" period of the Cypriot banking sector largely due to the accession of Cyprus to the European Union in 2004 and the lifting of restrictions on capital movements (I.M.F., 2014). The rapid increase in deposits in Cypriot banks by foreign depositors exerted pressure on financial institutions to dispose of this extra liquidity. The result was that all the Cypriot banks engaged in lending with very loose control criteria and without any respect to risk assessment procedures (Savvides, 2013). The ease of lending increased the number of loans in

the real estate and construction sector thus increasing private sector debt above 300% of GDP (I.M.F., 2014).
Banks were expanding their loan portfolio showing an accounting profit that would justify high salaries and bonuses to their managers. The fact that a large proportion of these loans could soon become non-performing did not seem to worry bank officials. Accounting profit was all that mattered as this would make it possible to issue new shares and thus meet the capital adequacy requirements (Savvides, 2013). The excess liquidity that could not be invested in the local economy was used to purchase Greek government bonds and set up branches abroad (Greece, Russia, Ukraine, United Kingdom, Australia) (Savvides, 2013). Therefore, instead of Cypriot banks converting deposits into reliable assets, accumulated huge amounts of NPLs and several billions of investments in Greek government bonds and branches abroad. In addition, the high interest rates to attract foreign depositors greatly hindered the financing of viable local businesses (Savvides, 2013).
The Greek PSI at the end of 2011 was a big blow to the two largest banks of the island as it meant losses amounting to 25% of GDP. This led to a request for state support (10% of GDP) in 2012. These developments were followed by a large outflow of deposits and the need to fall back on the Emergency Liquidity Assistance (ELA) mechanism. The ELA dependence reached 60% of GDP by the end of 2012 (I.M.F., 2014; Georgiou, 2013).

2.3 NPLs in Cypriot Banks

The banking sector is now smaller, systemic banks have increased their capital adequacy at a very satisfactory level, under the circumstances, with good prospects of further enhancement (Central Bank of Cyprus, 2014). Capital controls have been lifted, and deposits have stabilized (I.M.F., 2014). These developments, together with the implementation of a series of key structural changes, repositioned the banking sector on a more sound footing. The monetary authorities focus on loan restructuring and NPLs in the hope of achieving lower interest rates and a healthier economic climate.
Despite recent claims by various officials about the Cypriot Economic success story NPLs remain at very high levels. The ratio of NPLs of the core domestic sector increased sharply from 20 percent at end-2012 to 57 percent at end-July, 2014. Corporate NPLs stood at 50 percent and were highly concentrated, with construction NPLs now at over 73 percent. NPLs on primary-residence mortgages are around 40 percent. Provision coverage remains relatively low, at 34 percent compared to the European average of 46 percent. Failure to address non-performing loans is a threat to the long-term viability of the banking system and economic recovery (I.M.F., 2014).

2.4 The Current Research Plan

Research carried out so far, concerning the factors that affect the level of NPLs, both at times of economic expansion and recession, confirm the existence of

correlation between the banking and business cycles as expressed by macroeconomic indicators. In addition, factors that have to do purely with the banking industry such as effective credit risk management, corporate governance and the total percentage of loans, also seem to influence the index.

The deterioration of public finances (eg increase in public debt, reducing GDP growth, rising unemployment) tends to increase the percentage of NPLs. Given the recent economic recession in Cyprus, it is considered necessary to introduce indicators in the current research model that describe the state of the economy. The most important indicators to be introduced are GDP growth and the rate of unemployment. It was also considered necessary to study the influence of public debt on NPLs given the statistically important findings of Louzis et all (2011), Vogiazes and Nikolaidou (2011) και Makri et al (2013) but also given the very high percentage of the public debt in proportion to the GDP. Since the consequences of macroeconomic factors need time to influence the dependent variable (Jesus & Gabriel (2006); Bofondi & Ropele (2011); Jimenez & Saurina (2006); Vazquez et al (2012)), further research must be carried out concerning the time lag effects. Specifically, the effects of real GDP changes with 1, 2, 3 and 4 quarters' delay (lags) will be tested. The immediate effect of unemployment and public debt is examined. If the results are not statistically significant then their effect on NPLs, with a time lag, will also be tested.

According to D.P. Louzis et al (2011), a model is firstly built using macroeconomic indicators as the only independent variables. As the external factors are often not sufficient to fully explain the development of NPLs, the effect of microeconomic factors is also examined. Bearing in mind the special circumstances under which the Cypriot banks were led to have such high rates of NPLs, extra management performance and quality indicators are introduced in the model. Assuming that quality of management affects the rate of NPLs and that the higher the rate of profitability the lower the need for high risk investments, the extra indicators selected are ROE (Return On Equity) and ROA (Return On Assets). These indicators have been used by a number of researchers giving statistically significant results. As expected both indicators exhibit negative correlation with the rate of NPLs. Finally, the rate of the previous year's NPLs is used as an independent variable since their development depends to a large degree on their current position as they are very persistent. This assumption also underlies research by Makri et al (2013), D.P. Louzis et al (2011) and a number of other studies mentioned in the literature review section.

In table 1 that follows the dependent variable and the explanatory variables (Fiscal macroeconomic and microeconomic) introduced in the model are stated.

Table 1: Symbols and Definitions of Dependent and Non-dependent Variables

Dependent Variable	
NPL_t/TL_t	the ratio of nonperforming loans/total loans for period t % (source: IMF)
Independent Variables	
NPLt-1/TLt-1	the ratio of nonperforming loans/total loans for period t-1 % (πηγή IMF)
Macro Variables of Non-Performing Loans	
DEBTt	$DEBT_t$=General Government Gross $Debt_t$/Nominal GDP_t at period t (%) (source: Eurostat)
UNt	The rate of unemployment (15+) at period t (%) (source: Cystat)
ΔGDPt	The quarterly GDP growth at constant prices at period t (%) (source: Cystat)
ΔGDPt-1	The quarterly GDP growth at constant prices at period t-1 source: Cystat)
ΔGDPt-2	The quarterly GDP growth at constant prices at period t-2 (%) (source: Cystat)
ΔGDPt-3	The quarterly GDP growth at constant prices at period t-3 (%) (source: Cystat)
ΔGDPt-4	The quarterly GDP growth at constant prices at period t-4 (%) (source: Cystat)
Bank Specific Determinants of Non-Performing Loans	
ROAt	Return on Assets at period t (source: IMF)
ROEt	Return on Equity at period t (source: IMF)

According to the literature review similar studies use both aggregate data for the banking industry as a whole and disaggregate data for individual banks. Yet, Boudriga et al (2009), claims that the use of aggregate data for the whole banking industry of a country as opposed to the use of disaggregate data for individual banks is preferable as the risk of bias is reduced. Furthermore, researchers like Rinaldi & Sanchis-Arellano (2006) use aggregate data thus overcoming the hurdle of restricted access to data banks of individual banking institutions. For both of the above reasons it has been decided to use only aggregate data for the purposes of the present research. The NPLs statistics are given on a quarterly basis and are prepared on the basis of the IMF Financial Stability Data Bank. Macroeconomic indicators are obtained from the official web page of the Cyprus Statistical Service and the EUROSTAT. It is also necessary to point out that the choice of the testing period has mainly been determined by the availability of statistical data on NPLs. Such data is not easily forthcoming in the case of the banking system and relates

to the period starting the last quarter of 2008 up to the second quarter of 2014. There was no quarterly data before the last quarter of 2008.[3]

3 Empirical Analysis

To achieve the objectives of the study various statistical tools and procedures have been used. These are ranging from simple descriptive tests to more complex tests such as correlation analysis and regression analysis. As already explained in the introductory section, a model is initially set up containing only macroeconomic and fiscal independent variables and the percentage of NPLs of the previous period. The variables used are NPL_{t-1}/TL_{t-1}, $DEBT_t$, UN_t and ΔGDP_{t-n}, n = 0, 1, 2, 3, 4 which make up the predictive variables and dependent variable is the ratio $NPLt/TL_t$. Since there are more than one independent variables, multiple regression analysis is applied and the resulting model is expected to take the following format.

$$NPL_t/TL_t = \alpha + b_1 NPL_{t-1}/TL_{t-1} + b_2 DEBT_t + b_3 UN_t + b_4 \Delta GDP_{t-n} \quad (1)$$

Regarding the independent variables ΔGDP_{t-n}, n = 0, 1, 2, 3, 4, the explanatory variable that exhibits the largest correlation with the dependent variable will be selected. The specific test is based on the hypothesis that any fluctuation in the rate of change in GDP has no direct effect on the percentage of NPLs but any potential repercussions will possibly appear with certain time-lag. The testing will take place using Pearson's linear regression analysis. The value of the correlation coefficient is higher in the case of the explanatory variable ΔGDP_{t-4} ($r = -0.716$, $p < 0.001$). Based on the results of the analysis it can be concluded that the effect on NPLs of the rate of GDP change is maximum subject to a delay of four quarters. This conclusion agrees with earlier findings as noted in the literature review. The negative correlation coefficient indicates that large values of one variable are accompanied by small values of the other variable and vice versa.[4]

3.1 Correlation Analysis

Correlation methods of analysis attest the relation between two or more variables, but do not measure the causal relation between them. It may also indicate the intensity of the relationship between variables. The results of the correlation analysis are presented in table 2.

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[3] Annual data for the period before 2008 has been found in the IMF report on Cyprus: Financial Sector Assessment Program Update –Technical Note – Measuring Banking Stability in Cyprus. These relate to the time period 1999-2007 (balanced data).

[4] Normality tests have taken place using the Kolmogorov – Smirnov test (KS test) indicating normal distribution of variables.

Table 2: Correlation between Dependent and Independent Variables

Correlations						
		NPLt	DEBTt	UNt	ΔGDPt_4	NPLt_1
NPLt	Pearson Correlation	1	,951**	,870**	-,716**	,965**
	Sig. (2-tailed)		,000	,000	,000	,000
	N	23	23	23	23	22
DEBTt	Pearson Correlation	,951**	1	,946**	-,709**	,920**
	Sig. (2-tailed)	,000		,000	,000	,000
	N	23	23	23	23	22
UNt	Pearson Correlation	,870**	,946**	1	-,661**	,856**
	Sig. (2-tailed)	,000	,000		,001	,000
	N	23	23	23	23	22
ΔGDPt_4	Pearson Correlation	-,716**	-,709**	-,661**	1	-,701**
	Sig. (2-tailed)	,000	,000	,001		,000
	N	23	23	23	23	22
NPLt_1	Pearson Correlation	,965**	,920**	,856**	-,701**	1
	Sig. (2-tailed)	,000	,000	,000	,000	
	N	22	22	22	22	22
**. Correlation is significant at the 0.01 level (2-tailed).						

Based on the p values of the 2-tailed test there are serious indications against the null hypothesis (H_0). It appears that for the observed significance level, corresponding to the statistical testing for the existence or non-existence of a linear relationship between the two variables, the correlation coefficient is zero for all the pairs thus rejecting the H_0 at 0.001 significance level and accepting the alternative hypothesis (H_1). Therefore the dependent variable is correlated to every independent variable; hence the multiple regression analysis can be applied.

3.2 Application of Regression Analysis

Since there appears to be a high correlation between the independent variables, it is not necessary to introduce all of them in the same model. Initially, simple linear regressions for every independent variable separately are applied thus four (4) different prediction models are created. The relationships that are expected to emerge for each separate model take the following form:

$$\mathrm{NPL_t/TL_t} = \alpha_1 + \mathrm{b_1 NPL_{t-1}/TL_{t-1}} \quad (2)$$

$$\mathrm{NPL_t/TL_t} = \alpha_2 + \mathrm{b_2 DEBT_t} \quad (3)$$

$$\mathrm{NPL_t/TL_t} = \alpha_3 + \mathrm{b_3} UN_t \quad (4)$$

$$\mathrm{NPL_t/TL_t} = \alpha_4 + b_4 \Delta\mathrm{GDP_{t-n}} \quad (5)$$

In addition, due to the high linear correlation between the independent variables, (see table 2) stepwise regression is applied in order to find a useful and reliable model. Through this process an optimum fifth model is created that contains two independent variables as follows:

$$NPL_t/TL_t = \alpha_5 + b_{51}NPL_{t-1}/TL_{t-1} + b_{52}DEBT_t \quad (6)$$

An attempt will be made to estimate the regression line by defining the coefficients α_i, i=1,2,3,4,5, b_i, i=1,2,3,4 και b_{5i}, i=1,2. All necessary conditions have already been checked and therefore the methodology can be applied. Variables are measured on a proportional scale and originate from distributions that are close to normal. Also, based on the calculation of Pearson's coefficient, paired variables (dependent and independent variable) exhibit strong linear correlation. The results of the analysis are presented in a series of tables for each separate model.

The first set of tables (tables 3, 6, 9, 12, 15) is a summary of the linear regression model. The validity of the hypothesis is also tested by the one-way ANOVA analysis. Using the F-test the goodness of fit is determined by testing the null hypothesis that all regression variables equal to zero. More specifically, the ANOVA table shows the test results of the null hypothesis H_0: b_i=0 against the alternative hypothesis: $b_i \neq 0$. The tables show the statistical value of F_α, df_1, df_2 (where α is the pre-determined level of statistical significance). The ANOVA results appear in separate tables for each model (tables 4, 7, 10, 13, 16). Next follows the table with estimated parameters (tables 5, 8, 11, 14, 17) according to which, the regression model is determined. Finally, in order to validate the regression results, a test is performed regarding the estimation errors (residuals). These errors must be distributed normally, and be homoscedastic and random.

3.2.1 Model 1

$$NPL_t/TL_t = \alpha_1 + b_1NPL_{t-1}/TL_{t-1}$$

Table 3: Summary of the Simple Regression Model NPLt/TLt & NPLt-1/TLt-1

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.965[a]	0.931	0.928	3.15156	0.931	270.748	1	20	.000
Predictors: (Constant), NPL_{t-1}									

The coefficient of determination and the adjusted coefficient of determination are 0.931 and 0.928, respectively. The high values of these coefficients show that the independent variable may explain 92.8% of the variance of the dependent variable. This result confirms our initial hypothesis that NPLs are very persistent, relying heavily to their most recent pattern.

Table 4: Variance Analysis - Model 1

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2689.165	1	2689.165	270.748	.000[b]
	Residual	198.647	20	9.932		
	Total	2887.812	21			
a. Dependent Variable: NPLt						
b. Predictors: (Constant), NPL_{t-1}						

Based on the results presented in table 4, the F value of 270.748 falls within the rejection area of the null hypothesis as the p value is smaller than 0.001.

Table 5: Estimation of Parameters - Model 1

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.312	1.047		.298	.769	-1.873	2.496
	NPLt_1	1.119	.068	.965	16.454	.000	.977	1.261
a. Dependent Variable: NPLt								

The values of the regression coefficients α_1 and b_1 are shown in the second column of table 5. The value of constant α_1 is 0.312. Yet for the population, the result varies with 95% confidence, from -1,873 up to 2,496 and therefore it is possible that the coefficient assumes a zero value. This is also the case when applying the t criterion which tests the H_0: $\alpha_1=0$ against the H_1: $\alpha_1\neq0$. The result of the t criterion is not statistically significant and therefore the null hypothesis is not rejected that perhaps coefficient α_1 is not different to zero. This means that coefficient α_1 has no practical value for the model. The value of coefficient b_1 is 1.119, which means that for every unit increase of NPLs of the previous quarter the NPLs of the next quarter increase by 1.119. The resulting model is therefore

$$NPL_t/TL_t = 1.112NPL_{t-1}/TL_{t-1}$$

This linear model is statistically significant as can be seen from the analysis of variance ($F(1,20)=270.748$, $p<0.001$). According to the coefficient of determination the independent variable NPL_{t-1}/TL_{t-1} can interpret 92.8% of the variance of the dependent variable NPL_t/TL_t.

3.2.2 Model 2

$$NPL_t/TL_t = \alpha_2 + b_2 DEBT_t$$

Table 6: Summary of Simple Regression Model NPLt/TLt & DEBTt

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
2	.951[a]	.904	.899	3.69703	.904	197.187	1	21	.000
a. Predictors: (Constant), $DEBT_t$									

The coefficient of determination and the adjusted coefficient of determination have values 0.904 και 0.899, respectively. The high values of these coefficients show that the level of public debt as a percentage of GDP can interpret 89.9% the percentage of NPLs.

Table 7: Variance Analysis – Model 2

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	2695.155	1	2695.155	197.187	.000[b]
	Residual	287.029	21	13.668		
	Total	2982.183	22			
a. Dependent Variable: NPLt						
b. Predictors: (Constant), $DEBT_t$						

Table 7 indicates that the F statistic (197.187) falls within the rejection area of the null hypothesis, as the observed level of statistical significance p is smaller than 0.05 and more specifically, smaller than 0.001, and therefore the model is statistically significant.

Table 8: Estimation of parameters – Model 2

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
2	(Constant)	-29.591	3.136		-9.436	.000	-36.113	-23.069
	DEBTt	.552	.039	.951	14.042	.000	.470	.634
a. Dependent Variable: NPL_t								

The second column of table 8 presents the estimated regression coefficients. The constant term α_2 in this model is -29.591 and b_2 coefficient is 0.552. This means that for every unit of increase in public debt as compared to GDP the NPLs increase by 0.552 units. The above table also shows the results from applying the two t criteria. These criteria relate to the regression coefficients α_2 and b_2 and test the null hypothesis (H_0: $\alpha_2=0$, $b_2=0$) that the coefficients are not different to zero and respectively the alternative hypothesis that the coefficients are different to zero (H_1: $\alpha_2\neq0$, $b_2\neq0$). In this case it is observed that the results of the t criteria are statistically significant and therefore the two regression coefficients are different

to zero hence they have a practical value for the model. The resulting model is

$$NPL_t/TL_t = -29.591 + 0.552DEBT_t$$

This linear model is statistically significant as shown by the analysis of variance (F(1.21)= 197,187, p<0.001). According to the coefficient of determination the independent variable $DEBT_t$ can interpret 90% of the variance of the dependent variable NPL_t/TL_t.

3.2.3 Model 3

$$NPL_t/TL_t = \alpha_3 + b_3 UN_t$$

Table 9: Summary of the Simple Regression Model NPLt/TLt & UNt

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
3	.870[a]	.758	.746	5.86760	.758	65.619	1	21	.000
a. Predictors: (Constant), UN_t									

The values of the coefficient of determination and adjusted coefficient of determination show that the unemployment rate can interpret 74.6% the variability of NPLs.

Table 10: Variance Analysis - Model 3

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
3	Regression	2259.180	1	2259.180	65.619	.000[b]
	Residual	723.003	21	34.429		
	Total	2982.183	22			
a. Dependent Variable: NPLt						
b. Predictors: (Constant), UN_t						

Table 10 shows that the value of F (65.619) falls within the rejection area of the null hypothesis, and therefore the regression model used is statistically significant.

Table 11: Estimation of Parameters - Model 3

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
3	(Constant)	-9.020	2.992		-3.015	.007	-15.242	-2.799
	UNt	2.271	.280	.870	8.101	.000	1.688	2.854
a. Dependent Variable: NPL_t								

As can be seen in the second column of table 11, in this model the value of α_3 -9.02 and b_3 is 2.271, meaning that for every unit increase in the unemployment percentage the NPLs increase by 2.271. Table 11 also shows the results of applying the two t criteria. These relate to the regression coefficients α and b testing the H_0: $\alpha_3=0$, $b_3=0$ against the H_1: $\alpha_3\neq0$, $b_3\neq0$. In this case it is observed that the results of the t criteria are statistically significant and therefore both coefficients are different to zero thus being of practical value to the model. The resulting model is

$$NPL_t/TL_t = -9.02 + 2.271UN_t$$

This linear model is statistically significant as indicated by the analysis of variance ($F(1,21) = 65.619$, $p<0.001$). Based on the coefficient of determination, the independent variable UN_t can explain 74.6% of the variance of the dependent NPL_t/TL_t.

3.2.4 Model 4

$$NPL_t/TL_t = \alpha_4 + b_4\Delta GDP_{t-n}$$

Table 12: Summary of Simple Regression Model NPLt/TLt & ΔGDPt_4

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
4	.716[a]	.513	.490	8.31313	.513	22.152	1	21	.000
a. Predictors: (Constant), ΔGDP_{t-4}									

The values of the coefficient of determination and the adjusted coefficient of determination show that the variability in the rate of change of the real GDP can explain the rate of NPLs by 49%. It must be noted that the rate of change of GDP relates to four quarters before the quarter under study as the preliminary tests showed that changes in the growth rate of real GDP affect NPLs more with a delay of four quarters.

Table 13: Variance Analysis - Model 4

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
4	Regression	1530.912	1	1530.912	22.152	.000[b]
	Residual	1451.271	21	69.108		
	Total	2982.183	22			
a. Dependent Variable: NPLt						
b. Predictors: (Constant), ΔGDP_{t-4}						

Table 13 indicates that the statistical value of F (22.152) falls within the rejection area of the null hypothesis as p is smaller than 0.001, and therefore the

regression model used is statistically significant.

Table 14: Estimation of Parameters - Model 4

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
4	(Constant)	11.031	1.788		6.170	.000	7.313	14.750
	ΔGDPt_4	-8.955	1.903	-.716	-4.707	.000	-12.912	-4.999
a. Dependent Variable: NPL_t								

The second column of table 14 presents the value of α_4 of 11.031 and the value coefficient b4 of -8.955. This means that for every unit of increase in real GDP the percentage of NPLs four quarters later is reduced by 8.955 units. The table also shows the results from applying the two t criteria. These criteria relate to the regression coefficients α_4 and b_4 and test the H_0: $\alpha_4=0$, $b_4=0$ against the H_1: $\alpha_4\neq0$, $b_4\neq0$. The results given by the t criteria are statistically significant and therefore both coefficients are different to zero and have a practical value to the resulting model

$$NPL_t/TL_t = 11.031 - 8.955\Delta GDP_{t-n}$$

This linear model is statistically significant as shown by the analysis of variance ($F(1.21) = 22.152$, $p<0.001$). Based on the coefficient of determination, the variable $\Delta GDPt_4$ can explain 49.6% of the variance of the dependent variable NPL_t/TL_t.

3.2.5 Model 5

$$NPL_t/TL_t = \alpha_5 + b_{51}NPL_{t-1}/TL_{t-1} + b_{52}DEBT_t$$

Table 15: Multiple Regression Model NPLt/TLt & NPLt-1/TLt -1 & DEBTt

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.981[a]	.962	.958	2.39222
a. Predictors: (Constant), NPLt_1, DEBTt				
b. Dependent Variable: NPL_t				

The coefficient of determination and the adjusted coefficient of determination are 0.962 and 0.958 respectively. Therefore, 96.2% of the variation of the dependent variable is explained by factors used in the model.

Table 16: Variance Analysis - Model 5

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2779.080	2	1389.540	242.810	.000[b]
	Residual	108.732	19	5.723		
	Total	2887.812	21			
a. Dependent Variable: NPLt						
b. Predictors: (Constant), NPL_{t-1}, $DEBT_t$						

In order to examine whether each of the independent variables of the model contributes items of information to be used in predicting the independent variable we test the H_0: $\alpha_5=0$ $b_{5i}=0$ i=1,2 against the H_1: at least one of the parameters is different to zero. The F value is 242.810. Also the observed significance level is zero. The null hypothesis is rejected at 0.05 level of significance and the therefore it can be concluded that at least one of the parameters is different to zero.

Table 17: Estimation of Parameters - Model 5

Coefficients[a]										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	-15.299	4.018		-3.808	.001	-23.709	-6.890		
	DEBTt	.271	.068	.451	3.964	.001	.128	.414	.153	6.525
	NPLt_1	.638	.132	.550	4.839	.000	.362	.914	.153	6.525
a. Dependent Variable: NPL_t										

Table 17 shows the regression coefficients α_5, b_{51} και b_{52}. According to the t criteria, regression coefficients that are statistically significant differ to zero and are therefore of practical value to the model. A further useful conclusion that can be drawn from the above table is related to the estimation of the level of significance of every independent variable in estimating the dependent variable. Based on the value of the standardized regression coefficient Beta it can be concluded that the percentage of NPLs of the previous time period (Beta=0.550) is slightly more significant than the percentage of public debt on GDP (Beta=0.451). The value of α_5 in this model is -15.299 and the values of coefficients b_{51} and b_{52} are 0.271 and 0.638 respectively. Therefore, the resulting multiple linear regression model is

$$NPL_t/TL_t = 15.299 + 0.638 NPL_{t-1}/TL_{t-1} + 0.271 DEBT_t$$

This linear model is statistically significant in accordance with the analysis of variance F(219) = 242.81, p<0.001. Based on the coefficient of determination the independent variables $DEBT_t$ (Beta = 0.451, p<0.05) and NPL_{t-1}/ TL_{t-1} (Beta = 0.550, p<0.05) explain 96.2% of the variance of the dependent variable NPL_t/TL_t.

3.3 Testing of Assumptions - Residual Analysis

In order to confirm the validity of the results, the assumptions used regarding the residuals must be tested. These errors of estimation must be normally distributed, homoscedastic and random. The hypothesis that residuals are normally distributed applies to all models except in the case of model 1. The assumption of homoscedasticity is violated on most occasions but it is not totally circumvented. Generally speaking the empirical data in question does not obey to the strict and ideal rules set by researchers. On the basis that all other pre-conditions are satisfied, the violation of the homoscedasticity pre-condition does not diminish the reliability of models 2, 3, 4, 5.

3.4 Introducing Institutional Factors into the Basic Model

Having tested the effect of macroeconomic factors on NPLs, microeconomic variables are introduced into the models. Firstly, test the pre-conditions multi-linear regression model are performed. There is no linearity between the microeconomic variables and the dependent variable and no high correlation between them. On the other hand the microeconomic variables exhibit an almost perfect linear positive correlation.

Table 18: Correlation between Variables NPLt & ROA & ROE

Correlations				
		NPLt	ROA	ROE
NPLt	Pearson Correlation	1	-.191	-.201
	Sig. (2-tailed)		.394	.369
	N	23	22	22
ROA	Pearson Correlation	-.191	1	.997**
	Sig. (2-tailed)	.394		.000
	N	22	22	22
ROE	Pearson Correlation	-.201	.997**	1
	Sig. (2-tailed)	.369	.000	
	N	22	22	22
**. Correlation is significant at the 0.01 level (2-tailed).				

According to the p values of the 2-tailed test in table 18, there is no statistical significance. The observed significance level regarding the presence or not of a linear relationship between the two variables, with H_0 being zero and H_1 being different to zero with a value greater than 0.05 regarding the pairs of values that are created by the independent variable with the dependent variables. Therefore, the null hypothesis cannot be rejected and therefore the dependent variable is not linearly correlated to any of the independent variables. The linear correlation is a fundamental pre-condition for the implementation of the linear multiple regression and therefore it is not advisable to proceed with the introduction of microeconomic variables in the model.

4 Conclusions

This is an empirical study of the main factors determining the percentage of NPLs in Cypriot commercial banks for the period starting in the fourth quarter of 2008 and ending in the second quarter of 2014. The main conclusions are the following. The analysis of the effect of macroeconomic variables has indicated that economic cycles influence the quality of bank loan portfolios. As expected, all macroeconomic variables used have been found to be statistically significant in influencing the level of NPLs. The percentage of NPLs to total loans (NPL/Total Loans) rises during periods of recession while the return to growth leading to higher incomes and lower unemployment results in a decrease of NPLs as a percentage of total loans. These are the results we expected to find even before embarking on our research. The percentage of unemployment as well as the rate of change of the GDP have been found to be statistically significant. The correlation in the case of unemployment is positive while in the case of GDP rate of change, it is negative. A decrease in GDP and increase in unemployment lead to an increase in bad loans. However, the influence of unemployment is more significant and acts faster. The GDP rate of change influences NPLs with a time lag of 4 quarters and with lesser intensity. As Messai & Jouini (2013) point out, unemployed borrowers cannot fulfill their loan obligations and at the same time, a rise in unemployment leads to a reduction in purchasing power and hence lower production and fewer resources available to businesses to meet their debt obligations.

Our findings suggest that government debt as a percentage of GDP is the single most important reason for the variability of the dependent variable for the period under examination. According to these findings, a debt crisis may affect the quality of the loan portfolios of banks. This is in line with the findings of Louzis et al (2012), Vogiazas & Nikolaidou (2011) and other researchers. The recent world economic crisis has made obvious that national debt crises, give rise to banking crises. The use of public debt as an explanatory variable gives statistically significant results. The independent variable shows strong positive correlation with the dependent variable. It is clear that the public debt variable has a much higher bearing than unemployment or GDP rate of change. Reinhart & Rogoff (2010) point out that the effect of public debt on NPLs is due to the fact that the worsening of government finances prompts National Banks to set stricter liquidity standards and therefore the availability of lending is reduced. This limits the ability of debtors to refinance their debts through extra borrowing. Additionally, Perotti (1996) indicates that an increase in public debt may lead to a series of fiscal measures like for example tax increases and cuts in government expenditure. The resulting decrease in family income may lead to inability to meet household loan obligations. Furthermore, the reduction in the purchasing power of households decreases consumption and therefore the ability of businesses to meet their loan obligations due to fewer resources. Based on the results of our analysis it appears that NPLs are very persistent. By using the percentage of NPLs of the

preceding time period as an independent variable, we obtain statistically significant results. As shown in model 5 the percentage of NPLs of the preceding time period is more significant than the percentage of public debt.

In relation to microeconomic factors, financial indicators like ROA and ROE have not shown to be significantly correlated to the dependent variable and therefore their use in the model would be of no practical value. This result was not as expected as banks showing high rates of profitability do not have to take high investment risks hence the expectation for low percentages of NPLs. We would therefore expect the independent variables to be negatively correlated with the dependent variable. It is important to note that similar conclusions have been reached by other researchers like Makri et al (2014), while studying factors affecting NPLs within the Eurozone.

The findings of this study indicate that financial stability can only be the result of a wider macro-preemptive policy. The findings also show that through the use of appropriate statistical analysis, given the projections for certain macro-economic indicators, the expected level of NPLs can be estimated.

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