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Original Research Article

Relationship between Risk Shifting Behavior and Moral Hazard in the Iranian Banking System

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The concept of moral hazard is related with risk shifting and asset portfolio. The banking background focuses on sources and types of risk shifting. However, the moral hazard problem has provided a brief analysis of the incentive of risk shifting. The present study aims to figure out the model for the Iranian banking system during 2000-2024 in order to determine the dominant risk shifting behavior. Risk shifting can cause conflicts between shareholders, depositors, and creditors. Risk shifting can also be related to the risk taking behavior in the banking systems. Accepting risk by one party can lead to transfer of that risk to other parties. Therefore, the present study aims to figure out whether the risk changes are related to capital ratio and other structures of the balance sheet in the banking system, using the deposit and non-deposit debt ratio in order to reach the rate of risk transfer to depositors and other parties.
The results showed that the type of risk shifting is deposit side in the Iranian banking system and shareholders tend to shift risks to depositors. Return on equity seems to be a suitable variable increasing the moral hazard behavior and risk shifting. Thus, profitable banks have powerful signals for risk transfer. However, large banks supported by the Central Bank and Government show more risk shifting behaviors, the incentives of which can be detected in the banking system and decreased by regulation and supervision.

Keywords: Banking, Risk shifting, moral hazard.
JEL Classification*:* G10, G21, G32

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1 Introduction

Risk shifting is produced by agency problems in moral hazard. Risk shifting can result in conflicts between shareholders and depositors. Jensen and Meckling (1976) emphasized the existence of risk shifting in moral hazard problem. Risk shifting problem explains asset substitution in banking system. Specifically, shareholders may incentivize the bank to invest in riskier

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projects, thereby increasing the probability of bankruptcy. The cost of bankruptcy risk is associated with decreasing the benefits of wealth transfer.

In banking systems, conflicts can result in high leverage creating incentivize risk-shifting. However, these incentives force shareholders to select high risk investments, high leverage leads to high-risk projects causing the shareholders to tend to shift the risks to the creditors and depositors. This study focuses on risk shifting in the Iranian banking system, surveying the risk shifting behavior by the simultaneous equation system and classifying the type of risk shifting like Duran and Lozano-Vivas (2014). The recent studies in banking highlight how risk increases in banking and leads to risk transformation to other parties. The present study applies an empirical approach in order to figure out how banks avoid risk shifting to other parties. This paper tries to suggest an appropriate regulation for banking system in order to reduce risk-shifting.

Banks create liquidity through maturity transformation, known as time intermediation. In other words, they take demand deposits and other short-term funds and lend them in forms with longer maturity. Hence, intermediation creates operations in banking when the parties' preferences are different. Banks tend to accept more risks in the banking system while bank shareholders prefer risky lending and do not accept losses in financial crisis. (Allen & Gale, 2000)

In addition, the structure of the balance sheets and bank statements force most major banks to make more risky investment decisions and fund high-risk projects. (Gan, 2004).

In theory, shareholders and managers should have a higher risk appetite than those of a cooperative due to the larger share of residual value that they can extract from the firm. If so, a decrease in the value of senior claims would at least partially offset the increase in equity value, which is, however, not the case, as the value of all types of financial claims either increases or, at worst, remains unchanged. (Lazzari & Vena, 2023)

Other studies such as Leland (1998) and Ericsson (2000) surveyed the risk shifting problem using a theoretical framework, the background of which motivates the conflict of interest between shareholders and creditors. For instance, Leland (1998) studied the relation between risk management and shifting, regarding the incentive to manage cash flow risk. Then, this paper focuses on risk shifting in Iranian banking system and contributes to the empirical literature on risk shifting. It proposes a method to find out whether risk is shifted.

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Risk shifting in banking refers to the practice where banks or their stakeholders (such as shareholders or management) transfer risk to other parties, often depositors, taxpayers, or the broader financial system. Understanding this concept is crucial for assessing financial stability, regulatory effectiveness, and institutional behavior.

Risk shifting in banking is a critical concept that affects regulatory design, financial stability, and institutional behavior. Effective management and oversight of this phenomenon are vital to ensure banks remain resilient, transparent, and aligned with the broader interests of the economy and society. Therefore, this paper survey this concept with moral hazard in banking system. Then, section 2 describes the importance of risk shifting in banking, section 3 reviews the related studies, section 4 describe the type of risk transfers, and section 5 introduces the data and methodology for determining the risk shifting. Finally, Section 6 and 7 report the results and discussions.

2 Theoretical Foundations

Risk shifting is transfer of risk(s) from one party to another party. Risk shifting could create many forms, this form depended to the performance and portfolio of banks. When the bank takes more risks (borrowing additional debt) to stay afloat, it increases the stake of debtholders in the bank. At the same time, it decreases the shareholder's equity in the company. The purpose of risk shifting is to pass the financial liability of risks, like legal expenses, damages awarded and repair costs, to the party. It is crucial to distinguish risk shifting from risk transfer. Risk transfer is commonly confused with risk shifting. To reiterate, risk transfer is passing on ("transferring") risk to a third party. On the other hand, risk shifting involves changing ("shifting") the distribution of risky outcomes rather than passing on the risk to a third party. Risk transfer refers to the process of assigning responsibility for risk to a third party, by mechanisms such as insurance contracts or indemnity agreements. In contrast, risk shifting involves changing the distribution of risk outcomes without fully removing the risk from the organization. This can occur through outsourcing, the use of financial derivatives, or restructuring of capital, whereby the burden of risk is redistributed among different stakeholders rather than being entirely externalized

Risk shifting is important to an increase in bank dividends following an increase in risk and is related to banking fragility according to the researches such as Laeven, (2002); Calomiris and Mason, (2003); Barth et al., (2008); Acharya et al., (2016). Bank dividends refer to benefits to its owners, reduce the negative impact of a potential default on personal wealth of bank owners,

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and shift risk. The ability of banks could be creating a solid capital buffer and thus capture risk-shifting to debt-holders (Acharya et al. 2011). Recent anecdotal evidence has suggested that banks were unwilling to cutting dividends during 2007–2009, and risk-shifting has been as an explanatory factor for behavior of bank. Risk-shifting is related to the regulatory and requirements that banks force do to it.

While risk shifting is applicable to negative risks, risk sharing relates to positive risks that present an opportunity to the bank. Risk sharing involves increasing the probability of the positive risk happening by distributing the risk to other organizations or departments. When the company is faced with a positive risk, it agrees to partner with other parties to increase the odds of the risk happening. The company also agrees to share the benefits and burden of loss that arise from the opportunity when the risk occurs.

The presence of government guarantees and the free-rider problem among dispersed creditors motivate financial regulations that represent the interests of creditors and limit bank risk taking when bank solvency declines (Dewatripont & Tirole, 1994).

The importance of risk shifting in financial institutes is well recognized both theoretically and empirically. The risk shifting surveys have been done using different methods. Black and Scholes (2019) investigated the link between shareholders and creditors. Parrino and Weisbach (1999) presented empirical evidences for risk shifting behavior. Fang and Zhong (2004) estimated asset risk and displayed evidences of risk shifting in firms using a market-based method. Hjortshoj and Wei (2007) explored the impact of debt governance on risk shifting when firms face financial distress, the results of which showed that risk shifts to the other parties when the default risk rate is high, and debt governance has a major role in controlling financial volatility. John et al., (2000) surveyed the risk shifting theory in financial institutes. Further, the risk shifting theory showed that banks tend to transmit risks to deposit insurance. Grossman (1992), and Hovakimian and Kane (2000) elaborated the risk shifting to the deposit insurance. These studies showed the positive relation between deposit insurance and risk taking behavior. However, some studies showed that banks tend to accept excessive risks that deposit insurance and diminish bank incentives for more risky operations. Duan et al., (1992) found out that deposit insurance reduces banks' risk shifting. They estimated the market value of banks' asset to prove a positive relation between leverage and asset risk. Thus, banks can adopt the premium risk for changing risk shifting behaviors in the US samples during 1927-1932. Wagster (2007) reviewed the impact of deposit insurance on risk shifting in

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Canada's banking system. Flannery (1989) focused on the factors that eliminate risk shifting.

Banks with unstable funding can affect risk shifting behavior in banking systems. Unstable funding has a significant impact on the default risk and risk profile of banks. Regulations, particularly capital adequacy requirements, can mitigate such behavior. Berger et al., (1995) and VanHoose (2007) surveyed the relationship between regulation and risk-shifting, concluding that regulatory capital can influence asset risk and alter risk-shifting incentives. Ely and Weaver (1991) found out that capital ratios and the asset risk have a negative relation. They figured out that big banks are highly capable of avoiding market discipline and adjustment in risk shifting behavior. Big banks obtain guarantee for their deposits in bankruptcy compatible with the "too big to fail" problem in banking. This paper focuses on the interplay between risk-shifting and regulatory arbitrage. In the literature, regulatory arbitrage is often analogized to tax avoidance. Restructuring of banks' asset and liability could define by impact of regulatory regimes. Regulatory regimes for capital, liquidity and other requirements increase the sensitivity of risk. Banks uses internal models for capital purposes; although there are banks which have developed internal models and submitted a model application but do not yet use them for capital purposes. Basel II attempted to solve tackling problems of regulatory arbitrage and combat risk-shifting by increasing the granularity of risk weights. This meant more buckets in the Standardized Approach and a continuous function mapping risk to capital in the form of the IRB and AMA approaches. If capital increases sufficiently with risk, banks should not be incentivized to shift into risky portfolios. There is the little empirical analysis addressing the question of whether increasingly granular risk- weighted approaches generally curbs risk shifting incentives. Benetton et al., (2017) provide evidence for risk shifting in the mortgage market.

In regulation, Basel I cannot pursue the reduction goal in risk shifting while Basel II tried to create a framework for mitigating the risk shifting incentives. However, the financial crises demonstrated that Basel II's performance in curbing risk transfers was inadequate. Internal models were created under estimating risk sensitivity. Risk shifting can occur due to restructuring balance sheets and regulation. Determining the risk weights can prevent from risk shifting. However, banks consider the risk weight to increase the capital adequacy then mitigate the risk shifting incentives in their portfolio. John et al., (1991) proposed a solution for eliminating risk shifting. They suggested that an optimal tax structure can be efficient in reducing risk shifting. Their solutions included social objective function which consisted of banks'

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liquidity service benefits and investment distortion costs of risk shifting. The risk shifting was surveyed using the relation between leverage, asset price and capital adequacy. Adrian and Shin (2008), and Geanakoplos (2010) emphasized the effect of leverage on asset price, using the risk taking behavior theory in banking and its application in monetary policies. Barlevy (2008) focused on the risk shifting and financial intermediation using the dynamic framework.

More recently, Lee et al. (2019) show that the compensation contracts of managers can be as important to determine risk shifting behavior, because managers have a contract with variable compensation based on the mutual fund's performance relative to their benchmark. However, these contracts are asymmetric and portfolio managers have incentives to shift the volatility of the fund. Fund managers can change risk to impress fund investors that this concept survey in the researches such as Huang et al. (2011). The role of risk shifting in creating financial instability has been discussed in the some studies such as e.g. Jensen and Meckling, (1976). Risk shifting in a systemic setting that could redistributing risk in ways that affect the entire financial system. Instead of reducing risk, it spreads it across institutions and borders, making crises more severe and harder to contain. A first exception is Acharya et al. (2010) that show combining portfolio choice of real investments with network choices of financial connections. This concept raises new questions and allows us to provide suggestive evidence consistent with risk shifting through portfolio choices in a network setting. A second exception is Farhi and Tirole (2012). In their model, banks face liquidity risk and banks increase liquidity risk if other banks also have greater liquidity risk. Then, banks are likely to be illiquid at the same time, which prompts an intervention from the authorities.

In several studies, risk shifting behavior is harmful to investors without focusing on its performance consequences. Risk shifting behavior can be driven by very different reasons; therefore, the consequences can also be different. From the investor's perspective, risk-shifting is typically undesirable when it stems from trades by unskilled fund managers aimed at increasing personal compensation. However, risk shifting is result of trades of skilled managers that trade to take advantage. Risk shifting behavior would be desirable for fund investors, because they would benefit from superior performance. Therefore, it is important to extend previous evidence to investigate the performance consequences of risk shifting behavior using a holdings-based measure of risk.

The consequences of risk-shifting likely depend on its underlying economic motivation. If there are agency problems, we should not expect

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superior performance for risky funds. We expect risk shifters to underperform. In addition, if fund managers with lower ability are more prone to change investment strategies and thus more likely to shift risk, we should expect worse performance for risk-shifting funds. On the other hand, if risk shifting is a sign of skilled fund managers adjusting their portfolio composition to take advantage of stock selection or timing ability, we should expect risk shifting funds to outperform. There are different ways to deal with risk shifting, but we have dealt with this issue by examining the system of simultaneous equations.

Excessive risk shifting can lead to systemic risk, where problems in one bank can spread rapidly through the financial system. For example, if a bank makes risky investments that fail, it could trigger a chain reaction of losses for other institutions that are exposed to that bank through lending or other financial arrangements.

If banks know they can shift risk, they may be less cautious about taking on risky activities, leading to increased potential for losses .When many banks engage in similar risk-shifting strategies, it can create a situation where a shock to one bank can quickly spread throughout the entire financial system . Risk shifting can lead to situations where bank shareholders benefit from risk-taking while other stakeholders, like depositors or bondholders, bear the brunt of the losses .

Agency problems arise when the interests of bank managers or shareholders diverge from the interests of other stakeholders. Risk shifting can exacerbate these problems by creating incentives for managers to prioritize shareholder returns over the safety and soundness of the bank.

Then, risk shifting is a complex issue in banking, with both legitimate uses and potential dangers. Effective risk management, sound regulation, and strong supervisory oversight are essential to ensure that banks manage risks appropriately and maintain the stability of the financial system.

3 Literature Review

Risk shifting is a type of conflict between creditors and shareholders. Creditors obviously produce loan agreements to prevent expropriation and value extraction by shareholders while creditors do not limit the risk behavior which can result in problems in the banking system. The aforementioned issue has been a matter of high interest for researchers to analyze.

Rauh (2007) surveyed how asset allocation is related to risk shifting incentives. This relation impacts on limiting the costs and investing in projects. This survey discovered that moral hazard has a major role in asset

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allocation, risk management and decreasing financial crisis costs. Landier et al. (2011) provided evidences of risk shifting in financial crisis. They focused on the distortion in risk preferences in financial crisis. Fischer et al. (2011) analyzed government guarantees resulting in incentives of risk taking. The risk taking behavior in banks is related to the business environment. Implicit government guarantees have several contexts and affect credit access. Similarly, Gropp, Hakenes and Schnable (2010) emphasized the decreasing lending in the balance sheets. However, based on empirical evidences government can guarantee to reduce risk taking. Fischer et al. found out eliminating this guarantee influenced risk taking behavior in Germany banking system. Their method applies differently in different frameworks. Fischer et al. proved that banks tend to lend the more risky borrowers while not adjusting the interest rate. How government guarantee affects risk taking behavior is more important to be surveyed. Eisdorfer (2010) studied risk shifting and investment asymmetry by empirical evidences, surveying which direct effect of investments pays off in banking risks. Shareholders tend to risk shifting through increasing the equity risk and asymmetric pay off distributions. Shareholders vary the asymmetry of pay offs in order to transfer the risk shifting costs to the other parties. Becker and Ivashina (2015) provided evidences of risk shifting in the insurance market. They reported that the capital requirement can lead to more limitation, thus the capital requirement reduced and there was no evidence of risk shifting to other parties. Gulzani and Watanabe (2010) showed the relation between deposit insurance and risk shifting incentives in Japan. They reported that banks transfer risk to the deposit insurer, using the option pricing model. Banks insured by flat rate based deposit insurance were involved with risk shifting, which means banks with high asset risk decreased leverage and risk taking behavior. However, high risk shifting behaviors were observed in low capital banks.

Srivastav et al. (2014) investigated debt holding and risk shifting. Banks' more risky decisions and less liquid assets can affect risk shifting. Bank pay out can influence on increasing banks' equity holder wealth. Bank pays out increases the banking risk because shareholders prefer to obtain higher risks. Debt-based compensation can impact risk shifting and result in a higher inside debt than the inside equity based on bank pay out. Risk shifting can be confirmed with moral hazard problem, both of which can influence banks' decision. Rivera (2015) analyzed risk shifting by the existence of moral hazard. Contract flexibility allowed shareholders to accept risks. Based on their results, there is a non-monotonic relation between risk shifting and leverage. Therefore, interactions between moral hazard and risk shifting are

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more important and their study emphasized capital structures and business cycles. Huberman and Repullo (2014) investigated moral hazard and debt maturity, which showed that bank maturity uninsured debt. This study applies the simultaneous equation system that uses the data of balance sheets in the Iranian banking system during the 2000-2017. Short term debt and long term debt have different effects on risk shifting behavior. Short term debt is more important for reducing moral hazard and risk-taking behavior. Their model proved that low profitability of banks along with high liquidity of the global asset market effect selecting either long- or short-term debt. This study mainly aims to determine risk shifting behavior in the Iranian banking system, indicating how banks' limited liabilities result in increasing risky assets.

Risk shifting in the mortgage market was surveyed by Benetton et al. (2017), in which adopting IRB models and rising capital with risk weight capital requirement can be important. Risky mortgages are potentially more profitable, while banks do not need to keep more capital than theirs in order to reveal mortgages to be riskier.

Batten and Vo (2016) described the risk shifting behavior in the emerging market in Vietnam. Their study shows that Banks with risky asset portfolio had limited security insurances. The link between diversification and risk is more important in risk shifting. Their results showed that non-interest income plays the main role in banks' risky behavior. Diversification had negative effects on more risky behavior in banking systems.

Chang and Ho (2017) surveyed evidences of risk shifting in the commercial banks in the US. Based on their results, risk shifting was related to adopting risk-based deposit insurance. These incentives can affect capitalization in banking systems. However, risk assessment can eliminate moral hazard problem, banks' size and their level of being capitalized affect their decision about deposit insurance.

Chaigneau (2018) described strategic complementarities among bank creditors that can create bank runs. His analyzed whether the new current institutional arrangements can substitute regulation, severe capital adequacy and supervisions.

Dinc and Bilgin (2022) show that banks lean toward expanding their customer base with firms already in the credit market. The purpose of this research is to survey of the number of bank relationships as a firm-specific determinant of capital structure and to discuss its impact on the banking sector. This study applies the Generalized Method of Moments (GMM) estimation technique to a sample of 213 Turkish non-financial, publicly listed firms with positive shareholder value during the period 2012–2017. The sample

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comprises 213 Turkish non-financial, publicly listed firms with a positive shareholder's value for the 2012–2017 period. The results show the number of bank relationships increases the leverage of sample firms while the concentration in the banking sector decreases it.

Lazzari and Vena (2023) survey that the relationship between the enterprise value and risk shifting in the Banking Industry. They assess the effectiveness of these two alternatives by leveraging on a natural experiment provided by the Italian 2015 reform mandating the largest cooperative banks to switch to a corporate form. A compression of the risk profiles of the banks' financial claims contributed to this positive value effect, which negates the long-held belief of demutualization as a possible cause of an asset substitution risk. They investigated the Pareto efficiency of demutualization in the banking system with respect to all classes of financial stakeholders. This is a much broader perspective than the one seen in most event studies in which the equity value commonly serves as a proxy for the enterprise value.

Clark and Ebrahim (2022) investigate that the relationship between Risk shifting and regulatory arbitrage. Their study identifies a robust negative relationship between operational risk exposure and bank capital levels among large U.S. banks. These results are consistent with the notion that capital-constrained banks increased operational risk exposure at the time when Basel I regulations did not require an explicit capital charge for operational risk. More broadly, their results indicate that financial regulations incentivize banks to shift their risk taking to less regulated risk areas. This paper focuses on operational risk as a key example, given that it represents an initially unregulated risk category that evolved into a major risk component, accounting for approximately 25% of large U.S. banks' risk-weighted assets.

Andreu et al. (2019) analyzes that Risk shifting consequences depending on manager. This paper survey the performance consequences of the risk shifting behavior by domestic equity mutual funds through the analysis of monthly portfolio holdings. Implications of risk shifting for mutual fund investors is the main goal of this paper. Their findings indicate that funds that increase their risk level achieve significantly better performance compared to funds with stable or reduced risk levels.

Gete and Gómez (2018) analyze the model's risk-shifting through the changes of banks' lending standards, where lower standards lead to a riskier bank portfolio.

Pugachev (2022) survey that risk-shifting value of payout. This paper studies the investor's value payout. The results of this paper show that market responses are significantly worse for enforced banks. The cross-section of

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abnormal returns suggests that risk-shifting, not agency cost-reduction, drives payout. In their sample of distressed banks, in financial crises, the ability to shift risk through payout has value. Restricted access to payout reduces firm value and the role of payout in mitigating agency costs of equity, their results highlight that a largely under-explored attribute: payout deflects shareholder risk toward other corporate claimants. In the sample, this advantage surpasses the effect of agency cost-reduction.

Kogler (2020) indicated that there are the related the risk-shifting problem of banks and offering a novel rationale for macro prudential regulation. The interaction between this agency problem and equilibrium investment creates a welfare-reducing financial externality that causes capital misallocation and extreme bank risk taking. Therefore, the banking sector tends to be too large, under-capitalized, and inefficiently risky. This distortion is independent of typical attrition like government guarantees or default costs. Macro prudential regulation with capital requirements or deposit rate ceilings precise misallocation thereby magnifying rent opportunities for banks to reduce risk shifting.

Kobayashi (2024) survey that cash outflow risk influences banks' dividend policies by incentivizing shareholders to receive cash before the shock hits the economy. While banks need deposit insurance to pursue their primary role of risk transformation, it allows banks to engage in risk-shifting by increasing dividends and reducing capital levels. Although capital regulations can limit banks' risk-shifting, bank dividends and risk are positively related when cash outflow risk increases and negatively related when investment return increases. When cash outflow risk is high, dividend restrictions are more effective than capital requirements in limiting bank risk.

Stertz (2024) studies the occurrence of risk-shifting within Euro area banks from 2015 to 2022 and examines how size, business model, and country of origin influence it. The analysis shows that distinct risk-shifting patterns, with small banks engaging in other debt-based risk-shifting, posing higher risks for non-depository creditors. Additionally, the analysis highlights different types of risk-shifting, depending on a country’s level of indebtedness. Furthermore, by examining the factors that change such behavior, it shows that capital buffers effectively curb excessive risk-taking. Then, this paper focuses on the concept of risk shifting because risk transfer is a fundamental aspect of modern banking. While essential for financial innovation and resilience, improper use of risk transfer tools can amplify systemic risks.

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4 Model and Variables

The data includes active banks in the Iranian banking system per month, during 2000-2022. This financial information was retrieved from the Central Bank database and the Iranian economic databases (Table 1). The statistical characteristics of banking are shown in Table 1. The change average in the capital, deposit and non-depository ratio is 0.5334, 0.1129 and 0.2145, respectively. The banks' size as measured by the total asset log in the Iranian banking system is 5.1637, on average.

Table 1
The Summary of the Statistics

Variables	Mean	Median	min	max	Stdv.
Changes in capital	0.5334	0.1423	0.261	0.772	0.9374
Changes in deposit	0.1129	0.0522	-0.211	0.407	0.3681
Changes in non-depository	0.2145	0.01236	0.032	0.394	0.5412
Risk weighted asset ratio	0.3530	0.8193	0.167	0.661	0.1165
Return on equity	0.3169	0.2487	-1.71	4.98	0.1269
Size of banks	5.1637	5.9174	3.63	6.24	0.6358

Source: Research findings

The dataset includes information on bank balance sheets that is obtained from banking database and macroeconomic reports of the Central Bank of Iran during 2000-2022. The systems of 25 banks in Iran were studied. The present study applies a dynamic system GMM estimator. The GMM estimator selects the parameter, estimates it so that the correlations between the instruments and disturbances are most possibly close to zero, as defined by a criterion function. By selecting the weighting matrix appropriately in the criterion function, GMM can be made robust to heteroskedasticity and/or autocorrelation of an unknown form.

The unit root test for each variable is important in order to avoid spurious regression problems for both time series and panel data. Therefore, Levin, Lin and Chu, Im, Pesaran and Shin W-stat, and Fisher test were used to reflect the common unit root of variables (Table 2).

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Table2
Results of the Common Unit Root Test

Variable	Levin, Lin, Chu t.	Im,Pesaran, Shin W-stat	ADF – Fisher Chi-square	PP-Fisher chi-square
Changes in capital	-5.1294 (0.000)	-8.32592 (0.000)	169.191 (0.000)	188.185 (0.000)
Changes in deposit	-3.3144 (0.000)	-3.7667 (0.0003)	116.070 (0.0004)	116.481 (0.000)
Changes in non-depository	-5.156 (0.000)	-6.33 (0.0002)	112.127 (0.006)	158.69 (0.000)
Changes in Risk weighted asset ratio	-2.2041 (0.000)	-4.4579 (0.000)	125.349 (0.0001)	125.459 (0.000)
Return on Equity	-9.66134 (0.0002)	-3.546 (0.007)	112.583 (0.000)	189.611 (0.000)
Size	-8.36 (0.000)	-9.53 (0.0007)	191.43 (0.0007)	199.68 (0.000)

Source: Research findings

Table3
Results of unit root test with cross-sectional dependence (Pesaran CIPS)

Variable	Pesaran CIPS (in Constant)	Critical values	
Changes in capital	-2.7974	1%	-2.30
		5%	-2.16
		10%	-2.08
Changes in deposit	-2.4083	1%	-2.30
		5%	-2.16
		10%	-2.08
Changes in non-depository	-4.78	1%	-2.30
		5%	-2.16
		10%	-2.08
Changes in Risk weighted asset ratio	-2.753	1%	-2.30
		5%	-2.16
		10%	-2.08
Return on Equity	-3.166	1%	-2.30
		5%	-2.16
		10%	-2.08
Size	-1.884 (-4.101)	1%	-2.30
		5%	-2.16
		10%	-2.08

Source: Research findings

Table 3 represents results of unit root test with cross sectional dependence-Pesaran (2006,2007). The CIPS test results represent that all the variables are stationary at level I(0). According to the critical value stated in Table 3, it can

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be Pesaran CIPS unit root test show that the variables of the model have significance and only size variable has significance at the first level in unit root test.

In a banking system, simultaneous equations can be used to model the relationships between various factors like risk, capital, and profitability, especially when considering how these factors shift or interact under different conditions. This approach is particularly useful in dynamic situations, such as when banks adjust their risk-taking behavior in response to regulatory changes or economic shocks. By using simultaneous equations, researchers and analysts can better understand how these factors influence each other and the overall stability of the banking system.

In fact, many economic relationships can be explained by single equation models. In these models, one variable is considered as a function of one or more other variables, and the causal relationship between the two variables is assumed to be one-way. However, there are cases where there is a two-way flow of causality between economic variables; that is, an economic variable is affected by another economic variable while affecting it. When the dependent variable in an equation is an explanatory variable in another equation, the model or system of simultaneous equations is such that for each endogenous variable in the system, there is a behavioral or structural equation. Since a simultaneous equation system is structurally different from multivariate regressions, it may not satisfy the classical assumptions governing multivariate regressions. For example, one of the characteristics of a system of simultaneous equations is that the dependent variable in one equation appears as an explanatory variable in other equations in the system. Such an explanatory variable may be correlated with the residual term of the equation in which it is included as an explanatory variable, and the correlation of the explanatory variable with the residual term in an equation violates are zero. In such circumstances, the use of ordinary least squares estimators leads to results that are not only biased, but also inconsistent; that is, even if the sample size tends to infinity, the ordinary least squares estimators still do not equal the true values of the population. Therefore, due to the lack of independence between the endogenous explanatory variables and the disturbance component, the ordinary least squares method is inappropriate for estimating an equation in a simultaneous system, and the application of the generalized method of moments is more efficient in these cases. In fact, by using the simultaneous equation framework, the relationship between these variables can be shown along with other influential variables. This is while in most studies, the equations have only been addressed separately. In this study,

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considering the importance of this simultaneity, the simultaneous equation system has been used.

The present study applied the simultaneous equation in order to examine how risks shifted to other parties in banking systems. These systems are based on the relations between risk and capital ratio, and deposit and non-depository ratio. The three systems of simultaneous equation are as follows:

$$\Delta\, RISK_{i,t} = r_0 + r_1 \Delta\, capitalratio_{i,t} + r_2 size_{i,t} + r_3 ROE_{i,t} + r_4 \Delta\, RISK_{i,t-1}$$
$$\Delta\, capitalratio_{i,t} = r_0 + r_1 \Delta\, RISK_{i,t} + r_2 size_{i,t} + r_3 ROE_{i,t} + r_4 \Delta\, capitalratio_{i,t-1} \quad (1)$$
$$\Delta\, RISK_{i,t} = r_0 + r_1 \Delta\, depositratio_{i,t} + r_2 size_{i,t} + r_3 ROE_{i,t} + r_4 \Delta\, RISK_{i,t-1}$$
$$\Delta\, depositratio_{i,t} = r_0 + r_1 \Delta\, RISK_{i,t} + r_2 size_{i,t} + r_3 ROE_{i,t} + r_4 \Delta\, depositratio_{i,t-1} \quad (2)$$
$$\Delta\, RISK_{i,t} = r_0 + r_1 \Delta\, nondepository_{i,t} + r_2 size_{i,t} + r_3 ROE_{i,t} + r_4 \Delta\, RISK_{i,t-1}$$
$$\Delta\, nondepository_{i,t} = r_0 + r_1 \Delta\, RISK_{i,t} + r_2 size_{i,t} + r_3 ROE_{i,t} + r_4 \Delta\, nondepository_{i,t-1} \quad (3)$$

Where, for bank i in period t, changes in risk indicate the risk weigh asset. In system (1), capital ratio is the independent variable influencing changes in risk variable. Other explanatory variables are size i.e. the total logarithm asset, profit i.e. the return on equity and the level of risk in t-1. The level of risk in t-1 is shown by the level of risk weight asset in t-1. The change in the deposit-to- nondeposit funding ratio from the previous period is employed in the other systems. The relation between risk and deposit ratio is focuses in system (2) and the relation between risk and non-depository ratio is defined in system (3).

Most researchers used Shrieves and Dahl's (1992) model, based on the changes in capital as a function for changes in risk and vice versa. As both the risk and capital are anticipated to be closely related to both-way causation and equation, a simultaneous model in structural form can be a suitable to estimate and survey the impact of various variables.

Risk shifting can be related to risk taking behavior in banking systems. Accepting risks can lead to risk transfers to other parties. Thus, this study focuses on the risk changes which are related to capital ratio and other structures of the balance sheet in the banking system. Deposit and non-depository debt ratio were used in the present study in order to transfer risk to

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depositors and other parties. The risk shifting group studied in the present study is compatible with that in Clark and Ebrahim (2022) and Duran and Lozano-Vivas (2016) study. There are four different groups of risk shifting. The first group is double-sided, transferring risk to depositors and non-depository debt which is determined by capital, deposit, and non-depository ratio. The capital ratio is estimated to affect negatively while deposit and non-depository ratio are expected to be positive and significant.

The second group is deposit-based risk shifting in which capital and non-depository ratio are negative and significant while deposit ratio is positive and significant. According to Duran and Lozano-Vivas (2016) and Andreu et al., (2019) non-depository ratio can be insignificant.

Debt-based risk shifting is the third group in which shareholders transfer the risk to non-depository debt. Capital and deposit ratio are negative, the latter of which can be insignificant while non-depository ratio is estimated to be significantly positive. The fourth risk shifting group includes the insignificant coefficients of deposit and non-depository ratio. Therefore, the estimation of system reveals no obvious risk shifting.

5 Results

Table 3 includes two parts, showing the estimations of the systems (1)-(3). The upper part of which shows the results of the estimation by the equations applied to the changes in risk weighted asset ratio which is the dependent variable. The lower part of the Table refers to the equations applied to the changes in capital, deposit and non-depository ratio which are dependent variables. The changes in capital and non-depository ratio are important for determining the type of risk shifting. Thus, the coefficient of changes in deposit is similar to the aforementioned ones.

The results for Systems (1) through (3) are presented in Table 4. The relation between changes in risk and capital ratio is negative and significant. The type of risk shifting is determined by coefficient signs in the estimated equations. Based on the results, the changes in capital are negative and significant while the changes in deposit ratio are positive and those in non-depository ratio are negative and significant. Therefore, deposit-based risk shifting exists in the Iranian banking system. Based on the results, these systems show how banks transfer risks to the depositors by the shareholders. According to the result of Chang and Ho (2017), reducing capital ratio is related to increasing deposit ratio while decreasing non depository ratio creates an increasing overall risk.

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To ensure instrument validity, the Sargan test can be used that is shown in the table 4. This test examines whether all the instruments used in the model are uncorrelated with the error term, i.e. whether they are exogenous. In this method, the validity of the matrix instrument will be tested by the Sargan test. The Sargan test the null hypothesis point out that matrix tools are not correlated with interrupted variables. As can be seen, the null hypothesis is not rejected. Therefore, matrix tools are not correlated with interjected variables, and the practical instrument has the necessary strength for estimation.

Table 4
the estimation of system of risk shifting in the Iranian banking system

variables	**System (1)**	**System (2)**	**System (3)**
Part 1: dependent variable: ΔRWA			
Intercept	0.00605(1.78)	0.01467(2.24)	0.5746(1.65)
Δcapital ratio	-0.0796(-4.83)	---	---
Δdeposit ratio	---	0.00635(2.45)	---
ΔNon-depository ratio	---	---	-1.34(-2.14)
Size	0.00172(1.87)	0.00259(2.74)	0.253(1.73)
Return on Equity	0.00298(2.44)	0.00212(3.16)	0.0695(1.67)
ΔRWA(-1)	0.00586(2.28)	0.0833(2.38)	0.746(1.73)
Part 2: dependent variable : Δcapital ratio, Δdeposit ratio, ΔNon-depository ratio			
Intercept	0.01325(2.68)	0.231(2.29)	0.4205(5.67)
ΔRWA	0.1247(4.79)	0.716(1.78)	0.498(2.16)
Size	0.00236(2.47)	0.0427(2.19)	0.187(1.77)
Return on Equity	0.00918(1.96)	0.0221(1.75)	0.0519(5.31)
Δcapital ratio(-1)	0.01404(1.69)	---	---
Δdeposit ratio(-1)	---	1.92(2.75)	---
ΔNon-depository ratio(-1)	---	---	0.547(2.05)
D.W	2.28	2.01	1.99
R-squared	0.53	0.61	0.58
Sargan test (P-Value)	11.66 (0.35)	12.99 (0.33)	14.21 (0.42)

Source: Research findings

This type of risk shifting is required for the negative coefficients of changes in the capital and non-depository ratio. However, the shareholders tend to transfer risk to the depositors when changes in the deposit ratio are necessarily positive and significant. Thus, Iranian banks' behavior is deposit-based in which decreasing changes in capital ratio and increasing ones in deposit ratio affect non-depository ratio negatively and significantly.

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Banks prefer the shareholders' risk to transfer to the depositors, thus increasing the capital ratio is acceptable with decreasing the deposit ratio, simultaneously, in the system. The regulation and identification of risk shifting is required in the Iranian banking system. Financial imbalances and shock components are considered to be among the main causes of financial crises. The global financial crisis showed an important debate on risk shifting. The changes in risk and capital ratio are more important. Not identifying risk shifting can result in instability in the banking system. Undercapitalization in banks is the cause of instability in the Iranian banking system. Undercapitalized banks play the main role in financial crisis and instability. Undercapitalization can result in financing with short term capital, using insecure bank loans and showing risk taking behaviors.

In table 3, the size and return on equity have significant and positive effects. In other words, estimating the systems using the control variables shows significant results.

Return on equity seems to be a suitable variable increasing the moral hazard behavior and risk shifting. Thus, profitable banks have powerful signals for risk transfer. However, large banks supported by the Central Bank and Government show more risk shifting behaviors, the incentives of which can be detected in the banking system and decreased by regulation and supervision.

6 Conclusions

Financial imbalances and shock components are considered to be among the main causes of financial crises. The global financial crisis showed an important debate about risk shifting, which has attracted many economists, politicians and the public due to its important effects on the economy and financial stability.

Regulatory attempts to address these challenges by introducing more complex rules may not necessarily yield a safer system. This is because the optimal response to a complex problem is not always a complex solution, and additional complexity can expand opportunities for regulatory arbitrage. As Aikman et al. (2018) argue, a more effective approach is to design a regulatory framework composed of multiple complementary standards that interact and reinforce one another. Such a framework can help banks manage regulatory constraints without unnecessarily increasing systemic complexity.

The present study shows how banks' limited liabilities increase risky assets. In order to test risk shifting in the Iranian banking system, the present study used control variables such as the dependent and independent ones. The

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main aim of this study is to identify the type of risk shifting, which is determined by the relation between shareholders and depositors. Risk shifting behavior is changes relations and performance in banking systems.

The relation between changes in risk and the capital ratio is negative and significant. The risk shifting type is determined by coefficient signs in the estimated equations. The changes in capital are negative and significant, while the changes in deposit ratio are positive and those in non-depository ratio are negative and significant.

Iranian banking system has a deposit-based risk shifting, along with decreasing changes in the capital ratio, increasing ones in the deposit ratio and negative and significant non-depository ratio.

A policy recommendation to address risk-shifting in banking includes strengthening capital requirements, improving governance and compensation structures, enhancing transparency, and promoting competition among banks. Additionally, regulatory interventions like payout restrictions can be effective in mitigating risk-shifting .Effective implementation and enforcement of regulations are crucial for preventing risk-shifting, and regulators need to be vigilant in monitoring compliance .Banks may adapt to new regulations, leading to new forms of risk-shifting. Continuous monitoring and adaptation of policies are necessary.

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