An Empirical Analysis of Credit Risk Factors
of the Slovenian Banking System

Boštjan Aver

The study presents the results of an analysis of credit risk factors of the Slovenian banking system. The objective of the empirical analysis is to establish which macroeconomic factors influence the systematic credit risk of the Slovenian banking loan portfolio. The research results have confirmed the main hypothesis that certain macroeconomic factors have a major influence on the examined credit risk. We could conclude that the credit risk of the loan portfolio depends on the employment or unemployment rate in Slovenia, on short and long-term interest rates of Slovenian banks and the Bank of Slovenia, and on the value of the Slovenian stock exchange index. We cannot claim that the examined credit risk depends on the inflation rate in Slovenia, the growth of GDP (industrial production), EUR and USD exchange rates or the growth of Slovenian import and export.

Key Words: Slovenian banking system, credit risk factors,
     loan portfolio, Bank of Slovenia, macroeconomic factors
JEL *Classification:* G11, G21

Introduction

Empirical studies on credit risk factors have shown that the factors that influence risk in all sorts of investments and cause credit risk are mainly *different macroeconomic factors* (Saunders 1997; Crouhy, Galai, and Mark 2000). Changes in economic policies, political changes and the goals of leading political parties also influence the range of the investment credit risk (Saunders 1997; Belkin, Suchower, and Forest 1998). Since these factors are difficult to examine, there is no point in including them in 'the research model'. Our objective is therefore to establish which macroeconomic factors influence the systematic credit risk of the Slovenian banking system.

Foreign researchers, such as Saunders (1997), Asarnow (1996), Crouhy, Galai, and Mark (2000), Carty and Lieberman (1996), as well as Carty and Fons (1993), have determined that the range of the credit risk of an individual investment (e. g. loan) is influenced by risk factors, which can

Dr Boštjan Aver is President of the Management Board
of Vzajemna, d. v. z., Slovenia.

be divided into those influencing the risk of all investments and caus-
ing investment's systematic credit risk and those influencing the risk of
an individual investment and causing investment's unsystematic credit
risk. *The factors influencing the systematic credit risk* are macroeconomic
factors, changes in economic policies, political changes and the goals
of leading political parties. Macroeconomic factors include the inflation
rate, the employment rate, growth in gross domestic product, stock in-
dex and exchange rate movements, and conjuncture fluctuations in the
economy. Changes in economic policies are represented by changes in
monetary and tax policies, economic legislation changes, as well as im-
port restrictions and export stimulation (Saunders 1997; Temeljotov Salaj
2005)[1]. *The factors influencing the unsystematic credit risk* are primarily
the factors of individual customers, such as their personality, their finan-
cial solvency and capital, credit insurance and general terms and condi-
tions. In the case of companies, specific factors of the industry sector and
the company are emphasised (Mramor 1996). Industry factors include
the structure and economic successfulness of the industry, maturity of
the industry and its stability, while company factors include factors such
as general characteristics of the company, management, financial posi-
tion, sources of funds and financial reporting.

When deciding about new bank customers it is thus important to con-
sider the credit risk of an individual customer, which can nowadays be
measured with the help of various modern credit models (Aver 2003).
However, in assessing the influence of an individual obligor on the bank
operation risk and the influence of capital requirements, the risk of the
entire bank portfolio (see Asarnow 1996) must also be taken into ac-
count. Customer risk and portfolio risk are specified by the expected
loss and standard deviation of the loss, which defines the unexpected
loss (Ong 2000). The latter is often assessed as a multiple of the standard
deviation of the loss (Bessis 1998).

According to CreditMetrics™ technical document (JP Morgan 1997),
company credit risk may also be influenced by *systematic market risk,*
which is reflected in the changes in interest rates, stock index, exchange
rates and unemployment level. The probability of default of a company
and the probability of its credit rating migration is thus related to market
risk. In an ideal world, the methodological tool for bank risk measure-
ment should therefore link market risk and credit risk, which banks are
exposed to in their operations.

Figure 1 presents the *influence of the state of world economy* on default
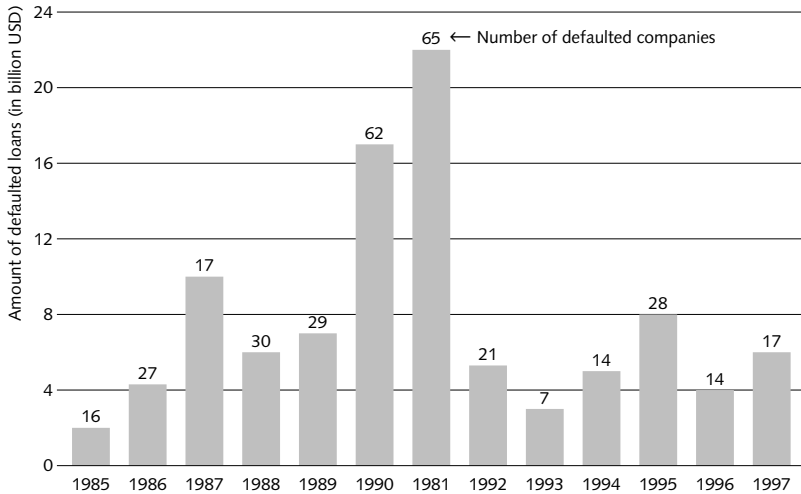
FIGURE 1   Number of defaulted companies and the amount of defaulted loans
(adapted from Crouhy, Galai, and Mark 2000, 319)

probabilities of companies or frequencies of default of foreign companies in the period from 1985 to 1997. In 1990 and 1991, when the world economy was in recession, the frequency of company defaults rose substantially. On the other hand, during the period after 1991, which was characterised by a growing economy, the number of defaults declined.

Actual default probabilities of companies vary over time, depending on the state of economy. In 1996, Carty and Lieberman conducted a study on average probabilities of default and their standard deviations for individual credit rating categories of bank obligors in the period from 1970 to 1995, the results of which are provided in table 1. Similar studies have been conducted by Carty and Fons (1993) and Lucas and Lonski (1992).

Tom Wilson and McKinsey and Company (Paul-Choudhury 1998) developed CreditPortfolioView, a multifactorial model for credit risk measurement, which can be useful for generating the distribution of default probabilities and credit rating migration probabilities for different industry sectors and for each individual country. CreditPortfolioView takes into account that default probabilities and probabilities of obligor credit rating migrations *depend on the state of the economy*. When the economy is not doing well, the probability of default of companies and credit downgrades increase, and vice versa when the economy is strong (Belkin, Suchower, and Forest 1998). Slower economic growth thus causes more frequent credit rating migrations, with lower credit rating classes having

TABLE 1   One-year default probabilities in the period from 1970 to 1995

Credit rating category	One-year default probability	
	Average	Standard deviation
AAA	0.00%	0.00%
AA	0.02%	0.12%
A	0.01%	0.05%
BAA	0.15%	0.30%
BA	1.22%	1.35%
B	6.32%	4.78%

NOTE   Adapted from Moody's Investor Service 1995.

FIGURE 2   Markov transition matrix

Initial rating	Rating at year-end							
	AAA	AA	A	BBB	BB	B	CCC	Def.
AAA								
AA								
A				Recession				
BBB								
BB								
B				Expansion				
CCC								

NOTE   Adapted from Wilson 1997.

a higher correlation with macroeconomic factors. Credit rating migrations during the time of economic recession and expansion can be clearly illustrated with the Markov transition matrix, as shown in figure 2.

As economic growth depends on macroeconomic factors, CreditPortfolioView takes into account the links between macroeconomic variables and default and credit rating migration probabilities of companies. *The model includes* the unemployment rate, gross domestic product growth, the level of long-term interest rates, foreign exchange rates, government expenditures and the savings rate *among macroeconomic factors* (Belkin, Suchower, and Forest 1998).

During a period of recession, default probabilities of speculative-grade obligors are higher than their average default probability, as frequencies of obligor migrations to lower credit rating categories are increasing and frequencies of upward obligor migrations are decreasing. The contrary

holds true for the period of economic expansion. The probabilities of obligor credit rating migrations thus depend on the credit cycle, the industry sector and the country, the credit cycle, however, being the most important factor in the variability of company default probabilities (Bangia, et al. 2002).

The Duffie and Singleton model has been generalised by Lando (1997) and Jarrow and Turnbull (1998) with an assumption that the intensity of default or the obligor default probability (λ) depends on the vector of various macroeconomic variables (X_t), such as risk-free interest rate, stock index, etc. The obligor default probability is modelled in the form of the Cox distribution, which has the characteristics of the Poisson distribution and depends on the vector of macroeconomic variables (X_t):

$$\lambda(t) = \lambda(X_t). \tag{1}$$

In 1997, Duffie and Singleton derived a risk-adjusted short-term interest rate (Y):

$$Y(t) = r(t) + \lambda(t)\text{LGD} + 1. \tag{2}$$

In order to simplify the model implementation, Jarrow and Turnbull suggested the following:

1. the risk-free interest rate $r(t)$ is in accordance with the one-factor Vasicek model from 1977,
2. the obligor default probability $\lambda(t)$ depends on the change in the risk-free interest rate $r(t)$ and unexpected changes in the value of the market index $W_M(t)$:

$$\lambda(t) = \lambda_0 + \lambda_1 r(t) + \lambda_2 W_M(t), \tag{3}$$

where λ_0, λ_1 and λ_2 are constants. $W_M(t)$ indicates unexpected changes in the value of the market index according to the value of the stock index $M(t)$, for which standard lognormal distribution is presupposed:

$$dM(t) = [r(t)dt + \sigma_M dW_M(t)]M(t). \tag{4}$$

1. the level of loss given default (LGD) is constant,
2. the liquidity premium (l) depends on the risk-free interest rate $r(t)$, the stock index $M(t)$ and the variability of the daily value of the stock index:

$$l(t) = l_0 + l_1 r(t) + l_2 M(t) + l_3 [M_H(t) - M_L(t)]^2, \tag{5}$$

where $M(t)$ is the stock index value on a certain day, while $M_H(t)$ and $M_L(t)$ indicate its highest and lowest daily value.

In the following sections, we explain the underlying conceptual and methodological framework and the results of the analysis conducted according to foreign findings on the example of the Slovenian banking sector.

Developing the Hypotheses

On the basis of conducted studies and analyses, Saunders (1997), Asarnow (1996), Crouhy, Galai, Mark (2000), Carty and Lieberman (1996), as well as Carty and Fons (1993) have determined that the range of the credit risk of an individual investment is influenced by risk factors which influence the systematic credit risk and risk factors which influence the unsystematic credit risk of an investment. The factors influencing the systematic credit risk are macroeconomic factors, changes in economic policies, political changes and the goals of leading political parties. Macroeconomic factors include primarily the inflation rate, the employment rate, growth in gross domestic product, stock index and exchange rate movements, and conjuncture fluctuations in the economy. Changes in economic policies are represented by changes in monetary and tax policies, economic legislation changes, as well as import restrictions and export stimulation (Saunders 1997; Mramor 1996).

Based on the above-mentioned findings of foreign researchers and experts, particularly in terms of the macroeconomic factors which can influence the range of systematic credit risk, the main hypothesis can be developed:

H1 *The range of the credit risk of the Slovenian banking system depends on specific macroeconomic factors.*

The main hypothesis can be further divided into several subhypotheses. The results of testing the latter represent the basis of confirming or rejecting the main hypothesis (H1). In order to confirm or reject individual subhypotheses, it is necessary to determine the influence of specific macroeconomic variables on the credit risk of our banking system. The subhypotheses (H1-1 to H1-7) and examined variables for testing them are as follows:

H1-1 *The systematic credit risk of the Slovenian banking system depends on the inflation rate in Slovenia. Examined variables:* REVALOR, CZP *and* DPC.

H1-2 *The systematic credit risk of the Slovenian banking system depends on the employment or unemployment rate in Slovenia. Examined variables:* ZAPOSL *and* BREZPOSL.

H1-3 *The systematic credit risk of the Slovenian banking system depends on the growth in Slovenian gross domestic product. Examined variable:* RASTINDU.

H1-4 *The systematic credit risk of the Slovenian banking system depends on the short-term and long-term interest rate activities of banks and the Bank of Slovenia. Examined variables:* MEDBOM, LOMBOM, ZOM, OMTEKPO, OMSTAN, OMOS, OMPOTR, NOMOBS, NOMPOTR, NOMOS, NOMSTAN, NOMDOBS *and* NOMDOS.

H1-5 *The systematic credit risk of the Slovenian banking system depends on the movement of specific exchange rates. Examined variables:* EUR *and* USD.

H1-6 *The systematic credit risk of the Slovenian banking system depends on the movement of the value of the Slovenian stock exchange index (*SBI*) or the movement of share trade on the organised securities market. Examined variables:* SBI *and* PROMDELN.

H1-7 *The systematic credit risk of the Slovenian banking system depends on the Slovenian export and import growth. Examined variables:* IZVOZ *and* UVOZ.

In examining the influence of 25 chosen macroeconomic variables on the Slovenian banking system credit risk, factorial analysis is employed in order to find new dimensions of macroeconomic factors, which represent common characteristics of some macroeconomic variables. Thus, *the second hypothesis* can be developed:

H2 *The method of principal components and choice of two factors will provide us with good enough partial correlation coefficients between individual macroeconomic variables and both factors, so that the first factor and second factor will together account for more than 50% of the overall credit risk variance.*

Thus, the used empirical analysis of the credit risk factors of the Slovenian banking system portfolio is based on monthly *data* of 25 chosen macroeconomic factors and the calculated indicator of the Slovenian banking system portfolio credit risk for the period from 31 December 1995 to 30 November 2002. The evaluation of the initial hypothesis (H1): *The range of the credit risk of the Slovenian banking system depends on*

specific macroeconomic factors, was based on the set research model explained below.

Research Methodology

DATA COLLECTION AND OPERATIONALISATION
OF THE VARIABLES

According to the findings of foreign researchers such as Saunders (1997), Crouhy, Galai, and Mark (2000), Belkin, Suchower, and Forest, (1998), Carty and Lieberman (1996), as well as Carty and Fons (1993), the *data* on potential factors that influence systematic credit risk could be found among different macroeconomic variables, e. g. inflation rate, employment or unemployment rate, the increase in gross domestic product (industrial production), the movement of short and long term interest rates of banks and the central bank, the movement of exchange rates (e. g. EUR and USD), the movement of the value of the stock exchange index and share trade, and other macroeconomic factors (e. g. import and export). Thus, 25 different macroeconomic factors were chosen to test the stated hypothesis.

The research model design is shown in figure 3. The figure presents chosen factors which can influence the systematic credit risk and which represent the entry model variables used to determine which of the chosen 25 macroeconomic variables have a significant influence on the range of the Slovenian banking system credit risk.

The following *data sources* were used in the analysis:

- GVIN – *Gospodarski vestnik* database,
- SORS – Statistical Office of the Republic of Slovenia database,
- Bank of Slovenia database (the archive of financial data from the *Bulletins of the Bank of Slovenia*),
- monthly balance sheets and profit and loss accounts of all Slovenian banks for the period from 31 December 1995 to 30 November 2002,
- other publicly available materials of the Bank of Slovenia.

The conducted analysis of the Slovenian banking system portfolio is a quantitative analysis, since the attributes used to describe the systematic credit risk factors of the banking portfolio are *numerical,* not descriptive. The influence of specific macroeconomic factors on the range of the Slovenian banking system credit risk has been examined with the help of SPSS software and specific statistical methods, such as *multiple linear regression and factorial analysis.*

FIGURE 3   Systematic credit risk factors

Inflation rate	REVALOR	Revalorisation clause
	CZP	Consumer goods prices*
	DPC	Retail prices
Employment	ZAPOSL	Employment rate
	BREZPOSL	Unemployment rate
GDP	RASTINDU	Industrial production
Interest rates	MEDBOM	Interbank IR
	LOMBOM	Lombard IR
	ZOM	Default IR
	OMTEKPO	Real IR on current business loans*
	OMSTAN	Real IR on long-term home loans
	OMOS	Real IR on long-term fixed asset loans
	OMPOTR	Real IR on short-term consumption loans
	NOMOBS	Nominal IR on short-term current asset loans*
	NOMPOTR	Nominal IR on short-term consumption loans
	NOMOS	Nominal IR on long-term fixed asset loans
	NOMSTAN	Nominal IR on long-term home loans*
	NOMDOBS	Nominal IR on short-term foreign exchange loans for current assets
	NOMDOS	Nominal IR on long-term foreign exchange loans for fixed assets
Exchange rates	EUR	EUR exchange rate
	USD	USD exchange rate*
Stock exchange market	SBI	Slovenian stock exchange index
	PROMDELN	Stock exch. trade and the trade on the free share market*
Export/ import	IZVOZ	Import of goods and services
	UVOZ	Export of goods and services

* Systematic credit risk.

THE SAMPLE

The established model is based on the data of the variety of macroeconomic credit risk factors, collected on monthly basis, as well as on monthly data of the calculated indicator of the Slovenian banking system portfolio credit risk for the period from 31 December 1995 to 30 November 2002. The chosen assessment period of the Slovenian banking system

after 1995 is the most appropriate one for the analysis, since the period before the end of the year 1995 would mystify the results of the analysis to a great extent.

In that period, the range of the Slovenian bank portfolio credit risk was being contracted due to different system effects, among others, due to the implementation of the rehabilitation programme in Ljubljanska banka, d. d. and Kreditna banka Maribor, d. d. (in 1993), as well as in LB Komercialna banka Nova Gorica, d. d. (in 1994). System measures are also visible in the period from March 1994 to September 1996, namely in the exchange of poor receivables with government bonds.

Taking into account the examined period from 31 December 1995 to 30 November 2002, when there were no significant system effects on the range of the Slovenian bank credit risk, good results can be obtained on the basis of a statistical analysis of the effect of macroeconomic factors on the credit risk of the Slovenian banking system portfolio. At the same time, monthly data for all *independent variables and dependant variables* can be examined as individual cases and not as time series, thus neglecting the time influence or the time components on the credit risk range.

The *indicator of loan portfolio credit quality* was first defined as a ratio between the range of formed value corrections for credit risk of loans to the non-banking sector[2] (government excluded) and the range of gross loans given to the non-banking sector (government excluded). The loans given to the government were excluded. According to the methodology of the Bank of Slovenia, the loans given to the government are included in the loans given to the non-banking sector. Therefore, they influence or have greater effect on the percentage of the formed value corrections, since receivables to the government had better ratings. We analysed the mentioned indicator of the credit quality of the Slovenian banking system loan portfolio in the period from December 1995 to November 2002.

DATA ANALYSES

We can establish which of the 25 chosen macroeconomic variables influence the range of the Slovenian banking system portfolio credit risk with the *method of multilinear regression.* The following indicator (TVEG1) was defined for measuring the credit risk:

> *Value corrections for the credit risk of loans given to the non-banking sector/gross loans to the non-banking sector.*

The multiple linear regression model can also be presented as (see figure 3):

$$\text{TVEG1} = \beta_1 + \beta_2\text{REVALOR} + \beta_3\text{CZP} + \beta_4\text{DCP} + \beta_5\text{ZAPOSL}$$

$$+ \beta_6\text{BREZPOSL} + \beta_7\text{RASTINDU} + \beta_8\text{MEDBOM}$$

$$+ \beta_9\text{LOBOM} + \beta_{10}\text{ZOM} + \beta_{11}\text{OMTEKPO} + \beta_{12}\text{OMSTAN}$$

$$+ \beta_{13}\text{OMOS} + \beta_{14}\text{OMPOTR} + \beta_{15}\text{NOMOBS}$$

$$+ \beta_{16}\text{NOMPOTR} + \beta_{17}\text{NOMOS} + \beta_{18}\text{NOMSTAN}$$

$$+ \beta_{19}\text{NOMDOBS} + \beta_{20}\text{NOMDOS} + \beta_{21}\text{EUR} + \beta_{22}\text{USD}$$

$$+ \beta_{23}\text{SBI} + \beta_{24}\text{PROMDELN} + \beta_{25}\text{IZVOZ}$$

$$+ \beta_{26}\text{UVOZ} + u \tag{6}$$

The analysis of the influence of the 25 chosen macroeconomic variables on the credit risk of the Slovenian banking system could also be conducted with a *factorial analysis (method of principal components),* by finding new dimensions of macroeconomic factors that represent common characteristics for some of the macroeconomic variables.

Findings and Results

RESULTS OF MULTIPLE LINEAR REGRESSION MODEL

As a result, we get a *multiple linear regression model* of seven statistically significant variables, with *R*-square being equal to 0.863. This means that 86.3% variability of the systematic credit risk of the Slovenian banking system portfolio is explained by linear dependency on seven macroeconomic factors. It can be noticed that the increase in the real interest rate for short-term consumption loans, the increase in the Slovenian stock exchange index, a decreasing number of employees in Slovenia, an increasing securities interest rate (interest rate of the Bank of Slovenia for securities exchange) and the increase in the real interest rate on home loans have the greatest influence on the increase in credit risk. In a way, the mentioned results are logical. On the other hand, the two results, the increase in the real interest rate for long-term loans for current assets and the increase in the inter-banking interest rate, which have an effect on the decrease of the Slovenian banking system portfolio credit risk, seem less logical.

The obtained results are shown in table 2 and figure 4. Table 2 shows partial regression coefficients for all 7 macroeconomic factors which have a significant influence on the range of the examined credit risk, as well

TABLE 2   Partial regression coefficients and *T*-test for testing their influence

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Constant	17.62368	1.981	–	8.898	0.000	–
OMPOTR	0.45794	0.068	2.902	6.775	0.000	0.614
SBI	0.00050	0.000	0.551	6.046	0.000	0.570
OMOS	−0.66577	0.119	−2.681	−5.577	0.000	−0.539
ZAPOSL	−0.00001	0.000	−0.463	−4.441	0.000	−0.454
MEDBOM	−0.05264	0.014	−0.350	−3.684	0.000	−0.389
LOMBOM	0.09185	0.027	0.179	3.343	0.001	0.358
OMSTAN	0.12914	0.066	0.600	1.949	0.050	0.218

NOTES   Column headings are as follows: (1) unstandardized coefficients: *B*, (2) standard error, (3) standardized coefficients: *β*, (4) *T*-test: *t*, (5) significance, (6) partial correlation coefficients.
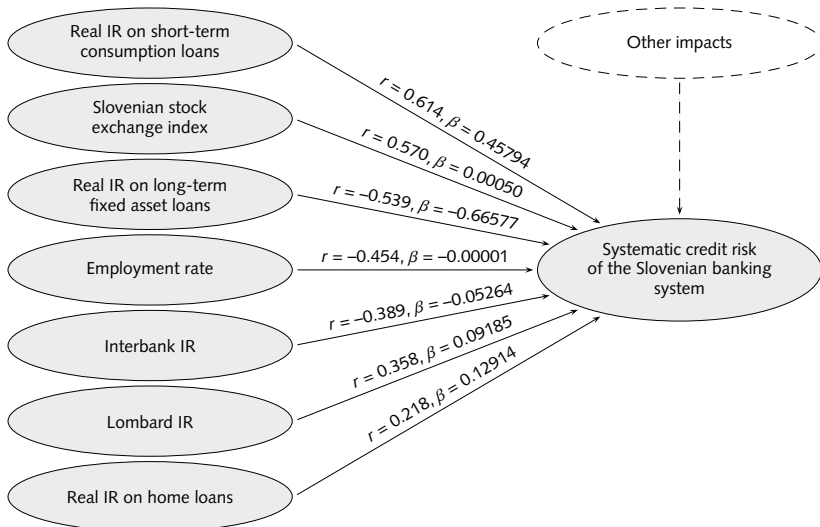

FIGURE 4   Dependence of the Slovenian banking system credit risk on seven macroeconomic variables on the basis of partial correlation coefficients (*r*) and partial regression coefficients (*β*); $R^2 = 0.863$

as *T*-test results in relation to testing the characteristics of the independent variables' influence on the credit risk. Moreover, figure 4 illustrates an extended linear regression model, which fully explains the variability of the systematic credit risk range of the Slovenian banking system portfolio.

RESULTS OF FACTORIAL ANALYSIS – METHOD OF PRINCIPAL COMPONENTS

In examining the influence of 25 chosen macroeconomic variables on the Slovenian banking system credit risk, factorial analysis was employed in order to find new dimensions of macroeconomic factors that represent common characteristics for some of the macroeconomic variables.

The method of principal components and choice of two factors provided us with partial correlation coefficients between individual macroeconomic variables and both factors. The first factor (various interest rates of the Slovenian banking system) explains 58.8% of the credit risk variance, while the second factor (other macroeconomic factors) explains 10.8%. Thus, the entire model explains approximately 69.6% of the overall credit risk variance. The rest of the variance can be ascribed to specific impacts that are not included in the model. The obtained result is relatively good, although it should be borne in mind that there exist other credit risk factors besides the examined ones.

The obtained communalities for individual macroeconomic variables show what extent of the individual variable variance is accounted for by both factors. Despite the fact that only the variables with a communality higher than 0.2 should be included in the analysis, the variables of consumer goods prices (CPZ) and retail prices (DPC) – their explained variance with both factors being less than 20% – have also been included in the analysis. The explained variance of the other 18 macroeconomic variables with both factors is more than 20%. Therefore, they can be included in the examined analysis without difficulty.

Thus, the results of the factorial analysis have shown that 20 macroeconomic variables are connected into 2 significant factors. The following 10 variables form the part of the first factor and they represent short and long-term real and nominal interest rates:[3] real interest rate on current business loans, real interest rate on long-term current asset loans, real interest rate on long-term home loans, real interest rate on short-term home loans, nominal interest rate on short-term current asset loans, nominal interest rate on short-term consumption loans, inter-bank interest rate, nominal interest rate on long-term home loans, nominal interest rate on long-term current asset loans and back interest rate.

The macroeconomic variables that form the second factor are the following: export of goods and services, import of goods and services, the rate of industrial production, the number of all people employed in

Slovenia, retail prices, cost of goods sold, USD exchange rate, EUR exchange rate, the value of the Slovenian stock exchange index, stock exchange trade and the trade on the free share market.

The first factor could be labelled as 'interest rates of the Slovenian banking system', for it comprises different real and nominal (short and long-term) interest rates of Slovenian banks. The second factor could be labelled as 'other macroeconomic factors', for it comprises 10 different macroeconomic variables, e. g. export (import) of goods and services, employment rate, growth rate of production, exchange rate, developments on the securities market and the inflation rate in Slovenia.

It is possible to show the position of the above-average and below-average risk of portfolios of our banking system regarding the first factor that represents the interest rates of the Slovenian banking system and regarding the second factor representing other macroeconomic factors. The group of the 46 above-average risk portfolios of the Slovenian banking system lie in the top right square,[4] which means that the above-average risk portfolios have high values of the first factor (high short and long-term interest rates) and medium values of the second factor (variety of macroeconomic factors). On the other hand, the below-average risk portfolios of our banking system lie in the bottom left square,[5] which means that these portfolios have low values of short and long-term interest rates and low values of the variety of macroeconomic factors. The position of the above-average and below-average portfolios of our banking system regarding the first factor, which represents the interest rates of the Slovenian banking system, and regarding the second factor, which represents other macroeconomic factors, is shown by figure 5.

Conclusions and Implications

The results of the analysis of the credit risk of the Slovenian banking system for the period from December 1995 to November 2002 show that *specific macroeconomic factors have important influence on the range of the credit risk of the Slovenian banking system portfolio.* The increase in credit risk is highly influenced by the increase in short and long-term interest rates of Slovenian banks, the increase in the value of the Slovenian stock exchange index and the decrease in the number of employees.

In the examined period of 84 months, one of the most prominent features of the portfolio has shown above-average risk in the period of high real and nominal interest rates on different short and long-term loans, during the period of high loan on securities interest rates and high inter-
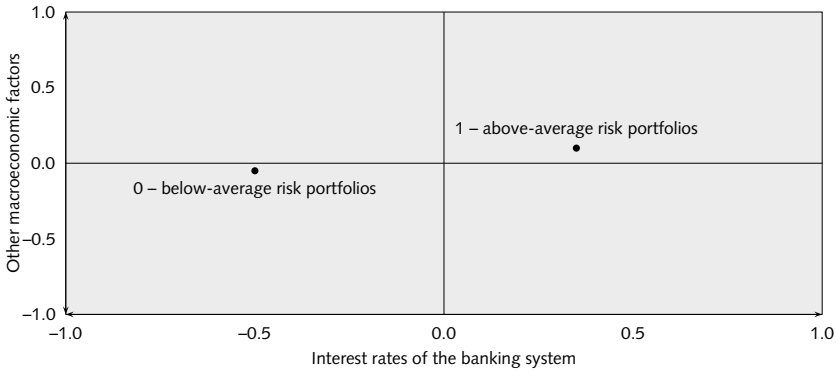
FIGURE 5   Position of the above-average and below-average portfolios of the Slovenian banking system

bank interest rate, in the period of high unemployment (or low employment) and in the period of low EUR and USD exchange rates. Taking into account the theory of macroeconomic factors' influence on credit risk, the given results are fairly logical and expected.

The *examined macroeconomic variables are related by 2 characteristic factors.* The first is represented by the interest rate of the Slovenian banking system, which includes different real and nominal interest rates for both short and long-term loans. The second can be described as the other macroeconomic factors, as it consists of different macroeconomic variables. The high value of the first factor and the medium value of the second factor is the most significant in the group of 46 above-average risk portfolios of the banking system. On the other hand, the low value of both factors is significant for the group of below-average risk of all credit risk factors.

The analysis findings have shown that certain macroeconomic factors have significant influence on the range of the Slovenian banking system credit risk. Therefore, we can conclude that, among other factors, Asian and Russian crises most probably influenced the increase of the range of the loan portfolio credit risk in non-bank sectors in the period between 1997 and 1998. On the other hand, favourable movements of macroeconomic government environment, the growth of consumption prior to VAT implementation, good business results in the real sector and growth of the economies of the most important market partners influenced the increase in the quality of credit portfolios of banking systems between 1999 and 2000. Thus, we can state with certainty that *credit risk in Slove-*

*nian banks shows positive reactions and that banks have prompt reaction
time in cases of unfavourable market situation.*

In spite of the analysis findings showing that macroeconomic factors
have substantial influence on the range of the credit risk in the Slovenian
banking system, we cannot overlook the *influence of other factors that the
analysis does not explain – limitations of the research model.* These are the
other factors that could have influenced credit risk in the banking system
in the examined period between December 1995 and November 2002:

- the first case of bankruptcy in Slovenia: the bankruptcy of Komer-
  cialna banka Triglav d. d. in 1996, due to compulsory liquidation,
- stricter criteria for client categorisation since January 1997 (since
  that date, the receivables insured by assets put in pledge could be
  solely categorised into one group higher than the debtor's credit
  rating);
- the influence of the bank business results on provisions policy
  (more conservative policy on estimating bank clients is typical for
  the period of higher profits and preparation for new investments),
- considerably higher net provisions for credit risk for the portfolio
  of the bank s k b d. d. in December 2001.

The results of the influence of the chosen macroeconomic factors on
the credit risk in the banking system have *confirmed the main hypothesis*
(h1), as certain macroeconomic factors have major influence on the ex-
amined credit risk. Further, we also *confirmed some subhypotheses* (h1-2,
h1-4 and h1-6), concluding that the credit risk portfolio of the Slove-
nian banking system depends on the employment or unemployment
rate in Slovenia (h1-2), on short and long-term interest rates activities
of Slovenian banks and the Bank of Slovenia (h1-4), and on the value
of the Slovenian stock exchange index (h1-6). Contrary to that, we can-
not claim that the examined credit risk depends on the inflation rate in
Slovenia (h1-1), the growth of g d p – industrial production (h1-3), e u r
and u s d exchange rates (h1-5) or the growth of Slovenian import and
export (h1-7).

On the basis of the obtained factorial analysis results we can *also con-
firm the second hypothesis* (h2) that more than 50% of the overall credit
risk variance of the examined Slovenian banking system portfolio can be
accounted for by the two factors together.

The conducted analysis and obtained results of the study of credit risk
factors in Slovenia can also be *beneficial to banks in other countries in*

transition, which do not yet apply the latest credit risk measurement and management methods . Moreover, an *important challenge is seen in reconducting the study of the influence of macroeconomic factors* on the range of the credit risk of the Slovenian banking system portfolio with the data which are yet to become available in the following years. It would also be useful to undertake such studies in other countries, particularly in the area of ex-Yugoslavia, where different findings about the influence of individual macroeconomic factors on the credit risk can be expected to arise due to a higher risk of their banking system portfolio and lower economic development. The results of our analysis are also applicable to other financial institutions such as insurance companies or pension funds in risk managements of their financial investments. Finally, it will be useful to elaborate the study of credit risk factors by employing new and coming statistical tools such as structural equation modelling or gravitational macroeconomic models, which can further increase the reliability of results.

Notes

1 In addition to the mentioned factors, the systematic credit risk of an investment may also be influenced by the environment, e. g. the movements of immovable property value, etc. (Temeljotov Salaj 2006).
2 Provisions and charges.
3 A high partial correlation coefficient associated with the first factor is significant for the 10 variables mentioned.
4 The value of the first factor is 0.38 and the value of the second factor is 0.09.
5 The value of the first factor is –0.5 and the value of the second factor is –0.12.

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