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Macroeconomic and Bank-Specific Determinants of Non-Performing Loans: Evidence from Nepalese Banking System[1]

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Abstract: This paper aims to evaluate the macroeconomic and bank-specific determinants of non-performing loans (NPL) in the Nepalese banking system using both static and dynamic panel estimation approaches. The study considers 30 Nepalese commercial banks over the period 2003-2015 and uses 7 bank-specific and 5 macroeconomic variables to assess the impact of banking management and economic indicators on NPL. The findings show that NPLs have significant positive relationship with the export to import ratio, inefficiency, and assets size and a negative relationship with the GDP growth rate, capital adequacy, and inflation rate. The results of the empirical study indicate low economic growth as the primary cause of high NPLs in Nepal and suggest that efficient management and effective financial policies are required for a stable financial system and economy. This is the first complete study in the Nepalese banking system and also the first study that has evaluated the effects of remittance, public debts and interest spreads on NPL. The findings of this study will be helpful in designing the macroprudential and fiscal policies in Nepal.

Keywords: economic condition, financial stability, generalized method of moments, monetary policy, non-performing loans, static panel estimation.

JEL classification: E44, G21

Running title: Determinants of non-performing loans

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Introduction

In general, the loans that remain unpaid are called non-performing loans (NPLs). According to the International Monetary Fund, a loan is considered a non-performing loan if it does not generate interest and principal for a minimum of 90 days. The concept of non-performing loan used in this study is, however, based on Alton and Hazen (2001), which states that the loan becomes non-performing if the full payment of the principal and interest has not yet been made on the maturity date and is no longer anticipated in the future. Lack of frequent monitoring of borrowers, poor credit policy, low skilled credit experts, high interest spreads, and low credit standards are the main bank-specific factors that cause high NPLs. Similarly, low economic activities, high unemployment, high inflation rate, and weak monetary policy are the major macroeconomic situations that cause high NPLs and, consequently, an unstable financial system.

NPL is a common indicator to measure credit risk as it directly affects the banking system. The 1997 Asian financial crisis and the 2007 global crisis are the two examples that best explain how NPL can affect the financial system. Reinhart and Rogoff (2010) emphasized that NPL can be an indicator of the beginning of a banking crisis as it adversely affects the economic strength of the nation by reducing credit growth (Ivanović, 2016). A low level of NPL indicates a sound financial system, whereas high NPL can indicate a vulnerable financial system. A high level of NPL initially affects the individual commercial banks and in the long run, it ultimately ruins the financial system and the economy of the entire nation (Feijó, 2011). An increasing trend of NPL in the banking system seriously hampers their efficiency as it introduces the chance of banking crisis (Louzis, Vouldis, & Metaxas, 2012; Nkusu, 2011). More specifically, the non-performing loans block interest revenues, deduct investment opportunities as well as create liquidity crisis in a financial system, which can bring bankruptcy problem and also worsen economic activities. Therefore, identifying the factors that affect NPL is necessary to reduce its level for a stable financial system and economy (Stijepović, 2014).

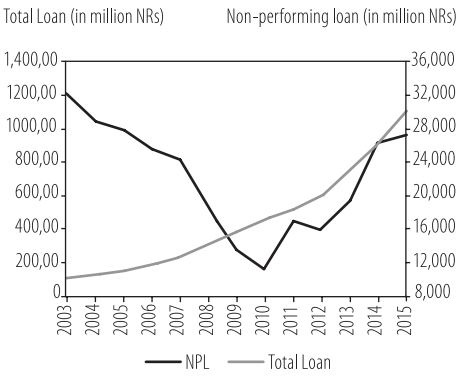
Nepal Rastra Bank (NRB) is the central bank that regulates the financial system in Nepal. Nepalese financial system is dominated by the banking sector, particularly commercial banks, which represent about 80% of the total financial system. Therefore, understanding the soundness of commercial banking industries is important to ensure the financial stability in Nepal. The Nepalese financial system has shown tremendous growth after the initiation of financial liberalization in 1980. Since then, the number of commercial banks in Nepal has increased from 2 to 30 to date. Figure 1 shows an increasing trend of non-performing loans after

2010 in Nepal. Continuation of this trend at the current pace could undoubtedly bring about liquidity crisis and financial instability in the near future. Therefore, it is very important to evaluate the determinants of non-performing loans in the Nepalese banking industry to ensure a long-term financial and economic stability.

Despite several studies worldwide on the determinants of non-performing loans, the studies on Nepalese banking system are very scarce. Moreover, to the best of our knowledge, there are no studies on Nepalese banking industry that have included interest spreads, remittance, and public debt as determinants of problem loan. Most previous studies have used the panel data of only selected commercial banks and therefore, the findings do not provide a complete picture of the real financial situation in Nepal. In contrast, our study includes a panel data of all commercial banks that have existed in Nepal since their establishment. Therefore, this study is the first complete study for a Nepalese banking system. Here, we have attempted to assess the factors affecting non-performing loans using seven bank-specific and five macroeconomic elements under panel data of 30 commercial banks operating in Nepal.

The rest of the paper is organized as follows. Section 2 discusses the existing literature on bank-specific and macroeconomic variables governing NPLs. Section 3 presents the sources of data, defines research variables, formulates the hypotheses related to bank-specific and macroeconomic variables and describes the econometric methodology. Section 4 and 5 provide estimation and discussion of results, while section 6 concludes the study.

Figure 1: Trends of loans and non-performing loans in Nepalese banking system



Literature Review

A number of studies have explored the effects of various macroeconomic and bank-specific factors to explain non-performing loans. Some studies have independently evaluated their effects, while other studies have evaluated them together. Here, we discuss the existing literature and use them as a basis of selecting explanatory variables for this study.

Effect of Macroeconomic Factors

İslamoğlu (2015) examined the effect of macroeconomic variables (commercial loan interest rate and public debt/GDP ratios) on non-performing loans with quarterly data of 13 banks in Borsa, Istanbul from 2002-2013 using VAR analysis. The study revealed that the decrease in interest rate causes an excessive loan growth in the long run and increases non-performing loans. The study also found that an increased public debt causes an increase in non-performing loans. Jakubík and Reininger (2013) studied the relationship between macroeconomic factors and NPLs using GMM estimation with quarterly data of Central Eastern and Southeastern European (CESEE) countries (Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, Russia, Slovakia, and Ukraine) from 2004 to 2012. They found a negative relationship of NPL with the real GDP and the stock price index, and a positive relationship with the nation's exchange rate and the private credit to GDP. Badar and Javid (2013) studied the long and short run dynamics between non-performing loans of commercial banks and the macroeconomic variables (inflation, exchange rate, interest rate, GDP, and money supply) in Pakistan over the period 2002-2011. The Johansen and Juselius multivariate co-integration test suggested a long run relationship between the macroeconomic variables and NPLs. Similarly, the vector error correction model found a short run relationship among the variables. Ravi Prakash (2013) investigated the macroeconomic determinants of credit risk in Nepalese banking sector by time series modelling using 11 years (2001-2011) data of commercial banks. The study found that credit risk was significantly negatively affected by inflation and foreign exchange fluctuations. However, other macroeconomic variables, such as GDP growth, broad money supply growth, and market interest rate were found to have no influence on credit risk in the Nepalese banking industry. Castro (2013) employed the dynamic panel data approaches on 15-year quarterly data (1997-2011) of a particular group of countries - Greece, Ireland, Portugal, Spain, and Italy (GIPSI) to analyse the link between macroeconomic factors and banking credit risk. The study showed that credit default increases with a decrease in GDP growth, the share and housing prices indices, and rises when the unemployment rate, interest rate, and credit growth rate increase. Akinlo and Emmanuel (2014) used the co-integration analysis to develop a macroeconomic model of non-performing loans for Nigeria. The empirical analysis confirmed that the GDP growth and the stock market index have a negative effect on NPLs, whereas the unemployment rate, the credit to private sectors, and the exchange rate have a positive influence on non-performing loans. Using 75 countries as a sample, Roland, Petr, and Anamaria (2013) assessed the macroeconomic factors affecting non-performing loans through GMM estimation. They found that the real GDP

growth, the share prices, the exchange rate, and the interest rate significantly affect NPLs.

Effect of Bank-specific Factors

Berger and DeYoung (1997) described the relationship between bank-specific variables and problem loans using several hypotheses. They used inefficiency to describe "poor management", and capital adequacy to represent "moral hazard". They focused on the relationship between capital adequacy, inefficiency, and problem loans to formulate possible hypotheses, namely "bad luck", "skimping", "moral hazard", and "bad management" hypotheses. For their analyses, they took a sample of US banks from 1985 to 1994 and concluded that the cost efficiency plays an important role in raising problem loans. Keeton (1999) used a vector autoregressive model to analyse the impacts of credit growth and loan delinquencies in the America from 1982 to 1996. The study found a strong relationship between the credit growth and impaired loans. Specifically, this study argued that the rapid credit growth with a low credit standard contributed higher loan losses in certain states of USA. Thi Minh Hue (2015) investigated the determinants of non-performing loans in a Vietnamese banking system using an ordinary least square estimation for the period 2009-2012. Twenty commercial banks were taken as the study sample. The study found that the growth rate of loans, the total assets of banks, last year's NPLs, and a dummy variable increased NPLs in the recent years. Kirui (2014) analyzed the effect of non-performing loans on profitability of commercial banks in Kenya during 2004-2013. Employing a multi-regression model, they found that NPLs reduced the profitability (return on assets) of banking sectors. Hu, Li, and Chiu (2006) analysed the relationship between NPLs and the ownership structure of commercial banks in Taiwan with a panel dataset covering a four-year period (1996-1999). The study confirmed that the banks with a higher government ownership have lower non-performing loans and the bank size is negatively related to NPLs. Godlewski (2005) used return on assets (ROA) as a profitability indicator in the study of 129 banks in Spain over 1993-2000. The result suggested that the return on assets can be used as a tool to reduce NPLs in Spain.

Combined Effect of Macroeconomic and Bank-specific Factors

Crouhy, Galai, and Mark (2000) and Tanasković and Jandrić (2015) concluded that the range of non-performing loan is influenced by both a systematic risk (macroeconomic factors) and an unsystematic risk (bank-specific factors).

Makri, Tsagkanos, and Bellas (2014) identified the factors affecting NPL in euro area`s banking system using aggregate panel data of 14 countries over the period 2000-2008. Using GMM estimation, they found a strong positive effect of the public debt and the unemployment rate on NPLs and a negative influence of the capital ratio, the return on equity, and the GDP growth on credit risk. However, the return on assets ratio, the loan to deposit ratio, the inflation rate, and the budget deficit were found to have no effect on NPLs. By using GMM estimation on the panel data of Spanish commercial and saving banks over 1985-1997, Fernández de Lis, Martínez Pagés, and Saurina (2000) found that the GDP growth and the bank size had a negative effect on problem loans in a recession period. They concluded that the loan growth, the collateral loans, the net interest margin, and the market power increase NPLs. Louzis et al. (2012) investigated 9 big Greek banks to study the determinants of NPLs for the period 2003Q1-2009Q3. The generalized method of moments (GMM) was followed to study the effect of macroeconomic (GDP growth rate, interest rate, unemployment, public debt) and the bank-specific variables (leverage ratio, inefficiency, non-interest income, return on equity, capital adequacy ratio, bank size) on NPLs. The study revealed that the real GDP growth rate and the return on equity have a negative significant effect, whereas the interest rate, the unemployment rate, the inefficiency, and the public debt have a positive significant association with NPLs. Taking the sample of 1,927 Italian banks during 2006-2008, Cotugno, Stefanelli, and Torluccio (2010) studied the factors affecting non-performing loans using a multivariate regression model. They found that the bank size, the functional distance, and the loan growth positively affected the default rate, while the return on assets and the GDP growth reduced the default rate. Messai and Jouini (2013) examined 85 banks in three countries (Italy, Greece and Spain) using the macroeconomic and financial variables for the period 2004-2008 with the help of fixed effect model. The results showed that the GDP growth and the return on assets had a negative impact on non-performing loans, whereas the unemployment rate, the loan loss reserve to total loan ratio, and the interest rate had a positive effect on impaired loans. Boudriga, Taktak, and Jellouli (2010) examined the effect of various micro and macro variables on NPLs by taking a sample of 46 banks of 12 countries (Middle East and North Africa -MENA countries) over the period 2002-2006. They found that the high credit growth, the loan loss provisions, and the foreign participation of developed countries significantly affect NPLs. Macit (2012) examined the 15 largest commercial banks in Turkey with the help of quarterly data of 2005-2010. In order to investigate the effect of macroeconomic and the bank-specific variables on NPLs, a feasible generalized least square estimation was applied. The results revealed that the higher equity to total assets, the higher net interest margin brought higher NPLs, while the net loans to total assets ratio reduced NPLs. In terms of the macroeconomic factors, eco-

nomic slowdown and the domestic currency depreciation deteriorated the loan portfolios of commercial banks. Ghosh (2015) examined the state-level banking-industry specific as well as the regional economic factors to evaluate the effect of non-performing loans on commercial banks and savings institutions across 50 USA states and the District of Columbia for 1984–2013. Using fixed effects and the dynamic-GMM estimations, the study found that the high capitalization, liquidity risks, poor credit quality, high cost inefficiency, and the size of banking industry significantly increase NPLs, whereas the high bank profitability lowers NPLs. Moreover, the inflation rate, the state unemployment rates, and the U.S. public debt significantly increase NPLs. Ekanayake and Azeez (2015) studied the nine licensed commercial banks for the period 1999-2012 to determine the factor affecting non-performing loans in Sri Lanka's banking system. The level of NPLs had a positive correlation with the size of banks, the efficiency, the loan to assets ratio, and the prime lending rate during the study period. However, the credit growth, the GDP growth rate, and the inflation rate were associated with a low level of non-performing loans. Dimitrios, Helen, and Mike (2016) identified the main determinants of non-performing loans in the euro-area banking system for the period 1990Q1-2015Q2 using GMM estimations. The study included the micro and macro variables, such as the return on assets, the return on equity, the loan to deposit ratio, the government debt (as % of GDP), the income tax, the output gap, the inflation rate, the unemployment rate, and the GDP growth rate. Among the micro variables, return on equity was significant in all models supporting the "bad management" hypothesis of Berger and DeYoung (1997). The growth rate and the output gap reduced NPLs, whereas the inflation rate, the unemployment rate, and the income tax were found to increase NPLs. Espinoza and Prasad (2010) examined the effect of macroeconomic and the bank-specific factors taking a sample of 80 banks from the Gulf Cooperation Council countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates) for the period 1995 -2008. Using different econometric specifications, the study confirmed that both macroeconomic and bank-specific variables determined the level of non-performing loans in the Gulf countries. Klein (2013) applied a panel VAR to investigate the effect of bank-specific and macroeconomic factors on NPLs taking the sample of a 16 Central, Eastern, and South-Eastern European nations (CESEE) for the period 1998-2011. The empirical results showed that the unemployment rate and the exchange rate depreciated NPLs ratio, whereas the inflation rate, the euro area GDP growth, and the Global risks aversion had a direct impact on the asset quality of banks. Similarly, the profitability reduced NPLs, while the loan to assets ratio and the credit growth rate increased NPLs during the pre-crisis and post-crisis periods. Amuakwa–Mensah and Boakye–Adjei (2015) studied the bank-specific and macroeconomic factors in Ghana for the period 1998-2009 using a panel regression model. The study revealed that the

inflation rate, the real GDP per capita growth rate, the real exchange rate, and the net interest margin had a negative impact on NPLs, while the bank size had a positive effect on NPLs. Rinaldi and Sanchis-Arellano (2006) found a significant association of household NPL with the disposable income, households' financial wealth, and the nominal lending rates.

Methodology

Data and Data Sources

From the literature discussed above, it is evident that an increasing trend of non-performing loans is experienced by commercial banks all over the world and that NPL is determined by both bank-specific and macroeconomic factors. This study examines the effect of these factors on the NPLs of 30 Nepalese commercial banks. The set of explanatory variables are divided into bank-specific and macroeconomic factors. The examined bank-specific variables are the credit/loan to deposit ratio (CDR), the loan to assets ratio (LAR), the return on assets (ROA), the interest spreads (IS), the capital adequacy ratio (CAR), the operating expenses to operating income ratio (inefficiency, OEOIR), and the bank size (BS), while the macroeconomic variables are the GDP growth rate (GDPGR), the remittance rate (RE), the exports to import ratio (EIR), the per capita outstanding debt (PCOD), and the inflation rate (IR).

The choice of variables and time period is determined based on the review of existing literature and data availability. This paper covers a period of 13 years (2003-2015), which includes both booming period and a recent global financial crisis. At the end of July 2015, Nepalese commercial banking system consisted of 30 banks, including 3 government banks, 7 joint venture banks, and 20 private local owned banks representing about 80% of the total assets of financial system. All the data used in this study are publicly available. The bank-specific data are obtained from the banking and financial statistics, bank supervision report of Nepal Rastra Bank (NRB), economic bulletin of NRB, banking and financial stability report of NRB, and the annual report of commercial banks. The sample includes both large and medium sized banks. The annual monetary policy report and economy survey report are the main source of macroeconomic data. The collected data are on annual basis.

Research Variables

We consider 7 bank-specific and 5 macroeconomic variables as the potential determinants of non-performing loans in the Nepalese banking system and therefore, use them as independent variables in this study (Table 1). These variables and their expected relationships with the non-performing loans are discussed below.

Bank-specific Variables

Interest spread (IS): The difference between lending rate and depositing rate is known as interest spread. A higher lending rate results in higher spreads and higher cost on loans and advances, which seems to reduce the payment capacity of borrowers and increase the default rate. Similarly, narrowing the interest rate spreads assists financial liberalization, which enhances the competition, increases the efficiency and eventually reduces NPLs. Therefore, as shown by Ngugi (2001), Chirwa and Mlachila (2004), Siddiqui (2012), and Were and Wambua (2014), we assume a positive relationship between credit risk and interest spread.

Bank size (BS): Bank size is the ratio between the assets of banks i in year t to total assets of all commercial banks in year t. It is computed as the log of total banks' assets.

$$\text{Bank size (BS)} = \log\left(\frac{\textit{Assets of bank } i}{\textit{Total assets of year } t}\right)$$

Size of banks reflects the strength and their ability to cope with the problem of information asymmetry. Large bank size reflects the bank's strength and information asymmetry because of the availability of high skilled manpower and technology bases. Salas and Saurina (2002) and Fernández de Lis et al. (2000) reported a negative relationship between NPL and bank size. According to their studies, large-sized banks monitor loans regularly, have better risk management policies and high diversification opportunities. Hence, a negative coefficient of bank size is expected.

Inefficiency (OEOIR): Inefficiency is measured as the ratio between operating expenses and operating incomes. It is also termed as operating expenses to operating income ratio (OEOIR).

$$\text{Inefficiency (OEOIR)} = \frac{\textit{Operating expenses}}{\textit{Operating incomes}}$$

High value of this ratio indicates poor management efficiency. Poor management and inefficient managers imply weak monitoring in operating activities and borrowers (Berger & DeYoung, 1997), which increases the probability of default loans. Therefore, as shown by Garr (2013), we expect a positive coefficient of the inefficiency.

Return on assets (ROA): The return on assets (ROA) is a popular indicator to measure the profitability of banks. It is calculated as:

$$\text{Return on assets (ROA)} = \frac{\textit{Net profit}}{\textit{Total assets}}$$

Higher ROA indicates a sound financial performance and a stable financial system. The profitable banks are less constrained to invest in risky loans because of less pressure to generate more revenue. Therefore, we assume a negative relationship between ROA and NPL, which has been shown by Godlewski (2005), Louzis et al. (2012), and Boudriga et al. (2010). However, Jha and Hui (2012) found a positive correlation between ROA and NPLs in the Nepalese banking system, while Makri et al. (2014) found no significant relationship between ROA and the level of NPLs.

Capital adequacy ratio (CAR): The capital adequacy ratio measures the solvency level of banks. It is calculated with the help of total capital fund and the total risk weighted assets.

$$\text{Capital adequacy ratio (CAR)} = \frac{\textit{Total risk weighted assets}}{\textit{Total capital fund}}$$

Maintaining a minimum capital adequacy ratio is mandatory for each financial institution (Basel Accord). The portfolio risk arises with the increase in minimum capital ratio. However, it is claimed that low capital ratio increases NPLs (moral hazard hypothesis) (Berger & DeYoung, 1997). In contrast, Louzis et al. (2012) and Cheng, Lee, Pham, and Chen (2016) found insignificant effect of CAR on NPLs.

Credit to deposit ratio (CDR): The liquidity is measured by loan to deposit ratio and is calculated as:

$$\text{Credit to deposit ratio (CDR)} = \frac{\textit{Total loans granted}}{\textit{Total deposits recived}}$$

Higher credit to deposit ratio indicates that deposits are mobilized for generating revenues and increasing profitability. The profitability encourages investing

deposits in less risky sectors with high credit standards. This activity prevents bad loans. Similarly, lower loan to deposit ratio indicates inefficiency in resource allocation and low profit. Based on the empirical studies of Jameel (2014) and Anjom and Karim (2016), the credit to deposit ratio has a negative relationship with the NPLs.

Loan to assets ratio (LAR): It is the ratio between total loan amount and total assets. It measures the risk appetite and the liquidity of firms and is calculated as:

$$\text{Loan to assets ratio (LAR)} = \frac{\textit{Total loan amount}}{\textit{Total assets}}$$

A higher loan to assets ratio represents high credit level and an increasing chance of credit risk. Therefore, a positive coefficient of loan to asset ratio is expected, which has also been shown by Klein (2013) and Ekanayake and Azeez (2015). However, Shingjergji (2013) found a negative significant association between non-performing loans and loans to assets ratio.

Macroeconomic Variables

Gross domestic product (GDP): The main macroeconomic element, which measures the development of an economy, is the gross domestic product (GDP). Louzis et al. (2012) argued that GDP growth has a significant negative effect on NPLs. This is because, growth in GDP creates employment opportunities, which increases the income level of borrowers and consequently reduces NPLs. Hence, when there is slowdown in the economy, the level of NPLs increases.

Per capita outstanding debt (PCOD): The debt owned by the central government with a view of financing budget deficit and trade deficit is termed as per capita outstanding debt or public debt. It is calculated as:

$$\text{Public debt} = \frac{\textit{Total debt of a country}}{\textit{Total no. of population}}$$

Generally, public debt is caused when the Government faces budget deficit or trade deficit. According to Makri et al. (2014) and Ghosh (2015), public debt is positively correlated with the NPL. This has also been supported by the study of Reinhart and Rogoff (2010). Consistent with previous findings, we assume a positive relation between public debt and NPL in this study.

Inflation rate (IR): The rise in price of goods and services in an economy, over a period of time, is known as inflation. It is calculated as:

$$\text{Inflation} = \frac{\textit{Current consumer price index - historical concumer price index}}{\textit{Current consumer price index}} \times 100$$

According to the price stability indicator, a low level of inflation is favourable for the economic growth, whereas a high inflation rate weakens the borrower's ability to service debt by reducing their real income and hence, increases NPLs (Rinaldi & Sanchis-Arellano, 2006). Some studies have, however, found a negative relation with the credit risk (e.g. Škarica, 2014; Vogiazas & Nikolaidou, 2011; Zribi & Boujelbène, 2011).

Remittance (RE): The total compensation of employees, workers, and migrants transferred to their home country in the name of their recipients is called remittance. It is calculated as:

$$\text{Remittance} = \frac{\textit{Remittance amount}}{\textit{Total GDP}} \times 100\%$$

Remittance can be expected as a mediator for the development of a financial sector, because it facilitates investment in productive areas for the economic growth. The remittance impacts the economic growth of a country positively (Fayissa, Nsiah, & Tadasse, 2008). A higher remittance leads to higher growth of the economy, which lowers problem loans and brings financial stability (Ebeke, Loko, & Viseth, 2014). Hence, remittance is expected to be negatively correlated with the NPLs.

Export to import ratio (EIR): The export to import ratio less than 1 represents trade deficit. The increasing trade deficit may collapse domestic companies in the long run due to failure of the domestic products to compete with the high quality imported goods. Therefore, banks investing in domestic companies may ultimately collapse. The regular trade deficit devaluates domestic currency and decreases domestic job opportunities, which can prevent the economic growth in the long run. An increase in trade deficit depreciates the local currency, which leads to an increase in NPLs (Kavkler & Festić, 2010).

Table 1: Macroeconomic and bank-specific variables used in this study and their expected relations with the non-performing loans

Variables	Expected sign	Research support
Loans to assets ratio (LAR)	Positive	Klein (2013), Ekanayake and Azeez (2015)
Capital adequacy ratio (CAR)	Negative	Berger and DeYoung (1997), Boudriga et al. (2010),
Return on Assets (ROA)	Negative	Godlewski (2005), Boudriga, Boulila Taktak, and Jellouli (2009), Louzis et al. (2012)
Credit to deposit (CDR)	Negative	Jameel (2014), Anjom and Karim (2016)
Assets size (BS)	Negative	Salas and Saurina (2002), Hu et al. (2006), Fernández de Lis et al. (2000)
Interest spread (IS)	Positive	Ngugi (2001), Chirwa and Mlachila (2004), Siddiqui (2012), Were and Wambua (2014)
Inefficiency (OEOIR)	Positive	Berger and DeYoung (1997), Kwan and Eisenbeis (1997), Garr (2013)
GDP growth rate (GDPGR)	Negative	Salas and Saurina (2002), , Louzis et al. (2012), Škarica (2014), Fofack (2005), Jiménez and Saurina (2006)
Remittance (RE)	Negative	Ebeke et al. (2014)
Export to import (EIR)	Negative	Kavkler and Festić (2010)
Inflation (IR)	Positive	Nkusu (2011), Rinaldi and Sanchis-Arellano (2006)
Debt per capita (PCOD)	Positive	Reinhart and Rogoff (2010), Ghosh (2015), Makri et al. (2014)

Econometric Framework

Each variable is observed over a different time period. Thus, the panel is unbalanced. The implemented econometric model is similar to the model by Makri et al. (2014) and Dimitrios et al. (2016), which were used to determine the credit risk of the euro area countries. In order to provide consistent and unbiased results, both static and dynamic panel methods are used in this study. The two econometric models are examined to find the impact of bank-specific and macroeconomic factors on NPLs.

Static Estimation

The first econometric model is shown below.

$$NPL_{i,t} = a_0 + a_1X_{i,t} + a_2M_{i,t} + \mu_{i,t} \quad (1)$$

$U_i + \varepsilon_{i,t} = \mu_{i,t}$ has the standard error component structure

where, a_0 is a constant term. The subscripts i=1, ….,N and t=1, …,T denote the examined banks of the sample and time dimension of panel, respectively. $X_{i,t}$ is the vector of bank-specific variables and $M_{i,t}$ is the vector of macroeconomic variables. a_1 and a_2 are the coefficients to be estimated. U_i refers to unobserved bank-specific effects (heterogeneity) and $\varepsilon_{i,t}$ is an independently and identically distributed error term. First, the Equation (1) is estimated using pooled-OLS, Fixed effect, and Random effect model separately and finally one method is selected based on the results of Hausman test.

Dynamic Estimation

To expand the empirical analysis and check the magnitude of variables, the second econometric model is applied where the lagged dependent variable is used as an explanatory variable for the persistence of credit risk and to capture the effect of possibly omitted explanatory variables. The inclusion of the lagged dependent variable as a regressor is commonly used in dynamic panel data, which is similar to the method of Louzis et al. (2012), Castro (2013), Makri et al. (2014), Ghosh (2015), and Dimitrios et al. (2016). The second econometric model is expressed as:

$$NPL_{i,t} = a_0 + bNPL_{i,t-1} + a_1X_{i,t} + a_2M_{i,t} + \mu_{i,t} \quad (2)$$

where $NPL_{i,t-1}$ is the lagged dependent variable. Based on these two models, three different scenarios are estimated. First, only the bank-specific factors are examined as the explanatory variables. Second, only macroeconomic variables and finally the combination of both macroeconomic and bank-specific variables are used. The equation (1) is estimated with the static panel estimation and the equation (2) is estimated with the dynamic specification using Generalized Method of Moments (GMM) proposed by Arellano and Bond (1991). Under dynamic estimation, the macroeconomic variables and the bank-specific variables are assumed as exogenous (control variables) and endogenous determinants, respectively. Since this study has more experimental variables, it increases the number of instruments. Therefore, in order to prevent over-identifying restrictions and to validate the instruments in dynamic panel data specifications, differenced GMM estimation developed by Arellano and Bond (1991) is applied, thus leading to consistent estimates.

Previous studies have shown that a small number of individual units may prevent the use of full set of instrumental variables. This implies that, in order to make estimation reliable, the number of instruments must be reduced. Hence, this study uses difference GMM estimation for a dynamic panel data. The first

and second period lagged variables are employed as instruments for explanatory variables, which are in line with the results of Sargan test and ensures that the number of instrument is less than the number of cross sections. To check the auto correlation and the validity of instruments, two specification tests are suggested by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998): (i) Arellano-Bond first-order serial correlation and (ii) Sargan test of over-identifying restrictions test. One should reject the Arellano-Bond first-order serial correlation and do not reject the second-order serial correlation. The Hansen J statistics test the null hypothesis that the over-identifying restrictions are valid.

The variables are changed into logarithmic forms prior to analyses. To prevent from the stochastic or deterministic trends and the spurious regression results, unit root test is conducted using the Augmented Dickey-Fuller test. The first difference of the series is used in order to make them stationary if the series are non-stationary in level.

Empirical Results

To examine the impacts of macroeconomic and bank-specific variables on NPLs, six different specifications are introduced. The first three specifications use a static panel model and the remaining three specifications use a dynamic panel model with the lagged one period dependent variable. Considering the fact that the economic variables are highly correlated with the NPLs, they are introduced separately. This study includes one- and two-period lagged variables as instruments for the endogenous variables.

Table 2 presents the panel unit root test results. Its null hypothesis is that all variables contain unit roots in level against the alternative of stationarity. The variables, which exhibit non-stationarity in their levels form, are first differenced to be made stationary. The results indicate that all variables are stationary in level except the outstanding debt per capita and the export to import ratio.

Table 2: Results of panel unit root test

Variables	Fisher Type-ADF (p-values)	Fisher Type-ADF (statistics)
NPL	0.000	-2.19631
ROA	0.000	-5.15834
CAR	0.000	-7.35641
CDR	0.000	-5.02052
LAR	0.000	-5.40269
OEOIR	0.000	-4.25228
BS	0.000	-7.90831
IS	0.000	-7.46173
GDPGR	0.000	-15.4489
PCOD	0.8881	-1.21664
IR	0.000	-4.69015
EIR	1.000	-7.23946
RE	0.000	-6.17133

Static Estimation Results

To explore the impact of bank-specific and macroeconomic variables on NPLs, the following three specifications are estimated under static panel estimation:

$$NPL_{i,t} = a_0 + a_1X_{i,t} + \mu_{i,t}$$
$$NPL_{i,t} = a_0 + a_1X_{it} + a_2M_{it} + \mu_{i,t}$$
$$NPL_{i,t} = a_0 + a_1M_{i,t} + \mu_{i,t}$$

where, $X_{i,t}$ and $M_{i,t}$ are the vector of bank-specific and macroeconomic variables, respectively. The bank-specific variables include the weighted average interest spreads (IS), the capital adequacy ratio (CAR), the bank size (BS), the return on assets (ROA), the loans to assets ratios (LAR), the inefficiency ratios (OEOIR), and the credit to deposit ratios (CTD). The macroeconomic variables consist of the GDP growth rate (GDPGR), the inflation rate (IR), the export to import ratio (EIR), the remittance (RE), and the outstanding debt per capita (PCOD).

The static estimation results are shown in Table 3. As expected, the result indicates that when the GDP grows, the level of NPLs decreases significantly. From this result, it is clear that credit risk tends to increase when economic condition falls. The level of NPLs is positively affected by the export to import ratio, which is beyond the expected hypothesis. The inflation rate is negatively significantly correlated, and indicates that the rise in inflation rate decreases the real value of loan and decreases default loans. With the increase in per capita outstanding

debt, debt burden increases, which in turn, decreases the economic growth, and hence increases NPLs. The per capita outstanding debt has positive association with the default loans. The remittance and the credit to deposit ratios are insignificant, while the inefficiency and the return on assets are positively significant with the NPL level. The large-sized banks have higher NPLs according to specification 2 and 3 and hence, support the "too big to fail" hypothesis, which is consistent with Louzis et al. (2012) but contrast with Espinoza and Prasad (2010). Increase in interest spread and fall in the loans to assets ratio lead to a rise in NPLs in model 2, but have insignificant effect in model 3. Similarly, capital adequacy is negatively significant in model 3, which indicates that highly capitalized banks have a higher long-term financing capacity and solvency. These banks, therefore, have low NPLs.

Table 3: Static estimation results of macroeconomic and bank-specific factors

Variables	Model 1	Model 2	Model 3
RE	0.005723		0.005895
	(0.144288)		(0.167995)
GDPGR	-0.60404*		-0.62758**
	(-1.88275)		(-2.1955)
IR	-1.32903***		-1.11603***
	(-5.25949)		(-4.8372)
PCOD	2.935027**		2.217752**
	(2.289996)		(1.969328)
EIR	1.420095***		1.041934**
	(3.0464)		(2.479371)
OEOIR		1.907008***	1.475315***
		(11.48833)	(8.446033)
CAR		-0.29229	-0.43568**
		(-1.40323)	(-2.15935)
CDR		-0.18073	-0.19509
		(-1.02079	(-1.1644)
IS		0.243703**	0.146204
		(2.141546	(1.364525)
ROA		11.00749***	9.706119***
		(4.255028)	(3.867811)
LAR		-0.63214**	-0.20171
		(-2.22515)	(-0.66271)
BS		0.431589***	0.400861**
		(2.70864)	(2.011827)
Cross-Sections / N	292 / 30	286 / 30	286 / 30
Adj R^2	0.221	0.386	0.718
F-stat.	17.53	26.61	18.66

Notes: t-statistics are reported in parenthesis. * $p < 0.1$, **$p < 0.05$, *** $p < 0.01$.

Dynamic Estimation Results

The results of following three specifications, which are estimated under the dynamic panel estimation, are shown in Table 4. They show the impact of bank-specific and macroeconomic variables on NPLs.

$$NPL_{i,t} = a_0 + bNPL_{i,t-1} + a_1X_{i,t} + \mu_{i,t}$$

$$NPL_{i,t} = a_0 + bNPL_{it-1} + a_1X_{i,t} + a_2M_{i,t} + \mu_{i,t}$$

$$NPL_{i,t} = a_0 + bNPL_{it-1} + a_1M_{i,t} + \mu_{i,t}$$

The value of 'b' between 0 and 1 implies the persistence of NPLs. The lagged dependent variable has a significant positive coefficient in this study (Table 4), which indicates the effect of last year's NPLs on the current NPLs.

Table 4: GMM estimation results of macroeconomic and bank-specific factors

Variables	Model 4	Model 5	Model 6
NPL_{it-1}	0.302784*	0.454862*	0.353125***
	(1.826726)	(1.76548)	(4.145918)
RE	0.004624		0.013097
	(0.143521)		(0.886918)
GDPGR	-0.30036		-0.196404*
	(-1.21216)		(-1.745515)
IR	-0.51391*		-0.17088
	(-1.92831)		(-0.679967)
PCOD	1.304953		0.980884
	(1.245887)		(1.375874)
EIR	0.834549**		0.594925**
	(1.999627)		(2.283547)
OEOIR		1.380526**	1.146153***
		(2.35577)	(5.016251)
CAR		-0.44986	-0.272887***
		(-0.83463)	(-2.790815)
CDR		-0.00942	-0.086667*
		(-0.05283)	(-1.949885)
IS		0.215498	0.131422**
		(0.78176)	(2.366724)
ROA		6.744587	1.59774
		(0.919993)	(1.115224)
LAR		-0.13268	-0.147144
		(-0.09193)	(-0.636441)
BS		0.774035	0.384211*
		(0.447121)	(1.742432)
Cross-Sections / N	202 / 30	194 / 30	194 / 30
A-B AR (1) p-value	0.0019	0.0006	0.0013
A-B AR (2) p-value	0.3511	0.1492	0.2155
Sargan test (p-value)	0.00369	0.478	0.05897

Notes: t-statistics are reported in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Capital adequacy is negatively significant with the non-performing loans in model 6 (Table 4), which is consistent with the moral hazard hypothesis (Berger & DeYoung, 1997). This means that the thinly capitalized banks generally grant loans to riskier borrowers, which can potentially lead to higher NPLs. In model 5 (Table 4), CAR is insignificant and similar to the findings of Louzis et al. (2012) and Cheng et al. (2016).

Turning to the bank-specific determinants, the credit to deposit ratio, the asset size, and the interest spread have significant influence on NPLs in model 6 but insignificant effect in model 5 (Table 4). The empirical results show that the remittance, the per capita outstanding debt, the return on assets, and the loan to assets ratio do not have significant effect on NPL ratio. In all the models, inefficiency has a positive association with the loan losses. It confirms the bad management hypothesis (Berger & DeYoung, 1997) and the result is consistent with Espinoza and Prasad (2010) for the GCC nations, and Louzis et al. (2012) and Podpiera and Weill (2008) for Greek and Czech banks, respectively.

Of all the macroeconomic determinants, the export to import ratio is extremely influential as it is positively significant in all estimations. A negative relation between inflation rate and NPLs can be seen in model 4 (Table 4). Theoretically, inflation reduces the real value of debt and causes debt servicing easier. Hence, it reduces NPLs. However, in model 6, the inflation rate does not have any effect on NPLs.

The GDP growth rate is negatively significant in model 6, which indicates that an increase in GDP creates job opportunities, which in turn, raises the payment capacity of the borrowers and hence reduces NPLs. This result is consistent with the expected research hypothesis. In all dynamic models, the (AR) test does not reject the null hypothesis of no second-order serial correlation. In specification (5) and (6), the Hansen J (Sargan) test statistics support the null hypothesis of valid instruments. It implies that GMM estimation results are consistent.

Discussions

The estimation results of our models are presented in Tables 3 and 4, where the coefficients of the explanatory variables and their corresponding t-statistics are shown. Most of the estimated coefficients have signs as expected in the hypotheses and theoretical arguments in the literature. The lagged non-performing loans show positive significant correlation in all the models, which is in contrast to the results found by Sorge and Virolainen (2006) and Louzis et al. (2012) in their

panel of the Finnish banking system and the Greek banking system, respectively. However, our results are consistent with the studies of Jiménez and Saurina (2006), Makri et al. (2014), Ghosh (2015), and Dimitrios et al. (2016).

The coefficient of inefficiency is positive and significant in all models. An increase in operating expenses increases inefficiency, and inefficiency, in turn, raises non-performing loans. Our empirical evidence support the "bad management" hypothesis of Berger and DeYoung (1997), which is consistent with Podpiera and Weill (2008), Espinoza and Prasad (2010), and Louzis et al. (2012). This finding proves that better management is essential to improve the loan quality in Nepalese banking industries. Positive effect of inefficiency on NPLs suggests that bad management in a banking system could lead to a banking crisis.

The results show the positive effect of bank size on NPL in models 2 and 3 of static estimation results (Table 3), and model 6 of dynamic estimation results (Table 4), which means that large banks take excessive risk. This finding is consistent with the results of Cotugno et al. (2010), Louzis et al. (2012), and Amuakwa–Mensah and Boakye–Adjei (2015), but in contrast with the result of Espinoza and Prasad (2010). Our empirical results support the "too big to fail" effect on risk taking. However, there is positive insignificant association between the credit risk and the bank size in model 5 (Table 4), which conforms with the result of Asamoah (2015).

The non-performing loans have negative relationship with the capital adequacy ratio explained by the "moral hazard hypothesis" of Berger and DeYoung (1997), which is similar to the results of Klein (2013) and Makri et al. (2014). This means that the thinly capitalized banks generally grant loans to riskier borrowers, which could potentially influence a rise in non-performing loans (Keeton, 1999; Salas & Saurina, 2002). Higher CAR represents higher long-term financing capacity, solvency, and security and hence less chance of default loans.

In most of the models, ROA has insignificant effect on NPLs. This indicates that the asset values of the banking industries are not influenced by the NPL levels. There is a significant positive relation between NPLs and ROA in model 2 and 3 (Table 3), which is consistent with the finding of Jha and Hui (2012) who argued that Nepalese commercial banks are capable of managing credit risk effectively.

The credit to deposit ratio measures the liquidity and reflects the risk attitude of banks. The results show a negative significant effect on NPLs in model 6 (Table 4), which is consistent with the findings of Anjom and Karim (2016) and Dimitrios et al. (2016). The lower the credit to deposit ratio, the lower the profit. In order

to increase profitability, banks therefore, grant loans haphazardly without maintaining credit standard, which may lower the loan quality and hence, increase the NPLs ratio. This result is consistent with the "moral hazard" hypothesis. The insignificant effect of the credit to deposit ratio on NPLs is consistent with the findings of Jameel (2014), Makri et al. (2014), and Cheng et al. (2016).

The loan to assets ratio is negatively insignificant in all models except model 2. It has a negative significant effect on NPLs in model 2 (Table 3) at 5% level, consistent with the findings of Shingjergji (2013), Anjom and Karim (2016) and Macit (2012), which indicates that the loan to assets ratio reduces NPL level. The obtained result is, however, beyond the expected hypothesis.

There is a positive association between NPLs and the interest spread in model 2 (Table 3) and model 6 (Table 4), as expected. Ngugi (2001), Chirwa and Mlachila (2004), and Were and Wambua (2014) also found positive influence of interest spread on NPLs.

The remittance is the major source of fund for Nepalese commercial banks, because a major portion of remittance in Nepal is transferred with the help of different financial institutions as a formal network. The remittance can be invested in productive sectors for the economic growth. The economic growth creates employment opportunities, and the employment increases the payment capacity of borrowers. Therefore, it is expected that the remittance pays a significant role in reducing non-performing loans. However, the result is in contrast with our expectation. The remittance is found to have insignificant effect on NPLs. This indicates that the inflow of remittance transferred through official channel is not stable. Due to poor governance, the remittance has not been invested in productive sectors.

The negatively significant coefficient of GDP growth rate is found in models 1, 3 (Table 3) and 6 (Table 4). This shows that the economic growth indicates an improvement in business performance where a payment capacity is positively increased. The models suggest that the GDP growth causes a reduction in NPL level. Our finding matches with the results of Salas and Saurina (2002), Messai and Jouini (2013), Fofack (2005), Jiménez and Saurina (2006), Louzis et al. (2012), Škarica (2014), and Dimitrios et al. (2016).

The public debt per capita is positively significant in models 1 and 3 (Table 3) over the period. It is consistent with the results of Louzis et al. (2012) and Makri et al. (2014). Higher public debt reduces loan in the market, which increases the interest on loan. Increase in interest rates increases the cost of loans and, as a

result, there is less chance of timely payment of loans, which causes high NPLs. In contrast, the public debt has a negative significant coefficient in the study of Garr (2013) and an insignificant coefficient in the study of Dimitrios et al. (2016).

The expected hypothesis on inflation is clearly rejected. Increase in the inflation rate reduces the real value of loans and eases the borrowers to pay loan on time, and hence decreases default risks. It is consistent with our models 1, 3 (Table 3) and 4 (Table 4). Our empirical result is consistent with the findings of Zribi and Boujelbène (2011), Ekanayake and Azeez (2015), and Anjom and Karim (2016). In contrast with our results, Nkusu (2011) and Rinaldi and Sanchis-Arellano (2006), however, found a positive relationship between credit risk and inflation, while Castro (2013) found an insignificant effect of inflation on NPL.

In Nepal, the economic growth has been driven by service sector, mainly by trade, transport, and communication. The agriculture and industry sectors are in a decreasing trend. Hence, the export to import ratio is found to have significant positive effect on NPLs in all the models, which indicates that the economic growth is dependent on the import trades. Our finding is, however, in contrast with the results of Kavkler and Festić (2010).

Conclusion

The NPL ratio is an important proxy to measure the stability of a financial system as well as the economy of a country. The non-performing loans are not only affected by the monetary policy and the economic growth of a nation but also by the management of a banking industry, which is evident from the "bad management", "moral hazard", and "too big to fail" hypotheses supported by this study. This paper shows that low economic growth, low inflation and high trade deficits are associated with the high non-performing loans. Our empirical results show that banks having higher interest spread are likely to incur higher level of NPLs. The findings of this paper indicate that the management efficiency and effective financial policy are required to stabilize the financial system and economy. For the purpose of financial stability, the regulatory authorities should focus more on risk management systems, managerial performance, and measures to identify banks with possible default loans. The results of this paper have implications for decision makers at both macroeconomic and bank levels. The findings can be helpful in designing the macroprudential and fiscal policies in Nepal.

This is the first empirical study, which has examined remittance, export to import ratio, and debt per capita as potential explanatory variables in a single study.

The study recommends that loans granted to borrowers should be adequately reviewed regularly to assess the credit risk level and each loan should be secured with high valued collateral. This study can be extended further by including development banks in the study sample and the bank-specific variables over a longer period of time. It would be equally useful to examine other underdeveloped and least developed countries to generalize the empirical results found in this study. Similarly, in the future research, the model could be used to highlight regulatory, institutional, and legal factors as the key determinants of non-performing loans.

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