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Risk Dynamics in Iraqi Banking Sector: Role of Bank Capital and Efficiency

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The succession of financial crises has made it necessary for economists and policymakers to have a comprehensive understanding of financial systems and efficiency to reduce risks. Therefore, this study is designed to analyze the relationship between bank capital, efficiency, and risk in Iraqi banking sector by using the data from 2011-2022 for 20 commercial banks in the country. Efficiency is measured by three factors, including allocating efficiency (AE), technical efficiency (TE) and cost efficiency (CE). Results of the panel GMM indicate that bank capital is negatively associated with one risk measure (Zscore) while it is positively related to other measures of risk (SDROA and SDROE). Moreover, AE, TE and CE are also significant determinants of risk factors in banking. TE and CE are negatively related to solvency risk (ZSCORE) and SDROA, while positively associated with SDROE. But AE is only negatively related to Z-score and positively related to SDROA and SDROE. This study contributes valuable insights into the performance, efficiency, and stability of the Iraqi banking sector, providing policymakers, regulators, and industry stakeholders with essential information for decision-making and strategic planning.

Keywords: capital, allocative efficiency, cost efficiency, technical efficiency, risk

Jel Codes:D24, D61, D81

The global banking industry has witnessed continuous dynamic transformations over the last two decades due to environmental factors, technological development, deregulation, and financial and economic globalization. These factors have led to an increase in the intensity of competition and concentration in the banking sector, prompting policymakers and stakeholders to intensify discussions about the banking environment and its role in making this sector more efficient and stable.(Hellmann et al., 2000).Regions have implemented precautionary measures throughout successive financial crises, which help increase regulation and enhance capital adequacy standards. The first Basel Accord, launched in 1988, underwent reconsideration at the end of the twentieth century, prompting the Basel Committee to issue the Basel II Accord, followed by Basel III after the 2008 crisis exposed the fragility of many banks' financial conditions. However, banking and financial institutions have been weakened by successive financial crises and require a better understanding of the factors that influence performance and risk behaviour. Due to inefficient and ineffective capital management, financial crises have also highlighted the vulnerability of weak banks, which are a significant cause of economic shocks, particularly in Iraq. The weak regulatory framework has not prevented banks from being exposed to high levels of risk, highlighting the need for a better understanding of risk determinants in the banking industry. Various macroeconomic factors such as market capitalization, inflation and growth rate influence the nature and dynamics of banking activities and are also linked with the sectoral environment (Koopman & Szekely, 2009).

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The series of financial crises in the Middle East, especially following the COVID-19 pandemic, has made it essential for policymakers and financial economists to conduct a comprehensive and in-depth review of the links between financial systems and banking behaviour to mitigate risks. The financial crisis highlighted the regulatory framework's failure to ensure financial stability in the banking sector. These controls not only protected banks from high levels of risk, but also underline the need for a better understanding of risk factors as well as the nature and dynamism in the banking operations. It puts it in direct contact with the sectoral and general environment represented by macroeconomic variables. Crises have demonstrated that banks lacking efficiency in risk and capital management may be more vulnerable to financial and economic shocks. Over the years, efficiency has been one of the most prominent topics on the research agenda, and the reasons behind the increase in this research are attributed to the increasing changes in the operational regulatory environment, which prompts banks to search for the best solutions to control costs and increase revenues (Chortareas et al., 2013). Efficiency enables banks to make informed decisions about the optimal marketing mix, utilising the least inputs to achieve the best outputs.

The succession of financial crises made it imperative for economists and policymakers to have a comprehensive and in-depth understanding of the links between financial systems and banking behaviour to reduce risks. Capital regulation is critical for lowering bank failure risks, particularly during the global financial crisis, by addressing budget imbalances (Saeed et al., 2020). Independent bodies like the central bank and other public institutions keep an eye on commercial banks to make sure that they follow Basel requirements for capital regulation to lower risk and assist banks to work more efficiently and increase their profitability(Bitar et al., 2016).

For many years, measuring efficiency and analyzing its behaviour with risk has become vital in dealing with the multifaceted and dynamic landscape of the modern banking sector. Previous studies have discussed the role of efficiency in the banking industry and revealed that it helps to meet regulatory requirements, boost profitability, optimize resource allocation, enhance competitiveness and create value for the long term with stakeholders (Matabaro, 2019; Albaity, 2019; Le et al., 2020). In addition, fewer studies have measured and analysed the efficiency relationship with risk and competition (Goetz, 2018; Fang et al., 2019; & Tan et al., 2021).While fewer studies have analyzed efficiency measures in relation to the risk and performance of banks in different regions(Lotto, 2018; Dias, 2021).

This study contributes to the literature by examining the relationship between risk, capital, and efficiency in Iraq's banking system. Moreover, the present study is also unique in that it analyses the relationship between risk and efficiency from all three measures of risk (i.e., technical efficiency, allocative efficiency, and cost efficiency). This research is compiled in 5 sections. Recent selected literature is discussed in section 2, aligning with the relevant theories. Data and methodology are discussed in section 3, while section 4 is reserved for results and discussion, and the study is concluded in section 5 with limitations and policy implications.

Literature Review

Understanding the relationship between capital, risk, and efficiency remains a cornerstone of banking and financial stability research. Theoretical and empirical studies have long debated whether higher capital leads to risk-taking behaviour by banks and how efficiency mediates this relationship. The foundational theoretical perspectives include the Regulatory Hypothesis, Moral Hazard Hypothesis, Bad Management Hypothesis, Bad Luck Hypothesis, and Cost Skimming Hypothesis.

The regulatory hypothesis emphasizes the centrality of supervisory bodies to maintain the continuity of banking operations. According to Kim and Santomero (1988), capital requirements limit the risk of deposit mispricing. The moral hazard hypothesis by Jeitschko and Jeung (2005) promotes an inverse relationship between capital and risk, as banks with low capital tend to take on more risky investments due to weak oversight and inadequate legal reserves. Bougatef and Mgadmi (2016) and Abbas et al., (2021) showed an inverse relationship between risk-weighted capital ratios and capital reserve ratios.

By contrast, the Bad Management Hypothesis (Berger & DeYoung, 1997; Williams, 2004) links inefficiency and inadequate internal controls in underperforming banks to higher risk. The Bad Luck Hypothesis (Berger & DeYoung, 1997) contends that unfavorable outside events that are out of the bank's control increase risk and reduce productivity (Kolia & Papadopoulos, 2020; Tan & Floros, 2013). The Cost Skimming Hypothesis reveal that cost-efficient banks take more risk as they rely on a thinner capital buffer without sacrificing profitability (Kolia & Papadopoulos, 2020 Fiordelisi & Mare, 2014).

It has been suggested that capital regulations assist banks and industries to alleviate risks, particularly in undercapitalized groups of banks. Jacques and Nigro (1997) and Siddika and Haron (2020) found that capital regulations helped mitigate risks, especially in undercapitalized banks. Camara et al., (2010) and Van Roy, (2005)Indicated that banks with insufficient capital often engage in high-risk strategies. Ding and Sickles (2019), Jokipii and Milne (2011) and Zhang et al., (2008)further explored how capital adequacy affects risk-taking dynamics in developed markets. Sarkar et al., (2019)presented mixed evidence on efficiency-risk dynamics across different bank ownership types in India. Saeed et al., (2020)showed that Islamic banks tend to increase capital in response to rising bankruptcy risk, but with limited impact on reducing risk. Deelchand and Padgett (2009) and Fiordelisi et al., (2011) emphasized how efficiency influences capital-risk behavior in cooperative and EU commercial banks.

More recent literature after the COVID-19 pandemic offers expanded insights. Nguyen et al., (2023) reported that banks with lower capital reduced risk exposure more aggressively during the COVID-19 crisis, whereas highly capitalized banks maintained risk levels. Boamah et al., (2023)found that in emerging markets, capital regulation and improved efficiency are crucial for enhancing performance. Fatouh et al., (2024) showed that leverage ratios reduce risk-taking without compromising efficiency in UK banks. Güngör (2023)highlighted how capital-risk relationships vary by market segment in Turkey. Subsequently, numerous studies obtained different results between risk and efficiency (Huizhi & Xianghua, 2023; Boamah et al., 2023)but results do not provide a consensus on the relationship between risk and efficiency. For example Alsharif (2021) found that higher levels of efficiency will lead to reduced insolvency and credit risk, while Sarkar et al., (2019) investigates risk, capital, and efficiency in Indian banking by analyzing various relationships between distinct ownership kinds. Empirical results have conflicting results on the positive relationship between low efficiency and increased credit risk in public banks, and a positive association between efficiency and risk in international banks. Cevikcan and Tas (2022)found that risk is positively related to efficiency in Turkish brokerage enterprises.

Over the past decade, many studies have dealt with banking efficiency, especially for those countries that have witnessed the transition towards a liberal economy. Many previous studies dealt with the cost efficiency of banks during the transitional period.(Anwar, 2019; Blankson et al., 2022). Some studies analyzed the relationship between efficiency and liquidity or credit risk in banks (Boamah et al., 2023; Hasnaoui & Hasnaoui, 2022). But the literature on the relationship between risk, capital and efficiency is missing in Arab countries, especially in Iraq, where a number of new banks are opening since the last years without any consideration of stability and efficiency.

By studying the connection between capital regulation, risk and efficiency, the research sheds light on the links of these aspects and their effects on the whole strength of the banking sector. This study is essential for policy makers looking for an equilibrium among the regulatory requirements, market demand, competition and financial stability. This analysis adds valuable insights into the overall performance, proficiency, and stability of the Iraqi banking sector, offering policymakers, officials, regulators, and business stakeholders dynamic information to inform their decision-making and strategic planning. This study aims to investigate the relationship between capital, risk, and efficiency in the Iraqi banking sector.

Method

To analyze the relationship between capital, risk and efficiency, the present study uses the panel data of commercial banks in Iraq. The study uses the data from 2011 to 2022 of twenty (20) commercial banks, thus we have 240 observations for analysis. There were very few missing values in some banks for one to two years, which were estimated by using the extrapolation method in STATA 15. Time horizon and selection of banks are made based on data availability, and banks with very few observations or missing data are not included in the sample. The study consists of all 20 commercial banks for which complete and consistent financial data were available during the 12-year study period. Given the nascent and evolving nature of the Iraqi commercial banking sector, data availability has been a significant limitation. Many banks lack historical records or have not publicly disclosed financial statements for extended periods. Data were collected from the annual reports of banks as well as the Central Bank of Iraq (CBI) bulletins and publications. Data on macroeconomic variables were obtained from World Development Indicators (WDI). Remaining details of data and sources are mentioned in Table 1.

The present study employs the generalized method of moments (GMM) for the regression analysis. The generalized method of moments (GMM) is widely used in dynamic data analysis, especially in banking, finance, and economic studies, because of its ability to address specific challenges in empirical research especially for dynamic estimation of panel data (Nguyen et al., 2024; Tran & Nguyen, 2024). The GMM system is particularly suitable for this research because it effectively addresses challenges such as endogeneity, simultaneity, heteroskedasticity, autocorrelation, and unobserved heterogeneity inherent in banking data (Abbas et al., 2021; Tran & Nguyen, 2024).

Model

The study model is given below in equation 1.

$$Risk_{it} = \alpha_0 + \alpha_1 Risk_{i.t-1} + \alpha_2 Risk_{i.t-2} + \alpha_3 Cap_{it} + \alpha_4 Efficiency_{it} + \alpha_5 ROA_{it} + \alpha_6 SIZE_{it} + \alpha_7 Liquidity._{it} + \alpha_8 C3_{it} + \alpha_9 RMSD_{it} + \alpha_{10} GDPG_{it} + \alpha_{11} \text{Inf.}_{it} + v_i \quad (1)$$

Where 'i' represents the cross-section of the sample (banks), while 't' refers to time. Bank risk-taking is proxied by Z-score, SDROA, and SDROE. Capital regulation is proxied by the equity to total assets ratio. Efficiency is calculated by data envelopment analysis (DEA) and represented by technical efficiency, allocative efficiency and cost efficiency. Banking sector and macroeconomic variables are explained in Table 1, while $v_{it}$is the random error term in Equation 1.

Measurement and Description of Variables Efficiency

We use Data Envelopment Analysis (DEA) to estimate efficiency. DEA is a non-parametric method for evaluating the relative efficiency of decision-making units (DMUs) considering multiple inputs and outputs. In our study, we opted to use Data Envelopment Analysis (DEA) over Stochastic Frontier Analysis (SFA) due to several methodological and empirical reasons that align with the nature of our data and research objectives. DEA is preferable for a small sample size, like our study data is limited to20 banks and only for 12 years, therefore, DAE preferable over SFA (Coelli et al., 2005). Moreover, the banking sector has multiple outputs like interest income, loans, service charges etc, for which DAE is an efficient measure to calculate efficiency with multiple output which SFA cannot adjust (Berger & Humphrey, 1997). The first model was developed by Charnes et al., (1978), known as CCR, this model assumes that the optimal level of efficiency depends on the minimum production input required to produce a given output, and that farm size does not have a significant impact on efficiency as long as all DMUs operate within the optimal range. Efficiency was defined as the ratio of output to input. Given the diverse production scenarios, there must be multiple outputs and inputs. Therefore, calculating the most realistic efficiency requires weighing the inputs and outputs. Technical efficiency can be defined as:

$$Technical\ efficiency = \frac{Weighted\ sum\ of\ outputs}{Weighted\ sum\ of\ inputs} \quad (2)$$

Risk-taking Behavior

In our study, we use several indicators to represent risk behavior (bank credit risk, bank soundness, and liquidity risk). We measure the bank's credit risk as a representation of credit quality by measuring loan loss provisioning as part of total loans, as a follow-up to Dias (2021), Kwan and Eisenbeis (1997), and Tan and Floros, 2013). The Z-score is another metric we use to quantify bank risk since it is an indicator of financial solvency that has been adopted in a large number of studies (Shira, 2023; Dias, 2021; Mohsni & Otchere, 2018 etc.). The Zscore is calculated as follows:

$$Z_{Scorei} = \frac{ROA_{it} - \frac{EQ_i}{TA_i}}{\sigma ROA} (3)$$

ROA_{it} Represent the Return on assets of the bank$i$ in year t , $\frac{EQ_i}{TA_i}$ Represent the Ratio of total equity to total assets of the bank i in year t and σROA represent to Standard deviation of the ROA for each bank (Assthanasoglou et al., 2008).

Bank Capital

The two primary ideas of bank capital that are most frequently utilized in the literature are funds generated by issuing shares and retained earnings. Real capital is sometimes referred to as physical capital and regulatory capital. In our study and follow-up (Nguyen & Nghiem, 2015;Tan & Floros, 2013), the ratio of equity to total assets is used as an indicator of capital representation in the Iraqi banking sector.

Table 1

Description of the study variables

Variables	Notation	Definition
Risk	Z-Score	The ratio between a bank's return on assets plus equity capital/total assets
	ZROA	The standard deviation of ROA
	ZVORE	The standard deviation of ROE
Efficiency	TE	Technical Efficiency
	AE	Allocative Efficiency
	CE	Cost Efficiency
Capital	Capital	Book value of capital to total assets
Bank-specific variables		
Profitability	ROA	Return on assets
	Size	logarithm of total assets
	Liquidity	Loan-to-assets ratio
Indicators for the banking industry		
	C3	The ratio of total assets of the three largest banks to the overall total assets.
	RMSD	Ratio of stock market capitalization over GDP
Macroeconomics variables		
	GDPG	Annual percentage growth in real GDP
	INF	Inflation

Data Sources: Data is collected from the Central Bank of Iraq (CBI), World Bank Development Indicators (WDI), and annual bank reports.

Results and Discussion

Descriptive Statistics

The foundation for understanding the dataset's structural components and their importance for empirical modelling is laid by examining descriptive statistics in Table 2, which provide vital insights into the distributional features of key variables. We list the key attributes of these indicators along with their relevance to the subject of the study. Risk, Susceptibility, and Economic Stability. The ZSCORE average (Mean = 5.809, SD = 4.6) shows a moderate degree of financial stability, while the significant cross-sectional variability (Min = 2.308, Max = 18.868) reveals notable variations in bankruptcy risk among observations. Elevated SDROE values (Max = 13.013) raise the possibility that there are outliers connected to high levels of financial or operational leverage. The volatility metrics SDROA (Mean = 1.08) and SDROE (Mean = 2.833) show that returns on equity are significantly more volatile than returns on assets. Disparate approaches to risk management or disruptions unique to a company could lead to a mismatch. According to the efficiency ratios, which range from 0 to 1, organizations function with a moderate level of efficiency (TE = 0.446, AE = 0.567, CE = 0.434). Organizations with low-cost efficiency or measurement anomalies that need more investigation are indicated by a CE metric score of 0. According to earlier research in sectors with notable structural or regulatory constraints, systemic inefficiencies appear when the averages of the three efficiency metrics drop below 0.5. Low variance in the SIZE variable (log-transformed, mean = 5.721, SD = 0.253) points to either sector-specific sampling or regulatory size uniformity. These are traits of the market and business structure. Markets with substantial oligopoly are indicated by the C3 concentration index (Mean = 81.55 percent, SD = 12.16), while the minimum concentration (Min = 56.6 percent) exceeds the requirements for moderate concentration. This structural feature may necessitate the inclusion of rules related to market power in models that assess the trade-offs between efficiency and competition. Four. Macroeconomic Framework The inflation rate ranges from deflationary periods (minimum = -0.2 percent) to extremely inflationary phases (maximum = 6.6 percent), with a mean of 1.83 percent and a standard deviation of 2.13 percent. The GDPG has a mean of 4.01 percent and a standard deviation of 6.72 percent, indicating considerable volatility as evidenced by a noteworthy contraction of -11.32 percent and strong growth of 13.94 percent. This macroeconomic variability emphasizes how important it is to distinguish between firm-specific dynamics and cyclical fluctuations using country- or time-fixed effects. Larger variations in some variables like ROA and CAP is due to difference in bank size and capitalization strategies.

Table 2

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ZSCORE	240	5.809	4.6	2.308	18.868
SDROA	240	1.08	.704	.099	3.224
SDROE	240	2.833	2.09	.092	13.013
TE	240	.446	.285	.02	1
AE	240	.567	.19	.167	1
CE	240	.434	.27	0	1
SIZE	240	5.721	.253	4.874	6.264
C3	240	81.554	12.164	56.598	94.759
RSMD	240	4.706	1.447	2.313	6.956
INFLATION	240	1.829	2.132	-.2	6.6
GDPG	240	4.014	6.719	-11.324	13.936
ROA	240	1.693	1.935	-3.76	8.35
CAP	240	.556	.696	.06	9.921

Table 3 presents the results of the relationship between efficiency, risk, and capital using GMM-SYS estimators. The risk measure is calculated by Z-score as the dependent variable in model 1 and model (2)

shows SDROA as the dependent variable, while SDROE is represented as the dependent variable in model (3).

Regarding the results of model (1), the results indicate that there is an inverse relationship between solvency risk and capital, meaning that more capital acquired by banks tends to be riskier, which supports the moral hazard hypothesis. The apparent results indicate that capital has a greater impact on solvency risk, meaning that increasing capitalization increases the chances of banks being exposed to risks, and this is consistent with the moral hazard hypothesis. This result is consistent with Fiordelisi et al., (2011), Saeed et al., (2020) Alrwashdeh et al., (2024) also found that banks respond to regulatory measures by increasing capital, leading to increased asset risk. Our results indicate that TE is also negatively and significantly related to solvency risk (β = -9.82; $p < 0.01$). Competition imposes itself on an imperfect, risk-exposed banking industry, leading experienced managers to take more risks than to reduce them. However, companies with low efficiency tend to take greater risks to compensate for the lower returns, which leads to efficiency affecting banking risk levels (Altunbas et al., 2007).

Regarding the second model, if standardized return on assets (SDROA) is adopted as an indicator of risk, we find an inverse relationship between the levels of profitability risk by banks and efficiency (β = -0.5876; $p < 0.05$). Technically efficient banks have less volatility in returns, thus have greater earning stability. This stability in the banking sector reduces shocks and volatility in return on assets. The results are consistent with Abbas et al., (2021) and Dias (2021).

Table 3

GMM Estimates of the Relationship Between Risk, Capital and Technical Efficiency

	(1)	(2)	(3)
VARIABLES	**ZSCORE**	**SDROA**	**SDROE**
CAP	-3.7800***	0.1847***	0.1192***
	(0.7780)	(0.0396)	(0.0266)
TE	-9.8188***	-0.5876**	1.9161*
	(2.8456)	(0.2290)	(1.0508)
ROA	-0.6051***	0.0242	-0.0074
	(0.1222)	(0.0188)	(0.0553)
SIZE	-5.4027***	-0.2345	2.8826
	(1.6700)	(0.3173)	(1.8218)
RSMD	1.4639***	0.0094	-0.1551*
	(0.0919)	(0.0268)	(0.0937)
LIQUIDITY	-0.1471	0.6965***	3.0643**
	(4.6977)	(0.2278)	(1.3404)
GDPG	0.2684***	0.0113***	0.0281**
	(0.0178)	(0.0032)	(0.0129)
INFLATION	-0.0090	0.0015	-0.0028
	(0.1085)	(0.0122)	(0.0328)
C3	0.2680***	-0.0065***	-0.0168***
	(0.0171)	(0.0017)	(0.0059)
L.ZSCORE	0.4315***		
	(0.0500)		
L2.ZSCORE	0.2329***		
	(0.0192)		
L.SDROA		0.7770***	
		(0.0576)	
L2.SDROA		0.0356	

		(0.0599)	
L.SDROE			0.8959***
			(0.0823)
L2.SDROE			-0.1251**
			(0.0554)
Constant	10.3382	1.5204	-17.5214
	(8.9270)	(1.9081)	(11.9665)
Wald Chi2	86841.03	34806.99	308349.26
AR(2)	1.29 (0.198)	-0.09 (0.932)	-0.92 (0.357)
SARGAN (Prob.)	19.74 (0.072)	5.55 (0.986)	6.70 (0.753)

In the third model, we adopted the standard deviation of returns on equity (SDROE) as an indicator to measure the risks in bank returns. Table 3 presents the results of the relationship estimates between risk variables, technical efficiency, and capital. The results provide evidence that capital has a positive effect on performance risk (SDROA) and equity risk (SDROE). These results support the risk-return hypothesis, which reveals that banks with more capital have greater capacity to take risk, which yields higher expected returns (Berger, 1995). Thus, such strategies may increase the profitability of banks and increase volatility in earnings and ROA, which is reflected in SDROA. This is because of strict capital regulation requirements in the banking sector, which compel analysts and policymakers to reassess the investment strategies. Within the strict capital regulations, banks may seek to improve their returns with greater risk. However, this approach involves greater uncertainty and significant financial risks. Thus, to avoid negative consequences and retain sustainability, banks need to adjust regulatory requirements with efficient risk management practices carefully. It, therefore, emphasizes the need for banks to balance regulatory requirements with prudent risk management practices carefully.

The results of technical efficiency reveal that higher efficiency is associated with lower risk in the banking industry of Iraq, and vice versa. As lower efficiency squeezes the profits and return on assets, it increases the amount of risk in banks. On the contrary, higher efficiency leads to better credit and risk assessment as well as lowering the risk of non-performing loans (NPLs), thus reducing credit and liquidity risk (Alrwashdeh et al., 2024). Therefore, it is suggested that banks should invest in assets with high returns to mitigate the restrictions imposed by capital regulations(Berger & DeYoung, 1997).

Table 4

GMM Estimates of the Relationship Between Risk, Capital and Allocative Efficiency

	(1)	(2)	(3)
VARIABLES	ZSCORE	SDROA	SDROE
CAP	-4.0613**	0.3388***	0.2866**
	(1.7928)	(0.0352)	(0.1198)
AE	-3.5709*	1.5567***	2.2607**
	(2.0313)	(0.6030)	(1.1225)
ROA	-0.5416***	0.0202	-0.0530
	(0.2049)	(0.0205)	(0.0578)
SIZE	-1.7830	0.0813	-0.5036
	(1.1663)	(0.1178)	(1.1375)
RSMD	1.6282***	-0.0774**	-0.1181*
	(0.0978)	(0.0358)	(0.0707)
LIQUIDITY	-1.7906	1.0491***	4.4922*
	(1.3010)	(0.2822)	(2.6457)
GDPG	0.2835***	-0.0003	0.0224*
	(0.0139)	(0.0050)	(0.0125)
INFLATION	-0.0255	0.0074	-0.0055
	(0.1421)	(0.0127)	(0.0289)

C3	0.3371***	-0.0085***	-0.0290***
	(0.0107)	(0.0027)	(0.0072)
L.ZSCORE	0.6057***		
	(0.0218)		
L2.ZSCORE	0.2977***		
L.SDROA		0.8280***	
		(0.0260)	
L2.SDROA		0.0047	
		(0.0325)	
L.SDROE			0.8695***
			(0.0823)
L2.SDROE			-0.1135
			(0.0807)
Constant	-19.2066**	-1.2370*	1.2431
	(8.4056)	(0.6590)	(6.6408)
Wald Chi2	79688.12	21774.84	43356.19
AR(2)	1.28 (0.202)	-1.30 (0.194)	-0.79 (0.427)
SARGAN (Prob.)	19.93 (0.068)	6.18 (0.722)	7.83 (0.931)

Table 4 provides a comprehensive overview of the relationship between capital, allocative efficiency (AE) and risk in banking. In the first model using Z-score (column 1), the significant negative coefficient of CAP (β = -4.0613 ; $p < 0.05$) reveals an inverse relationship between capital and bank stability. This supports the regulatory hypothesis proposed by Kim and Santomero (1980) and later refined by Fiordelisi et al., (2011) that higher capital requirements may encourage banks to pursue riskier asset portfolios to maintain returns on equity, contradicting the traditional buffer assumption. The negative coefficient on allocative efficiency (β = -3.5709 ; $p < 0.1$) demonstrates that more efficient banks tend to be less stable. This aligns with Berger and DeYoung's (1997) findings that efficient banks may leverage their operational advantages to engage in higher-risk activities for greater returns. However, market concentration (C3) is positively related to risk (β = 0.337; $p < 0.01$), implying that more concentrated banks foster greater stability by investing in more risky assets to reduce competitive pressure and strict monitoring capabilities (Beck et al., 2006).

Furthermore, results in Table 4 show that allocative efficiency is positively and significantly related to two measures of risk in the last two models (β = 1.5567; $p < 0.01$). This reinforces the "efficient-risk" hypothesis that efficiency gains may be channeled into higher-risk, higher-return activities rather than stability enhancement, which is consistent with the study of Altunbas et al., (2007). The third model using SDROE (standard deviation of return on equity) shows consistent positive relationships between capital and risk (β = 0.2866; $p < 0.05$) and between allocative efficiency and risk (β = 2.2607; $p < 0.05$). The liquidity coefficient (β = 4.4922; $p < 0.1$) suggests that the opportunity cost of holding excess liquidity is particularly pronounced when considering equity returns, supporting Abbas et al., (2021) findings on liquidity management trade-offs.

Table 5

GMM Estimates of the Relationship Between Risk, Capital and CostEfficiency

	(1)	(2)	(3)
VARIABLES	**ZSCORE**	**SDROA**	**SDROE**
CAP	-4.0424***	0.0815***	0.3061
	(0.6479)	(0.0080)	(0.2049)
CE	-15.4125***	-0.4190**	3.5569***
	(4.7297)	(0.1937)	(1.1558)
ROA	-0.5591**	-0.0070	-0.1349**
	(0.2384)	(0.0250)	(0.0657)

SIZE	-5.3249*	-0.2742	6.3125**
	(2.7510)	(0.2931)	(2.6188)
RSMD	1.4222***	0.0032	-0.1595***
	(0.2252)	(0.0311)	(0.0619)
LIQUIDITY	-2.7278	1.0551**	5.5933***
	(9.5752)	(0.4507)	(1.6045)
GDPG	0.2519***	0.0135***	0.0318***
	(0.0178)	(0.0040)	(0.0105)
INFLATION	0.1462	0.0027	-0.0608
	(0.1197)	(0.0123)	(0.0423)
C3	0.2116***	-0.0043**	-0.0151**
	(0.0372)	(0.0018)	(0.0077)
L.ZSCORE	0.2266**		
	(0.0958)		
L2.ZSCORE	0.1986***		
L.SDROA		0.5066***	
		(0.0674)	
L2.SDROA		-0.2892***	
		(0.0457)	
L.SDROE			0.5431***
			(0.1214)
L2.SDROE			-0.0900
			(0.0868)
Constant	20.8226	1.9357	-39.2251**
	(19.1320)	(1.5403)	(17.1593)
Wald Chi2	4608.69	9930.49	15006.15
AR(2)	1.05 (0.296)	- 1.47 (0.141)	0.60 (0.545)
SARGAN (Prob.)	19.04 (0.163)	12.62 (0.180)	6.78 (0.963)

Table 5 shows how bank risk relates to capital and cost efficiency using three different risk mitigation strategies. When we measure risk as Z-scores, the coefficient of cost effectiveness is indeed significant (β = -15.4125; $p < 0.01$). Banks with better cost management have lower liquidity shortage, and they tend to minimize operational cost, hence have more resources to utilize. A stronger liquidity position improves profitability and lower deviation from returns on assets. This concept is similar to the savings-of-money idea proposed by Berger and DeYoung (1997), suggest that banks can appear efficient by cutting corners in risk management. In the second model, using SDROA, cost efficiency reduces the volatility of earnings in this model (β = -0.4190**; $p < 0.05$), which is the opposite of what we estimated in the Z-score model. This suggests that effectiveness affects different types of risk differently, as proposed by Fiordelisi et al., (2011). In the final model using the SDROE, the capital ratio is positive but not significant (β = 0.3061; $p > 0.1$), and the relationship between capital and risk is less clear when looking at the volatility of the equity. However, cost efficiency strongly increases the volatility of return on equity (β= 3.5569; $p < 0.01$), which supports the risk-efficiency ideas of Altunbas et al., (2007) that efficient banks could channel these efficiency gains to riskier activities. These results also reveal that banks with more cost efficiency are engaged in high-yield activities to maximize shareholder returns. These mixed results across various risk measures demonstrate that banking risk is complex and is unlikely to be managed by simple, one-size-fits-all regulations. Finally, results of control variables show that stock market capitalization (RSMD) and country economic growth rate (GDPG) are positively and significantly related to risk in most models. While bank size and ROA are negatively associated with different measures of risk in most models, inflation has no significant relationship with the bank risk at the national level.

Conclusion

This paper examines the relationship between risk, capital, and efficiency in the Iraqi banking industry. The study uses 12 years data of twenty commercial banks in Iraq and employs Panel GMM technique to investigate the impact of bank capital, technical efficiency, allocative efficiency and cost efficiency on risk behaviour of banks. We are motivated by the fact that previous literature focusing on banking behavior in Iraq is almost rare and that the available evidence for the Middle East region is mixed and inconclusive due to the differences in regulatory influences on banking behavior during periods of financial liberalization. Our analysis shows that there is a negative relationship between capital requirements and solvency risk in the banking industry of Iraq, meaning that increasing capitalization increases the chances of banks being exposed to risks, and this is consistent with the moral hazard hypothesis. But other measures of risk (SDROA and SDROE) are positively related to bank capital. The results also indicate that efficiency in banks affects risk, with efficient firms taking greater risks to compensate for low returns.

Our study finds the mixed results of different efficiency measures with different risk measures. These results are differed as each efficiency measure capture distinct nature of performance and each risk measure emphasizes on heterogeneous dimension of risk. For example, TE reflects maximization of output within the given level of inputs, and more TE leads to engaging in high-risk activities, which raises volatility-based risk such as SDROA and SDROE. These volatilities strengthen the liquidity buffer and reduce liquidity risk.

Results of this study reveal that more efficient banks tend to operate with a lower risk portfolio. These results underscore the importance of investing in technologies, training, and development programs to boost efficiency and profitability for bank managers. Based on the findings of the three papers, the study's results demonstrate the importance of the banking sector in times of economic change and its role in achieving financial stability, providing guidance for policymakers to explore successful mechanisms for transitioning to a market economy. It also emphasizes the gradual transformation, avoiding intersecting stages and taking into account the specificities of each economy during periods of financial liberalization. The results also demonstrate the importance of restructuring the Iraqi banking sector to facilitate a controlled transition to a market economy.

The banking sector in Iraq faces many challenges, such as financial inclusion, limited use of technology and consumer trust. To improve the efficiency and profitability of Iraqi banks, the results of this study provide several recommendations for policymakers and investors. Enhance capital adequacy: Encourage banks to increase their capital buffer through retained earnings, reduce the cost of capital, and hire low-cost funding agents. This approach can increase deposits from rural and small areas, expand lending opportunities, and ultimately boost returns. As our results also indicate a negative relationship, we encourage banks to increase their capital buffer through retained earnings, reduce the cost of capital, and hire low-cost funding agents. This approach can increase deposits from rural and small areas, expand lending opportunities, and ultimately boost capital and solvency risk. The study suggests that top management should discourage the riskier with more capital by limiting internal risk and avoiding aggressive risk-taking. Privatize Public Banks: Advance the privatization of public banks as a component of financial reform. Transferring ownership from the public to the private sector will stimulate competition, enable banks to independently establish interest rates, and allow lending decisions to be based on market conditions. Advocate for bank mergers: stimulate mergers between commercial banks to diminish the supremacy of state banks and bolster the financial robustness and efficiency of the private banking sector. Enhance Banking Service Quality and Competitiveness: Prioritize the elevation of banking service standards and the promotion of competitiveness among local financial entities. This will enhance efficiency, customer happiness, and overall sector performance.

The present study is limited to Iraqi banking system by considering three variables, capital, risk and efficiency. Future studies can be conducted using panel data from other Middle East countries or regions to explore the nexus of these variables. Moreover, future studies can be enhanced to examine the mediating relationship between risk and efficiency or capital and efficiency by taking any one of them (capital or risk)

as a mediating variable. External factors are not included in this study due to the post-war effect in Iraq, which could also be significant determinants in other regions or countries.

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