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ORIGINAL CONTRIBUTION

Human Capital Deficiencies, Operational Risk Disclosure Intensity, and Financial Performance: Evidence from Banks and Insurance Companies across Six Economies

Hamed Abdallah Hamed Mosa[1]*, Dalal Alsahliy[2]

[1, 2]Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia

Abstract— Operational controls fail to function independently. Within banks and insurance businesses, their efficacy is heavily reliant on the personnel in charge of executing them, challenging existing practices, and responding effectively when issues arise. This study looks into the relationship between worker vulnerabilities and financial performance, whether these vulnerabilities are reflected in the extent of operational risk disclosure, and how High-Performance Work Systems (HPWS) affect this relationship. From 2020 to 2025, the study used a balanced panel of 36 publicly traded banks and insurance companies from six economies, resulting in 216 firm-year observations. HCD and HPWS are quantified using multidimensional formative indicators, which are weighted using principal component analysis. ORDI assesses the proportion of relevant operational risk topics reported by each firm. The empirical analysis incorporates both firm and year fixed effects, and statistical inference is based on CR2 standard errors clustered at the institution level. HCD is negatively related to return on assets (beta = -0.561, CR2 SE = 0.058, $p < 0.001$) and positively related to ORDI (beta = 0.640, SE = 0.047, $p < 0.001$). After including both factors into the performance model, ORDI still shows a significant negative correlation with performance ($\beta = -0.428$, SE = 0.068, $p < 0.001$). The calculated coefficient for HCD similarly decreases to -0.287 (SE = 0.052, $p < 0.001$). In addition, the interaction between HCD and HPWS is negative and statistically significant ($\beta = -0.157$, SE = 0.073, $p = 0.031$). HCD's conditional effect drops from 0.797 when HPWS is low to 0.483 when HPWS is high. These results show connections rather than causal effects. Because ORDI measures reporting breadth rather than proven loss severity, a high score could imply operational strain, increased transparency, or both. Ultimately, the data establish a relationship between workforce capabilities, risk reporting, and profitability, implying that better established HPWS policies may mitigate the disclosure reaction associated with HCD.

Index Terms— Human capital deficiencies, Operational risk disclosure, Banking sectors, Insurance underwriters, Strategic human resource management, Financial performance, Organizational resilience

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Introduction

A control framework can appear strong in a policy manual yet fail during everyday implementation. In banks and insurance companies, such failures often arise from routine operational pressures rather than a single major error. A vacancy may remain unfilled, an experienced employee may leave, a new system may be introduced before the team is prepared, or a cyber incident may expose gaps in knowledge as technology advances. Although each issue may seem manageable individually, their combined effect can weaken oversight and disrupt accuracy-dependent routines. Operational resilience therefore depends not only on the formal control framework but also on the workforce responsible for implementing and maintaining it.

*Corresponding Author: hala10hamed@gmail.com

Most strategic human resource management research emphasizes the value of knowledgeable personnel, cumulative expertise, and consistent work habits. This study investigates the inverse: what happens when the workforce continuously lacks the skills required in regulated financial professions. High turnover can degrade institutional memory, while insufficient development programs can leave personnel behind on regulatory changes, and deficiencies in compliance or digital skills can disrupt systems with little room for error. We use the term Human Capital Deficiencies (HCD) to describe this group of weaknesses. At the organizational level, HCD represents a risk profile rather than simply a low score on an otherwise positive human capital scale.

Examining this risk profile creates a practical measurement challenge. Comparable public data on operational losses are limited, as detailed information is generally held by institutions, supervisors, or commercial providers. Although annual and sustainability reports are publicly available, they contain diverse types of information. A report may describe an incident, explain an effective control, identify oversight responsibilities, or discuss preparations for future disruptions. Thus, broad disclosure may reflect operational pressure, careful reporting, or both. In this study, Operational Risk Disclosure Intensity (ORDI) measures only the number of relevant topics addressed by a firm and does not represent realized operational loss.

The analysis answers three linked questions. First, how does financial performance alter as HCD differs inside a company? Second, do companies with greater HCD report on a broader spectrum of operational risk issues, and does this trend statistically explain the HCD-performance relationship? Third, is the link between HCD and disclosure weaker among organizations that report more advanced High-Performance Work Systems (HPWS)? Between 2020 and 2025, the panel will include 36 publicly traded financial organizations from six different economies. Because the study is conducted in an observational environment, the results are presented as conditional relationships rather than causal effects. They should not be regarded as proof of causality.

Theoretical Foundations and Research Background

Human Capital Theory and the Resource-Based View

According to Human Capital Theory, investing in education, experience, and job-specific training can help increase productive capacity (G. S. Becker, 1964). However, the opposite can also happen: when experienced personnel depart, some expertise established around a company's specialized processes and routines may with them. Skills can quickly become obsolete as technology and legislation evolve, and multiple minor gaps may emerge faster than management can rectify them. Crook et al. (2011) synthesize evidence linking higher levels of human capital to improved organizational performance. However, the definition of human capital varies according to the level at which it is analyzed (Zhang et al., 2023). This study focuses on the organizational level. HCD refers to observable flaws in the workforce that may make everyday activities more vulnerable to errors and disruption.

The Resource-Based View (RBV) enhances this argument by moving the emphasis from just having resources to how well they are used. A valuable resource provides little benefit if a company cannot effectively keep, coordinate, or deploy it (Ali & Agushi, 2024; Barney, 1991). Recent RBV research emphasizes managerial actions that link resources to organizational outcomes (D'Oria et al., 2021; Gerhart & Feng, 2021; Muavua et al., 2021). In this light, repeated turnover can jeopardize the preservation of firm-specific expertise. Weak training may cause delays in adapting to new standards, whereas a lack of digital skills might make technology-dependent procedures more vulnerable. Even if an organization's practical capacity to carry out the activity falls, its formal structure and policies may continue to appear adequately resourced. This reasoning leads to Hypothesis 1:

H1: Higher Human Capital Deficiencies are linked to poorer institutional financial performance.

Operational risk reporting and high-performance work systems

If HCD influences how work is carried out, some of its effects may also appear in operational risk reporting. Inadequate preparation can increase the likelihood of processing errors, while employment-related compliance failures may require formal disclosure. Similarly, limited digital expertise can make cybersecurity and business continuity planning more challenging (Kunz & Heitz, 2021; Oelrich & Slapničar, 2026). Greater HCD may be connected with reporting on a broader range of operational risk themes. However, this isn't the only potential interpretation. Firms with better monitoring systems and a more transparent reporting culture may detect and disclose flaws that other companies do not (Abdulla & Elshandidy, 2023; Ahmed et al., 2020). Thus, ORDI should be understood as a measure of reporting breadth rather than loss severity.

H2: Higher Human Capital Deficiencies are associated with increased Operational Risk Disclosure Intensity.

The financial implications of operational failures are equally significant. Remediation can consume significant resources, regulatory sanctions can result in direct financial consequences, service disruptions can result in lost income, and reputational harm can last beyond the initial event (Berger et al., 2022). When ORDI shows serious control deficiencies inside the organization, increased disclosure of operational risks may result in reduced profitability. However, disclosure may rise for a more positive reason: better-governed institutions may have more robust and capable reporting systems (Basto & Marques, 2024). Rather of presuming a negative link based on how ORDI is designed, we assess whether the data supports the expected negative association.

H3: Higher operational risk disclosure intensity correlates with poorer institutional financial performance.

Taken together, the previous reasons offer a sequence that may be tested with data. Higher HCD may be connected with more comprehensive operational risk disclosure, whereas ORDI may be related to financial performance. Estimating these two routes allows us to divide the total HCD-performance association into direct and indirect statistical components. This decomposition merely reveals observable connections; it does not show that disclosure directly translates workforce shortfalls into financial results.

H4: Low Operational Risk Disclosure Intensity is connected with lower financial performance due to human capital deficiencies.

HPWS reveals that the link between HCD and ORDI may differ by firm. Training, career development, appraisal, and employee participation are more likely to work well together as part of an integrated system than as individual HR initiatives (Jiang et al., 2012; Kellner et al., 2023). In financial institutions, such a framework can clarify roles, preserve essential expertise, and assist companies in learning from operational mistakes before they occur again. A firm with such routines may detect and address a workforce problem earlier, before the problem is reflected across a wider range of risk disclosures. On that basis, we expect stronger reported HPWS to reduce, rather than remove, the positive association between HCD and ORDI (Zhou et al., 2023).

H5: High-Performance Work Systems weaken the positive association between Human Capital Deficiencies and Operational Risk Disclosure Intensity.

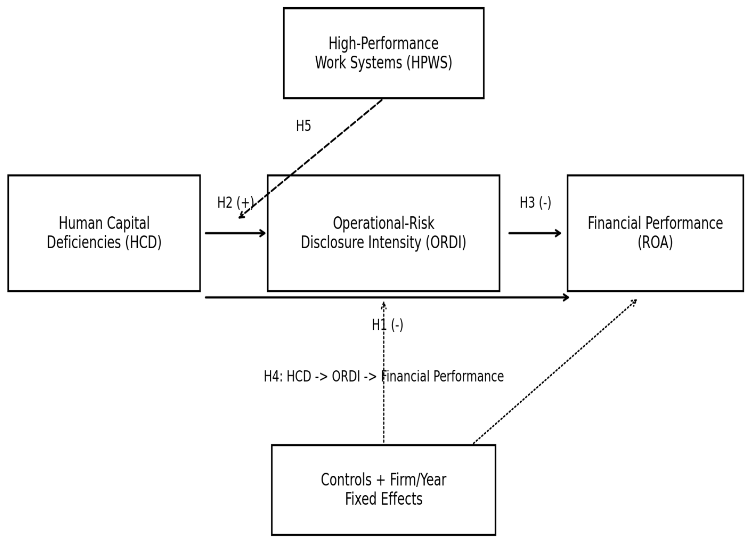

Fig. 1 *Conceptual model and hypothesized relationships*

Note. H1-H3 are direct relationships. H4 is the indirect association calculated along the HCD to ORDI to financial-performance path. The dashed line marks the proposed moderating role of HPWS in the HCD-ORDI relationship (H5); dotted lines denote the controls and fixed effects included in the models.

Methodology

Research design

The dataset follows the same institutions over six years, so the natural unit of analysis is the firm-year. We use a balanced panel and estimate relationships from changes that occur within a firm over time. Firm fixed effects remove stable institutional characteristics from those comparisons, while year fixed effects absorb events shared by the sample in a given year. The design contains no instrument, natural experiment, or comparable source of exogenous variation. Its goal is to analyze conditional correlations while accounting for relevant controls, rather than to make causal claims.

Four equations are utilized to investigate various aspects of the research argument. The first model predicts the association between HCD and financial performance. The second employs ORDI as the outcome variable and investigates its relationship with HCD. The third incorporates both HCD and ORDI into the performance equation, allowing the proposed indirect pattern to be decomposed. The final equation includes ORDI, HPWS, and the HCD × HPWS interaction term. The same firm-level and macroeconomic controls are used across all specifications. Figure 1 shows how the model specifications connect to the study’s hypotheses.

Sample selection and data sources

The analytical sample includes 36 publicly traded financial organizations from Saudi Arabia, the UAE, Qatar, Malaysia, the UK, and Canada. For each economy, we chose three commercial banks and three insurance businesses, yielding an evenly distributed sample of 18 banks and 18 insurers. We intentionally refer to the setting as six economies because the comparison spans multiple institutional frameworks, but the firms chosen are not intended to represent the entire financial sector. Observations run from 2020 through 2025, producing 216 firm-years. This period was particularly challenging. Financial institutions moved from pandemic-related disruption toward restructuring, rapid digital adoption, and increased regulatory attention to operational resilience. These conditions make workforce capability and operational risk especially relevant. At the same time, they may influence the estimates, meaning that the findings should be interpreted within the context of this turbulent six-year period.

The same selection criteria were applied across all countries and years. An institution was included in the sample only if it was publicly listed, published audited financial statements, provided sufficient workforce information to construct the HCD and HPWS measures, and disclosed operational risk information in enough detail to calculate ORDI. All four parameters had to be met consistently throughout a six-year period. If a firm failed to meet any of the conditions in a given year, it was removed from the sample rather than preserved for the years when the required data were available.

This rule increases data continuity while also influencing the sample composition. Large listed firms that publish accessible English-language reports, or reports that can be coded on a comparable basis, are more likely to meet the requirements. Consistent disclosure gives us a firmer basis for following change over time and across the six economies. At the same time, it limits how far the findings can be extended beyond this comparatively transparent group of institutions.

Table I
Distribution of the study sample

Country	Market Type	Banks	Insurance Companies	Total
Saudi Arabia	Emerging	3	3	6
United Arab Emirates	Emerging	3	3	6
Qatar	Emerging	3	3	6
Malaysia	Emerging	3	3	6
United Kingdom	Developed	3	3	6
Canada	Developed	3	3	6
Total	-	18	18	36

Note: The panel contains 36 listed institutions observed in each year from 2020 to 2025: 18 banks and 18 insurance companies.

Saudi Arabia, the United Arab Emirates, Qatar, and Malaysia are labeled emerging economies, while the United Kingdom and Canada are labeled developed economies. The labels are descriptive and do not imply that the sampled firms represent either group.

Sample adequacy, statistical power, and generalizability

The 216 firm-year observations should not be mistaken for 216 independent units. Statistical inference rests on 36 institutional clusters. That is a modest base for models that include an interaction, an indirect-path calculation, five controls, and firms operating under different regulatory regimes. The design is better suited to identifying moderate and recurring patterns within the sample than to detecting small effects or distinguishing finely between country- and sector-level variations.

The cross-sectional constraint is partially due to the measurement technique. HCD, HPWS, and ORDI required examining and classifying corporate reports for each firm over six years. Although this manual approach gathers information not found in standard databases, it restricts the number of institutions that may be continuously followed. Using a balanced panel helps to maintain a consistent sample composition over time and allows for clearer within-firm comparisons. However, it does not improve the number of independent clusters and cannot compensate for the loss of precision caused by the small sample size of 36 firms.

Fixed effects address some of this problem, but not all of it. However, they do not account for regulatory changes or economic disruptions that affect a certain country in a given year. With only six institutions per economy, a fully saturated set of country-by-year or sector-by-country terms would throw more strain on the data than the sample can dependably support. As a result, the pooled coefficients provide information on the selected institutions rather than generic population factors for banks and insurers.

Table II
Sampled financial institutions

Country	Commercial Banks	Insurance Companies	Total
Saudi Arabia	Al Rajhi Bank; Saudi National Bank; Riyad Bank	Tawuniya; Bupa Arabia; Al Rajhi Takaful	6
United Arab Emirates	First Abu Dhabi Bank; Emirates NBD; Abu Dhabi Commercial Bank	Orient Insurance; Sukoon Insurance (formerly Oman Insurance); Abu Dhabi National Insurance Company	6
Qatar	Qatar National Bank; Commercial Bank of Qatar; Doha Bank	Qatar Insurance Company; Doha Insurance Group; Qatar Islamic Insurance Company	6
Malaysia	Maybank; CIMB Group; Public Bank	Allianz Malaysia; Syarikat Takaful Malaysia; Etiqa General Takaful	6
United Kingdom	HSBC Holdings; Barclays; Lloyds Banking Group	Aviva; Prudential; Legal & General	6
Canada	Royal Bank of Canada; Toronto-Dominion Bank; Bank of Nova Scotia	Manulife Financial; Sun Life Financial; Intact Financial	6
Total	18 Banks	18 Insurance Companies	36

Note: Only firms who regularly met all four criteria over the course of the year were considered. Equal numbers of banks and insurers give descriptive balance across the six economies, but this does not mean that each firm represents an equal percentage of its home market.

Table III
Data sources and variable construction

Data Category	Variables	Primary Data Source	Purpose
Financial data	ROA, ROE, Tobin's Q, SIZE, LEV, CAR	Bloomberg, Refinitiv Eikon, Annual Reports	Measurement of financial performance and firm-specific controls
Human capital disclosures	Human Capital Deficiencies (HCD); High-Performance Work Systems (HPWS)	Annual Reports, ESG Reports, Sustainability Reports, Corporate Governance Reports	Construction of formative HCD and HPWS indices using structured content analysis and PCA weighting
Operational risk disclosures	Operational Risk Disclosure Intensity (ORDI)	Annual Reports, Risk Management Reports, Operational Risk Disclosures	Construction of a binary-item disclosure-intensity ratio
Macroeconomic indicators	GDP Growth (GDP); Inflation (INF)	World Bank - World Development Indicators (WDI); International Monetary Fund - World Economic Outlook (WEO)	Country-level macroeconomic controls

Note: Financial data were gathered from Bloomberg, Refinitiv Eikon, and audited annual reports.

Annual, ESG, sustainability, and governance reports were used to collect workforce information, whereas ORDI was coded using annual reports, risk-management reports, governance disclosures, and operational risk disclosures. GDP growth and inflation data were sourced from the World Bank's World Development Indicators and the International Monetary Fund's World Economic Outlook. When papers contained overlapping information, the audited annual report or the report explicitly related to the relevant fiscal year received priority. Each item was coded using its operational definition rather than keyword matching, with the same source hierarchy and fiscal-year rule applied consistently across all firms.

Sample construction

Six institutions were eliminated because their annual reports were incomplete. Another five lacked sufficient workforce disclosures to build the composite indexes, and three did not offer enough information to reliably calculate ORDI. Two more institutions were rejected due to inadequacies in the necessary financial data. Following these exclusions, only 36 institutions remained in the final sample.

Table IV
Sample construction

Stage	Sample Selection Criterion	Institutions Remaining
Initial sample	Publicly listed banks and insurance companies identified across the six selected countries	52
Excluded	Institutions with incomplete annual reports	46
Excluded	Institutions with insufficient workforce-related (HR, ESG, or sustainability) disclosures	41
Excluded	Institutions with incomplete operational risk disclosures	38
Excluded	Institutions with incomplete financial information	36
Final sample	Balanced panel (2020-2025)	36
Firm-Year Observations	36 x 6 years	216

Note: The counts are totaled across all screening steps. The final 36 institutions offer six year observations apiece, for a total of 216 firm-year observations.

Each of the institutions included in the sample provides six annual observations. Missing values were not estimated or interpolated, and incomplete series were not preserved for years where data was available. Any gaps in the sequence resulted in the firm's disqualification. This method provides a strictly balanced panel and assures that year-over-year comparisons are based on the same institutional set. Table IV depicts the total screening phases.

Variable definitions and measurement logic

The four focus variables have varied empirical roles. HCD is the primary explanatory variable, ORDI represents an intermediate reporting outcome, financial performance is the ultimate outcome, and HPWS is the proposed moderator. HCD and HPWS are classified as formative composites since their constituents determine each construct rather than being interchangeable indicators of a single underlying characteristic. ORDI takes a different measurement approach, as it is a bounded ratio based on expressly stated items.

Regression models also account for company size, leverage, capital adequacy, GDP growth, and inflation. These variables provide for a variety of possible institutional and macroeconomic influences, while no set of controls may entirely cover all potential omitted aspects. Table 5 highlights the function, operational definition, and measurement of each variable.

Table V
Variable definitions and measurement

Variable	Role	Operational Definition	Measurement
Human Capital Deficiencies (HCD)	Independent variable	Formative profile of workforce-related organizational deficiencies	PCA-weighted index of workforce instability, training and development gaps, workforce-related compliance failures, and digital-capability gaps
Operational Risk Disclosure Intensity (ORDI)	Intermediate reporting variable	Breadth of publicly disclosed operational risk topics; not realized loss severity	Ratio of explicitly disclosed applicable items to total applicable items (0-1)
Financial Performance (FP)	Dependent variable	Organizational financial performance	Return on Assets (ROA), Return on Equity (ROE), and Tobin's Q
High-Performance Work Systems (HPWS)	Moderating variable	Formative bundle of reported strategic HR practices	PCA-weighted index of training, employee development, appraisal, involvement, and HR-disclosure quality
Firm Size (SIZE)	Control variable	Organizational size	Natural logarithm of total assets
Leverage (LEV)	Control variable	Financial leverage	Total liabilities divided by total assets
Capital Adequacy Ratio (CAR)	Control variable	Regulatory capital strength	Regulatory capital divided by risk-weighted assets
GDP Growth (GDP)	Control variable	National economic growth	Annual % growth in gross domestic product
Inflation (INF)	Control variable	Macroeconomic inflation	Annual consumer price inflation rate

Note. Prior to applying the PCA weights, the HCD and HPWS indicators were standardized.

The ORDI shows the proportion of operational risk issues that are explicitly stated. ROA is the primary financial performance metric, with ROE and Tobin's Q serving as robustness indicators. The analysis clearly distinguishes between formative composites, the disclosure ratio, and the reflective latent construct.

Measurement of key constructs

Human capital deficiencies

HCD identifies four types of workforce vulnerability: personnel insecurity, insufficient training and development, employment-related compliance problems, and poor digital capabilities. The index is formative because each component reflects a different type of weakness, and deleting any one of them would narrow the scope of the construct. As a result, the components are not predicted to substantially correlate and are not considered indicators of a single underlying disease (Boon et al., 2019; Zhang et al., 2023).

The four indicators were coded from publicly available firm data, with the direction aligned so that larger numbers constantly indicated bigger deficit. The raw variables were then converted into z-scores to increase comparability between enterprises and countries with varying reporting scales. Weights were derived from the shared variation using PCA, with all four dimensions retained. In this work, PCA is used as a transparent weighting and data reduction strategy rather than as evidence of a one-factor structure. Higher HCD scores correspond to a less attractive worker profile.

Table VI
Construction of the human capital deficiencies index

Dimension	Operational Indicator	Primary Data Source	Expected Direction
Workforce instability	Voluntary employee turnover rate	Annual reports	+
Training and development deficiency	Inverse of annual training intensity	ESG and sustainability reports	+
Workforce-related compliance failures	HR-related compliance breaches and disciplinary incidents	Corporate governance reports	+
Digital capability deficiency	Content-analysis score reflecting workforce digital capability gaps	Sustainability reports and annual reports	+

Note. Prior to standardization, all indicators were coded in the same way, with higher numbers representing more deficit. Thus, training intensity was entered in inverted form.

Table VII
Measurement model results

Indicator / Diagnostic	Operational Definition / Criterion	Value
Panel A	Principal-component loadings	-
WI	Workforce instability	0.781
TDD	Training and development deficiency	0.744
WCF	Workforce-related compliance failures	0.817
DCD	Digital capability deficiency	0.768
Panel B	PCA diagnostics	
Kaiser-Meyer-Olkin (KMO)	Recommended threshold > 0.70	0.781
Bartlett's Test of Sphericity	Significant	$p < 0.001$
First Principal Component Eigenvalue	Recommended threshold > 1.00	2.34
Variance Explained (%)	Recommended threshold > 50%	58.5

Note. The first component explains 58.5% of the variance, with a KMO value of 0.781 and a significant Bartlett's test. These findings support the use of PCA for data weighting and reduction, but they do not establish reflective concept or content validity on their own.

High-performance work systems

The HPWS index measures five practices stated by each firm: training intensity, employee development, formal appraisal, employee involvement, and HR disclosure quality. Although these practices may complement one another, each is a different component of the HR package. After coding, the measures were normalized and merged with PCA-derived weights. The resulting formative index measures the level of reported strategic HR practices, with higher values suggesting a more comprehensive HPWS (B. Becker, 1998; Jiang et al., 2012; Kellner et al., 2023).

Table VIII
Construction of the high-performance work systems index

Dimension	Operational Indicator	Primary Data Source	Expected Direction
Training Intensity	Annual training hours or training expenditure per employee	ESG and sustainability reports	+
Employee Development	Career development, leadership development, and succession planning programs	Annual and sustainability reports	+
Performance Appraisal	Formal performance evaluation systems linked to employee development and rewards	Corporate governance reports	+
Employee Involvement	Employee participation, empowerment, and engagement practices	ESG, sustainability, and HR disclosures	+
HR Disclosure Quality	Composite HR disclosure index covering workforce development, diversity, wellbeing, and talent management	Annual and sustainability reports	+

Note. HPWS reflects the set of practices described in company disclosures. However, it should not be construed as direct evidence of employees' actual experiences or the effectiveness with which each technique is applied in the workplace.

Table IX
Principal-Component Loadings and diagnostics for the HPWS index

Indicator / Diagnostic	Operational Definition / Criterion	Value
Panel A	Principal-component loadings	-
TRAIN	Training intensity	0.812
DEV	Employee development	0.845
PA	Performance appraisal	0.791
EI	Employee involvement	0.827
HRDQ	HR disclosure quality	0.774
Panel B	PCA diagnostics	
Kaiser-Meyer-Olkin (KMO)	Recommended threshold > 0.70	0.826
Bartlett's Test of Sphericity	Significant	$p < 0.001$
First Principal Component Eigenvalue	Recommended threshold > 1.00	2.97
Variance Explained (%)	Recommended threshold > 50%	59.4

Note. These findings support the use of PCA for weighting and data reduction, rather than as proof of a reflective measurement model.

Because training improves HPWS but has the opposite effect on HCD, some of the apparent difference between the two indices may be mechanical. This overlap is consequently taken into account when interpreting the moderation finding. Once the coded data is available, a leave-one-component-out analysis would be useful as an additional robustness check.

Operational risk disclosure intensity

ORDI is made up of 12 items coded from annual reports, risk management documents, governance declarations, and ESG or sustainability reports. These topics address operational risk governance, internal controls, compliance, reported loss incidents, fraud or misbehavior, technological risks, and business continuity. For each firm-year observation, an applicable topic is assigned a value of 1 if it is expressly stated, and 0 otherwise. The resulting ratio thus captures a single but useful aspect of reporting: the proportion of relevant operational risk subjects revealed by the firm. However, it does not distinguish between positive representations of controls and negative occurrences, nor does it capture the severity of actual operational losses.

$ORDI_{it} = (\sum_j \text{Disclosure Item}_{jit}) / (\text{Total Applicable Disclosure Items}_{it})$

A higher ORDI value simply means that a larger proportion of relevant operational risk topics were disclosed. The ratio itself does not explain why a company disclosed more information. Increased reporting may represent higher operational concerns, improvements in disclosure and governance standards, or both at the same time. As a result, a high ORDI score does not necessarily indicate increased operational losses.

Table X
Construction of the operational risk disclosure intensity index

Dimension	Operational Risk Disclosure Item	Coding
Risk Governance	Description of the operational risk governance framework	0 / 1
	Description of board oversight of operational risk	0 / 1
Internal Controls	Description of internal-control systems	0 / 1
	Description of internal-audit arrangements	0 / 1
Compliance Risk	Description of the compliance-risk framework	0 / 1
	Regulatory breach disclosures	0 / 1
Operational Loss Events	Operational loss event disclosures	0 / 1
	Fraud and misconduct incidents	0 / 1
Technology Risk	Description of cybersecurity risks and controls	0 / 1
	Information technology failures and disruptions	0 / 1
Business Continuity	Description of business-continuity management	0 / 1
	Description of crisis-management and recovery procedures	0 / 1

Note. The numerator shows the amount of applicable items coded as 1, while the denominator shows the total number of things applicable to each firm-year.

The item list and coding standards were used consistently throughout the investigation. Nonetheless, variances in regulatory requirements, terminology, report structure, and national reporting procedures may prevent exact comparison between enterprises and countries.

Financial performance and control variables

Return on Assets (ROA) is the primary financial performance metric since it ties profitability to the asset base and is applicable to both banks and insurance companies Alternative performance measures used in the robustness analysis include Return on Equity (ROE) and Tobin's Q. SIZE is determined as the natural logarithm of total assets, LEV as total liabilities divided by total assets, and CAR as regulatory capital divided by risk-weighted assets. Annual GDP growth and consumer price inflation are provided to reflect national economic circumstances. The regression findings are presented as standardized coefficients, allowing the main connections to be compared on a consistent scale.

3.5.5 Content-analysis procedure

The coding process was carried out in accordance with a codebook created prior to the examination of the reports. The codebook specified each HCD, HPWS, and ORDI item, including its intended meaning, coding direction, preferred data source, and scoring method. All observations were made at the firm year level. To determine coding consistency, the lead researcher independently recoded a random 20% of the reports after a two-week period. The agreement exceeded 92%, with a mean Cohen's kappa of 0.89. Because both coding rounds were completed by the same researcher, the statistics reflect intra-coder consistency rather than agreement among independent coders (Landis & Koch, 1977). The definitions were used similarly across the six economies, although disparities in national reporting processes could not be totally avoided.

Panel diagnostics and small-cluster inference

The Breusch-Pagan Lagrange Multiplier test implies that panel estimation is superior than pooled OLS, although the Hausman test prefers fixed effects over random effects. The Wooldridge test reveals no evidence of first-order serial correlations. In contrast, the Modified Wald test detects groupwise heteroskedasticity, whilst the Pesaran CD test does not detect substantial cross-sectional dependence.

As a result, the primary analyzes use CR2 standard errors clustered at the company level, with a small-sample adjustment for the restricted number of clusters. As an extra sensitivity check, wild-cluster bootstrap results are presented. These methods give a more reliable treatment of sampling uncertainty around calculated coefficients. However, they are unable to address reverse causality or unobserved time-varying confounding variables.

Table XI
Panel-data diagnostic tests

Diagnostic Test	Test Statistic	*p*-value	Interpretation
Breusch-Pagan Lagrange Multiplier (LM) Test	412.67	< 0.001	Panel-data estimation preferred over pooled OLS
Hausman Specification Test	18.42	0.010	Fixed-effects estimator preferred
Wooldridge Test for First-Order Autocorrelation	2.13	0.146	No evidence of serial correlation
Modified Wald Test for Groupwise Heteroskedasticity	296.84	< 0.001	Heteroskedasticity detected
Pesaran Cross-sectional Dependence (CD) Test	1.12	0.263	No evidence of cross-sectional dependence

Note. The diagnostic tests guide estimator selection, but they do not eliminate endogeneity concerns.

Firm effects account for features that are stable across each institution, whereas year effects account for shocks that occur throughout the sample. Time-varying omitted factors, reverse causality, and country-specific year shocks may still influence the estimates.

Econometric models

We estimate the following four fixed-effects equations:

Model 1: $FP_{it} = \beta_0 + \beta_1 HCD_{it} + \beta_2 Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it}$

Model 2: $ORDI_{it} = \beta_0 + \beta_1 HCD_{it} + \beta_2 Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it}$

Model 3: $FP_{it} = \beta_0 + \beta_1 HCD_{it} + \beta_2 ORDI_{it} + \beta_3 Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it}$

Model 4: $ORDI_{it} = \beta_0 + \beta_1 HCD_{it} + \beta_2 HPWS_{it} + \beta_3 (HCD_{it} \times HPWS_{it}) + \beta_4 Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it}$

FP denotes financial performance. HCD, ORDI, and HPWS are defined above, and Controls includes SIZE, LEV, CAR, GDP, and INF. Firm and year fixed effects are represented by μ_i and λ_t; ε_{it} is the idiosyncratic error. HCD and HPWS are mean-centered before the interaction is formed.

Analytical approach and interpretive scope

All four specifications contain firm and year fixed effects. For the focal predictors, we report standardized coefficients, firm-clustered CR2 standard errors, t statistics, exact p-values, and 95% confidence intervals. The moderation analysis uses the HCD x HPWS coefficient and evaluates the conditional HCD slope when HPWS is one standard deviation below its mean, at the mean, and one standard deviation above it. The difference between the low and high slopes is a linear transformation of the interaction term and is tested with its CR2 standard error and confidence interval.

At mean HPWS, the indirect association is calculated as the product of the HCD-ORDI and ORDI-ROA coefficients. The available CR2 output does not provide a separately resampled confidence interval for this product. We therefore use it only as an algebraic decomposition and do not present it as a formal causal-mediation test. Joint Wald tests add a conservative check of whether the components of each formative block contribute collectively to the relevant equation.

The fixed effects address cross-country heterogeneity only in part. Firm effects absorb persistent features of the institution, its country, and its sector; year effects capture events common to all six economies. A policy change or macro-financial shock confined to one country and one year remains outside that protection. Nor does the design contain an instrument, natural experiment, or defensible temporal sequence that would establish direction. The estimates are accordingly interpreted as conditional associations throughout.

Data Analysis

Descriptive statistics

Table XII
Descriptive statistics

Variable	Observations	Mean	SD	Minimum	Maximum
HCD	216	0.000	1.000	-2.341	2.587
ORDI	216	0.618	0.147	0.250	0.917
ROA	216	0.021	0.018	-0.041	0.083
ROE	216	0.114	0.087	-0.182	0.347
Tobin's Q	216	1.287	0.432	0.641	3.214
HPWS	216	0.000	1.000	-2.118	2.746
SIZE	216	16.842	1.734	13.287	20.614
LEV	216	0.781	0.103	0.421	0.941
CAR	216	17.462	4.183	10.200	31.700
GDP	216	3.274	2.418	-5.700	8.900
INF	216	3.618	2.167	0.100	11.400

Note: HCD and HPWS are standardized with a zero mean and one standard deviation.

The ORDI has a mean of 0.618 (SD = 0.147), indicating that the typical firm-year reports about 62% of the relevant operational risk issues. The average values of ROA, ROE, and Tobin's Q are 0.021, 0.114, and 1.287, respectively.

The observed ranges have enough variety to show significant disparities within the panel. ORDI ranges from 0.250 to 0.917, and ROA goes from -0.041 to 0.083. As a result, the sample contains both loss-making and very profitable firm years, as well as significant heterogeneity in the degree to which firms report operational risk information.

Correlations and multicollinearity

Table XIII
Correlation matrix and variance inflation factors

Variable	HCD	ORDI	ROA	HPWS	SIZE	LEV	CAR	GDP	VIF
HCD	1.000								2.18
ORDI	0.521***	1.000							2.41
ROA	-0.438***	-0.397***	1.000						-
HPWS	-0.472***	-0.284***	0.416***	1.000					2.06
SIZE	0.118	0.147*	0.226**	0.183**	1.000				1.74
LEV	0.209**	0.174*	-0.318***	-0.146*	0.267***	1.000			1.88
CAR	-0.241***	-0.193**	0.362***	0.228**	0.154*	-0.421***	1.000		2.03
GDP	-0.124	-0.088	0.207**	0.163*	0.091	-0.051	0.142*	1.000	1.32
INF	0.097	0.116	-0.181**	-0.093	-0.064	0.132*	-0.148*	-0.372***	1.49

Note. HCD has a positive correlation with ORDI (r = 0.521) and a negative correlation with ROA (r = -0.438) before controlling for fixed effects and other factors.

HPWS has negative relationships with HCD and ORDI, but a good correlation with ROA. The maximum VIF is 2.41, showing that multicollinearity is not a significant concern. These relationships are simply descriptive; they do not take into account firm-specific or year effects.

Fixed-effects estimates

Table XIV
Fixed-effects results with CR2 small-cluster inference

Path / Predictor Variable	Standardized Beta	CR2 SE	*t*-value	95% Confidence Interval	*p*-value
Model 1: HCD -> ROA	-0.561	0.058	-9.67	[-0.675, -0.447]	< 0.001
ORDI equation: HCD -> ORDI (main effect)	0.640	0.047	13.62	[0.549, 0.731]	< 0.001
Model 4: HPWS -> ORDI	-0.214	0.062	-3.45	[-0.336, -0.092]	0.002
Model 4: HCD x HPWS -> ORDI	-0.157	0.073	-2.15	[-0.301, -0.014]	0.031
Model 3: ORDI -> ROA	-0.428	0.068	-6.29	[-0.562, -0.294]	< 0.001
Model 3: HCD -> ROA (direct)	-0.287	0.052	-5.52	[-0.389, -0.185]	< 0.001

Note. The estimations are based on 216 observations from 36 publicly traded banks and insurance firms over the 2020-2025 period.

All models account for firm effects, year effects, and the stated institutional and macroeconomic control factors. Coefficients are standardized, and CR2 standard errors are grouped at the company level. Control-variable estimates are not shown in the table to keep the focus on the key relationships. In Model 1, HCD has a negative correlation with ROA (β = -0.561, CR2 SE = 0.058, p < 0.001). Thus, a one-standard-deviation rise in HCD leads to a 0.561-standard-deviation fall in ROA. Given the observed ROA standard deviation (0.018), this effect corresponds to about 0.0101 in the ROA ratio, or 1.01 percentage points.

In Model 1, HCD has a negative correlation with ROA (β = -0.561, CR2 SE = 0.058, p < 0.001). Thus, a one-standard-deviation rise in HCD leads to a 0.561-standard-deviation fall in ROA. Given the observed ROA standard deviation (0.018), this effect corresponds to about 0.0101 in the ROA ratio, or 1.01 percentage points.

The disclosure equation has the opposite pattern. The HCD coefficient is 0.640 (SE = 0.047, p < 0.001). Given ORDI's standard deviation (0.147), a one-standard-deviation rise in HCD corresponds to approximately 0.094 in the disclosure ratio, or 9.4 percentage points.

Model 3 evaluates HCD and ORDI simultaneously. ORDI remains adversely linked with ROA (β = -0.428, SE = 0.068, p < 0.001), but the negative coefficient for HCD decreases (β = -0.287, SE = 0.052, p < 0.001). Using the observed standard deviation of ROA, these standardized coefficients are roughly 0.77 percentage points for ORDI and 0.52 percentage points for the entire HCD relationship. These results are within-sample relationships rather than estimates of causal effects.

Indirect-association decomposition

Table XV
Indirect-association decomposition at mean HPWS

Quantity	Standardized Estimate	Calculation	Interpretation
Total HCD-ROA association	-0.561	Model 1	Total association
Direct HCD-ROA association	-0.287	Model 3	Association holding ORDI in the model
Indirect association through ORDI	-0.274	0.640 x -0.428	Product of HCD-ORDI and ORDI-ROA paths

Note. Multiplying the HCD-ORDI coefficient of 0.640 by the ORDI-ROA coefficient of -0.428 results in an indirect effect of -0.274 at the average HPWS level.

Adding this value to the direct HCD coefficient of −0. This computation is a statistical breakdown, not evidence of a causal mediation process. Because the CR2 result does not provide a resampled confidence interval for the product term, the indirect effect cannot be construed as causal mediation.

The computed route coefficients match the predicted signs under H4: HCD is positively related with ORDI, but ORDI is negatively associated with ROA after adjusting for HCD, resulting in a negative coefficient product. Although this trend lends support to the postulated statistical relationship, it does not prove that ORDI causes workforce inadequacies to affect financial performance.

Moderation by high-performance work systems

This gives slopes of 0.797 at low HPWS, 0.640 at the mean, and 0.483 at high HPWS. Standard errors for the two individual +/-1 SD slopes cannot be reconstructed without the covariance between the main and interaction estimates. The low-high contrast is -2 times the interaction coefficient: 0.314 (SE = 0.146, 95% CI [0.028, 0.602], p = 0.031). Inference for the mean slope is the CR2 result reported for HCD.

Table XVI
Conditional HCD slopes and CR2 test of attenuation

HPWS Level / Contrast	Centered Value	Conditional HCD Slope	CR2 Inference	95% CI / *p*-value
Low HPWS	-1 SD	0.797	Point estimate	-
Mean HPWS	0	0.640	SE = 0.047	[0.549, 0.731]; $p <$ 0.001
High HPWS	+1 SD	0.483	Point estimate	-
Low - High slope difference	2 SD span	0.314	SE = 0.146	[0.028, 0.602]; $p =$ 0.031

Note. The conditional HCD slope equals $beta_HCD + beta_interaction(HPWS), usingbeta_HCD = 0.640andbeta_interaction$ = -0.157.

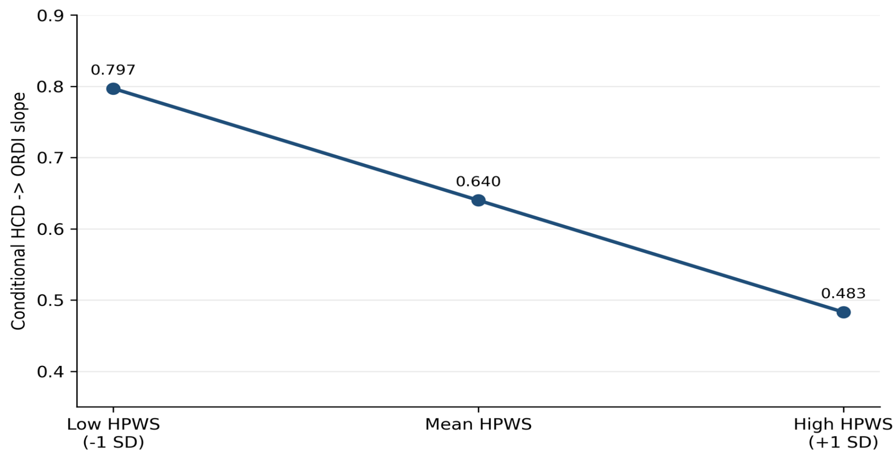

Fig. 2 *Conditional HCD slopes across HPWS levels*

The figure plots the conditional HCD slopes from Table 16 at low (-1 SD), mean, and high (+1 SD) HPWS. It is descriptive; statistical inference rests on the interaction coefficient and the CR2 low-high contrast.

Robustness and small-cluster sensitivity checks

Table XVII
Formative-component exclusion wald tests

Tested Formative Block	Model Context	Wald Statistic	df	*p*-value
HCD component block	ROA framework	114.06	3	< 0.001
HPWS component block	ORDI / moderation framework	37.71	3	< 0.001

Note. The tests address whether the specified formative blocks contribute jointly to the models.

They neither establish content validity nor demonstrate that every component is essential. CR2 small-cluster inference provides the main basis for the results, with wild-cluster analysis used as a sensitivity check. The HCD x HPWS interaction remains different from zero at the 5% level under CR2 inference ($p = 0.031$); the moderation finding is therefore not an artifact of uncorrected conventional cluster errors. The component-exclusion tests also reject joint irrelevance for the HCD block in the ROA model (chi-square(3) = 114.06, $p < 0.001$) and the HPWS block in the ORDI moderation model (chi-square(3) = 37.71, $p < 0.001$). These tests show that the blocks add explanatory information collectively. They do not establish the validity or necessity of each individual item. In particular, training-related information appears in both indices and remains a source of measurement overlap.

Discussion and Conclusion

Discussion

The strongest pattern in the results is the negative HCD-ROA relationship (beta = -0.561, $p < 0.001$). On the scale observed in the sample, a one-standard-deviation rise in workforce deficiencies is associated with roughly a 1.01 percentage-point drop in ROA. Human Capital Theory and the RBV offer a coherent explanation. Persistent turnover, insufficient personnel growth, compliance flaws, and a lack of digital knowledge can all make complicated financial operations more difficult to manage and more expensive to fix. However, the current data does not reveal the direction of this link. Managers who experience poor financial performance may also delay recruitment, restrict training, or postpone technological investments.

Workforce shortcomings are also linked to greater risk disclosure. The HCD-ORDI coefficient is 0.640 ($p < 0.001$), indicating a 9.4-point increase in ORDI for every one standard deviation increase in HCD. One possible interpretation is that labor instability, compliance failures, and digital skill shortages cause problems that must finally be addressed in operational risk reporting. Alternatively, well-governed organizations may simply be better at spotting and communicating shortcomings in both areas. Because ORDI integrates information on governance and business continuity with disclosures of bad occurrences, the present data cannot differentiate between these reasons (Abdulla & Elshandidy, 2023).

The indirect path analysis yields a more sophisticated perspective. The predicted indirect effect is -0.274, whereas the joint equation's HCD coefficient remains -0.287. This shows that ORDI is responsible for a significant statistical percentage of the overall link between HCD and financial performance. However, this does not mean that disclosure causes a workforce shock to profitability. Management quality, regulatory attention, and firm-specific reporting standards may all have an impact on both connections and result in a similar decomposition.

HPWS adds an extra dimension to the analysis. The interaction between HCD and HPWS is negative ($\beta = -0.157$, $p = 0.031$), with the conditional HCD-ORDI slope decreasing from 0.797 at low levels to 0.483 at high levels. One possible practical rationale is that regular employee development, clearer performance appraisal, and genuine employee involvement allow businesses to discover and address competence gaps earlier. As a result, fewer of these flaws may evolve into issues that necessitate disclosure across a broader variety of operational risk themes. However, this view should be approached with caution because training affects the HCD and HPWS indices in opposing directions, thereby introducing some mechanical contrast between the measures (Kellner et al., 2023).

Theoretical contributions

Conceptually, the article views HCD as an organizational risk profile in its own right, rather than just the negative counterpart of positive human capital. Turnover, employee development deficiencies, compliance problems, and digital skill gaps are all examples of workforce vulnerability in this profile. These dimensions may not always indicate a single underlying condition (Crook et al., 2011; Zhang et al., 2023) As a result, a formative approach provides a more accurate representation of the various ways that workforce vulnerabilities might occur in financial institutions.

The linkage between HCD and ORDI also connects two research fields that are frequently studied separately: strategic human resource management and operational risk disclosure. The approach preserves ORDI's interpretive ambiguity, noting that broader reporting may reflect increased operational concern, improved transparency, or a mix of the two (Basto & Marques, 2024). Distinguishing disclosure breadth from realized loss is thus a key component of the paper's contribution.

Finally, the HPWS data show that the link between HCD and ORDI differs according to organizational setting. Its strength is influenced by the claimed maturity of the firm's HR system (Kellner et al., 2023). This turns the attention away from personnel shortages and toward the organizational capacity to detect, manage, and learn from them.

Practical and policy implications

The findings underscore the importance of taking workforce and risk information into account jointly for boards, chief risk officers, and HR executives. Rising staff turnover, continuous essential talent shortages, employment-related compliance difficulties, and digital capacity gaps might be more important warning signs when combined with internal audit results, operational loss occurrences, and financial performance. ORDI should also be carefully construed. A higher score may demand a closer look, but it does not always imply more losses, as broader reporting may suggest greater transparency and stronger oversight.

Comparing institutions presents a similar issue for regulators and standard-setters. Reporting would be easier to understand if it explicitly separated forward-looking assertions about governance and controls from proven losses and documented control failures. This distinction may give supervisors, investors, and analysts a better basis for determining whether extensive disclosure indicates increased transparency, operational pressure, or a combination of the two.

Limitations and future research

Sample design and generalizability

The first constraint is the sample size. Although the panel has 216 observations, they are from only 36 independent firm clusters. As a result, tiny effects, country-specific regulatory variances, and disparities between banks and insurers are difficult to evaluate accurately. Furthermore, the firms were chosen based on the availability and completeness of their disclosures, rather than by random sampling. As a result, the results are most relevant to the institutions represented in the sample. Larger samples, longer observation periods, and greater variance in country settings would be required to assess whether these tendencies are constant across contexts.

Measurement limitations

Measurement second barrier is measurement HCD and HPWS are built on information supplied by enterprises, whereas ORDI is a disclosure-based measure. As a result, all three variables may capture reporting quality in addition to the organizational characteristics they are designed to represent. Training intensity enters HCD and HPWS in opposing routes, perhaps introducing mechanical covariance between the measurements. Although the component-exclusion Wald tests show that the tested blocks together provide more information, they do not substitute indicator-level sensitivity analysis.

Future research could address this issue by reconstructing each formative index multiple times, excluding one component at a time, and then re-estimating the main models. This approach would indicate whether the findings are driven by a single indicator or remain consistent when the disclosure-based measures are modified more broadly.

Endogeneity and causal inference

Endogeneity is the third and most serious constraint. Although HCD may contribute to lower profitability, the inverse link is also possible: poor performance may prompt management to reduce training, postpone recruitment, or postpone digital investment. Unobserved factors, such as management quality, risk culture, digital strategy, and regulatory scrutiny, may all have an impact on several research variables. Firm and year effects mitigate some of these difficulties, but they cannot determine causality.

A more robust research design would necessitate believable time lags, an appropriate instrument, or a policy shift that generates plausible exogenous variation. Direct data on realized operational losses and near-miss occurrences would also be useful since they may help distinguish between what companies disclose and the severity of actual events. Estimating the models independently for banks and insurers, as well as in more comparable regulatory contexts, would provide more evidence on whether the pooling associations are stable.

Conclusion

Higher Human Capital Deficiencies are connected with lower profitability and broader operational risk disclosure among the 36 listed financial institutions investigated in this study. Firms with more developed High-Performance Work Systems exhibit a decreased positive link between HCD and ORDI, although the relationship remains evident. The bigger consequence is clear: worker capabilities should be included in operational resilience and risk governance. Treating it as a separate administrative issue may lead to an overlook of both the sources of control difficulties and how institutions respond.

The evidence is associational, and the measures still blend underlying conditions with reporting practice. Progress now depends on improving both sides of the design. Future studies should distinguish transparency from realized operational risk more directly and use identification strategies capable of testing whether the observed relationships follow the sequence proposed in the conceptual model.

Conflict of Interest

The authors declare no conflicts of interest that could have influenced the design, analysis, interpretation, or reporting of this study.

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Ethics Statement

The study uses publicly available secondary information from annual, sustainability, ESG, governance, risk-management, and regulatory reports, together with licensed financial databases. It did not involve human participants, identifiable personal data, or confidential respondent information. Formal human-subject ethics approval was therefore not required under the applicable institutional guidelines.

Informed Consent Statement

Not applicable.

Author Contributions

Hamed Abdallah Hamed Mosa and Dalal Alsahliy contributed to the manuscript, reviewed its content, and approved the final version.

Data Availability Statement

Derived data and coding materials are available from the corresponding author on reasonable request, subject to the licenses governing Bloomberg and Refinitiv Eikon data. Public-source documents can be obtained from issuer and regulatory websites. Where licensing permits, a de-identified coding file and codebook can be supplied to reviewers or deposited in an appropriate repository.

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