Macroeconomic and Bank Specific Covariates of Non-Performing Loans (NPLs) in Pakistani Commercial Banks: Panel Data Evidence

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Abstract

Non-performing loans has become an important part of commercial banking of a country. This paper empirically tests the macroeconomic and bank-specific covariates of non-performing loans for a panel of 13 commercial banks for period of 2003-2012. Using fixed effects with Driscoll and Kraay standard errors, the influence of macroeconomic and bank-specific covariates is found meaningful. Recommendations include the policy steps to complement the sound financial system with a healthy macroeconomic environment to reduce non-performing loans in commercial banks in Pakistan. Moreover, need is highlighted for a policy approach with emphasis on the apposite credit culture and lending policy designed with pertinent economic and financial factors.

1. Introduction

It is a common consensus that amount of nonperforming loans (NPL) linked with bank failure and financial erosion in both developing countries as well as in developed countries. Apart from bank's profitability, economic conditions of the country also affect NPLs. Saunders & Cornett (2006) suggest that the very nature of banking business is sensitive because more than 85% of the liability of banks is deposits. The basic function of the banks is credit creation and banks perform this function by using the deposit

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amounts of their customers. Credit creation activity is actually a revenue generating process which enables bank to create not only revenues for the banks but also exposes banks to dangerously high risk which consequently lead to financial erosion and bankruptcy.

Literature on interactions between the macroeconomy and financial sector traces back to King and Plosser (1984), Bernanke and Gertler (1989), Kiyotaki and Moore (1997) and Bernanke, Gertler and Gilchrist (1998). Pesaran, Schuermann, Treutler and Weiner (2006) develop a framework linking the valuechanges of a credit portfolio to a dynamic global macro-econometric model. They find that the relationship between the firms and the business cycle is the maindriver of default probabilities.In a developing country like Pakistan, NPLs had an increase of 54.3% during 2008-2011. Such an increase in NPLs cannot be overlooked in the light of existing literature on NPLs and its association with macroeconomy. To address this contemporary issue, this paper empirically tests the covariates of NPLs that include macroeconomic variables as well as bank-specific variables of commercial banks. Macroeconomic variables include interest rate, GDP and inflation while bank-specific variables market share of the bank in the banking market, return on assets of bank, return on equity and statuary liquidity requirements.

1.1 Objectives of the Research

This research undertakes the empirical scrutiny of impact of macroeconomic factors and bank specific variables on non-performing loans in banking industry of Pakistan. Accordingly, the hypothesis is built as follows:

H$_A$: Non-performing loans are influenced by macroeconomic conditions and bank specific variables of banking industry of Pakistan.

2. Literature Review

Following is brief review of existing literature on NPLs. From competition point of view, Koskela (2000) shows that more competition generates lower loans and so tend to higher investments and less chances of bankruptcy. Another study of Baba (2001) using real option theory shows that some banks have uncertainties in writing off the nonperforming loans such as they are not sure the releasing of funds by writing off or their liquidation cost or the expected possible subsidy schemes by the government. These factors encourage banks to hold on in writing off NPLs. Matutes (2002) show if the competition is less it would certainly lead higher loans and so the chances of bankruptcy. According to them, monopoly plays a vital role in monitoring the clients and so increasing the outputs while a less monopolistic or less powered institutions cannot achieved as such results.

Salas and Saurina (2002) investigated that GDP expansion and credit smoothness to borrowers, institutional size and power and capital ratio create variations in Nonperforming loans. Hu *et al.* (2004) researched between the ownership structure of commercial banking and nonperforming loans and told that banks under the supervision of government create less nonperforming loans. Similarly the research of Jimenez and Saurina (2005) has proved that GDP growth and smooth credit terms along with flexible interest rates also affect the nonperforming loans. Fofack (2005) also finds that the nonperforming loan can be determined by different factors e.g. GDP, interest rate, exchange rate, net interest margins, interbank loans etc. this author describes the strong link between the macroeconomic factors and nonperforming loans.

Accordingly to Boyd and de Nicolo (2005) concentration-stability is that institutional power which generates higher profits and as a result creates more stability is at least incomplete because it ignores the effects of market power and of the cost of the loans on borrower's behavior. The high interest rates charged by the banks would lead

the films that take loans to assume higher risks, which would consequently increase systematic risk. Beck *et al.* (2006) found that in more concentrated banking markets, happening of crises are less even after controlling for differences in regulatory policies, environment of institutions, macroeconomic conditions and shocks. While in concentration-fragility, more concentrated banking structure means more films/weak it will be.

Further studies on concentration stability and fragility include Demirguc-Kunt& Levine (2000), Beck *et al.* (2006), Chang *et al.* (2008) and Uhde & Heimeshoff (2009) describe two different hypotheses that explain the relationship of concentration stability in the banking, one hypotheses is the concentration stability and the other hypotheses is the concentration fragility. The concentration stability means that a banking system consisting of small banks and low concentration is more probable to financial erosion than a banking system consisting of few large banks. On the other hand, hypotheses of concentration fragility means that a more concentrated banking system is always considered as more fragile.

Maggi and Guida (2009) model the effect of the non-performing loans on the cost structure of the commercial banking system. They stress that traditional efficiency indicators of cost elasticity do not fit properly with such a problem and propose a measure based on the costs for managing and monitoring the loans which, according to the related density function, will reveal effectively as non-performing. Swamy (2012) using panel data techniques examined the impact of macroeconomic and endogenous factors on non-performing assets during 1997-2009. He finds the lending rates insignificant in affecting the non-performing loans, which is contrary to the general perception. Such assets have a negative and significant influence, indicating that large banks may have better risk management procedures and technology which definitely allows them to finish up with lower levels of non-performing assets compared to smaller banks.

Comprehension of these studies highlights that non-performing loans can be influenced by macroeconomic factors and bank specific variables. Research on the same is absent in case of Pakistan. It is worthwhile to conduct a similar empirical inquiry for banking sector of Pakistan. Therefore, this paper tries to fill this gap in literature.

3. Descriptive Analysis

Following table reveals the Jarque-Bera statistics and their probability values that allow to explore normality condition of the data. For all Jarque Bera statistics, the corresponding p-values are greater than 0.05. Null hypothesis of normal distribution is not rejection and the population residual (μ) is normally distrbuted which fulfills the assumption of a good regression line. In this case, the dataset appears in both cross-sections and time dimension. So, panel data regression estimates are suitable in this case.
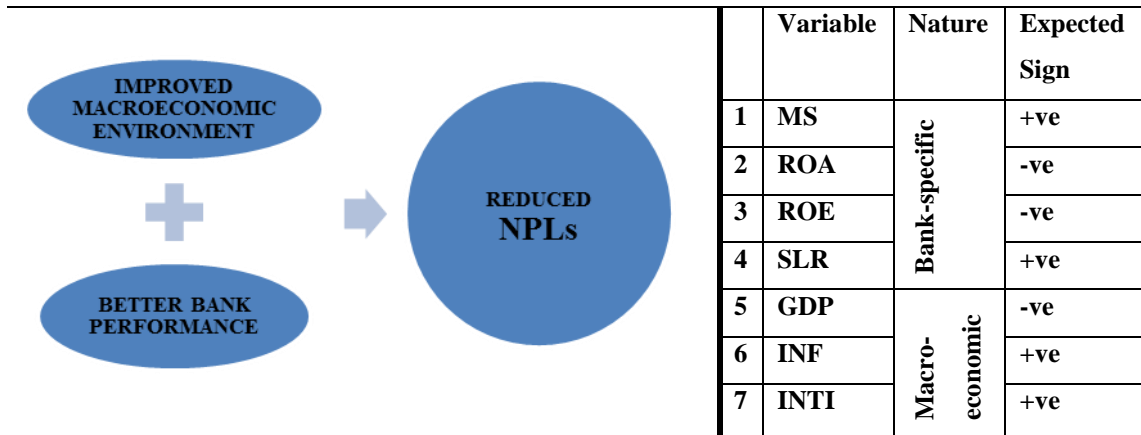
Table 1: Normality Test								
Variables	**NPL**	**MS**	**ROA**	**ROE**	**SLR**	**GDP**	**INF**	**INTI**
Observations	130	130	130	130	130	130	130	130
Jarque-Bera	2.77	1.59	3.36	3.42	2.59	4.24	4.31	1.98
p-value	0.25	0.45	0.19	0.18	0.27	0.12	0.11	0.37
Author's Estimates using Eviews 7.2								

4. Schematic Flow of Hypothesized Relationship

The dependent and independent variables can be linked as depicted in the following flowchart. Macroeconomic factors and bank specific variables collectively determine the level of non-performing loans in the banking sector of Pakistan.

Figure 1: Schematic flow of Expected Relationships

	Variable	Nature	Expected Sign
1	MS		+ve
2	ROA	Bank-specific	-ve
3	ROE		-ve
4	SLR		+ve
5	GDP		-ve
6	INF	Macro-economic	+ve
7	INTI		+ve

4.1 Estimable Model

In order to conduct empirical estimation of relationship between the variables we develop a function as follows:

NPL = f (MS, ROA, ROE, SLR, M) . . . .**(1)**

Here **MS** is market share of bank in the loan market, **ROA** is return on bank assets, **ROE** is return on bank's equity and **SLR** is statutory liquidity requirement of banks. **M** is the set of macroeconomic factors. **M** vector includes interest rate, GDP and inflation rate. All of these variables are hypothesized to affect **NPL**s of sample commercial banks in Pakistan.[†]

Econometric specification of this function is as follows:

$$\ln(NPL_{i,t}) = \mu_i + \delta_t + \beta_1 \ln(MS_{i,t}) + \beta_2 ROA_{i,t} + \beta_3 ROE_{i,t} + \beta_4 \ln(SLR_{i,t}) + \beta_5 \ln(GDP) + \beta_6 INF + \beta_7 INTI + \varepsilon_{i,t}$$ . . . .**(1.e)**

[†]$NPL = \dfrac{Current\ year\ NPL\ provision - Previous\ year\ NPL\ provision}{Current\ year\ NPL\ provision} \times 100$

$MS = \dfrac{Total\ loan\ of\ each\ bank}{Total\ loan\ of\ all\ banks\ in\ the\ sample\ size} \times 100$

$NPL = \dfrac{Net\ profit\ after\ tax}{Total\ assets\ of\ bank}$

$ROE = \dfrac{Net\ profit\ after\ tax}{Share\ holder's\ equity}$

Where number of observations: $\mathbf{n = N \times T}$ (number of groups $\times$ temporal observations) $\forall i \in \mathbf{[1,N]}$ and $\forall\, t \in \mathbf{[1,T]}$. $\boldsymbol{\mu_i}$ and $\boldsymbol{\delta_t}$ capture the unobserved country-specific effects and time-specific effects, respectively, and $\boldsymbol{\varepsilon_{i,t}}$ is the error term and is assumed to be i.i.d. null mean and variance equal to $\boldsymbol{\sigma_\varepsilon^2}$.

4.2 Data

The data used in this study is a panel data consisting of 13 banks for the period of 2003-2012. The time period for data and selection of banks is dependent on the availability of data. The information and all the data of all the variables have been collected from the World Development Indicators (WDI) and annual reports (Income statements and balance sheets) of the commercial banks.

5. Panel Data Estimation

For estimation of the panel dataset, following sequence of tests is followed in subsections below.

5.1 Test for Multi-Collinearity

First econometric concern is to check the existence of multi-colliearity among the independent variables. As a general rule, if the variance inflation factors (VIFs) of variables exceed 10, which usually happens when R^2 exceeds 0.90, it shows the existence of severe multi-collinearity. VIF of the explanatory variables reported in the Table 2 are lower (less than 5.05) than the threshold level and thus it is less likely to have multi-collinearity in our estimation.

If there is heterogeneity among sample banks (different characteristics like organizational structure and working environment etc.) OLS shall be incomplete specification and fixed/random effects model should be estimated. Following two tests are instrumental in making suitable estimation technique for panel data analysis.

5.2 Breusch and Pagan Lagrangian Multiplier Test for Random Effects or OLS

This post-estimation test helps in choosing between random effects regression and a simple OLS regression. The null hypothesis in the LM test is that variances across countries (σ_μ^2) is zero or no panel effect (significant difference across countries) exists. Here the significance of $\bar{\chi}^2$ indicates the presence of panel (fixed or random) effects.

5.3 Hausman Test

This post-estimation test allows choosing between fixed or random effects model. The results of both approaches have been estimated and then subjected to this test. The criteria for selecting the better of the two effects is comparison of probability value i.e. if p-value is less than 1%, 5% and 10% then fixed effects model is better specification for panel data estimation. The probability value of χ^2 is less than 0.05 which implies the test is significant and H_o is rejected and fixed (systematic) effects model is more suitable. Three tests in subsections 5.1, 5.2 and 5.3 are tabulated as follows:

Table 2: Tests for Panel Data Estimation Technique					
Test for Multi-collinearity			**Schematic Selection of Panel Data Estimation Technique**		
Variable	**VIF**	$1/_{VIF}$	**Breusch-Pagan Lagrange Multiplier (LM)**	**Hausman Test: Choice between Fixed or Random Effects**	
MS	1.19	0.84			
ROA	1.99	0.50	$[\textbf{Ho:}\sigma_\mu^2 = 0]$ **Null Hypothesis:** No panel effect.	**Hypothesis:** H_o: Difference in coefficients not systematic. H_A: Difference in coefficients systematic.	
ROE	2.33	0.43			
SLR	4.60	0.22			
GDP	2.24	0.45	$\bar{\chi}^2(01)$ 739.23	**Value**	**Decision**
INF	5.05	0.20		p-val> $\chi2$ = 0.0012	Since p-val> $\chi2$ > 0.05 as well as 0.01 **fixed effects** model is preferred
INTI	1.23	0.81	p-val> F 0.000		
Mean VIF	**2.66**	-			
STATA 12.0 **vif** command			STATA 12.0 **xttest0** command	STATA 12.0 **xtreg** and **Hausman** commands	

On being affirmed about the estimation technique for panel data, the model established in subsection 4.1 is estimated and its results are tabulated and interpreted as under:

Table 3: Regression Model Estimations				
Dependent Variable is NPL				
	I		**II**	
Regressors	**Fixed Effects Estimation (Ordinary Least Square, OLS)**		**Fixed Effects Estimation with Driscoll and Kraay standard errors**	
	Coefficient	**p-value**	**Coefficient**	**p-value**
Market Share of Bank in the Loan Market ($MS_{i,t}$)	-0.7762 (0.0819)	0.000	**-0.7761 (0.1236)**	**0.000**
Return on Bank Assets ($ROA_{i,t}$)	-0.1192 (0.0478)	0.014	**-0.1191 (0.0307)**	**0.000**
Return on Bank's Equity ($ROE_{i,t}$)	-0.4897 (0.2901)	0.091	**-0.4895 (0.4991)**	**0.328**
Log of Statutory Liquidity Requirement of Banks ($LSLR_{i,t}$)	-53.0820 (12.3848)	0.000	**-53.0810 (18.1744)**	**0.004**
Log of Gross Domestic Product ($LGDP_{i,t}$)	-0.2927 (0.1885)	0.123	**-0.2929 (0.2744)**	**0.287**
Inflation Rate ($INF_{i,t}$)	2.5935 (3.4182)	0.462	**2.5933 (4.5598)**	**0.570**
Interest Rate ($INT_{i,t}$)	2.0444 (0.7572)	0.000	**2.0447 (0.6742)**	**0.003**
Intercept C	-10.4253 (16.7607)	0.540	**-10.4251 (17.9728)**	**0.563**
	R^2	0.4102	**R^2**	**0.4102**
	Adjusted R^2	0.3796	**Adjusted R^2**	**0.3796**
	$F(7, 101)$	3.02	**Wald $\chi^2(7)$**	**557.70**
	p-val> F	0.0064	**p-val> χ^2**	**0.000**
Model Specification Tests	**Ramsey Test** **H$_o$:** Model has no omitted variables		$F(3, 109) =$ 102.47	p-val> F = 0.215
	linktest (Single-equation estimation) **xtreg [, fe]**		**_hat**	p-val = 0.096 > 0.000
			_hatsq	p-val = 0.237 > 0.000

Notes:
  i. Parentheses contain standard errors.
  ii. Commands in STATA 12.0 **xtreg [, fe]** for Fixed Effects Estimation (Ordinary Least Square, OLS) **xtscc [, fe]** for Fixed Effects Estimation with Driscoll and Kraay standard errors.

5.4 Fixed Effects Estimates

The model is estimated to be an overall significant model. F statistic with its p-value verifies this. The coefficients of the regressors are as expected in theory. Market share (MS) is found to be significant and reduces the non-performing loans (NPL) by 0.77 units when increased by 1 unit or reduces the non-performing loans (NPL) by 7.7 units when increased by 10 units. Similarly, return of assets (ROA) decrease NPL by 1.1 units when increased by 10 units. NPL shows a negative relationship of magnitude 4.8 units in response to 10 units fall in return of equity (ROE). Statuary liquidity ratio (SLR) decreases the NPL by 0.53 (53.08 ÷ 100) when raised by 1 unit. Division of the coefficient of SLR by 100 is necessitated due to linear-log model. Gross domestic product (GDP) has a similar impact as the above-mentioned regressors. Precisely stating, GDP curtails NPL by 2.92 units if increased by 10 units. MS and LSLR are statistically sufficient at 1% (automatically at 5% and 10% as well). While ROA is statistically significant at 5% and 10% and ROE and GDP are only statistically significant 1%.

On the other hand, both rate regressors [inflation rate (INF) and interest rate (INT)] are showing positive relationship with NPL. A decrease of 1 unit each in INF and INT decreases the NPL by 2.59 and 2.04 units and vice versa. Existence of intercept reveals the existence of a non-proportional relationship though it is not found to be statistically significant. Value of R^2 is substantive i.e. 0.41, which is high enough for such type of unfinished model – A regression model contains an error term that includes unexplained variation, hence the model remains an unfinished model with some or many missing/unknown independent variables.

Findings in this study conform to other studies in Asian countries including India and Bangladesh. For instance, Ahmed (2006), Beck *et al.* (2006), Tabak *et al.* (2007), Khemraj & Pasha (2009) and Misra & Dhal (2010). For testing model specification, Ramsey test for possibility of omitted variables and linktest for single equation model,

are applied. Both Ramsey test statistic and estimated hat-square in linktest are insignificant, implying correct specification of the model.

5.4.1 Test for Serial Correlation

Serial correlation in case of micro panels (with years less than 20) is usually not expected. In technical terms, serial correlation renders standard errors of coefficients smaller than their actual values and inflates R^2. This paper deals with micro panel data (t = 13 > 20), this mitigates the likeliness of serial correlation test. But for the sake of exactness, test is applied. Interestingly, statistic in table 3 show that null hypothesis is rejected (p-val< 0.05 & p-val< 0.01) and it can be inferred that there is serial correlation among residuals. Consequently, OLS coefficients are likely to be biased, inconsistent and inefficient.

5.4.2 Test for Heteroskedasticity

The error term ε can be heteroskedastic if variance of the conditional distribution of ε_i given X_i [$var(\varepsilon_i|X_i)$] is non-constant for i = 1, 2,…, n, and specifically does not depend on X; else, ε is homoscedastic." Heteroskedasticity can result in wrong estimates of standard errors for coefficients and hence of their t-values. While the estimates of OLS might not be biased in this case, standard errors do become wrong. Results show that null hypothesis is rejected (p-val< 0.05) and it can be concluded that residuals are not homogeneous. Consequently, the estimates of standard errors for coefficients and therefore their t-values are unlikely to be correct. Tests in subsections 5.4.1 and 5.4.2 are tabulated as follows:

Table 4: Tests for Serial Correlation and Heteroskedasticity in Fixed Effects Regression			
Wooldridge Test for Serial Correlation		Modified Wald Test for Group Wise Heteroskedasticity	
Wooldridge Test		Modified Wald Test	
H_o: No First Order Serial Correlation		$H_o: \sigma_i^2 = \sigma^2$ for all i	
F(1, 11)	426.214	$\chi^2 (12)$	2752.70
p-val> F	0.000	p-val> χ^2	0.000
STATA 12.0 **xtserial** command		STATA 12.0 **xttest3** command	

5.5 Fixed Effects Estimates with Driscoll and Kraay Standard Errors

Results of Wooldridge test for serial correlation and Modified Wald test for group-wise Heteroskedasticity call for the fixed effects regression with Driscoll and Kraay standard errors (S.E) as in column II in table 4. The error structure is supposed to be heteroskedastic, autocorrelated up to some lag and possibly correlated between the countries. Recent applications of fixed Driscoll and Kraay standard errors include Mehmood, Shahid & Ahsen (2013) and Mehmood & Mustafa (2013). Estimations in this paper reveal no upsetting change as compared to results of fixed effects estimates. Only t-ratios have marginally changed due to new Driscoll and Kraay standard errors causing negligible change in p-values but none in statistical significance. The command in STATA for this variant of fixed effects regression is 'xtscc'. More specifically, impact of macroeconomic and bank-specific covariates has survived the new standard error structure model.

6. Conclusion

This paper indicates that banks used different credit risk management tools and assessment models to administer their credit risk and that they all have one main objective that is to reduce the level of nonperforming loans which is actually a principal cause of bank failure. The paper has also proved that banks with sound credit management policies do not only earn high incomes (high interest) and they also have lower quantum of bad loans (NPLs). It is revealed that institutions with regulated credit management can better

absorb credit losses. Role of macroeconomic conditions cannot be over looked in case of sample commercial banks in Pakistan.

Findings of this paper highlight the need for apolicy approach with emphasis on

 the apposite credit culture and lending policy designed with pertinent economic and financial factors. The macroeconomic effect on non-performing loans could be coped with suitable terms of lending in terms of maturity, loan interest rate and capital requirement.In a nut shell, a healthy macroeconomic performance and sound financial sector can lead towards a curtailed amount of non-performing loans.

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