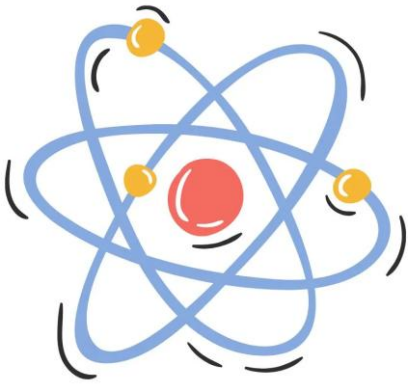

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FIRM SOCIAL CAPITAL AND CORPORATE RISK-TAKING: CAUSAL MACHINE LEARNING EVIDENCE FROM VIETNAM

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Abstract: In transition economies where, formal institutions remain underdeveloped and information asymmetry is pervasive, relational networks substitute for market mechanisms in allocating resources and managing uncertainty. This study investigates the impact of firm-level social capital on corporate risk-taking behavior among 338 non-financial companies listed on the Ho Chi Minh Stock Exchange (HOSE) from 2019 to 2024. Our contribution to the literature is twofold. First, we move beyond traditional binary metrics to build a comprehensive, four-dimensional formative index of corporate social capital. This index integrates an automated CSR disclosure score aligned with GRI standards, a biographical locus measure reflecting the CEO's social network, political connections, and bank connectivity. Second, we address the challenge of causal identification by deploying a dual strategy. Specifically, we pair Two-way Fixed Effects with the Panel Double Machine Learning method to eliminate nonlinear confounding and ensure the robustness of our causal inferences. The empirical evidence suggests that social capital functions as a strategic risk management toolkit with dual roles. While political and bank ties act as institutional buffers that dampen earnings volatility, they simultaneously act as a catalyst for financial expansion. These ties increase leverage capacity by 14.6 percentage points for every standard deviation increase in connectivity. Furthermore, CEO networks and political ties drive a shift toward precautionary cash holdings. Notably, the Panel Double Machine Learning approach uncovers significant effects overlooked by linear models, confirming the material importance of nonlinearity in relational networks. By dismantling the binary view of social capital as either a risk-booster or a risk-reducer, this study positions it as a sophisticated portfolio that stabilizes performance while broadening financial flexibility.

***Keywords*:** Firm social capital, corporate risk-taking, Panel Double Machine Learning, automated content analysis, Vietnam, transition economy

1. Introduction

Corporate risk taking is a fundamental aspect of strategic decision making, including decisions on investment intensity, financial leverage, innovation, and strategic diversification. These decisions have direct implications for firm performance, growth capacity, and long-term value creation [1]. In an era of heightened global volatility, understanding the determinants of such risk-taking behavior has become a major concern of both the academic community and the corporate practitioners.

Social capital is a key factor in this process. It is defined as the actual or potential resources embedded in an individual's or organization's network of relationships [2]. Many regard it as a key factor in a company's long-term competitive advantage [3-5]. Social networks provide firms with access to information and business opportunities [4, 6], while also serving as informal mechanisms that reduce information asymmetry, mobilize resources, and enhance legitimacy with stakeholders [2]. In emerging markets specifically, managerial risk-taking is significantly shaped by business and political network ties, highlighting the role of social capital where formal institutions remain underdeveloped [7, 8].

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The direction of social capital's effect on risk-taking, however, remains an open question. On one hand, social capital may function as a shield, meaning that relational networks provide informal risk-sharing mechanisms and reduce information asymmetry, enabling firms to pursue bolder investment strategies with greater confidence [3, 9]. On the other hand, social capital may function as a veil, meaning that entrenched managers can exploit their networks to pursue excessive risk for personal gain or shield self-serving behavior from market scrutiny [10]. This ambiguity reflects the dual-edged nature of social capital that existing studies have yet to resolve.

Vietnam offers a distinctive context for examining this question. Since the Doi Moi reforms of 1986, Vietnam has transitioned from a centrally planned to a market-oriented economy, producing a hybrid institutional environment in which formal institutions like legal systems, property rights protection, and contract enforcement, remain relatively weak by international standards. These institutional gaps, combined with limited governance transparency and high administrative compliance costs, generate pervasive information asymmetry in Vietnam's nascent capital markets [11, 12]. As a result, informal relational networks serve as a substitute for formal market mechanisms in coordinating transactions and accessing resources [13]. Ties with government agencies, financial institutions, and business partners explain firm-level outcome differences that standard financial metrics cannot fully capture [13]. Corporate social responsibility disclosure (CSRD) further functions as a signaling mechanism for legitimacy and mutual commitment, partially compensating for weak governance transparency. However, the voluntary quality of CSRD remains limited relative to international standards, producing significant variation in trust-based social capital across Vietnamese listed firms. The substantial residual state ownership in listed companies also creates distinctive risk-aversion pressures, reflected in lower earnings and stock price volatility relative to private-sector peers [11, 14].

Despite a growing body of empirical work on social capital and firm outcomes, important gaps remain, particularly in emerging markets. First, while international studies document positive effects of CEO social capital on risk-taking and value creation [15], the specific mechanisms through which social capital operates in weak-institution environments dominated by relationship-based transactions are not well understood. Second, empirical findings remain inconsistent: some studies report a positive effect on risk-taking [9] while others find the opposite [3, 13], suggesting that the type of social capital and institutional context matter considerably. In Vietnam, direct evidence linking social capital to risk-taking is fragmented, focusing on isolated phenomena such as ownership concentration or political connections without a comprehensive framework. Third, most studies measure the trust dimension of social capital through surveys or country-level indices, and no study in Vietnam has proposed and validated a firm-level proxy suited to the limited public data availability of an emerging market.

This study addresses these gaps by examining the effect of firm-level social capital on corporate risk-taking among 338 non-financial companies listed on the Ho Chi Minh Stock Exchange (HOSE) over 2019–2024. We make two principal contributions. First, we construct a four-dimensional formative Firm Social Capital (FSC) index comprising: CSR disclosure (CSRD) as a proxy for the trust dimension of stakeholder relationships, measured through an automated content analysis pipeline validated against 1,360 manually coded observations (ICC = 0.842); CEO social capital via a ten-dimension locus approach drawn from public biographical data; political connections; and bank connectivity. Second, we address the identification challenge commonly neglected in social capital research by employing a dual-identification strategy that combines Two-way Fixed Effects (TWFE) to remove time-invariant unobserved heterogeneity with Panel Double Machine Learning (Panel DML) [16], which relaxes the linearity assumption on confounding functions through machine learning algorithms and recovers social capital effects that linear models systematically underestimate.

The remainder of the paper is organized as follows. Section 2 reviews the theoretical foundations and develops the research hypotheses. Section 3 describes the data, variable measurement, and estimation strategy. Section 4 presents and discusses the empirical

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results. Section 5 concludes with policy implications, limitations, and directions for future research.

2. Literature Review

2.1. Conceptualizing Social Capital in Corporate Settings

Social capital is defined as the actual and potential resources embedded in, available through, and derived from an individual's or social unit's network of relationships [2]. From this perspective, social networks are widely recognized as a form of intangible asset that resides in the structure and quality of relational ties themselves [17, 18]. Most empirical work identifies networks and trust as the two foundational pillars of social capital, operating in a complementary fashion: networks reduce information asymmetry and search costs [6] while trust functions as an informal commitment mechanism that mitigates agency risk [18].

Despite its theoretical grounding, social capital is an abstract construct that cannot be measured directly and is typically inferred from its observable effects. It is also inherently multidimensional, making any single indicator an incomplete representation [19]. Scrivens and Smith [20] identify four main measurement approaches used in empirical research: personal relationships, social network support, community engagement, and trust together with cooperative norms.

At the individual level, a firm's social capital depends directly on the relational networks of its management team. CEO social capital has therefore become a widely used proxy, capturing the resources accessible through a chief executive's professional and personal connections, including ties with other business leaders, board members, industry figures, government officials, and key stakeholders, that provide access to valuable information, resources, and legitimacy [21, 22].

At the organizational level, corporate social responsibility (CSR) activity is commonly used as a proxy for the trust dimension of social capital [18], [23]. Through a signaling mechanism, CSR activities allow firms to build and communicate trust between management and stakeholders while demonstrating managerial competence and integrity [23, 24]. CSR disclosure also maps directly onto the three dimensions of social capital identified by Nahapiet and Ghoshal [2]: establishing cooperative networks (structural dimension), reinforcing trustworthiness (relational dimension), and sharing common ethical norms (cognitive dimension). At the same time, CSRD functions as an operational hedging tool that reduces information asymmetry and protects firm value against reputational shocks [24, 25].

Importantly, the measurement of social capital must reflect the specific institutional context of the research setting. In Vietnam, where the financial system is bank-based and the privatization process remains incomplete, political connections and bank relationships are critical channels for accessing capital and policy benefits [11, 14, 26]. These ties reduce transaction costs and confer strategic competitive advantages in a business environment that relies heavily on relational networks.

Drawing on the above arguments, this study adopts a four-dimensional framework to measure firm-level social capital: (i) CEO social capital; (ii) trust-based social capital through CSRD; (iii) political connections; and (iv) bank connectivity. This multidimensional approach provides an objective and comprehensive representation of the depth of social capital in shaping risk-taking behavior among Vietnamese listed firms.

2.2. Conceptualizing corporate risk-taking

Corporate risk-taking refers to strategic decisions and actions associated with uncertainty and potential outcomes that may generate substantial returns but also carry significant downside risk. It is a fundamental dimension of strategic management, driving firms to pursue innovation, growth, and competitive advantage [1]. In practice, risk-taking manifests in decisions such as investing in new projects, entering untested markets,

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adopting disruptive technologies, or any strategic move involving financial and operational uncertainty.

Empirically, there is no single agreed-upon measure of corporate risk-taking. Drawing on prior literature, existing measures fall into two broad categories. The first category captures risk as the volatility of financial performance. This is also the most widely used approach in empirical research. Standard measures include the standard deviation of return on assets (ROA) and stock return volatility, both of which reflect the degree to which a firm's financial outcomes fluctuate over time [3, 4]. The second category measures risk through strategic decisions and organizational behavior such as acquisition propensity, research and development (R&D) expenditure, capital expenditure intensity (CAPEX), financial leverage, and cash holdings. Each captures a distinct dimension of how firms allocate resources under uncertainty [3, 27].

This study employs both categories. Earnings and stock return volatility capture overall operational risk, while capital expenditure intensity, cash holdings, and financial leverage reflect deliberate strategic risk-taking choices. Together, these five measures provide a comprehensive view of how social capital shapes corporate risk-taking across multiple dimensions.

2.3. Theoretical Foundations

Understanding how social capital shapes corporate behavior requires a multi-theoretical approach in which complementary frameworks explain how intangible relational resources translate into organizational decisions.

Social capital theory holds that network relationships constitute valuable resources that facilitate information flows, reduce transaction costs, and strengthen cooperation between firms and their stakeholders [2, 18]. Applied to the corporate context, social capital helps firms access financial, human, and technological resources [21, 22], obtain timely information that reduces decision-making uncertainty [1], and enhance organizational legitimacy [2, 21, 22]. Network ties also serve as a resource buffer that absorbs operational shocks and stabilizes earnings. This effect is particularly pronounced in emerging markets where formal institutions are weak [14, 26]. At the same time, social capital functions as a form of career insurance for CEOs: by reducing the personal cost of failure, it may encourage more confident long-term capital allocation decisions, including greater use of financial leverage [3].

Resource dependence theory argues that organizations depend on their external environment for critical resources needed to survive and grow [28]. A key strategic objective is therefore to manage these dependencies, reduce environmental uncertainty, and secure a stable resource flow. From this perspective, social capital satisfies the criteria of being valuable, rare, inimitable, and non-substitutable since trust-based relationships are difficult to replicate, and the tacit knowledge flowing through networks cannot easily be substituted. In the Vietnamese context, political connections and bank relationships serve as strategic bridges that help firms secure financing, reduce information asymmetry, and broaden market access. As environmental dependence decreases, firms can both stabilize earnings and take on greater debt with greater confidence.

Institutional theory highlights the particular importance of social capital in contexts where formal institutions are weak [7, 8]. In a transition economy like Vietnam, political connections provide implicit institutional protection during downturns, while bank relationships facilitate access to credit. However, institutional theory also warns that excessive reliance on informal networks can entrench inefficiency and enable rent-seeking behavior [13].

Agency theory offers a more cautious perspective. On the positive side, social capital reduces information asymmetry and strengthens monitoring; CEO networks that function as career insurance may also encourage value-enhancing risk-taking rather than excessive risk aversion [6, 21]. On the negative side, extensive networks can reinforce managerial power, leading to entrenchment and weakening board independence [29], then indirectly increasing corporate risk along unintended dimensions.

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2.4. Social Capital and Corporate Risk-Taking: Empirical Evidence

Most empirical evidence on the relationship between social capital and corporate risk-taking comes from the United States. Studies consistently document a positive association between social capital and aggregate risk-taking, including stock return volatility, earnings volatility, R&D expenditure, and financial leverage. The underlying mechanisms include superior information access, better resource mobilization, and reduced career concerns for CEOs. As a result, well-connected CEOs face lower personal costs of failure and are therefore more willing to pursue high-risk, high-return projects [3, 9]. However, not all evidence supports a straightforwardly positive effect. El-Khatib et al [6] show that highly central CEOs tend to initiate more value-destroying M&A transactions, suggesting that broad connectivity can shield managers from governance mechanisms and entrench their power. At the organizational level, the trust dimension of social capital, which is typically proxied by CSR, tends to reduce extreme risk by functioning as an operational hedge: CSR activity protects firm value against reputational shocks and crises. Similarly, institutional embeddedness through political connections and bank relationships is expected to create an earnings buffer through implicit political protection and relationship lending, thereby reducing earnings volatility [3, 13].

Evidence from comparable transition economies adds important nuance. In China, which shares with Vietnam a significant state ownership presence and reliance on informal networks, Li et al. [30] find that interlocking director networks significantly influence risk-taking through information sharing, resource access, and normative pressure, though the direction of effects depends on network characteristics and firm context. Research on politically connected firms in Malaysia finds that political ties are associated with substantially lower risk-taking yet higher financial performance [31] suggesting that political patronage enables superior outcomes without the need for risky strategies. In Vietnam, direct empirical evidence linking social capital to risk-taking remains limited. Nguyen et al. [12] identifies bank networks as the strongest driver of firm investment, while political connections provide value primarily in regions with weaker institutional quality. A small number of studies have begun examining the role of CEO reputation in expanding the scope for risk-taking strategies [11, 14]. Most existing research, however, focuses on isolated dimensions such as state ownership or political connections and stops short of constructing a comprehensive framework that integrates the multiple dimensions of firm-level social capital.

The literature reviewed above reveals three research gaps. First, the mechanisms through which social capital operates in Vietnam's institutional environment remain unclear, and the inconsistency of findings across markets suggests that the type of social capital and contextual factors must be examined jointly in an integrated model. Second, no study in Vietnam has proposed and validated a firm-level composite measure of social capital that simultaneously captures individual, organizational, and financial dimensions within the constraints of limited public data availability. Third, existing studies rely predominantly on linear models that ignore the identification challenge arising from nonlinear interactions and unobserved confounding in unbalanced panel data.

3. Research Methodology

3.1. Sample Selection and Data Sources

The study uses an unbalanced panel of 338 non-financial firms listed on the Ho Chi Minh Stock Exchange (HOSE) over 2019–2024, yielding 2,013 firm-year observations. Financial firms are excluded due to fundamental differences in capital structure, regulatory environment, and risk profiles relative to non-financial corporations.

The 2019–2024 period is selected for two reasons. First, the six-year window spans the pre-, during-, and post-COVID-19 periods, allowing us to test whether social capital effects are robust across varying macroeconomic conditions. Second, this period coincides with

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the broader standardization and consistent electronic publication of annual reports by Vietnamese listed companies, enabling reliable automated CSR data collection.

Financial and accounting data are obtained from FiinPro and Vietstock. CSR disclosure data are extracted and processed from annual reports using an automated content analysis pipeline, which is validated against a manually coded dataset to ensure objectivity and replicability. All continuous variables are winsorized at the 1st and 99th percentiles by year to reduce the influence of extreme outliers prior to estimation.

3.2 Variable Measurement

Measuring Corporate Risk-Taking

Five risk-taking measures are computed across two groups. The first group captures outcome-based risk that reflect overall earnings and return variability: CRT1 is the standard deviation of ROA computed over a five-year rolling window; CRT2 is the standard deviation of daily stock returns within each fiscal year. The second group captures behavioral risk-taking through financial policy choices: CRT3 is capital expenditure (CAPEX) scaled by average total assets; CRT4 is cash and cash equivalents scaled by average total assets; CRT5 is financial debt divided by total investor-supplied capital (financial debt plus equity).

Measuring Firm Social Capital (FSC)

Given the multidimensional nature of social capital, including relational structure, trust, and institutional legitimacy across qualitatively distinct domains, this study constructs FSC as a formative composite index comprising four components. Unlike a reflective construct, a formative construct does not require high inter-indicator correlations because each dimension captures an independent mechanism of social capital formation.

FSC is built from four components: (i) CSR disclosure index (SC1_CSRD), measuring the trust and stakeholder commitment dimension; (ii) CEO social capital (SC2_CEO Network), measuring individual-level leadership networks; (iii) political connections (SC3_POLCON), measuring institutional ties with the state; and (iv) bank connectivity (SC4_BANKCON), measuring relationships with commercial banks. Each of the four components (SC1–SC4) is standardized annually to zero mean and unit variance before aggregation. The composite index of social capital, FSC_EW is then computed as the simple equal-weighted average of the four standardized scores

CSR Disclosure Index (SC1_CSRD)

CSRD is constructed through an automated content analysis pipeline applied to all annual reports in the sample. This approach differs from most CSRD research in Vietnam in two ways. First, regarding the scoring scale, rather than a binary 0/1 scheme that records only the presence or absence of a CSR topic - the dominant approach in empirical CSRD studies in developing countries [32-34], this study applies a three-point ordinal scale: 0 (no disclosure or purely rhetorical statement), 1 (qualitative disclosure with substantive content), and 2 (quantitative disclosure with specific figures and measurement units). This distinction captures both the breadth and depth of CSR disclosure, consistent with the argument that social capital is built through credible commitment signals rather than mere mention. Second, regarding the scoring process: manual coding across the full sample is prone to coder fatigue and inter-rater inconsistency. An automated pipeline eliminates subjectivity and ensures transparency and replicability at scale [35]. The keyword dictionary was developed from Global Reporting Initiative (GRI) Standards and iteratively refined through 1,360 manually coded reports (2019–2022), ensuring that it reflects the actual reporting language of Vietnamese listed companies rather than a mechanical translation from international standards (see Appendix B for details).

CSRD evaluates 31 disclosure criteria organized into three groups: Environmental (15 criteria), Community (7 criteria), and Labour (9 criteria), following the GRI Standards framework and Circular 96/2020/TT-BTC (full list in Appendix A). For firm i in year t, CSRD is calculated as:

$$\text{CSRD}_{i,t} = \sum_{j=1}^{31} s_{ij} / 62 \qquad (1)$$

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Where $s_{ij} \in \{0,1,2\}$ is the score assigned to criterion *j* for firm *i*, and 62 is the maximum possible score (= 31 × 2). CSRD takes continuous values in [0, 1], reflecting both the breadth and depth of CSR reporting. To validate the automated pipeline, its outputs are benchmarked against a manually coded calibration sample of 1,360 firm-year observations (2019–2022). The intraclass correlation coefficient (ICC = 0.842) meets the good reliability threshold [36]; Pearson and Spearman correlations are 0.844 and 0.930, respectively; mean absolute error MAE = 0.036 (3.6% of the index scale). Full pipeline details and year-by-year reliability results are reported in Appendix B.

CEO Social Capital (SC2_CEO_SC)

Following the locus approach widely adopted in emerging market research [21, 22], CEO social capital is measured as a composite score across ten binary dimensions drawn from publicly available CEO biographical data: firm tenure, leadership tenure, financial connections, management education, multi-firm executive experience, international experience, academic network, industry association network, legal background, and political network. The raw score is log-transformed as ln(1 + CEO social capital score) to reduce the influence of outliers. Full definitions of the ten dimensions are provided in Appendix C.

Political Connections (SC3_POLCON)

Political connections represent a form of bridging social capital within the structural dimension, providing firms with access to state resources and informal policy benefits. In Vietnam's institutional context, state ownership is the most observable and widely used proxy for political connectivity. POLCON is measured as the proportion of equity held by state entities, including central government agencies, local authorities, and state-owned enterprises as disclosed in the annual ownership structure.

Bank Connectivity (SC4_BANKCON)

Bank lending relationships capture the structural dimension of social capital through firm–bank ties. SC4_BANKCON is constructed from two sub-indicators: (i) the bank debt ratio, measuring the intensity of financial dependence on bank credit; and (ii) the number of banking relationships, measuring the breadth of the creditor network. The two sub-indicators are standardized separately and then averaged to form BANKCON, avoiding double-weighting bias when integrating into the composite FSC index.

Detailed variable definitions are provided in Appendix D.

3.3 Estimation Strategy

This study combines classical panel econometrics with causal machine learning to examine the effect of firm social capital on corporate risk-taking. The two estimators are complementary: two-way fixed effects controls for time-invariant unobserved heterogeneity, while Panel DML relaxes the linearity assumption on the confounding functions.

Two-way Fixed Effects (TWFE). The baseline estimating equation is:

$$Y_{it} = \alpha_i + \lambda_t + \beta \cdot SC_{it} + \gamma \cdot X_{it} + \varepsilon_{it} \qquad (2)$$

where Y_{it} is a risk-taking outcome (CRT1–CRT5) for firm i in year t; SC_{it} the social capital variable (SC1-SC4, FSC_EW); X_{it} is a vector of controls; α_i and λ_t are firm and year fixed effects, respectively. Firm fixed effects absorb all time-invariant unobserved firm characteristics such as corporate culture; year fixed effects control for common macroeconomic shocks. Standard errors are clustered at the firm level to address heteroskedasticity - confirmed by the Modified Wald test ($\chi^2 > 1600$, $p < 0.001$) and first-order serial correlation - confirmed by the Wooldridge (2002) test ($F=16.82$, $p<0.001$). The preference for TWFE over random effects is validated by the Hausman test ($\chi^2 = 40.99$, $p < 0.001$) and an F-test for the joint significance of firm fixed effects ($F = 10.08$, df = 337, $p < 0.001$).

Panel Double Machine Learning (Panel DML):

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To assess robustness against violations of the linearity assumption, we apply the Panel DML estimator of Semenova and Chernozhukov [16]. The procedure proceeds in three steps: (i) a within-transformation that removes time-invariant confounders, identical to the TWFE demeaning step; (ii) estimation of nonlinear nuisance functions using machine learning; and (iii) application of Neyman orthogonalization with K-fold cross-fitting to eliminate regularization bias. Two learners are implemented in parallel: LassoCV, suited under approximate sparsity, and Random Forest with restricted depth (max_depth = 3, min_samples_leaf = 20), suited for more complex nonlinear interactions while guarding against overfitting given N=338 firms. Convergence between β̂ (TWFE) and θ̂ (Panel DML) across both learners confirms that the main findings are not an artifact of linear misspecification of the control function.

4. Findings and Discussion

4.1 Descriptive analysis

Table 1. Descriptive analysis

Variable	N	Mean	SD	Min	Median	Max	Skew
Dependent Variables (Firm Risk-Taking)							
CRT1_ SD_ROA	2012	0.0322	0.0377	0.0000	0.0197	0.3618	3.287
CRT2_SD_RET	1984	0.4220	0.1472	0.0756	0.4066	13.206	0.928
CRT3_CAPEX/TA	1950	0.0251	0.0688	-0.1855	0.0068	0.3831	2.320
CRT4_Cash/TA	1950	0.0485	0.0584	0.0000	0.0279	0.6983	3.256
CRT5_Leverage	1950	0.2941	0.2169	0.0000	0.2802	0.7414	0.248
Main Independent Variable (Social Capital)							
SC_EW	2013	-0.0000	0.5546	-1.5970	-0.0205	19.766	0.256
SC1_CSRD	2013	-0.0000	1.0000	-2.0552	-0.0360	33.965	0.409
SC2_CEO Network	2013	0.0000	1.0000	-3.9260	0.4077	19.905	-1.299
SC3_PolCon	2013	0.0000	1.0000	-0.6665	-0.6665	32.125	1.217
SC4_BankCon	2013	0.0000	1.0000	-1.2546	-0.1379	38.277	0.847
Control Variables							
CEO Ownership	2008	0.0318	0.0776	0.0000	0.0015	0.6116	3.975
Board Independence	2007	0.2528	0.1431	0.0000	0.2500	1.0000	0.075
Board Size (ln)	2007	1.7255	0.2384	1.0986	1.6094	2.5649	0.025
Firm Growth	2011	0.1056	0.5074	-0.8334	0.0391	2.9532	2.836
Firm Size (ln)	2013	28.5453	1.4895	25.2745	28.3081	34.3604	0.677
Firm Age (ln)	2013	2.9335	0.3904	0.6931	2.9444	4.1589	-0.539
Competition	2013	0.7999	0.1241	0.3630	0.8048	0.9382	-1.166

Source: by authors

Table 1 reports descriptive statistics for all variables. The dependent variables exhibit the right-skewed distributions typical of corporate financial data. Mean SD_ROA is 3.22%, with a small subset of firms showing very high earnings volatility - concentrated in the COVID-19 period (2020-2021). Mean SD_RET is 42%, reflecting the elevated market volatility characterizing the Vietnamese stock market during the study period. Mean CAPEX/TA is only 2.51% (median 0.68%), indicating that capital expenditure is concentrated among a small group of manufacturing and infrastructure firms. Mean Cash/TA is 4.85% but strongly right-skewed, with some firms holding up to 69.83% of total assets in cash - typically real estate companies in the capital-raising phase or with projects yet to be deployed.

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Regarding the main independent variable, the composite FSC_EW index has a mean of approximately zero and a near-symmetric distribution (Skew = 0.256), indicating that no firm group dominates the composite and confirming the balance achieved by annual z-scoring. Among the four SC components, SC3 is strongly right-skewed (Skew = 1.217), reflecting that most firms carry negligible state ownership, while SC2 is left-skewed (Skew = −1.299), consistent with CEOs accumulating experience and connections over time.

Among the control variables, CEO ownership has a median of only 0.15%, confirming that most CEOs hold no meaningful equity stake. Mean board independence is 25.28%, modestly above the 20% statutory minimum under Vietnamese corporate law. Two further characteristics define the sample: a high average level of industry competition (Competition mean = 0.80) and a mean firm age equivalent to approximately 18 years of operation.

4.2 Estimation Results

Table 2 reports Two-way Fixed Effects estimates with firm-clustered standard errors, using the composite social capital index (FSC_EW) as the main independent variable.

Table 2: TWFE estimates - Composite Social Capital Index

Independent Variables	CRT1 SD_ROA (1)	CRT2 SD_RET (2)	CRT3 CAPEX (3)	CRT4 CASH (4)	CRT5 LEVERAGE (5)
FSC_EW	-0.0086* (0.0050)	0.0247 (0.0180)	0.0124 (0.0116)	0.0153** (0.0066)	0.0647*** (0.0190)
CEO_OWN	0.0054 (0.0151)	0.1227 (0.1110)	0.0011 (0.0307)	0.0039 (0.0243)	-0.0519 (0.0804)
B_INDEP	0.0068 (0.0180)	0.0012 (0.0473)	0.0220 (0.0198)	-0.0057 (0.0129)	-0.0118 (0.0307)
B_SIZE	0.0155 (0.0147)	-0.0123 (0.0339)	-0.0255 (0.0162)	0.0078 (0.0110)	-0.0461 (0.0296)
F.GROWTH	0.0019 (0.0021)	-0.0006 (0.0070)	0.0116** (0.0049)	0.0041* (0.0023)	0.0063 (0.0056)
F.SIZE	-0.0115** (0.0056)	0.0159 (0.0163)	0.0369*** (0.0104)	-0.0020 (0.0077)	0.1647*** (0.0206)
F.AGE	0.0094* (0.0162)	-0.1162** (0.0603)	-0.0388 (0.0378)	-0.0391 (0.0390)	-0.0675 (0.0596)
COMPETE	-0.0446 (0.0297)	0.2928** (0.1195)	0.1117** (0.0526)	0.0760* (0.0450)	0.0578 (0.0766)
N (obs)	2003	1980	1949	1949	1949
R^2 (within)	0.0212	0.0121	0.0325	0.0119	0.2284

Source: by authors

Table 3 reports Two-way Fixed Effects estimates with firm-clustered standard errors, using the four individual SC components as separate regressors.

Table 3: TWFE Estimates — Four SC Components

Independent Variables	CRT1 SD_ROA (1)	CRT2 SD_RET (2)	CRT3 CAPEX (3)	CRT4 CASH (4)	CRT5 LEVERAGE* (5)
SC1_CSRD	-0.0027* (0.0019)	0.0072 (0.0065)	0.0028 (0.0042)	0.0041 (0.0027)	-0.0005 (0.0058)
SC2_CEO Network	-0.0015 (0.0024)	0.0108* (0.0061)	-0.0023 (0.0049)	0.0045** (0.0018)	-0.0106 (0.0078)
SC3_POLCON	-0.0068 (0.0054)	-0.0003 (0.0183)	0.0039 (0.0049)	0.0173 (0.0107)	-0.0030 (0.0109)
SC4_BANKCON	-0.0006 (0.0036)	-0.0061 (0.0126)	0.0185*** (0.0060)	-0.0051 (0.0038)	—

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CEO_OWN	0.0041 (0.0151)	0.1132 (0.1109)	0.0123 (0.0342)	0.0038 (0.0238)	0.0317 (0.0779)
B_INDEP	0.0064 (0.0177)	0.0037 (0.0476)	0.0195 (0.0193)	-0.0040 (0.0125)	-0.0085 (0.0315)
B_SIZE	0.0154 (0.0148)	-0.0135 (0.0337)	-0.0237 (0.0158)	0.0076 (0.0107)	-0.0404 (0.0287)
F.GROWTH	0.0018 (0.0021)	-0.0010 (0.0070)	0.0120** (0.0048)	0.0041* (0.0023)	0.0064 (0.0055)
F.SIZE	-0.0125* (0.0017)	0.0230 (0.0179)	0.0277*** (0.0098)	0.0038 (0.0075)	0.1736*** (0.0201)
F.AGE	0.0086* (0.0162)	-0.1192** (0.0602)	-0.0396 (0.0376)	-0.0369 (0.0392)	-0.0346 (0.0579)
COMPETE	-0.0441 (0.0300)	0.2930** (0.1187)	0.1128** (0.0520)	0.0756* (0.0445)	0.0302 (0.0751)
N (obs)	2003	1980	1949	1949	1949
R^2 (within)	0.0230	0.0136	0.0400	0.0206	0.2087

Source: by authors

** Note: The CRT5 specification excludes SC4 due to construct overlap with financial leverage.*

Diagnostic tests confirm the validity of the Two-way FE specification. The maximum Variance Inflation Factor (VIF) is 1.21, ruling out multicollinearity. First-order serial correlation is detected (Wooldridge-type, $p < 0.001$) and addressed through firm-clustered standard errors. The Pesaran (2004) test finds statistically significant cross-sectional dependence in 3 of 5 models; however, the mean cross-correlation coefficient is very small ($\bar{\rho} \leq 0.039$) and Driscoll–Kraay standard errors are smaller than clustered SEs in all cases, confirming that firm-clustered SEs represent the more conservative choice. F-tests confirm the joint significance of both firm fixed effects ($p < 0.001$) and year fixed effects (4 of 5 models), rejecting pooled OLS; the Hausman test supports FE over RE. The Im–Pesaran–Shin panel unit root test confirms that all main variables are stationary I(0) series, ruling out spurious regression.

Table 4 reports the causal effect estimates θ for the social capital variables obtained from Panel DML estimation

Table 4: Panel DML Estimates

Independent Variables	CRT1 SD_ROA (1)	CRT2 SD_RET (2)	CRT3 CAPEX (3)	CRT4 CASH (4)	CRT5 LEVERAGE (5)
Panel A — SC_EW					
SC_EW (Composite Index)	-0.0089*** (0.0028)	0.0259* (0.0140)	0.0112 (0.0084)	0.0151*** (0.0049)	0.0633*** (0.0109)
Panel B — 4 SC Components					
SC1_CSRD	-0.0027** (0.0013)	0.0081 (0.0055)	0.0025 (0.0031)	0.0048** (0.0021)	-0.0008 (0.0035)
SC2_CEO Network	-0.0017 (0.0016)	0.0102** (0.0050)	-0.0027 (0.0037)	0.0043*** (0.0015)	-0.0107** (0.0046)
SC3_POLCON	-0.0062** (0.0029)	0.0002 (0.0142)	0.0041 (0.0041)	0.0164** (0.0068)	-0.0052 (0.0074)
SC4_BANKCON	-0.0010 (0.0026)	-0.0063 (0.0100)	0.0179*** (0.0051)	-0.0054* (0.0029)	excl.

Source: by authors

Three quality checks confirm the reliability of the Panel DML estimates. First, the out-of-sample R^2 of the nuisance functions is approximately zero in 4 of 5 models, indicating that the linearity assumption underlying TWFE is adequate in most specifications and that Panel DML primarily serves as a robustness confirmation; the exception is CRT5 (R^2 =

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0.19), where DML yields a meaningful improvement over FE. Second, coefficient estimates are stable across the Random Forest and LassoCV learners, with differences below 15% for all statistically significant results. Third, the maximum pairwise correlation among the four SC components is 0.202 which is well below the 0.85 discriminant validity threshold of Fornell and Larcker [37], confirming that the four dimensions are sufficiently distinct to be included simultaneously in the same model.

4.3 Discussion

Regarding earnings volatility (CRT1_SD_ROA), FSC_EW has a negative and statistically significant effect on SD_ROA under both TWFE ($\beta = -0.0086$, $p < 0.10$) and Panel DML ($\theta = -0.0089$, $p < 0.01$). The strengthening of significance from TWFE to DML suggests that linear estimation underestimates the true effect due to nonlinearity in the control function. At the component level, SC1 (CSRD) and SC3 (political connections) both yield significant negative coefficients under DML ($\theta = -0.0027$, $p < 0.05$; $\theta = -0.0062$, $p < 0.05$), while TWFE detects only SC1 at the 10% level — confirming the presence of nonlinear dynamics that DML captures more effectively. These results are consistent with the institutional buffer mechanism documented by Boubakri et al.[31] and with the argument of Servaes and Tamayo [24] that CSR disclosure builds stakeholder trust, thereby stabilizing business outcomes. Among controls, only firm size carries a significant negative coefficient, reflecting the earnings-stabilizing effect of operational diversification in larger firms.

In relation to stock return volatility (CRT2_SD_RET), FSC_EW is not significant under TWFE, but Panel DML detects a marginally positive effect ($\theta = +0.026$, $p < 0.10$). At the component level, SC2 (CEO network) is positive and significant under both estimators. Stock return volatility primarily reflects market expectations rather than internal operational risk. Well-connected CEOs generate more information events, elevating price volatility without necessarily indicating deterioration in business fundamentals. The DML result suggests a transmission channel operating through CEO networks. Among controls, industry competition increases stock volatility while firm age helps stabilize share prices.

With regard to capital expenditure (CRT3_CAPEX/TA), SC4 (bank connectivity) is the only component with a strong and consistent positive effect on CAPEX under both TWFE ($\beta = +0.0185$) and DML ($\theta = +0.0179$), both $p < 0.001$. This confirms bank connectivity as the specific channel through which social capital translates into long-term investment capacity. The finding reinforces evidence from Nguyen et al. [12] in Vietnam and is consistent with resource dependence theory: In a bank-based financial system with limited corporate bond markets, banking relationships directly expand a firm's ability to fund long-term investment. Among controls, firm size, revenue growth, and industry competition all promote capital expenditure, which is consistent with scale advantages, reinvestment of growth momentum, and strategic investment under competitive pressure.

In respect of cash holdings (CRT4_Cash/TA), FSC_EW has a positive and significant effect on cash holdings under both TWFE ($\beta = +0.0153$, $p < 0.05$) and DML ($\theta = +0.0151$, $p < 0.01$). DML additionally reveals significant positive effects for SC1 ($\theta = +0.005$, $p < 0.05$), SC2 ($\theta = +0.004$, $p < 0.01$), and SC3 ($\theta = +0.016$, $p < 0.05$), as well as a marginally negative effect for SC4 ($\theta = -0.005$, $p < 0.10$), none of which are detected by TWFE. The positive effects reflect the stakeholder commitment obligations that accompany higher social capital, requiring larger liquidity buffers [24]. The negative effect of SC4 is consistent with a substitution mechanism: firms with strong banking relationships can readily draw on short-term credit lines and therefore hold less precautionary cash. Among controls, fast-growing firms hold more cash to fund working capital needs, while high industry competition motivates larger cash reserves as a strategic buffer against competitive shocks.

As regards financial leverage (CRT5_Leverage), FSC_EW has a large positive and highly significant effect under both TWFE ($\beta = +0.0647$, $p < 0.001$) and DML ($\theta = +0.0633$, $p < 0.001$). Higher social capital reflects stronger non-financial creditworthiness, enabling firms to access wider credit limits at lower borrowing costs — generating an asymmetric

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credit access advantage. Notably, Panel DML reveals a significant negative effect of SC2 on leverage ($\theta = -0.011$, $p < 0.05$) that TWFE does not detect, suggesting that well-networked CEOs are more conservative in debt utilization and this is consistent with agency theory [6]. Among controls, firm size ($\beta = +0.165$, $p < 0.001$) is the dominant predictor: larger firms hold more collateral, carry stronger credit reputations, and face lower expected bankruptcy costs, all of which support greater debt capacity.

Overall, the results challenge the one-dimensional view prevalent in the social capital [3, 9]: social capital does not simply increase or decrease risk-taking, but simultaneously stabilizes operational earnings and expands financial capacity. This dual pattern reflects the distinctive role of relational networks in a transition economy where informal ties substitute for underdeveloped formal institutions [7, 8].

5. Recommendation

The findings carry practical implications for three groups. For *firm management*, social capital should be recognized as a strategic asset with measurable financial effects, not merely a public relations activity. The evidence shows that investing across all four SC dimensions - CSR disclosure, CEO network development, state-sector relationships, and bank relationship diversification - reduces earnings volatility and expands access to financial resources. For *investors*, social capital represents a valuation-relevant intangible that is not fully captured by conventional financial analysis. Firms with higher FSC exhibit more stable earnings streams, a feature valuable in defensive portfolios. However, the positive effect of social capital on leverage requires investors to distinguish between debt supported by genuine repayment capacity and debt sustained primarily by relational access to credit. For regulators and the banking system, the finding that social capital influences credit allocation raises concerns about concentration risk: when lending decisions are significantly shaped by relational ties, additional supervisory mechanisms are needed to ensure that credit is allocated on the basis of financial fundamentals rather than connections alone.

This study has three main limitations. First, despite the application of Panel DML, the possibility of reverse causality cannot be fully ruled out — firms with better financial outcomes may be better positioned to accumulate social capital over time. Second, CSRD measures CSR disclosure rather than CSR implementation, and proxying political connections through state ownership does not capture the full depth of informal government relationships. Third, restricting the sample to HOSE-listed companies may underestimate the role of social capital among small and medium-sized enterprises, where informal networks tend to be more central to business operations. Future research could address these limitations through social network analysis and stronger instrumental variable designs, and extend the framework to SMEs and other emerging markets with comparable institutional characteristics.

Appendix

Appendix A: CSR Disclosure Scoring Criteria

Table A.1. CSR Disclosure Scoring Criteria

Category	No	Items	References
Environment	1	Materials used by weight or volume	GRI 301-1, Circular No.96
	2	Recycled input materials used	GRI 301-2, Circular No.96
	3	Energy consumption within the organization	GRI 302-1, Circular No.96
	4	Reduction of energy consumption	GRI 302-4, Circular No.96
	5	Water withdrawal	GRI 303-3, Circular No.96
	6	Water discharge	GRI 303-4
	7	Water consumption	GRI 303-5, Circular No.96
	8	Percentage and total amount of water recycled and reused	Appendix IV of Circular No.96
	9	Water and effluents management	GRI 303
	10	Reduction of water consumption	GRI 303

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	11	Direct GHG emissions and energy indirect GHG emissions	GRI 305-1, GRI 305-2; Circular No.96
	12	Reduction of GHG emissions	GRI 305-5, Circular No.96
	13	Management of significant waste-related impacts	GRI 306-2
	14	Waste generated	GRI 306-3
	15	Waste directed to disposal	GRI 306-5
Community	16	Scholarships	GRI 413-1
	17	Charity programs and funds to support the poor are directly organized by the enterprise for the community	
	18	Healthcare activities such as blood donation, organizing medical examination and treatment for local people	
	19	Developing local facilities and infrastructure	
	20	Charitable donations through other organizations	
	21	Job creation and vocational training for local residents	
	22	Community & social responsibility award	
Employment	23	New employee hires and employee turnover	GRI 401-1
	24	Benefits provided to full-time employees that are not provided to temporary or part-time employees	GRI 401-2
	25	Worker participation, consultation, and communication on occupational health and safety	GRI 403-4
	26	Average hours of training per year per employee	GRI 404-1
	27	Programs for upgrading employee skills and transition assistance programs	GRI 404-2
	28	Diversity of governance bodies and employees	GRI 405-1
	29	Significant investment agreements and contracts that include human rights clauses or that underwent human rights screening	GRI 412–3
	30	Average wages of workers	Appendix IV of Circular No.96
	31	Ratio of basic salary and remuneration of women to men	GRI 405-2

Source: GRI (2020) Standards, Circular No. 96/2020/TT-BTC (Ministry of Finance of Vienam)

Appendix B: Automated Text-Processing Pipeline and Inter-Method Reliability

B1. Construction of the CSR Keyword Dictionary

Table B.2: Illustration of the CSR Keyword Dictionary - 31 Criteria (Vietnamese)

No.	Group	Criterion	Selected Keywords	Unit - Score 2
1	Environment	Materials used by weight or volume	Nguyên vật liệu đầu vào; Tổng lượng nguyên vật liệu được sử dụng; Quản lý nguồn nguyên vật liệu; Giá trị nguyên vật liệu sử dụng	*tấn, kg, m³, tỷ VND*
2	Environment	Recycled input materials used	Vật liệu tái chế; Quay vòng; Sửa chữa; Dùng lại; Kinh tế tuần hoàn; Phụ phẩm, phế phẩm; Bao bì thải bỏ; EPR	*tấn, kg, %, m³*
3	Environment	Energy consumption within the organisation	Tiêu thụ năng lượng; Điện; Năng lượng tiêu thụ; Sử dụng năng lượng; Kiểm toán năng lượng; Năng lượng tái tạo; Năng lượng sạch; Nhiên liệu hóa thạch; Nhiệt thải	*kWh, GJ, MWh, triệu kWh*
4	Environment	Initiatives to reduce energy consumption	Tiết kiệm điện; Năng lượng tiết kiệm được; Tiết kiệm năng lượng; Sáng kiến sử dụng năng lượng hiệu quả; Tắt điện; Thu hồi nhiệt thải; Tối ưu hóa thiết kế công trình	*kWh, GJ, %*

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No.	Group	Criterion	Selected Keywords	Unit - Score 2
5	Environment	Water intake	Nguồn nước; Nước mặt; Nước ngầm; Nước mưa; Nguồn cung cấp nước; Cung cấp nước sạch	*m^3, lít, triệu lít*
6	Environment	Water discharge	Nước thải; Hệ thống xử lý nước thải; Tái tạo nguồn nước; Tuần hoàn nước thải	*m^3, lít, triệu lít*
7	Environment	Water consumption	Tiêu thụ nước; Lượng nước sử dụng; Lượng nước sinh hoạt phát sinh trong năm	*m^3, lít, triệu lít*
8	Environment	Water recycled and reused	Tái sử dụng nước; Tỷ lệ nước tái chế; Tổng lượng nước tái chế; Tái sử dụng	*m^3, %*
9	Environment	Management of water-related impacts	Quan trắc môi trường nước; Kiểm tra định kỳ hệ thống nước; Kiểm soát hệ thống xử lý nước thải; Quan trắc	lần/ lượt
10	Environment	Initiatives to reduce water consumption	Tiết kiệm nước; Tái sử dụng nước; Bảo trì đường ống dẫn nước; Tránh rò rỉ, thất thoát nước	*m^3, %*
11	Environment	Greenhouse gas emissions (Scope 1 & 2)	Phát thải khí nhà kính; Kiểm kê phát thải; Phạm vi 1; Phạm vi 2; CO2 tương đương; Tổng phát thải GHG	*tấn CO_2e, tấn CO_2*
12	Environment	Initiatives to reduce greenhouse gas emissions	Giảm thiểu phát thải; Cắt giảm CO2; Gián tiếp giảm phát thải khí nhà kính; Bán Chứng chỉ Năng lượng sạch RECs	*tấn CO_2e, %*
13	Environment	Management of waste-related impacts	Thu gom chất thải; Phân loại rác thải tại nguồn; Hợp đồng xử lý rác thải; Chất thải nhựa; Chất thải rắn	*(qualitative — Score 1 maximum)*
14	Environment	Waste generated	Chất thải rắn; Chất thải lỏng; Chất thải rắn thông thường; Chất thải nguy hại; Chất thải nhựa; Bao bì sản phẩm	*tấn, kg, m^3*
15	Environment	Waste treated	Xử lý chất thải nguy hại; Chất thải rắn được xử lý; Chất thải nhựa; Bao bì sản phẩm	*tấn, kg*
16	Community	Scholarship funds	Học bổng; Khuyến học; Hỗ trợ học sinh nghèo; Học sinh có hoàn cảnh khó khăn; Quỹ bảo trợ học đường; Hỗ trợ phát triển giáo dục	*triệu VND, tỷ VND, suất*
17	Community	Charitable programmes and poverty relief funds (organised by the enterprise)	Tổ chức các chương trình thiện nguyện; Phát cơm tình nguyện; Hộ gia đình khó khăn; Trao tặng quà; Cộng đồng; Khắc phục thảm họa thiên tai; Tạo ra giá trị chia sẻ	*triệu VND, tỷ VND, hộ*
18	Community	Community health activities (blood donation, medical check-ups)	Hiến máu nhân đạo; Khám chữa bệnh; Tài trợ thiết bị y tế; Quỹ vắc xin; Phát thuốc miễn phí; Cung cấp dịch vụ xét nghiệm	*lần/ lượt, người, triệu VND*
19	Community	Development of local infrastructure and facilities	Nhà tình thương; Xây lớp học; Trao tặng nhà đại đoàn kết; Hệ thống nước sinh hoạt; Ủng hộ xây dựng tuyến đường; Hàng cây xanh	*căn, km, triệu VND, tỷ VND*

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No.	Group	Criterion	Selected Keywords	Unit - Score 2
20	Community	Charitable giving through other organisations	Ủng hộ quỹ vì người nghèo; Quyên góp cho đồng bào thiên tai; Thăm viếng nghĩa trang liệt sỹ; Gia đình chính sách	*triệu VND, tỷ VND*
21	Community	Local employment creation and vocational training	Tạo việc làm; Sinh viên thực tập; Phát triển kinh tế địa phương; Đào tạo nghề	*người, suất*
22	Community	Community responsibility awards	Huân chương Lao động; Giải thưởng trách nhiệm với cộng đồng; Khen thưởng	
23	Labour	New employee hires and turnover rate	Số lượng lao động; Tuyển dụng mới; Nghỉ việc; Tổng số nhân sự; Lao động chính thức; Lao động tuyển mới; Thống kê lao động	*người, %*
24	Labour	Benefits provided to full-time employees	Chế độ lương; Chính sách phúc lợi; Bảo hiểm sức khỏe; Khám sức khỏe định kỳ; Nghỉ mát hàng năm; Trợ cấp tăng ca; Bảo hiểm nhân thọ; Nhà ở xã hội	*triệu VND/người, % lương*
25	Labour	Occupational health and safety (union agreements)	An toàn vệ sinh lao động; Huấn luyện an toàn lao động; Quan trắc môi trường lao động; Bảo hộ lao động; PCCC; Khám tầm soát bệnh nghề nghiệp; Mua bảo hiểm tai nạn	*người (tham gia), giờ, số vụ tai nạn, tỷ lệ chấn thương; lần*
26	Labour	Average training hours per year per employee	Số giờ đào tạo trung bình; Tổng số giờ đào tạo; Đào tạo nội bộ; Đào tạo bên ngoài	*giờ/người, giờ*
27	Labour	Employee skills enhancement programmes	Chính sách đào tạo; Đào tạo phát triển nguồn nhân lực; Bồi dưỡng kỹ năng nghiệp vụ; Đào tạo kỹ năng mềm; Đào tạo định hướng và hội nhập	*người (tham gia)*
28	Labour	Diversity at management and employee levels	Cơ cấu lao động; Cơ cấu giới tính theo nhóm tuổi; Cơ cấu lao động theo trình độ; Lãnh đạo nữ; Nữ quản lý cấp trung	*%*
29	Labour	Investment contracts incorporating human rights clauses	Không phân biệt đối xử; Không sử dụng lao động cưỡng bức; Không sử dụng lao động trẻ em; Bình đẳng giới; Đa dạng và bình đẳng; Phòng chống quấy rối tình dục	%, *number of contracts*
30	Labour	Average employee remuneration	Thu nhập bình quân; Mức lương bình quân; Thu nhập người lao động; Chính sách lương, thưởng, trợ cấp	*triệu VND/tháng, triệu VND/năm*
31	Labour	Female-to-male pay ratio	Thù lao của nam, thù lao của nữ; Tỷ lệ lương phân theo giới tính; Thu nhập bình quân tháng theo giới tính	*%*

Source: by authors

Note: The "Selected Keywords" column lists representative keywords; the complete dictionary additionally includes abbreviated forms, sector-specific compound terms, and common variants found in Vietnamese annual reports. The keyword dictionary operates on Vietnamese-language

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source documents. All 31 criteria and their associated keyword sets were developed in Vietnamese to match the reporting language of HOSE-listed companies. English translations of criterion labels are provided for reference; the full Vietnamese keyword dictionary is available from the authors upon request.

B.2. Automated Pipeline Architecture

Table B.3: Automated Content Analysis Pipeline Architecture

Stage	Name	Description
Stage 1	Text extraction & noise removal	Annual reports (PDF) are converted to plain text; headers, footers, page numbers, and formatting artefacts are stripped to isolate substantive content.
Stage 2	Sentence tokenisation & normalisation	The corpus is segmented into individual sentences using Vietnamese-adapted tokenisation rules. Whitespace, diacritics, and abbreviations are normalised for consistent keyword matching.
Stage 3	Keyword-based criterion detection	A criterion-specific keyword dictionary — constructed from GRI Standards and iteratively refined against 1,360 manually coded annual reports (see Section B.0) — is applied sentence-by-sentence across all 31 CSRD indicators.
Stage 4	Sentence-level conflict resolution	Each sentence may be attributed to at most one criterion. Where semantic overlap arises, allocation priority is determined by keyword length, term exclusivity, and evidence scarcity.
Stage 5	Quantitative evidence extraction	Regular expressions detect co-occurrence of CSR keywords and criterion-specific measurement units (e.g., kWh, m^3, %, tons, VND) within the same sentence, enabling automatic assignment of Score 2.
Stage 6	Rule-based scoring with criterion-specific constraints	Definitional constraints are enforced per criterion (e.g., for GRI 302-1, only organization-wide energy figures qualify for Score 2; plant-level data are capped at Score 1; Absolute claims without unit-level data are uniformly capped at Score 1,...)

Source: by authors

B.3. Inter-Method Reliability Assessment

Table B.4: Inter-Method Reliability Test Results by Year

Year	N	ICC	CCC	Pearson r	MAE	Bias
2019	328	0.646	0.646	0.680	0.035	+0.017
2020	336	0.926	0.926	0.929	0.032	+0.007
2021	340	0.886	0.886	0.888	0.034	+0.003
2022	342	0.893	0.893	0.897	0.043	+0.006
Total	1,360	0.842	0.842	0.844	0.036	+0.010

Source: by authors

Note:ICC = Intraclass Correlation Coefficient (two-way mixed, absolute agreement; Koo & Mae, 2016); CCC = Lin's Concordance Correlation Coefficient (Lin, 1989); MAE = Mean Absolute Error expressed as a proportion of the [0,1] index scale; Bias = pipeline score minus manual score (positive value indicates pipeline overestimates).

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Appendix C: CEO Social Capital - Locus Scoring Scheme

Table C.1: CEO Social Capital Scoring Criteria across Ten Dimensions

Dimension	Label	Coding Rule
SC1	Firm tenure	= 1 if the CEO has ≥5 years of experience at the firm and/or has held multiple positions within it; = 0 otherwise.
SC2	Leadership tenure	= 1 if the CEO has held a position of Vice-Director or above for ≥5 years; = 0 otherwise.
SC3	Financial capital	= 1 if the CEO has previously held a position at a financial institution (e.g., a commercial bank or investment firm); = 0 otherwise.
SC4	Managerial capital	= 1 if the CEO holds an MBA degree or an undergraduate degree in Business Administration; = 0 otherwise.
SC5	Business capital	= 1 if the CEO has served as Vice-Director or above, or as a board member, at another firm; = 0 otherwise.
SC6	International capital	= 1 if the CEO has lived, worked, or studied abroad; = 0 otherwise.
SC7	Academic network	= 1 if the CEO has worked at a university or research institute; = 0 otherwise.
SC8	Industry network	= 1 if the CEO has held a position in an industry association or chamber of commerce; = 0 otherwise.
SC9	Legal capital	= 1 if the CEO has professional experience in law or compliance; = 0 otherwise.
SC10	Political network	= 1 if the CEO has held a government position (central, provincial, or district level) or has served as a director at a state-owned enterprise; = 0 otherwise.

Sources: Biographical information was hand-collected from annual reports, company websites, and the FiinPro database.

Note: For each CEO-year observation, each dimension d_k is coded 1 if the criterion is satisfied and 0 otherwise. The raw score is transformed as $CEO\_SC = \ln(1 + \Sigma\, d_k)$ to reduce the influence of extreme values.

Appendix D: Summary of variables in the model

Table D.1: Summary of Variable Definitions

Variable	Symbol	Measurement
Dependent Variables - Corporate Risk-Taking (CRT)		
Earnings volatility	CRT1_SD.ROA	Standard deviation of industry- and year-adjusted ROA over a 5-year rolling window
Stock return volatility	CRT2_SD.RET	Standard deviation of daily equity returns within each fiscal year
Investment intensity	CRT3_CAPEX	Capital expenditures / average total assets
Cash holdings	CRT4_CASH	Cash and cash equivalents / average total assets
Financial leverage	CRT5_LEVERAGE	Financial debt (long-term + short-term) / (Financial debt + Equity)
Main Independent Variables - Firm Social Capital (FSC)		
CSR disclosure	SC1_CSRD	Automated content analysis pipeline scoring 31 GRI-aligned criteria on a 0–2 ordinal scale; CSRD = raw score / 62, then standardized
CEO social capital	SC2_CEO	ln(1 + sum of scores across 10 biographical dimensions), then standardized

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Political connections	SC3_POLCON	Proportion of equity held by state entities or state-controlled organizations, then standardized
Bank connectivity	SC4_BANKCON	Standardized composite of (i) bank debt-to-assets ratio and (ii) number of banking relationships
Composite FSC	FSC_EW	Equal-weighted average of standardized SC1, SC2, SC3, SC4
Control Variables		
CEO ownership	CEO.OWN	Proportion of shares held by the CEO
Board independence	B.INDEP	Number of independent directors / total board size
Board size	B.SIZE	Natural logarithm of total number of board members
Firm growth	F.GROW	Annual revenue growth rate
Firm size	F.SIZE	Natural logarithm of total assets
Firm age	F.AGE	Natural logarithm of years since incorporation
Industry competition	COMPETE	(1 − HHI), where HHI = sum of squared market shares of all listed firms in the same industry

Note: All continuous variables are winsorized at the 1st and 99th percentiles by year prior to estimation. SC1–SC4 are standardized (z-scored) annually before constructing the composite FSC index. HHI = Herfindahl–Hirschman Index.

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