

## Пример статьи-отчета по экономическим наукам

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

**Ptasica T.**

### **МОДЕЛИРОВАНИЕ ВЛИЯНИЯ ИНФЛЯЦИИ НА УРОВЕНЬ НЕВОЗВРАТНЫХ КРЕДИТОВ В КОММЕРЧЕСКИХ БАНКАХ КИПРА**

**Пташиц Т.**

### **МОДЕЛЮВАННЯ ВПЛИВУ ІНФЛЯЦІЇ НА РІВЕНЬ НЕПОВОРІТНИХ КРЕДИТІВ В КОМЕРЦІЙНИХ БАНКАХ КІПРУ**

**Пташиц Т.**

*Объектом данного исследования являются коммерческие банки Кипра. В работе рассматривалось влияние макроэкономических изменений, в частности инфляции, на уровень неработающих кредитов в коммерческих банках. Исследуемые макроэкономические показатели включают показатели инфляции. Методология исследования опирается на теоретический и методологический анализ научной литературы, статистический и эконометрический методы, а также наблюдение, сравнительный метод, описание, измерение, анализ и моделирование. Для разработки статистической модели, представляющей взаимосвязь показателей инфляции и невозвратных кредитов на Кипре автор использует простую линейную корреляцию и такие методы анализа данных, как коэффициент корреляции и коэффициент детерминации.*

*Результаты данного исследования показывают, что полученная эконометрическая модель является приемлемой, так как коэффициент детерминации равен 0,504, а показатели инфляции являются определяющими для уровня неработающих кредитов. Это связано с тем, что коэффициент корреляции между данными переменными равен  $-0,7$ , и по Шкале Чеддока магнитуда связи является высокой. Кроме того, коэффициент корреляции показателей инфляции и невозвратных кредитов на Кипре является статистически значимым, так как значение коэффициента корреляции находится за пределами показателей критических значений, равных  $|0,468|$ . Также из результатов исследования было установлено, что в случае Кипра показатели инфляции отрицательно связаны с невозвратными кредитами, так как полученный коэффициент корреляции – отрицательное число. Полученная модель не используется для составления краткосрочного прогноза, в силу*

недостаточного значения коэффициента детерминации (50,4%). В целом предлагается, чтобы лица, определяющие политику, уделяли значительное внимание детерминантам неработающих кредитов, так как ухудшающиеся условия неработающих кредитов будут влиять не только на банковские учреждения, но и на общее состояние финансовой системы Кипра. Практическая значимость исследований, приведенных в работе, заключается в том, что результаты исследований могут быть использованы в качестве справочного материала для бизнеса, правительства и образования.

**Ключевые слова:** состояние финансовой системы Кипра, невозвратные кредиты, коммерческие банки, линейная корреляция.

Об'єктом даного дослідження є комерційні банки Кіпру. В роботі розглядався вплив макроекономічних змін, зокрема інфляції, на рівень непрацюючих кредитів в комерційних банках. Досліджувані 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  $-0,7$ , 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 детерминантам 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	2009	2010	2011	2012	2013	2014	2015	2016	2017
Inflation (%)	4.86	1.98	2.79	3.97	1.89	2.04	2.25	2.17	4.39	0.18	2.56	3.48	3.09	0.39	-0.3	-1.5	-1.2	0.7
Non-performing loans (%)	8.5	7.9	9.5	11.3	11.7	7.1	5.4	3.4	3.6	4.5	13.3	17.3	27.1	43.2	47.5	45.3	46.4	43.8

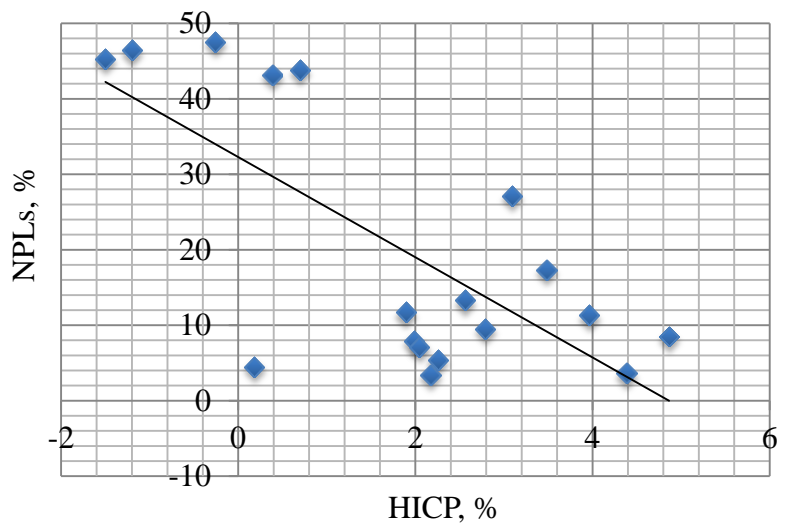
**Note:** compiled by the author based on data from the Ministry of Finance of Cyprus [26], the International Monetary Fund [27] and the Central Bank of Cyprus [28]

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	$-$	$\pm 0.468$	$ 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  $\pm 0,468$ . 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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*The object of this research is the commercial banks of Cyprus. The paper examines the impact of macroeconomic changes, in particular inflation, on the level of non-performing loans in commercial banks. The macroeconomic indicators studied include inflation rates. The research methodology is based on theoretical and methodological analysis of the scientific literature, statistical and econometric methods, as well as observation, comparative method, description, measurement, analysis and modeling. To develop a statistical model that represents the relationship between inflation rates and non-performing loans in Cyprus, the author uses simple linear correlation and data analysis methods such as the correlation coefficient and the determination coefficient.*

*The research results show that the resulting econometric model is acceptable, since the determination coefficient is equal to 0.504, and inflation indicators are decisive for the level of non-performing loans. This is due to the fact that the correlation coefficient between these variables is  $-0.710$ , and according to the Chaddock scale the coupling magnitude is high. In addition, the correlation coefficient of inflation and non-performing loans in Cyprus is statistically significant, since the value of the correlation coefficient is beyond the limits of critical values of  $|0,468|$ . Also from the research results it is found that in the case of Cyprus, inflation rates are negatively associated with non-performing loans, since the resulting correlation coefficient is a negative number. The resulting model is not used to compile a short-term forecast, due to the insufficient value of the determination coefficient (50.4 %). In general, it is proposed that policy makers devote considerable attention to the determinants of non-performing loans, as the deteriorating conditions of non-performing loans will affect not only banking institutions, but also the general state of the financial system of Cyprus. The practical significance of the research cited in the work lies in the fact that the research results can be used as reference material for business, government and education.*

**Keywords:** *state of the financial system of Cyprus, non-performing loans, commercial banks, linear correlation.*

## **Ptasica Tatjana**

Postgraduate Student

Baltic International Academy,

4, Lomonosova str., Riga, Latvia, LV1019

e-mail: [tatjana.ptc@inbox.lv](mailto:tatjana.ptc@inbox.lv)

Phone: +37(0XX) XXX-XX-XX

Number of publications in national editions – 3

Number of publications in foreign indexed publications – 1

Hirsch Index – 0

ORCID: <https://orcid.org/0000-0002-6771-3449>

**Пташиц Татьяна**

Аспирант

Балтийская международная академия,  
ул. Ломоносова, 4, Латвия, Рига, LV1019

e-mail: [tatjana.ptc@inbox.lv](mailto:tatjana.ptc@inbox.lv)

Контактный телефон: +37(0XX) XXX-XX-XX

Количество публикаций в национальных изданиях – 3

Количество публикаций в иностранных индексируемых изданиях – 1

Индекс Хирша – 0

ORCID: <https://orcid.org/0000-0002-6771-3449>

**Пташиц Тетяна**

Аспірант

Балтійська міжнародна академія,  
вул. Ломоносова, 4, Латвія, Рига, LV1019

e-mail: [tatjana.ptc@inbox.lv](mailto:tatjana.ptc@inbox.lv)

Контактний телефон: +37(0XX) XXX-XX-XX

Кількість публікацій в національних виданнях – 3

Кількість публікацій в іноземних індексованих виданнях – 1

Індекс Хірша – 0

ORCID: <https://orcid.org/0000-0002-6771-3449>