The impact of intellectual capital on business performance: Resilience and recovery from the COVID-19 pandemic

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Abstract:

This study investigates the impact of intellectual capital (IC) on firm performance and examines its moderating role in enhancing resilience during the COVID-19 pandemic and supporting post-crisis recovery. Using the Modified Value-Added Intellectual Coefficient (MVAIC) framework and a two-way fixed-effects model, the analysis is conducted on a balanced panel of 340 non-financial firms listed in Vietnam over the period 2015–2024. The baseline results show that capital employed efficiency (CEE) and human capital efficiency (HCE) exert positive effects on profitability, as measured by return on assets (ROA), while CEE is the primary determinant of market valuation, proxied by Tobin's Q. In contrast, relational capital efficiency (RCE) is negatively associated with ROA. The moderation analysis reveals a structural shift in the contribution of IC during and after the pandemic. Specifically, the influence of CEE on market valuation weakens, whereas structural capital efficiency (SCE) emerges as a critical buffer during the crisis and a key driver of post-pandemic recovery. In addition, RCE plays a significant role in strengthening accounting-based resilience and recovery. Overall, the findings highlight the heterogeneous and context-dependent effects of intellectual capital components in shaping firm performance and enabling firms to adapt to macroeconomic shocks.

Keywords: intellectual capital, MVAIC, firm performance, COVID-19, crisis resilience.

1. Introduction

Intellectual capital (IC) is defined as the knowledge-based assets, such as information, experience, and intellectual property, that can be exploited to create economic value (Stewart, 1998). This kind of capital is widely recognized as a fundamental driver of innovation (McDowell et al., 2018; Salehi et al., 2022), competitive advantage (Kamukama, 2013; Yaseen et al., 2016), corporate reputation (Ginesti et al., 2018),

employees' satisfaction (Torre et al., 2021), financial performance (Chen et al., 2005; Ginesti et al., 2018; Smriti & Das, 2018; Wang et al., 2021), and market value (Chen et al., 2005; Smriti & Das, 2018) under stable economic conditions.

However, a critical research gap persists regarding its dynamic role during systemic macroeconomic shocks. While sparse literature suggests IC aids in crisis survival (Tong & Serrasqueiro, 2026; Ashraf et al., 2023), comprehensive empirical evidence evaluating its dual capacity to buffer against immediate disruptions and accelerate post-crisis recovery remains heavily underexplored, particularly in emerging markets like Vietnam. Existing research within the Vietnamese context has largely been confined to evaluating the aggregate impact of IC on firm performance (Hoang et al., 2020), assessing the proportional contributions of IC components to overall IC efficiency (Hanh et al., 2023), or conducting general literature reviews (Tu, 2021). With escalating geopolitical conflicts in Ukraine and the Middle East raising the specter of a new global economic downturn, firms urgently require evidence-based strategies to withstand severe volatility. Consequently, this study leverages the COVID-19 pandemic to empirically investigate IC's impact on the resilience and recovery of Vietnamese firms, providing timely strategic insights for navigating future macroeconomic turbulence.

2. Literature review

Intellectual capital (IC) represents a firm's knowledge-based resources that can be transformed into economic value, including human expertise, organizational routines, internal processes, intellectual property, and relationships with external stakeholders. From the resource-based view, firms achieve sustained competitive advantage by controlling resources that are valuable, rare, inimitable, and non-substitutable (Barney, 1991). The knowledge-based view by (Grant, 1996) further suggests that knowledge is one of the most strategically important resources of the firm because firms create value by integrating and applying specialized knowledge. Therefore, IC - comprising knowledge, information, intellectual property, experience - can be regarded as a critical resource that enhances firms' ability to create value, improve performance, and sustain competitiveness (Stewart, 1998).

To measure IC, prior studies have commonly used either survey-based measures (Bontis, 1998; Torre et al., 2021) or financial statement-based measures (Ginesti et al., 2018; Smriti & Das, 2018). This study adopts the financial statement-based approach because it provides standardized, comparable, and auditable data across listed firms. In this approach, the value-added intellectual coefficient (VAIC) model developed by Pulic (2000) is widely used to measure how efficiently firms generate value from capital employed, human capital, and structural capital. However, as the traditional VAIC model does not explicitly capture relational capital, this study follows the modified VAIC approach of Xu and Liu (2020) by incorporating relational capital efficiency. This extended framework allows a more comprehensive assessment of IC

efficiency, particularly in contexts where customer relationships, market connections, and external networks are important to firm performance.

Empirical studies generally show that IC contributes to firm performance, but the effects of its components are not uniform. Prior literature consistently highlights CEE and HCE as the primary engines of traditional profitability and market valuation, particularly in emerging and manufacturing-heavy markets (Smriti & Das, 2018; Xu & Wang, 2018, Xu & Liu, 2020). Conversely, the impact of relational capital - which captures marketing and stakeholder networking - is often heterogeneous. While crucial for long-term brand equity, heavy relational investments are typically recognized as immediate current-period expenses rather than capitalized assets, potentially imposing a short-term burden on accounting profitability (Xu & Liu, 2020). Given these diverse mechanisms, we propose the first hypothesis:

H1. Intellectual capital components exhibit heterogeneous impacts on firm performance.

While the role of IC in stable environments is well-documented, the COVID-19 pandemic introduced an unprecedented systemic shock, fundamentally altering resource valuation. During crises characterized by strict lockdowns and supply chain paralysis, traditional physical assets (CEE) often transition from value drivers to financial liabilities due to idle capacity and high maintenance costs (Papíková & Papík, 2022). In contrast, intangible assets emerge as vital survival mechanisms. Structural capital (SCE) - encompassing digital infrastructure, remote-work capabilities, and agile internal processes - provides a crucial "buffering effect," enabling business continuity (Tong & Serrasqueiro, 2026). Similarly, strong customer loyalty and external networks (RCE) act as financial shields to sustain revenue streams when physical operations are disrupted (Pramono et al., 2022).

Furthermore, post-crisis recovery depends heavily on a firm's adaptability. The pandemic has seemingly triggered a permanent market paradigm shift, wherein investors continue to penalize heavy, inflexible physical structures while rewarding "asset-light," structurally agile firms (Tong & Serrasqueiro, 2026). To examine this dynamic shift during and after the crisis, we propose the following hypotheses:

H2. The COVID-19 crisis penalizes physical capital while amplify the buffering effect of intangible capital.

H3. In the post-pandemic period, intangible capital positively drive performance recovery, whereas the market contribution of physical capital remains weakened.

3. Methodology

3.1 Data and sample selection

The research is conducted under quantitative method using a sample of non-financial companies listed on HOSE and HNX. Financial data were retrieved from audited financial statements provided by the Vietstock database. To ensure data consistency, firms listed after 2015 and those with missing data required for calculating research variables are excluded. The final balanced panel dataset comprises 340 firms over the

period of 2015-2024, yielding 3,400 firm-year observations. To mitigate the potential distorting effects of extreme outliers, all continuous variables are minorized at the 1st and 99th percentiles.

3.2 Research variables

3.2.1 Dependent variables

This study employs two widely used proxies for firm performance.

- Return on Assets **(ROA):** Measures accounting-based profitability, calculated as the ratio of net income to total assets (; Kim & Tran, 2024; Xu & Li, 2022).
- Tobin's Q **(TobinQ):** Represents the market-based performance and future growth prospects. Following Chung and Pruitt (1994), it is calculated as the sum of total liabilities and market capitalization divided by total assets.

3.2.2 Independent variables

The independent variable is IC, measured using MVAIC framework by Xu and Liu (2020). The IC components are computed through the following sequential steps:

- Step 1: Calculate value added (VA)

  VA = Operating Profit + Employee Costs + Depreciation + Amortization.
- Step 2: Determine IC components

  HC= total employee salaries and benefits

  CE = total assets - intangible assets

  SC = VA - HC

  RC = selling and marketing expenses
- Step 3: Calculate efficiency ratios of IC components

  HCE *= VA / HC*

  CEE *= VA / CE*

  SCE *= SC / VA*

  RCE *= RC / VA*

3.2.3 Moderating variables and Control variables

This study incorporates two moderating variables, COV_D and COV_P, to examine whether IC components enhance firms' resilience during the COVID-19 pandemic and support their recovery in the post-pandemic period. These two variables are constructed as dummy variables that take the following values:

- *COV_D: takes the value of 1 for the years 2020 and 2021, and 0 otherwise.*
- *COV_P: takes the value of 1 for the years 2022 onward, and 0 otherwise.*

Moreover, to isolate the impact of IC on firm performance, we control for firm-specific characteristics, including economies of scale with variable firm size (**SIZ**), learning curve effects and market experience with variable firm age (**AGE**), and firm's financial risk and capital structure with variable financial leverage (**LEV**) (Tong & Serrasqueiro, 2026; Salehi et al., 2022; Xu & Liu, 2020).

3.3 Research model

To examine the relationship between IC and firm performance, as well as the moderating effects of the COVID-19 pandemic, this study employs panel regression models with two alternative dependent variables: ROA and TobinQ. The empirical analysis is conducted in two steps.

Firstly, a baseline model is conducted to investigate the overall effects of IC components on firm performance over the full sample period, controlling for firm-specific characteristics.

$$FP_{it} = \beta_0 + \sum_{j=1}^{k} \beta_j IC_{jit} + Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

Secondly, a comprehensive moderation model interaction model is developed to examine whether IC enhanced firms' resilience during the COVID-19 pandemic and supported their recovery in the post-pandemic period.

$$FP_{it} = \beta_0 + \sum_{j=1}^{k} \beta_j IC_{jit} + \sum_{j=1}^{k} \gamma_j (IC_{jit} \times COV\_D_t) + \sum_{j=1}^{k} \delta_j (IC_{jit} \times COV\_D_t) + Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

Where:

- FP_{it} : The performance of firm i in year t, measured by ROA and TobinQ.
- IC_{it}: IC components of firm i in year t.
- β_j: Direct effects of IC components on firm performance.
- γ_j: The "resilience" role of each IC component during the COVID-19 period
- δ_j: The "recovery" role of each IC component in the post-COVID-19 period
- μ_i: Firm fixed effects
- λ_t: Year fixed effects
- ε_{it}: The random error term for observation i at time t

Following standard practices in corporate finance literature, this study employs a two-way fixed effects panel regression to control for unobserved time-invariant firm heterogeneity and macroeconomic time shocks. Robust standard errors clustered at the firm level are used to address potential heteroskedasticity and within-firm serial correlation.

4. Results and discussion:

Table 1. Descriptive statistics

Variable	N	mean	sd	min	max

ROA	3400	0.072	0.070	-0.082	0.450
TobinQ	3400	1.202	0.611	0.402	4.814
HCE	3400	2.857	3.454	0.090	28.278
SCE	3400	0.018	1.388	-10.166	0.965
CEE	3400	0.199	0.136	0.007	0.849
RCE	3400	0.258	0.247	0.000	1.193
SIZ	3400	8.947	0.657	7.577	10.857
AGE	3400	29.824	14.975	4.000	97.000
LEV	3400	0.458	0.211	0.033	0.928

(Source: Own research)

The descriptive statistics in Table 1 reveal generally robust performance, as evidenced by a positive mean ROA (0.072) and a Tobin's Q exceeding unity (1.202). Regarding IC components, HCE has the highest mean value of 2.857, suggesting the key role of human capital in value creation, although its large dispersion indicates substantial variation in human capital efficiency across firms. Notably, SCE has a remarkably low mean (0.018) alongside high volatility (ranging from -10.166 to 0.965), implying that structural capital contribution is highly unstable across firms. Furthermore, the sample is characterized by highly mature and established firms, with an average age (AGE) of nearly 30 years and a moderate mean leverage ratio (LEV) of 45.8%. These well-established operational foundations suggest that the sample firms might possess a strong inherent resilience.

Table 2. Correlation matrix

	ROA	TobinQ	HCE	SCE	CEE	RCE	SIZ	AGE	LEV
ROA	1.000								
TobinQ	0.583***	1.000							
HCE	0.262***	0.177***	1.000						
SCE	0.275***	0.149***	0.377***	1.000					
CEE	0.713***	0.464***	0.116***	0.294***	1.000				
RCE	-0.143***	-0.053**	-0.133***	0.105***	0.374***	1.000			
SIZ	-0.054**	0.089***	0.327***	0.247***	-0.136***	-0.154***	1.000		
AGE	0.015	0.095***	-0.112***	-0.081***	0.069***	0.092***	0.018	1.000	
LEV	-0.467***	-0.222***	-0.069***	-0.214***	-0.318***	0.006	0.289***	-0.011	1.000

(Source: Own research)

Table 2 reports the pairwise Pearson correlations among the variables. The results show that HCE, SCE, and CEE are positively and significantly correlated with both firm performance measures, whereas RCE is

negatively correlated with ROA (-0.143) and Tobin's Q (-0.053). Among the IC components, CEE has the strongest correlation with ROA (0.713), suggesting its close association with accounting performance. Overall, the findings indicate that IC components may have heterogeneous relationships with accounting-based and market-based performance. The correlations among independent variables are generally low to moderate, with the highest value between HCE and SCE (0.377). In addition, all VIF values range from 1.04 to 1.42, well below the conventional threshold of 10, indicating that multicollinearity is not a serious concern.

Table 3. Regression results

	Baseline model		Interaction Model	
	ROA	**TobinQ**	**ROA**	**TobinQ**
HCE	0.002*** (3.96)	-0.006 (-1.48)	0.002*** (3.72)	-0.004 (-0.69)
SCE	-0.000 (-0.22)	-0.001 (-0.21)	0.001 (1.05)	-0.013* (-1.79)
CEE	0.484*** (20.34)	1.057*** (5.67)	0.477*** (19.44)	1.268*** (6.13)
RCE	-0.112*** (-11.25)	-0.128 (-1.58)	-0.123*** (-11.50)	-0.114 (-1.18)
COV_D#HCE			0.000 (0.73)	-0.003 (-0.49)
COV_D#SCE			-0.001 (-1.40)	0.029** (2.51)
COV_D#CEE			0.007 (0.38)	-0.687*** (-3.97)
COV_D#RCE			0.020** (2.38)	0.011 (0.13)
COV_P#HCE			-0.000 (-0.74)	-0.005 (-0.74)
COV_P#SCE			-0.002*** (-2.76)	0.022** (2.13)
COV_P#CEE			0.025 (1.47)	-0.444** (-2.26)
COV_P#RCE			0.015* (1.74)	-0.023 (-0.30)
SIZ	0.003 (0.48)	-0.248*** (-2.76)	0.007 (0.99)	-0.267*** (-3.00)
AGE	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)
LEV	-0.031*** (-2.98)	0.352** (2.28)	-0.032*** (-3.11)	0.349** (2.30)
Constant	-0.016 (-0.28)	3.099*** (4.16)	-0.047 (-0.79)	3.274*** (4.43)
Observations	3400.000	3400.000	3400.000	3400.000
Adj. R-squared	0.888	0.731	0.889	0.734

Notes: *, **and *** denotes the significance level at 10%, 5% & 1%, respectively, t statistics in parentheses.

(Source: Own research)

Table 3 reports the results of the two-way fixed-effects regressions for the baseline and interaction models. The baseline results show that IC components have heterogeneous effects on firm performance. For accounting-based performance, HCE (β = 0.002, p < 0.01) and CEE (β = 0.484, p < 0.01) are positively and significantly associated with ROA. This aligns with prior literature suggesting that physical capital and human resources remain the foundational drivers of operational profit in emerging markets (Smriti & Das, 2018; Xu & Wang, 2018). In contrast, SCE does not have a significant direct effect on ROA and RCE

demonstrates a significant negative effect on ROA (β = -0.112, p < 0.01). This implies that relational capital expenditures, such as marketing and customer-related costs, may reduce short-term profitability because their benefits are not immediately realized. Prior evidence also shows mixed results for relational capital, with some studies reporting negative or insignificant effects on profitability (Xu & Liu, 2020). Regarding market-based performance, CEE is the only component demonstrating a highly significant and positive associated with TobinQ (β = 1.057, p < 0.01), while HCE, SCE, and RCE show no significant association. The result implies that investors in the sampled market traditionally anchor their valuations heavily on tangible assets rather than intangible knowledge resources.

For the COVID-19 period, the coefficient of the interaction term between CEE and COV_D is negative and significant (β = -0.687, p<0.01), whereas those between SCE and COV_D is positive and significant (β = 0.029, p<0.05) in TobinQ model. These results indicate a profound paradigm shift in how the market values firms' various resources during a crisis. Compared with the baseline model, although CEE remains a strong and positive determinant of TobinQ, the negative interaction between CEE and COV_D implies that its positive contribution weakened significantly during the COVID-19 shock, possibly because asset-based efficiency became less effective under demand contractions, supply-chain disruptions, and lower capacity utilization. Conversely, although SCE does not show a strong direct effect in the baseline model, the positive interaction between SCE and COV_D indicates that structural capital became more valuable during the crisis by supporting business continuity, internal coordination, and operational flexibility. Furthermore, this buffering role is also evident in ROA model, where the interaction between RCE and COV_D turns significantly positive (β = 0.02, p < 0.05), compelling evidence that established customer loyalty and strong external relational networks acted as a shield, helping firms sustain revenue streams when traditional physical operations were paralyzed.

For the post-pandemic recovery period, these pandemic-induced valuation trends largely persisted. The coefficient of the interaction term between CEE and COV_P remains significantly negative (β = -0.444, p<0.05) in TobinQ model, suggesting a sustained investor shift away from purely asset-heavy models toward long-term adaptability. Meanwhile, structural capital continues to positively drive market recovery (coefficient of variable SCE*COV_P = 0.022, p<0.05). Although investing in structual capital slightly depresses immediate accounting profitability (coefficient of variable SCE*COV_P in ROA model = -0.002, p<0.01), the market clearly looks beyond these short-term expenses, rewarding structural agility as a cornerstone of sustainable value creation. Finally, RCE positively contributes to ROA recovery (β = 0.015, p<0.1), helping firms restore sales networks. This implies that firms with stronger customer relationships, market connections, and external networks may have been better able to restore sales and business activities after the crisis. Overall, the findings suggest that IC contributes to post-pandemic recovery heterogeneously:

relational capital supports accounting-based recovery, while structural capital enhances market-based recovery.

5. Conclusion and recommendation

This study provides comprehensive empirical evidence on the dynamic relationship between IC and firm performance, specifically highlighting how macroeconomic shocks like the COVID-19 pandemic reshape resource valuation. While physical and financial assets are still efficiently utilized by Vietnamese listed firms under normal economic conditions, their role appears to weaken during periods of crisis and recovery. Our findings support hypothesis H2 that intangible assets, such as structural capital and relational capital are the true determinants of crisis survival. Furthermore, validating hypothesis H3, the persistent positive valuation of structural capital in the post-COVID period suggests that the pandemic has permanently altered investor behavior, shifting the focus from physical scale to structural agility and digital readiness

These findings imply that managers should strategically balance their investments in intellectual capital according to the firm's operating context. The market reward for structural capital during and after the pandemic strongly signals that firms must prioritize investments in internal databases, digital infrastructure, and agile management protocols. Firms should also manage relational capital as a risk mitigation tool because customer and market networks can support resilience and recovery, but carefully balancing these relational expenditures to prevent significant erosions in short-term accounting profitability. Regarding capital employed, instead of continuously expanding idle physical capacities, companies should optimize existing tangible assets and redirect capital toward high-yield intangible investments to maximize long-term market valuation (TobinQ). Finally, as human capital remains a consistent driver of short-term profitability, firms must continuously invest in employee training and well-being. A highly skilled workforce is the foundational prerequisite for effectively deploying the newly upgraded structural and digital systems.

Future studies may extend this research by examining sector-specific differences, using alternative measures of IC, or applying dynamic panel models to better address potential endogeneity.

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Ảnh hưởng của vốn trí tuệ đến thành quả hoạt động của doanh nghiệp: Khả năng chống chịu và phục hồi từ đại dịch COVID-19

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Tóm tắt:

Nghiên cứu này xem xét ảnh hưởng của vốn trí tuệ (IC) đến thành quả hoạt động của doanh nghiệp và vai trò của nó trong việc giúp doanh nghiệp chống chịu trong khủng hoảng và phục hồi sau khủng hoảng COVID-19. Nghiên cứu sử dụng mô hình MVAIC để đo biến phụ thuộc IC và thực hiện hồi quy tác động cố định theo doanh nghiệp và năm cho dữ liệu bảng gồm 340 doanh nghiệp phi tài chính niêm yết tại Việt Nam trong giai đoạn 2015-2024. Kết quả cho thấy hiệu quả sử dụng vốn vật chất (CEE) và vốn nhân lực (HCE) thúc đẩy thành quả về mặt kế toán (ROA), còn thành quả về mặt thị trường (Tobin's Q) được thúc đẩy bởi CEE. Ngược lại, hiệu quả sử dụng vốn quan hệ (RCE) cho thấy ảnh hưởng tiêu cực ngắn hạn đến thành quả về mặt kế toán. Khi xem xét vai trò điều tiết của COVID-19, có một sự chuyển hướng trong vai trò của các thành phần IC đến thành quả doanh nghiệp: vai trò tích cực của CEE bị suy yếu, trong khi SCE nổi lên như một yếu tố quan trọng giúp doanh nghiệp chống chịu trong khủng hoảng và phục hồi sau khủng hoảng ở cả khía cạnh thành quả kế toán và thị trường. Ngoài ra, RCE cũng hỗ trợ tích cực khả năng chống

chịu và phục hồi thành quả kế toán. Những phát hiện này cho thấy vai trò không đồng nhất của các thành phần vốn trí tuệ trong các bối cảnh kinh tế khác nhau, đồng thời nhấn mạnh vai trò của các thành phần vốn phi vật chất như SCE, RCE trong việc gia tăng khả năng chống chịu và phục hồi của doanh nghiệp trước các cú sốc kinh tế.
Từ khóa: vốn trí tuệ, MVAIC, thành quả hoạt động của doanh nghiệp, COVID-19, khả năng chống chịu, khả năng phục hồi.