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Review Article

ASSESSING RISK FACTORS AFFECTING BANKING SYSTEM CREDIT PORTFOLIO RETURNS IN IRAN USING AGENT-BASED MODELS APPROACH

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Abstract
Agent-based models were introduced into the investment literature by Sharpe in the 1960s with the design of the single-index model and then expanded with the design of multi-index models. From this perspective, the macroeconomic affects ROI through two categories including general and specific risk factors. The present study tested the impact of the variance of changes in the risk factors affecting Iran's banking system credit portfolio returns based on the same approach over the period 2004–2018 using the OLS technique. According to the results of this test, among the general and specific risk factors, the variance of changes in GDP growth rate, oil revenues, real interest rate, and NPL ratio had a direct relationship with the growth rate of the banking system credit portfolio returns and the inflation rate had an inverse relationship with it. Besides, the results indicated that all risk factors affected the banking system's credit portfolio returns after a lag period.

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INTRODUCTION

According to some financial experts, investment is involving money or other resources in the present, hoping to gain future benefits (Bodie et al., 2012). One of the fundamental problems with such an approach to investment is that any type of investment may face uncertainties under certain circumstances, which may jeopardize ROI in the future. The factors that may contribute to this problem may vary depending on the type of industry and the factors that affect it. In the banking industry, the allocation of investment resources to economic activity through loans and bank credit is part of the investment activity of banks, whose returns are influenced by macroeconomic variables such as GDP fluctuations, oil revenue fluctuations, inflation growth rates, and interest rate changes, and may be associated with many uncertainties. Studies by Trenca et al. (2005) showed that disregarding macroeconomic uncertainties can have a major impact on the banking system and ultimately lead to bank failures and economic crises.

Despite widespread changes in the nature of bank profits, in some countries, about 80% of bank profits are still derived from traditional sources such as lending and earning interest (Barry & Laurie, 2010). Furthermore, in Iran, the share of interest income from total bank profits is over 85% (Mehrara & Sadeghian, 2008). Under these circumstances, assessing the risk factors affecting the ROI of banks to find a suitable model for the optimal management of the credit portfolio of the banking system can be of great importance.

Despite banks' long history of lending, there is still no consensus on lending strategies. In the current banking literature, there are two main theories about loan portfolio strategies: traditional banking theory and corporate finance theory. Traditional banking theory holds that banks should diversify their credit portfolios by lending to different economic sectors to reduce their risk. In contrast, corporate finance theory states that banks should become comparatively advantageous in certain sectors by focusing their activities on them. In so doing, banks expand their ability to provide better services in those sectors as well as reducing bank risks in areas such as accurate collateral valuation and inappropriate customer selection for lending (Lydia et al., 2010). Moreover, Andersen & Burger (1969) believed that banks form their loan portfolios based on two approaches: the matching principle and the profit maximization principle. According to the matching principle, banks make up their loan portfolios based on the demand. Conversely, based on the profit maximization principle, banks form their loan portfolios so that they maximize the profit based on the rate of return and the risk.

Basically, banks have four categories of non-bank financial activities in addition to lending activities: (1) securities activities, (2) insurance activities, (3) real estate activities, (4) ownership and shareholding of nonfinancial companies (Mazaheri et al., 2018). Banks invest less in these activities and mainly invest on resources in lending to various economic sectors. Therefore, their future benefits are influenced by the risk factors and their returns are accompanied by uncertainty.

Given the importance of the subject, and in line with previous studies, the question arised as to how the risk factors affecting the activities of firms are related to the credit portfolio returns of the banking system, and how do credit portfolio returns affect the banking system? Agent-based models are an approach in the investment literature that discusses the relationship between risk and return in terms of risk factors affecting ROI. Thus, the present study sought to investigate and analyze the risk factors affecting the country's credit portfolio return of the banking system using the criteria of this model, and to assist the banking system in the

optimal management of the credit portfolio, using the obtained results.

This article was organized into five sections. Section II provided the theoretical foundations and background of the research. Section III presented the research methodology. Section IV provided data analysis. Finally, section V presented the results of the research.

A REVIEW OF THEORETICAL FOUNDATIONS AND PREVIOUS STUDIES

Theoretical Foundations

William Forsyth Sharpe introduced agent-based models in 1961 by explaining beta as the risk. Agent-based models are formed based on a new definition of risk factors and are divided into two categories: the single-index model and the multi-index model (Raei and Pouyan Far, 2013).

The single-index model assumes that the two types of events cause changes in ROI over two consecutive periods. The first type is called a macro event, examples of which are unexpected changes in the inflation rate, changes in the interest rate by the central bank, or changes in the base interest rate. These events change the market portfolio rate of return and cause the rate of return on each share of investment to change, with a severe impact on the market. The second event that changes the returns of a share (stock) in a single-index model, are inherently micro-events that can affect a company. However, this effect is not generalizable and does not apply to all companies, such as the production of a new product, strike, fire, and death or the resignation of the CEO (Hagen, 1993).

Multi-index models provide a better explanation of ROI. These models offer an easy way to measure various macroeconomic risks and build risk-free investment portfolios. The multi-index model equation is an extended form of the single-index model, described as Eq. 1 (Bodie, Kane & Markus, 2012):

$$R_i = E(r_i) + \beta_{i1}F_1 + \beta_{i2}F_2 + \cdots + \beta_{in}F_n + e_I \quad (1)$$

Ri = Return on investment portfolio at a given time
E (Ri) = Risk-free rate of return
βi = sensitivity coefficient
Fi = Risk factors
ei = Error terms

The strength of the application of agent-based models lies in the portfolio risk assessment. To estimate the total portfolio risk (overall risk of the portfolio), the estimated residual variance must be added to the estimated systematic risk. If the residuals are assumed to be unrelated, and none of the risk factors is interdependent (for example, inflation and unexpected growth rates in industrial products), portfolio variance can be expressed as Eq. 2 (Hagen, 1394):

$$\sigma^2(r_p) = \beta_{i,p}^2\sigma^2(i) + \beta_{g,p}^2\sigma^2(g) + \sigma^2(\varepsilon_p) \quad (2)$$

Equation 2 can be expressed as follows:

Residual variance + systematic risk (variance of industrial product variation) + systematic risk (variance of changes in inflation) = total variance

Previous studies

There have been numerous studies on the factors affecting the performance of banks within the country; however, few studies have been conducted on the risk factors affecting the banking system's credit portfolio return. Therefore, the present study can be of particular importance along with previous studies. In domestic studies, in a study entitled "Analysis of Factors Affecting the Profitability of Commercial Banks", Bagheri (2006) examined the determining factors affecting the profitability of Refah Kargaran Bank during the period 1983-2001, using a linear regression model. According to his research findings, among the internal factors affecting the banking system, cost management, liabilities management, loans, and controllable assets had a positive and significant relationship with bank profitability. On the other hand, among the external factors, the economic growth rate had a positive and significant relationship with bank profitability and the inflation rate had a significant and negative relationship with it.

In a study entitled "Factors Affecting Bank Profitability", Mehrabanpour et al. (2017) examined factors affecting bank profitability. Their research sample consisted of 15 banks over a 10-year period from 2005 to 2014; a linear regression model was used to estimate the relationships between variables. According to the research of these researchers, the factors affecting bank profitability were divided into two main groups: the first group included criteria specific to each bank and the second group included factors related to industry structure and macroeconomic environment. The results showed that there was a positive relationship between asset structure, income diversification, economic growth, inflation, and bank profitability; in contrast, there was a negative relationship between capital, financial structure, size, bank competition, interest rate, and bank profitability.

In an article entitled "The Impact of Macroeconomic Risks on Credit Risk in the Credit Portfolio of the Serbian Banking System", Dragiša (2015) tested the impact of banking system loans to households and companies on the credit portfolio return of the Serbian banking system, using the panel database for the period 2008-2012. According to his research, deteriorating business cycles and lower exchange rates have led to a deterioration in the quality of banks' credit portfolio over that period. Furthermore, household loans are sensitive to short-term interest rates, which have reduced the quality of the bank credit portfolio. His findings also showed that further development of primary and secondary securities markets helped in reducing the risks.

Elisa & Guido (2016) conducted a study on 35 top European banks to investigate the relationship between specific characteristics of banks and their profitability to find out the role of bank internal factors in achieving high profitability. They examined a set of bank internal variables, using regression analysis on data collected from banks over the period 2009-2013. According to their research findings, bank size and capital ratio were two important determinants of European bank profitability. Moreover, higher deposits and higher loan-to-asset ratios were positively correlated with bank profitability; however, their effects were not statistically significant.

Eric & Baimba (2013) examined the factors affecting bank lending in Sierra Leone, using data from 13 commercial banks over a ten-year period (2002–2011) using a fixed-effects model. They showed that mere risk, the share of non-performing loans (NPLs) (overdue claims), capital ratio and level of deposits had a positive and significant effect on lending to the private sector; on the other hand, bank size had a significant negative impact on it. In addition, GDP and type of bank were among important determinants of loan contribution in Sierra Leone's credit portfolio.

In a study, Filip et al. (2018) examined the impact of banking, industry-specific, and macroeconomic factors on bank profitability indices in Croatia, including ROA and RNIM. They tested independent variables such as asset size, loan portfolios, GDP growth, risk, and administrative expenses on ROA and the gross profit margin ratio of banks as dependent variables, using

the DOLS technique and data from selected Croatian banks over the period 2007–2014. The results of their research proved the positive and significant impact of asset size (economic scale) and GDP growth and the negative impact of risk and administrative expenses on bank profitability.

In a study, Salih Katırcıoglu et al. (2018) examined the long-run equilibrium relationship between the banking sector's profitability and its internal and external factors, including inflation growth rate and oil price growth rate in Turkey. In this study, the researchers used the ARDL model to test the effects of oil price changes on bank profitability. The results of this study showed that changes in oil prices had a significant impact on the profitability of the Turkish banking sector through inflation channels. Furthermore, the causality test results showed that there was a one-way relationship between oil prices to inflation and from inflation to profitability in the banking sector in Turkey.

RESEARCH METHODOLOGY

This was descriptive-correlational research and part of applied research in terms of purpose-based categorization because it aimed to apply the results in the country's banking system. The statistical population of this research included the total amount of loans (loans) paid to public and non-governmental sectors by the country's banking system. Among them, only the portion of the facility whose return had been recorded in the bank balance sheet in the account of income and earnings of the years to come (future earnings), was selected as the sample. The reason for choosing this sample for research was that the account of bank income and earning of the years to come could draw a correct picture of the credit portfolio return of banks and was a good representative of bank returns (performance). The spatial scope of the research included all banks and credit institutions within the country, the information of all of which have been collected and given to the central bank.

The time-domain of the research was from the beginning of 2004 to the beginning of 2018. Fifty-seven time-series data have been analyzed seasonally. This time period had several features that distinguish it from other periods. First, during this time period, the emergence of private banks in the country's banking industry and their competition with state-owned banks has affected the banking system's credit portfolio more than any other periods. Second, other markets, including housing, stock exchange, currency, gold, and coins, etc., have experienced large fluctuations during this time period. Banks have either invested in these markets themselves or their equity and allocation operations have been affected by the volatility of these markets. Third, the country's liquidity has grown unprecedentedly during this time period (Rezaei, 2017); it is undeniable that the credit portfolio of the country's banking system has been affected by this. Fourth, detailed information was available on all the selected variables of the study over the given time period.

The theoretical model of the research was the multi-index model which used the variance of (variation in) risk factors as a criterion for risk and its relationship with portfolio return to explain the relationship between risk and return on the investment portfolio. The operating model of the research was the ordinary least squares (OLS) method, which was intended to estimate model parameters because of its desirable properties in minimizing the sum of squares of disturbance terms and fitting the best data regression line. Eviews software was used to analyze the data.

Research variables and their relationships

The dependent variable

The dependent variable of the research was the rate of return of the credit portfolio of the country's banking system, which was calculated based on the loans that banks invest each year in different economic sectors. The return on the facility was recorded in the account of income and earnings of the years to come and was manifested in the financial statements of banks and credit institutions. Statistics and figures related to this variable were available in the Statistics and Data section of the Central Bank of the Islamic Republic of Iran - Economic Statistics Excerpt - Major Monetary and Credit Figures.

Independent variables

With the help of theoretical foundations and research background, four of the most influential variables on the investment return of all companies were used as general risk factors and one variable as the specific risk factor in this study. These variables were:

1. GDP fluctuations: In most studies and the theoretical foundations of agent-based models, GDP has been identified as one of the risk factors influencing return on investment (ROI). To obtain the value of this variable, statistics and figures on changes in GDP without oil were extracted from the Central Bank of the Islamic Republic of Iran website - economic indicators - at constant prices and seasonally and then their variances were calculated, and considered as an explanatory variable.

2. Oil Revenue Fluctuations: Energy and especially oil affect all industries and ROI as well. Moreover, the results of some research indicated that the occurrence of oil revenue shocks could lead to increased production, consumption, investment and employment (Hosseinzadeh et al., 2017). In this study, oil value-added changes were extracted from the Central Bank of Iran website - economic indicators - seasonally and then their variances were calculated and considered as one of the independent variables in the operating model of the research.

3. Inflation Rate Fluctuations: In addition to the theoretical foundations of agent-based models, in approximately most studies, inflation has been introduced as one of the factors affecting firm returns and profitability (Lotf Alipour et al., 1977). In this study, inflation rate changes were extracted from the Central Bank of Iran website - economic indicators - seasonally, and then their variances were calculated and considered as an independent variable.

4. Interest Rate Fluctuations: In this study, the real interest rate variance was used as an independent variable. The interest rate on the declared bank deposits was considered as the nominal interest rate. Then, the real interest rate was calculated using the Fisher equation and was considered as an independent variable in the operating model of the research after determining the variance. Deposits` interest rate figures were extracted from the Central Bank of the Islamic Republic of Iran website - economic indicators.

5. In the banking industry, overdue (past due) claims and doubtful debts (accounts) are examples of specific risk factors known as non-performing loans. In this study, the variance of changes in nonperforming loans to total gross loans ratio was used as an independent variable. Statistics and figures for this variable were extracted from the Central Bank of the Islamic Republic of Iran website - economic indicators, and then their variance was calculated.

Hypotheses

H1: There is a direct relationship between GDP fluctuations and the return on the credit portfolio of the country's banking system.
H2: Oil revenue fluctuations have a negative impact on the country's banking system credit portfolio returns.

H3: There is a direct relationship between inflation rate fluctuations and credit portfolio returns of the country's banking system.
H4: There is a direct relationship between interest rate fluctuations and credit portfolio returns of the country's banking system.
H5: There is an inverse relationship between fluctuations in nonperforming loans to total gross loans ratio and the return on the credit portfolio of the country's banking system.
H6: All risk factors have a significant relationship with a lag period with the credit portfolio returns of the banking system.

Model structure and its components

Based on the theories of the subject and the empirical studies on risk factors affecting bank returns, the empirical research model based on Eqs. 3 and 4 are presented as follows:

$$LR_{i,t} = f(LF1, LF2, LF3, LF4, LF5) \quad (3)$$

All variables are logarithmic; according to Eq. 4, the coefficients of parameters (β) are estimated to investigate and analyze the first to fifth hypotheses:

$$LR_{i,t} = c + \beta_1 L\sigma^2 F_1 + \beta_2 L\sigma^2 F_2 + \beta_3 L\sigma^2 F_3 + \beta_4 L\sigma^2 F_4 + \beta_5 L\sigma^2 F_5 + e_{i,t} \quad (4)$$

LR_{it}= Logarithm of the growth rate of the credit portfolio of the country's banking system
$L\sigma^2 F_1$= Logarithm of the variance of changes in GDP without oil
$L\sigma^2 F_2$= Logarithm of the variance of changes in oil revenue
$L\sigma^2 F_3$= Logarithm of the variance in the inflation rate
$L\sigma^2 F_4$= Logarithm of the variance in real interest rate
$L\sigma^2 F_5$= Logarithm of the variance in the ratio of nonperforming loans to total loans
β_t= Estimated coefficients of risk factors
$e_{i,t}$= Error term

Furthermore, to test the sixth hypothesis, Eq. 5 was used as follows:

$$LR_{i,t} = c + \beta_1 L\sigma^2 F_1(-1) + \beta_2 L\sigma^2 F_2(-1) + \beta_3 L\sigma^2 F_3(-1) + \beta_4 L\sigma^2 F_4(-1) + \beta_5 L\sigma^2 F_5(-1) + e_{it} \quad (5)$$

DATA ANALYSIS

Descriptive statistics of research variables

To achieve the objectives of this research, the statistical data collected from the banks were used seasonally from 2004-05-21 to 2018-06-21. Table 1 provides a statistical summary of the survey data.

Table 1. Statistical Properties of the Survey Data

Variable	The variable symbol in the model	Amount of data	Min	Max	Mean	SD	Median	Skewness	Kurtosis
Changes in Banks' Income and Profit for the Next Years (R)	LRET	57	0.3	35.4	22.89	9.48	24.1	0.9	2.3
Variance of changes in GDP (F1)	LF1	57	0.4	1.76	0.23	0.31	0.1	0.52	1.96
Variance of changes in oil revenue (F2)	LF2	57	0.01	100.5	7.15	18.62	0.44	0.26	1.77
Variance of changes in inflation rate (F3)	LF3	57	0.029	9.35	1.08	1.9	1.08	1.23	1.13
Variance of changes in interest rate (F4)	LF4	57	0.01	6.07	0.66	1.19	0.3	0.19	1.84
Variance of changes in nonperforming loans to total gross loans ratio (F5)	LF5	57	0.0011	17.96	1.31	2.87	0.23	0.11	2.16

Reviewing specific tests and topics

Unit root test

Econometric models are always based on the assumption of time series variables. The use of non-stationary data can lead to false regressions (Surrey, 2012). To ensure that time-series do not have a unit root and no false regression is produced, a unit root test was performed for all of the research variables. The augmented Dickey-Fuller (ADF) method and the Schwarz criterion were used to perform this test. Initial test results indicated that all variables rejected the H0 hypothesis of having a unit root, and were stationary. Table 2 reflects the results of this test for the level of variables

Table 2. Augmented Dickey-Fuller test for the level of variables

Variable	Variable description	Optimal lag	ADF-statistic	McKinnon values		
				1%	5%	10%
Lret	Returns logarithm	1	-3.12	-3.56	-2.91	-2.59
LF1	Logarithm of production fluctuations	1	-4.47	-3.55	-2.91	-2.59
LF2	Logarithm of oil revenue fluctuations	1	-4.1	-3.55	-2.91	-2.59
LF3	Logarithm of inflation rate fluctuations	1	-3.82	-3.55	-2.91	-2.59
LF4	Logarithm of interest rate fluctuations	1	-4.68	-3.55	-2.91	-2.59
LF5	NPL ratio logarithm	1	-5.32	-3.55	-2.91	-2.59

Heteroscedasticity test

The White test was used to detect heteroscedasticity. According to the White test, the H0 hypothesis of heteroscedasticity was confirmed if the probability statistic for F and chi-square values was less than 5%. Table 3 presents the results of this test. As can be seen, the F value was 1.36 and the corresponding probability coefficient was 0.20, and the chi-square coefficient was 24.59 and the corresponding probability was 0.21, indicating that this model had no heteroscedasticity.

Table 3. Results of the White's test for heteroscedasticity

F-statistic	1.365742	Prob .F(20 and 36)	0.2030
Obs*R-squared	24.59054	Prob. Chi-Square(20)	0.2175
Scaled explained SS	17.09329	Prob .Chi-Square(20)	0.6469

Source: Researcher Findings

Coefficient stability test

There are several tests to check the stability of the coefficients of variables, the most popular of which are the Chow Breakpoint Test, the CUSUM Test, and the Virtual Variables Test (Surrey, 2012). In this study, CUSUM was used to test the stability of the coefficients; the results have been presented in Figure 1.

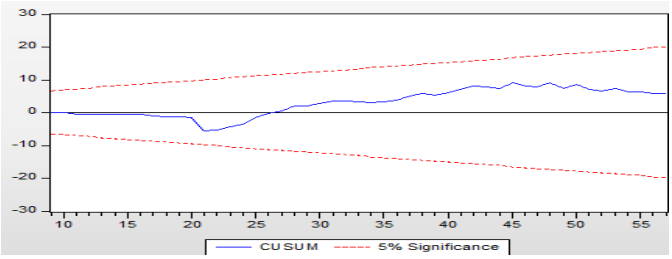

Figure 1. CUSUM over the course of the research period

Source: Researcher Findings

According to the results in Figure 1, none of the cumulative errors was out of boundaries, so this test showed no structural change.

Regression residual normality test

The normality of the regression residual terms has been investigated using the Jarque-Bera test. The probability statistic above 0.05 for Jarque-Bera showed that the regression residual was normal. Table 4 presents the test results.

Table 4. Results of regression error term`s normality

Statistic	Mean	SD	Skewness	Kurtosis	Jarque-Bera	Prob.
Regression error terms	-2.39	4.73	0.47	3.2	2.97	0.33

Source: Researcher Findings

According to the results presented in Table 4, the probability statistic for Jarque-Bera was higher than 0.05 and 0.33. Therefore, the regression error terms had a normal distribution.

Multicollinearity test

The variance inflation factor (VIF) was used to identify the multicollinearity. Based on the econometric analysis, the model had multicollinearity if the VIF was greater than 10. Table 5 shows the VIF value for each of the explanatory variables

.

Table 5. Estimation of the VIF of explanatory variables

Variable	CV	VIF
LF_1	0.005090	2.97
LF_2	0.001985	1.23
LF_3	0.011176	5.023
LF_4	0.015935	1.69
LF_5	0.003370	1.63

Source: Researcher Findings

According to the results in Table 5, the VIF was less than 10 for all explanatory variables; hence, the model had no multicollinearity.

Pattern estimation

Table 6 presents the results of the model estimation.

Table 6. Results of estimation of model parameter coefficients

Predictor variables	β	Std.Error	t-statistic	p-value
Constant coefficient (c)	2.24	0.57	3.88	0.0003
GDP Fluctuations (F1)	0.034	0.038	0.91	0.36
Oil revenue fluctuations (F2)	0.038	0.023	1.62	0.10
Inflation Rate Fluctuations (F3)	-0.415	0.21	-1.95	0.05
Interest rate fluctuations (F4)	0.149	0.076	1.93	0.05
Nonperforming loans (F5)	0.022	0.034	0.63	0.52
	F=19.81	Prob F=0.00000	DW=1.95	R-squared =0.70 Adjusted R-squared=0.67

Source: Researcher Findings

According to the results of the estimation presented in Table 6, the estimated pattern (model) can be explained by Eq. 5:

$$R_{it}=2.24+0.034F1+0.038F2-0.41F3+0.14F4+0.022F5+e_i \quad (5)$$

Research findings and results of hypothesis testing

1. The coefficient of determination (R^2) of 0.70 and the adjusted coefficient of determination of 0.67 indicated that the selected explanatory variables could largely explain the variations of the dependent variable in accordance with agent-based models.

2. Based on the results of the estimated model, the coefficient for the Fisher F statistic was 19.81 and the probability statistic less than 1% (Prob F = 0.000), showed that the regression equation could explain the Y changes well, so the regression was significant.

3. The Durbin-Watson statistic value was 1.95, which was close to 2. According to econometric analysis, the closer the value of the Durbin-Watson statistic was to 2, the assumption of autocorrelation between disturbance terms was firmly rejected.

4. The results of the model estimation for testing the first hypothesis confirmed this hypothesis. The coefficient for this variable (F1) was 0.034 and had a positive sign. Therefore, the H1

assumption of a direct relationship between GDP growth rate fluctuations and the banking system credit portfolio returns growth rate was confirmed and the H0 assumption was rejected.

5. The results of the model estimation for testing the second hypothesis showed that this hypothesis was rejected. The results of the regression fit showed that the "coefficient of oil revenue fluctuations" (F2) variable was 0.038. The positive sign of the coefficient indicated a positive linear relationship between the two variables. Therefore, the H1 assumption of the negative impact of oil revenue fluctuations on the banking system credit portfolio returns was rejected and the H0 assumption was confirmed.

6. The results of the model estimation for testing the third hypothesis regarding a direct relationship between inflation rate fluctuations and the return on the credit portfolio of the banking system suggested that this hypothesis was rejected. The coefficient of the variable of inflation rate fluctuations (F3) was -0.41. The negative sign indicated an inverse relationship between the two variables. Moreover, a corresponding probability statistic (p-value) of 0.05 indicated that this relationship was significant, as well. Therefore, the H1 assumption of a direct relationship between inflation rate fluctuations and the rate of return growth in the credit portfolio of the banking system was rejected and the H0 hypothesis was confirmed.

7. The model estimation results for testing the fourth hypothesis confirmed this hypothesis. The coefficient of "interest rate fluctuations" (F4) variable was 0.149 with a positive sign, and the probability statistic corresponding to this variable with a value of 0.05 indicated that the obtained coefficient was significant. Therefore, the H1 assumption of a direct relationship between interest rate fluctuations and the return on the credit portfolio of the banking system was confirmed and the H0 assumption was rejected.

8. The model estimation results for the fifth hypothesis test showed that this hypothesis was rejected. The coefficient of the variable of NPL ratio fluctuations (F5) was 0.022. The positive sign of the variable indicated a direct relationship between two variables. Therefore, the H1 assumption of an inverse relationship between NPL ratio fluctuations and banking system credit portfolio returns was rejected and the H0 assertion was confirmed.

9. The estimation results for the sixth hypothesis test confirmed the hypothesis. Table 7 presents the estimated coefficients for the explanatory variables and their p-values, taking into account a time lag. The probability statistic of the GDP fluctuation coefficient was 0.08, which was significant at the 90% confidence level. In addition, it was less than 0.05 for other risk factors, which was significant at the 95% confidence level. Thus, the H1 hypothesis that all risk factors have a significant relationship with the bank credit portfolio returns after a period of time, was confirmed and the H0 hypothesis was rejected.

Table 7. Results of estimation of model parameter coefficients for time lags of risk factors

Predictor variables	β	Std.Error	t-statistic	p-value
Constant coefficient (c)	2.62	0.5	5.17	0.000
GDP fluctuations in the previous period (F1)	0.053	0.03	1.74	0.08
Oil revenue fluctuations (F2)	0.092	0.01	4.78	0.000
Inflation growth rate fluctuations (F3)	-0.47	0.17	-2.64	0.01
Interest rate growth fluctuations (F4)	0.12	0.06	2.03	0.04
NPL ratio (F5)	-0.07	0.02	-2.84	0.006
	F=33.07	Prob F=0.00000	DW=1.70	R-squared =0.80 Adjusted R-squared=0.77

Source: Researcher Findings

CONCLUSIONS AND SUGGESTIONS

This study aimed to evaluate how risk factors affect the credit portfolio return of the banking system by adopting an agent-based model approach. Bank profits and future earnings were selected as the dependent variable and the five variables related to risk factors (i.e., four variables, GDP fluctuations, oil revenue fluctuations, inflation rate, and interest rate fluctuations, from general risk factors, and one variable, fluctuations in nonperforming loans to total gross loans, from specific risk factors) were independent variables. By designing and testing six hypotheses, it was attempted to answer the question: "What is the relationship between the risk factors affecting the business activities and the banking system credit portfolio returns and how do they affect the banking system credit portfolio return?". According to the research results:

1. GDP fluctuations were directly related to the growth rate of the credit portfolio returns of the banking system. Components of GDP include private sector expenses, private sector investment cost, public sector expenses, exports, and more. An examination of the components of GDP showed which component of GDP fluctuations are strongly fluctuating, and investment decisions can be made based on it. It can be argued that individuals' ability to repay their debts increased with an increase in GDP, leading as well to an improvement in the economic situation and consequently a decrease in the bank credit risk and an increase in bank returns. This result was in line with the studies by Filip et al. (2018) in Croatia.

2. Oil revenue fluctuations had a direct relationship with the return on the credit portfolio of the banking system. It can be argued that part of the oil revenue has been invested in various sectors of the economy, through foreign exchange reserve accounts and the National Development Fund through banks (granting loans) over the research period, which has had a positive impact on bank credit portfolio returns. This result was also in line with studies by Saleh Katırcıoglu et al. (2018) in Turkey.

3. Inflation rate fluctuations were inversely and significantly correlated with credit portfolio returns. It is commonly argued that lenders are always at a loss and borrowers benefit from inflation as a result of currency depreciation; this result was in line with studies by Bagheri (2006) in Iran and Dragiša (2015) in Serbia.
4. Interest rate fluctuations had a direct and significant relationship with the return of the credit portfolio of the banking system. It can be argued that bank resources are strengthened and their ability to lend to various economic sectors increases with an increase in the interest rate on deposits, thereby improving the growth of bank credit portfolio returns. Hence, the obtained result was quite consistent with the behavior of banks in the real world.
5. Nonperforming loans to total gross loans ratio were directly related to the return on the credit portfolio of the banking system. Banks usually receive the collateral (late installment payment penalty) as the loan is overdue; therefore, part of the return on the bank lending operations is related to the collection of overdue claims on the principal and interest on the loan plus the collateral received from the customer. It can be argued that the more banks collect overdue claims, the greater their credit portfolio returns. This result was in line with studies by Eric & Baimba (2013).
6. Regarding how the risk factors affect the banking system credit portfolio returns, it can be stated with certainty that all the risk factors mentioned in this study affected the banking system credit portfolio returns after a lag period.

Based on the findings of this study, it is recommended to the decision-makers and policymakers of the banking sector, especially credit activists to:
1. Determine that severe fluctuations are related to which component of GDP when paying for loans by examining the components of GDP. After identifying the impact of GDP fluctuations, they should start lending and investing in different economic sectors. For example, if there are severe fluctuations in private-sector expenses, one can find out how well a particular good or service is consumed by knowing it and how much growth will there be in the future? If consumption is low, economic growth will be more limited, and investments may fail in the short term. If consumption is high, it will be a good opportunity to provide loans and invest.
2. A portion of the oil proceeds shall be made available to the applicant banks as resources of the National Development Fund for investment in various economic sectors (through the provision of loans). Banks are advised to make optimal use of these resources to increase their credit portfolio returns.
3. Economic crises and changing business conditions usually cause borrowers to have problems in repaying their loans, leading to overdue loans. Banks are advised to give special powers to executors so that they can collect claims in the shortest possible time, taking into account economic conditions and customer interaction.
4. Given the lagged response of bank credit returns to risk factors, it is recommended that banks adjust their credit policies in light of changes in risk factors in previous periods.
5. Given the negative impact of inflation on credit portfolio returns, it is recommended that banks invest part of their resources in other activities to offset their losses amid severe inflationary fluctuations.
6. Given the direct impact of interest rates on credit portfolio returns, banks are advised to equip resources by adjusting deposit plans with attractive interest rates.

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