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*Credit Risk in the Euro Area Compared to Other  
European Union Countries*

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### Abstract

**Theoretical background:** The article examines the microeconomic and macroeconomic determinants of credit risk in the European Union countries divided into two groups: countries that own the euro and countries outside the euro area.

**Purpose of the article:** This study is to identify differences in the shaping of credit risk in the EU depending on the country's affiliation to the monetary union.

**Research methods:** The statistical survey made it possible to identify significant differences between the mean values of the analyzed variables, and the econometric survey made it possible to identify differences in the determinants of credit risk in the two analyzed groups of countries. The study consisted of examining the occurrence of differences between the means for the collected variables and making the models using the GMM system.

**Main findings:** Differences in the influence of macroeconomic factors on the credit risk of euro area countries and other European Union countries were shown. The main difference concerns the insensitivity of credit risk of euro area countries to changes in the foreign currency exchange rate, as well as the significant impact of inflation and unemployment on the credit risk of these countries.

### Introduction

Credit risk analysis is the most important issue helping in bank management. Credit risk is measured by the NPL ratio. An increase in NPLs leads to a reduction in bank profits and may also lead to a loss on the bank's activities. The NPL ratio increased significantly during the financial crisis as the crisis limited the population's ability to pay liabilities. In some countries, the elevated level of credit risk has remained so far. Therefore, the demand for analyzes pointing to the determinants of credit risk is still high. Proper knowledge of the impact of individual determinants of credit risk allows for effective management of this risk in the entire banking system of a given country.

The article deals with the analysis of the impact of currency integration on the level of credit risk. So far, no such research has been carried out. The main purpose is to assess whether the monetary union affects the level of credit risk. To answer this question, a theoretical analysis of the research conducted so far on credit risk in the euro area was carried out, as well as proposing own empirical research based on which conclusions were built. This problem has not been presented in the literature so far, therefore, this article fills this gap.

The article examines the impact of microeconomic and macroeconomic factors on the credit risk of euro area countries and other European Union countries. Statistical analysis is based on the study of descriptive statistics and the indication of differences in means between selected variables. The econometric study began with checking the unit root test to select the appropriate form of the variable for the GMM model. The study is based on a dynamic panel model, so it was justified to use the GMM system. The research period is 2004–2017. The period included the great economic integration in 2004 and the period of the economic crisis of 2007–2009. This means that the models were also verified for the period of significant economic changes and high economic instability. The study verified the main research hypothesis: The impact of selected determinants of credit risk among the euro area country and other EU countries differs.

The main value of this article is to infer the differences between credit risk in the euro area and other European Union countries. The main conclusion from the study is that membership in a monetary union favors economic integration and lowers credit risk. Belonging to the euro area makes the credit risk of these countries insensitive to changes in foreign exchange rates. Credit risk was also verified in the conditions of the economic crisis. Macroeconomic variables such as unemployment and inflation rates have a significant impact on credit risk in the euro area. This is an important conclusion that shows the benefits for the banking sector of joining the monetary union. Consequently, the presented conclusions may be useful for the state administration.

### Literature review

The functioning of states in the common currency zone may, on the one hand, result in increased protection of the banking sector, and, on the other hand, may cause mutual contagion of states with the debt crisis. Buchholz and Tonzer (2016) indicate that the links between countries in banking and the sentiment in the single economic market are the main causes of contagion. Brownlees et al. (2021) point to the introduction of costly rescue packages for banks in the euro area, which turned out to be “too big to fail”. This action was aimed at easing the crisis in the entire banking sector of the euro area. It is worth recalling that the period before the 2007 crisis was characterized by declining interest rates and high demand for credit, in particular for the purchase of the real estate. This led to an increase in lending by banks and the liberalization of credit conditions (Hada et al., 2020).

The literature also points to some dependencies specific to the euro area. Macroeconomic factors have a particular impact on the functioning of the euro area, even inflation shocks significantly affect the monetary and financial stability of the euro area countries (Tsagkanos et al., 2018). This may suggest that some macroeconomic variables will have a significant impact on credit risk in the euro area. Indeed, most studies indicate a significant impact of macro variables on the credit risk of euro area countries (Beck et al., 2015). However, no studies are comparing whether the same relationships exist in other European Union countries.

There are two main groups of factors influencing credit risk, namely microeconomic factors – bank specific, and macroeconomic factors – country specific (Falla et al., 2021). In the literature, the following key determinants of credit risk can be indicated (the determinants are divided into micro- and macroeconomic ones):

#### Microeconomic factors

**The bank capital to total assets:** The amount of a bank’s capital has a significant impact on credit risk as banks with relatively little equity tend to have a greater exposure to credit risk. In the literature, this relationship is described as

moral hazard (Bayar, 2019 or Morris & Keeton, 1987). This ratio is important due to the fact that banks with a low level of capital are exposed to “moral hazard” (Berger et al., 2000).

**The liquid asset:** The literature indicates the relationship between non-performing loans and the ratio of liquid assets. The increase in liquid assets will be associated with a decrease in credit risk (Boussaad et al., 2020).

**Bank credit to bank deposits:** Another measure of a bank’s liquidity is the credit to deposits indicator, which shows how many deposits the bank has used for lending. This ratio should have a positive impact on credit risk, so an increase in the ratio will result in an increase in credit risk (Makri et al., 2014).

**The domestic credit level:** Credit increases increase credit risk. More loans increase the probability of defaulting some loans (Mpofu & Nikolaidou, 2018). This variable was indicated as a significant factor (Klein, 2013), or an insignificant one (Fofack & Fofack, 2005).

#### Macroeconomic factors

**The economic growth:** The key macroeconomic variable influencing credit risk is economic growth (Back et al., 2013). It is assumed that economic development is conducive to raising the general level of income, therefore, economic growth should be negatively correlated with credit risk. This dependence allows to indicate whether a given economy is in the development stage (Nkusu, 2011).

**The unemployment rate:** Unemployment should positively influence the increase in credit risk (Kjosevski et al., 2019). The increase in unemployment reduces the general income of the population, so the debt repayment capacity should also decrease. The increase in unemployment also reflects the general deterioration of the situation of enterprises in a given country. Borrowers (enterprises and the population) will have problems with the repayment of the current loan installment as a result of the deteriorating situation on the labor market.

**The inflation:** The nature of the impact of inflation on credit risk is ambiguous. On the one hand, high inflation reduces the purchasing power of the population (Erdoğan & Abazi, 2014; Szarowska, 2018). On the other hand, this high inflation reduces the real value of loans and thus facilitates debt repayment. It is possible to indicate a negative impact of inflation (Kjosevski & Petkovski, 2017) if the increase in inflation is not related to an increase in real wages. If the rise in inflation is accompanied by a steady rise in real wages, then inflation will have a positive effect on credit risk.

**The exchange rate:** The increase in foreign currency exchange rate will generally lead to an increase in credit risk (Hada et al., 2020; Castro, 2013). An increase in the exchange rate means that borrowers have to obtain more funds to repay a loan in a foreign currency, if they earn in the domestic currency (Klein, 2013). In the case of earning income in a foreign currency, the change in the exchange rate will be indifferent to the borrower.

**Implied volatility:** Implied volatility is most often measured using the VIX index (Chicago Board Options Exchange Market Volatility Index – annual change). It is assumed that the increase in implied volatility may be accompanied by an increase in credit risk, as increased risk in the capital market reduces bank profits (Karkowska, 2019). The VIX index is a specific variable because its value depends on changes in the Chicago market, although it is widely recognized as a good measure of market volatility. However, the fact that the source of this variable is outside the EU means that it should be considered separately from other macroeconomic variables.

As indicated above, not only macroeconomic variables affect credit risk, but bank-specific factors also play a very important role. However, both the euro area banks and the banks of the EU countries are subject to the same regulation, so it is difficult to point to significant differences in the microeconomic factors of NPLs in comparison to these two groups of countries.

Based on the literature review, it is possible to indicate the following research hypotheses:

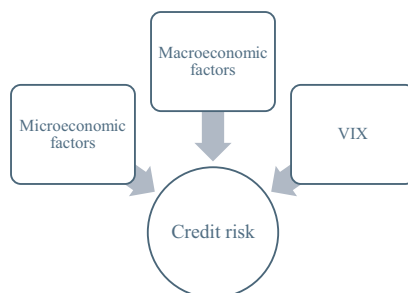
H0: The impact of selected determinants of credit risk among the euro area country and other EU countries differs.

H1: The factors describing the banking sector do not differentiate credit risk in euro and non-euro countries.

H2: The monetary union reduces the credit risk.

H3: The increase in the VIX index increases credit risk in the country, regardless of the monetary union.

The research hypotheses formulated above can be illustrated by the following scheme (Figure 1).



**Figure 1.** Credit risk determinants

Source: Authors' own study.

Research hypotheses will be empirically verified in the next part of the paper with the use of statistical and econometric tools.

## Research methods

The study used macroeconomic and microeconomic data for the years 2004–2017. 2004 was chosen as the starting year because that year saw a major enlargement of the EU. The longest possible period for which data are available was selected for analysis. The data is annual for the EU countries. The countries were divided into two groups, where the first group includes countries that do not have the euro, and the second group includes countries that have this currency.

The following variables were analyzed in the study (source: World Bank – World Development Indicators):

- NPL – non-performing loans, credit risk measure,
- Capital to total assets – bank capital to assets ratio (%),
- Credit to deposits – bank credit to bank deposits (%),
- Liquid assets to deposits – liquid assets to deposits and short-term funding in bank sector (%),
- Domestic credit – domestic credit to private sector by banks (% of GDP),
- EUR/USD – exchange rate EUR/USD,
- Growth – economic growth,
- Inflation – consumer prices (annual %),
- Unemployment – % of total labor force.

In addition, the variable denoting market volatility was analyzed, i.e. VIX – CBOE Volatility Index (source: investing.com).

Econometric analysis is based on the evaluation of a dynamic panel model in the general form (the GMM system was used):

$$NPL_{i,t} = \alpha_{i,t} + \beta_{i,t}NPL_{i,t-1} + \gamma_{i,t}B_{i,t} + \mu_{i,t}$$

where  $B$  are independent variables and  $\mu$  is the error that may be written as follows:

$$\mu_{i,t} = \delta_{i,t} + \gamma_{i,t} + \varepsilon_{i,t}$$

where  $\delta$  is the country-specific random effects,  $\gamma$  is the random effects assigned to the period, and  $\varepsilon$  is a random component with basic properties.

The selected research method is based on statistical and econometric analysis of data. Descriptive statistics are provided in Table 1 for the EU countries without the euro, and descriptive statistics for EU countries in the euro area are provided in Table 2. Comparing the data contained in both tables (1 and 2), differences between the groups can be noticed. The credit risk measure (NPL) is lower in euro area countries by 0.41%, which indicates that operating in the euro area brings benefits for the banking sector. Capital to total assets and credit to deposits are lower for euro area countries and liquid assets to deposits for these countries is higher. When analyzing

macroeconomic indicators, it should be indicated that economic growth and inflation are lower in the group of euro area countries, while unemployment and Domestic Credit index are higher in these countries. Statistics for the exchange rate and the VIX index do not depend on the data for individual countries.

**Table 1.** Descriptive statistics for non-euro zone in the EU

|                           | Mean   | Maximum | Minimum | Std. Dev. |
|---------------------------|--------|---------|---------|-----------|
| NPL                       | 6.88   | 21.87   | 0.10    | 5.38      |
| Microeconomic factors     |        |         |         |           |
| Capital to total assets   | 8.22   | 14.82   | 4.00    | 2.57      |
| Liquid assets to deposits | 33.68  | 76.63   | 6.76    | 15.02     |
| Credit to deposits        | 139.62 | 367.08  | 50.42   | 82.93     |
| Domestic credit           | 72.68  | 201.26  | 15.78   | 47.60     |
| Macroeconomic factors     |        |         |         |           |
| EUR/USD                   | 0.78   | 0.90    | 0.68    | 0.07      |
| Growth                    | 2.60   | 10.43   | -7.36   | 3.18      |
| Inflation                 | 2.61   | 12.35   | -1.54   | 2.61      |
| Unemployment              | 8.33   | 19.07   | 2.89    | 3.17      |
| VIX                       | 18.95  | 60.47   | 3.00    | 12.92     |

Source: Authors' own study.

**Table 2.** Descriptive statistics for euro zone in the EU

|                           | Mean   | Maximum | Minimum | Std. Dev. |
|---------------------------|--------|---------|---------|-----------|
| NPL ~                     | 6.47   | 48.68   | 0.10    | 8.68      |
| Microeconomic factors     |        |         |         |           |
| Capital to total assets   | 7.09   | 14.35   | 2.70    | 2.34      |
| Liquid assets to deposits | 35.15  | 130.60  | 5.26    | 18.55     |
| Credit to deposits        | 121.40 | 257.30  | 17.79   | 41.82     |
| Domestic credit           | 95.29  | 255.20  | 0.19    | 42.65     |
| Macroeconomic factors     |        |         |         |           |
| EUR/USD                   | 0.78   | 0.90    | 0.68    | 0.07      |
| Growth                    | 1.90   | 25.16   | -14.81  | 4.13      |
| Inflation                 | 1.98   | 15.40   | -4.48   | 2.09      |
| Unemployment              | 9.47   | 27.47   | 3.65    | 4.76      |
| VIX                       | 18.95  | 60.47   | 3.00    | 12.89     |

Source: Authors' own study.

The research focuses on identifying the differences in credit risk determinants between the euro area countries and the rest of the EU, therefore, the differences between the average data for these two groups should be checked. The null hypothesis about the equality of means in both groups is tested, which can be written as follows:

$$\begin{cases} H_0: m_1 = m_2 \\ H_1: m_1 \neq m_2 \end{cases}$$

where  $m_1$  and  $m_2$  are the averages for the first and second groups, respectively.

Before testing the equations in means, it was checked whether the data distribution was normal or not. This is necessary in order to select the correct equality test of the means. The results of the Kolmogorov–Smirnov test and Shapiro–Wilk test presented in Table 3 show that the distribution of variables is different than normal.

**Table 3.** Results of Shapiro–Wilk test and Kolmogorov–Smirnov test

|                           | Non-euro zone/Euro zone | Kolmogorov–Smirnov |     |              | Shapiro–Wilk |     |              |
|---------------------------|-------------------------|--------------------|-----|--------------|--------------|-----|--------------|
|                           |                         | Statistics         | Df  | Significance | Statistics   | Df  | Significance |
| NPL                       | 0                       | 0.18               | 112 | 0.00         | 0.90         | 112 | 0.00         |
|                           | 1                       | 0.26               | 252 | 0.00         | 0.65         | 252 | 0.00         |
| Microeconomic factors     |                         |                    |     |              |              |     |              |
| Capital to total assets   | 0                       | 0.13               | 112 | 0.00         | 0.94         | 112 | 0.00         |
|                           | 1                       | 0.08               | 252 | 0.00         | 0.96         | 252 | 0.00         |
| Liquid assets to deposits | 0                       | 0.11               | 112 | 0.00         | 0.96         | 112 | 0.00         |
|                           | 1                       | 0.15               | 252 | 0.00         | 0.92         | 252 | 0.00         |
| Credit to deposits        | 0                       | 0.29               | 112 | 0.00         | 0.76         | 112 | 0.00         |
|                           | 1                       | 0.08               | 252 | 0.00         | 0.97         | 252 | 0.00         |
| Domestic credit           | 0                       | 0.27               | 112 | 0.00         | 0.80         | 112 | 0.00         |
|                           | 1                       | 0.14               | 252 | 0.00         | 0.89         | 252 | 0.00         |
| Macroeconomic factors     |                         |                    |     |              |              |     |              |
| Growth                    | 0                       | 0.10               | 112 | 0.01         | 0.96         | 112 | 0.00         |
|                           | 1                       | 0.13               | 252 | 0.00         | 0.91         | 252 | 0.00         |
| Inflation                 | 0                       | 0.11               | 112 | 0.00         | 0.92         | 112 | 0.00         |
|                           | 1                       | 0.10               | 252 | 0.00         | 0.88         | 252 | 0.00         |
| Unemployment              | 0                       | 0.17               | 112 | 0.00         | 0.90         | 112 | 0.00         |
|                           | 1                       | 0.15               | 252 | 0.00         | 0.86         | 252 | 0.00         |

0 – data for a country without euro in the EU

1 – data for a country with euro in the EU

Source: Authors' own study based on data provided by World Bank database with the usage of SPSS software.

Non-parametric tests should be used to evaluate differences between means. The construction of the non-parametric Mann–Whitney test is as follows:

$$\begin{cases} H_0: F_1(x) = F_2(x) \\ H_1: F_1(x) \neq F_2(x) \end{cases}$$

where  $F_1$  and  $F_2$  is the distribution of variables, respectively  $x_1$  and  $x_2$ .

The results of the Mann–Whitney test are shown in Table 4, where interpretation of the results was indicated. In the last column of Table 4, the word “no” means no statistically significant differences in the mean values of the variables for the euro area countries and other EU countries. The word “yes” indicates statistically significant differences. From the point of view of the conducted analyses, the most important

conclusion is that there are statistically significant differences between the averages for the NPL ratio (credit risk).

**Table 4.** Differences in mean values – non-parametric test results

|                           | Mann–Whitney <i>U</i> test | Wilcoxon – <i>W</i> statistic | Z value | Asymptotic significance (two-sided) | Statistically significant differences in average |
|---------------------------|----------------------------|-------------------------------|---------|-------------------------------------|--|
| NPL                       | 11514.50                   | 43392.50                      | -2.80   | 0.01                                | yes  |
| Microeconomic factors     |                            |                               |         |                                     |  |
| Capital to total assets   | 10386.00                   | 42264.00                      | -4.02   | 0.00                                | yes  |
| Liquid assets to deposits | 13676.00                   | 20004.00                      | -0.47   | 0.64                                | no   |
| Credit to deposits        | 12324.00                   | 18652.00                      | -1.93   | 0.05                                | no   |
| Domestic credit           | 8372.00                    | 14700.00                      | -6.20   | 0.00                                | yes  |
| Macroeconomic factors     |                            |                               |         |                                     |  |
| Growth                    | 11996.00                   | 43874.00                      | -2.28   | 0.02                                | yes  |
| Inflation                 | 12427.00                   | 44305.00                      | -1.82   | 0.07                                | no   |
| Unemployment              | 12583.50                   | 18911.50                      | -1.65   | 0.10                                | yes  |

Source: Authors' own study based on data provided by World Bank database with the usage of SPSS software.

## Results

The variables were examined for the presence of unit roots. The Dickey–Fuller (ADF) test was used. The results for the test are presented in Tables 5 (level) and 6 (first differences).

**Table 5.** Unit Element Test Results – ADF Test (levels)

|                           | Non-euro zone |                 | Euro zone |                 |
|---------------------------|---------------|-----------------|-----------|-----------------|
|                           | statistic     | <i>p</i> -value | statistic | <i>p</i> -value |
| NPL                       | -2.38         | 0.01            | -14.83    | 0.00            |
| Microeconomic factors     |               |                 |           |                 |
| Capital to total assets   | 0.16          | 0.56            | 4.28      | 1.00            |
| Liquid assets to deposits | -3.13         | 0.00            | -2.25     | 0.01            |
| Credit to deposits        | 0.16          | 0.56            | -0.25     | 0.40            |
| Domestic credit           | -3.25         | 0.00            | 0.19      | 0.58            |
| Macroeconomic factors     |               |                 |           |                 |
| EUR/USD                   | 1.66          | 0.95            | -         | -               |
| Growth                    | -2.13         | 0.02            | -6.10     | 0.00            |
| Inflation                 | -0.62         | 0.27            | -2.73     | 0.00            |
| Unemployment              | -2.84         | 0.00            | -3.08     | 0.00            |
| VIX                       | -1.74         | 0.04            | -         | -               |

Source: Authors' own study based on data provided by World Bank database with the usage of GRETL software.

Based on the data from Table 5, there can be indicated the following variables for non-euro zone I (0): NPL, liquid assets to deposits, domestic credit, growth, un-

employment. There also can be indicated the following variables for euro zone I (0): NPL, liquid assets to deposits, growth, inflation and unemployment. Additionally, the VIX variable is also I (0).

**Table 6.** Unit Root Test Results – ADF Test (first differences)

|                           | Non-euro zone |                 | Euro zone |                 |
|---------------------------|---------------|-----------------|-----------|-----------------|
|                           | statistic     | <i>p</i> -value | statistic | <i>p</i> -value |
| NPL                       | -1.01         | 0.16            | -2.33     | 0.01            |
| Microeconomic factors     |               |                 |           |                 |
| Capital to total assets   | -3.56         | 0.00            | -6.26     | 0.00            |
| Liquid assets to deposits | -0.50         | 0.31            | -7.79     | 0.00            |
| Credit to deposits        | -1.30         | 0.10            | -11.02    | 0.00            |
| Domestic credit           | 0.65          | 0.74            | -2.22     | 0.01            |
| Macroeconomic factors     |               |                 |           |                 |
| EUR/USD                   | -3.94         | 0.00            | -         | -               |
| Growth                    | -7.54         | 0.00            | -13.95    | 0.00            |
| Inflation                 | -5.47         | 0.00            | -9.83     | 0.00            |
| Unemployment              | -2.98         | 0.00            | -4.49     | 0.00            |
| VIX                       | -7.76         | 0.00            | -         | -               |

Source: Authors' own study based on data provided by World Bank database with the usage of GRETLL software.

Based on the data from Table 6, there can be indicated the following variables for non-euro zone I (1): capital to total assets, credit to deposits, inflation. Also, there can be indicated the following variables for euro zone I (1): capital to total assets, credit to deposits and domestic credit. Additionally, the exchange rate EUR/USD is also I (1).

On the basis of the ADF test, the following model was built, the results of which are presented in Table 7. The model can be written as follows:

$$NPL_t = 2.302 + 0.818 * NPL_{1,t-1} - 0.154 * \Delta \text{Capital to total assets}_t - 0.047 * \text{Liquid assets to deposits}_t + 0.036 * \Delta \text{Credit to deposits}_t + 0.005 * \text{Domestic credit}_t - 0.213 * \text{Growth}_{t-1} - 0.051 * \Delta \text{Inflation}_{t-1} + 0.062 * \text{Unemployment}_{t-1} + 3.737 * \frac{\Delta \text{EUR}}{\text{USD}}_t + 0.006 * \text{VIX}_t \quad (1)$$

$$NPL_t = 0.828 + 1.123 * NPL_{1,t-1} - 0.377 * \Delta \text{Capital to total assets}_t - 0.012 * \text{Liquid assets to deposits}_t + 0.057 * \Delta \text{Credit to deposits}_t + 0.024 * \Delta \text{Domestic credit}_t - 0.270 * \text{Growth}_{t-1} + 0.604 * \text{Inflation}_{t-1} - 0.073 * \text{Unemployment}_{t-1} + 1.542 * \frac{\Delta \text{EUR}}{\text{USD}}_t + 0.005 * \text{VIX}_t \quad (2)$$

Model 1 applies to EU countries without the euro, and model 2 applies to the EU countries of the euro area. The GMM system (Arellano & Bond, 1991) was used for modeling. Macroeconomic variables have been delayed by one period because their impact on the NPL may be delayed. The correctness of the models was verified by 4 tests: AR (1), AR (2), Sargan test and Wald test. The *p*-values for these tests indicate the models as correct.

**Table 7.** GMM model for non-euro zone and euro zone

|                             | Non-euro zone |                 | Euro zone |                 |
|-----------------------------|---------------|-----------------|-----------|-----------------|
|                             | Model 1       | <i>p</i> -value | Model 2   | <i>p</i> -value |
| NPL (-1)                    | 0.818         | 0.000***        | 1.013     | 0.000***        |
| const                       | 2.302         | 0.000***        | -1.662    | 0.000***        |
| Microeconomic factors       |               |                 |           |                 |
| Δ Capital to total assets   | -0.154        | 0.345           | -0.314    | 0.01***         |
| Liquid assets to deposits   | -0.047        | 0.000***        | -0.005    | 0.435           |
| Δ Credit to deposits        | 0.036         | 0.014**         | 0.063     | 0.000***        |
| Domestic credit             | 0.005         | 0.212           |           |                 |
| Δ Domestic credit           |               |                 | 0.024     | 0.075*          |
| Macroeconomic factors       |               |                 |           |                 |
| Growth (t-1)                | -0.213        | 0.000***        | -0.221    | 0.000***        |
| Δ Inflation (t-1)           | -0.051        | 0.400           |           |                 |
| Inflation (t-1)             |               |                 | 0.513     | 0.000***        |
| Unemployment (t-1)          | 0.062         | 0.219           |           |                 |
| Unemployment                |               |                 | 0.162     | 0.044**         |
| Δ EUR/USD                   | 3.737         | 0.045**         | 1.257     | 0.450           |
| VIX                         | 0.006         | 0.473           | 0.009     | 0.210           |
| Tests                       |               |                 |           |                 |
| AR (1) <i>p</i> -value      | 0.000         |                 | 0.000     |                 |
| AR (2) <i>p</i> -value      | 0.439         |                 | 0.125     |                 |
| Sargan test <i>p</i> -value | 0.000         |                 | 0.000     |                 |
| Wald test <i>p</i> -value   | 0.000         |                 | 0.000     |                 |

NPL – non-performing loans, credit risk measure; Capital to total assets – bank capital to assets ratio (%); Credit to deposits – bank credit to bank deposits (%); Liquid assets to deposits – liquid assets to deposits and short-term funding in bank sector (%); Domestic credit – domestic credit to private sector by banks (% of GDP); EUR/USD – exchange rate EUR/USD; Growth – economic growth; Inflation – consumer prices (annual %); Unemployment – % of total labor force.

Source: Authors' own study based on data provided by World Bank database with the usage of GRETL software. Significance levels for the parameters are given in the table: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Delayed response variable has a statistically significant impact in both cases. For non-euro area countries, significant microeconomic factors of credit risk are: liquid assets to deposits and credit to deposits. Of the macroeconomic variables, only growth turned out to be a significant variable. For euro area countries, significant microeconomic factors of credit risk are: capital to total assets, liquid assets to deposits and credit to deposits. The most important macroeconomic variables include: growth, inflation and unemployment. In both models, the following variables had no statistically significant influence: domestic credit, EUR/USD and VIX.

## Discussions

The aim of this study was to empirically analyze the impact of the euro area on credit risk on the basis of theoretical aspects identified in the literature. The factors influencing credit risk in the euro area and other EU countries were identified by means of the influence of microeconomic and macroeconomic factors.

The influence of the NPL index delayed by one period is statistically significant in both cases and no significant differences were noticed in their scope. The results are similar to those obtained by Klein (2013) or Erdinç and Gurov (2016).

### Microeconomic factors

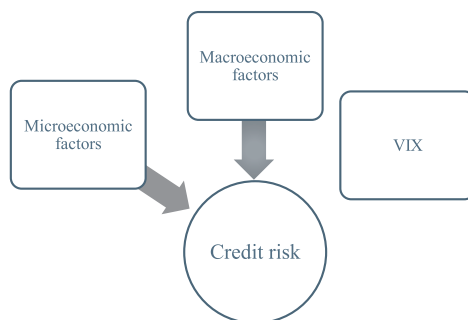
Capital to total assets has a negative impact on credit risk in the case of euro area countries, which confirms the results obtained by Erdinç and Gurov (2016). It is worth noting that the banks of the euro area are less capitalized, and the banks of, for example, emerging European countries have higher capital requirements, which is reflected in the average values of the statistics for the variable capital to total assets (Chiesa & Mansilla-Fernández, 2018). The liquidity ratio of assets to deposits for countries without the euro is negative, and for the euro area countries it does not affect NPL. This is in line with theoretical assumptions, as banks' increased liquidity of assets will result in a decrease in non-performing loans. Banks with high NPL ratios will not be willing to increase their lending (Afonso et al., 2011 or Berger & Bouwman, 2009) and, thus, will not expose themselves to increasing NPLs. The increase in credit to deposits causes an increase in NPL in both analyzed groups of countries. The result is consistent with the studies conducted so far by, e.g. Louzis et al. (2012) or Misra and Dhal (2010). In the case of this indicator, no significant differences in the effect on NPL were found in any of the analyzed groups. This indicator, like liquid assets to deposits, measures the bank's liquidity. In terms of liquidity analysis, the banks of the euro area and other EU countries are similar. The impact of domestic credit turned out to be statistically insignificant for countries outside the euro, and for the euro area countries it has a positive impact on NPLs. This is a confirmation of the results so far.

### Macroeconomic factors

Analyzing the impact of macroeconomic variables it can be seen that the impact of economic growth for the euro zone and the other is almost identical. The negative result of the coefficient in both models (Table 7) is consistent with the results obtained so far (Klein, 2013). The impact of inflation on NPLs is statistically significant only for the euro area countries. This result is due to the fact that euro area countries are required to keep inflation at a certain level. The value of adding the coefficient to the model means that the increase in inflation is not accompanied by an increase in real

wages, and consequently an increase in the inflation rate leads to an increase in the rate of non-performing loans. Similar conclusions can be drawn for the impact of unemployment on NPL. Unemployment has a significant impact on non-performing loans only in the euro area group of countries. The rise in unemployment leads to an increase in non-performing loans, which is consistent with the results and theoretical assumptions to date (Makri et al., 2014). Interesting results were obtained for the influence of the foreign currency exchange rate on NPL. In the case of countries outside the euro, this impact was significant and positive, so an increase in the exchange rate resulted in an increase in NPLs. In the case of euro area countries, it turned out that foreign exchange rates are not relevant to credit risk. Eurozone countries are insensitive to changes in the exchange rate. This is the main advantage of operating in the euro area in terms of credit risk. The impact of the VIX index turned out to be statistically insignificant in both cases. This means that market volatility does not affect the credit risk of EU countries.

The above-mentioned relationships can be illustrated using Figure 2.



**Figure 2.** Credit risk determinants in the EU based on the results of the conducted research

Source: Authors' own study.

In conclusion, in the case of the analysis of microeconomic variables, significant differences in the impact on credit risk were shown. Only one variable did not show any difference in impact. This means that banks similarly manage the liquidity measured by credit to deposits in all EU countries, regardless of membership in the euro area. This means that the research hypothesis H1 has been verified. For macroeconomic variables, significant differences were also identified in the impact of inflation, unemployment and the foreign exchange rate on NPLs of the euro area and other EU countries. It can be indicated that functioning in a common monetary union is conducive to the reduction of credit risk. The H2 hypothesis was thus verified. However, H3 was not verified because the influence of VIX turned out to be statistically insignificant in both cases. Summarizing, it can be indicated that the main hypothesis has been verified.

Operating in the euro area benefits the banking sector of the Member States in the form of a reduced level of non-performing loans. It is influenced by both microeconomic and macroeconomic factors. This means that this positive impact is not only due to the benefits of lower inflation and unemployment, but also of better managed bank capital. The above conclusions from the conducted research indicate the benefits for the banking sector of joining the monetary union of a given country. This is a significant argument for the countries that are currently preparing for this process to join the Eurozone.

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