“From innovation to stability: Evaluating the ripple influence of digital payment systems and capital adequacy ratio on a bank’s Z-score”

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ARTICLE INFO	Jamileh Ali Mustafa (2024). From innovation to stability: Evaluating the ripple influence of digital payment systems and capital adequacy ratio on a bank’s Z-score. *Banks and Bank Systems*, *19*(3), 67-79. doi:10.21511/bbs.19(3).2024.07
DOI	http://dx.doi.org/10.21511/bbs.19(3).2024.07
RELEASED ON	Monday, 02 September 2024
RECEIVED ON	Wednesday, 01 May 2024
ACCEPTED ON	Monday, 05 August 2024
LICENSE	This work is licensed under a Creative Commons Attribution 4.0 International License
JOURNAL	"Banks and Bank Systems"
ISSN PRINT	1816-7403
ISSN ONLINE	1991-7074
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine
www.businessperspectives.org

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FROM INNOVATION TO STABILITY: EVALUATING THE RIPPLE INFLUENCE OF DIGITAL PAYMENT SYSTEMS AND CAPITAL ADEQUACY RATIO ON A BANK'S Z-SCORE

Received on: 1st of May, 2024
Accepted on: 5th of August, 2024
Published on: 2nd of September, 2024

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Conflict of interest statement:
Author(s) reported no conflict of interest

Abstract

This study investigated the influence of digital payment systems on banks' stability by exploring their effect on the Z-score of the Jordanian banking sector during the period from 2004 until 2022. It specifically focused on liquidity risks generated from e-payment transactions and how sufficient capital adequacy ratios enhance banking sector stability over both short-term and long-term periods by standing against sudden volatilities yielded from large amounts of transactions executed through digital payment systems. To achieve this objective, the study utilizes time series dual regression analyses of vector autoregression and vector error correction models on E-views 12 to cover the time variation influences of digital payment on the banking sector Z-score. The regression results indicate varied effects between the benefits and risks of digital payment systems on a bank's Z-score that influence the immediate sector's stability, indicating that while digital payment systems can initially hold liquidity risks, leading to short-term instability; the strategic implementation of robust capital adequacy ratio stands as a protective buffer by fostering long-term banking sector resilience. The results also suggest future predictions and insights for financial sector legislators and regulators emphasizing the need for monitoring strategies that stimulate continuous innovations in the digital payment infrastructure while constantly ensuring the stability and resilience of the banking sector. Thus, prudent liquidity management and the reinforcement of capital buffers are encouraged to pilot the dual challenges and opportunities that appeared at the stages of the digital payment process, ultimately guiding the sector toward continuous growth and sustainability.

Keywords digital payment, liquidity risk, VAR, VECM, financial ecosystem

JEL Classification G21, G23, E42

INTRODUCTION

In recent years, the world financial ecosystems have witnessed rapid development in the digital payment infrastructure due to the tremendous progress in emerging technologies that have reshaped customers' demands and expectations. This development aimed to induce the use of innovative digital payment system (DPS) applications due to their ability to improve transparency and security, as well as leverage customers' experience in the banking sector. Indeed, digital payment transactions go through three main stages: payment, clearing, and settlement. This process may appear simple to customers during purchasing; however, one main technical fault could occur at the payment stages, or a missed step along the payment channel can lead to susceptible transactions. Further, banks and organizations involved in the DPS process may face various potential operational and liquidity risks while executing it. These risks arise from delays in a settlement that may relate to insufficient funds to complete transactions promptly, posing financial challenges to companies. This introduces the importance of careful liquidity management to ensure financial stability and effective cash flows, therefore, banks now are necessitated to maintain adequate capital ratios to handle unexpected financial strains, cover potential losses, and control the intensified fluidity of funds facilitated by DPSs, particularly during stages of digital transactions, where liquidity demands can be high. A sufficient capital adequacy ratio (CAR) can help to ensure that banks have the necessary liquidity to complete transactions without trouble, even in the face of operational challenges or market volatility, thus protecting both the banks and their customers from potential financial distress and improving banking sector stability.

Despite the huge quantity of literature on DPS and banking stability, there is still a gap in a detailed examination of the impact of these systems on the banking sector's Z-score, combined with the vital role of CAR in reducing the risks generated by them over short and long-term periods in Jordan's developing financial sector. Hence, this study focuses on the opportunities and challenges of DPS solutions to bridge the gap for future adoption of digital services by providing a comprehensive examination of the effect of DPS on the banking sector's resilience, thereby offering valuable insights for policymakers, and financial institutions in Jordan.

1. LITERATURE REVIEW

The evolution of DPSs has transformed banking operations and admitted a new era where transactions are digitally conducted with efficiency and transparency (Almajali et al., 2022; Al-Okaily et al., 2020; Gomber et al., 2018). These systems include all types of online payment solutions, such as cryptocurrencies, e-wallets, mobile payments, and payment cards. They have not only redefined customer interactions but have also brought significant operational efficiencies and expanded market outreach for banks (Mills et al., 2016; Jameaba, 2022).

It is worth noting that the adoption of DPSs offers significant benefits and risks, while Digital payment tools enhance customer satisfaction and loyalty due to their convenience and efficiency, as evidenced by a study by Susanto et al. (2023), which showed increased customer retention rates in banks that integrated comprehensive digital payment solutions, they also hold political, economic, and operational risks as revealed by (Akanfe et al., 2021). Further research by Ngumi (2014) and Mohammed et al. (2022) examined how innovative payment systems impact commercial banks' performance, finding that while POS, mobile, and online payments positively influence banks' return on assets (ROA), the real-time gross settlement systems (RTGS) have a negative influence. Similarly, studies by Wadesango and Magaya (2020), Udin et al. (2019), and Thankgod et al. (2019) investigated the impacts of DPSs on banks' ROA, concluding that while ATMs have an insignificant effect, internet banking, and POS significantly improve profitability, suggesting banks should enhance these services to enhance their financial performance and recommending further investment in digital platforms to improve performance. Conversely, Dzandu and Amegbe (2022) explored the digital payment methods and their transformative impact on consumer financial management, they noted the impact of these methods on customer satisfaction remains vague, urging for more investigations to guide service improvements and inform policymakers aiming to foster digital payments and financial inclusion.

Despite DPS benefits to banks, their applications might lead to service disruptions due to bank system failures or technical issues, stressing the need for robust cyberinfrastructure and contingency strategies, as noted by Johnson (2017), Raharja et al. (2020), and Roberts (2023). Further Udin et al. (2019) found that while technology usages, such as ATMs and mobile payments, positively correlate with bank liquidity ratios, they also introduce cyber and liquidity risks if financial obligations are not met timely. Moreover, Raharja et al. (2020) discussed liquidity challenges in digital banking, particularly through DPSs, which might cause regulatory disparities, affecting banks' statutory liquidity ratios. In contrast, Hang et al. (2021) showed that technological investments, in addition to other factors, might reduce a bank's liquidity risk, suggesting that planned technology investments are essential for effective liquidity manage-

http://dx.doi.org/10.21511/bbs.19(3).2024.07

ment. However, the advantages of DPSs could be reduced by unsuitable management of digital risks as Thaiyalnayaki and Reddy (2017) mentioned the liquidity issue happens due to failures in the managing of digital resources in the banking sector. Consequently, this reduces financial system stability, especially systematic risk (Risman et al., 2021). Moreover, Brown et al. (2024) observed a positive link between digital payment adoption and bank stability in European frameworks, advocating that digitalization might strengthen a bank's financial survivability through diversified revenue streams and improved risk management. The shift towards more online banking activities has increased the vulnerabilities of data breaches and cyber-attacks, inducing concerns over data integrity and financial security. These studies highlight the need for banks to have a buffer as sufficient CAR to mitigate liquidity risks resulting from DPS transactions, especially those with high amounts.

CAR was initially recognized by the Basel Committee on Bank Supervision (BCBS) in 1988 under the Basel I Capital Accord, which mandated banks to hold an adequate amount of capital to meet their obligations. As a response, world countries' financial authorities set the minimum capital level for their banks, and several quantitative analyses in literature have played a key role in predicting the determinants of CAR in banking sectors to reduce the different types of risks faced by the banking sector. For instance, studies by Hameed and Siddiqui (2023), Vu and Dang (2020), and Mustafa and Mumtaz (2022) revealed that return on assets (ROA), macroeconomic, and bank-specific factors significantly determine the required CAR as a buffer against losses.

In fact, the recent financial crises have introduced the vital role of CAR in improving banking sector stability, particularly its impact on the banking sector Z-score as suggested by Sareen and Sharma (2022) and Lepetit and Strobel (2013) that a higher CAR correlates with increased Z-score and reduced insolvency risk in banks. As a result, several studies focus on the crucial relationship between the Z-score and CAR to address the significance of sufficient CARs in fostering bank resilience and stability. For instance, Martínez and Baselga (2020) and Alam and Yusuf (2024) explored how regulatory changes in capital requirements impact the Z-score in Latin American banks, revealing that stricter capital adequacy standards correlate with enhanced bank stability. Furthermore, Rajhi and Hassairi (2013), Gowri and Sekar (2014), and Nguyen et al. (2023) highlighted the substantial role of CAR as a determinant of ensuring stability in Asian banking sectors, they found a significant role of CAR on banks Z-score especially during economic recessions. Also, Noman et al. (2018) examined the role of a bank's capital requirement and deposit insurance regulation on the relationship between competition and financial stability in the banking sector of Southeast Asian countries, they found that sufficient CARs are most effective in improving financial stability and mitigating credit risk. Similarly, Kharabsheh and Gharaibeh (2022) and AlAli (2019) investigated the determinants of financial stability in Jordanian banking and found that CARs positively affect the stability of the banking sector, while credit risk and liquidity risk negatively affect it. Therefore, it is necessary to highlight the role of CAR as a buffer against vulnerabilities related to digital transaction flows (Ghosh et al., 2016; Japparova & Rupeika-Apoga, 2017).

Thus, Berrospide and Edge (2010), Harkati et al. (2020), Gharaibeh (2023), and Mustafa et al. (2023) conducted studies in the framework of digital payments and found that sufficient CARs are essential in absorbing a bank's loss. According to Patricia et al. (2023), banks with sufficient CARs are better placed to meet liquidity requirements resulting from digital transactions. Similarly, Klapper et al. (2016) provided empirical evidence by showing the interconnection between CAR and e-payment risk management and the importance of holding higher CAR levels to maintain operational steadiness and liquidity within the significant fund flows brought by digital payments. In the same way, Ombongi (2021) and Patricia et al. (2023) explored the impact of CARs on banks' financial performance, using mobile banking as a DPS application. Their findings discovered a positive influence of CAR on ROA, emphasizing the vital role of CAR in the digital payment ecosystem. In addition, Kasri et al. (2022) examined the effect of DPSs on banks' financial stability, employing the payment penetration ratio and Z-Score as indicators. Their study indicates a positive short-term influence of digital transactions on stability, which indicates the evolving dynamics in the banking sector. Moreover, Abiodun et al. (2023) explored how various factors, including bank size, CAR, and asset quality, significantly influence the adoption of e-payment methods; they focused on the importance of investment in research and development and the need for a supportive regulatory framework to foster financial innovation.

Various academic empirical studies about the influence of DPS applications on the banking sector's stability indicate the importance of a CAR in enabling banks to stand against sudden liquidity shortages generated from e-payment transactions. So, this study contributes to the existing literature by thoroughly examining how DPSs impact banking sector stability in the context of a developing country like Jordan. It is unique in searching how CAR serves as a protective buffer against liquidity risks arising from these systems by employing a comprehensive econometric model that includes both VAR and VECM to reflect the time variation effect of DPS in the banking industry to provide insights to monetary decision-makers and banks regulators about the proper ratio of CAR in both short and long term that can mitigate DPS liquidity risk and enhance the resilience of banking sector against sudden shocks.

A series of hypotheses defined as follows:

H1: Stable Z-score ratios are aligned with sufficient CAR in banks.

H2: The evolution of DPSs has time variation effects on banks' Z-scores.

H3: CAR stands as a buffer against the liquidity risks brought by DPSs and mitigates their influence on banks' Z-scores over time.

2. METHODOLOGY

This research investigates how DPSs influence the stability of Jordan's banking sector. It employs VAR by Christopher Sims (1980) and VECM by Engle and Granger (1987) analyses through E-views 12 software to explore the dynamic influences of the study factors affecting banking stability. It also aims to quantify both short-term and long-term risks within the banking sector secondary data spanning from 2004 to 2022 and encompasses major banking challenges in 2008 and 2020, as well as a move in digital payment usage after the 2020 pandemic. This methodology aligns with scholars such as Kasri et al. (2022), Apostolakis and Papadopoulos (2019), Bayar et al. (2021), and Sargolzaei and Safaei Ilkhchi (2022). The data sourced from the Central Bank of Jordan (CBJ) annual national payment reports and the World Bank open data are utilized to provide an in-depth view of the banking sector's stability concerning the adoption of digital payment methods, as illustrated in Table 1.

The dependent variable Z-score is used to capture profitability relative to risk to measure banking

Table 1. Research metrics

Metric	Description	Source
Z-score	Banking sector Z-score: is equal to ROA + (equity/assets) / σ · ROA); σ ROA is the standard deviation of ROA, computed for realm-years per 23 bank-level observations	World Bank open data
CAR	Capital Adequacy Ratio is equal to the ratio of total bank regulatory capital to its assets held, weighted according to the risk of those assets	World Bank open data
PC	Number of payment card users	CBJ annual national payment reports
MOB	Total number of mobile banking users	CBJ annual national payment reports
ACH	Total number of Automated clearing house transactions	CBJ annual national payment reports
RTGS	Total number of real-time gross settlement transactions	CBJ annual national payment reports
ECC	Total number of electronic checks clearing transactions	CBJ annual national payment reports
IR	Annual real interest rate	World Bank Open data
t	Period	2004–2022

http://dx.doi.org/10.21511/bbs.19(3).2024.07

sector stability (S. Kasman & A. Kasman, 2015; Dwumfour, 2017; Tarkocin & Donduran, 2023) and opt-independent variables such as CAR (Ajayi et al., 2019; Harkati et al., 2020) as a buffer for losses and various known digital payment estimators. DPSs are measured by pursuing recommendations of prior studies for developing economies (Shatat, 2011; Sivathanu, 2019; Almajali et al., 2022; Al-Sabaawi et al., 2023; Bhuiyan et al., 2024). In addition, the model is controlled by the real interest rate that allowed researchers such as Demirgüç-Kunt and Huizinga (1999), Barth et al. (2004), and Ali and Puah (2019) to control economic influences on banking stability, as it takes inflation effect and has a significant impact on diverse aspects of banking operations and cost of borrowing for banks. Hence the proposed regression model is as follows:

$$Z-score_t = \beta 1 CAR_t + \beta 2\ PC_t + \beta 3\ MOB_t + \beta 4 ACH_t + \beta 5\ RTGS_t + \beta 6\ ECC_t + \beta 7 IRt + \varepsilon_t. \quad (1)$$

3. RESEARCH RESULTS

The descriptive insights give a foundational perception of the determinants of bank stability, as measured by the Z-score. The observed trends in Table 2 indicate the development interplay between regulatory capital, digital banking embracing, operational activities, and macroeconomic dynamics, all of which merge to shape the stability and performance of the banking sector in Jordan.

The analysis was initiated by investigating the descriptive statistics for the research variables from 2004 to 2022, showing the banking sector's stability through a Z-score average of 56.4, indicating consistent stability over the period. In the domain of digital payments, the study emphasized considerable engagement, with average user counts reaching millions for PC and ECC, and a substantial spread in MOB usage, suggesting a strong shift towards electronic banking. The data also showed high transaction numbers in ACH and RTGS, which are critical for assessing e-banking adoption. Furthermore, the CAR shows a robust average of 18.8%, reflecting the banks' compliance with regulatory standards and their solid capital buffers. The study control variable interest rate showed significant differences, cementing possible impacts on the sector's profitability and inclusive stability.

For further analysis, Figure 1 exhibited the evolving trends of ROA, ROE, CAR, and Z-score, presenting a comprehensive perspective on the financial resilience of the banking sector from 2000 to 2022. The Z-score trend initially shows marked stability, enhancing the pre-2008 financial crisis, followed by a steady decline post-crisis, yet staying above early 2000 levels, suggesting an emphasized safeguard against bankruptcy. CAR's consistent modest fluctuations feature a stable risk management and capital reserve devotion, notably during the 2008 crisis, where capital ratios were preserved, indicating strong capital buffers. The profitability indicators, ROA and ROE, experienced significant fluctuations, peaking in the mid-2000s, then dropping in 2008, and again during the 2020 pandemic, reflecting profitability challenges. Nevertheless, the reliability of the Z-score features the Jordanian banking sector's enhanced resilience, likely informed by the 2008 crisis experience, maintaining stability during profitability stresses.

Table 2. Summary statistics

Variable	Mean	Standard Deviation	Min	Max	Skewness
Z-score	56.4%	6.9	39.4%	66.3%	–0.69%
CAR	18.8%	1.2%	16.9%	21.4%	0.7%
MOB	667,845	951,163	4,001	3,200,001	1.8%
ACH	2,239,732	3,121,844	110,003	10,132,948	1.9%
PC	3,146,486	962,232	1,999,486	5,780,071	1.14%
ECC	10,564,952	1,588,537	6,800,110	14,230,234.00	–0.77
RTGS	33,070	4,341.49	25,680.00	42,779.00	0.48%
Ir	3.81%	4.51%	1.81%	8.25%	2.58%

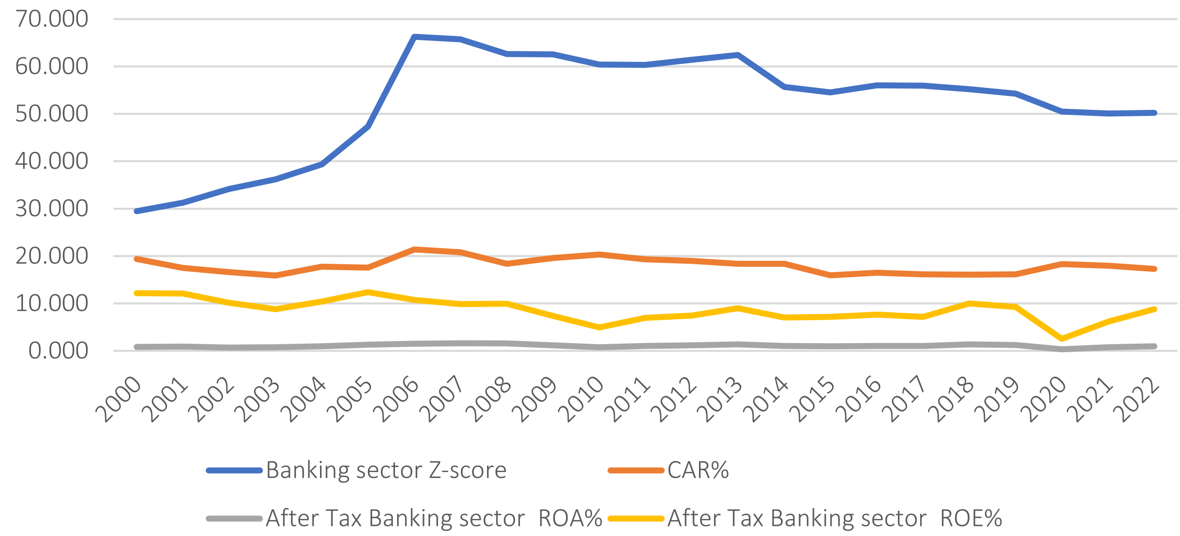

Figure 1. Evolution of profitability indicators in the banking sector (2000–2022)

For deeper examination, the correlation matrix results are provided in Table 3. The ECC showed a positive correlation of .3 with the bank's Z-score, associated with improved bank stability. This positive aspect of digitalization contrasts with the challenges posed by other digital payment methods. Conversely, PC exhibits a negative correlation of –0.29 with the Z-score, suggesting that an increase in PC could marginally decrease bank stability. This trend is further evidenced in the domain of MOB, where a moderate negative correlation of –0.42 proposes that advanced adoption levels of e-banking might inversely impact bank stability. Similarly, ACH with a correlation of –0.40 indicates potential risks associated with higher volumes of these transactions.

At the same time, RTGS systems show a weak negative correlation of –0.16 with the Z-score, suggesting that while RTGS transactions are essential for high-value transactions, their impact on overall bank stability is relatively minimal. Finally, IR also plays a significant role, as evidenced by a moderate negative correlation of –0.47 with the Z-score. This implies that higher interest rates could negatively affect bank stability.

Before the regression analysis, the augmented Dickey-Fuller (1981) and Engle-Granger two-step method (1987) tests were conducted as preliminary steps to check the validity of unit roots and cointegration within time series data, yielding key results as exhaustive in Tables 4 and 5. The results reveal that while the original series for Z-score, MOB, PC, ACH, RTGS, and CAR were non-stationary, their first differences achieved stationarity, as showed by their negative test statistics and p-values below 0.05, confirming the rejection of the unit root hypothesis. In contrast, the ECC and IR series were found to be stationary in their original state, eliminating the need for differencing. This underscores the critical role of stationarity in time series analysis, ensuring that the data are suitable for reliable analysis and interpretation in further research steps.

Table 3. Correlation matrix

Matric	Score	CAR	DC	ECC	MOB	ACH	RTGS	IR
Z-score	1.00	0.75	–0.29	0.30	–0.42	–0.40	–0.16	–0.47
ECC	0.30	0.33	–0.57	1.00	–0.72	–0.72	0.35	–0.09
PC	–0.29	–0.54	1.00	–0.57	0.93	0.91	–0.71	0.35
ACH	–0.40	–0.46	0.91	–0.72	0.98	1.00	–0.65	0.27
MOB	–0.42	–0.53	0.93	–0.72	1.00	0.98	–0.66	0.32
RTGS	–0.16	0.25	–0.71	0.35	–0.66	–0.65	1.00	–0.08
CAR	0.75	1.00	–0.54	0.33	–0.53	–0.46	0.25	–0.51
IR	–0.47	–0.51	0.35	–0.09	0.32	0.27	–0.08	1.00

http://dx.doi.org/10.21511/bbs.19(3).2024.07

Figure 2. ADF test result

Table 4. ADF test results

Variables	Test Statistic	P-value
Z-score	–1.766	0.229
D_1(Z-score)	–5.009	0.034
MOB	–1.224	0.16
PC	2.170	0.19
D_1(PC)	–6.233	0.016
D_1(MOB)	–4.516	0.008
ACH	–0.761	0.991
D_1(ACH)	–4.989	0.006
RTGS	–0.291	0.977
D_1(RTGS)	–4.126	0.001
ECC	–3.670	0.005
IR	–3.806	0.03
CAR	2.635	0.086
D1(CAR)	–4.073	0.017

Upon finding multicollinearity in the primary analysis, the Engle-Granger method is employed to search into cointegration by directing on pairs of Z-score other dataset variables as presented in Table 4.

Table 5. Engle-Granger two-step method results

Variable Pair	ADF Statistic	P-value
Z-score – PC	–3.935	0.0018
Z-score –MOB	–2.504	0.0146
Z-score – RTGS	1.819	0.998
Z-score – ECC	–0.171	0.942
Z-score – IR	3.143	1.00
Z-score – CAR	0.199	0.972

The results exhibit a cointegrating relationship between Z-score with PC and MOB, proved by an ADF statistic and a p-value less than .05 that implies stationary residuals. In opposition, pairs of Z-score with RTGS, ECC, CAR, and IR, with their p-values well above 0.05, display no cointegration signs, indicating no long-term equilibrium with the Z-score.

Based on the diagnostic analysis of stationarity and cointegration, regression analysis is conducted to investigate the short-term and long-term influences of digital payment variables and CAR on banks' stability. The analysis is launched using the method of the Vector Autoregression model to establish the short-term dynamics and then transitioned to the Vector Error Correction Model to reveal the long-term effects.

In the VAR short-term regression analysis results listed in Table 6, the VAR model constant term is not statistically significant, implying no essential bias in the model. The coefficient for CAR is remarkably positive and significant, advocating a strong impact on a bank's Z-score. Digital payment variables, such as ACH and MOB, exhibit negative coefficients, with ACH occurring significantly, suggesting an inverse relationship with the Z-score. The significance of RTGS highlights its negative effect. Conversely, the ECC variable, while positive, is not significant, suggesting vagueness in its effect.

On the other hand, Table 7 states the VECM regression results, explaining the long-term relations among the variables. The constant and the adjustment coefficients are negative and significant, highlighting the speed and direction of adjustment toward long-term equilibrium, whereas CAR and digital payment variables such as ECC and RTGS exhibit positive and significant coefficients, accentuating positive long-term impact; ACH displays a significant negative relationship, whereas other variables such as PC and MOB are not significant, indicating weak effect on Z-score in the long term.

Table 6. VAR regression analysis results

Variable	Coefficient	Std. Error	t-Value	P-value	95% Conf. Interval
Const	–12.6904	22.7	–0.56	0.5873	(–57.11)-(31.73)
CAR	4.17	0.81	5.13	0.0003	(2.58)-(5.76)
PC	0.065	0.08	0.82	0.082	(–0.09)-(0.22)
MOB	–0.006	0.005	–1.25	0. 083	(–0.015)-(0.003)
ACH	–0.005	0.002	–2.29	0.0231	(–0.009)-(0.0007)
RTGS	–0.0008	0.0003	–2.7	0.0091	(–0.001)-(–0.0009)
IR	–0.22	0.104	–2.09	0. 010	(–0.423)-(–0.014)
ECC	1.5	0.513	2.93	0.3720	(0.498)-(2.51)
R^2	58.8%				
Adjusted R^2	51.6%				
F-statistic	33.19				

http://dx.doi.org/10.21511/bbs.19(3).2024.07

Table 7. VECM regression analysis results

Variable	Coefficient	Std. Error	t-Value	P-value
Const	–1.5	2.72	6.72	0.0001
CAR	1.4	2.3	5.0	0.0002
PC	–0.25	1.02	–1.02	0.31
MOB	0.35	0.32	1.32	0.6
ACH	–0.15	3.75	–3.75	0.005
RTGS	0.05	2.5	2.5	0.012
IR	–0.45	5.62	–5.62	0.0001
ECC	0.25	4.17	4.17	0.0003
α (Adjustment Coefficients)	–0.07	3.5	–3.5	0.0007
R^2	56%			
Adjusted R^2	53.8%			
F-statistic	23.4			

The model's R-squared value indicates an ordinary explanatory power. Particularly, CAR exhibits a significant positive relationship with a coefficient of 1.4 with the banking sector Z-score, while PC and MOB have weak and non-significant impacts with coefficients of –.25 and .35, respectively. In contrast, ACH transactions, along with the IR_ trend, negatively affected stability with significant coefficients of –0.15 and –0.45, respectively, with RTGS's influence being small yet significant of .05. The variable for Electronic checks clearing system (ECC) trend has a positive and significant effect.

A synthesis of the VAR and VECM analysis results is consistent with the study hypotheses and reveals a uniformly positive influence of CAR on bank stability in both short and long-term contexts, with varying degrees of impact. This confirms the study's first and third hypotheses, sufficient CARs stand as a buffer against the liquidity risks brought by DPSs and mitigate their influence on banks' Z-scores over time. On the other hand, the results revealed different impacts of coefficients of DPS between short-run and long-run periods. This supports the study's second hypothesis regarding the time variation effects of DPSs on banks' Z-scores.

4. DISCUSSION

The research analyses reveal the ripple influence of digital payment systems and CAR on banks' Z-Score of the Jordanian banking sector during the period from 2004 to 2022 characterized by substantial financial events, including the global financial crisis, and the COVID-19 pandemic.

The regression results are consistent with results in the prevailing literature, such as Wang et al. (2023) on CAR and Taskaro and Suhari (2024) on digital payment systems, and support the evidence found on these financial metrics' effect on banking stability. Specifically, CAR has confirmed its vital role as a buffer against various risks, as suggested in the first and third hypotheses of the study. This confirms the findings of recent literature, particularly the studies by Kharabsheh and Gharaibeh (2022), Nguyen (2021), and Ernaningsih et al. (2023). CAR emphasizes the banking sector's resilience to withstand vulnerabilities from DPS adoption and other risk sources, emphasizing the sound regulatory environment of Jordan's banks.

DPSs, progressing since the 2000s, exhibit a complex relationship with bank stability, supporting the acceptance of the second hypothesis. Initially, systems such as RTGS, ACH, and MOB showed a negative influence on a bank's z-score, indicating the sector's risk during the short run is evolving as suggested by Thaiyalnayaki and Reddy (2017). In contrast, mechanisms such as ECC and PC showed a stabilizing impact, which is in line with results from Kasri et al. (2022). However, opposing relations over time, suggest a beneficial adjustment of MOB, RTGS, and ECC in the long run and adaptation of these systems, aside from PC, and ACH, which indicated an ongoing risk, possibly linked to open banking operations.

These DPSs' different impacts might also signify the sector's regulatory and infrastructural progress in embracing the digital revolution. The positive trends noted over time may signal successful strategic shifts and regulatory improvements.

Also, interest rate trends have demonstrated a remarkable impact on bank stability, where increased rates may constrain loan granting and increase deposit costs, potentially reducing profitability and increasing default and liquidity risks. This aligns with Diamond and Rajan's (2012) and Strasky's (2019) findings.

In summary, the study findings declare that the stability of the banking sector in Jordan is influenced by a developed structure of technological changes, monetary regulation, and macroeconomic consequences. This describes time-varied features of the sector's responsiveness to both the challenges and opportunities presented by digital financial innovations and macroeconomic events.

CONCLUSION

This study investigates the impact of DPSs and CAR on the stability of the Jordanian banking sector over a period from 2004 to 2022. The investigation conducted in this study fills a critical gap in the literature by providing an in-depth examination of the DPSs and CAR impacts on the stability of Jordanian banks measured by Z-score, particularly through conducting a dual- analysis models of VAR and VECM. The study offers a comprehensive examination of the instant and durable influences of DPSs on bank stability. The findings reveal that while DPSs generate revenues and efficiency gains, they also include challenges, particularly in terms of liquidity risk during the phases of payment transactions. In this complex scene, CAR emerges as the core of stability, enabling banks to secure themselves against the potential volatilities of DPSs.

Finally, this study highlights vital guide for bank regulators and policymakers and holds profound implications for policy formulation and strategic decision-making in the banking sector to improve the digital payment infrastructure, which needs to be balanced with prudent liquidity management strategies. Such strategies are vital to mitigate the risk of bankruptcy, particularly in an era where the digital transformation in banking is accelerating.

AUTHOR CONTRIBUTIONS

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Formal analysis: Jamileh Ali Mustafa.
Funding acquisition: Jamileh Ali Mustafa.
Investigation: Jamileh Ali Mustafa.
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Project administration: Jamileh Ali Mustafa.
Resources: Jamileh Ali Mustafa.
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ACKNOWLEDGMENT

The author is grateful to the Middle East University, Amman, Jordan for the financial support granted to cover the publication fee of this research.

http://dx.doi.org/10.21511/bbs.19(3).2024.07

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