Enhancing Financial Resilience of Public Hospitals in China: A Dynamic Capability Approach to Addressing VUCA Challenges

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ABSTRACT

The incidence of public health emergencies is rising in the context of Volatility, Uncertainty, Complexity, and Ambiguity (VUCA). This results in a scarcity of healthcare resources and service disruptions, significantly impacting public lives, safety, and health rights. Financial resilience is crucial for the sustainable provision of critical medical services amid interruptions, especially for public hospitals, which serve as the foundation of the national healthcare system. This study utilized dynamic capacity theory to analyze the impact of essential dynamic capcapability (revenue diversification capability, cost adjustment capability, budget flexibility, and financial informatization) on the financial resilience of public hospitals in China. 205 responses were collected from hospital management and staff. The collected data were analyzed using the Structural Equation Modeling Partial Least Squares (SEM-PLS) approach. The results indicate that revenue diversification and cost adjustment capability positively and significantly influence the financial resilience of public hospitals, addressing the theoretical gap in this area within developing countries and aiding public healthcare decision-makers in strengthening the financial resilience of public hospitals through enhanced revenue diversification and cost adjustment capcapability.

Keywords—Financial Resilience, Dynamic Capability Theory, Revenue Diversity, Flexibility Budget, Cost Adjustment

INTRODUCTION

In the era of volatility, uncertainty, complexity, and ambiguity (VUCA), unforeseen sudden events are on the rise. The global COVID-19 pandemic resulted in resource shortages and operational interruptions, leading to economic stagnation and recession across all nations and sectors (WHO, 2024). China, the greatest developing nation and the second most populous country globally, has steadily entered an aging society phase in recent years (NHC, 2024). The transformation of societal structure and disease patterns posed challenges to China's national healthcare system throughout the VUCA era.

As the cornerstone of the national healthcare system, public hospitals must address increasing demand within constrained public funds and be equipped to manage medical emergencies (Xu & Liu, 2024). The COVID-19 epidemic significantly impacted public healthcare operations, resulting in the postponement or cancellation of many surgeries. This led to a revenue reduction above 50% for most public hospitals in China within two years (NHC, 2024). Post-COVID-19 pandemic, national healthcare reform shifts its emphasis from enhancing public healthcare performance to fortifying the resilience of the public healthcare system. Concurrently, the World Health Organization underscores the importance of investing in public health resilience (WHO, 2024).

The organization's capacity to recuperate from a disaster is more complex than pursuing expansion under normal operating circumstances (Homayoun, 2024). In contrast to financial performance, financial resilience denotes an organization's capacity to foresee, prepare for, and react to gradual changes and unexpected shocks by employing suitable financial strategies to alleviate adverse effects and ensure operational sustainability (Sreenivasan & Suresh, 2023). The lack of financial resilience will jeopardize the organization's operational integrity (Neacsu & Georgescu, 2024). Teece et al. (1997) characterize dynamic capcapability as an organization's capacity to integrate, develop, and reorganize internal and external resources to respond to

swiftly changing business conditions. The implications of dynamic capacity theory align with resilience.

This study adopted dynamic capacity theory and the SEM-PLS methodology to examine the influence of essential dynamic capcapability, including revenue diversification, flexible budgeting, cost adjustment, and financial information—on the financial resilience of public hospitals. Based on the research mentioned above, the subsequent structure of the study is outlined as follows: Section 2 examines the literature about dynamic capacity theory and financial resilience. Section 3 provides the hypothesis and research framework, whereas Section 4 delineates the study approach. Section 5 delineates the findings and discussion, whereas Section 6 articulates the study's conclusion, encompassing managerial and practical implications and limits.

LITERATURE REVIEW

A. Dynamic Capability Theory

The sustainability and growth of organizations are primarily reliant on resources. In the VUCA era, simply having resources is inadequate for firms to manage unpredictable risks properly (Cavallaro & Villani, 2024). Prior research has examined this topic from several theoretical viewpoints. Tipu et al. (2023) established a paradigm grounded on principal-agent theory to assess the success of public-private partnership initiatives within a static context. Chen and Sun (2024) analyzed the implementation of organizational resource acquisition methods via the resource dependence theory lens. Nevertheless, this research concentrated on the influence of inherent resource advantages on organizational performance, overlooking the essential role of managerial competence as a variable. Akpan et al. (2022) established a link between organizational management competencies and an organization's recovery from crises, underscoring the significance of this element. Nevertheless, prior research has not employed dynamic capacity theory to analyze the financial robustness of public hospitals.

The dynamic capcapability theory (DCT) posits that companies may cultivate the ability to integrate, construct, and restructure resources in reaction to unforeseen occurrences and disruptive threats (Teece et al., 1997). Dynamic capacity theory examines an organization's response to unexpected and swift changes in the external environment by actively restructuring resources and addressing the disparity between managerial capability and unforeseen risks (Kazmi & Ahmed, 2022). This study utilizes the dynamic capability theory to rectify the shortcomings of prior research and establish a thorough evaluation framework in this domain.

B. The organization's resilience

Resilience is an organization's ability to withstand, adjust, and recuperate from crises (Coutu, 2002). From the dynamic capacity perspective, the study of organizational resilience focuses on reallocating resources and proactively adjusting to changes to secure long-term sustainability benefits (Akpan et al., 2022). During the COVID-19 epidemic, several industrial firms adopted financial resilience strategies to maintain financial performance and sustain operations. South Korean hospitals adopted a budget redundancy approach involving expenditure modifications to address unforeseen crises. Consequently, the prior study identified many essential financial management strategies, including redundancy, flexibility, and revenue diversification, to successfully address unpredictability. Prior studies on the comprehensive financial disruption process (before, during, and after) recommended classifying organizational resilience into three dimensions: robustness, adaptability, and flexibility (Alvarenga et al., 2023). The cultivation of dynamic talents is deemed to enhance resilience development.

C. Dynamic capcapability and financial resilience in public hospitals

Financial resilience refers to an organization's capacity to alleviate the adverse effects of unforeseen crises or shocks while proactively predicting and planning for unexpected calamities. Public sector accounting theory and practice utilize the concept of resilience to discern the factors and response mechanisms that affect resilience in the face of external environmental shocks, budgetary constraints, and resource limitations (Sreenivasan et al., 2023). Reorganizing resources within budgetary limitations and augmenting essential managerial competencies in businesses functioning under unpredictable conditions effectively addresses this

challenge.

Sreenivasan et al. (2023) assert that implementing financial redundancy can influence organizational performance during economic uncertainty. Moreover, revenue diversification can improve the efficacy of state-owned banks. Kazmi and Ahmed (2022) conducted research demonstrating that modifying the budget time allocation might enhance budgetary expenditure flexibility. Chandra et al. (2011) examined the cost drivers method to diminish variable healthcare costs using a flexible cost structure. Liu and Qi (2024) assert that financial information technology may enhance the operations of public health organizations in a modern context. Prior studies have examined the significance of financial resilience across several sectors, including banking, financial institutions, governmental bodies, and non-profit organizations (Kazmi & Ahmed, 2022).

The current literature is inadequate in resolving the difficulties mentioned above. Consequently, further study is required to comprehend the relationship between dynamic capacities and the financial resilience of hospitals. This study utilized dynamic capcapability theory within a financial resilience framework to examine the impact of financial management strategies, such as revenue diversification, flexible budgets, cost adjustment, and financial informatization, on the financial resilience of public hospitals (Alvarenga et al., 2023).

HYPOTHESIS DEVELOPMENT

Diversification is a strategy to mitigate an organization's operational risk, aiding in crisis management and risk prevention. Adem (2023) asserts that revenue diversification enhances organizational stability but adversely affects risk indicators. The relationship between revenue diversification and crisis significantly influences stability assessments (Duho et al., 2023). Revenue diversification in hospitals pertains to techniques that produce income from sources beyond conventional outpatient and inpatient care. The approach is founded on concepts of financial diversification and aims to diminish reliance on a singular revenue source while mitigating financial risk (Adem, 2023). Duho (2023) found that during COVID-19, public hospitals' revenue rebounded due to growth in other revenue streams, facilitating the revival of hospital operations. Future initiatives should investigate alternate revenue streams, establish financial reserves, and enhance operating efficiency. Consequently, the subsequent hypotheses are formulated:

H1: Revenue diversification has a positive and significant effect on the financial resilience of hospitals.

Public hospitals, the paramount healthcare sector, enhance organizational efficiency by using public funding to further their goal (Chan et al., 1997). Cost management can modify the distribution of financial resources to priority operations by altering the expenditure structure (long-term vs short-term or fixed versus variable expenses). Modifying cost structures enables hospitals to reduce dependence on external resources, such as government subsidies, while adhering to budgetary limits. Modifying expenses through reorganizing expenditures within a limited budget is a dynamic capacity that aids hospitals in managing uncertainty risk while being pragmatic and steady. As a result, this study formulated the subsequent hypotheses:

H2: Cost adjustment positively and significantly affects the hospital's financial resilience.

Flexible budgeting is a dynamic management tool that facilitates modifications in reaction to evolving conditions. Flexible budgets adjust to variations in income, expenditures, and other external factors affecting financial performance, unlike typical static budgets that remain constant for a designated time. Agyemang et al. (2023) discovered that business departments endorse flexible budgetary restrictions as their enterprises are more effectively supported by adaptable resources amongst environmental fluctuations. Flexible budgets enable hospitals to adapt to fluctuating market conditions and patient requirements, effectively integrating fixed budgets with budget redundancy to equip hospitals for routine operations and unexpected disruptions caused by unforeseen events (Lusardi et al., 2021). A flexible budget allows hospitals to pinpoint areas for enhancement and elevate performance by facilitating dynamic resource allocation in various contexts. Consequently, we put up the subsequent hypothesis:

H3: Flexible budgeting has a positive effect on improving hospital financial resilience.

In a changing environment, it is more essential for firms to reorganize and optimize their use of favorable assets than to merely hold them (Homayoun et al., 2024). Financial informatization utilizes information technology to automate and enhance an organization's financial management procedures (Alvarenga et al., 2023). Digital systems may transcend temporal and geographical limitations, interlink organizational departments, partners, and stakeholders, and facilitate effective collaboration through adaptable business processes and operational models in dynamic environments.

Initially, financial information technology enables hospitals to access real-time financial data more effectively, monitor performance metrics, and discern growth prospects (Garcia-Perez et al., 2023). Moreover, it augments hospitals' ability to adjust to changing market dynamics, regulatory mandates, and financial obstacles by enabling data-informed decision-making and strategic operations. By implementing more effective financial management techniques through digital technology systems, hospitals may regulate expenditures, enhance resource allocation, and provide backups and redundancies (Garcia-Perez et al., 2023). Financial informatization in healthcare encompasses several applications, including hospital resource planning systems (HRP), budget management systems, financial analysis systems, and decision-making support systems. The aforementioned financial informatization tool facilitates efficient governance and risk management protocols, mitigates financial risks, protects assets, and enhances the resilience of hospitals in practice. Consequently, the subsequent hypothesis was formulated:

H4: Financial Informatization has a positive effect on improving the financial resilience of hospitals.

The path relationships between variables are hypothesized based on the above hypothesis, as shown in Figure 1.

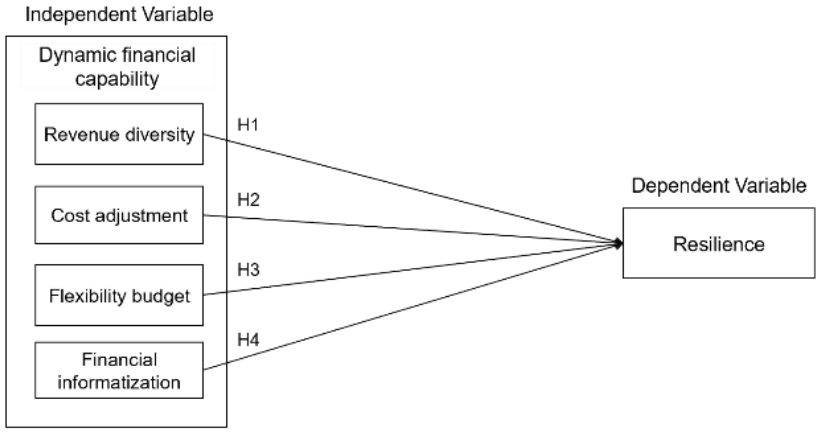

Figure 1. The conceptual framework

METHODOLOGY

A structured questionnaire was utilized in this study to look at the dynamic capability of financial management in public hospitals, including revenue diversification capability (Busch & Kick, 2009; Mnasriand Abaoub, 2010), budget flexibility (Ekholm & Wallin, 2011), cost adjustment capability (Zhang et al., 2020), and financial informatization.

The questions on the scale are based on existing relevant literature. Respondents were financial department administrators and staff from China's public hospitals (tertiary, secondary, and primary community hospitals). We selected them due to their experience with budgetary reductions, revenue declines, and cost challenges during the COVID-19 epidemic. They ultimately conquered and recovered from a seven-point Likert scale measured all three sections of the questionnaire: demographic data (Section A), organizational information (Section B), and dynamic skill in financial management and resilience characteristics (Section C), which were measured by a seven-point Likert scale. Anderson and Gerbing (1984) showed that a sample size of 150 is generally suitable for SEM modeling when there are three or more indications for each element. This study

ultimately collected 205 valid questionnaires. The sample size exceeded the minimal criterion, boosting the findings' statistical power and robustness. We evaluated the data adopted using SPSSAU for demographics and Smart PLS 4.1 for structural equation modeling (SEM) (Garcia-Perez et al., 2023).

DATA ANALYSIS

A. Demographic statistic

Table 1 presents the demographic information of the respondents. Among the respondents, 40.48% were over the age of 40, 52.19% were employed in hospital management, 60.98% worked in secondary-level hospitals or higher, 85.85% possessed a bachelor's degree or higher, and 28.78% had over ten years of experience. Consequently, most of the study's participants possess the requisite professional experience, educational qualifications, and cognitive aptitude in the research domain.

Table 1: The demographic statistic

Item	Option	Frequency	Percentage (%)	Accumulate percentage (%)
1. Gender:	Male	88	42.93	42.93
	Female	117	57.07	100.00
2. Age	Below 30 years	33	16.10	16.10
	30 - 40 years	89	43.41	59.51
	41 - 50 years	62	30.24	89.76
	Above 50 years	21	10.24	100.00
3. Education:	Doctor	9	4.39	4.39
	Masters	56	27.32	31.71
	Bachelor	111	54.15	85.85
	Other	29	14.15	100.00
4. Years of service experience	Less than one year	14	6.83	6.83
	1 - 5 years	61	29.76	36.59
	5 - 10 years	71	34.63	71.22
	More than ten years	59	28.78	100.00
5. Level of your hospital	The tertiary hospital	70	34.15	34.15
	The second level	84	40.98	75.12
	The primary level	41	20.00	95.12
	Other	10	4.88	100.00
6. Position:	Dean	12	5.85	5.85
	Managers	95	46.34	52.20
	staff	90	43.90	96.10
	Other	8	3.90	100.00
	Sum	205	100.0	100.00

Resource: SPSSAU analysed by authors

Table 2 demonstrates a Cronbach's α score of 0.951, signifying substantial dependability in the data. Table 3 demonstrates a KMO score of 0.929, signifying efficient data extraction. The KMO value and Bartlett's test of sphericity indicate that the data is acceptable for factor analysis. The comprehensive reliability and validity assessments endorse the subsequent phase of this investigation.

Table 2: Cronbach reliability analysis

Item	Sample	Cronbach α coefficient
26	205	0.951

Table 3: KMO and Bartlett's test		
KMO-value		**0.929**
Bartlett Sphericity Test	X^2	3084.346
	df	325
	p-value	0.000

B.PLS Measurement model

Table 4 demonstrates that all model constructs' composite reliability (CR) values exceed 0.70, signifying enhanced internal consistency and dependability (Fornell & Larcker, 1984). All constructs have average variance extracted (AVE) values over 0.50, signifying adequate convergent validity (Fornell & Larcker, 1981). The SRMR value of 0.072 signifies an acceptable model fit, as noted by Heseler et al. (2014).

Table 4: The Reliability and convergent validity of the measurement model

	Cronbach α	**CR**	**AVE**	**SRMR**
SD	**＞0.7**	**＞0.7**	**＞0.5**	**＜0.08**
FR	0.808	0.813	0.567	0.072
RD	0.764	0.767	0.586	
FB	0.750	0.755	0.502	
EA	0.838	0.845	0.555	
FI	0.758	0.776	0.512	

Resource: Hair Jr. et al. (2017), Henseler et al. (2015), Diamantopoulos and Siguaw (2006), Henseler et al. (2014).

Table 5 illustrates that the measurement model exhibits discriminant validity, since the cross-factor loadings surpass 0.7 and exceed the loadings of other factors. Furthermore, the disparity between factor loading and cross-loading exceeds 0.1. Consequently, Table 5 demonstrates that all elements in the measurement model conform to the established requirements (Chin, 1998b).

Table 5: The discriminable validity of the measurement model

	Expenditure adjustment	**Flexible budget**	**Financial informatization**	**Hospital resilience**	**Revenue diversity**
Expenditure adjustment	0.74				
Flexible budget	0.60	0.71			
Financial informatization	0.63	0.60	0.71		
Hospital resilience	0.61	0.61	0.61	0.75	
Revenue diversity	0.62	0.64	0.62	0.60	0.77

Source: Author(s) calculation

C. The Structural measurement

Table 6 presents the outcomes of the structural model. We employed bootstrapping in PLS-SEM 4.1 with 5,000 samples to evaluate the hypotheses and assess the structural (inner) model. We employed the coefficient of determination (R^2), as recommended by Chin (1998b) and Ringle (2004), to assess the model's predictive efficacy. The R2 values for financial resilience are 0.741, signifying the model's predictive solid accuracy (Cohen, 1988; Hair Jr. et al., 2017a, 2017b). Revenue diversification, flexible budgeting, and cost adjustment significantly impact financial resilience, but financial informatization has a little effect (F2>=0.02 is minor, >= 0.15 is medium, and >= 0.35 is large) (Cohen, 1988). This study then utilized blindfolding to evaluate the model's predictive relevance (Q2). The significance of Q2 in Table 6, greater than zero, indicates that the exogenous construct adequately predicts the endogenous latent variables. This indicates that the model possesses enough predictive capability (Hair et al., 2017).

Table 6: Path coefficients of the measurement model

	R^2＞0.67	**F^2＞0.02**	**Q^2＞0**	**P＜0.05**
Hospital resilience	0.741 (moderate)		0.406 (medium)	
Revenue diversity-> Financial resilience		0.043(moderate)		0.050
Flexible budget -> Financial resilience		0.043(moderate)		0.031
Cost adjustment-> Financial resilience		0.046(moderate)		0.002
Financial informatization->Financial resilience		0.027(weak)		0.060

HYPOTHESES TESTING

Figure 2 illustrates the route model. All path coefficients for revenue diversification, flexible budgeting, cost adjustment, and financial informatization exceed 0.20 (Hair et al., 2019). Nevertheless, some factor loadings for flexibility budgeting, cost adjustment, and financial informationization are below 0.70. Nonetheless, the convergent validity satisfies the condition as the AVE value is above 0.5, indicating that the indicator's dependability fulfills the standards. Table 7 displays the coefficients from the PLS path analysis for each association. The path coefficient analysis indicates that all factors positively influence hospitals' financial flexibility.

Hair et al. (2017) state that if the t-value surpasses 1.96 ($\alpha = 0.05$) or the p-value is below the designated significance level (e.g., 0.05), the null hypothesis is rejected in favor of the alternative hypothesis, indicating a significant result. If not, the null hypothesis remains unrefuted, indicating the absence of significance. Table 7 indicates that, except for financial information, all variables with p-values < 0.05 were deemed statistically significant. Table 7 indicates that revenue diversification and cost adjustment positively and substantially correlate with financial resilience, validating H1 and H3. Moreover, the flexible budget and financial data exhibit a positive, although small, correlation with financial resilience, leading to the rejection of hypotheses H2 and H4.

Table 7: The Structural measurement (Path correlation)

Path	**β**	**T-value＞1.96**	**P-value＜0.05**	**Result**
H1: Revenue diversity->	0.209	2.592	0.005	Supported

Financial resilience				
H2: Flexible budget -> Financial resilience	**0.240**	**1.868**	**0.031**	**Reject**
H3: Cost adjustment-> Financial resilience	0.264	2.907	0.002	Supported
H4: Financial informatization->Financial resilience	**0.203**	**1.554**	**0.060**	**Reject**

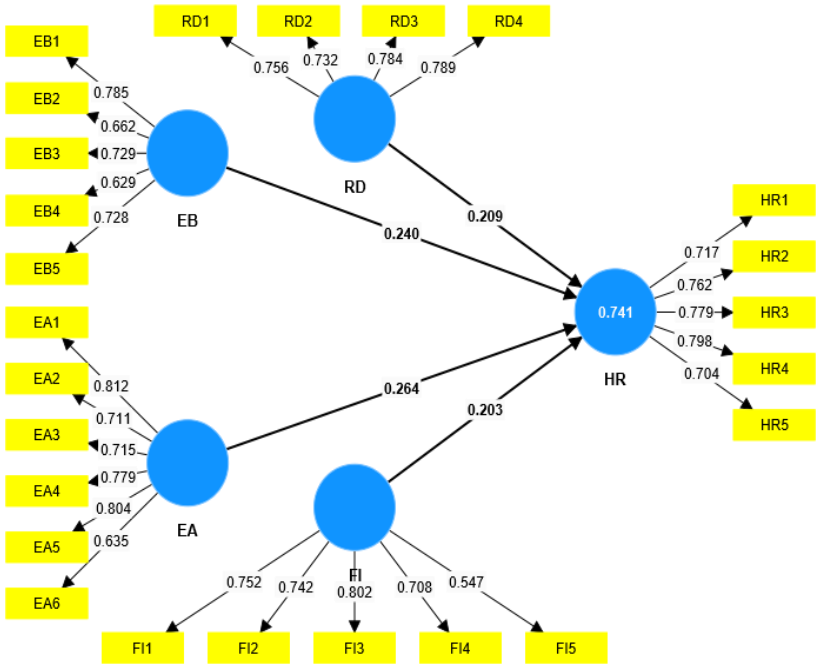

Figure 2: The factor loading and path test of the study framework

FINDING AND DISCUSSION

The findings of this study indicate a positive and substantial relationship between revenue diversification and financial resilience (β = 0.209, t = 2.592, 1.96, p < 0.05), hence corroborating H1. This discovery underscores the significance of revenue diversification in enhancing financial resilience in public hospitals and is consistent with other research (Adem, 2023; Duho et al., 2023). Revenue diversification will enhance hospitals' resilience against internal and external difficulties, facilitate adaptation to evolving contexts, and ensure the sustainability of operations over the long run.

The research indicates a positive albeit statistically insignificant link between flexible budgeting and financial resilience (β= 0.240, t=1.868 < 1.96, p=0.06 > 0.05). This result contradicts the second hypothesis (H2), indicating that although flexible budgeting correlates with several variables, including robustness, adaptability, and flexibility in financial management, it does not markedly enhance reaction capcapability concerning financial resilience. A robust operational basis generates budgetary redundancy, an essential element of a flexible budget. Nevertheless, corporations cannot attain budget redundancy in volatile contexts, resource deficiencies, and service disruptions. Consequently, there is little data indicating that a flexible budget substantially influences financial resilience.

The findings demonstrate that cost adjustment significantly enhances financial resilience (β = 0.264, t = 2.907, p < 0.05), hence corroborating H3. This discovery corroborates the prior research conducted by Liu (2024). Elevated fixed costs have become a significant risk factor impacting the stability and sustainability of

healthcare companies' operations. Cost modifications within constrained budgetary resources provide an innovative strategy for companies to address unexpected disruptions and surmount healthcare resources and services limitations. Increasing the amount of variable expenses can assist in alleviating unforeseen shocks caused by the dynamic environment.

The H4 test findings do not corroborate the idea. Financial informatization exerts a modestly beneficial influence on stable, adaptive, and flexible financial operations; nonetheless, this impact is statistically negligible ($\beta = 0.203$, $t = 1.554$, $p \leq 0.001$). This discovery contradicts the prior research conducted by Alvarenga et al. (2023) and Garcia et al. (2023). The statistical findings indicated that financial information enhances the sustainable functioning of public healthcare institutions in times of crisis. Financial information technology requires substantial investment, prolonged development, and intricate procedures. These will affect the real application effect. Consequently, there is no evidence to substantiate the premise that financial information improves hospital financial resilience.

CONCLUSION

In Volatility, Uncertainty, Complexity, and Ambiguity (VUCA), public hospitals play a vital role in providing essential healthcare services, although facing financial difficulties due to unexpected external variations. Diverse revenue streams and cost adjustments are essential dynamic qualities in financial management that enable hospitals to withstand, adapt to, and recover from challenges by fostering resilience, adaptability, and flexibility. This discovery corroborates the prior research.

A. Management implication

This study indicates that public hospitals may diversify and enhance healthcare services beyond conventional outpatient and inpatient operations to establish a robust and sustainable operational model for healthcare. These findings indicate that future projects should identify alternate revenue sources to the primary income, develop non-operating revenue streams, enhance financial reserves, and mitigate interruption risk. A prior study showed that cost adjustment is advantageous within the government's fiscal limitations to guarantee the sustainable provision of emergency resources and services. Deliberately modifying variable cost structures helps protect essential and urgent healthcare operational expenses. Hospital administrators and politicians must prioritize cost-adjustment strategies to improve the sustainability of healthcare delivery (Kazancıoğlu et al., 2023). Although the findings concerning flexible budgeting and financial informatization were statistically insignificant, it is crucial to acknowledge the potential indirect impact of these factors on the financial resilience of public hospitals and to investigate the complex nature of these relationships in future studies.

B. Contribution

This study utilized dynamic capacity theory to connect the theoretical relationship between dynamic capability and resilience in the financial administration of public hospitals, offering significant insights into the essential factors influencing hospital resilience. The SEM-PLS analytical approach was employed to furnish empirical data for study in this domain. This study further applies the notions of dynamic capacities and organizational resilience to the financial management of public healthcare in developing nations. This can enhance the healthcare resilience of public hospitals in both academic and practical domains. This work contributes to the current literature by addressing prior studies' methodological and knowledge constraints.

C. Limitation

Nonetheless, we must address specific difficulties and regard them as potential avenues for future research. The study employed a cross-sectional methodology that failed to include temporal observations. Secondly, as an exploratory research, it concentrates only on the organizational level, disregarding external considerations such as political, economic, social, and legal surroundings. Thirdly, the study's temporal and breadth constraints result in insufficient data for public hospitals of varying sizes and locations. Ultimately, the R2 value of 0.742 indicates that it is essential to discover possible influencing factors, revenue diversification, and cost adjustment variables.

D. Future improvement

Future research should employ time series analysis to examine the evolving dynamic capacity hypothesis. A broader array of stakeholders, including regulators, external suppliers, and patients, should be incorporated into future investigations. Furthermore, future studies can design more scientific and rational resilience decision-making models based on the characteristics above.

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