Iranian Journal of Finance

Print ISSN 2676-6337
Online ISSN 2676-6345

The Impact of Monetary Policy and Moderating Role of Capital on the Relationship between Bank Liquidity Creation and Failure Risk in Banks listed on the Tehran Stock Exchange

Ata Shafieinia

MSc. in Finance, Department of Financial Management, Faculty of Management and Accounting, Farabi Campus of University of Tehran, Qom, Iran. (Email: atashafienia@ut.ac.ir)

Asgar Noorbakhsh*

*Corresponding Author, Assistant Prof., Department of Financial Management, Faculty of Management and Accounting, Farabi Campus of University of Tehran, Qom, Iran. (Email: anoorbakhsh@ut.ac.ir)

Iranian Journal of Finance, 2025, Vol. 9, No.3, pp. 1-26.
Publisher: Iran Finance Association
doi: https://doi.org/10.30699/ijf.2025.397104.1413
Article Type: Original Article
© Copyright: Author(s)
Type of License: Creative Commons License (CC-BY 4.0)

Received: May 03, 2024
Received in revised form: October 12, 2024
Accepted: December 28, 2024
Published online: July 20, 2025

Abstract

The concept of liquidity creation has received much attention in project financing, as increased liquidity facilitates easier access to financial resources for long-term projects (Berger & Bouwman, 2009). However, the liquidity creation process is often accompanied by risk. Despite its advantages, if not managed properly, it can cause problems for the banking system and even the entire economy. On the other hand, capital is considered an influential variable in risk management, which helps the bank control challenging conditions. In

this regard, the present research was conducted to investigate the moderating role of capital in the relationship between liquidity creation and failure risk, and further tried to examine the role of the monetary policy adopted by the central bank, considering the macro effects of this variable. This applied research project examined the banks admitted to the Tehran Stock Exchange from 2012 to 2018. The results showed that by controlling the variables of interbank interest rate and the variety of loans and deposits, liquidity creation is significantly and directly associated with failure risk. Moreover, the findings confirmed the moderating role of bank capital in the relationship between liquidity creation and failure risk. However, the monetary policy adopted by the central bank revealed an insignificant effect on this relationship. Therefore, decision-makers should consider these factors in the decision process.

Keywords: Liquidity Creation, Failure Risk, Bank Capital, Monetary Policy

JEL Classification: G21, G28, E52, G32, E44

Introduction

To compete in financial markets, banks should undertake two missions: (1) liquidity creation and (2) risk shifting (Bhattacharya & Thakor, 1993). The first mission is based on the mediation theory. Banks are often forced to reform their high-quality assets and provide liquidity, keep non-liquidating claims in favor of the firm, and instead provide depositors with sight deposits. All of these are due to the limited deposits, the inevitability of the short-term liabilities, and the long-term or large demands of the fund applicants (Bryant, 1980; Diamond & Dybvig, 1983). In this process, banks create liquidity based on the spread between what banks do with deposits and the ways they find to finance the firm's activities (Bhattacharya & Thakor, 1993). According to the literature, this process takes place by converting non-current assets into current liabilities (Bryant, 1980; Diamond & Dybvig, 1983) or through off-balance-sheet activities, including loan covenants (Holmstrom & Tirole, 1998; Kashyap et al., 2002; Thakor, 2005).

From the financing perspective, although the liquidity creation process seems useful in its balance sheet, the bank contrasts illiquid claims of the firm and unreliable money with definite liquid debts to depositors. This might turn the capital structure into an unusual state and expose the bank to a risk (Allen & Gale, 2004; Allen & Santomero, 1997); in case of default, this could make the bank unstable and put it at risk of failure (Fungacova et al., 2015). Furthermore, since the balance sheet items are related to other banks, this problem will be transferred to them and finally to the whole economy as a

domino effect (Friedman & Schwartz, 1963). In economic terms, banks generate liquidity by extending credit beyond their reserves, effectively creating financial assets without intrinsic value. Excessive and unregulated expansion of such liquidity can contribute to forming and escalating asset bubbles, inflationary pressures, and ultimately financial crises (Acharya & Naqvi, 2012). Therefore, the second mission of banks, i.e., risk management and shifting, becomes significant so that banks remain stable in the face of instability by adopting appropriate measures (Khodaei & Kohandel, 2011).

Consequently, banks with sufficient capital, assets with suitable liquidity, and stable financial structures can withstand negative economic shocks, effectively maintain their mediating capacity, help the economy, and flexibly continue to create money that leads to economic value. This subject has been of interest to the Basel Committee over the years and is specifically stated in its third statement (Repullo, 2004; Von Thadden, 2004). However, some believe higher capital forces banks to be more active and increase their risk-taking. Despite the different views on the role of capital, liquidity creation is always coupled with risk. Thus, it has become an important concern for decision-makers to decide on the balanced levels of bank capital and liquidity creation and the simultaneous impact of these elements on the risk factor and ultimately the macroeconomy. It should be considered that excessive liquidity creation can result in a future crisis (Berger et al., 2008), and also low levels of creation may put the bank’s profitability, risk management, and economic cycle at risk.

Principally, this issue is important in Iran because the economic system is bank-oriented, owing to the inefficiency of the capital market, and essentially, banks provide long-term financing. Additionally, most of the banks are state-owned, which has led them to override the country's economic cycle. Thus, banks have become influential levers for the government and the central bank as monetary authorities and policymakers. Considering the importance and complexity of this issue, it is essential to have comprehensive information and awareness about the dimensions and influences of these factors before making any decision. Otherwise, it results in improper conclusions and the establishment of wrong policies, which can irreversibly damage the entire economic system. Therefore, the present research aims to investigate the concepts of capital, liquidity creation, and failure risk, considering the monetary policies adopted by the central bank. Besides, it fills the existing gap in the literature and academically facilitate decision-making for policymakers, managers, and monetary authorities so that they can make the most effective decisions considering all aspects of the issue.

Literature Review

Liquidity creation and failure risk

The literature has different views on the relationship between liquidity creation and bank failure risk. In this regard, Diamond and Dybvig (1983) proposed an argument that was extended by Allen and Santomero (1997) and Allen and Gale (2004). They emphasize that liquidity creation exposes banks to failure risk by converting long-term assets into short-term liabilities. Contrarily, some views believe that this relationship is vice versa, based on two reasons: (1) liquidity creation is one of the main functions of the bank and indicates the bank's ability to support the economy and meet the maturities. Therefore, the bank's inability to manage the balance sheet and the liquidity creation process could be a warning for future problems (Fungacova et al., 2015). Chatterjee (2018) consistently revealed that low liquidity creation levels could lead to a recession in the United States economy. (2) Banks actively manage their capital, concerning the level of risk (Berger et al., 2008), and especially, in the case of the inadequacy of the liquidity level, they enhance their capital buffer through the process of liquidity creation (Distinguin et al., 2013).

Vaez Barzani and Ebrahimi (2014) theoretically analyzed the effect of credit creation and financial crises. Their results showed that the creation of extrinsic value would cause economic volatility, and its constant repetition could result in financial crises and permanently reduce production and welfare. To prevent these crises, it is necessary to move towards a financial system based on the creation of intrinsic value and funded liquidity creation under specific criteria. Other findings emphasize the positive effects of liquidity creation by observing and controlling the scope of liquidity increase. For example, by examining Russian banks from 2000 to 2007, Fungacova et al. (2015) showed that increased liquidity creation had positive results. However, the creation beyond a specific limit could intensify bank failure. Moreover, Stoop and Sornette (2010) examined the recent global crisis that started in 2007 and stated that money is similar to fuel, without which the economy cannot work. However, if too much money passes through the arteries of the financial system, it leads to an artificial increase in asset prices, which does not truly reflect economic growth; this extra credit creation causes economic instability and bubbles, and thus, it should be controlled.

Bank capital and liquidity creation

Two theories are suggested regarding the effect of bank capital on liquidity creation. First, the Financial Fragility Theory proposes that capital negatively impacts liquidity creation and a higher capital ratio makes the bank less fragile (Diamond & Rajan, 2001). Also, high capital may reduce liquidity creation due to the pressure of deposits, which is one of the significant triggers of liquidity creation (Gorton & Winton, 2017). Second, the Risk Absorption Theory denotes the positive effect of capital on liquidity creation because capital expands the margin of risk-taking and improves the capacity of liquidity creation (Allen & Gale, 2004; Allen & Santomero, 1997; Bhattacharya & Thakor, 1993; Repullo, 2004; Von Thadden, 2004).

Horváth et al. (2014) investigated the banks of the Czech Republic from 2000 to 2010 and found that in small banks, capital is inversely associated with liquidity creation; this supports the financial fragility hypothesis. Again, consistent with this hypothesis, the examination of fourteen economies in Asia and the Pacific, using the generalized method of moments (GMM), demonstrated a negative two-way relationship between capital and liquidity creation, where the banks had created only 22% of liquidity from the balance sheet (Fu et al., 2016). In Iran, Shahchera and Taheri (2015) studied the effect of banks' capital structure and found that higher capital leads to less liquidity and reduces financial fragility in the banking network. Furthermore, the study of annual Chinese banking data from 1988 to 2009 revealed a negative relationship between capital ratio and liquidity creation, so the financial fragility hypothesis also harmonizes with Chinese banks (Lei & Song, 2013).

Furthermore, a parallel study (Berger & Bouwman, 2009) empirically examined the relationship between bank capital and liquidity creation among commercial banks in the United States and supported both of the mentioned hypotheses. This study evidenced direct and indirect associations between the mentioned variables in large banks (that provide the most liquidity) and small banks, respectively, which align with the effects of risk absorption and financial fragility. Moreover, conducting the GMM among Iranian banks, Rezazadeh Karsalarei and Sargolzaee (2019) showed a significant positive effect of shareholders' equity on liquidity creation, such that with the increase of equity, the liquidity creation increases. Thus, their results are consistent with the risk absorption hypothesis because of the obtained positive relationship between capital and liquidity creation. Also, among American and European commercial banks from 2000 to 2006, Distinguin et al. (2013) represented that capital and liquidity creation affect the public markets, bank size plays an

essential role in this relationship, and the direction of the effects relies on the size of the bank in these markets. Regarding lending behavior in American banks, Carlson et al. (2013) showed that the effect of capital on loan growth varies based on the type of loan. Also, loans are more flexible in relatively low capital ratios; this indicates the non-linear association of capital and bank loans.

Bank capital and failure risk

Several theories have been proposed that consider the role of bank capital in failure risk. Some (e.g., Repullo, 2004; Von Thadden, 2004) believe that bank capital reduces failure risk and acts as a shield that absorbs potential losses stemming from unexpected asset returns. Another set of theories that focus on the motivational effects of capital states that capital pushes banks to highly control their transactions with borrowers, which would reduce the probability of default (e.g., Holmstrom & Tirole, 1998) and the excessive risk-taking motivations (e.g., Acharya et al., 2016). These theories assume an indirect association between bank capital and bank failure risk. Various empirical studies have been conducted in this area, indicating that failure risk mainly originates from low capital. However, some studies concluded the opposite, the results of which are also mentioned in the following.

The study of American banks shows that a group of basic variables that explain the bank's condition (such as capital and net income, which are usually used to predict failure) can foresee the banks' durability, also, these variables are significantly related to the period of failure, which is often caused by the low amount of capital (Cole & Gunther, 1995). Moreover, seeking the determining factors of failure during the recent financial crisis, Beltratti and Stulz (2012) examined 164 banks in thirty-two countries; their results suggested bank capital as one of the explanatory factors of failure. In other words, banks with greater capital buffers were more flexible in facing adverse shocks and indicated lower failure risk. Besides, examining the effects of market structure on the profitability and stability of banks among forty emerging and advanced economies shows that an increase in capital ratio leads to an increase in banks' stability and a decrease in risk (Mirzaei et al., 2013). Demirguc-Kunt et al. (2013) used the quarterly data of banks in twelve countries during the financial crisis of 2007 to examine the relationship between capital structure and stock returns; they showed that capital is crucial, especially for big banks, and its higher quantity and better quality provide banks with a stronger position to deal with failure during the crisis.

Contrarily, Lin et al. (2005) examined the relationship between risk-based capital adequacy, insolvency risk, and financial performance in Taiwan's banking industry. The study found that higher risk-based capital adequacy ratios were associated with lower insolvency risk, indicating that well-capitalized banks were more stable. However, the results also suggested that excessively high capital requirements could negatively impact financial performance, potentially reducing profitability. The paper emphasized the need for a balanced approach to capital regulation to ensure stability and efficiency in the banking sector. Furthermore, using simultaneous equations, Selgi and Talebi (2017) investigated the causal relationship between capital ratio and risk among Iranian banks and presented an interactive two-way relationship between the variables. In particular, the increase in the capital ratio leads to an increase in risk, and an increase in risk leads to a decrease in the capital ratio; however, with a one-unit increase in capital, banks increase their risk by almost three units. Also, a positive correlation is reported between capital and risk for the behavior of European and Canadian banks in the 90s (Van Roy, 2008). Although no significant relationship is found among American banks, there is a significant indirect association between these two variables in Japanese banks. This author also notes that in the case of risk, banks with weak capital increase their capital ratio faster than banks with substantial capital, in America. In a study using a dynamic model, Calem and Rob (1999) showed that a bank's level of risk-taking depends on the temporary state of its capital, and there is a "U-shaped" relationship between capital and risk.

Monetary policy, liquidity creation, capital, and failure risk

Regarding capital, the examination of banking requirements and credit restrictions shows that the ratio of capital to assets in a bank determines how the bank reacts to monetary policy, among the banks of the UK (Peek & Rosengren, 1995). Probing this effect, and specifically, the monetary policy transmission channels, De Haan (2001) investigated the process of monetary policy transmission through the credit and lending channels in Dutch banks and found that the negative effect of the deflation policy on smaller banks is greater than that on larger banks, also, the volume of deposits positively reacts to deflation policies. Besides, research on the effect of capital on the lending behavior of Italian banks revealed heterogeneity in enforcing monetary policies such that the application of monetary deflation decreases lending to a lesser extent among the banks with good capital accumulation (Gambacorta & Mistrulli, 2004). Also, examining the lending and risk-taking channel of monetary policy, Ariccia et al. (2013) stated that the risk-taking of American banks is negatively associated with the increase in short-term interest rates.

Considering the role of capital, the aforementioned negative effect is less pronounced for low-capital banks. As a result, the transmission of monetary policy through capital would be neutral for banks with lower capital. However, in the long run, banks' risk-taking increases as interest rates rise.

Regarding risk, Setoodeh nia and Abedi (2013) studied the policies adopted from 1971 to 2010 in Iran, using the infinite-error correction method with reversal patterns to identify the effect of monetary and financial policies on financial stability. They found that monetary policy and excessive liquidity creation are indirectly and directly associated with financial instability. Again, in the banking network of Iran, the study of the applied policies shows that the decrease in the interest rate increases the risk-taking of the system, with larger effects obtained in state banks than in private banks (Ahmadian et al., 2016). Moreover, examining the relationship between interest rates and systemic risk, Selgi and Alizadeh (2019) declared a significant long-term relationship between monetary policy and systemic risk. Thus, the policies adopted on balance sheet items affect the systemic risk. In this regard, Faiaa and Karau (2021) specify that changes in interest rates could affect systemic risk in three ways: affecting the bank's leverage and risk portfolio, influencing the bank's tendency to finance through the market and interbank communication, and inducing banks to earn more profit. Consequently, because of the extensive interbank communication, any shock in the monetary system would be quickly transferred to other banks and the entire financial system, which could provoke a crisis and collapse (Claessens et al., 2013).

Regarding liquidity creation, research on the determinants of bank liquidity creation in Germany reveals that liquidity creation is influenced by economic and monetary policies, with these measures showing an inverse relationship to tighter and more restrictive monetary policies (Rauch et al., 2010). Also, using the dynamic panel estimation technique, Matousek and Sarantis (2009) investigated the lending channel of a large number of banks in eight countries of the European Union from Eastern and Central Europe during 1994-2003. They found that the effect of monetary policy on lending varies based on the size of the bank, the amount of capital, liquidity, and ownership structure. The size of the bank and liquidity play the most crucial role in the banks' response to the changes in monetary policy. Furthermore, considering the interest rate as an indicator of monetary policy among Chinese banks indicates that the effect of monetary policies on lending is smaller for large banks and banks with a lower level of liquidity, however, the banks’ reactions to monetary policies do not necessarily rely on their capital (Gunji & Yuan, 2010). In addition, this study shows that profitable banks are less sensitive to monetary policies.

Research hypotheses

The existing literature has extensively explored the relationship between liquidity creation and bank risk and the role of bank capital in mitigating risk. However, several gaps remain unaddressed. First, while studies have examined the direct link between liquidity creation and failure risk, there is limited empirical evidence on how this relationship varies across different bank capital levels. Second, the moderating role of bank capital in weakening the liquidity creation-failure risk nexus has not been thoroughly investigated, particularly in the context of varying regulatory and economic environments.

Third, the impact of central bank policies, such as monetary tightening or easing, on the interplay between liquidity creation, bank capital, and failure risk remains underexplored. This study aims to fill these gaps by comprehensively analyzing how bank capital and central bank policies influence the relationship between liquidity creation, bank capital, failure risk, and the adopted monetary policies, offering new insights for regulators and policymakers. Particularly, the relationship between bank capital and liquidity creation will be positive or negative, depending on the prevalence of the risk absorption or financial fragility hypotheses. Also, theories show that the association between liquidity creation and failure risk could be positive or negative. However, there is a consensus on a negative relationship regarding bank capital and failure risk.

Besides, although the associations of monetary policies with risk and liquidity creation are shown to be direct or indirect, most studies confirm that their direction relies on whether the policy is deflationary or inflationary. Their intensity depends on the capital situation. Therefore, to fill the existing research gap, considering the monetary policy, it seems necessary to examine the effect of changes in bank capital on the relationship between liquidity creation and bank failure risk. To achieve the research goal, the hypotheses are proposed as follows:

(1) There is a significant relationship between liquidity creation and failure risk.

(2) Increased bank capital weakens the relationship between liquidity creation and failure risk.

(3) The inclusion of the policies of the central bank changes the impact of bank capital on the relationship between liquidity creation and failure risk.

Research Methodology

1. Study sample and data

To examine the research hypotheses, we evaluated data from the banks admitted to the Tehran Stock Exchange from 2012 to 2018. The inclusion and exclusion criteria were as follows:

- To facilitate the comparison process of the results, the fiscal years of the banks must end in March and include no changes during the examination period.
- The investigated banks must be admitted to the Tehran Stock Exchange before the fiscal year of 2012 and be active during the examination period.

Among the banks listed on the Tehran Stock Exchange, we excluded the Tourism Bank, Mehr Eqtesad Bank, Ansar Bank, Bank Hekmat Iranian, Ghavamin Bank, and Refah Bank, owing to violating inclusion or exclusion criteria (Table 1). Therefore, the study sample included seventeen banks as follows: Eghtesad Novin, Iran Zamin, Ayandeh, Parsian, Pasargad, Post Bank, Tejarat, Middle East Bank, Day, Resalat, Saman, Sarmayeh, Sina, Shahr, Saderat, Karafarin, and Mellat. Also, the required data to calculate the variables of liquidity creation, failure risk, changes in bank capital, and the variety of bank loans and deposits were extracted from the audited and published annual reports of banks in the Comprehensive Database of All Listed Companies[1] (CODAL). Besides, we collected the data related to monetary policy and interbank interest rates from the reports available in the Central Bank of Iran database[2]Therefore, based on the data being extracted from authoritative and reliable websites, it can be claimed that the data is also valid.

Table 1. Inclusion and Exclusion Criteria

Criteria	Bank Name	Violation
Fixity of fiscal years	Tourism	Change of fiscal year in 2017 from December 21 to March 20
Being active during the examination period	Mehr Eqtesad, Ansar, Ghavamin, Hekmat Iranian	Merging with Sepeh Bank and canceling their activities
	Refah	Privatization and constitutional changes, the contradiction of reports from 2013 to 2015

[1] https://codal.ir/

[2] https://www.cbi.ir/

2. Study models

According to the research goal and the three hypotheses, three models were considered as follows.

Model 1:

$$BankFailureRisk_{i,t} = \beta_0 + \beta_1 LiquidityCreation_{i,t} + \beta_2\, HHI - LON_{i,t} + \beta_3\, HHI - DEP_{i,t} + \beta_4\, IIR_t + \varepsilon_{i,t} \quad (1)$$

Where i, t, ε, and β0 represent the bank, year, error, and constant components, respectively. Also, BankFailureRisk, LiquidityCreation, HHI-LON, HHI-DEP, and IIR indicate the measure of failure risk, the measure of bank liquidity creation, the variety of bank loans, the variety of bank deposits, and the interbank interest rate, respectively.

The following model (Model 2) was used to examine the moderating effect of capital, which is raised as the second research hypothesis.

Model 2:

$$BankFailureRisk_{i,t} = \beta_0 + \beta_1 LiquidityCreation_{i,t} + \beta_2 \Delta BankCapital_{i,t} + \beta_3 LiquidityCreation_{i,t} \times \Delta BankCapital_{i,t} + \beta_4\, HHI - LON_{i,t} + \beta_5\, HHI - DEP_{i,t} + \beta_6\, IIR_t + \varepsilon_{i,t} \quad (2)$$

Where ΔBank Capital indicates the changes in bank capital.

According to the third research hypothesis, the following model (Model 3) was used to include the monetary policy.

Model 3:

$$BankFailureRisk_{i,t} = \beta_0 + \beta_1 LiquidityCreation_{i,t} + \beta_2 Policydummy_t + \beta_3 LiquidityCreation_{i,t} \times \Delta BankCapital_{i,t} + \beta_4 BankCapital_{i,t} + \beta_5\, HHI - LON_{i,t} + \beta_6\, HHI - DEP_{i,t} + \beta_7\, IIR_t + \varepsilon_{i,t} \quad (3)$$

Where Policydummy represents the deflationary or inflationary monetary policy adopted by the central bank.

3. Variables

3.1. Dependent variable

According to the literature, bank failure risk constitutes the dependent variable, which is often calculated using the Altman Z-score model. The history of the Z-score statistic dates back to the studies of Roy (1952). It comprises accounting principles in the risk calculation and coordinates with other variables in the current research. Thus, it was preferred over the Altman model, which considers market factors. This measure was calculated based on the study of Mare et al. (2017) with the following equation (4).

$$Z - Score_{it} = (ROA_{it} + CAR_{it})/\sigma(ROA_{iT}) \quad (4)$$

where i, t, ROA, CAR, and σ(ROA) respectively stand for the bank, year, return on assets, equity to assets ratio, and a standard deviation of ROA during the T period, where T = 1, 2, 3..., t. Since the Z-score includes a high skewness, its logarithm was used as a risk measure, according to the literature (Laeven & Levine, 2009). Since this score could take a negative value, which is unacceptable as the argument of the logarithm function, Imbierowicz and Rauch (2014) recommend adding the negative values, along with other positive values, to 10 before operating the function. It should be noted that the calculated criterion is inversely related to failure risk, such that a higher value represents a lower risk.

3.2. Independent variables

(1) Liquidity creation constitutes the first independent variable of the study; this variable was estimated through the following three steps (Berger & Bouwman, 2009). The method proposed by Berger & Bouwman (2009) is chosen for estimating liquidity creation due to its comprehensive approach in capturing both on- and off-balance-sheet activities, making it highly relevant for assessing financial intermediation. Its ability to account for different asset, liability, and off-balance-sheet categories ensures a more accurate and holistic measurement of liquidity creation in banking studies:

- First step: the classification of balance sheet items, including items above and below the balance sheet line, into three types of liquid, semi-liquid, and illiquid items;
- Second step: weighing the balance sheet items classified in the first step;
- The third step is calculating the liquidity creation index of banks by combining the previous two steps.

Considering these steps, the calculating equation of liquidity creation is as shown in equation (5):

$$Liquidity\ Creation = (0.5 \times illiquid\ assets\ + 0 \times semi - liquid\ assets - \ 0.5 \times liquid\ assets) + (0.5 \times liquid\ liabilities\ + 0 \times semi - liquid\ liabilities - 0.5 \times illiquid\ liabilities) + (-0.5 \times liquidoffbalance\ sheet\ + 0 \times semi - liquid\ off\ balance\ sheet + 0.5 \times illiquidoffbalancesheet) \quad (5)$$

Mahmoudinia (2019) adapted the formula suggested by Berger and Bouwman (2009) to calculate liquidity creation using the balance sheet items of Iranian banks. Table 2 presents the required items to calculate liquidity creation. The present study also calculated liquidity creation based on these items.

Table 2. Required Items for the Calculation of Liquidity Creation Adapted for the Balance Sheet of Iranian Banks

Liquid assets (coefficient = -0.5)	Semi-liquid assets (coefficient = 0)	Illiquid assets (coefficient = 0.5)
Cash / Claims from the Central Bank / Claims from banks and credit institutions / Contribution and other similar bonds / Forthcoming items / Investments and contributions	Granted facilities and claims from the public sector / Granted facilities and claims from the private sector	Fixed assets / Other assets
Liquid liabilities (coefficient = 0.5)	Semi-liquid liabilities (coefficient = 0)	Illiquid liabilities (coefficient = -0.5)
Liabilities to the Central Bank/liabilities to banks and credit institutions / Sight deposits / Savings and similar deposits / Forthcoming items	Short-term investment deposits / Other deposits	Long-term investment deposits / Reserves and other liabilities / Equities
Liquid off-balance-sheet (coefficient = -0.5)	Semi-liquid off-balance-sheet (coefficient = 0)	Illiquid off-balance-sheet (coefficient = 0.5)
-	-	Obligations for letters of credit / Obligations for the issued guarantees / Other obligations / Managed funds and the like / Other off-balance-sheet items

(2) According to the third hypothesis, monetary policy is the second independent variable and enters the model as a virtual variable. This variable's deflationary or inflationary nature was determined based on the results of the reports and instructions from the Central Bank during the examining period. Thus, this variable holds the values of 1 or 0 in the case of inflation or deflation, respectively.

3.3. Moderator variable

According to the research goal, change in bank capital is considered a moderating variable in the model and is calculated using the equation (6).

$$BankCapital_{i,t} = BankCapital_{i,t} - BankCapitali, t_{i,t-1}) \quad (6)$$

3.4. Control variables

(1) The Interbank interest rate (IIR) is calculated with the weighted average of interbank interest rates, based on the monthly interbank trading volume, during a year.

(2) The variety of loans among banks (HHI-LON) is calculated with the Herfindahl-Hirschman index.

(3) The variety of deposits among banks (HHI-DEP) is calculated with the Harfindal-Hirschman index.

Also, the Harfindal-Hirschman index is calculated as equation (7)(Bikker & Haaf, 2002):

$$HHi = \sum_{i=1}^{k} \left(\frac{xj}{\sum_{j=1}^{n} xj} \right)^2 \quad (7)$$

Where k, Xj, and $\sum_{j=1}^{n} X_j$ represent the total number of deposits (loans), the amount of the deposit (loan) of j type, and the total amount of deposits (loans).

Results

1. Exploring the variables

We discussed and made the study variables explicit in the previous section. In the following, the extracted data are presented to provide a good insight into the status of the variables in the studied banks.

(1) Liquidity creation

Figure 1 reports the average liquidity created during the examination period for each bank.

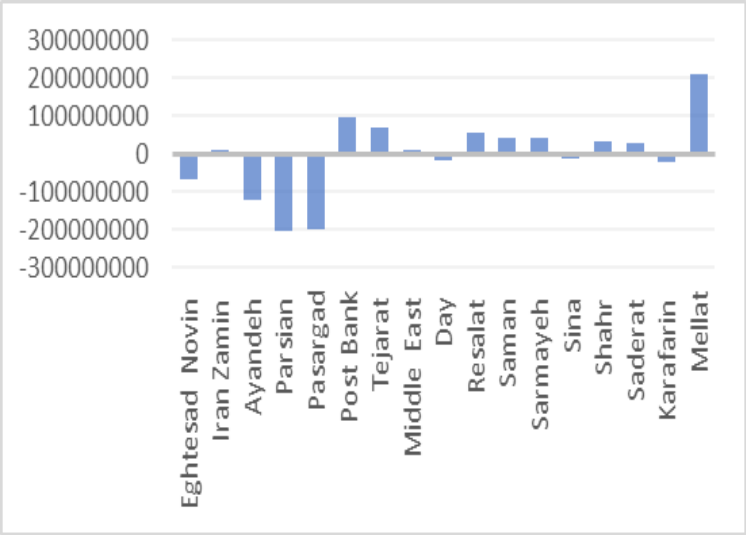

Figure 1. Average Liquidity Creation by Bank (numbers are in millions IRR)

(2) Interbank interest rate

Figure 2 presents the changes in the interbank interest rates by year.

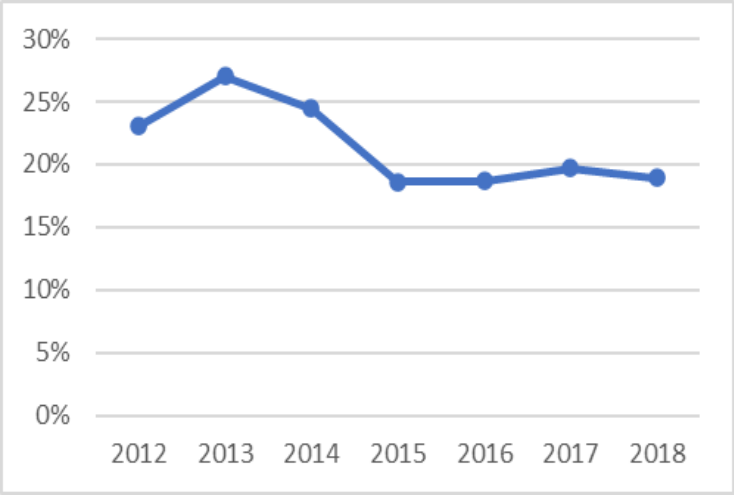

Figure 2. Interbank Interest Rate by Year

(3) Variety of bank loans and deposits

Figure 3 represents each bank's average variation of loans and deposits during the examination period.

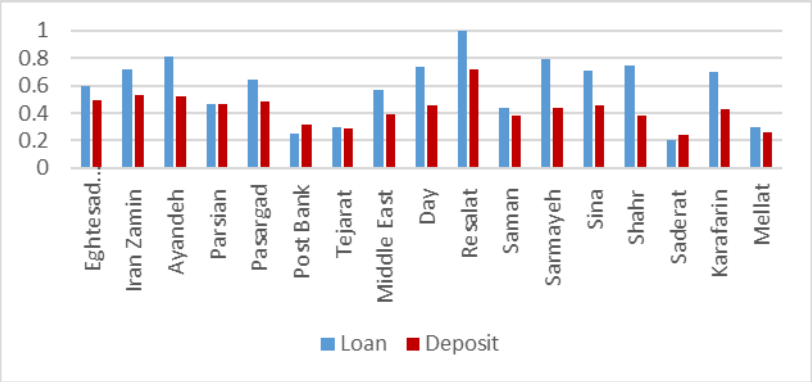

Figure 3. Average Variety of Loans and Deposits

(4) Failure risk

Figure 4 reports the average failure risk index calculated for each bank during the examination period.

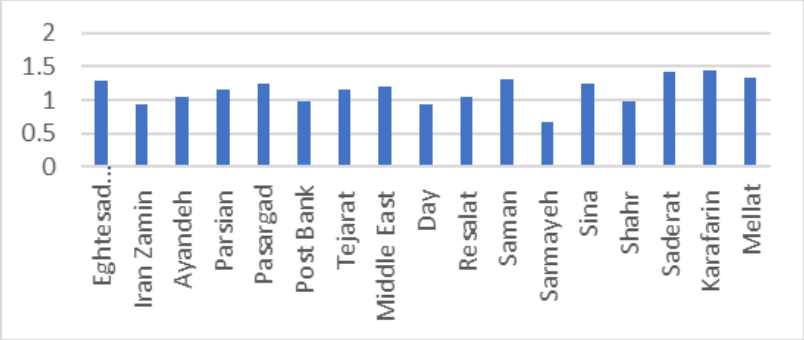

Figure 4. Average Failure Risk Index

(5) Monetary policy

Table 3 reports the results of the monetary policy applied by the Central Bank during each year of the examination period.

Table 3. Adopted Monetary Policy by Year

Year	2012	2013	2014	2015	2016	2017	2018
Policy	inflationary	deflationary	deflationary	inflationary	inflationary	inflationary	inflationary

(6) Bank capital

Figure 5 indicates each bank's capital change during the examination period; the increase order is shown in blue, red, and green, respectively.

Figure 5. Capital changes of Banks (numbers are in millions IRR)

2. Estimation and analysis of study models

Before estimating the study models, the classical prerequisite conditions of linear regression were tested, and the variables were checked. The test results revealed first-order serial correlation for all three models. Therefore, the AR(1) term, which represents the first-order interval of the residual term, was added to the model to solve this problem. Also, the models were estimated based on the panel method with fixed effects. However, we utilized the OLS[1] estimator for the first model and the GLS[2] estimator for the second and third models to equalize the variances. Table 4 reports the results of the first model's estimation.

Table 4. Estimation of Model 1

Model 1				
$BankFailureRisk_{i,t} = \beta_0 + \beta_1 LiquidityCreation_{i,t} + \beta_2 HHi\text{-}LON_{i,t} + \beta_3 HHi\text{-}DEP_{i,t} + \beta_4 IIR_t + \beta_5 AR(1) + \varepsilon_{i,}$				
Descriptive Variable	Coefficient	Standard Error	t	P-value
C	0.7682	0.1215	6.3229	0.0000
LC	-6.0723	2.4101	-2.5192	0.0138
IIR	1.7390	0.5772	3.0126	0.0035
HHI_LON	0.2078	0.1251	1.6613	0.1006
HHI_DEP	-0.4723	0.1734	-2.7232	0.0079
AR(1)	0.3775	0.08269	4.5648	0.0000
F (P-value)	10.9588 (0.0000)		Coefficient of Determination	0.7420
Durbin–Watson Statistic	1.9248		Adjusted Coefficient of Determination	0.6743

According to Table 4, the model is significant and rejects the null hypothesis. Besides, all the variables, except HHI_LON, are significant at the level of 0.05, and considering the negative coefficient of the liquidity creation term, this variable is inversely related to the calculated measure of failure risk (the Z-score). This inverse relationship means that the higher the Z-score, the lower the level of risk. Thus, liquidity creation has a direct relationship with failure risk, and the increase in liquidity creation exposes the bank to higher risk. Consequently, this interpretation confirms the first research hypothesis,

[1] . OLS: Ordinary Least Squares

[2] . GLS: Generalized Least Squares

which is consistent with the results of Mahmoudinia (2019), Vaez Barzani and Ebrahimi (2014), Hilbers et al. (2005), Fungacova et al. (2015), and Stoop and Sornette (2010).

Table 5. Estimation of Model 2

Model 2				
$BankFailureRisk_{i,t} = \beta_0 + \beta_1 LiquidityCreation_{i,t} + \beta_2 LiquidityCreation_{i,t} \times \Delta BankCapital_{i,t} + \beta_3 \Delta BankCapital_{i,t} + \beta_4 HHI\text{-}LON_{i,t} + \beta_5 HHI\text{-}DEP_{i,t} + \beta_6 IIR_t + \beta_7 AR(1) + \varepsilon_{i,t}$				
Descriptive Variable	Coefficient	Standard Error	t	P-value
C	0.7942	0.0754	10.5272	0.0000
LC	-1.9810	1.7012	-1.1650	0.2476
BC	1.2709	0.2774	4.6016	0.0000
LCBC	-1.5716	0.6059	-2.5864	0.0116
IIR	1.6285	0.5570	2.9237	0.0045
HHI_LON	0.1636	0.0778	2.1021	0.0388
HHI_DEP	-0.4489	0.1175	-3.8211	0.0003
AR(1)	0.4289	0.0473	9.0607	0.0000
F (P-value)	10.5837 (0.0000)		Coefficient of Determination	0.7573
Durbin–Watson Statistic	1.8449		Adjusted Coefficient of Determination	0.6857

According to Table 5, the second model is significant and rejects the null hypothesis. In this model, all the variables, except liquidity creation, are significant at 0.05. The comparison of the results of the first and second models declares that the introduction of the capital to the second model implies not only the significant effects of the bank capital and moderator variables but also the reduction of the coefficient of the liquidity creation variable. This indicates that the capital inclusion in the second model weakens the relationship between liquidity creation and failure risk. This interpretation supports the second hypothesis of the research.

Table 6. Estimation of Model 3

Model 3

$BankFailureRisk_{i,t} = \beta_0 + \beta_1 LiquidityCreation_{i,t} + \beta_2 Policydummy_t + \beta_3 LiquidityCreation_{i,t} \times \Delta BankCapital_{i,t} + \beta_4 \Delta BankCapital_{i,t} + \beta_5 HHI\text{-}LON_{i,t} + \beta_6 HHI\text{-}DEP_{i,t} + \beta_7 IIR_t + \beta_8 AR(1) + \varepsilon_{i,t}$				
Descriptive Variable	Coefficient	Standard Error	t	P-value
C	0.7823	0.6051	1.2927	0.2000
LC	-2.0611	1.5817	-1.3089	0.1944
BC	1.2509	0.2501	5.0215	0.0000
LCBC	-1.5718	0.5721	-2.7420	0.0076
PLC	0.0038	0.1489	0.0261	0.9793
IIR	1.6753	2.5389	0.6598	0.5113
HHI_LON	0.1639	0.0719	2.2789	0.0254
HHI_DEP	-0.4508	0.1223	-3.6863	0.0004
AR(1)	0.4301	0.0452	9.5051	0.0000
F (P-value)	10.0326 (0.0000)		Coefficient of Determination	0.7576
Durbin–Watson Statistic	1.8527		Adjusted Coefficient of Determination	0.6821

According to Table 6, the third model is also significant and rejects the null hypothesis. Also, all variables except liquidity creation, monetary policy, and interbank interest rate are significant at 0.05 in this model. Comparing the results of the second and third models, the monetary policy is an insignificant variable; the introduction of which to the model leads to insignificant changes in the coefficient of determination and the coefficients of the other variables. Therefore, the monetary policy variable does not help in the model explanation. Hence, although the null hypothesis is statistically rejected, the significance of the model can be mainly attributed to bank capital and its relatively significant effect on the model.

Conclusion

Liquidity creation constitutes one of the most crucial subjects in economics and banking literature and influences various factors in banking and macroeconomics. The general framework of the liquidity creation process is enforced through the monetary policy adopted by the central bank. Although this process paves the way to finance projects and meet the liquidity demands of fund applicants, it could expose the bank to instability and failure risk. Furthermore, due to the close interbank connections, this threatening flow can quickly spread to other banks and cause several problems. Besides, from an economic point of view, the excessive creation of liquidity can initiate the formation of a bubble in asset prices.

However, bank capital and the monetary policy adopted by the central bank could provide a backbone to support banks in managing the abovementioned risk caused by liquidity creation. Therefore, to provide comprehensive insight into the dimensions and impacts of these factors, this study investigated banks admitted to the Tehran Stock Exchange from 2012 to 2018. The obtained results showed that by controlling the interbank interest rate and the variety of bank loans and deposits, liquidity creation is significantly and directly associated with failure risk. Also, bank capital moderates this relationship, weakening the relationship between liquidity creation and failure risk. This result is consistent with the declarations of the Basel Committee, which always emphasize the role of the quantity and quality of bank capital in risk management. Accordingly, bankers and managers should pay more attention to the role and importance of this issue. Moreover, the results confirmed the insignificance of the monetary policy adopted by the central bank. This implies that the decisions made by the monetary authorities could be affected by some banking factors and become inefficient, regardless of the commitment to be implemented by the bank. For this reason, policymakers and monetary authorities must examine and study bank characteristics before making and implementing their decisions.

Finally, findings align with Berger & Bouwman (2009) on liquidity creation increasing risk, Acharya & Naqvi (2012) on capital moderating risk, and Diamond & Rajan (2001) on interbank contagion. Also, the results on monetary policy inefficiency contradict Ariccia et al. (2013) and Faiaa & Karau (2021), who highlight its role in risk management.

Recommendations

The present results point to the proficiency of bank capital in lowering the relationship between liquidity creation and failure risk, as well as the insignificance of the monetary policy adopted by the central bank. Consequently, other possible factors play a role in this relationship. Therefore, it can be a subject for future investigations to identify these factors and determine their effects. Thus, unlisted active banks should be investigated to provide supplementary research related to the current study. Also, other banking indices proposed in the CAMELS model for inter-bank comparisons can be considered in analyzing the role of capital. In addition, other exogenous macro variables, such as a crisis, should be used to study the role of monetary policy.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest concerning the research, authorship and, or publication of this article.

Funding

The authors received no financial support for the research, authorship and, or publication of this article.

References

Acharya, V., & Naqvi, H. (2012). The seeds of a crisis: A theory of bank liquidity and risk taking over the business cycle. *Journal of Financial Economics*, *106*(2), 349–366. https://doi.org/10.1016/j.jfineco.2012.05.014

Acharya, V. V., Mehran, H., & Thakor, A. V. (2016). Caught between Scylla and Charybdis? Regulating Bank Leverage When There Is Rent Seeking and Risk Shifting. *The Review of Corporate Finance Studies*, *5*(1), 36-75. https://doi.org/10.1093/rcfs/cfv006

Ahmadian, A., Rahmani, T., & Kianvand, M. (2016). An analysis of the relationship between monetary policy and risk-taking of the Iranian banking network. *Journal of Monetary & Banking Research*, *29*, 21.

Allen, F., & Gale, D. (2004). Financial Intermediaries and Markets. *Econometrica*, *72*, 28. http://dx.doi.org/10.1111/j.1468-0262.2004.00525.x

Allen, F., & Santomero, A. M. (1997). The theory of financial intermediation. *Journal of Banking & Finance*, *21*(11), 1461-1485. https:/doi.org/10.1016/S0378-4266(97)00032-0

Ariccia, G. D., Laeven, L., & Suarez, G. (2013). *Bank Leverage and Monetary Policy's Risk-Taking Channel: Evidence from the United States*. https://ideas.repec.org/p/imf/imfwpa/2013-143.html

Beltratti, A., & Stulz, R. M. (2012). The credit crisis around the globe: Why did some banks perform better? *Journal of Financial Economics*, *105*(1), 1-17. https:/doi.org/10.1016/j.jfineco.2011.12.005

Berger, A. N., & Bouwman, C. H. S. (2009). Bank Liquidity Creation. *The Review of Financial Studies*, *22*(9), 3779-3837. https://doi.org/10.1093/rfs/hhn104

Berger, A. N., DeYoung, R., Flannery, M. J., Lee, D., & Öztekin, Ö. (2008). How Do Large Banking Organizations Manage Their Capital Ratios? *Journal of Financial Services Research*, *34*(2), 123–149. https://doi.org/10.1007/s10693-008-0044-5

Bhattacharya, S., & Thakor, A. V. (1993). Contemporary Banking Theory. *Journal of Financial Intermediation*, *3*(1), 2–50. https:/doi.org/10.1006/jfin.1993.1001

Bikker, J. A., & Haaf, K. (2002). Measures of Competition and Concentration in the Banking Industry: A Review of Literature. *Economic & Financial Modeling*.

Bryant, J. (1980). A model of reserves, bank runs, and deposit insurance. *Journal of Banking & Finance*, *4*(4), 335–344. https:/doi.org/10.1016/0378-4266(80)90012-6

Calem, P., & Rob, R. (1999). The Impact of Capital-Based Regulation on Bank Risk-Taking. *Journal of Financial Intermediation*, *8*(4), 317-352. https:/doi.org/10.1006/jfin.1999.0276

Carlson, M., Shan, H., & Warusawitharana, M. (2013). Capital ratios and bank lending: A matched bank approach. *Journal of Financial Intermediation*, *22*(4), 663–687. https://dx.doi.org/10.2139/ssrn.2295201

Chatterjee, U. K. (2018). Bank liquidity creation and recessions. *Journal of Banking & Finance*, *90*, 64–75. https:/doi.org/10.1016/j.jbankfin.2018.03.002

Claessens, S., & Kose, M. A. (2013). Financial crises: Explanations, types, and implications. IMF Working Paper, 13(28), 1–66. https://dx.doi.org/10.2139/ssrn.2295201.

Cole, R. A., & Gunther, J. W. (1995). Separating the likelihood and timing of bank failure. *Journal of Banking & Finance*, *19*(6), 1073-1089. https:/doi.org/10.1016/0378-4266(95)98952-M

De Haan, L. (2001). *The credit channel in the Netherlands: evidence from bank balance sheets*. https://ideas.repec.org/p/ecb/ecbwps/200198.html

Demirguc-Kunt, A., Detragiache, E., & Merrouche, O. (2013). Bank Capital: Lessons from the Financial Crisis. *Journal of Money, Credit and Banking*, *45*(6), 1147–1164. http://www.jstor.org/stable/23463595

Diamond, D. W., & Dybvig, P. H. (1983). Bank Runs, Deposit Insurance, and Liquidity. *Journal of Political Economy*, *91*(3), 19. https://doi.org/10.1086/261155,

Diamond, D. W., & Rajan, R. G. (2001). Liquidity Risk, Liquidity Creation, and Financial Fragility: A Theory of Banking. *Journal of Political Economy*, *109*(2), 287-327. https://doi.org/10.1086/319552 (Journal of Political Economy)

Distinguin, I., Roulet, C., & Tarazi, A. (2013). Bank regulatory capital and liquidity: Evidence from US and European publicly traded banks. *Journal of Banking & Finance*, *37*(9), 3295-3317. https:/doi.org/10.1016/j.jbankfin.2013.04.027

Faiaa, E., & Karau, S. (2021). Systemic Bank Risk and Monetary Policy. *International Journal of Central Banking*, *17*(71), 1-40.

https://ideas.repec.org/a/ijc/ijcjou/y2021q5a4.html (International Journal of Central Banking)

Friedman, M., & Schwartz, A. J. (1963). *A Monetary History of the United States, 1867-1960*. Princeton University Press. http://www.jstor.org/stable/j.ctt7s1vp

Fu, X., Lin, Y., & Molyneux, P. (2016). BANK CAPITAL AND LIQUIDITY CREATION IN ASIA PACIFIC. *Economic Inquiry*, *54*(2), 966-993. https://EconPapers.repec.org/RePEc:bla:ecinqu:v:54:y:2016:i:2:p:966-993

Fungacova, Z., Turk, R., A, & Weill, L. (2015). *High Liquidity Creation and Bank Failures: Do They Behave Differently?* https://ideas.repec.org/p/imf/imfwpa/2015-103.html

Gambacorta, L., & Mistrulli, P. E. (2004). Does bank capital affect lending behavior? *Journal of Financial Intermediation*, *13*(4), 436-457. https://doi.org/https://doi.org/10.1016/j.jfi.2004.06.001

Gorton, G., & Winton, A. (2017). Liquidity Provision, Bank Capital, and the Macroeconomy. *Journal of Money, Credit and Banking*, *49*(1), 5-37. https://doi.org/10.1111/jmcb.12367 (Journal of Money, Credit and Banking)

Gunji, H., & Yuan, Y. (2010). Bank profitability and the bank lending channel: Evidence from China. *Journal of Asian Economics*, *21*(2), 129-141. https://doi.org/https://doi.org/10.1016/j.asieco.2009.12.001

Hilbers, P. L. C., Pazarbasioglu, C., Johnsen, G., & Otker, I. (2005). *Assessing and Managing Rapid Credit Growth and the Role of Supervisory and Prudential Policies*. https://ideas.repec.org/p/imf/imfwpa/2005-151.html

Holmstrom, B., & Tirole, J. (1998). Private and Public Supply of Liquidity. *Journal of Political Economy*, *106*(1), 1-40. https://doi.org/10.1086/250001 (Journal of Political Economy)

Horváth, R., Seidler, J., & Weill, L. (2014). Bank Capital and Liquidity Creation: Granger-Causality Evidence. *Journal of Financial Services Research*, *45*(3), 341-361. https://doi.org/10.1007/s10693-013-0164-4

Imbierowicz, B., & Rauch, C. (2014). The relationship between liquidity risk and credit risk in banks. *Journal of Banking & Finance*, *40*, 242-256. https://doi.org/https://doi.org/10.1016/j.jbankfin.2013.11.030

Kashyap, A. K., Rajan, R., & Stein, J. C. (2002). Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit-taking [https://doi.org/10.1111/1540-6261.00415]. *The Journal of Finance*, *57*(1), 33-73. https://doi.org/https://doi.org/10.1111/1540-6261.00415

Khodaei, M., & Kohandel, A. (2011). *The investigation of the relationship between profit management and corporate governance with the auditor's opinion* Arak branch of Islamic Azad University].

Laeven, L., & Levine, R. (2009). Bank governance, regulation and risk taking. *Journal of Financial Economics*, *93*(2), 259–275. https://doi.org/https://doi.org/10.1016/j.jfineco.2008.09.003

Lei, A. C. H., & Song, Z. (2013). Liquidity creation and bank capital structure in China. *Global Finance Journal*, *24*(3), 188–202. https://doi.org/https://doi.org/10.1016/j.gfj.2013.10.004

Lin, S. L., Penm, J. H. W., Gong, S.-C., & Chang, C.-S. (2005). Risk-based capital adequacy in assessing on insolvency-risk and financial performances in Taiwan's banking industry. *Research in International Business and Finance*, *19*(1), 111-153. https://doi.org/https://doi.org/10.1016/j.ribaf.2004.10.006

Mahmoudinia, D. (2019). Central Bank Monetary Policy and Its Role In The Emergence Of Banking Crises In The Iranian Economy Within Modified Money Market Pressure *Journal of Economic Research and Policies 89*, 37.

Mare, D. S., Moreira, F., & Rossi, R. (2017). Nonstationary Z-Score measures. *European Journal of Operational Research*, *260*(1), 348–358. https://doi.org/https://doi.org/10.1016/j.ejor.2016.12.001

Matousek, R., & Sarantis, N. (2009). The bank lending channel and monetary transmission in Central and Eastern European countries. *Journal of Comparative Economics*, *37*(2), 321-334. https://doi.org/https://doi.org/10.1016/j.jce.2008.09.008

Mirzaei, A., Moore, T., & Liu, G. (2013). Does market structure matter on banks' profitability and stability? Emerging vs. advanced economies. *Journal of Banking & Finance*, *37*(8), 2920-2937. https://doi.org/https://doi.org/10.1016/j.jbankfin.2013.04.031

Peek, J., & Rosengren, E. (1995). Bank regulation and the credit crunch. *Journal of Banking & Finance*, *19*(3), 679-692. https://doi.org/https://doi.org/10.1016/0378-4266(94)00148-V

Rauch, C., Steffen, S., Hackethal, A., & Tyrell, M. (2010). Determinants of Bank Liquidity Creation.

Repullo, R. (2004). Capital requirements, market power, and risk-taking in banking. *Journal of Financial Intermediation*, *13*(2), 156–182. https://doi.org/https://doi.org/10.1016/j.jfi.2003.08.005

Rezazadeh Karsalarei, F., & Sargolzaee, M. (2019). The Impact of Banking Performance on Liquidity Creation in Banking System. *Empirical Studies in Financial Accounting 64*, 21. https://doi.org/https://doi.org/10.22054/qjma.2020.42572.2006

Roy, A. D. (1952). Safety First and the Holding of Assets. *Econometrica*, *20*(3), 431-449. https://doi.org/10.2307/1907413

Selgi, M., & Alizadeh, M. (2019). Investigating the impact of monetary policy on systemic risk *Journal of Budget and Finance Strategic Research*, *1*, 30.

Selgi, M., & Talebi, M. (2017). Investigating the relationship between risk and capital adequacy ratio: Evidence from Iranian banks. *Journal of Monetary & Banking Research*, *30*, 31.

Setoodeh nia, S., & Abedi, F. (2013). The Impact of Fiscal and Monetary Policies on Fiscal Consolidation in Iran. *Quarterly Journal of The Macro and Strategic Policies*, *1*(Vol1-No3), 103-115. https://www.jmsp.ir/article_5728.html

Shahchera, M., & Taheri, M. (2015). The effect of banking structure on the role of banks' liquidity creation in Iran's economy. *Journal of Monetary & Banking Research*, *21*, 23.

Stoop, M., & Sornette, D. (2010). Credit creation and its contribution to financial crises. *An unpublished master thesis submitted to the department of management, technology and economics (Mtec), Swiss Federal Institute Of Technology*.

Thakor, A. V. (2005). Do Loan Commitments Cause Overlending? *Journal of Money, Credit and Banking*, *37*(6), 1067-1099. http://www.jstor.org/stable/3839028

Vaez Barzani, M., & Ebrahimi, B. (2014). Theoretical analysis of the effect of credit creation on the financial crisis. *Marifat-e Eghtesad-e Islami*, *2*, 24.

Van Roy, P. (2008). Capital Requirements and Bank Behaviour in the Early 1990: Cross-Country Evidence. *International Journal of Central Banking*, *4*(3), 29–60. https://ideas.repec.org/a/ijc/ijcjou/y2008q3a2.html (International Journal of Central Banking)

Von Thadden, E.-L. (2004). Bank capital adequacy regulation under the new Basel Accord. *Journal of Financial Intermediation*, *13*(2), 90-95. https://ideas.repec.org/a/eee/jfinin/v13y2004i2p90-95.html (Journal of Financial Intermediation)

Bibliographic information of this paper for citing:

Shafieinia, Ata & Noorbakhsh, Asgar (2025). The Impact of Monetary Policy and Moderating Role of Capital on the Relationship between Bank Liquidity Creation and Failure Risk in Banks listed on the Tehran Stock Exchange. *Iranian Journal of Finance*, 9(3), 1-26.

Copyright © 2025, Ata Shafieinia and Asgar Noorbakhsh