

Unemployment as a Determinant of Credit Risk

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Abstract: This paper is based on the premise that credit risk has a significant impact on banking activity and is influenced by a number of determinants. The paper discusses possible determinants of credit risk with a focus on unemployment. The aim of the paper is to assess the long-term relationship between credit risk and unemployment. In this study, relationship between credit risk and unemployment was analyzed in a bank-based economy, represented by the Czech Republic, for the 2002-2022 period. Credit risk was represented by non-performing loans to household and non-financial corporations. The relationship is examined using the Engle-Granger cointegration test on monthly data. Based on the analysis, the increase in the unemployment rate was found to have an increasing impact on non-performing loans to households and non-financial corporations. Cointegration among the given variables was confirmed.

Keywords: banking; credit risk; non-performing loans; macroeconomic determinant; unemployment; cointegration

JEL Classification: G21; J64; C22

1. Introduction

Banks play a crucial role on financial markets as financial intermediaries, which ensure the flow of free financial resources between individual economic entities. In particular, by providing loans, they influence consumption and investment, which can support the economy. The banking sector is therefore an important component of economic development, especially in countries whose financial systems are classified as bank-based and where banks have a significant position, as is the case in the Czech Republic. Like other businesses, banks generate profits. A stable, profitable and efficient banking system is necessary to finance both private and public investments and expenses, especially in times of economic fluctuations.

By the core of their activities, banks are exposed to a range of financial risks. The materialization of any financial risks can affect bank profitability. The disruption of the stability of the banking sector can lead to a stagnation of the transfer of free financial resources from surplus units to deficit units, which can result in a slowdown in economic development. For this reason, it is necessary to pay attention to factors that can affect the stability of the banking sector. Since credit activities are one of the main activities of the banking sector, the most significant risk is credit risk. Credit risk represents the risk of financial losses for banks in cases where their counterparties do not meet their obligations on

time due to inability to pay. The materialization of credit risk can be the beginning of a banking system crisis (Castro, 2013; Reinhart & Rogoff, 2010).

The issue of increasing credit risk is currently relevant, especially in connection with the ongoing consequences of the Covid-19 pandemic and further in connection with geopolitical changes in the world. In the context of changing market conditions, it is possible that a number of entities will not be able to meet their previous commitments due to the restriction of economic activity and the related restriction of business operations and layoffs of employees. Unemployment has consequences not only for individuals, but also for society and its economy, where one of the potential areas affected is credit risk. Therefore, the aim of the paper is to assess the existence of a relationship between credit risk and unemployment. The paper will discuss possible determinants of credit risk with a focus on unemployment, assess the long-term relationship between credit risk and unemployment, and based on the results, formulate recommendations to eliminate the impact of unemployment on credit risk.

One way to quantify credit risk is through non-performing loans (Ahmad & Ariff, 2007; Castro, 2013; Foglia, 2022; Chaibi & Ftiti, 2015; Khan et al., 2018; Naili & Lahrichi, 2022; Nikolopoulos & Tsalas, 2017). The rate of non-performing loans can affect the profitability of banks.

There are a number of determinants of credit risk. These can influence credit risk both positively and negatively. Generally, these factors can be divided into two categories (Ahmad & Ariff, 2007; Anastasiou & Louri, 2016; Chaibi & Ftiti, 2015; Khan et al., 2018; Louzis et al., 2012; Messai & Jouini, 2013; Naili & Lahrichi, 2022; Nikolopoulos & Tsalas, 2017; Salas & Saurina, 2002; Swamy, 2012).

The first category is internal factors. These are factors specific to the bank. These are internal factors that may arise from the decisions of the bank's management and their political goals. The relationship between bank-specific characteristics and non-performing loans and efficiency indicators was first studied by Berger and DeYoung (1997). Using four hypotheses, namely "bad luck", "bad management", "skimping" and "moral hazard", they formulate possible mechanisms for the relationship between internal factors and loan performance. By examining a sample of US banks from 1985 to 1994, it was concluded that cost efficiency may be an indicator of the future development of problematic loans. Podpiera and Weill (2008) built on this work. They extended the model to include the generalized method of moments (GMM), which they applied to a sample of Czech banks from 1994 to 2005. Their results also confirm that an increase in non-performing loans precedes a deterioration in cost efficiency.

The analysis of bank-specific factors has also been studied by Ahmad and Ariff (2007). They present a comparative study of factors affecting credit risk in the period 1996-2002 in developed and developing economies. They consider the efficiency of management, loan losses, the loan-to-deposit ratio, leverage, regulatory capital, financing costs, liquidity, spreads, and total assets to be determinants of credit risk specific to the bank. They find that for banks with a dominance of lending in developing economies, the quality of management is crucial, while for banks offering a range of products, regulatory capital is essential. The

influence of two to four factors significantly determines credit risk in both developing and developed economies.

The second category is external factors. These are external factors that reflect the business environment in which the bank is operating. This category includes macroeconomic factors, which are beyond the control of the bank's management. These factors can also affect the credit risk and profitability of the bank. This category includes GDP, inflation, interest rates and unemployment (Berge & Boye, 2007; Castro, 2013; Chaibi & Ftiti, 2015; Khan et al., 2018; Naili & Lahrichi, 2022; Nkusu, 2011; Petrovski et al., 2018; Rinaldi & Sanchis-Arellano, 2006; Škarica, 2014). In addition, we can include in this category domestic credit, which has a positive impact on non-performing loans reflecting lower credit quality during increase in credit, and public debt with a negative effect due to the sample selected in the study (Foglia, 2022). Khan et al. (2018) also included tax rate, whereby their results indicate positive relation between the tax rate and non-performing loans ratio with lesser ability of the borrowers to repay their loans at higher level of tax rate. A rising GDP implies an economic recovery. With rising incomes, the financial situation of debtors improves, as does their payment ability. The trend of non-performing loans is therefore decreasing. On the other hand, in a recession, GDP decreases. A declining payment ability of debtors is accompanied by an increasing trend in the development of non-performing loans (Beck et al., 2015; Foglia, 2022; Chaibi & Ftiti, 2015; Petrovski et al., 2018). With increasing inflation, the real value of unpaid loans decreases and the real incomes are also devalued. If there is no increase in real incomes, the economic entities' costs will rise and their available financial resources for loan repayment will decrease, which will increase non-performing loans (Nkusu, 2011; Škarica, 2014). Interest rates have a direct impact on non-performing loans, with a positive relationship expected. As interest rates increase, the debt burden of subjects increases, leading to an increasing trend in non-performing loans (Berge & Boye, 2007; Castro, 2013; Chaibi & Ftiti, 2015; Nkusu, 2011; Rinaldi & Sanchis-Arellano, 2006). An increase in the unemployment rate reduces the consumers' ability to repay. Therefore, they will not be able to meet their loan repayment obligations, which will result in an increase in non-performing loans. Similarly, an increase in unemployment weakens the position of companies due to a decrease in demand for products and services, which affects their financial situation and ability to repay their debts. The relationship between unemployment and non-performing loans is therefore expected to be positive (Berge & Boye, 2007; Castro, 2013; Foglia, 2022; Chaibi & Ftiti, 2015; Khan et al., 2018; Nkusu, 2011; Rinaldi & Sanchis-Arellano, 2006).

The aim of this paper is to assess the impact of the unemployment rate on credit risk in the Czech Republic over the past 20 years, from 2002 to 2022.

Unemployment in the Czech Republic has fluctuated from 2002 to 2022 depending on economic conditions and other non-economic factors. Initially, there was a decreasing trend in unemployment in connection with economic growth and increasing demand for workers from companies. However, the financial crisis led to an increase in unemployment due to the deteriorating economic situation worldwide and a decrease in demand for workers. Subsequently, unemployment gradually decreased again as the Czech economy recovered. The Covid-19 pandemic also affected the development of unemployment, causing further growth due to the limitation of economic activity and layoffs of workers.

2. Methodology

The data in the article are from the Czech National Bank's ARAD Time Series System (Czech National Bank, 2022). The data are monthly for the time period of January 2002 to October 2022. For the analysis is credit risk represented by non-performing loans (NPLs) as it was in many reviewed studies (Ahmad & Ariff, 2007; Castro, 2013; Chaibi & Ftiti, 2015; Nikolopoulos & Tsalas, 2017). We selected non-performing loans to households (*NPL_hh*) and non-performing loans to non-financial corporations (*NPL_nc*). Both time series are expressed in relative terms as the ratio of NPLs to total loans. Unemployment (*unemploy*) is expressed as the gross unemployment rate in percentages. A total of 250 observations from the Czech Republic are used for the analysis. All of the time series are log-transformed, which leads to their stabilization.

An econometric analysis is conducted to establish the relationship between unemployment and non-performing loans. The method used is the Engle-Granger cointegration test for time series analysis. This method is used to determine the long-term cointegration between non-performing loans and one of its macroeconomic determinants, i.e. selected types of non-performing loans (*NPL_hh* and *NPL_nc*) and the unemployment rate (*unemploy*). The relationships of economic time series and their interdependence are examined using vector autoregressive models, which are used for testing cointegration and forecasting (Hušek, 2007). The use of this method is appropriate because it prevents spurious regression, which can be caused by common long-term trends in economic time series.

First, it is necessary to select an appropriate model and an optimal length of delay. This is done based on an information criterion that compares the residuals of models with different lengths of delay (Artl & Artlová, 2007). The Akaike information criterion is used. The Akaike information criterion can be expressed by the formula (Akaike, 1981):

$$AIC = n \cdot \ln (RSS/n) + 2k \quad (1)$$

where *RSS* is the residual sum of squares, *RSS/n* is the residual variance, *k* is the number of parameters, and *n* is the number of measurements.

The next step is testing the stationarity of the variables. Stationarity of the variables is a prerequisite for using the vector autoregressive model, as non-stationary economic time series may exhibit common long-term trends that can lead to spurious regression (Hušek, 2009). A time series is stationary if the characteristics of its random variables do not change over time (Artl & Artlová, 2007). The conditions for stationarity can be written as follows: (Artl & Artlová, 2007):

The mean value function:

$$\mu_t = E(X_t) \quad (2)$$

The variance function:

$$\sigma_t = D(X_t) = E(X_t - \mu_t)^2 \quad (3)$$

The covariance function:

$$(t, t - k) = E(X_t - \mu_t)(X_{t-k} - \mu_{t-k}) \quad (4)$$

The correlation function:

$$\rho(t, t - k) = \gamma(t, t - k) / \mu_t \sigma_{t-k} \quad (5)$$

where X_t is the dependent variable, $E(X_t)$ is the mean, and $D(X_t)$ is the variance.

Stationarity is verified by the unit root test. In the presence of a unit root in the VAR model, it is non-stationary. Using the Augmented Dickey-Fuller test (ADF test), the presence of a unit root is examined. The hypotheses are formulated as follows (Dickey & Fuller, 1979):

- H_0 : a unit root is present in the time series,
- H_1 : a unit root is not present in the time series.

The resulting p-value of the given analysis is compared with the significance level α , which is set at 0.05. If the p-value is greater than α , H_0 is not rejected. Then a unit root is present in the time series, and the time series is non-stationary. In such a case, by converting to first or second difference, the stationarity of the time series is achieved (Hušek, 2009).

In the next step, the time series' cointegration is tested. Variables are considered cointegrated if they report interdependence. Variables are considered long-run dependent if they do not diverge in the long run and if their economic relationship can be explained (Artl & Artlová, 2007). The system may under certain limits, due to shocks, show some deviations from the direction in which it is moving, but then it will return to the long-term dominant level.

Cointegration is tested using the Engle-Granger cointegration test. The Engle-Granger test works on the basis of a unit root test and the estimation of cointegration regression residuals. The EG test works with stationary variables. The hypotheses are formulated as follows (Engle & Granger, 1987):

- H_0 : the time series are not cointegrated,
- H_1 : the time series are cointegrated.

The resulting p-value of the given analysis is compared with the significance level α , which is set at 0.05. If the p-value is higher than α , we do not reject H_0 , the time series are not cointegrated, and there is no long-term dependence. When testing cointegration, the following formula is assumed (Artl & Artlová, 2007):

$$\Delta X_t = (\phi_1 - 1)X_{t-1} + \sum ai \Delta X_{t-1} + e_t \quad (6)$$

where X_t is the dependent variable, e_t is the residual, and p is the lag.

3. Results

The subject of analysis is to test the relationship between non-performing loans of households and non-performing loans of non-financial corporations and the unemployment rate in the Czech Republic using monthly data from January 2002 to October 2022. All of the time series are log-transformed, which leads to their stabilization. The level of significance α is set at 0.05. The calculations are carried out in the Gretl software. As part of the analysis, tests for optimal lag lengths, stationarity tests and verification of cointegration of time series, and possibly Granger causality tests will be performed.

The first step of the analysis is to determine the optimal lag length of the VAR model variables. This is done based on the results of the Akaike Information Criterion (AIC). The maximum lag length considered is 12 months. The optimal lag length is chosen according to the minimized AIC value. The test type with a constant or with a constant and trend is chosen. The resulting optimal lag orders and test type are used in the following analysis steps. The optimal lag length results and the chosen test types are presented in the Table 1.

Table 1. Optimal lag length results

Time Series	min AIC	Lag Lengths	Test
<i>NPL_hh and unemploy</i>	-4.002429*	7	with a constant
<i>NPL_nc and unemploy</i>	-4.115005*	9	with a constant

The next step is to verify the stationarity of the time series through the extended Dickey-Fuller test (ADF test). The null hypothesis H_0 : a unit root is present in the time series is tested. In the presence of a unit root in the VAR model, it is non-stationary. Based on the previous results, the test with a constant is selected. Stationarity is a prerequisite for further analysis, so non-stationary time series are made stationary by converting to differences. The logarithmic time series used as input (labeled $I_$ before the variable) were non-stationary. Stationarity was achieved by converting to the first difference (labeled by $d_$ before the variable). Results are presented in the Table 2.

Table 2. ADF stationarity test results

Variables	p-value	H_0	Stationarity
<i>I_NPL_hh</i>	0.9250	not rejected	non-stationary
<i>d_I_NPL_hh</i>	0.0005122	rejected	stationary
<i>I_NPL_nc</i>	0.1991	not rejected	non-stationary
<i>d_I_NPL_nc</i>	0.01284	rejected	stationary
<i>I_unemploy</i>	0.8734	not rejected	non-stationary
<i>d_I_unemploy</i>	0.0000001847	rejected	stationary

The interdependence of pairs of time series is tested by Engle-Granger cointegration test. If their residuals are non-stationary, the time series are not cointegrated. The following table shows the results of the EG cointegration test for the pairs of time series *NPL_hh* and *unemploy*, and *NPL_nc* and *unemploy*. We consider the unemployment rate (*unemploy*) as the independent variable and non-performing loans (*NPL_hh* and *NPL_nc*) as the dependent variables. The results are in the Table 3. The optimal lag length and test type setting from the previous results are shown. The null hypothesis H_0 : the time series are not cointegrated at the significance level α (0.05) is tested.

Table 3. Engle-Granger Cointegration Test Results

Time Series	Lag	Test	p-value	H_0	Relationship
<i>NPL_hh and unemploy</i>	7	with a constant	6.29×10^{-78}	rejected	<i>cointegration</i>
<i>NPL_nc and unemploy</i>	9	with a constant	5.99×10^{-46}	rejected	<i>cointegration</i>

Based on the Engle-Granger cointegration tests, long-run relationships were discovered between the non-performing loans to household and non-performing loans to non-financial

corporations and unemployment rate. Calculated p-values were below the α significance level set at 0.05; therefore, the null hypotheses on the time series' non-integration were rejected.

4. Discussion

Banks are exposed to a range of financial risks due to the nature of their activities. Given the centrality of lending activity in the banking sector, credit risk is one of the most significant of these risks. Credit risk was quantified through non-performing loans, as in Ahmad and Ariff (2007), Castro (2013), Chaibi and Ftiti (2015), and Nikolopoulos and Tsalas (2017).

Credit risk has a number of determinants. These can be divided into internal and external factors (Ahmad & Ariff, 2007; Anastasiou & Louri, 2016; Chaibi & Ftiti, 2015; Louzis et al., 2012; Messai & Jouini, 2013; Nikolopoulos & Tsalas, 2017; Salas & Saurina, 2002; Swamy, 2012). External factors include macroeconomic factors, such as unemployment. Unemployment affects individuals as well as society and the economy as a whole. In the context of the ongoing impacts of the Covid-19 pandemic, which has led to reduced economic activity and business closures and layoffs, and current geopolitical changes, unemployment is a factor that can cause the materialization of credit risk.

The aim of this article was to assess the impact of unemployment on credit risk in the Czech Republic over the past 20 years, from 2002 to 2022. The variables were represented by non-performing loans of households, non-performing loans of non-financial corporations, and the unemployment rate.

The results of our econometric analysis suggest that there is a long-term dependence between the development of household non-performing loans and the unemployment rate, and the development of non-performing loans of non-financial corporations and the unemployment rate. This was confirmed by the Engle-Granger cointegration test. Our results are consistent with the studies of other authors (Berge & Boye, 2007; Castro, 2013; Chaibi & Ftiti, 2015; Nkusu, 2011; Rinaldi & Sanchis-Arellano, 2006).

This confirmed the expectation that unemployment affects the performance of the loan portfolio. Unemployment can reduce the ability of an economic entity to repay its loans, leading to an increase in non-performing loans. Unemployment also weakens the position of non-financial corporations, as aggregate demand for goods and services declines, worsening their financial situation and ability to meet their obligations. The impact of unemployment on the credit portfolio may depend on various factors, such as the length of unemployment benefits in a given country.

Banks could eliminate the negative impact of unemployment by adapting loan conditions for entities in financial distress, such as allowing for the postponement of payments, reducing payments, increasing the number of payments, or allowing for a longer repayment period. Diversifying the credit portfolio with a focus on providing loans to applicants from different sectors and different geographic areas may also reduce the impact of unemployment in a particular sector or geographic area. Banks should also be cautious in providing loans to applicants from sectors that are more susceptible to unemployment. Our calculations show that governments, in implementing fiscal policy

and central banks, in implementing monetary policy, must consider unemployment as a significant determinant of credit risk in financial markets. The government's active employment policy can therefore influence the profitability and stability of the banking market and, in turn, financial intermediation.

Further research can focus on other macroeconomic factors that may somehow affect credit risk, or research can be expanded to a sample of more countries.

5. Conclusions

This article discusses the possible determinants of credit risk, focusing on the impact of unemployment. The aim of the article is to assess the existence of a relationship between credit risk and unemployment. Based on an econometric analysis using the Engle-Granger cointegration test, a long-term relationship between the unemployment rate and the rate of non-performing loans of households and non-financial corporations, which represent credit risk, was confirmed in the Czech Republic in the years 2002 to 2022. Financial market participants must consider unemployment as a significant determinant of credit risk. Banks can eliminate the negative impact of the unemployment rate on the quality of the credit portfolio by adjusting credit conditions to their clients, while the government can contribute through active employment policy. Unemployment is not the only determinant of credit risk, so future research must also focus on other factors. Extending the analysis to more countries is appropriate.

Acknowledgments: This research was supported by the University of Pardubice - grant No. SGS_2022_017.

Conflict of interest: none

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