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Research Paper

Credit Risk Modeling Using Markov Switching Model[1]

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INTRODUCTION

Today, the most crucial issue in the banking system is the assessment and measurement of credit risk. To mitigate the perilous consequences associated with credit risk, it is imperative to exert control over this risk. Statistical methods, such as regression, have now become commonplace for predicting and managing credit risk. However, these regression methods encounter challenges that, to a certain extent, complicate the process of predicting and measuring the magnitude of risks (Tran et al., 2021). Intelligent methods, exemplified by the multivariate switching model, offer the potential to derive suitable solutions through behavior-based multiple decomposition (Bellini et al., 2019). This paper delves into the analysis of influential variables using the multivariate switching method. It explores the scoring of various factors crucial to effective credit risk control, their categorization, and consequently, the prediction of risk. An innovative approach involves utilizing the financial distress index as a financial variable. The two-regime Markov switching model, with Hamiltonian specifications, is employed to scrutinize the economic and financial variables under investigation. It aims to evaluate the impact of each variable on measuring credit risk.

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MATERIALS AND METHODS

The data encompass all commercial and specialized government banks, non-governmental banks, and non-bank credit institutions listed on the Tehran Stock Exchange during the period between 2011 and 2020. Three hypotheses have been formulated for investigation:

1. Economic indicators exert a significant effect on credit risk.
2. Financial indicators demonstrate a significant effect on credit risk.
3. External shocks exhibit a significant effect on credit risk.

The predictive variables of the model are outlined in Table 1.

Table 1. Research variables

Name	Type
Capital adequacy ratio (CAR)	Microeconomic variables
Asset quality (AQ)	
Banking System Liquidity (BSL)	
Real Gross Domestic Product (Real GDP)	Macroeconomic variables
Inflation (I)	
Budget Deficit (BD)	
The ratio of M2 to foreign exchange reserves (M2)	Financial factors
Private Credits (PC)	
Government Credits (GC)	
Debt	
Two indicators of financial distress (BSF1-BSF2)	
Banking Sanctions (BS)	External shocks
Foreign Exchange Assets (FEA)	

Formulas 1 and 2 express the two indices of distress proposed in this paper.

BSF1:

$$\frac{(CAR_t - \mu_{CAR})}{\sigma_{CAR}} + \frac{(AQ_t - \mu_{AQ})}{\sigma_{AQ}} + \frac{(BSL_t - \mu_{BSL})}{\sigma_{BSL}} + \frac{(Real\ GDP_t - \mu_{Real\ GDP})}{\sigma_{Real\ GDP}} + \frac{(Deb_t - \mu_{Deb})}{\sigma_{Deb}} + \frac{(Fea_t - \mu_{FEA})}{\sigma_{FEA}} \quad (1)$$

BSF2:

$$\frac{(CAR_t - \mu_{CAR})}{\sigma_{CAR}} + \frac{(NA_t - \mu_{NA})}{\sigma_{NA}} + \frac{(BSLt_t - \mu_{BSL})}{\sigma_{BSL}} + \frac{(Real\ GDP_t - \mu_{Real\ GDP})}{\sigma_{Real\ GDP}} + \frac{(FEA_t - \mu_{FEA})}{\sigma_{FEA}} \Big/ 5 \quad (2)$$

In this paper, the Markov switching method is used to analyze the relationship between the variables in Table 1 to evaluate the relationship between each of the variables and credit risk.

RESULTS AND DISCUSSION

Figure 1 illustrates the BSF index, indicating that the movement patterns of BSF1 and BSF2 are largely similar. BSF1 includes all variables associated with primary factors influencing credit risk, comprising CAR, AQ, BSL, S, BD, M2, BS, FEA, and GC. Conversely, BSF2 encompasses these variables along with additional sub-variables like exports, imports, and the money refund rate. Upon examination of the graph, one can posit that banking transactions have a limited impact on the turbulent state of Iran's banking sector and the assessment of credit risk.

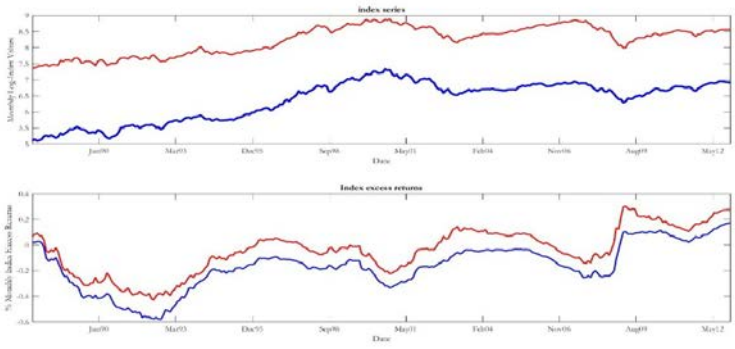

Figure 1. BSF Risk Indicators Trend

Table 2 displays the results of the unit root test. The critical value of the statistic at a confidence level of 1% is 0.240. Consequently, the significance of the examined variables has been assessed at the 1% level. The findings reveal that the null hypothesis, which posits stability, is not rejected for any of the variables at the 1% significance level.

Table 2. The result of the unit root test

with width from the origin		Variable
result statistics	The amount of test	
stable	0.180	CAR
stable	0.110	AQ
stable	0.190	BSL
stable	0.100	Real GDP
stable	0.080	I
stable	0.170	BD
stable	0.200	M2
stable	0.065	GC
stable	0.210	PC
stable	0.188	FEA

Table 3 illustrates the model fit, and the results validate all three tested hypotheses. Economic indicators exhibit a significant and inverse relationship with credit risk, indicating that an increase in their values corresponds to heightened risk. Conversely, financial indicators, such as inflation, BSF, and BD, demonstrate a direct relationship with risk, implying that higher values of these variables result in increased risk.

Table 3. Switching model fit

Type of relationship	probability	T-measure	standard deviation	Coefficient	Variable
reverse	0.0024	-3.077	0.009	-0.030	CAR
reverse	0.0013	-3.270	0.0004	-0.001	AQ
reverse	0.000	-10.14	0.059	-0.605	BSL
reverse	0.000	-8.25	0.034	-0.400	Real GDP
Direct	0.0243	2.270	0.125	0.283	I
Direct	0.0039	2.926	0.011	0.033	BD

Type of relationship	probability	T-measure	standard deviation	Coefficient	Variable
reverse	0.0002	3.8407	0.0148	0.056	M2
reverse	0.001	-5.356	0.0032	-0.017	GC
reverse	0.000	-5.356	0.0032	-0.017	PC
reverse	0.000	-11.356	0.0042	-0.099	FEA
Direct	0.0001	3.922	0.070	0.275	BSF

CONCLUSION AND SUGGESTIONS

The results derived from the proposed Markov switching method highlight the distress within Iran's banking system attributed to the escalation of currency shock factors, such as exchange rate fluctuations, sanctions, and macroeconomic variables including inflation, BD, CAR, AQ, and Real GDP. Conversely, an increase in Real GDP, CAR, and AQ, coupled with a decrease in exchange rates, sanctions, and inflation, has the potential to alleviate critical situations and mitigate credit risk. These findings align with existing studies in the field.

The insights garnered from this research can aid bank managers in responding to precarious conditions by understanding the factors influencing credit risk. Additionally, understanding the impact of credit risk on investment returns and consistently monitoring credit risk in banks can help prevent risks and their associated consequences. Based on the results, discussions, and analyses presented in the findings section, the following suggestions are put forth:

1. This study is equipped to identify the shift from a tranquil period to a high-risk phase, ascertain the duration of critical conditions, and assess the likelihood of banking risk shocks. Consequently, banking authorities should take these factors into consideration to formulate policies for predicting critical conditions and managing credit risk.
2. The economic cycle is expected to persist in cycles of crisis and stagnation. Hence, all stakeholders, particularly macro-banking and monetary authorities, must enhance their awareness and expedite their actions in anticipating crises and subsequent high-risk scenarios.

Keywords: Credit Risk, Prediction, Markov Switching.

JEL Classification: G01, G21, G32.

Reference

Bellini, T. (2019). IFRS 9 and CECL Credit Risk Modelling and Validation: A Practical Guide with Examples Worked in R and SAS: Academic Press.

Tran, C. S., Nicolau, D., Nayak, R., Verhoeven, P. J. J. o. R., & Management, F. (2021). Modeling Credit Risk: A Category Theory Perspective. 14(7), 298.