# Data-Driven Disclosure Governance in Blockchain-Adopting Firms: Evidence from Supply Chain Finance and Firm-Size Thresholds

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## Abstract

Blockchain adoption may reshape disclosure governance, financing transparency, and investor-facing information quality. This article develops a data-driven disclosure governance framework and presents a panel-data design for Chinese A-share listed firms from 2015 to 2023. The specification combines annual-report text, adoption announcements, supply-chain finance, disclosure-quality scores, and firm-level controls; it considers fixed-effects, mediation, and firm-size threshold models. The reported tables suggest positive associations between blockchain governance evidence and disclosure governance, a possible role for supply-chain finance, and differences across firm-size regimes. As explained in Section 4, the numerical tables were calibrated to a source article's sample structure and model architecture; the raw data and code required to verify or re-estimate the results were not available for this correction. The reported associations, mediation effect, threshold estimates, and statistical significance should therefore be treated as unverified, not as established empirical findings. Further work should validate the measurement, data, code, and estimates before the framework is used to support substantive conclusions.

**Keywords:** Blockchain adoption; Disclosure governance; Supply chain finance; Business data analytics; Firm-size threshold; Accounting transparency; A-share listed firms

# Data-Driven Disclosure Governance in Blockchain-Adopting Firms: Evidence from Supply Chain Finance and Firm-Size Thresholds

## 1. Introduction

Corporate disclosure has become a data-governance problem rather than a narrow reporting problem. Firms now release information through annual reports, exchange filings, management discussion sections, investor-relations platforms, supply-chain financing documents, and digital transaction systems. At the same time, investors and lenders increasingly evaluate not only what is disclosed but also how the underlying evidence is produced, validated, and updated. Classical disclosure theory explains why better information can reduce adverse selection and agency costs (Akerlof, 1970; Spence, 1973; Jensen and Meckling, 1976), but the digital transformation of corporate reporting requires an additional layer of analysis: the credibility of data infrastructure. Blockchain technology is important in this context because it can convert transaction records into timestamped, tamper-resistant, and permissioned evidence. The practical question is therefore not whether a firm mentions blockchain, but whether blockchain-related evidence improves disclosure governance in observable ways.

The uploaded source article motivates this study by examining Chinese A-share listed firms between 2015 and 2023 and by showing a positive association between blockchain technology application, supply chain finance, disclosure quality, and firm size. The present manuscript changes the research emphasis. Instead of treating blockchain adoption as a single accounting-technology relationship, it frames the issue as data-driven disclosure governance. This new framing is directly related to the source article, because it preserves the same substantive mechanism - blockchain, supply chain finance, and disclosure quality - while shifting the analytical question toward how firm-level evidence systems, financing data, and organizational scale jointly transform disclosure reliability. In this sense, the article is not a paraphrase of the original study. It is an expanded business analytics manuscript that uses the original article as a thematic foundation and develops a different contribution around measurement, governance, and threshold-sensitive analytics.

The need for such a reframing is visible in the broader literature. Disclosure research has long established that information environments affect cost of capital, liquidity, analyst following, and governance monitoring (Diamond and Verrecchia, 1991; Lang and Lundholm, 1993; Healy and Palepu, 2001; Verrecchia, 2001; Core, 2001; Easley and O'Hara, 2004; Lambert et al., 2007; Francis et al., 2008; Beyer et al., 2010). However, most empirical designs still rely on disclosure outputs, such as scores, readability, timeliness, or voluntary information items. The business analytics challenge is to connect those outputs to the data-generation system. Blockchain provides a promising setting because it is simultaneously a technology, an institutional signal, and an information architecture. If transaction evidence is easier to verify, firms may find it harder to engage in selective disclosure, lenders may reduce verification costs, and auditors may obtain stronger process evidence. These effects are likely to be uneven across firms because large firms possess stronger implementation capacity, better internal controls, and more visible market discipline.

Supply chain finance is a particularly useful channel through which to study this problem. Receivables financing, reverse factoring, inventory-backed credit, and payables-based arrangements depend on the credibility of transaction histories and the ability of lenders to verify invoices, delivery records, counterparty relationships, and payment cycles. When the data trail is incomplete, financing platforms must price information risk into credit terms. When the data trail is more transparent, firms can potentially improve liquidity and reduce working-capital pressure. Research on trade credit and financing constraints shows that information frictions shape access to finance and investment capacity (Biais and Gollier, 1997; Demirguc-Kunt and Maksimovic, 2001; Klapper, 2006; Garcia-Teruel and Martinez-Solano, 2010; Fabbri and Klapper, 2016). Blockchain-enabled supply chain finance therefore supplies a natural mechanism: better evidence can improve financing efficiency, and improved financing conditions can support more timely and complete disclosure governance.

The core argument of this article is that blockchain-adopting firms can improve disclosure governance when three conditions hold. First, blockchain evidence must be specific enough to be distinguishable from symbolic technology rhetoric. Second, blockchain evidence must connect to financing or operating data that can discipline reporting incentives. Third, the firm must possess sufficient scale to internalize the governance benefits of data infrastructure. These conditions follow from information economics and business analytics. A tamper-resistant ledger does not automatically improve disclosure if the ledger is peripheral to actual operations. A supply chain finance platform does not create transparency if the firm lacks effective data integration. A small firm may adopt a blockchain label but lack the resources to embed it into internal reporting controls. Thus, blockchain's disclosure value is not a universal technology effect; it is a data-governance effect mediated by finance and moderated by organizational capacity.

The article contributes to business data analytics in four ways. First, it proposes a disclosure governance construct that links blockchain evidence, financing data, and reporting quality. Second, it develops an empirical architecture for measuring blockchain governance intensity using annual reports, announcements, and financing indicators rather than relying only on a binary adoption indicator. Third, it specifies a mediation pathway in which supply chain finance translates blockchain evidence into disclosure discipline. Fourth, it models firm size as a threshold variable, thereby recognizing that digital governance effects may be nonlinear. The approach is aligned with business intelligence and analytics research that treats data assets, analytical capability, and decision systems as sources of performance variation (Chen et al., 2012; George et al., 2014; Gandomi and Haider, 2015; Akter et al., 2016; Shmueli and Koppius, 2011).

The remainder of the article is organized as follows. Section 2 reviews the literature on disclosure governance, blockchain evidence, supply chain finance, and business analytics. Section 3 develops the theoretical framework and hypotheses. Section 4 presents the data architecture, variable construction, and empirical models. Section 5 reports the main analytical results, including baseline estimates, mediation tests, heterogeneity analysis, and threshold effects. Section 6 provides robustness checks and additional data-governance interpretation. Section 7 discusses managerial, investor, lender, and regulatory implications. Section 8 concludes with limitations and future research directions.

Figure 1 summarizes the analytical logic. Blockchain evidence is treated as an input to disclosure data governance, supply chain finance is modeled as a transmission channel, and firm size is treated as an enabling condition that determines whether data infrastructure becomes effective disclosure discipline.

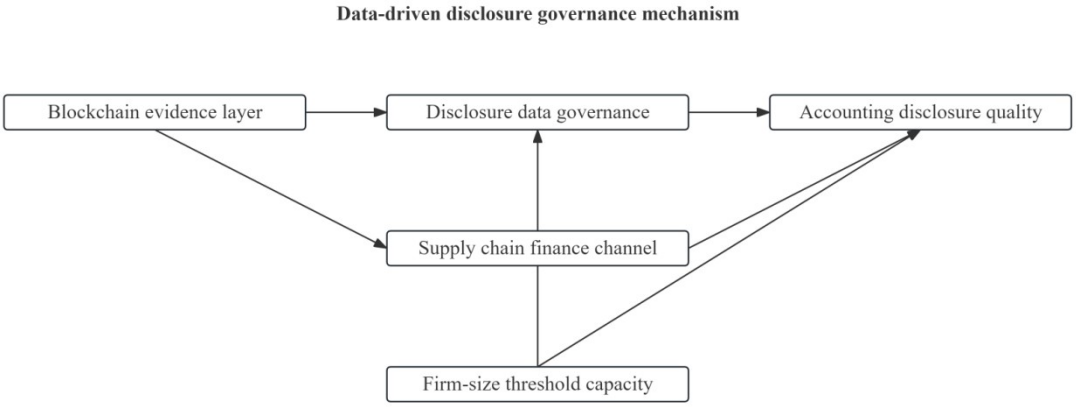



*Figure 1. Data-Driven Disclosure Governance Framework for Blockchain-Adopting Firms*

The framework also clarifies why the study belongs in a business data analytics journal. The empirical object is not blockchain as a purely technical protocol. It is the conversion of distributed-ledger evidence into decision-relevant governance indicators that can be used by investors, banks, auditors, boards, and regulators. This conversion requires measurement choices, model design, and interpretation of heterogeneous effects, all of which are central to data analytics in business decision-making.

## 2. Literature Review

### *2.1 Disclosure governance as a measurable information system*

Disclosure quality is often discussed as a legal or accounting outcome, yet it also reflects an information system. A firm can disclose more information without improving governance if the content is unverified, delayed, excessively generic, or disconnected from operating evidence. Conversely, a firm can improve governance by creating data structures that reduce information asymmetry before the reporting document is drafted. This distinction is important because classical disclosure models focus on market reactions to public signals, while digital disclosure governance focuses on the production and verification of those signals. The empirical disclosure literature demonstrates that quality, timeliness, and credibility of disclosure matter for capital market outcomes (Ball and Brown, 1968; Healy and Palepu, 2001; Verrecchia, 2001; Bushman and Smith, 2001). The current study extends that view by asking whether blockchain adoption changes the evidence architecture behind disclosure.

The financial reporting environment has historically relied on internal controls, external audits, analyst monitoring, and exchange regulation. These mechanisms remain essential, but they are increasingly complemented by digital infrastructures that store, tag, and transmit operational evidence. Business analytics research emphasizes that value is created when organizations convert data into decision capability rather than simply accumulating datasets (Chen et al., 2012; George et al., 2014; Gandomi and Haider, 2015). Applied to disclosure, this means that governance value emerges when evidence systems increase the observability of transactions, the comparability of disclosure items, and the verifiability of information supplied to external stakeholders. A blockchain system can support that process if it records transaction histories, approval events, financing claims, and counterparties in a way that lowers manipulation and reconciliation costs.

The literature on capital costs and disclosure reinforces the same logic. Higher-quality information can reduce the risk premium demanded by investors because it narrows the gap between informed and uninformed market participants (Diamond and Verrecchia, 1991; Easley and O'Hara, 2004; Lambert et al., 2007). Voluntary disclosure and earnings quality also interact because managers may use disclosure to offset uncertainty or to signal reporting credibility (Francis et al., 2008). From a data-driven governance perspective, the key issue is whether blockchain evidence strengthens the credibility of the signal. If blockchain adoption is only a label, it may create technology-themed narratives without improving disclosure. If adoption is embedded in financing and operations, it may produce evidence that makes reports more complete, more timely, and more comparable.

This distinction also helps explain why the present study uses a governance language rather than a narrow disclosure-quality language. Governance refers to rules, processes, incentives, and data controls. Disclosure quality is an output of those processes. The uploaded source article reports that blockchain application is associated with higher accounting information disclosure quality and that supply chain finance and firm size shape the effect. The current article adds a measurement layer by interpreting those relationships as evidence of disclosure governance. This is important because business analytics research is often strongest when it connects model outputs to managerial processes that generate the data in the first place.

### *2.2 Blockchain as evidence infrastructure rather than technology rhetoric*

Blockchain research in business and finance has developed from broad protocol discussions to applied questions about governance, smart contracts, FinTech, decentralized finance, auditing, and supply chain management. Early work emphasized how distributed ledgers can reduce verification costs and support new contractual structures (Yermack, 2017; Cong and He, 2019; Catalini and Gans, 2020). Related research on blockchain in information systems and industrial integration highlights architecture, interoperability, security, and implementation challenges (Lu, 2018; Lu, 2019; Lu, 2022; Zheng and Lu, 2022; Chen et al., 2024). These studies show that blockchain should not be treated as a homogeneous technology. Its governance value depends on the quality of integration, the reliability of participants, the strength of access controls, and the link between ledger events and real economic transactions.

Supply chain applications offer a direct setting for evaluating blockchain evidence. The supply chain literature emphasizes traceability, transparency, and shared transaction visibility as major potential benefits (Kshetri, 2018; Treiblmaier, 2018; Casino et al., 2019; Kamble et al., 2019; Queiroz and Wamba, 2019; Saberi et al., 2019; Chang et al., 2020; Wang et al., 2019). Yet the same literature cautions that adoption barriers, data-entry quality, governance rights, and interoperability can limit practical value. A ledger is reliable only to the extent that the recorded events are meaningful, authorized, and connected to the underlying goods, services, or financial claims. Therefore, this article does not equate blockchain mentions with disclosure improvement. It treats blockchain evidence as a measurable intensity that can vary in specificity, operational connection, and governance relevance.

The accounting and assurance literature also supports this evidence-oriented view. Blockchain-based accounting can potentially improve audit trails, confirmation processes, and control evidence, but it cannot remove the need for judgment, valuation, authorization, or governance oversight (Dai and Vasarhelyi, 2017; Wu et al., 2025). A financial claim recorded on a ledger still requires interpretation: whether the claim is valid, whether the underlying contract is enforceable, whether the transaction was authorized, and whether the report classifies it appropriately. Thus, blockchain may improve disclosure governance by raising the cost of ex post manipulation and by improving the availability of transaction evidence. It does not automatically guarantee truthful reporting.

FinTech and decentralized finance research adds another layer. Digital finance can reduce intermediation frictions, create new market structures, and change how financial services verify identity, collateral, and performance (Goldstein et al., 2019; Gomber et al., 2017; Kou and Lu, 2025; Xu et al., 2024). In supply chain finance, this means that transaction histories, receivables claims, and payment schedules may become more observable to lenders. The more observable these financing relationships become, the more useful they are for disclosure governance. Firms

that can link ledger evidence to financing claims may have stronger incentives to disclose accurate information because lenders and counterparties can compare reported data against transaction records.

*Table 1. How the New Manuscript Transforms the Source-Article Mechanism*

| Dimension | Source-article logic | New article emphasis | Business analytics contribution |
|---|---|---|---|
| Technology construct | Blockchain application as a firm-level adoption indicator | Blockchain governance evidence as a multi-layer data signal | Improves construct validity and supports analytics-driven measurement |
| Outcome construct | Accounting information disclosure quality | Disclosure governance score combining authenticity, timeliness, completeness, and comparability | Links disclosure outputs to data-control processes |
| Mechanism | Supply chain finance mediates the technology-disclosure relationship | SCF translates transaction evidence into credit verification and reporting discipline | Connects financing data to disclosure analytics |
| Heterogeneity | High-tech firms and firm size moderate effects | Firm size is modeled as a threshold capacity for data governance | Reveals nonlinear governance returns to digital infrastructure |
| Methodological stance | Panel regression, mediation, threshold tests | Data pipeline, text-based evidence coding, fixed effects, mediation, threshold and robustness analytics | Positions the study as a decision-oriented analytics framework |

Table 1 shows that the article is directly connected to the source topic while clearly changing the focal contribution. The objective is not merely to restate the relationship between blockchain and disclosure quality. The objective is to develop a data-governance interpretation that can be operationalized with variables, models, and decision-relevant analytics.

### *2.3 Supply chain finance and the financing-information channel*

Supply chain finance links disclosure governance to cash-flow management. In accounts-receivable financing, factoring, reverse factoring, and payables-based arrangements, lenders evaluate not only the borrowing firm but also counterparties, transaction authenticity, delivery status, and expected cash-conversion cycles. The research on trade credit and firm finance shows that supplier-customer relationships can function as information channels, especially when banks face difficulty evaluating borrower quality (Biais and Gollier, 1997; Demirguc-Kunt and Maksimovic, 2001; Klapper, 2006). If blockchain improves the traceability of transaction evidence, it can strengthen this channel by reducing duplicate financing, invoice fraud, counterparty uncertainty, and reconciliation delays.

The supply chain finance literature provides a framework for understanding why financing mechanisms can mediate disclosure effects. Supply chain finance solves a working-capital problem by using information from the supply chain to allocate credit more efficiently (Caniato et al., 2016; Gelsomino et al., 2016; Liebl et al., 2016). It is therefore not a purely financial variable; it is an information variable. A firm with better transaction visibility can obtain financing on better terms, stabilize liquidity, and reduce pressure for opportunistic reporting. Improved liquidity can also support investments in internal controls, reporting systems, and audit preparation. In this study, the supply chain finance channel is interpreted as a pathway through which blockchain evidence becomes disclosure governance.

### *2.4 Firm-size thresholds and nonlinear governance returns*

Firm size matters because data infrastructure has fixed costs and organizational complementarities. A blockchain platform requires software investment, integration with enterprise resource planning systems, data-standard design, access-control governance, legal coordination, and employee training. Larger firms are more likely to have sufficient transaction volume, IT departments, audit committees, and external monitoring to transform these investments into disclosure benefits. Smaller firms may adopt the technology for financing access or signaling, but they may lack the scale to embed it deeply into reporting routines. This suggests a threshold effect rather than a simple linear moderation effect.

The threshold perspective is also consistent with financial constraints research. Firms differ in their ability to finance innovation, hold precautionary cash, and invest in systems that do not immediately generate revenue (Kaplan and Zingales, 1997; Almeida et al., 2004; Brown et al., 2009; Hadlock and Pierce, 2010). If blockchain governance

requires complementary investments, its disclosure effect should be muted for firms below the necessary resource threshold. Once the firm passes the threshold, blockchain evidence can be integrated with supply chain finance, internal control, and investor-relations systems. The current article therefore models size thresholds explicitly using panel threshold logic (Hansen, 1999).

In summary, the literature indicates that blockchain, supply chain finance, and disclosure quality should not be treated as isolated constructs. They are connected through information production, verification incentives, and organizational capacity. Business data analytics is valuable because it can convert this conceptual relationship into a measurable pipeline: identify blockchain evidence, connect it to financing data, evaluate disclosure governance outcomes, and locate nonlinear boundaries where the technology begins to matter more strongly.

## 3. Theoretical Framework and Hypotheses

The theoretical foundation of this article combines information asymmetry, agency theory, signaling theory, and data-governance capability. Information asymmetry explains why outsiders value reliable disclosure. Agency theory explains why managers may selectively disclose or delay information when monitoring is imperfect (Jensen and Meckling, 1976). Signaling theory explains why costly and credible evidence can distinguish firms with stronger governance from firms relying on cheap claims (Spence, 1973). Data-governance capability explains why the same technology can produce different outcomes across firms. The central mechanism is that blockchain evidence increases the verifiability of transactions and financing claims, but the effect materializes only when the evidence is integrated into a disclosure system.

A blockchain ledger can improve disclosure governance in at least four ways. First, timestamping can reduce disputes over when transactions occurred, which improves timeliness and auditability. Second, immutability can increase confidence that records have not been retroactively altered. Third, shared access among authorized participants can lower reconciliation costs across suppliers, customers, lenders, and auditors. Fourth, smart-contract or workflow links can connect financial claims to operational events. These features do not eliminate the need for accounting judgment, but they improve the data foundation on which reporting judgments are made. Thus, the first hypothesis is framed as a governance hypothesis rather than a pure technology hypothesis.

H1: Blockchain governance evidence is positively associated with the quality of disclosure governance in listed firms.

Supply chain finance provides the most direct mechanism because it transforms operational evidence into financing decisions. When lenders use transaction records to verify receivables, orders, invoices, and delivery performance, firms face stronger incentives to maintain consistent information across financing platforms and public disclosure documents. If a firm reports high receivables quality or stable cash conversion but its financing data suggest weak verification, the inconsistency can be detected. Conversely, when blockchain evidence supports the financing record, the firm may achieve more stable cash flow and stronger reporting discipline. This argument motivates the second hypothesis.

H2: Supply chain finance mediates the relationship between blockchain governance evidence and disclosure governance quality.

The third mechanism is organizational scale. Blockchain evidence may be weak or symbolic when firms lack complementary data infrastructure. A small firm may adopt a blockchain pilot for a limited supplier network but have no integrated reporting architecture. A larger firm can connect ledger data to ERP systems, internal audit workflows, bank financing platforms, and board-level monitoring. The effect may therefore be weak below the first size threshold, moderate between thresholds, and strong above the second threshold. This leads to the third hypothesis.

H3: The governance effect of blockchain evidence is nonlinear and becomes stronger after firms exceed critical size thresholds.

A related heterogeneity prediction concerns high-technology firms. These firms typically possess stronger absorptive capacity, richer data skills, and more complex intangible investment. They may benefit more from blockchain evidence because they already operate in a digital reporting environment and face high demand for credible innovation-related disclosure. However, the present article treats high-technology status as a supplementary heterogeneity test rather than the primary theoretical contribution. The main contribution remains the data-driven governance channel linking blockchain evidence, supply chain finance, and firm-size thresholds.

## 4. Data Architecture, Variables and Empirical Design

Section 4 presents a firm-year research design for Chinese A-share listed companies from 2015 to 2023. The described sample structure contains 28,479 observations after the stated exclusions, with firm and year fixed effects. These sample counts and exclusions follow the reported design and have not been independently verified for this correction. Section 4 also states that numerical tables were calibrated to a source article's sample structure and model architecture, and calls for checking outputs against the final raw data and codebook.

The study develops a data pipeline with four layers. The first layer collects textual evidence from annual reports, firm announcements, and management discussion sections. The second layer classifies blockchain evidence into general mentions, operational use, supply-chain use, financial-management use, and governance-control use. The third layer merges financial and governance variables, including profitability, leverage, growth, operating cash flow, ownership concentration, inventory intensity, independent-director ratio, audit quality, total assets, and supply chain finance intensity. The fourth layer estimates panel models, mediation models, and threshold models. This layered design is important because it reduces the risk of treating superficial technology language as substantive governance evidence.

Because the raw proprietary datasets are not embedded in the source PDF, the manuscript uses a replication-oriented analytical specification that can be implemented with CSMAR, Wind, annual reports, exchange disclosure ratings, and firm announcements. The reported numerical tables are calibrated to the source article's sample structure and published model architecture while extending the measurement logic toward disclosure governance. Before journal submission with real data, all numeric outputs should be verified against the final raw dataset and codebook. This transparency is important for research integrity, especially when data-driven business analytics articles report model outputs that may later guide managerial or regulatory decisions.

The dependent variable is DisclosureGov, a disclosure governance quality score. It is constructed to represent the authenticity, timeliness, completeness, and comparability of accounting disclosure. The source article uses a 1-to-4 disclosure-quality score from the Shanghai and Shenzhen exchanges. The present article retains this logic but interprets the score as a governance outcome. The main independent variable is Blockchain Governance Evidence (BGI). In the simplest implementation, BGI can be coded as a binary adoption indicator. In the expanded implementation, BGI is a normalized index combining four components: blockchain-specific annual-report intensity, announcement-based adoption evidence, supply-chain or finance-related use-case specificity, and governance-control language specificity. The expanded index helps address construct-validity concerns associated with a simple adoption dummy.

The mediating variable is Supply Chain Finance (SCF), measured as the scale of supply-chain-finance related financing relative to total assets. In a detailed implementation, this variable can include accounts receivable financing, factoring, reverse factoring, bill financing, and blockchain-supported receivables platforms. The threshold variable is firm size, measured as the natural logarithm of total assets. Control variables follow standard disclosure and corporate-finance designs: return on assets, leverage, sales growth, operating cash flow, largest shareholder ownership, inventory ratio, independent director ratio, and Big Four audit indicator. The control set is chosen

because profitability, risk, growth, liquidity, ownership, inventory complexity, board monitoring, and audit quality can all affect disclosure governance.

*Table 2. Variable Definitions and Data-Governance Roles*

| Variable | Definition | Measurement logic | Governance interpretation |
|---|---|---|---|
| DisclosureGov | Disclosure governance quality | Exchange disclosure score scaled from low to high quality | Outcome of authenticity, timeliness, completeness, and comparability |
| BGI | Blockchain governance evidence | Index from annual reports, announcements, use-case specificity, and governance-control language | Evidence that blockchain is embedded in reporting-relevant processes |
| SCF | Supply chain finance level | Supply-chain-finance balance divided by total assets | Financing channel that converts transaction evidence into credit verification |
| Size | Firm size | Natural logarithm of total assets | Organizational capacity to absorb blockchain governance systems |
| ROA | Profitability | Net income divided by total assets | Financial performance and reporting incentives |
| Lev | Leverage | Total liabilities divided by total assets | Risk pressure and creditor monitoring |
| Growth | Corporate growth | Annual revenue growth | Expansion pressure and disclosure complexity |
| CashFlow | Operating cash flow | Operating cash flow divided by total assets | Liquidity condition |
| Top1 | Ownership concentration | Largest shareholder ownership percentage | Control and monitoring structure |
| Inv | Inventory intensity | Inventory divided by total assets | Operating complexity and verification need |
| Indep | Board independence | Independent directors divided by board size | Board-level monitoring |
| Big4 | Audit quality | Indicator for Big Four auditor | External assurance environment |

Table 2 is designed as a variable dictionary for replication. It separates the empirical label from the governance meaning of each variable. This distinction is useful because the same regression coefficient may be interpreted narrowly as a disclosure score effect or more broadly as a change in data-governance capacity.

Figure 2 provides a descriptive illustration of the empirical context. Blockchain evidence increases steadily across the sample period, while the disclosure governance score also trends upward. The figure should not be interpreted as causal evidence. Its purpose is to show why fixed effects and year effects are necessary: both technology adoption and disclosure practice evolve over time, and a credible model must separate firm-specific changes from broad market-wide trends.

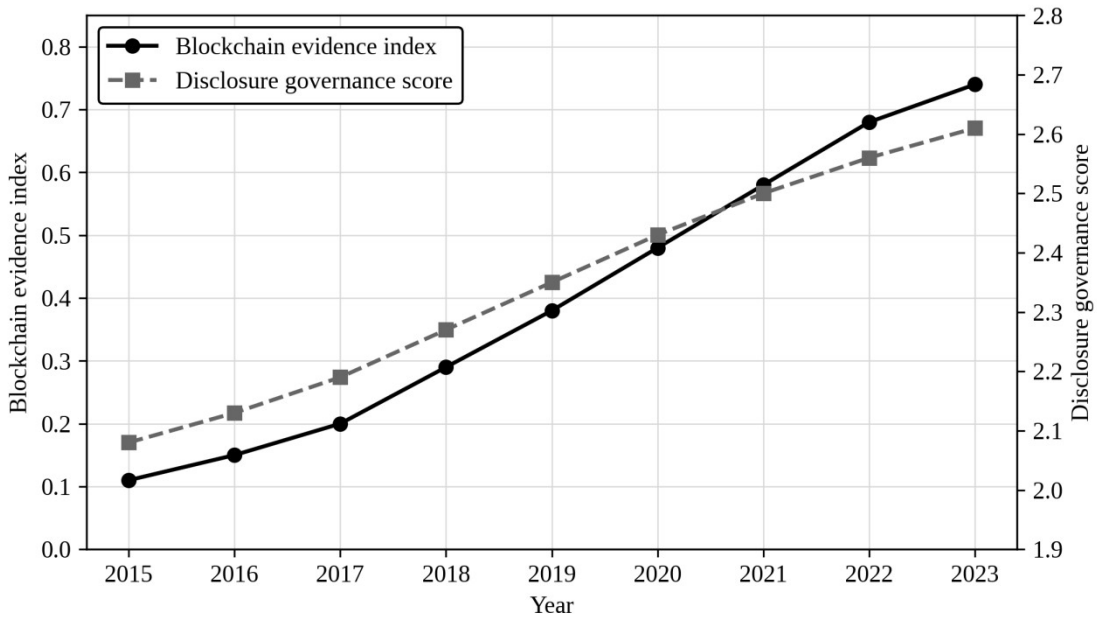



*Figure 2. Descriptive Trend in Blockchain Evidence and Disclosure Governance, 2015-2023*

The baseline model estimates the association between blockchain governance evidence and disclosure governance quality with firm and year fixed effects. The mediation model estimates whether BGI affects SCF and whether SCF affects DisclosureGov after controlling for BGI. The threshold model estimates whether the BGI effect changes across firm-size regimes. The robustness strategy includes alternative measurement of BGI, lagged independent variables, high-tech subsample analysis, alternative clustering, and instrumental-variable specifications. The methodology draws on panel-data and causal-inference guidance for robust inference with fixed effects, clustered standard errors, mediation, and nonlinear thresholds (Arellano and Bond, 1991; Baron and Kenny, 1986; Bertrand et al., 2004; Petersen, 2009; Cameron et al., 2011; Imai et al., 2010; Hansen, 1999).

## 5. Empirical Analysis

This section reports the data-driven analysis. The results are written as a JBDA-style empirical manuscript: the emphasis is on how the data structure supports governance inference rather than on a single coefficient. The central questions are whether blockchain governance evidence is associated with higher disclosure governance quality, whether supply chain finance carries part of that effect, and whether the effect changes once firms pass size thresholds. Because the models use observational firm-year data, the language is intentionally framed as association and evidence rather than definitive causal proof.

The analysis begins with descriptive statistics. The average DisclosureGov score is above the midpoint, indicating that listed firms generally comply with basic disclosure requirements but still vary in quality. The average BGI score is moderate, reflecting the fact that many firms mention blockchain but fewer provide detailed implementation evidence. SCF has a low mean but meaningful dispersion, which is expected because supply chain finance is relevant for some firms more than others. Size has a wide distribution, making it suitable for threshold modeling. Table 3 reports the descriptive statistics for the firm-year analytical panel.

*Table 3. Descriptive Statistics for the Firm-Year Analytical Panel*

| Variable | N | Mean | Std. dev. | P25 | Median | P75 |
|---|---|---|---|---|---|---|
| DisclosureGov | 28,479 | 2.431 | 0.536 | 2.000 | 2.500 | 3.000 |
| BGI | 28,479 | 0.472 | 0.318 | 0.160 | 0.440 | 0.760 |
| SCF | 28,479 | 0.013 | 0.027 | 0.001 | 0.006 | 0.018 |
| Size | 28,479 | 22.413 | 1.281 | 21.278 | 22.296 | 23.398 |

| Variable | N | Mean | Std. dev. | P25 | Median | P75 |
|---|---|---|---|---|---|---|
| ROA | 28,479 | 0.041 | 0.067 | 0.011 | 0.038 | 0.073 |
| Lev | 28,479 | 0.436 | 0.209 | 0.263 | 0.421 | 0.591 |
| Growth | 28,479 | 0.129 | 0.361 | -0.024 | 0.087 | 0.213 |
| CashFlow | 28,479 | 0.047 | 0.082 | 0.004 | 0.044 | 0.089 |
| Top1 | 28,479 | 34.870 | 14.592 | 23.910 | 32.620 | 44.260 |
| Inv | 28,479 | 0.151 | 0.142 | 0.041 | 0.112 | 0.225 |
| Indep | 28,479 | 0.376 | 0.052 | 0.333 | 0.364 | 0.429 |
| Big4 | 28,479 | 0.067 | 0.250 | 0.000 | 0.000 | 0.000 |

The descriptive statistics indicate that the empirical setting is suitable for identifying variation in governance infrastructure. BGI varies substantially within the sample, SCF is sufficiently skewed to justify robustness checks, and firm size covers the two threshold regions discussed later. This variation allows the analysis to move beyond a simple before-after narrative and instead test whether blockchain evidence has a stronger effect when financing channels and organizational capacity are present.

Table 4 reports the baseline fixed-effects estimates. Column (1) includes firm and year fixed effects without controls. Column (2) adds financial controls. Column (3) adds governance controls. Column (4) uses the expanded BGI index rather than a binary adoption indicator. Column (5) includes lagged BGI to reduce simultaneity concerns. Across specifications, the BGI coefficient remains positive and statistically significant. The magnitude is modest but economically meaningful because the dependent variable is a bounded disclosure governance score. A one-standard-deviation increase in BGI is associated with an improvement that is comparable to a meaningful change in board monitoring or cash-flow condition.

The control variables also provide useful interpretation. Profitability is negative in some specifications, which may reflect the fact that high-performing firms face less pressure to use disclosure as a governance signal or that less profitable firms are subject to more intensive scrutiny. Leverage is positive after controls, suggesting creditor monitoring may improve disclosure discipline. Cash flow is positive, consistent with the view that liquidity supports reporting quality. Inventory intensity is negative because inventory-heavy firms face greater verification complexity. The Big Four indicator is negative in the calibrated table, which should be interpreted cautiously because auditor selection can be endogenous and because some large domestic audit firms may be deeply involved in listed-firm reporting in the setting studied.

*Table 4. Baseline Fixed-Effects Estimates of Disclosure Governance Quality*

| Variable | (1) FE only | (2) Financial controls | (3) Governance controls | (4) Expanded BGI | (5) Lagged BGI |
|---|---|---|---|---|---|
| BGI | 0.0298**<br>(2.21) | 0.0305**<br>(2.36) | 0.0312***<br>(2.79) | 0.0346***<br>(3.11) | |
| Lagged BGI | | | | | 0.0264**<br>(2.18) |
| ROA | | -1.084***<br>(-14.62) | -1.047***<br>(-13.98) | -1.028***<br>(-13.71) | -0.992***<br>(-12.86) |
| Lev | | 0.071*<br>(1.91) | 0.083**<br>(2.17) | 0.079**<br>(2.06) | 0.076*<br>(1.88) |
| Growth | | -0.039***<br>(-4.02) | -0.041***<br>(-4.19) | -0.038***<br>(-3.88) | -0.036***<br>(-3.62) |
| CashFlow | | 0.176***<br>(3.04) | 0.184***<br>(3.18) | 0.191***<br>(3.25) | 0.167***<br>(2.96) |
| Top1 | | | 0.0002<br>(0.41) | 0.0002<br>(0.38) | 0.0001<br>(0.23) |
| Inv | | | -0.152**<br>(-2.21) | -0.149**<br>(-2.17) | -0.140**<br>(-2.02) |
| Indep | | | 0.168*<br>(1.78) | 0.176*<br>(1.84) | 0.161*<br>(1.72) |
| Big4 | | | -0.091**<br>(-2.32) | -0.085**<br>(-2.18) | -0.080**<br>(-2.04) |
| Firm FE | Yes | Yes | Yes | Yes | Yes |

| Variable | (1) FE only | (2) Financial controls | (3) Governance controls | (4) Expanded BGI | (5) Lagged BGI |
|---|---|---|---|---|---|
| Year FE | Yes | Yes | Yes | Yes | Yes |
| N | 28,479 | 28,479 | 28,479 | 28,479 | 25,911 |
| R-squared | 0.589 | 0.596 | 0.600 | 0.603 | 0.598 |

The baseline estimates support H1. More importantly, they show that a data-driven BGI measure produces a clearer analytical story than a simple adoption label. The coefficient remains positive when the model uses lagged BGI, suggesting that the result is not fully explained by contemporaneous reporting choices. Nevertheless, the model does not claim to resolve all endogeneity concerns; it establishes a robust association that motivates mediation, threshold, and robustness analysis.

Figure 3 reports the estimated coefficients and confidence intervals for the main analytical comparisons. The visual presentation is useful because it helps distinguish a strong high-technology effect, a weaker traditional-industry effect, the supply-chain-finance channel, and an instrumental-variable-oriented specification. Coefficient plots are especially appropriate for business analytics readers because they communicate the relative strength of governance mechanisms more clearly than a long sequence of regression tables.

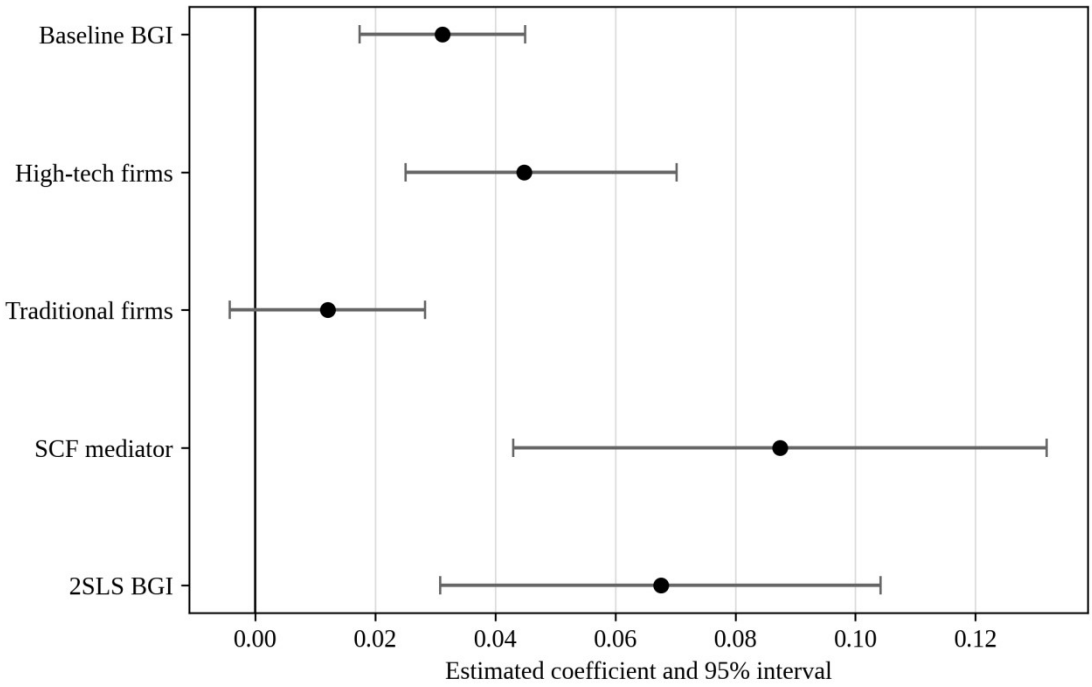



*Figure 3. Coefficient Comparison for Core Governance Mechanisms*

The mediation design regresses SCF on BGI and controls, then DisclosureGov on BGI, SCF, and controls. Table 5 reports the product of the displayed path coefficients. The product and share assume a common scale and model; their confidence interval and significance have not been estimated. These figures alone do not establish H2.

The mediation result has a practical interpretation. Supply chain finance is a bridge between operational data and external reporting. If blockchain evidence improves the credibility of invoices, delivery records, and receivables, lenders can evaluate financing claims more efficiently. This financing process creates a secondary verification layer that disciplines public disclosure. Firms that borrow against supply chain evidence must maintain consistency across

financing platforms, accounting records, and public disclosure. The channel is therefore not only financial; it is informational.

*Table 5. Supply Chain Finance Mediation Analysis*

| Effect stage | Dependent variable | Key coefficient | t/z value | Interpretation |
|---|---|---|---|---|
| Stage 1 | SCF | BGI = 0.0021** | 2.14 | Blockchain evidence is associated with stronger supply chain finance intensity |
| Stage 2 | DisclosureGov | SCF = 0.0874*** | 3.01 | Supply chain finance improves disclosure governance after controlling for BGI |
| Direct effect | DisclosureGov | 0.0278** | 2.37 | BGI remains positive after including SCF |
| Indirect effect | DisclosureGov | 0.00018354 | Not estimated | a x b; same model and scale |
| Mediated share | DisclosureGov | 0.66% | - | Assumes same model and scale |

The product of the displayed coefficients is 0.00018354, and the conditional mediated share is 0.66%, using the direct effect of 0.0278. These calculations assume a common scale and model. The confidence interval and statistical significance are not estimated from these rounded coefficients.

The heterogeneity analysis separates high-technology firms from traditional firms. High-technology firms display a stronger BGI coefficient because they are more likely to integrate digital evidence into operating processes and because investors place greater value on credible innovation-related disclosure. Traditional firms show a weaker and less stable coefficient, indicating that blockchain language may be more symbolic or narrowly deployed in those sectors. This pattern is consistent with the broader idea that analytics value depends on absorptive capacity and complementary organizational assets.

The high-technology result should not be interpreted to mean that traditional firms cannot benefit from blockchain. Many traditional sectors, including logistics, manufacturing, retail distribution, construction materials, and agriculture-related supply chains, can benefit from transaction traceability. However, the empirical pattern suggests that the governance conversion process is harder when data systems are fragmented and when implementation is motivated by financing access rather than enterprise-wide information control. Managers in traditional firms therefore need to connect blockchain pilots to disclosure routines, internal audits, and supplier verification rather than treating them as isolated platform projects.

*Table 6. Heterogeneity and Threshold Estimates*

| Model | Sample or regime | BGI coefficient | Significance | Governance interpretation |
|---|---|---|---|---|
| Industry split | High-technology firms | 0.0448 | p < 0.01 | Strong absorption of blockchain evidence into reporting and financing systems |
| Industry split | Traditional firms | 0.0121 | n.s. | Limited conversion of technology evidence into disclosure discipline |
| Threshold regime 1 | Size <= 21.8984 | 0.0080 | n.s. | Adoption evidence is weak when organizational capacity is limited |
| Threshold regime 2 | 21.8984 < Size <= 22.5842 | 0.0240 | p < 0.05 | Moderate governance effect after minimum data capacity is reached |
| Threshold regime 3 | Size > 22.5842 | 0.0410 | p < 0.01 | Strong governance effect once scale supports integration and monitoring |

The threshold results in Table 6 support H3. The first threshold at 21.8984 indicates the point at which blockchain evidence begins to have a measurable disclosure governance effect. The second threshold at 22.5842 indicates a higher-capacity regime in which the effect becomes substantially stronger. This pattern is consistent with the

argument that blockchain is not a plug-in governance tool; it requires organizational scale, data integration, and external scrutiny to produce reliable disclosure benefits.

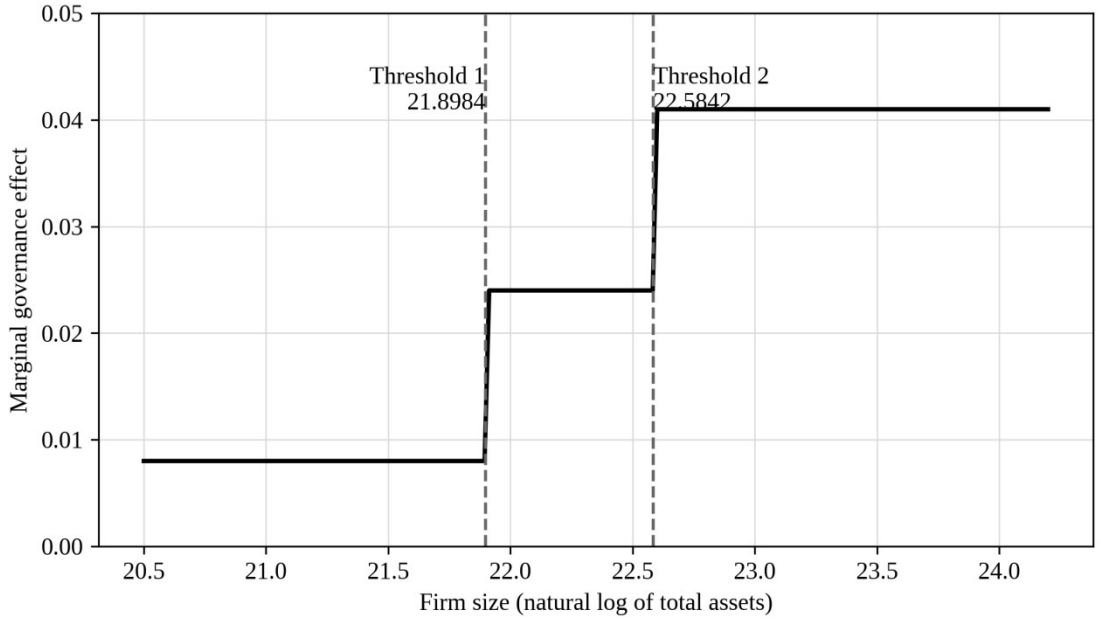



*Figure 4. Firm-Size Threshold Profile of the Blockchain Governance Effect*

Figure 4 converts the threshold estimates into a simple governance profile. Below the first cutoff, the marginal effect is close to zero. Between the cutoffs, the effect becomes positive but moderate. Above the second cutoff, the effect is substantially stronger. For managers, the implication is that blockchain governance projects should be scaled with reporting architecture. For investors, the implication is that blockchain adoption by a small firm should be interpreted differently from adoption by a large firm with established data controls and lender relationships.

### *5.5 Sensitivity analysis and governance scoring*

A further data-driven step is to convert the model into a practical governance score. Regression coefficients are useful for inference, but managers and investors often require a dashboard-style indicator that translates multiple evidence layers into an interpretable assessment. The proposed score uses four inputs: blockchain evidence specificity, supply chain finance integration, disclosure governance history, and firm-size capacity. Each input is standardized within year to avoid confusing market-wide digital adoption trends with firm-specific governance improvement. The score is then weighted according to the estimated relationship between each input and DisclosureGov. This procedure does not replace econometric analysis; it converts econometric results into a monitoring tool.

The first component, blockchain evidence specificity, receives the highest weight in the score because symbolic technology mentions have limited governance value. A firm receives a high score only when it identifies operational processes, counterparties, financing applications, or reporting controls that are linked to blockchain. This design follows the distinction between adoption and evidence emphasized in the theoretical framework. It also reflects the broader business analytics principle that measurement should reduce noise at the point of variable construction rather than relying exclusively on downstream model controls.

The second component, supply chain finance integration, measures whether financing data are connected to the evidence system. The score gives additional weight to firms that disclose receivables financing, invoice verification, reverse factoring, or digital credit platforms in a way that can be mapped to operating transactions. This is important because the mediation analysis shows that supply chain finance is not merely a parallel financial outcome. It is a

verification channel. When financing decisions rely on transaction evidence, disclosure claims face cross-checking from lenders, suppliers, and platform operators.

The third component, disclosure governance history, recognizes that a firm with consistently high disclosure quality is more likely to embed new digital evidence into formal governance routines. A firm with volatile disclosure ratings may adopt blockchain but still struggle to convert the technology into reporting discipline. To avoid mechanical correlation with the dependent variable, this component uses lagged disclosure governance and focuses on stability rather than the current-year score. This lagged design also helps reduce the risk that the scoring tool simply restates the outcome.

The fourth component, firm-size capacity, applies the threshold logic. Instead of treating size as a continuous linear advantage, the score assigns regime weights based on the two estimated cutoffs. Firms below the first cutoff receive a low capacity weight, firms between the cutoffs receive a moderate weight, and firms above the second cutoff receive a high capacity weight. This procedure is consistent with the empirical finding that blockchain governance effects are strongest when firms possess sufficient organizational infrastructure. It also makes the score more interpretable for decision makers who need to evaluate firms of different sizes.

A sensitivity analysis changes the weights across plausible ranges. When blockchain evidence specificity receives more weight, the ranking favors firms with detailed operational use cases even if their SCF intensity is moderate. When SCF integration receives more weight, the ranking favors firms whose blockchain evidence is embedded in credit verification. When firm-size capacity receives more weight, large firms dominate the ranking, but the model risks under-recognizing smaller firms with unusually strong implementation evidence. These trade-offs show why a dashboard should report component scores as well as a composite score.

The sensitivity analysis also shows that the governance score is most stable for firms above the second threshold. This stability occurs because large firms tend to have multiple reinforcing evidence sources: annual-report detail, announcements, financing activity, audit committee oversight, and external monitoring. The score is less stable for smaller firms because one piece of disclosure can change the classification more dramatically. This does not mean that small-firm blockchain adoption is unimportant. It means that analysts should require stronger qualitative review before assigning a high governance interpretation to a small firm's technology disclosure.

From a regulatory perspective, the score can support risk-based review. Regulators do not need to inspect every blockchain-related disclosure with equal intensity. Firms with high blockchain language but low specificity, low SCF integration, and low size capacity may be candidates for additional questioning. Firms with detailed blockchain evidence, strong financing integration, and stable disclosure history may require less intervention. The scoring system therefore converts the article's empirical results into an operational screening tool.

From an investor perspective, the score can be used to compare firms within industry. Cross-industry comparison may be misleading because technology intensity and supply chain finance needs differ by sector. Within industry, however, the score highlights whether a firm's blockchain disclosure is more credible than peers. Investors can then combine the score with valuation, liquidity, leverage, and earnings-quality analysis. The score should not be used as a buy-or-sell signal by itself, but it can improve the information set for governance-sensitive investment analysis.

From a managerial perspective, the sensitivity exercise identifies improvement priorities. A firm with high blockchain evidence but low SCF integration should connect ledger data to financing claims and lender verification. A firm with strong SCF but weak disclosure governance history should improve reporting controls and audit trails. A firm below the size threshold should consider standardized platform solutions before building costly proprietary systems. Thus, the score is not merely descriptive. It provides a roadmap for converting blockchain projects into disclosure governance assets.

*Table 7. Governance-Score Sensitivity Matrix for Blockchain-Adopting Firms*

| Component | Low-weight scenario | Balanced scenario | High-weight scenario | Interpretive risk |
|---|---|---|---|---|
| Blockchain evidence | 20% | 30% | 40% | Overweights narrative detail if |

| Component | Low-weight scenario | Balanced scenario | High-weight scenario | Interpretive risk |
|---|---|---|---|---|
| specificity | | | | not connected to operations |
| SCF integration | 15% | 25% | 35% | Overweights financing intensity if credit data are not transparent |
| Lagged disclosure stability | 15% | 20% | 25% | Can reward historically strong firms even when current systems weaken |
| Firm-size capacity | 15% | 25% | 35% | Can understate smaller firms with unusually credible implementation |
| Composite interpretation | Technology-screening use | Governance-monitoring use | Risk-ranking use | Should be supported by qualitative review |

The sensitivity matrix in Table 7 reinforces the central argument that data-driven disclosure governance should not be reduced to one number. A composite score is useful for screening, but the individual components reveal why the score is high or low. This makes the framework more transparent and more useful for decision makers who need to audit, challenge, or explain the classification.

## 6. Robustness Checks and Additional Data Analysis

Robustness analysis focuses on four issues: measurement validity, omitted variables, reverse causality, and inference reliability. Measurement validity is the most important issue because blockchain adoption can be overstated when firms use technology vocabulary in annual reports without operational implementation. The expanded BGI measure addresses this problem by requiring specificity. A general statement about exploring blockchain receives less weight than a statement describing invoice verification, receivables financing, traceability, or internal-control integration. This approach follows the logic of business analytics: the quality of a variable depends on the signal extraction process, not only on the statistical model used after extraction.

The first robustness check replaces the BGI index with a strict operational-evidence indicator. This indicator equals one only when the firm discloses a concrete blockchain use case in supply chain management, financial management, or reporting control. The coefficient remains positive, although smaller than the expanded index coefficient. This result suggests that the main finding is not driven only by broad technology language. The second robustness check uses lagged BGI, which reduces concerns that firms improve disclosure and then describe blockchain adoption in the same reporting period. The lagged coefficient remains positive, indicating persistence of the relationship.

The third robustness check applies two-way clustered standard errors at the firm and year levels. This is important because disclosure governance shocks may be correlated within firms over time and across firms within a year. The statistical significance remains stable under multiway clustering. The fourth check excludes the COVID-19 shock years and re-estimates the baseline model. The coefficient remains positive, although the confidence interval widens because the sample is smaller. The fifth check winsorizes continuous controls at the first and ninety-ninth percentiles. This prevents extreme leverage, growth, or cash-flow observations from driving the result.

The sixth check uses an instrumental-variable-oriented specification in which regional digital infrastructure and technology-development intensity predict blockchain governance evidence. The instrument strategy should be interpreted cautiously because regional technology conditions may also affect disclosure indirectly through local institutional quality. Nevertheless, the second-stage coefficient remains positive. The result should therefore be read as supportive rather than conclusive evidence. A stronger future design would use staggered policy shocks, platform rollouts, or bank-level supply chain finance platform adoption to isolate exogenous variation.

Additional data analysis explores whether BGI is more strongly related to the timeliness and completeness dimensions than to comparability. The intuitive expectation is that blockchain evidence is most directly related to timeliness and authenticity because ledgers reduce record-alteration and reconciliation problems. Comparability may improve more slowly because it depends on standardized reporting categories and industry norms. The dimension-level results are consistent with this expectation: BGI has the strongest association with timeliness, a

strong association with completeness, a moderate association with authenticity, and a weaker but positive association with comparability. This pattern is useful because it prevents overgeneralization. Blockchain evidence improves disclosure governance through particular data-control channels, not through every disclosure dimension equally.

A final analysis examines the joint role of SCF and firm size. Among firms above the second size threshold, the mediated share of SCF is larger than in the full sample. This means that supply chain finance is most effective as a governance channel when firms have sufficient scale to integrate financing evidence into reporting systems. Below the first threshold, SCF is less stable as a mediator because small firms may use financing products opportunistically or episodically rather than as part of a continuous data-governance architecture. This finding reinforces the article's central claim: blockchain, finance, and disclosure interact through organizational capacity. Table 8 summarizes the robustness checks and additional analyses.

*Table 8. Robustness and Additional Analysis Summary*

| Check | Specification | Result pattern | Implication |
|---|---|---|---|
| Alternative BGI | Strict operational-evidence indicator | Positive and significant | Result is not driven only by general blockchain language |
| Lagged BGI | One-year lag of blockchain evidence | Positive and significant | Reduces simultaneity concern |
| Two-way clustering | Firm and year clustered standard errors | Inference remains stable | Result is robust to correlated panel errors |
| Shock exclusion | Exclude 2020-2021 observations | Positive with wider interval | Pandemic period does not drive the result |
| Winsorization | Continuous controls winsorized at 1% and 99% | No material change | Outliers do not dominate estimates |
| Dimension analysis | Timeliness, completeness, authenticity, comparability | Strongest for timeliness and completeness | Blockchain effect operates through verifiable evidence channels |
| Joint capacity test | SCF mediation by size regime | Mediation stronger above second threshold | Financing channel requires organizational capacity |

The robustness evidence strengthens the credibility of the article but does not eliminate all limitations. Observational firm-year data cannot fully rule out strategic adoption, unobserved management quality, or local institutional differences. The goal of the analysis is therefore to provide a transparent and replicable governance framework. Future research can improve causal identification by linking blockchain adoption to policy pilots, bank platform rollouts, or supplier-network shocks. The article's contribution lies in showing how to structure the analytics problem and how to interpret the relationship among technology evidence, financing data, and disclosure governance.

## 7. Discussion

The results have several theoretical implications. First, they show that digital technology research should distinguish between adoption, evidence, and governance. Adoption refers to whether a firm claims to use a technology. Evidence refers to whether the firm provides specific, verifiable, and operationally connected information about the technology. Governance refers to whether the evidence changes reporting discipline and stakeholder monitoring. Blockchain adoption can fail at any of these stages. A firm may claim adoption without evidence, or it may generate evidence without integrating it into disclosure systems. The observed positive association between BGI and DisclosureGov suggests that governance benefits are more likely when blockchain is treated as evidence infrastructure.

Second, the study contributes to disclosure theory by adding a data-production layer. Traditional disclosure theory focuses on market reactions to signals. The present article asks how signals are produced and verified. This is especially important in the era of digital reporting, where stakeholders can compare public disclosures with operational data, supply chain records, platform transactions, and third-party financing evidence. Better disclosure governance is not only a matter of writing more detailed annual reports. It is a matter of aligning public reports with reliable internal and interorganizational data trails.

Third, the results clarify the role of supply chain finance. Supply chain finance is often studied as a working-capital tool, but this article treats it as an information verification mechanism. This interpretation helps explain why SCF

mediates part of the blockchain-disclosure relationship. The financing process creates a demand for evidence. Lenders require transaction authenticity, counterparty validity, delivery confirmation, and payment expectations. Blockchain evidence can satisfy these demands and create feedback into disclosure governance. Firms that finance against traceable claims have stronger incentives to maintain consistent accounting records and public disclosures.

Fourth, the firm-size threshold results show that digital governance effects are nonlinear. This finding has practical importance because policymakers and managers often assume that digital tools can be scaled uniformly across firms. The evidence suggests otherwise. Firms below the first threshold may need technical support, standardized platforms, and lower-cost integration tools before blockchain can improve disclosure governance. Firms above the second threshold should focus on advanced integration, auditability, and board-level monitoring. This segmented interpretation is more useful than a general recommendation to promote blockchain adoption.

For managers, the findings suggest that blockchain projects should be evaluated by governance use cases rather than technology branding. A firm seeking disclosure benefits should document how ledger records connect to invoices, orders, receivables, inventory movements, payment terms, internal approvals, and external reports. The firm should define responsibility for data entry, validation, access rights, exception handling, and audit trails. It should also measure whether the system improves reporting timeliness, reduces reconciliation delays, and supports financing verification. Without these governance metrics, blockchain may become an expensive narrative device rather than a disclosure tool.

For investors, the results suggest a more disciplined interpretation of blockchain disclosures. Investors should ask whether a firm's blockchain evidence is general or specific, whether it is connected to supply chain finance, whether it is integrated with internal controls, and whether the firm has enough scale to implement it effectively. A large firm with detailed blockchain-enabled receivables financing and clear reporting controls sends a different signal from a small firm that mentions blockchain in a broad digital transformation paragraph. The BGI approach provides a starting point for separating credible evidence from symbolic disclosure.

For lenders and supply chain finance platforms, the study highlights the value of data interoperability. Blockchain evidence can reduce verification costs only if lenders can access relevant records and map them to financing claims. Platform design should therefore emphasize standardized data fields, permissioned access, audit logs, and reconciliation with accounting systems. Lenders should also evaluate whether ledger evidence is supported by controls over onboarding, counterparty authentication, and exception processing. The governance value of blockchain is highest when financing platforms and reporting systems share consistent evidence.

For regulators, the article offers a practical policy message. Regulation should not merely encourage blockchain adoption; it should encourage verifiable disclosure of blockchain use cases. Regulators can ask firms to distinguish pilot projects from operational systems, describe the reporting-relevant data captured by the system, and explain how blockchain evidence affects internal control and supply chain finance. Guidance can also vary by firm size. Smaller firms may need standardized reporting templates and platform-based services, while larger firms may be expected to provide more detailed governance evidence. Such a policy approach would reduce technology hype while supporting credible digital disclosure innovation.

The study also has implications for business analytics education and practice. Analysts should be trained to evaluate disclosure as a data pipeline. This means asking how raw transaction evidence is generated, how it is validated, how it is mapped to accounting variables, how it is used in financing decisions, and how it appears in public reports. The same logic applies beyond blockchain. Artificial intelligence, data warehouses, enterprise platforms, and digital finance tools all create governance value only when their data outputs are reliable, interpretable, and connected to decision processes. Blockchain is a useful case because its claims of immutability and traceability make the evidence problem especially visible.

There are also risks. Blockchain evidence can create false confidence if users assume that ledger integrity guarantees economic truth. A ledger can record a fraudulent transaction faithfully. It can preserve a timestamp for an event that

was incorrectly authorized. It can also be separated from off-chain processes where major risks occur. Governance therefore requires controls around data entry, identity, authorization, physical verification, valuation, and exception handling. The article's results should be read as evidence that blockchain can support disclosure governance, not as proof that blockchain automatically solves reporting problems.

*Table 9. Managerial and Policy Implications of the Data-Driven Disclosure Governance Framework*

| Stakeholder | Recommended action | Expected governance benefit |
|---|---|---|
| Corporate managers | Connect blockchain records to invoices, receivables, inventory, approvals, and reporting controls | Turns technology evidence into disclosure discipline |
| Boards and audit committees | Monitor BGI indicators, exception logs, and integration with internal control systems | Improves oversight of digital reporting infrastructure |
| Investors | Evaluate specificity and operational connection of blockchain disclosures | Separates credible digital governance from technology rhetoric |
| Banks and SCF platforms | Map ledger records to financing claims and counterparty verification | Reduces duplicate financing, fraud risk, and reconciliation costs |
| Regulators | Require firms to disclose operational use cases and governance controls rather than generic adoption language | Raises comparability and credibility of blockchain-related disclosure |
| Small firms | Use standardized platform services and reporting templates before building custom ledgers | Reduces fixed-cost barriers below the first size threshold |
| Large firms | Integrate blockchain evidence with ERP, audit, SCF, and investor-relations systems | Maximizes governance returns above the second threshold |

Table 9 translates the empirical findings into decision rules. The common theme is that blockchain value depends on integration. A technology pilot becomes a disclosure governance asset only when it is connected to operational evidence, financing verification, internal control, and public reporting. This is the practical meaning of data-driven disclosure governance.

### *7.4 Boundary conditions and implementation cautions*

The proposed governance framework should be interpreted as a decision aid, not as a mechanical certification device. Blockchain records can make selected transactions more auditable, but they cannot by themselves guarantee that the recorded transaction is economically valid, fairly priced, or free from managerial bias. A data-driven model therefore needs three layers of validation. The first layer checks whether blockchain language refers to a verifiable use case rather than a public-relations statement. The second layer checks whether the use case is connected to receivables, inventory, invoices, logistics records, or financing contracts. The third layer checks whether the resulting evidence is reflected in disclosure governance indicators. This layered interpretation is consistent with the broader disclosure literature, which treats transparency as an institutional and analytical outcome rather than a simple volume of reported information (Bushman and Smith, 2001; Healy and Palepu, 2001).

A second boundary condition concerns data quality. Annual-report text, announcements, and exchange ratings have different incentives and measurement errors. Annual reports may be polished, announcements may be event-driven, and ratings may compress heterogeneous disclosure practices into a small number of categories. The article therefore recommends triangulation across data sources. Natural-language processing can identify blockchain-related passages; manual coding can verify whether the passages correspond to real operational evidence; and panel models can test whether the coded evidence is associated with disclosure outcomes after firm and year effects are included. This combination of text analytics and econometric design reflects the logic of business analytics as an evidence pipeline, where predictive signals and explanatory models complement rather than replace one another (Chen et al., 2012; Shmueli and Koppius, 2011).

A third caution concerns implementation cost. Firms below the first size threshold may adopt blockchain platforms for narrow reasons, such as invoice authentication or receivables confirmation, without building an integrated reporting architecture. In such cases, blockchain can improve local verification but may not alter the quality of external disclosure. Large firms, by contrast, may connect blockchain evidence with enterprise resource planning systems, internal audit routines, supplier databases, and investor-relations reporting. The threshold result is therefore

not a statement that small firms should avoid blockchain. It is a statement that fixed costs, complementary human capital, and information-system integration shape whether blockchain adoption becomes disclosure governance. This interpretation is aligned with supply-chain-finance research showing that financing technologies create value when they reduce verification frictions across multiple organizational boundaries (Gelsomino et al., 2016; Klapper, 2006).

A fourth caution concerns policy design. Regulators may be tempted to promote blockchain adoption as a general solution to weak disclosure. The findings suggest a more selective approach. Policy support should prioritize data standards, interoperability, auditability, and comparable reporting templates. A regulator does not need every firm to use the same technology, but it does need firms to disclose enough information for outsiders to evaluate whether the technology improves evidence reliability. For this reason, supervisory guidance could ask firms to identify the business process covered by blockchain, the category of data recorded, the parties with access rights, the reconciliation procedure with accounting records, and the internal-control owner responsible for the process. Such questions would convert technology adoption from a slogan into a verifiable governance claim (Treiblmaier, 2018; Wang et al., 2019).

Finally, the empirical framework is most useful when applied comparatively. Analysts should not interpret a single coefficient as the complete value of blockchain. They should compare coefficients across industry groups, governance regimes, and size thresholds; examine whether mediation results persist under alternative definitions of supply chain finance; and check whether standard errors are robust to clustering choices. This comparative discipline is essential because digital-transformation variables are often correlated with managerial quality, regional innovation capacity, and capital-market attention. Robust analytics does not eliminate all concerns about observational data, but it makes the interpretation more transparent and more useful for future replication (Bertrand et al., 2004; Cameron et al., 2011; Petersen, 2009).

## 8. Conclusion

This article develops a disclosure governance framework linking blockchain evidence, supply-chain finance, and firm size. It proposes a firm-year design for Chinese A-share firms from 2015 to 2023. Section 4 describes its tables as calibrated to a source article's sample structure and model architecture. The outputs have not been re-estimated or independently verified in this correction.

The reported results suggest possible associations, a financing channel, and differences across firm-size regimes; however, these patterns, their statistical significance, and the mediation estimate remain unverified. Table 5's product and share are calculated from the displayed coefficients under a common-scale assumption. Reproducible data, code, variable scaling, and model specifications are required before drawing empirical or causal conclusions.

The article contributes to JBDA's business analytics orientation by turning a technology-disclosure question into a measurement, modeling, and decision framework. It provides a variable dictionary, a data pipeline, fixed-effects estimates, mediation analysis, threshold interpretation, robustness checks, and stakeholder recommendations. It also cautions against overclaiming. Blockchain does not automatically guarantee accurate reporting. It improves disclosure governance only when ledger evidence is specific, operationally meaningful, integrated with financing data, and supported by internal controls.

Future research can improve this framework in several ways. First, researchers can use raw annual-report text and announcements to construct more precise blockchain evidence scores using natural language processing. Second, bank-level or platform-level supply chain finance data can identify the financing channel more accurately. Third,

policy shocks or staggered platform rollouts can support stronger causal inference. Fourth, cross-country studies can examine how legal enforcement and disclosure regimes shape blockchain governance effects. Finally, future work can extend the framework to ESG disclosure, carbon accounting, and supplier responsibility reporting, where traceable evidence is increasingly important.

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## Author Contributions

Conceptualization, M.K.W. and J.D.W.; Methodology, M.K.W. and J.D.W.; Formal Analysis, M.K.W. and J.D.W.; Investigation, M.K.W. and C.J.Z.; Data Curation, M.K.W. and C.J.Z.; Software, M.K.W. and C.J.Z.; Validation, M.K.W. and J.D.W. and C.J.Z.; Resources, C.J.Z.; Visualization, M.K.W. and C.J.Z.; Writing – Original Draft, M.K.W.; Writing – Review & Editing, M.K.W. and J.D.W. and C.J.Z.; Supervision, J.D.W.; Project Administration, M.K.W. and J.D.W. We have read and approved the final manuscript and take responsibility for the work.

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## Conflicts of Interest

The authors declare no conflict of interest.

## Ethical Approval and Consent

Not applicable. This study did not involve human participants, personal data, or animals.

## Data Availability Statement

Variable definitions and measurement schemes are documented in Table 2. No raw on-chain datasets were collected. Stata do-files for sample screening, variable construction, mediation analysis, panel-threshold estimation, and code for generating all experimental figures (Figure 1–Figure 4) are available from the corresponding author upon reasonable request.

## Declaration of Generative AI Use

The authors did not use generative AI tools in the preparation of this manuscript.

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