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MODELING THE INFLUENCE OF INFLATION ON THE LEVEL OF NON-PERFORMING LOANS IN CYPRUS COMMERCIAL BANKS

Об'єктом даного дослідження є комерційні банки Кіпру. В роботі розглядався вплив макроекономічних змін, зокрема інфляції, на рівень непрацюючих кредитів в комерційних банках. Досліджувалися макроекономічні показники включають показники інфляції. Методологія дослідження спирається на теоретичний і методологічний аналіз наукової літератури, статистичний і економетричний методи, а також спостереження, порівняльний метод, опис, вимірювання, аналіз і моделювання. Для розробки статистичної моделі, що представляє взаємозв'язок показників інфляції та неповернутих кредитів на Кіпрі автор використовує просту лінійну кореляцію і такі методи аналізу даних, як коефіцієнт кореляції і коефіцієнт детермінації.

Результати даного дослідження показують, що отримана економетрична модель є прийнятною, так як коефіцієнт детермінації дорівнює 0,504, а показники інфляції є визначальними для рівня непрацюючих кредитів. Це пов'язано з тим, що коефіцієнт кореляції між даними змінними дорівнює $-0,710$, і за шкалою Чеддока магнітуда зв'язку є високою. Крім того, коефіцієнт кореляції показників інфляції та неповернутих кредитів на Кіпрі є статистично значущим, так як значення коефіцієнта кореляції знаходиться за межами показників критичних значень, рівних $|0,468|$. Також з результатів дослідження було встановлено, що в разі Кіпру показники інфляції негативно пов'язані з безповоротними кредитами, так як отриманий коефіцієнт кореляції – негативне число. Отримана модель не використовується для складання короткострокового прогнозу, в силу недостатнього значення коефіцієнта детермінації (50,4 %). В цілому пропонується, щоб особи, що визначають політику, приділяли значну увагу детермінантам непрацюючих кредитів, так як умови непрацюючих кредитів, що погіршуються, будуть впливати не тільки на банківські установи, а й на загальний стан фінансової системи Кіпру. Практична значимість досліджень, наведених в роботі, полягає в тому, що результати досліджень можуть бути використані в якості довідкового матеріалу для бізнесу, уряду та освіти.

Ключові слова: стан фінансової системи Кіпру, безповоротні кредити, комерційні банки, лінійна кореляція.

1. Introduction

Over the past decade, the global banking system has been hit hard by the economic downturn. It is known that a high percentage of non-performing loans in banks in both developed and developing countries are often associated with financial crises [1]. The global financial crisis has made the problem of non-performing loans again relevant. Non-performing loans create risks of financial instability and restrain credit growth in the economy. With the onset of the financial crisis, the distribution of non-performing loans among EU member states was very uneven. The countries affected by the crisis suffer from a significant increase in the rates of non-performing loans, which is a serious problem for the economies of these countries. Thus, by the end of June 2018, in three EU member states, the level of non-performing loans still exceeded 10 %: Greece – 44.8 %, Cyprus – 34.1 %, and Portugal – 12.4 % [2]. Thus, given the high level of non-performing loans in Cyprus, the question arises as to how key macroeconomic indicators, in particular inflation indicators, affect the level of non-performing loans in commercial banks in Cyprus. These issues become particularly relevant as Cyprus emerges from the 2013 banking crisis and is facing slow economic recovery. Based on the above, the relevance of the investigated issue is due to the fact that the current level of non-performing loans is still very high and creates the risk

of financial instability in Cyprus. Therefore, *the object of this research* is commercial banks in Cyprus. And *the aim of research* is determination of the inflation effect on the level of non-performing loans in commercial banks in Cyprus. This will help policy makers and banking institutions in monitoring whether certain macroeconomic indicators, such as inflation rates, affect the ability of borrowers to fulfill or not fulfill their obligations to the bank.

2. Methods of research

To achieve this aim, let's use the analysis of scientific publications on macroeconomic indicators, in particular, on inflation indicators affecting the level of non-performing loans. So, despite the surge in research efforts to model credit risk and default risk over the past decade, few studies take into account the effect of macroeconomic factors on business defaults [3]. A number of studies are devoted to the fact that the effect of inflation indicators on the level of non-performing loans can be ambiguous, since it can be both negative and positive [4–6]. There is also an opinion that higher inflation could increase the solvency of borrowers, reducing the real value of their outstanding debt and, theoretically, for constant nominal interest rates, inflation should reduce the real cost of debt. And, therefore, facilitate debt servicing, which, in turn, will lead to a reduction in non-performing loans [7]. In addition,

there are studies that confirm that inflation is negatively associated with non-performing loans [8]. And there are also studies that find support for a positive relationship between non-performing loans and inflation [9–11]. Moreover, researchers observe a positive relationship between non-performing loans and inflation rates in the countries of Central and Eastern Europe, as well as in the state on the northeast coast of South America and in the state in northern Africa [12–14]. In addition, there are studies that show that the relationship between inflation rates and non-performing loans is insignificant [15–17].

Consequently, according to the literature review, the relationship between inflation rates and non-performing loans can be significant and insignificant, as well as positive and negative. For better data comparability, the International Monetary Fund recommends classifying loans and other assets as non-performing when payments representing the principal amount of a loan payment and interest are overdue by 90 days or more. The 90 day criterion is the most common practice in different countries for determining non-performing loans [18]. In turn, consumer price inflation in the Eurozone is measured by the Harmonized Index of Consumer Prices (HICP), which measures the change over time in the prices of consumer goods and services purchased, used or paid for by households in the Eurozone [19].

To achieve this aim, the method of correlation analysis is also used, which is used by the author to develop a model of the influence of inflation indicators on the level of non-performing loans. Correlation is used when a researcher links two or more variables to see if they affect each other [20, 21]. The degree of relationship is expressed by the correlation coefficient. To calculate the correlation coefficient, the author uses one of the formulas presented in the materials on econometrics [22]. The correlation coefficient obtained as a result of calculations is interpreted by the author [23], as well as a qualitative assessment based on the Chaddock scale [24]. In addition, the determination coefficient is calculated [23] and the critical values of the correlation coefficient are determined using the table of critical values for the correlation coefficient [25].

3. Research results and discussion

To accomplish this aim, the author builds an econometric model of a simple linear correlation of inflation rates and the level of non-performing loans. For what uses the statistical data presented in Table 1.

Table 1
Indicators of inflation and non-performing loans
in Cyprus (%), 2000–2017

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Inflation (%)	4.86	1.98	2.79	3.97	1.89	2.04	2.25	2.17	4.39
Non-performing loans (%)	8.5	7.9	9.5	11.3	11.7	7.1	5.4	3.4	3.6
Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Inflation (%)	0.18	2.56	3.48	3.09	0.39	-0.3	-1.5	-1.2	0.7
Non-performing loans (%)	4.5	13.3	17.3	27.1	43.2	47.5	45.3	46.4	43.8

Note: compiled by the author based on data from the Ministry of Finance of Cyprus [26], the International Monetary Fund [27] and the Central Bank of Cyprus [28]

The results of the calculations obtained in Excel from the data in the above table show that the correlation coefficient (r) of the inflation and non-performing loans is -0.710 and the determination coefficient (r^2) is 0.504 (Table 2, Fig. 1).

Table 2

Results and interpretation of the obtained model calculations

Correlation coefficient	r	-0.710	$-0.9 < -0.710 < -0.7$
Determination coefficient	r^2	0.504	$0.504 < 0.7$
Critical values	-	± 0.468	$ 0.710 > 0.468 $

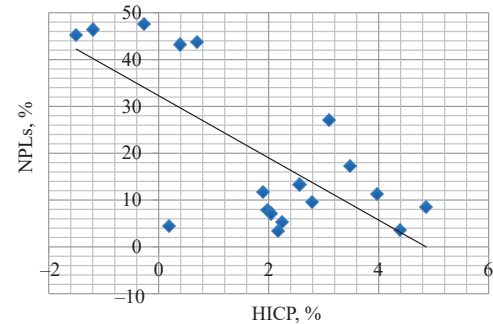


Fig. 1. The relationship between inflation rates (HICP) and non-performing loans (NPLs) in Cyprus, 2000–2017

The model obtained as a result of calculations is acceptable, since the determination coefficient is slightly more than 50 % (0.504).

4. Conclusions

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

- 1) there is a linear relationship between inflation rates and non-performing loans, since $-1 < -0.710 < 1$;
- 2) since the obtained correlation coefficient is a negative number, there is a negative relationship between the inflation indicators and non-performing loans, namely:
 - as the inflation rate increases, the level of non-performing loans decreases;
 - as the inflation rate decreases, the level of non-performing loans increases;
- 3) the magnitude of the relationship between inflation rates and non-performing loans is high, since the Chaddock Scale is $-0.9 < -0.710 < -0.7$;
- 4) 50.4 % of non-performing loans are directly related to inflation rates (and vice versa), since the determination coefficient (r^2) is equal to 0.504 . Since the constructed model is acceptable, but $0.504 < 0.7$, the author does not use this model to draw up a short-term forecast of the level of non-performing loans in Cyprus;
- 5) since in this study $n=18$, and the degrees of freedom are 16 ($df=n-2$ and $18-2=16$) and using the table of critical values for the correlation coefficient $df=16$ with $\alpha=0.05$, the author determines that critical values are ± 0.468 . Since $r=-0.710$ and $|0.710| > |0.468|$, the correlation coefficient of inflation rates and non-performing loans in Cyprus is statistically significant.

The results obtained in this paper provide various opportunities for further research. Most banks quarterly store data on non-performing loans in their unpublished

databases, and, if obtaining such data for research aims is possible, collecting and researching such data will contribute to more accurate results.

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