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Research paper

The Banking Crisis and Macroprudential Policy: Evidence From Iran

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Abstract:
This study aims to identify the macroeconomic factors influencing the likelihood of a banking crisis in Iran, with a particular focus on macroprudential policy. We employed a discrete econometric model (Logit/Probit) using data from 2011 to 2023. The independent variables include the loan-to-deposit ratio (LTD) as a proxy for macroprudential policy, the interbank interest rate as a proxy for monetary policy, as well as the inflation rate and exchange rate volatility as indicators of macroeconomic instability. The positive and significant coefficient of LTD confirms that liquidity risk arising from excessive credit expansion is the main domestic factor increasing the probability of a crisis. The strong and positive coefficients for inflation and exchange rate volatility suggest that macroeconomic and currency shocks threaten financial stability by deteriorating asset quality and increasing loan defaults. The coefficient for the interbank rate implies the dominance of the disciplinary and supervisory effects of monetary policy over liquidity risk, meaning that a targeted increase in the policy rate by the central bank effectively reduces the probability of a crisis by imposing higher costs on riskier banks. Overall, the findings indicate that financial stability in Iran is influenced by short-term liquidity management and macroeconomic shocks, and that macroprudential policy plays an effective role in curbing risk-taking behavior.

Keywords: Banking crisis, macroprudential policy, Loan to Deposit ratio, Exchange Rate Volatility, Systemic risk.
JEL Classification: G28; G21; C35; P34; E44.

1 Introduction

Financial and banking crises, especially the global financial crisis of 2007-2008, have highlighted the importance of maintaining financial system stability and the role of macroprudential policies in preventing such crises. Macroprudential policies are designed as a set of supervisory and regulatory tools aimed at controlling the accumulation of systemic risks and moderating credit cycles to reduce the likelihood of banking crises and enhance the resilience of the financial system [28]. In Iran's economy, the dependence on oil revenues and severe volatility in macroeconomic variables, have heightened the banking system's sensitivity to shocks.

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In this context, macroprudential policy can play an important role in reducing the vulnerability of the banking system [22, 24]. The global financial crisis of 2007-2008 demonstrated that weaknesses in supervision and control of systemic risks can lead to widespread collapse of banking system and destructive economic consequences [31, 32]. Macroprudential policies were designed as a set of supervisory and regulatory tools aimed at controlling risk accumulation, moderating credit cycles, and increasing the resilience of the entire financial system to reduce the likelihood of banking crises [28, 31].

The banking system in Iran faces numerous structural challenges such as increasing non-performing loans, excessive credit creation, and institutional weaknesses, all of which have increased the risk of banking crises [23]. Moreover, the economy's heavy reliance on oil revenues and volatility in macroeconomic variables have intensified the banking system's sensitivity to domestic and external shocks [17–19, 21, 25]. Empirical studies have shown that macroprudential policies in Iran have been able to reduce the banking system's vulnerability and prevent financial crises by limiting credit growth and improving the quality of bank assets [24, 25]. However, the effectiveness of these policies depends on the quality of supervision. Weak policy coordination and institutional constraints can reduce the effectiveness of macroprudential policies and even lead to risk shifting toward the informal sector [36].

After the global financial crisis of 2007-2009, macroprudential policy has become one of the most important economic policy tools for preventing financial instability and banking crises [4, 10]. In economies like Iran, which face exchange rate volatility, structural inflation, and high dependence on oil revenues, the design and effectiveness of macroprudential policies are of even greater importance. In Iran, over the past two decades, the banking system has faced challenges such as financial sanctions, capital outflow, high non-performing loans, and a lack of effective risk control instruments [17–19, 25]. Although policies such as exchange rate controls and administratively set interest rates have been implemented at various times, the possibility of a banking crisis remains a key concern in Iran.

The key question is whether macroprudential policy can also be effective in controlling banking crises. This is especially relevant given that monetary policy in Iran is mainly controlled through direct tools, the exchange rate is unstable, inflation is high, and the interbank interest rate plays the role of the policy rate. The banking system in Iran's economy has always played a dominant role in financing the real sector. On the other hand, the bank-centered structure, the absence of developed capital markets, exchange controls, and chronic balance sheet problems of banks have intensified the system's vulnerability to domestic and external shocks [18, 19, 24]. Given these conditions can increase the likelihood of a banking crisis. Moreover, banking system in Iran has faced serious vulnerabilities in recent decades due to structural problems, weak supervision, and excessive credit creation. Key factors such as state and quasi-state ownership of banks, the weak independence of

the central bank, banks' involvement in commercial enterprises, administratively set interest rates, and non-performing loans have laid the groundwork for banking crises and widespread imbalance [24, 40].

The literature on banking crises in Iran mainly employed the logit and Markov-switching models. They largely overlooked the role of macroprudential policy for mitigating banking crisis risks. Despite the growing international consensus—advanced by [11], and IMF policy frameworks—that macroprudential instruments play a central role in containing systemic risk and enhancing banking system resilience. Prior studies emphasize credit expansion, inflation, exchange rate, interest rate, and banking sector efficiency as key predictors of banking crises. However, they do not assess whether and to what extent macroprudential policy interventions can alter the probability of crisis occurrence. As a result, the domestic literature remains largely diagnostic rather than policy-oriented, focusing on crisis prediction rather than crisis prevention. This gap underscores the need for an integrated analytical framework that explicitly incorporates macroprudential policy indicators into empirical models of banking crisis probability. Aligning with the macroprudential literature, such an approach enables an evaluation of how policy-induced financial resilience interacts with traditional macro-financial risk factors. Addressing this gap not only contributes to the domestic banking crisis literature but also provides policy-relevant evidence on the effectiveness of macroprudential regulation in emerging and developing economies.

Another contribution of this study lies in employing an EGARCH model to extract exchange rate volatility and incorporating this measure as an independent variable in a Probit framework. To the best of our knowledge, this approach is applied for the first time in the Iranian context to empirically test the effectiveness of macroprudential policies in influencing the probability of banking crises using a Probit model. This methodological strategy is particularly critical for policy analysis under conditions of heightened uncertainty.

In this paper, using a probit model with monthly data over the period 2011 to 2023, we examine the impact of macroprudential policy tools—especially changes in the loan-to-deposit ratio (LTD)—on the probability of a banking crisis in Iran's economy. Specifically, we use the probit model to estimate the effects of macroprudential policy on the likelihood of a banking crisis while controlling for macroeconomic variables. To this end, following the methodology of [34], who studied the probability of currency crises, this approach is applicable to banking crises as well because it is based on Nakatani's theoretical model, which predicts the occurrence not only of currency crises but also banking crises [33].

The research questions are: What role does macroprudential policy play in reducing the probability of a banking crisis in Iran? And are inflation rate, interbank market interest rate, and exchange rate volatility in Iran effective in the efficiency of macroprudential policy? This paper is structured as follows: In the second section, we explain the theoretical background related to banking crises and macroprudential

policy. In the third section, we review the empirical literature. The fourth section devoted to empirical model, estimation method and data used for estimation. In the fifth section, we extract exchange rate volatility. It follows the extraction of banking crisis probability in section six. In section seven, we provide the empirical model and the baseline estimation results based on the probit model and robustness checks using various binary choice models. Section eight, devoted to the interpretation of the results. Finally, we conclude with policy recommendations.

2 Theoretical Background

Macroprudential policy refers to a set of actions designed to maintain financial stability, increase the overall resilience of the financial system, and reduce systemic risks. The ultimate goal of macroprudential policy is to prevent banking crises and mitigate their damaging effects on the real economy. Among macroprudential policy tools, the loan-to-deposit ratio (LTD) limit is one of the borrower-based tools. Macroprudential policy complements monetary policy, and coordination between the two increases effectiveness in controlling financial and economic fluctuations [25]. These two policies interact with each other through common banking channels and can complement each other. Especially under inflationary conditions, macroprudential policy is used in a targeted manner to reduce financial risks [30]. To prevent undesirable banking crises, macroprudential policy has been implemented in many countries.

Davis and Karim developed an early warning system to predict banking crises [13]. According to their findings, credit and real GDP growth are important predictors of banking crises. Ma found that macroprudential policy reduces the probability of crises and smooths consumption [29]. Alpanda et al. showed that prudential tools such as LTV are highly effective in curbing rapid credit growth and protecting bank balance sheets against default risk [5]. Within the theoretical framework of recent studies, the relationship between macroprudential policy and the probability of banking crises is explained through credit and balance sheet channels. According to Nakatani's model, in economies with rapid credit growth, an increase in LTV raises systemic risk, leads to the accumulation of risky debt, and consequently increases the probability of a banking crisis [33, 35]. According to Nakatani, the probability of a banking crisis can be predicted as a function of macroeconomic conditions and changes in policy indicators. By developing a theoretical model based on the relative efficiency of prudential policies, he showed that reducing macroprudential indicator significantly decreases the probability of banking crises. This underscores the necessity of an empirical study for Iran's economy [33].

The contribution of this paper includes macroeconomic variables related to banking crises in Iran, which are detailed as follows:
a) High Inflation Rate and Banking Crisis: Inflation can affect banking crises through two channels. High and volatile inflation causes instability in expectations,

capital flight, higher nominal interest rates, and a decline in asset values—all of which increase banking risk. Additionally, high inflation can destabilize expectations, raise nominal interest rates, and reduce the real value of collateral assets; factors that all increase the likelihood of a banking crisis [27, 37].

b) Interbank Market Interest Rate: Monetary policy, through the policy rate (and in Iran's case, due to its absence, the interbank market rate), plays a dual role in financial stability. This can lead to risk accumulation on balance sheets and create the conditions for a banking crisis. A persistently low interbank interest rate can lead to excessive credit growth and increased risk-taking by banks [24]. This situation often appears as credit or asset bubbles and can lead to crises if financial conditions reverse [2, 15]. Conversely, a sudden rise in interest rates can increase repayment pressure on borrowers and raise default rates.

c) Exchange Rate Volatility: Severe exchange rate fluctuations can lead to banking crisis. A depreciation of the national currency, in the presence of currency mismatch on the balance sheets of banks or firms, increases repayment pressure and adversely affects banks' performance [23]. Additionally, instability in foreign exchange income and exchange rates can cause capital outflows, reduce capital inflows, and lower banks' foreign reserves. Declining asset quality and foreign exchange volatility, combined with financial sanctions, increase the probability of a banking crisis [17–19].

d) Macroprudential Policy Indicator: Macroprudential policy indicators, such as changes in the LTD ratio, play an important role in reducing the probability of banking crises by influencing credit growth. These tools limit financial leverage and curb excessive credit growth, preventing systemic risk accumulation and controlling financial cycle fluctuations in Iran [25].

The LTD ratio mitigate liquidity risk by limiting banks' reliance on unstable short-term funding sources. This tool addresses the management of risks associated with lending activities and the valuation of borrowers' assets.

3 Literature Review

Abonouri et al., employed a logit model to analyze the determinants of the probability of banking crises. Their results indicated that the banking system's cost-to-income ratio, the ratio of credit to the private sector to GDP, and inflation, increase the likelihood of a banking crisis [1]. Zarei & Komijani evaluated the money market pressure index using a Markov-switching model and indicated that Iran experienced banking crises during certain periods [41]. The early warning system tests revealed that growth in the real exchange rate and the average real interest rate on loans are among the key predictors of the probability of banking crises in Iran. Furthermore, Akbarmousavi et al. examined the probability of banking crises using a logit model for 13 countries. Their findings show that three leading crisis indicators—broad liquidity, the stock price index, and inflation—are the main drivers of banking crises

[3].

Belkhir et al., assessed the impact of macroprudential policies on the likelihood of systemic banking crises using a sample that covers more than 100 countries over the 2000-2017 period. The results suggest that macroprudential policies have a positive net effect on financial stability [7]. Using data from 65 countries between 2000 and 2016, Nakatani finds that lowering the loan-to-value (LTV) ratio reduces the probability of banking crises by curbing credit growth [35]. Similarly, Altunbas et al. highlight that macroprudential tools—particularly higher capital requirements for smaller and weakly capitalized banks—help mitigate the severity of crises [6]. Nakatani further shows that these policies are more effective under inflation-targeting regimes and when supported by flexible exchange rate arrangements [35]. Evidence from the International Monetary Fund indicates that in the absence of capital controls, housing-related measures can help prevent crises triggered by sudden capital inflows [8]. The effectiveness of these policies differs across economies: in emerging markets, borrower-based tools such as debt-service-to-income (DSTI) caps limit risky credit expansion, while in advanced economies, combining these measures with liquidity requirements yields better outcomes [14].

During the COVID-19 pandemic, countries that paired macroprudential policies with targeted liquidity support faced fewer bank failures [8]. Overall, empirical evidence consistently supports the stabilizing role of macroprudential tools. Following the global financial crisis, for example, the European Union overhauled its macroprudential framework, underscoring that strong supervisory institutions and cross-policy coordination are essential for financial stability, particularly in times of systemic stress [16]. In the same vein, Khalif argues that macroprudential policies are most effective when designed around country-specific conditions and institutional capacities [26]. Econometric studies, including probit model estimations, further confirm that tightening macroprudential measures substantially lowers the likelihood of banking crises [35]. Cerutti, Claessens, and Laeven find that borrower-based measures outperform capital-based tools in containing risky credit growth, particularly when implemented proactively [10]. Nakatani, who studied the link between macroprudential indicators and banking crises across 65 countries during 1990–2015, shows that the effectiveness of macroprudential policies is weaker in economies with fixed exchange rates or weak capital controls, underscoring the importance of the broader policy environmentv [35]. Similarly, Dell'Ariccia et al. demonstrate that prolonged low interest rates, when not accompanied by credit controls, encourage excessive lending and risk-taking, thereby increasing crisis risk over the long run [15].

Tomczak examined the effect of the COVID-19 pandemic on the banking sector and to assess if COVID-19 was a trigger for the banking crisis [38]. The results suggested that the pandemic contributed to higher volatility and risk in banking sector but did not confirm a systematic banking crisis. Kelly and Rose highlighted the facts that depart from the 2023 banking crisis. They described the crisis as

a reaction to bank business models that focused on providing banking services to certain economic sectors, that had come under economic pressure during the preceding year [20].

In sum, the literature strongly supports the view that macroprudential tools reduce systemic banking risks. However, their success hinges on institutional capacity, policy coordination, and broader macroeconomic conditions. While international evidence is robust, the Iranian context—characterized by volatile exchange rates, high liquidity growth, and persistent inflation—requires dedicated empirical research to assess how macroprudential policies could mitigate banking sector vulnerabilities. Our contribution is threefold:

First, context-specific relevance: Iran represents a highly bank-based economy with a dominant role of state-owned banks, administered interest rates, and limited integration with international financial markets due to sanctions. Hence, Iran provides a unique laboratory to test the effectiveness of macroprudential tools under such constraints.

Second, literature gap: Existing studies on the nexus between macroprudential policy and banking crises have largely focused on open economies with liberalized financial systems. Empirical evidence is needed for economies with the combination of financial frictions, banking sector imbalances, and external constraints. This study fills this gap by providing evidence from a constrained, bank-based financial system.

Third, policy relevance: The Iranian banking sector has been experiencing chronic imbalances, such as high non-performing loans, maturity mismatches, and liquidity shortages. In this context, understanding whether macroprudential instruments can mitigate the probability of banking crises is of high policy relevance. Our results can thus enrich the global debate on the effectiveness of macroprudential policy in different institutional settings.

Therefore, the novelty of our study is on providing insights into how macroprudential policy works in a banking system under structural and external constraints, a context that is largely absent in the existing literature. We aim to fill this gap by using Iranian economic data, a binary crisis probability model, and updated macroprudential policy indicators to produce localized results based on Iran's economic structure.

4 Empirical Model and Estimation Method

We employ a Probit model. The dependent variable is a dummy variable called banking crisis, which takes the value one in years when a crisis occurs and zero in other years. The main independent variables include the macroprudential policy indicator (loan-to-deposit ratio), inflation rate, interbank market interest rate, and

exchange rate volatility. The general form of the model is as follows:

$$Pr(y_t = 1|x_t) = \varphi(x'_{i,t}\beta) + \epsilon_t \tag{1}$$

where:
Pr denotes probability, and the subscript t indicates time.
Y denotes a dummy variable that equals one if a banking crisis occurs and zero otherwise.
X denotes the set of independent variables.
φ denotes the normal cumulative distribution function.
β denotes the vector of maximum likelihood estimates.
ϵ denotes the error term.

The dates of banking crises were identified by calculating the money market pressure index, using a Markov switching model. The macroprudential policy indicator (LTD) is derived from the loan-to-deposit ratio, and the exchange rate volatility variable is extracted using an Exponential GARCH (EGARCH) model. The last explanatory and independent variable is the inflation rate. The variables, definitions and source of data are described in Table 1.

Table 1: Data Description

Variable	Definition	Source
Banking crisis	Crisis=1 ; no crisis=0	CBI
LTD	Loan uytitto deposit	CBI
Inflation	Monthly inflation rate (%)	CBI
Monetary policy	Inter-bank interest rate (%)	CBI
Exchange rate volatility	EGARCH	CBI

CBI: Central Bank of Iran

Table 2 provides the descriptive ststistics (mean, standard deviation, minimum and maximum) of the variable used in the model.

The rationale for using LTD as a macroprudential policy tool is that the loan-to-deposit ratio (LTD) is a widely recognized indicator of both liquidity risk and credit risk in the banking system, and thus plays a crucial role in assessing the likelihood of banking crises. In Iran, due to the absence of a centralized and comprehensive database for recording the market value of collateral and borrowers' actual income, macro-level monitoring and implementation of loan-to-value (LTV) and debt-to-income (DTI) ratios face serious challenges. In Iran's banking system, which is

Table 2: Summary statistics

Variable	Mean	Std.dev	Min	Max
Banking crisis	0.4615	0.5001	0	1
LTD	4.7647	2.8567	1.1730	9.5821
Inflation	28.7201	3.1348	8.6	59.3
Monetary policy	20.9864	14.8829	15.0901	29.3273
Exchange rate volatility	1.7786	2.2703	0.00002	7.4327

Source: Authors' findings

highly dependent on unstable deposits, controlling the LTD ratio represents the most effective operational tool for containing procyclical credit fluctuations and funding risk. In practice, central bank policies—such as asset–liability management measures and credit ceilings—have indirectly and predominantly focused on managing the LTD ratio as a key operational indicator. A high LTD ratio implies that banks have converted a large share of their deposits into loans, leaving them with limited liquidity buffers. This increases their vulnerability to sudden deposit withdrawals or liquidity shocks. As banks expand their lending relative to deposits, they often loosen credit standards in order to maintain growth. This behavior increases the likelihood of riskier loans entering their portfolios, thereby raising the share of non-performing loans (NPLs). In the Iranian context, the financial system is highly bank-based and relies predominantly on deposits as the main funding source and reliable data on LTD are available. The persistently high LTD ratios observed in recent years have been one of the root causes of balance sheet fragility, liquidity shortages, and episodes of banking stress in Iran. In sum, LTD serves as a critical indicator of systemic vulnerabilities and a key instrument of macroprudential policy. Thus, focusing on LTD allows us to capture systemic vulnerabilities and evaluate the effectiveness of macroprudential policy in mitigating banking crises.

5 Extraction of Exchange Rate Volatility

To extract the EGARCH, we followed two-steps. First, the optimal time-series specification is selected based on the Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC). Second, the presence of conditional heteroskedasticity is formally tested using the ARCH-LM statistic, after which the estimated conditional variance from the EGARCH model is employed as the volatility measure entering the probit regression. The EGARCH specification is preferred to the standard GARCH model due to its ability to capture asymmetric volatility dynamics, which are particularly relevant for Iran's exchange rate. In this context, adverse shocks tend to generate strong volatility responses. As reported in Table 3, the null hypothesis of homoscedasticity is rejected, confirming the presence of ARCH effects and

justifying the use of a conditional volatility model. Moreover, the Jarque–Bera test strongly rejects normality of residuals, indicating fat-tailed behavior in exchange rate returns. Consequently, the EGARCH (1,1) model is estimated under a Student's t-distribution, which allows for heavy tails and improves the robustness of volatility estimates.

Table 3: ARCH-LM Test Results

Statistic	Value	Probability
F	19.914	0.0000
nR^2	17.939	0.0000

Source: Authors' findings

The estimation results in Table 4 confirm the suitability of the EGARCH (1,1) specification. All coefficients are statistically significant and indicate persistent and asymmetric volatility dynamics. The estimated degrees of freedom of the Student's t-distribution (approximately five) further confirm the presence of excess kurtosis in the data. These results validate the use of a non-normal error distribution and ensure efficient estimation of conditional variance.

Table 4: EGARCH Model Estimation for Exchange Rate

Variable	Cofficient	Standard Error	Z	Prob
C	1.056	0.196	5.373	0.0000
α_0	0.413	0.095	4.308	0.0000
α_1	-0.271	0.097	-2.777	0.0055
β	0.359	0.053	6.656	0.0000
γ	0.901	0.016	53.47	0.0000
T-DIST. DOF	5.055	2.176	2.323	0.0202

Source: Authors' findings

Importantly, the Student's t-distribution is applied exclusively in the first-stage volatility extraction. The resulting conditional volatility series enters the probit model as an observed explanatory variable, while the probit specification itself maintains the assumption of normally distributed errors. Thus, the use of a heavy-tailed distribution in the EGARCH stage does not compromise the validity of inference in the crisis probability model. On the contrary, improving the accuracy of volatility measurement enhances the reliability of the estimated relationship between exchange

rate instability and banking crises (Table 5).

Table 5: ARCH-LM Test Results

Statistic	Value	Probability
F	0.1908	0.6629
nR^2	0.1931	0.6604

Source: Authors' findings

The extracted conditional volatility series (Figure 3) exhibits pronounced clustering and sharp spikes, reflecting episodes of heightened exchange rate instability. Rather than serving as a descriptive historical narrative, these episodes are interpreted as empirical illustrations of the transmission channels captured by the probit estimates. Major volatility surges—most notably those associated with the 2012 and 2018 exchange rate shocks—coincide with periods of intensified balance-sheet stress, rising non-performing loans, and liquidity pressures within the banking system. These mechanisms provide an empirical interpretation for the positive and statistically significant coefficient on exchange rate volatility in the probit model (1.0114), indicating that higher volatility substantially increases the probability of a banking crisis.

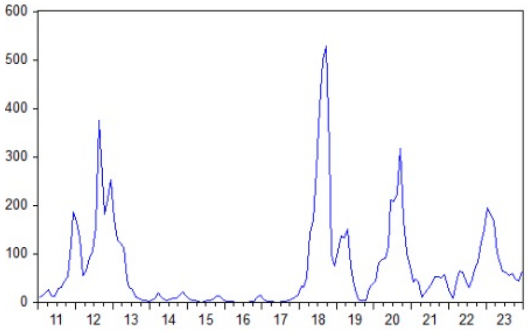

Figure 1: Conditional Exchange Rate Volatility Extracted from EGARCH (1,1) Model
Source: Authors' findings

6 Extraction of Banking Crisis Probability

To figure out major banking crises in Iran, the Market Pressure Index (MPI) has been evaluated using a Markov-switching model approach on monthly data from 2011 to 2023. The results indicated that Iran experienced banking crises during certain periods. The Market Pressure Index is defined as a weighted average of changes in the ratio of loans granted by the Central Bank to banks relative to total

banking network deposits, plus changes in the real short-term interest rate. The weights are based on the sample's standard deviations of these two components. The index can be expressed as follows:

$$MPI_t = \frac{\Delta\gamma_t}{\sigma_{\Delta_\gamma}} + \frac{\Delta r_t}{\sigma_{\Delta_r}} \tag{2}$$

One issue in analyzing banking crises is contagion, which can be indicated by a dummy variable. However, this method is not applicable in our binary choice model, because it is well-known that estimated coefficients become highly biased when time-fixed effects are introduced [12]. As any variable capturing contagion in financial markets naturally has time-varying characteristics, we cannot incorporate it here. Another concern is omitted variable bias. Although this can occur in any econometric specification, such bias is generally negligible in probit and logit models. Wooldridge demonstrated that this bias does not affect the impact of other independent variables on the outcome in probit models [39]. Marginal effects are not affected by omitted variable bias because they are not affected by omitted variables. Therefore, in our analysis, we can confidently state that potential omitted variables do not have a significant impact on the statistical significance or size of the estimated regression coefficients. All data have been extracted from the Central Bank of Iran's database. The monthly data covers the years from 2011 to 2023 (Table1). Summary statistics for each variable are shown in Table 2. The selection of the 2011–2023 sample period is motivated not only by data availability but also by institutional and regulatory factors. Specifically, this period coincides with the formal initiation of Basel III requirements and the more structured implementation of macroprudential policies in Iran's banking system. Including data from earlier periods would have introduced structural bias due to substantial changes in variable definitions and heterogeneity in supervisory practices. Accordingly, the chosen sample represents a relatively homogeneous regulatory and supervisory regime that is consistent with the core focus of the study on macroprudential policy and financial stability.

7 Empirical Model Results

The estimation results of the model are reported in Table 6. The results indicate that the estimated coefficient of the LTD variable has a positive and statistically significant effect on the probability of a banking crisis at the 1% level. This means that a higher LTD ratio is associated with a higher probability of a banking crisis. This is an intuitive result because a higher LTD ratio is considered a reduction in macroprudential policy, which can lead to financial instability. Appropriate metrics for the probit model are shown in Figure1. Figure1 shows that the area under the

Note: Δ denotes the difference operator, $\sigma\Delta\gamma$ denotes the standard deviation of the ratio of total reserves of the banking system to total bank deposits, $\sigma\Delta r$ denotes the standard deviation of the real short-term interest rate [21].

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receiver operating characteristic curve (ROC) is 0.9385, and the empirical characteristics of our probit model estimation provide excellent discrimination. Considering that this area under the ROC curve (AUROC) is higher than those found in the literature, for example, 0.717 in the logit model by Taylor & Schularick [37], as well as higher than the probit model of Nakatani, which is equivalent to 0.887, Figure (1) distinctly shows that our probit model is very effective in predicting banking crises [35].

Table 6: Empirical Model Estimation Results

Estimation Method: Probit	Cofficient	Standard Error	Z	Prob
LTD	0.6182	0.1733	3.57	0.000
Inflation	0.0949	0.0255	3.72	0.000
Monetary policy	-0.3429	0.1296	-2.64	0.008
Exchange rate volatility	1.0114	0.2307	4.38	0.000

Source: Authors' findings

The positive estimated coefficient on the LTD variable indicates that tightening the LTD ratio is associated with a lower probability of a banking crisis through the credit channel. This result aligns with the matching theory and this study is pioneering in estimating this effect on the probability of a banking crisis. The estimated coefficient of the inflation variable is statistically significant at the 1% level and positive. In Iran's inflationary context, where inflation is above 50%, this high and volatile level causes instability in expectations, capital flight, increased nominal interest rates, and a decrease in asset values, all of which increase banking risk. The coefficient of the policy rate variable (interbank interest rate) is also statistically significant at the 1% level and negative, indicating that an increase in it is associated with a lower probability of a banking crisis. This result is logical because an accommodative monetary policy can lead to a credit bubble, which often results in banking crisis. In the model, the LTD ratio serves as the primary macroprudential policy instrument for managing liquidity and credit risks within the banking system. The LTD ratio reflects the proportion of bank deposits that have been transformed into loans. In many countries, regulatory authorities use this ratio to ensure that banks maintain sufficient long-term funding to support their illiquid assets (i.e., loans). The policy objective behind setting LTD limits is to contain maturity transformation risk—that is, to prevent banks from excessively using short-term funding (deposits) to finance long-term loans. Banks with high LTD ratios have fewer liquid resources to meet withdrawal demands promptly. The inability of a large, highly leveraged bank to satisfy these demands can rapidly spread to other banks through contagion, leading to a systemic liquidity crisis and, consequently, a heightened likelihood of a banking crisis. The coefficient of the

exchange rate volatility variable is highly statistically significant at the 1% level and positive. Table 7 measures the marginal effect in the probit model.

Table 7: Calculation of the Marginal Effect in the Probit Model

Variable	$\frac{dy}{dx}$	Standard diviation	statistic Z	Prob
LTD	0.2272	0.0492	4.61	0.000
Inflation	0.0348	0.0073	4.75	0.000
Monetary policy	-0.126	0.0374	-3.37	0.001
Exchange rate volatility	0.3717	0.0851	4.37	0.000

Source: Authors' findings

Additionally, Figure 2 illustrates the area under the ROC curve.

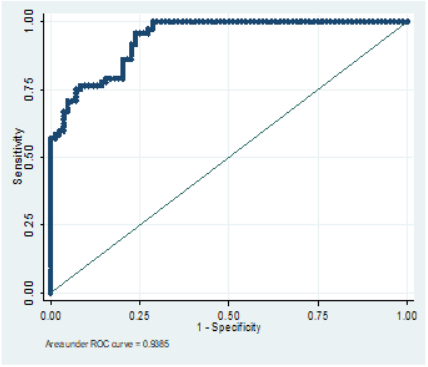

Figure 2: Area Under the ROC curve. *Source: Authors' findings*

8 Interpretation of the Results

A sudden increase in the exchange rate can lead to an increase in non-performing foreign currency claims, a decrease in the value of banks' foreign currency assets, and consequently, an increased probability of a banking crisis. High inflation in Iran is usually accompanied by liquidity growth and monetization of the government's budget deficit. This situation can lead to a decrease in the real value of banks' assets, an increase in non-performing claims, which reduce the health of the banking system. A high interbank interest rate indicates a liquidity shortage in the banking system. In Iran's context, this liquidity shortage partly stems from the increase in banks' non-performing claims. An increase in the interbank interest rate can raise banks' financing costs and consequently reduce their profitability, which can increase the likelihood of a banking crisis.

The Probit model results show that the coefficient of the LTD variable is positive and significant. This means that a higher LTD ratio is associated with an increased probability of a banking crisis. The inflation rate has a positive and significant effect on the probability of banking crisis. The interbank market interest rate has a negative and significant effect on the probability of a banking crisis; therefore, monetary policy alone cannot contain banking crises. Increasing the interbank rate affects the probability of a banking crisis through increasing short-term banks' financing costs; reducing liquidity in the banking system and increasing default risk. A negative coefficient for the interbank interest rate indicates the dominance of the central bank's "disciplinary" or "regulatory" effect over the "liquidity crunch" effect. This finding is particularly reasonable in the context of Iran's economy, where the banking system is under strict regulatory supervision. In such an environment, the interbank rate functions as a monetary control instrument of the Central Bank of Iran (CBI).

In practice, by raising the interbank rate, the central bank increases the cost of funding for those banks that have engaged in excessive lending. This policy constrains excessive risk-taking, compelling banks to manage their liquidity and asset portfolios more prudently. In Iran's banking environment, a higher interbank interest rate thus reflects the "cost of financial discipline" imposed by the regulator — a cost that, in the end, contributes to mitigating systemic risk. Exchange rate volatility can increase the probability of a banking crisis through the following channels: increasing foreign currency debt and reducing debtors' repayment capacity (currency mismatch); decreasing collateral values and client creditworthiness (balance sheet effects); and increasing distrust in the banking system and deposit withdrawals (confidence and contagion effects).

The empirical findings of this study (Table 5) indicate that exchange rate volatility, with a coefficient of 1.0114, is the most powerful predictor of banking crises in Iran. To explain the magnitude of this effect, it is necessary to analyze the transmission mechanisms through which exchange rate shocks affect financial stability. These mechanisms operate through three interrelated channels:

First, Balance Sheet and Currency Mismatch Channel:

The experience of major exchange rate depreciations over recent decades suggests that, due to significant currency mismatches in the balance sheets of many Iranian banks and their major borrowers, exchange rate shocks lead to an abrupt revaluation of foreign-currency liabilities. Given that a large share of banks' assets is denominated in domestic currency and exhibits low liquidity, exchange rate shocks may lead to the brink of financial distress.

Second, Asset Quality and Credit Risk Channel:

Evidence on exchange rate shocks, indicate that sharp exchange rate volatility disrupts industrial input supply chains and raises production costs. Consistent with the probit model results, these dynamics translate into higher loan default rates, leading to a surge in non-performing loans (NPLs). This process intensifies

asset illiquidity and balance-sheet deterioration, thereby substantially increasing the probability of systemic banking crises.

Third, Expectations and Deposit Withdrawal Channel:
In the Iranian economy, exchange rate movements function as a key barometer of inflationary expectations. Exchange rate shocks captured by the EGARCH model, characterized by asymmetric effects, trigger shifts in depositors' asset portfolios away from domestic currency toward alternative assets. This liquidity reallocation exposes banks to short-term funding stress and heightens pressure in the interbank market. As reflected by the statistically significant interbank rate coefficient (-0.3429), liquidity renewal costs increase disproportionately for structurally weak banks, amplifying systemic vulnerability.

In the Iranian economy, financial stability is intrinsically linked to exchange rate stability, and disturbances in the foreign exchange market are rapidly transmitted into balance-sheet stress and systemic banking crises.

9 Conclusion and Policy Recommendations

We found that tightening the LTD ratio is statistically and significantly associated with a lower probability of banking crises through the credit channel. Second, the inflation rate has a positive and significant impact on the probability of crisis. Third, the interbank market interest rate has a negative and significant effect on the probability of a banking crisis. Fourth, exchange rate volatility caused by financial crisis shocks leads to banking crises. Tightening the LTD instrument can play an important role in curbing risky credit growth and reducing the likelihood of crisis.

Based on the estimated results of the empirical model, the following policy recommendations are proposed.
First, Dynamic management of the loan-to-deposit (LTD) ratio: The positive coefficient of 0.6182 with a z-statistic of 3.57 indicates that an increasing imbalance between banks' funding sources and uses constitutes a major driver of banking crises. The central bank should move beyond static supervision and implement risk-based, dynamic LTD ceilings tailored to banks' risk profiles. Banks that exceed the prescribed LTD thresholds should be required to hold additional reserve requirements. This measure raises the marginal cost of credit creation and curbs excessive balance-sheet expansion, thereby mitigating systemic liquidity risk.

Second, Reconsidering the role of the interbank interest rate: The negative coefficient of -0.3429 suggests the dominance of a disciplinary effect, whereby higher interbank rates restrain liquidity demand and reduce the probability of a banking crisis. Monetary authorities should refrain from administratively suppressing the interbank interest rate. The interbank rate should function as an early warning signal rather than merely a conventional monetary policy instrument. Increases in this rate should be interpreted as indicators of bank-level stress and used to identify structurally weak banks, guiding them toward balance-sheet adjustment and risk

correction.

Third, Prioritizing exchange rate stability as a macroprudential instrument: Exchange rate volatility, with a coefficient of 1.0114—the largest in the model—exerts the strongest effect on banking crisis probability. In Iran's bank-based financial system, exchange rate stability is not merely a macroeconomic objective but a core supervisory necessity. The central bank should mandate exchange rate stress tests for banks. Given the magnitude of this coefficient, banks with unstable open foreign exchange positions should be required to hold higher capital buffers to prevent exchange rate shocks from triggering systemic bank failures.

Fourth, Inflation containment to preserve bank asset quality: The positive coefficient of 0.0949 confirms that inflation increases crisis risk by eroding real asset values and amplifying uncertainty. Effective coordination between monetary policy and macroprudential regulation is essential. By controlling inflation, policymakers can reduce banks' incentives to engage in non-core activities such as real-sector ownership and fixed-asset accumulation as a hedge against inflation. This, in turn, improves balance-sheet liquidity and lowers the likelihood of crises arising from asset illiquidity and balance-sheet rigidities.

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