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The Effects of Microeconomic and Macroeconomic Variables on Iran's Banking System Fragility Using Markov-switching Model

Pourebadollahan Covich, M.[1*], Asgharpur, H.[2], Fallahi, F.[3], Sattarrostami, H.[4]

Abstract

The main purpose of this study is to investigate the effects of variables of microeconomics and macroeconomics on the banking system fragility of Iran, using Markov-switching model. For that purpose, first, the Iran's banking system fragility index is developed over the period of 2002:2–2015:1. Based on the results, three major periods of high risk-taking, two periods of high fragility, and stability in the rest of the periods are observed. Accordingly, in the next step, three-regime Markov-switching model is used to investigate the effects of variables of microeconomics and macroeconomics on mentioned banking system fragility index. Findings based on Markov-switching regression analysis confirm the importance of both variables of microeconomics and macroeconomics in determining the Iran's banking system fragility. Findings indicate that microeconomic variables such as low capital adequacy, Low asset quality and low liquidity of banks along with macroeconomics factors such as decreasing real GDP growth, high inflation and increasing government budget deficit will lead to more fragility in the Iranian banking system.

Keywords: Banking System Fragility Index, Determinants of Banking System Fragility, Markov-Switching Model, Iran.

JEL Classification: C25, G21, E44, G01.

1. Introduction

Banks, as one of the most important components of financial system, have different functions including accepting deposits, granting loans and advances, providing payment services, etc. They are exposed to different types of risks such as bankruptcy, adverse selection and moral hazard, which make them fragile in the period of crises. Banking fragility is simply defined as vulnerability to crisis (Gale, 2000) that eventually could lead to serious breakdown in market functioning such as disruption in financial intermediation, credit crunch or lack of financing for new investment, and consumption activities. It may also reduce

1. Associate Professor of Economic Development and Planning, University of Tabriz **Email:** Mohsen_p54@hotmail.com
2. Associate Professor of Economic Sciences, University of Tabriz **Email:** Asgharpurh@gmail.com
3. Associate Professor of Economic Development and Planning, University of Tabriz **Email:** Firfal@yahoo.com
4. Ph.D. Student at Monetary Economics, University of Tabriz **Email:** H.sr38@yahoo.com

the level of confidence among local and foreign investors in financial sector. BSFI is an index used to monitor the level of fragility among banking system (Kibritcioglu, 2003). The main components of BSFI are associated with three excessive risk factors (credit risk, liquidity risk, and foreign-exchange risk) (Shen, 2008).The fluctuation of all the indicators used to compute BSFI is expected to explain the changes in the level of fragility in banking system.

During the financial crises in the last two decades, various banks and financial institutions have been damaged and some even have experienced bankruptcy. Historical evidences highlight the central role of banks' instability in financial crises (Hardy, 1998; Eigner and Thomas, 2015). Due to their importance in the financial stability of a country, banks are highly regulated in most countries. For preventing financial crises, it is essential to identify the sources of such crises. The great impact of these crises on real production, especially in the 1990s, led to a wave of research to study the causes and consequences of banks' fragility in contemporary economies.

The empirical literature on banking fragility is investigated under two categories. These are micro and macro approaches. At the micro level, institutional weaknesses are the main causes of bank failure. These studies focus on individual banks` balance sheet data and aim to identify micro variables that determine the reasons for individual bank failure. In particular, various financial ratios that are consistent with the CAMELS rating system are employed to produce an evaluation of the condition of the banks (Martin, 1977; Avery and Hanweck, 1984; Espahbodi, 1991, Kolari et al., 2002; Persons, 1999; Canbas et al., 2004; Rahman et al., 2004; Molina, 2002).

From the macro perspective, banks are strongly influenced by contractions that the economy experiences over time. In particular, banking sector and currency crises are highly influenced by a number of macro variables. For instance, high interest rate, increasing inflation, output downturns and adverse terms of trade shocks, decline in asset prices, credit expansion, market pressure and losses of foreign exchange reserves are some of the macro variables that influence the functioning of financial and economic systems as a whole (DemirgucKunt and Detragiache,1998a, b, 2000; Hutchison and McDill, 1999; Hutchison, 2002; Eichengreen and Arteta, 2000; Hardy and Pazarbasioglu, 1998 and Domac and Mertinez-Peria, 2003).

However, the recent empirical studies have started to give more importance to both micro and macro factors. Originally, Gonzalez-Hermosillo (1996) developed a theoretical framework that combined the role of both bank-specific (mainly financial ratios from bank balance sheets) and macro environment, for determining the banking sector distress in Mexico. Severe studies have been conducted on empirical examination of both micro and macro variables (Gonzalez-Hermosillo et al., 1996, 1999; Langrin, 2001; Heffernan, 1996; Borovikova, 2000 and Yilmaz, 2003).

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2. The model, estimation strategy and data

To estimate a Markov-switching model (MSM) we need an indicator that we will use to assess the state of the banking fragility. Therefore, in this section, we first present an index of banking system fragility, before presenting the MSM.

2.1. The banking system fragility index

Banks' risk-taking behavior and banking system fragility (as the outcome of such behavior) can be measured by the use of the banking system fragility index (BSFI). BSFI is constructed based on the average of liquidity risk, credit risk and exchange-rate risk indices. It uses the bank deposit growth as a proxy for liquidity risk, the bank credit to the domestic private sector growth as a proxy for credit risk, and the bank foreign liabilities growth as a proxy for exchange-rate risk. Formally, the BSFI is computed as follows:

$$BSFI_t = \frac{NDEP_t + NCPS_t + NFL_t}{3} \quad (1)$$

$$NDEP_t = \frac{DEP_t - \mu_{dep}}{\sigma_{dep}} \quad while \quad DEP_t = \frac{TDEP_t - TDEP_{t-4}}{TDEP_{t-4}} \quad (2)$$

$$NFL_t = \frac{FL_t - \mu_{fl}}{\sigma_{fl}} \quad while \quad FL_t = \frac{TFL_t - TFL_{t-4}}{TFL_{t-4}} \quad (3)$$

$$NCPS_t = \frac{CPS_t - \mu_{cps}}{\sigma_{cps}} \quad while \quad CPS_t = \frac{TCPS_t - TCPS_{t-4}}{TCPS_{t-4}} \quad (4)$$

Where $\mu(.)$ and $\sigma(.)$ stand for the arithmetic average and for the standard deviation of these three variables, respectively. NCPSt denotes the banking system's total real claims on the private sector; NFLt denotes the bank's total real foreign liabilities; and NDEPt denotes the total deposits of banks. One should notice that nominal series are deflated by using the corresponding domestic consumer price index.

Thresholds for levels of risk-taking and episodes of banking sector fragility are defined as follows:

A banking system is said to experience an excessive risk-taking if $BSFI > \sigma$,

A banking system is stable if $-\sigma < BSFI < \sigma$,

A banking system is said to be highly fragile if $BSFI < -\sigma$, where σ is the standard deviation of calculated BSFI.

2.2. The Markov-switching model

To achieve the object of the study, first, BSFI is computed for Iran's banking system, over the period of 2002:2–2015:1. In the next step, three-regime Markov- switching model (which happen to be more appropriate for our data) is established to capture the effects of microeconomic and macroeconomic variables on Iran's BSFI. These three regimes are: (i) the excessive risk-taking regime, (ii) the stability regime and (iii) the High fragility regime. Let y be a

banking system fragility index (as provided in the above subsection). We set up the model as follows:

$$y_t = \mu(S_t) + \left[\sum a_i (y_{t-i} - \mu(S_{t-i})\right] + \varepsilon_t \quad ; \varepsilon_t | S_t \sim NID(\circ, \sigma^2) \ , \ S_t = 1,2,3 \qquad (5)$$

In such a way that y_t is the time series examined, μ is the mean of the desired variable, and a_i represents the parameters of the model (Krolzig, 1997). The stochastic process on S_t can be summarized by the transition matrix Pr ($St = j \mid S_{t-1} = i$, $S_{t-2} = k \ldots$) = pr ($S_t = j \mid S_{t-1} = i$) = pij. The (3 × 3) transition matrix P is given by:

$$P = \begin{bmatrix} Pr(s_t = 1 | s_{t-1} = 1) & Pr(s_t = 1 | s_{t-1} = 2) & Pr(s_t = 1 | s_{t-1} = 3) \\ Pr(s_t = 2 | s_{t-1} = 1) & Pr(s_t = 2 | s_{t-1} = 2) & Pr(s_t = 2 | s_{t-1} = 3) \\ Pr(s_t = 3 | s_{t-1} = 1) & Pr(s_t = 3 | s_{t-1} = 2) & Pr(s_t = 3 | s_{t-1} = 3) \end{bmatrix} = \begin{bmatrix} p_{11} & p_{21} & p_{31} \\ p_{12} & p_{22} & p_{32} \\ p_{13} & p_{23} & p_{33} \end{bmatrix} \qquad (6)$$

Accordingly, the empirical model of the factors affecting the fragility of the banking system of Iran is dictated by the following:

$$BSFI_t(s_t) = \beta_1(s_t) + \beta_2(s_t) CAP_t + \beta_3(s_t) ASS_t + \beta_4(s_t) LIQ_t + \beta_5(s_t) INF_t + \beta_6(s_t) RGDP_t + \beta_7(s_t) BUDGET_t + u_t \qquad (7)$$

Where t represents the season and the variables BSFI, CAP, ASS, LIQ, INF, RGDP and BUDGET respectively indicate the index of banking system fragility, capital adequacy, asset quality, liquidity, inflation rate, real GDP growth rate and ratio of budget deficit to GDP.

Required data are extracted from the time series database available on the official website of the Central Bank of the Islamic Republic and central bank statistical journals (economic reports and economic indicators). The statistical population of the study is all banks and non-bank credit institutions licensed by the Central Bank. To estimate the model and to calculate the BSFI index, software OxMetrics6 Eviews9 and Excel2010 have been used.

3. Results

Based on the results, three major periods of excessive risk-taking, two periods of high fragility, and stability in the rest of the periods are observed (Fig.1). Nonetheless, regarding governmental ownership of majority of banks and governmental protections, there is no evidence of bankruptcy in the banking system of Iran. Results of accordingly Markov-switching model (Table 1) also indicate that microeconomic variables such as low capital adequacy and low liquidity of banks along with macroeconomic variables such as decreasing real GDP growth, high inflation and increasing government budget deficit are the main factors of Iran's banking system fragility. These findings are in line with previous related studies.

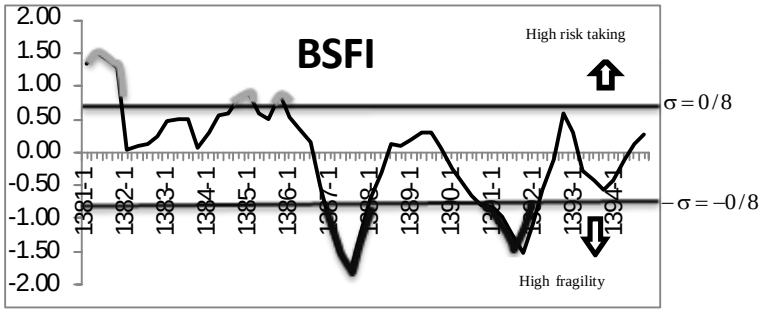

Fig.1: BSFI index calculated for the banking system of Iran

Table 1: Estimates of the Model MSIAH (3) -Ar (1) and the Likelihood transition matrix

Regime3		Regime2		Regime1		Variable
Coefficient	**Statistics t**	**Coefficient**	**Statistics t**	**Coefficient**	**Statistics t**	
**-20/35	-2/4e+005	**20/6	67/9	**4/26	34/8	Constant
**0/55	10/9	**0/02	2174	**0/90	137	$BSFI_{t-1}$
**24/55	78/9	**5/33	9309	**14/25	33/5	Capital adequacy
**-18/86	-27/8	**-7/62	-4/42 e+004	**8/25-	53/3-	Asset quality
**-8/89	-18/4	**-2/30	2/1e+004-	**3/19-	33/9-	liquidity
**-0/003	-0/42	**-0/15	3/5 e+004	**0/02-	37/9-	Inflation
**0/10	4/87	**0/43	9/1e+004	**0/05	20/2	GDP growth
**-0/37	-2/92	**0/91	5/65e+004	**0/16	13/8	Budget deficit
0/07		9/04e-004		0/006		Standard deviation
-4/91						AIC criterion
176/33						log-likelihood
370/34						LR linearity test
0/000						Davies

t			Conditional probabilities	
Regime3	Regime2	Regime1		
0/20	0/33	0/47	Regime1	$t+1$
0/33	0/45	0/23	Regime2	
0/46	0/22	0/30	Regime3	
2/38	1/75	1/8		Medium durability
37/25	27/45	35/29		Cumulative probability (percent)
19	14	18		Period duration (season)

** Significantly at 1% level
Source: Research calculations

4. Conclusion

Considering the results, it can be concluded that sufficient capital adequacy, increasing the quality of assets, controlling the country's inflation and government's budget deficit and improvement of economic growth are essential for managing the instability of Iran's banking system.

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