Analysis of relationship models between the macroeconomic indicators and Non-performing loans in the Commercial banks of Cyprus

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Abstract—The purpose of this paper is to determine and analyze the impact of the macroeconomic indicators on the Level of Non-performing loans (NPLs) in the Commercial banks of Cyprus, as well as to determine the magnitude and nature of relationship between them.

The object of this study shall be the Commercial banks of Cyprus. The paper reviews the impact of the macroeconomic changes on the Level of Non-performing loans in the Commercial banks of Cyprus between 2000 and 2018Q4. The macroeconomic indicators studied include: Gross Domestic Product at market prices - Real GDP (GDP), Unemployment (UNEMP) and Inflation rates- Harmonized Index of Consumer Prices (HICP).

The methodology of the study is based on theoretical and methodological analyses of scientific literature, statistical and econometric methods, as well as on observations, comparative method, description, measurements, analysis, modelling and forecasting. In order to develop the statistical models, representing the relationship between macroeconomic indicators and NPLs in Cyprus, the author is using a Simple linear correlation and such data analysis methods as Coefficient of correlation and Coefficient of determination. For creation of short-term forecast of NPLs in Cyprus between 2019 and 2022, the author has used a Simple linear regression.

The results of this study show that the obtained Linear model of relationship between the UNEMP and NPLs is near perfect. Thus, this linear model is used by the author for the preparation of a short-term forecast. In turn, the Linear model of relationship between the HICP and NPLs is describing mentioned data and the studies confirm that a statistically significant linear dependency exists between UNEMP and HICP and NPLs in Cyprus. In addition, the obtained Linear model of relationship between GDP and NPLs does not describe mentioned data (no linear relationship or weak relationship) and the studies confirm that there is not enough evidence to prove that a statistically significant linear dependency exists between GDP and NPLs in Cyprus.

In general, the author proposes that the people formulating policies in the country should pay special attention to the determinants of NPLs, since the deteriorating conditions of NPLs will affect both individual lenders and their ability to timely repay the loans, and also the banking establishments and the general financial system of Cyprus.

The practical significance of the studies carried out in the scope of the paper is in the fact that the obtained results of the studies may be used as an informative material for the government, business and educational purposes.

Keywords—non-Performing Loans, Commercial Banks, GDP, Unemployment Rate, Inflation Rate, Coefficient of Correlation, Coefficient of Determination

I. INTRODUCTION

The financial sector of Cyprus is still heavily burdened with NPLs, and their reduction remains a priority for the banks management and the supervising authorities. Despite significant reforms, the current level of NPLs is still a serious problem for the financial sector and the real economy.

The International Monetary Fund recommends defining loans and other assets as non-performing when loans are either more than 90 days past due in this regard the 90 day criterion is the most common practice in different countries for determining non-performing loans [1].

Gross NPLs for all banks operating in Cyprus and related to households and non-financial corporations accounts for €22.3 billion or 43.8% of the total loans and 120% of GDP in 2017 [2].

Thus, given the high level of NPLs in Cyprus, it is natural to ask what is the impact of key macroeconomic indicators on the Level of NPLs in Commercial Banks in Cyprus. These questions become particularly pressing as Cyprus emerged from the 2013 banking crisis and is facing a sluggish economic recovery.

The Research Object of the paper is Commercial Banks in Cyprus.

The Research Subject of the paper is the impact of macroeconomic changes on the Level of Non-performing loans in Commercial banks.

The aim of this paper is to determine and analyse the impact of the macroeconomic indicators on the Level of Non-performing loans in the Commercial banks of Cyprus.

To achieve the goal of the paper, the author solved the following research objectives:
1. To study the impact of macroeconomic changes on the Level of Non-performing loans;
2. To justify and analyse the relationship of key macroeconomic indicators and Non-performing loans;
3. To show the current situation with Non-performing loans and to create the forecast of Non-performing loans in Cyprus.

The methodology of the research is based on the theoretical and methodological analysis of the scientific literature, statistical and econometric methods, observations, comparative method, analysis and modelling.

II. METHODS OF RESEARCH

To achieve the aim of this paper, the author used the analysis of scientific publications on macroeconomic indicators affecting the level of NPLs. The author of the paper focuses on the domestic macroeconomic determinants...
of NPL. Domestic macroeconomic conditions establish a link between the business cycle and banking performance, since changes in macroeconomic conditions can directly affect the borrower’s ability to service debt [3].

In particular, it is often found that GDP growth has a negative correlation with NPLs, which reflects the anti-cyclical properties of NPLs [4]. The discovery of slowdown in economic growth associated with higher NPLs, as unemployment rises and borrowers face greater difficulties repaying debt, has become commonplace [5]. Some studies directly include unemployment in their models, and also reveal a strong positive relationship between unemployment and NPL, since higher unemployment reduces the ability of borrowers to service debts [6].

Besides, the effect of higher inflation on NPLs can be both positive or negative: if wages remain low, higher inflation reduces the solvency of borrowers, which can lead to an increase in NPL; otherwise, real debt servicing tends to decrease with higher inflation, which leads to a decrease in NPLs [7].

III. RESULTS

A. Modeling the relationship between GDP and NPLs

To achieve the goal set in the article, the author created an econometric Model Nr1 of a simple linear correlation of GDP and the Level of non-performing loans in Table I.

<table>
<thead>
<tr>
<th>Years</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP (%)</td>
<td>4.0</td>
<td>2.0</td>
<td>2.0</td>
<td>4.2</td>
<td>3.7</td>
<td>4.5</td>
<td>4.8</td>
<td>3.9</td>
<td>-1.8</td>
</tr>
<tr>
<td>NPLs (%)</td>
<td>7.9</td>
<td>9.5</td>
<td>11.3</td>
<td>11.7</td>
<td>7.1</td>
<td>5.4</td>
<td>3.4</td>
<td>3.6</td>
<td>4.5</td>
</tr>
</tbody>
</table>

The results of the Excel computation from the table above show that the Coefficient of Correlation (r) between real GDP and NPLs is equal to -0.356, while the Coefficient of determination (R2) is equal to 0.127 (see Table II, Fig. 1).

B. Modeling the relationship between Unemployment Rate and NPLs

To achieve the goal set in the article, the author created an econometric Model Nr2 of a simple linear correlation of Unemployment Rate and the Level of non-performing loans. The statistical data uses are presented in Table III.

<table>
<thead>
<tr>
<th>Years</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
<th>2028</th>
<th>2029</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment Rate (%)</td>
<td>6.3</td>
<td>7.9</td>
<td>11.8</td>
<td>15.9</td>
<td>16.1</td>
<td>15.3</td>
<td>14.1</td>
<td>11.1</td>
<td>7.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPLs (%)</td>
<td>13.1</td>
<td>17.3</td>
<td>27.3</td>
<td>43.2</td>
<td>47.5</td>
<td>45.3</td>
<td>46.5</td>
<td>43.8</td>
<td>32.01</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results of the Excel computation from the table above show that the Coefficient of Correlation (r) between UNEMP and NPLs is near perfect, as the Coefficient of determination (R2) is equal to 0.880 (see Table IV, Fig. 2).

C. Modeling the relationship between HICP and NPLs

To achieve the goal set in the article, the author create an econometric Model Nr3 of a simple linear correlation of HICP and the Level of non-performing loans. The statistical data uses are presented in Table V.
TABLE V. HICP AND NPLs IN CYPRUS (%), 2001-2018Q4. CREATED BY THE AUTHOR (BASED ON THE SOURCES: STATISTICAL SERVICE OF CYPRUS [16], MOF [17], IMF [18], CBC [19]).

<table>
<thead>
<tr>
<th>Years</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment Rate (%)</td>
<td>1.98</td>
<td>2.79</td>
<td>3.965</td>
<td>1.891</td>
<td>2.043</td>
<td>2.25</td>
<td>2.171</td>
<td>4.385</td>
<td>0.18</td>
</tr>
<tr>
<td>NPLs (%)</td>
<td>7.9</td>
<td>9.5</td>
<td>11.3</td>
<td>11.7</td>
<td>7.1</td>
<td>5.4</td>
<td>3.4</td>
<td>3.6</td>
<td>4.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment Rate (%)</td>
<td>2.56</td>
<td>3.48</td>
<td>3.09</td>
<td>0.39</td>
<td>-0.26</td>
<td>-1.5</td>
<td>-1.2</td>
<td>0.7</td>
<td>1.6</td>
</tr>
<tr>
<td>NPLs (%)</td>
<td>13.3</td>
<td>17.3</td>
<td>27.1</td>
<td>43.2</td>
<td>47.5</td>
<td>45.3</td>
<td>46.4</td>
<td>43.8</td>
<td>32.01</td>
</tr>
</tbody>
</table>

The results of the Excel computation from the table above show that the Coefficient of Correlation (r) between HICP and NPLs is equal to -0.706, while the Coefficient of determination (R²) is equal 0.499 (see Table VI, Fig. 3).

The obtained Linear Model Nr.3 of the relationship between HICP and NPLs in Cyprus is acceptable, as the Coefficient of determination is equal to 49.9 % (0.499). Stronger relationships will allow the author to make more accurate predictions than weaker relationships. The magnitude of the relationship between UNEMP and NPLs is very high and allows the best prediction of NPLs [20].

For the creation of a short-term forecast of NPLs in Cyprus between 2019 and 2022, the author has used a Simple linear regression.

The resulting Excel calculations are presented in the Table VII and in the Fig. 4.

Fig. 3. The relationship between HICP and NPLs in Cyprus, 2000 - 2018Q4. Created by the author, own calculations.

The obtained Linear Model Nr.3 of the relationship between HICP and NPLs is acceptable, as the Coefficient of determination is equal to 49.9 % (0.499).

To render the study even more conclusive, forecasting of data would be essential in trying to determine what will happen to the impact of macroeconomic indicators on NPLs in the future.

The obtained results of the research may be used to forecast future values of NPLs in Cyprus.

Thus, based on the results of the research, the author can conclude that Model 2: Unemployment Rate - NPLs can be used to make a prediction of NPLs, since the Coefficient of Determination is 0.880 (0.880 > 0.7). In other words, 88% of the variance in NPLs is predictable from the Unemployment ratio.

For the creation of a short-term forecast of NPLs in Commercial Banks in Cyprus 2019-2022, the author has used a Simple linear regression.

TABLE VII. THE FORECAST OF NPLS IN COMMERCIAL BANKS IN CYPRUS 2019-2022. CREATED BY THE AUTHOR BASED ON THE SOURCE: IMF [21], OWN CALCULATIONS.

<table>
<thead>
<tr>
<th>Years</th>
<th>UNEMP (%)</th>
<th>Forecast of NPLs (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>8.029</td>
<td>21.172</td>
</tr>
<tr>
<td>2020</td>
<td>7.025</td>
<td>17.612</td>
</tr>
<tr>
<td>2021</td>
<td>6.473</td>
<td>15.649</td>
</tr>
<tr>
<td>2022</td>
<td>6.195</td>
<td>14.663</td>
</tr>
</tbody>
</table>

Fig. 4. The forecast of NPLs in Commercial Banks in Cyprus 2019-2022. Created by the author, own calculations.
IV. CONCLUSION

Based on the research results, it is possible to draw the following conclusions:

1. There is a correlation between GDP and NPLs, since $-1 < -0.356 < 1$;
2. Since the obtained correlation coefficient is a negative number, there is a negative correlation between the GDP and NPLs, namely:
   - As the GDP increases, the level of NPLs decreases;
   - As the GDP decreases, the level of NPLs increases;
3. The magnitude of the correlation between GDP and NPLs is low (near to negligible), since the Chaddock Scale is $-0.5 < -0.356 < -0.3$;
4. 12.7% of NPLs are directly related to GDP (and vice versa), since the determination coefficient ($R^2$) is equal to 0.127;
5. Since in this study $n = 18$, and the degrees of freedom are $16$ ($\text{df} = n - 2$ and $18 - 2 = 16$) and using the table of critical values for the correlation coefficient $\text{df} = 16$ with $\alpha = 0.05$, the author determines that critical values are $\pm 0.468$. Since $r = -0.356$ and $[0.468,0.356]$, the correlation coefficient of GDP and NPLs in Cyprus is not statistically significant. There is no significant relationship between GDP and Non-performing loans in Commercial banks in Cyprus;
6. The linear model between GDP and NPLs does not describe the mentioned data.
7. There is a linear relationship between unemployment rates and NPLs, since $-1 < 0.938 < 1$;
   - Since the obtained correlation coefficient is a positive number, there is a positive relationship between the unemployment rates and NPLs, namely:
     - As the unemployment rate increases, the level of NPLs increases;
     - As the unemployment rate decreases, the level of NPLs decreases;
9. The magnitude of the relationship between unemployment rates and NPLs is high, since the Chaddock Scale is $0.9 < 0.938 < 0.99$;
10. 88.0% of NPLs are directly related to unemployment rates (and vice versa), since the determination coefficient ($R^2$) is equal to 0.880;
11. Since in this study $n = 18$, and the degrees of freedom are $16$ ($\text{df} = n - 2$ and $18 - 2 = 16$) and using the table of critical values for the correlation coefficient $\text{df} = 16$ with $\alpha = 0.05$, the author determines that critical values are $\pm 0.468$. Since $r = 0.938$ and $[0.938,0.468]$, the correlation coefficient of unemployment rates and NPLs in Cyprus is statistically significant. The constructed model is near perfect, since $0.7 < 0.88$ the author used this model to draw up a short-term forecast of the level of NPLs in Cyprus;
12. The forecast made by the author for 2019-2022 shows that the average rate of NPLs in Cyprus will be slowly but continuously decreasing. Thus, the Level of NPLs in Cyprus has a clear downward trend for the next 4 years.

REFERENCES


