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# **MACROECONOMIC FACTORS OF NON-PERFORMING LOANS: THE CASE OF BOSNIA AND HERZEGOVINA<sup>1</sup>**

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### ***Abstract***

*This paper examines the key macroeconomic factors of non-performing loans (NPLs) in the banking sector of Bosnia and Herzegovina. The research is conducted on quarterly time series data within the period from 2005 to 2019. The autoregressive distributed lag (ARDL) approach is used to model the long-run and short-run relationship between macroeconomic time series. The research results show that increase in real GDP is associated with decrease in NPLs, while rising unemployment and consumer prices are correlated with higher levels of NPLs at 5% significance level.*

**Keywords:** *non-performing loans, credit risk, factors*

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<sup>1</sup> The data that support the findings of this study are openly available in Mendeley Data, V2, doi: 10.17632/g9j9nkz22s.2

## 1. INTRODUCTION

Quality credit risk management requires an effective system for assessing clients' ability to service their debt. However, creditworthiness of the bank clients may change due to a change in economic conditions. A fresh reminder of the severity of consequences of deteriorating macroeconomic conditions on asset quality was the 2007-2009 financial crisis. These costly effects of banking crises led to a more frequent and more complex scrutiny of banking industry by the regulators. Under the IAS 39 accounting framework, banks provisioning practices were backward looking i.e. banks made provisions for losses that already occurred (objective evidence of loan impairment). Under the new IFRS 9 framework, banks are required to develop forward looking provision procedures or expected loss models that incorporate macroeconomic conditions and forecasts when predicting the level of non-performing loans. The size of non-performing loans is key metric used to assess stability of financial system of the country because it contains important information regarding the quality or riskiness of the loan portfolio.

The importance of macroeconomic factors for credit risk models is documented by Bellotti and Crook (2009). They show that inclusion of these factors improves model fit and affects probability of default yielding a modest improvement in predictions of default on an independent test set. According to numerous research studies across the world the main macroeconomic variables that impact the non-performing loans are GDP growth, unemployment rate, inflation rate, exchange rate, lending interest rate and stock market performance. However, these studies found somewhat mixed results regarding the main macroeconomic drivers of non-performing loans. This may be due to differences in the structure of financial system, different sector distribution of loans or differences in monetary policies. This highlights the importance of country studies that aim to explore the main determinant of bad loans in specific environment. This is especially puzzling in countries that have poor tools of monetary policy. One such example is Bosnia and Herzegovina where central bank operates under the currency board regime and has no means of taking certain position in relation to dynamics of economic conditions. This paper aims to fill this gap by trying to understand what macroeconomic factors are most relevant for default risk in these specific circumstances. Understanding factors behind dynamics of non-performing loans and incorporating these factors into provisioning practices of banks is important prerequisite of good credit risk management. Thus, the main goal of the paper is to explore the usefulness of macroeconomic variables in providing better quality information regarding the expected levels of non-performing loans.

The paper is organized as follows: Section 2 depicts the financial system of Bosnia and Herzegovina and non-performing loans dynamics. Section 3 briefly summarizes the existing literature on the link between macroeconomic conditions and credit risk. Section 4 describes the research sample, data and methodology used in hypothesis testing. The fifth part of the paper brings the main results of the paper and discussion, while the sixth part summarizes the main conclusions reached in this empirical study.

## 2. FINANCIAL SYSTEM OF BOSNIA AND HERZEGOVINA

Financial system of Bosnia and Herzegovina is bank oriented meaning that banks serve as main suppliers of the capital. Financial stability report for 2019 issued by the Central bank of Bosnia and Herzegovina (CBBiH) shows that value of assets under control of the banks is 88.7% of the total value of assets of financial intermediaries (CBBiH, 2019). Commercial banks in Bosnia and Herzegovina follow traditional banking business model of handling deposits and making loans to businesses and consumers. This is reflected through the structure of the balance sheet of the banking system of Bosnia and Herzegovina at the end of 2019 where total loans account for 63.6% of total assets (CBBiH, 2019). With this notion in mind, loan portfolio quality is the main driver of banking sector stability.

The changes in NPL levels over the 11-year period in Bosnia and Herzegovina are very similar to those of neighbouring countries and other countries in CEE region (except Greece). This can be seen of Figure 1 that shows NPL statistics in the countries of the CEE region.

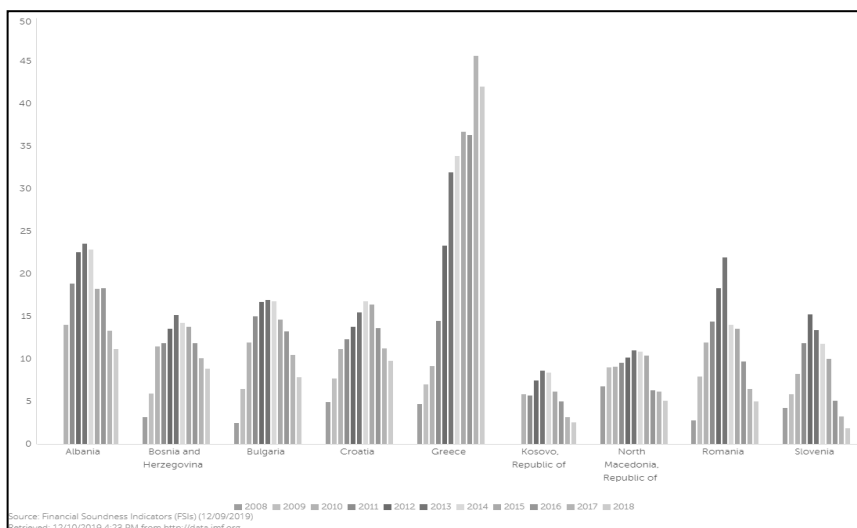


Figure 1 Non-performing loans in CEE countries

Source: *Financial Soundness Indicators, International Monetary Fund.*

Figure 1 displays comparison of NPL ratios between countries in CEE region from 2008 to 2018. After financial crisis majority of countries experienced rapid growth of NPL ratios while the growth varied significantly among different countries. In case of Greece NPLs continued to increase even after 2014 and peaked in 2017 when NPLs rose above 40%. During this period NPL ratios in high-income

countries from Organisation for Economic Co-operation and Development (OECD) varied from 3% in 2008 to 8% in 2014, while in Central and South-eastern Europe it was 4% in 2002, and reached almost 15% in 2014 (Kjosevski & Petkovski, 2017). NPLs in Bosnia and Herzegovina followed the same pattern. The lowest NPL ratio was recorded in 2008 (below 5%), peaked in 2014 (16.08%) and went down below 10% at the end of 2018. Within that, the level of non-performing loans to households in Bosnia and Herzegovina was 6.5%, while the level of NPLs in corporate sector has remained relatively high - 10.79%. According to literature review presented in the following chapter, the quality of credit portfolios may be attributed to certain changes in macroeconomic indicators such as such as the real GDP, consumer price index (CPI), stock market index, lending rate, exchange rate and unemployment rate. Figure 2 depicts the dynamics of non-performing loans ratio and selected macroeconomic variables in Bosnia and Herzegovina from 2005 to 2019.

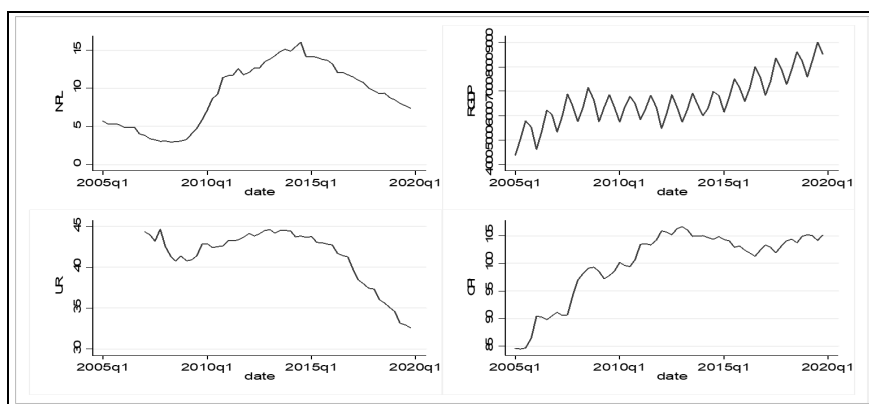


Figure 2 Time series graphs of the research variables

Source: Authors' creation based on the data from International Financial Statistics

The rise in NPL ratio during the financial crisis was accompanied with decline in real GDP, growth in prices and rising unemployment rate. This trend reversed in 2014 when NPLs began to decrease, together with rise in real GDP, falling prices and declining unemployment rate.

### 3. LITERATURE REVIEW

The vast majority of empirical papers regarding macroeconomic determinants of credit risk presented strong evidence that macroeconomic conditions as well as strong credit growth affect the quality of bank assets. Besides that, the number of empirical studies has shown that lower asset quality creates feedback effect that makes the macroeconomic picture even worse. Demirgüç-Kunt and Detragiache (1998) examined the factors associated with banking sector

fragility over the period 1980-1994 and found that low GDP growth, excessively high real interest rates and high inflation are associated with emergence of banking crises. Keeton and Morris (1987) investigated the causes of loan losses using sample of almost 2.500 banks in US for the period 1979–1985. They found that variation in loan losses was due to differences in local economic conditions and poor performance of some industries like agriculture and energy. Excess variation above the influence of these macroeconomic factors is contributed to higher risk appetite which is related to higher probability of default. Gambera (2000) also explored cyclical factors in forecasting bank failures in US. He suggests that a limited number of local macroeconomic variables like bankruptcy filings, farm income, state annual product, housing permits, and unemployment are often good predictors for bad-loan ratios, and that simple vector autoregressive (VAR) systems of one bank variable, one macroeconomic variable, and seasonal dummies can be very effective model of prediction.

Similar drivers of credit risk were detected in the rest of the world. Beck et al. (2013) studied the macroeconomic determinants of non-performing loans (NPLs) across 75 countries using dynamic panel estimates and found that real GDP growth, share prices, the exchange rate, and the lending interest rate significantly affect NPL ratios. Salas and Saurina (2002) explored determinants of problem loans of Spanish commercial and savings banks in the period 1985–1997 using panel data. They demonstrated that GDP growth rate, firms and family indebtedness, rapid past credit or branch expansion, inefficiency, portfolio composition, size, net interest margin, capital ratio, and market power are variables that explain credit risk. Furthermore, Jimenez and Saurina (2006) found strong empirical support for lagged relationship between rapid credit growth and bad loans. Authors argue that banks adjust their credit policies in relation to business cycle phase, meaning that credit expansion periods are followed by a loose credit scoring practices such as weak screening of borrowers and lower collateral requirements, while in bad times they tighten the credit terms and drive up capital requirements. Simons and Rolwes (2009) studied relation between default probabilities and selected macroeconomic variables (GDP growth, interest rate, exchange rate, stock market returns and volatility and oil price) on Dutch data. They found convincing negative relationship with GDP growth and oil price, while the interest and exchange rate links with default probabilities were somewhat weaker. However, default probabilities were not affected by stock market return and volatility. Bofondi and Ropele (2011) investigated the quality of loans to households and firms in Italy in the period Q1:1990 – Q2:2010 and found that changes in macroeconomic conditions generally affect the loan quality with a lag. The quality of loans was measured by the ratio of new bad loans to the stock of performing loans at the end of previous period. In case of households, bad loans were negatively associated with GDP growth and house price while positively related to unemployment rate and the short-term nominal interest rate. In case of firms, the level of bad loans moved in the same direction as the unemployment rate and the ratio of net interest expenses to gross operating profits, and in the opposite direction with the increases in consumption of durables. Arpa et al. (2001) analyzed

the macroeconomic factors of risk provisions of Austrian banks for the period 1990-1999. They found that risk provisions rise when GDP growth declines, real interest rates fall and real estate prices increase. Pain (2003) explored the reasons behind increases in loan-loss provisions for the major UK banks on panel data set covering the period 1978–2000. The main findings varied with the type of the bank. Increased provisions in commercial banks were associated with high real interest rates, slower GDP growth and faster lagged growth in aggregate lending while the relevant macroeconomic drivers for mortgage banks were domestic interest rates deflated by the house price inflation and GDP.

Credit risk of bank loan portfolio in transition countries has similar roots. Jakubik (2007) studied the impact of GDP, inflation and interest rate on the expected proportion of bad loans in the total loan portfolio of Czech banks between Q1:1997 and Q3:2005. He found the inverse relationship between default rate and GDP and positive effect of nominal interest rate. Inflation had a negative effect on default rate but the combination of nominal interest rates and inflation showed dependence of default rates on real interest rates rather than nominal rates, although the estimated coefficients were not exactly the same and had different lags. Babouček and Jančar (2005) also investigated a set of macroeconomic drivers of loan quality in Czech economy. Authors used comprehensive VAR methodology applied to monthly data. Based on impulse response analysis they found that unemployment, inflation and credit risk shock negatively affect the level of NPL ratios. Moreover, their stress testing analysis suggests that raising NPL ratio accompanied with inflation pressures and high levels of unemployment represents early sign of decreasing credit portfolio quality.

Škarica (2014) examined the determinants of NPLs in group of selected emerging markets (Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Romania and Slovakia) between Q3:2007 and Q3:2012. She found that GDP negatively affects NPL ratio while increase in unemployment and the inflation rate lead to increase in NPL ratio. Škarica (2014) concluded that the effect of higher interest rates due to inflation and the declining economic conditions usually associated with rising inflation prevails over the positive impact that inflation might have on borrowers' debt servicing capacities. Similar findings were documented by Klein (2013) who investigated non-performing loans in Central, Eastern and South-Eastern Europe (CESEE) including Bosnia and Herzegovina during the period from 1998 to 2011. He found that NPLs respond to macroeconomic conditions such as GDP growth, unemployment, and inflation, while bank-specific factors have low explanatory power. Moreover, his analysis suggests that there are strong feedback effects from the rising NPLs to the real economy.

More recent study of non-performing loans across Central and Southeast Europe (Bosnia and Herzegovina, Croatia, Montenegro, Serbia, and Slovenia) was conducted by Bykova and Pindyuk (2019). They found a negative link between GDP growth and all types of loans, but impact on corporate loans compared to consumer loans was much more intensive. A possible explanation for this given by authors is that the consumer loan amounts are smaller and often repaid by friends

or relatives. Besides that, authors documented that credit expansion was followed by higher NPL levels and that rise in consumer and producer prices led to more frequent defaults across all types of loans. They also found that changes in real interest rates and unemployment will hurt corporate sector more than households. Benazić and Radin (2015) examined the determinants of non-performing placements and off-balance sheet liabilities of Croatian banks. They found that increase in the real GDP reduces the level of NPLs in the long-run while the rise in prices, unemployment and lending rates as well as depreciation of exchange rate increase the level on NPLs. Hada et al. (2020) analyzed factors of NPLs in Romania during the 2009–2019 period using linear regression analysis. The results showed that all selected independent variables (exchange rates of the most used currencies (EUR, USD and CHF), unemployment rate, and inflation rate) have a significant impact on the level of NPLs. Louzis et al. (2012) investigated mortgage, economic and consumer loan portfolio in the largest banks in Greece from 2003 to 2009. They found that macroeconomic factors, and particularly real GDP growth, unemployment rate and lending interest rates, have a strong impact on NPLs of all categories.

Otašević (2013) explored the impact of macroeconomic and bank-specific factors on non-performing loans on a sample of 33 banks in the Republic of Serbia in the period from Q3:2008 to Q2:2012. The results of the research show negative relation between NPL ratio in household portfolio and GDP growth, consumer price index and exchange rate, while lagged NPL ratio and interest rates exhibit positive relation with the level of NPLs. These relations were also confirmed in the corporate loan portfolio apart from the interest rates which did not prove to be a statistically significant determinant of NPL ratio. More interestingly, author found that inclusion of the bank-specific variables does not yield statistically significant results.

Kjosevski et al. (2019) explored the bank-specific and macroeconomic determinants of non-performing loans (NPLs) to enterprises and households in the Republic of Macedonia in the period from Q4:2003 to Q4:2014 by applying the autoregressive distributed lag modelling approach. Empirical results have shown that the profitability of banks, the growth of loans and the growth of GDP, all have a negative impact on non-performing loans, while solvency and unemployment have a positive impact on non-performing loans in both portfolios. They also found that exchange rate has a positive and statistically significant impact on the level of NPLs in the corporate loan portfolio.

Kjosevski and Petkovski (2017) examined macroeconomic determinants of NPLs on a sample of 27 banks in Baltic countries (Estonia, Latvia and Lithuania) in the period of 2005-2014 using annual data. They found GDP growth, inflation and domestic credit to be the most important macroeconomic factors that influence non-performing loans. Moreover, they have documented that rise of non-performing loans contributes to a further blurring of the macroeconomic picture. This is seen through the feedback effects from increasing NPLs to domestic credit (as % of GDP), unemployment, GDP growth and inflation. Nikolaidou and Vogiazas (2014) investigated macroeconomic determinants of non-performing loans in Bulgaria during the 2001-2010 period using ARDL model. They found

that NPLs are positively associated with loan growth, unemployment rate and shock variable that represents regime change in Bulgaria and financial crisis, at 1% significance level. They also found negative link between NPLs and construction index (CON), while Greek crisis proxy was not significant.

Pašić and Omerbegović-Arapović (2016) investigated macroeconomic factors of non-performing loans in households sector of Federation of Bosnia and Herzegovina and found negative association between GDP growth and NPLs while inflation and unemployment were not significant predictors. Somewhat different results were obtained by Agić and Jeremić (2018) who analyzed macroeconomic and bank-specific factors of NPLs in Bosnia and Herzegovina during the 2006-2016 period. The authors found that rising NPLs are correlated with high unemployment rate, growth of consumer prices, return on assets and credit growth rates, while the effects of the GDP growth, capital adequacy ratio, return on equity and active interest rates are not statistically significant. Kozarić and Žunić Dželihodžić (2020) have also analyzed the correlation between macroeconomic conditions and non-performing loans over the period from 2006 to 2017. They found that improvements in macroeconomic conditions such as GDP growth, declining inflation and lower unemployment are associated with improvement in credit quality at 5% significance level. However, all of the studies conducted in Bosnia and Herzegovina employed correlation analysis or multiple linear regression ignoring time series properties of the data. This is the first study that employs time series regression model and cointegration testing of the long-run relationship between research variables.

#### 4. DATA AND METHODOLOGY

The study is conducted on quarterly time-series data extracted from International Financial Statistics database. Research sample covers the 11-year period - from 2005 to 2019. Independent variables are initially selected based on the existing literature of determinants of non-performing loans and structural characteristics of Bosnia and Herzegovina. These aggregate indicators are real GDP, consumer price index and unemployment rate. Non-performing loans are measured by the ratio of aggregate non-performing loans of the whole credit portfolio and total loans. In case of Bosnia and Herzegovina non-performing loans are defined as loans classified in status of default i.e. a loan where the debtor is late with repayment of due liabilities for more than 90 days in a material amount, or loans where bank deems certain that the debtor will not fully settle its obligations to the bank, its parent company or any of its subsidiaries of the legal entity without taking into account the possibility of collection from collateral (The Banking Agency of the Federation of Bosnia and Herzegovina, 2019). Measures of independent variables and expected signs in relation to dependent variable are given in Table 1.



Table 1

## Variable description and expected signs

| Dependent variable           | Measure   | Expected signs | Data source                       |
|------------------------------|---|----------------|-----------------------------------|
| NPL                          | Aggregate non-performing loans / total loans              |                | International Financial Statistic |
| <b>Independent variables</b> |   |                |                                   |
| RGDP                         | Gross domestic product index / consumer price index x 100 | -              | International Financial Statistic |
| CPI                          | Consumer price index                                      | +              | International Financial Statistic |
| UR                           | Unemployment rate   | +              | International Financial Statistic |

Source: Authors

Regarding the suggested hypotheses, it is reasonable to expect that economic growth affects disposable income of households and net income of the firms. Therefore, increasing income should reduce borrower probability of default, *ceteris paribus*. Inflation impact is two-sided. First, inflation means lower value of the loan and thus easier servicing of the debt. Second, higher inflation affects the real value of income making repayment more difficult. During the research period average growth of inflation-adjusted wages in Bosnia and Herzegovina was 0,60%, while the correlation between inflation and lending interest rates was moderate and negative (-0,61) (Džidić, 2022). It may seem, at first glance, that inflation should not negatively affect the loan portfolio quality because it would not result in lower disposable income of households or higher nominal interest rates. However, significantly higher NPL ratio in corporate sector of Bosnia and Herzegovina may reflect the upward pressure of inflation and wages on cash flows of the firms through more expensive inputs. In case of unemployment effect on non-performing loans it is reasonable to expect that higher unemployment reduces repayment abilities of existing borrowers resulting in the higher number of defaults. Moreover, diminishing employment usually reflects the economic slowdown thus increasing probability of new bad loans.

Quarterly data on the research variables are taken from IMF database – International Financial Statistics. Data sample covers the period between Q1:2005 and Q4:2019. Having in mind the fact that the research is conducted on quarterly data and that some of the time series plotted in Figure 2 exhibit clear seasonality, all the variables in the model were seasonally adjusted.

Although many macroeconomic indicators were considered, finally only real GDP index, unemployment rate and consumer price index were included in the regression model. Certain macroeconomic indicators such as the exchange rate, stock market index and lending interest rates were not selected in the model due to a couple of reasons. According to CBBiH (n.d.), loans with the currency clause account for 51.8% of total loans, and 99.7% of these loans are loans with clause

indexed to Euro. With a currency board in place and exchange rate fixed to Euro currency risk does not pose a significant threat to the borrower's ability to repay the loan. In addition, the majority of imports to Bosnia and Herzegovina come from the European Union. This means that even changes in other exchange rates should not have significant effect on non-performing loans. Stock market in Bosnia and Herzegovina is divided between two stock exchanges that are equally underdeveloped in terms of liquidity. Stock market liquidity measured by the volume of stocks traded as a percentage of market capitalization (turnover ratio) was 1.39% in 2014 (Džidić, 2014). With this notion in mind and the fact that equity is less valued in underdeveloped capital markets due to a lower transparency (Gelb & Zarowin, 2002; Lang & Lundholm 2000) and due to weak minority investor protection (La Porta et al. 2002) securities as collateral simply do not play important role as determinant of credit risk. This is in line with previous empirical work conducted by Škarica (2014) and Beck et al. (2013) who found no significant relation between stock market index and NPLs in countries with low stock market capitalization as % of GDP. Having in mind that Central bank of Bosnia and Herzegovina operates under the Currency board regime and thus cannot stimulate growth through monetary policy, lower lending interest rates may be reflection of improved macroeconomic conditions (GDP growth and declining unemployment) rather than their cause. Therefore, the final model is function of three most cited predictors of non-performing loans – real GDP, unemployment rate and consumer prices index.

$$NPL_t = f(RGDP_T, CPI_T, UR_T) \quad (1)$$

In order to check for stationarity of time series data, Augmented Dickey Fuller test (Dickey & Fuller, 1979) is used. The results of the unit-root tests are presented in Table 2.

Table 2

The Augmented Dickey Fuller test results

| Variable | Levels  |         |                    |         | First difference |         |                    |         |
|----------|---------|---------|--------------------|---------|------------------|---------|--------------------|---------|
|          | Const.  | p value | Constant and trend | p value | Const.           | p value | Constant and trend | p value |
| NPL      | -0.7940 | 0.8210  | 0.5540             | 0.9969  | -4.9830          | 0.0000  | -5.2760            | 0.0001  |
| RGDP     | -0.5600 | 0.8798  | -1.6590            | 0.7684  | -8.9980          | 0.0000  | -8.9250            | 0.0000  |
| CPI      | -3.0510 | 0.0304  | -1.7330            | 0.7362  | -6.1110          | 0.0000  | -6.6660            | 0.0000  |
| UR       | 1.4990  | 0.9975  | 0.1020             | 0.9951  | -7.0440          | 0.0000  | -7.6890            | 0.0000  |

Source: Authors' calculation based on the data from International Financial Statistics

The results of the unit-root tests indicate that non-performing loans ratio, unemployment rate and real GDP are integrated at order one I(1) i.e. they are stationary in their first differences, while consumer price index is integrated at its levels. Taking into account mixed order of integration of the research variables an autoregressive distributed lag modelling approach is used.

ARDL model was developed by Pesaran and Shin (1995) and represents a flexible OLS method that can be applied irrespective of whether the time series are stationary at levels or at first differences  $I(1)$  or fractionally integrated (Pesaran, Shin & Smith, 2001). Moreover, the ARDL approach is more reliable for small samples as compared to Johansen and Juselius's cointegration methodology (Haug, 2002, as cited in Menegaki, 2019). The general form of the model is as it follows:

$$\Delta NPL_t = c_0 + c_1 * t + \sum_{i=1}^n \alpha * \Delta NPL_{t-i} + \sum_{i=1}^n \beta * \Delta RGDP_{t-i} + \sum_{i=1}^n \gamma * \Delta CPI_{t-i} + \sum_{i=1}^n \delta * \Delta UR_{t-i} + \theta_1 * NPL_{t-i} + \theta_2 * RGDP_{t-i} + \theta_3 * CPI_{t-i} + \theta_4 * UR_{t-i} + \varepsilon_t \quad (2)$$

where  $c_0$  and  $c_1$  present constant and trend,  $\theta_1$ ,  $\theta_2$ , and  $\theta_3$  are the long-run multipliers while  $\alpha$ ,  $\beta$ , and  $\gamma$  represent the short-run dynamic coefficients. Symbol  $\Delta$  denotes first difference of the research variable. Due to a fact that model is being estimated on quarterly data the maximum lag order of 4 is specified. Following the Akaike information criterion (AIC), ARDL (4, 3, 3, 0) model is selected. The trend term is included in the model on the basis of higher values of the information criterions (AIC – Akaike Information Criterion, SBC – Schwarz Bayesian Criterion and HQ – Hannan-Quinn Criterion) recorded in the model that contains the trend term.

## 5. RESEARCH RESULTS AND DISCUSSION

Descriptive statistics of the research variables are given in Table 3. Data on all variables contain 60 observations except unemployment rate (52) which starts with Q1:2007. The quarterly data covers the period prior to the outbreak of the financial crisis in 2008.

Table 3

Descriptive statistics

| Variable           | Obs. | Mean     | Std. Dev. | Min      | Max      |
|--------------------|------|----------|-----------|----------|----------|
| NPL                | 60   | 9.24852  | 4.159792  | 2.968533 | 16.07977 |
| RGDP (in mln. BAM) | 60   | 6643.331 | 978.399   | 4374.976 | 9016.031 |
| CPI                | 60   | 100.0705 | 6.226976  | 84.47586 | 106.7106 |
| UR                 | 52   | 41.41453 | 3.390119  | 32.58561 | 44.66292 |

Source: Authors' calculation based on the data from International Financial Statistics

During this period non-performing loans ratio in the banking system of Bosnia and Herzegovina varied from 4.16% to 16.08% with the mean of 9.25%. A closer look at the NPLs graph in Figure 2 shows that NPL ratio was in raising trend before 2014 when it started to reverse. During the same period quarterly real GDP increased from 4.37 billion to 9.02 billion BAM with an average of 6.64 billion BAM. As shown in Figure quarterly real GDP declined after the financial crisis and remained below its pre-crisis level until 2014 when it started to trend upwards.

The mean unemployment rate was extremely high (41.41%) during this period and unemployment rate never fell below 32.6 %. Unemployment growth began with the financial crisis and lasted until 2015, after which it continued to fall to its lowest level of around 32% in 2019. The consumer price index peaked in 2013, then fell slightly until 2017, after which it continued to rise towards the previous peak.

The results of the correlation analysis presented in Table 4 show that NPL ratio exhibits the highest degree of correlation (positive and statistically significant) with consumer price index, while real GDP and unemployment rate record much smaller correlation with NPLs. As expected, the real GDP is positively correlated with consumer price index and negatively correlated with unemployment rate.

Table 4

## Correlation analysis

|             | <b>NPL</b> | <b>RGDP</b> | <b>CPI</b> | <b>UR</b> |
|-------------|------------|-------------|------------|-----------|
| <b>NPL</b>  | 1.0000     |             |            |           |
| <b>RGDP</b> | 0.2332     | 1.0000      |            |           |
| p-values    | 0.0729     |             |            |           |
| <b>CPI</b>  | 0.7340     | 0.5548      | 1.0000     |           |
| p-values    | 0.0000     | 0.0000      |            |           |
| <b>UR</b>   | 0.2615     | -0.8063     | -0.1939    | 1.0000    |
| p-values    | 0.0612     | 0.0000      | 0.1684     |           |

Source: Authors' calculation based on the data from International Financial Statistics

Before model estimation one needs to conduct the bound test in order to check whether there is a cointegration between the research variables. The results of this test are presented in Table 5. The F-statistic is higher than 99% upper bound so the hypothesis of no cointegration is rejected. This means that error correction model with long-run and short-run coefficients can be applied. Table 6 depicts the level relationship between non-performing loans and selected macroeconomic variables in the long-run.

Table 5

Testing for the existence of a level relationship among the variables in the ARDL model

| <b>F-statistic</b> | <b>90% Upper bound</b> | <b>95% Upper bound</b> | <b>97.5% Upper bound</b> | <b>99% Upper bound</b> |
|--------------------|------------------------|------------------------|--------------------------|------------------------|
| 5.678              | 3.74                   | 4.23                   | 4.68                     | 5.23                   |
|                    | <b>90% Lower bound</b> | <b>95% Lower bound</b> | <b>97.5% Lower bound</b> | <b>99% Lower bound</b> |
|                    | 2.97                   | 3.38                   | 3.8                      | 4.3                    |

Source: Authors' calculation based on the data from International Financial Statistics

Table 6

## Estimated long-run coefficients of the ARDL (4, 3, 3, 0) model

| Dependent variable: NPL |          |           |       |       |                      |          |
|-------------------------|----------|-----------|-------|-------|----------------------|----------|
| Variable                | Coef.    | Std. Err. | t     | P> t  | [95% Conf. Interval] |          |
| RGDP                    | -0.00451 | 0.001954  | -2.31 | 0.027 | -0.00847             | -0.00055 |
| UR                      | 0.449261 | 0.21924   | 2.05  | 0.048 | 0.005039             | 0.893484 |
| CPI                     | 0.240794 | 0.117057  | 2.06  | 0.047 | 0.003613             | 0.477975 |
| date                    | 0.342208 | 0.076327  | 4.48  | 0.000 | 0.187555             | 0.496861 |

Source: Authors' calculation based on the data from International Financial Statistics

The results presented in Table 6 show the long-run relationship between non-performing loans and selected macroeconomic indicators. All coefficients are statistically significant at usually accepted level of significance (95%). As expected, the increase in real GDP indicate light decrease in NPL levels, while unemployment and rising prices tend to increase percentage of bad loans. Direction signs of examined relations between research variables are in line with previous studies conducted in CEE region (Škarica, 2014; Klein, 2013; Kozarić & Žunić Dželihodžić, 2020). Table 7 summarizes estimation results for the error correction equation form while Table 8 presents regression diagnostics.

Table 7

## Error correction representation of the ARDL (4, 3, 3, 0) model

| Dependent variable: NPL |          |           |       |       |                      |          |
|-------------------------|----------|-----------|-------|-------|----------------------|----------|
| Variable                | Coef.    | Std. Err. | t     | P> t  | [95% Conf. Interval] |          |
| ADJ (NPL L1)            | -0.41752 | 0.097254  | -4.29 | 0.000 | -0.61457             | -0.22047 |
| NPL                     |          |           |       |       |                      |          |
| LD.                     | 0.139879 | 0.119766  | 1.17  | 0.250 | -0.10279             | 0.382547 |
| L2D.                    | 0.3495   | 0.114538  | 3.05  | 0.004 | 0.117423             | 0.581576 |
| L3D.                    | 0.513551 | 0.117567  | 4.37  | 0.000 | 0.275338             | 0.751765 |
| RGDP                    |          |           |       |       |                      |          |
| D1.                     | 0.001501 | 0.000763  | 1.97  | 0.057 | -4.4E-05             | 0.003047 |
| LD.                     | 0.000537 | 0.000602  | 0.89  | 0.378 | -0.00068             | 0.001758 |
| L2D.                    | 0.001105 | 0.000502  | 2.2   | 0.034 | 8.85E-05             | 0.002121 |
| CPI                     |          |           |       |       |                      |          |
| D1.                     | 0.011526 | 0.076166  | 0.15  | 0.881 | -0.1428              | 0.165852 |
| LD.                     | 0.045446 | 0.08165   | 0.56  | 0.581 | -0.11999             | 0.210884 |
| L2D.                    | -0.16893 | 0.084329  | -2    | 0.053 | -0.3398              | 0.001937 |
| cons                    | -31.6813 | 10.45924  | -3.03 | 0.004 | -52.8737             | -10.4889 |

Source: Authors' calculation based on the data from International Financial Statistics

Table 8

## Regression diagnostics

|   |            |          |           |           |
|---|------------|----------|-----------|-----------|
| R-squared   | 0.7028     |          |           |           |
| Adjusted R-squared  | 0.5904     |          |           |           |
| Log likelihood  | -20.669716 |          |           |           |
| Akaike information criterion                              | 71.33943   |          |           |           |
| Bayesian information criterion                            | 100.6081   |          |           |           |
| Skewness/Kurtosis tests for Normality of Residuals        | Skewness   | Kurtosis | adj.chi2  | Prob>chi2 |
|   | 0.0651     | 0.9257   | 3.61      | 0.1647    |
| Breusch-Pagan / Cook-Weisberg test for heteroscedasticity | chi2       | 0.26     | Prob>chi2 | 0.6118    |
| Breusch-Godfrey LM test for autocorrelation               | chi2       | 2.179    | Prob>chi2 | 0.1399    |

Source: Authors' calculation based on the data from International Financial Statistics

As can be seen from the Table 7 the error correction term is negative, as expected. It shows the speed at which the variables move toward the equilibrium, meaning that disequilibrium will be corrected at a speed of 42%. Short-run representation of the model shows statistically significant impact of real GDP on the level of non-performing loans but with the opposite sign compared to the level relationship in the long-run. The lagged values of NPL ratios (second and third quarter) seem to be important short-run predictor of current level of NPLs at 95% level of significance. This may indicate that worsening loan quality may result in even more loan delinquencies. As shown in Table 8 the R-squared statistic reveals that 70% of variation in the level of NPLs can be explained by the changes in consumer price index, real GDP index and unemployment rate. Skewness/Kurtosis test for normality indicates that residuals are normally distributed. The Breusch-Pagan test for heteroscedasticity indicates constant variance, while Breusch-Godfrey LM test shows absence of autocorrelation. These tests suggest that the model is properly estimated and that derived conclusions are sound and reliable.

## 6. CONCLUSION

The main goal of the paper was to explore the usefulness of macroeconomic variables in providing better quality information regarding the expected levels of non-performing loans in Bosnia and Herzegovina. The research results show that macroeconomic conditions should be considered when developing internal models of credit risk.

Empirical tests have confirmed that the rise of non-performing loans follows after deteriorating macroeconomic conditions. More precisely, the rise of bad loans is associated with declining real GDP, increasing unemployment rate and raising prices (CPI). Even though this study did not examine the feedback effects

of NPLs, significant positive effects of the second and third lag of NPL ratio on current level of NPLs may indicate some feedback effects of raising NPLs on further deterioration of credit portfolio quality in the short-run. These findings are in line with previous empirical studies of macroeconomic determinants of non-performing loans.

The main limitation of the study is the short history of time series data. This is due to the fact that Bosnia and Herzegovina is relatively young country with short history of macroeconomic data on selected macroeconomic variables. However, with years to come more data will certainly help to expand the research sample and challenge these findings. The second limitation lies in the fact that non-performing loans are also affected by the bank-specific variables that may yield a more nuanced understanding of the dynamics of non-performing loans. Thus, inclusion of the aggregate bank-specific predictors in the existing model is fruitful area for future research.

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## **MAKROEKONOMSKI ČIMBENICI NEPRIHODONOSNIH KREDITA: PRIMJER BOSNE I HERCEGOVINE<sup>2</sup>**

***Sažetak***

*U ovome radu istražuju se makroekonomske čimbenice neprihodonosnih kredita (NPK) u bankarskom sektoru Bosne i Hercegovine. Istraživanje je provedeno prikupljanjem podataka kvartalno u razdoblju 2005. – 2019. Za modeliranje dugoročnog i kratkoročnog odnosa između makroekonomskih vremenskih serija upotrebljava se pristup autoregresivnim distribuiranim modelom kašnjenja (ARDL). Rezultati istraživanja pokazali su da je rast realnoga BDP-a povezan sa smanjenjem neprihodonosnih kredita, dok su rast nezaposlenosti i potrošačkih cijena u korelaciji s višim vrijednostima neprihodonosnih kredita na razini značajnosti od 5%.*

***Ključne riječi: neprihodonosni krediti, kreditni rizik, čimbenici.***

***JEL klasifikacija: E44, E51, G21.***

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