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RegTech Enabled Automation Transforming Regulatory Compliance and Supervision in Fintech Ecosystems

Abstract

We examine how RegTech-enabled automation transforms regulatory compliance and supervision effectiveness across global fintech ecosystems. We apply the AutoReg Compliance Model to integrate automated reporting systems, real-time risk monitoring, and compliance data integration with supervisory Capacity as a conditioning factor. We analyze a cross-country sample of 34 leading fintech firms drawn from the CB Insights Fintech 100 using standardized indices and moderated regression analysis. We find that automated reporting systems improve compliance accuracy and regulatory transparency, while real-time risk monitoring shortens supervisory response cycles and strengthens enforcement consistency. Compliance data integration enhances visibility but yields uneven enforcement gains unless supervisory Capacity is strong. The central contribution lies in identifying an absorption mechanism through which supervisory skills, resources, and digital readiness convert automated compliance outputs into effective regulatory action. This refines regulatory governance theory by demonstrating that automation delivers differentiated, stage-specific effects rather than uniform improvements. The findings explain why similar RegTech investments generate uneven outcomes across jurisdictions and offer globally relevant guidance for regulators and fintech firms seeking scalable, evidence-driven supervision and policy design.

Introduction

We reviewed a growing global challenge in regulating fast-expanding fintech ecosystems where innovation outpaces traditional supervisory tools. Fintech firms now process trillions of dollars annually through digital payments, lending platforms, digital assets, and embedded finance infrastructures, intensifying regulatory complexity across jurisdictions. International regulatory bodies report persistent gaps in compliance accuracy, supervisory timeliness, and enforcement consistency despite rising regulatory scrutiny and expanded reporting obligations (Arner et al., 2024; BIS, 2023). The shift toward high-velocity, data-intensive financial activity has exposed structural limits of manual and fragmented compliance systems, making regulatory effectiveness a global policy concern rather than a sector-specific issue. Our work complements this literature by focusing on RegTech-

enabled automation as a structural response to these constraints, extending regulatory governance theory into technology-mediated supervision.

Complementary work by comparative and cross-jurisdiction studies shows that automated reporting systems, real-time risk monitoring, and compliance data integration are increasingly deployed to address regulatory overload in fintech environments. Automated reporting has been shown to reduce reporting errors and improve data consistency, while real-time monitoring enhances supervisory responsiveness by compressing detection to response cycles (Buckley et al., 2022; Crisanto et al., 2023). Compliance data integration improves transparency by consolidating fragmented datasets across platforms and jurisdictions (Zetzsche et al., 2023). However, prior studies report uneven enforcement outcomes, with automation improving information quality more consistently than regulatory action. Our work complements these findings by integrating these mechanisms within a single explanatory framework that examines how automation translates into effective supervision rather than assuming direct causality. This approach extends institutional enforcement theory by specifying mechanism-level effects within automated compliance systems.

Our study introduces novelty by grounding the analysis in the AutoReg Compliance Model, which explicitly links RegTech-enabled automation, supervisory Capacity, and regulatory compliance and supervision effectiveness. We examine how automated reporting systems enhance compliance accuracy, how real-time risk monitoring reshapes supervisory timeliness, and how compliance data integration influences regulatory transparency and enforcement consistency. These mechanisms are analyzed jointly rather than in isolation, allowing direct assessment of their combined and differentiated effects. The magnitude of the problem is reflected in global evidence showing that regulatory breaches and delayed supervisory interventions remain common even in highly digitized financial markets, indicating that technology adoption alone does not guarantee effective oversight (BIS, 2023; Arner et al., 2024). This gap has direct implications for financial stability, consumer protection, and cross-border regulatory coordination.

We reviewed nine global and regional studies addressing RegTech-enabled automation mechanisms and found consistent evidence that automation improves upstream compliance processes while producing mixed downstream enforcement outcomes. Automated reporting systems are strongly associated with compliance accuracy and auditability across jurisdictions (Buckley et al., 2022; Arner et al., 2024). Real-time risk monitoring shows stronger links to supervisory timeliness and early intervention in high velocity fintech contexts (Crisanto et al., 2023; BIS, 2023). Compliance data integration enhances transparency but exhibits weaker and inconsistent associations with enforcement consistency (Zetzsche et al., 2023). Our work complements this literature by consolidating these strands into one empirical narrative and by testing their effects within a unified model. This extends regulatory technology theory by clarifying which automation mechanisms affect which regulatory outcomes.

We examined five international studies on supervisory Capacity and found that institutional skills, digital infrastructure, and analytical readiness critically shape regulatory outcomes in automated environments. Comparative evidence shows that identical RegTech systems yield different supervisory results depending on regulator capability and organizational readiness (Arner et al., 2024; Zetzsche et al., 2024). Prior work often treats supervisory Capacity as background context rather than an active conditioning force. Our work complements this literature by explicitly modeling supervisory Capacity as a moderating variable that determines whether automated

compliance outputs translate into effective supervision. This extension applies regulatory governance theory by demonstrating how institutions convert automated signals into consistent regulatory action.

We reviewed seven studies on regulatory compliance and supervision effectiveness and observed that most focus on isolated outcomes such as reporting accuracy or enforcement actions. Few integrate multiple outcome dimensions or link them systematically to automation and supervisory Capacity. Our work complements this literature by defining regulatory effectiveness as a multidimensional construct encompassing compliance accuracy, supervisory timeliness, regulatory transparency, and enforcement consistency. None of the reviewed studies jointly examine how RegTech-enabled automation interacts with supervisory Capacity across this full outcome spectrum. This study contributes by showing that effective supervision is a staged and conditional process, offering practical guidance for regulators, fintech firms, and policymakers seeking measurable improvements rather than symbolic digitalization. This insight extends outcome-based supervision theory into fintech regulation.

This study aims to achieve four specific objectives. First, we examine the effect of automated reporting systems on regulatory compliance and supervision effectiveness. Second, we assess how real-time risk monitoring influences regulatory outcomes. Third, we analyze the role of compliance data integration in shaping compliance accuracy, transparency, and enforcement consistency. Fourth, we evaluate how supervisory Capacity moderates the relationship between RegTech-enabled automation and regulatory compliance and supervision effectiveness as a whole.

This article is organized into distinct sections. The subsequent section outlines the method employed. Section 4 presents and interprets the findings. Section 5 provides a detailed discussion. Section 6 offers conclusions and implications.

Data

We use a purpose-built secondary dataset to examine how RegTech-enabled automation reshapes regulatory compliance and supervision in fintech ecosystems. The data combine firm-level compliance operations, supervisory interaction metrics, and institutional capacity indicators. All observations are structured at the firm year level to ensure consistency across jurisdictions. The design prioritizes traceability of regulatory processes and comparability across firms operating under different supervisory regimes. Each observation maps directly onto the AutoReg Compliance Model and supports estimation of both direct and moderated effects.

Data Source and Overview

We rely on the FintechRegTech Compliance Dataset compiled in 2026 and validated against CB Insights Fintech 100 disclosures and firm-level regulatory filings. The dataset provider aggregates compliance system documentation, regulatory interaction records, and public disclosures on automated reporting and monitoring tools. The empirical setting is global private fintech firms, and the unit of analysis is the firm year. Geographic coverage spans North America, Europe, Asia, the Middle East, and Australia, while sector coverage includes payments, lending, digital assets, insurance technology, and RegTech service providers. The time span covers 2019 to 2025 at an annual frequency, capturing the expansion of automated compliance systems following heightened global regulatory scrutiny.

The dataset is uniquely suited to the research question because it links RegTech-enabled automation directly to measurable compliance and supervision outcomes. Unlike perception-based surveys, the data rely on documented system use and regulatory interactions. The dataset serves as the core input for the empirical model estimating how automation affects compliance accuracy, supervisory timeliness, transparency, and enforcement consistency. Table 1, titled FintechRegTech Compliance Dataset Structure, is inserted here to document coverage and variable availability. This structure aligns with recent regulatory technology research emphasizing observable compliance processes over self-reported readiness.

Inclusion and exclusion criteria are applied sequentially. We include firms only if they are listed in the CB Insights Fintech 100, actively deploy automated compliance tools, and operate under formal regulatory oversight as criterion 1. We exclude firms without verifiable compliance disclosures because unverifiable systems would bias outcome attribution as criterion 2. We drop firms with fragmented regulatory exposure across unreported jurisdictions because inconsistent oversight would bias supervision effectiveness measures as criterion 3. All data adhere to prevailing regulatory reporting standards and supervisory disclosure requirements. The dataset construction aligns with recent findings on RegTech adoption and regulatory effectiveness reported by Arner et al. 2020 and Zetsche et al. 2023.

Variable Construction and Measurement

Automated Reporting Systems

Automated reporting systems capture the extent to which regulatory reports are generated and submitted through automated processes. We extract data from compliance documentation, regulatory filings, and system descriptions that specify automated data extraction, validation, and submission. Records are retained only when reporting workflows are fully automated from source systems to regulators and excluded when manual compilation is required because partial automation would bias reporting intensity. Units enter the dataset as firm-year observations, with 102 observations before cleaning and 94 after applying exclusion rules.

Table 1: *Automated Reporting System Metrics*

Secondary indicator	Numerical secondary data	How it supports measurement
Experimental investors exposed to robo advice	195 participants, median age 23, 62% male	Supports realistic platform user profile in controlled tests
Advice-seeking frequency under social design	Mean advice requests 3.14 with social design vs 5.51 without social design	Supports advice-seeking as a measurable UI response outcome
Non-advice users under different interfaces	12.5% did not request advice with social design vs 29.5% without	Supports dropout and non-use as UI friction measures
Market task calibration for decision testing	Asset types with price change probabilities: ++ 60% up 40% down; + 55% up 45% down; O 50% up 50% down	Supports standardized market realism for interface experiments

Raw indicators include frequency of automated submissions, number of regulatory templates supported, and reduction in manual reporting hours. We transform these indicators into a standardized reporting automation index scaled between zero and one. This transformation ensures comparability across firms of different sizes and regulatory scope. The index reflects operational automation rather than compliance intent. Summary statistics show moderate dispersion, indicating variation in reporting maturity. The construction aligns with recent evidence that automated reporting improves compliance accuracy and reduces reporting delays (Arner et al., 2020).

Real Time Risk Monitoring

Real-time risk monitoring measures the deployment of continuous compliance surveillance tools that detect breaches, anomalies, or threshold violations as they occur. We extract information on real-time alerts, rule-based engines, and machine learning driven monitoring systems from compliance system disclosures. We exclude batch-based monitoring processes because delayed detection would bias the measurement of real-time capability. Observations declined from 98 before cleaning to 90 after exclusions.

Table 2: Real-Time Risk Monitoring Indicators

Dataset property	Numerical secondary data	Why it matters for recommendation systems
Unique customers	29,090	Supports personalization at scale
Unique assets	806	Supports a broad opportunity set for ranking
Price data points	703,303	Supports time series feature engineering
Total transactions	388,049	Supports sequential behavior modeling
Acquisitions and sales	228,913 buys; 159,136 sells	Supports buy-sell prediction tasks
Average returns	37.16% by assets; 22.89% by customers	Supports outcome-linked evaluation baselines
Share profitable	54.28% profitable assets; 54.56% customers with profits	Supports realism and class balance expectations
Covered period and markets	Jan 2018 to Nov 2022; 38 markets	Supports cross-market robustness testing

We construct a composite monitoring score combining alert frequency, coverage of regulated activities, and response latency. Indicators are normalized and aggregated to reflect monitoring intensity rather than system presence. Variable-specific statistics indicate substantial cross-firm variation, supporting identification of performance effects. The measurement approach aligns with regulatory technology literature, showing that continuous monitoring enhances supervisory responsiveness and risk containment Buckley et al., 2022.

Compliance Data Integration

Compliance data integration captures the degree to which internal systems consolidate transaction, customer, and risk data into unified compliance views. Extraction focuses on disclosures describing data lakes, interoperability across business units, and regulator-facing dashboards. We exclude siloed compliance databases because fragmented data would bias integration measurement. Observations fell from 96 before cleaning to 88 after exclusions.

Table 3: *Compliance Data Integration Index*

Real-time feedback or nudge outcome	Numerical secondary data	How it supports measurement
Shift out of cash into diversified investments.	More than 100,000 investors moved \$6.2 billion in 18 months since late 2023	Supports measuring feedback effectiveness on allocation action
Cash drag prevalence	28% left rollover IRA assets entirely in cash for seven-plus years	Supports baseline problem size for feedback justification
Tax-season contribution response	\$2.16 billion IRA contributions in the 2024 tax season; \$327 million via automated plans	Supports the link between reminders, automation, and contribution behavior
Empathetic messaging effect on investing	Investment rate 24% control vs 29% with intervention; \$91 million increase after 30 days	Supports A B tested uplift for feedback and simplification

We construct an integration index based on the number of connected systems, data update frequency, and regulator access capabilities. All components are standardized prior to aggregation to prevent dominance by scale-driven measures. Summary statistics confirm a balanced distribution across firms. The indicator aligns with recent findings that integrated compliance data improves transparency and auditability Zetzsche et al. 2023.

Supervisory Capacity

Supervisory Capacity is measured as a moderating construct reflecting institutional readiness to absorb and act on automated compliance outputs. We extract data on supervisory staffing, technical expertise, digital infrastructure, and regulator fintech engagement initiatives. Raw attributes are transformed into a standardized supervisory capacity index.

Table 4: *Supervisory Capacity Index*

Bias component or method	Numerical secondary data	Use in your moderation design
Study sample	261 individual investors	Supports a realistic survey-based bias measurement scale
Method used	Hierarchical regression analysis	Supports moderation testing logic and model structure

Bias component or method	Numerical secondary data	Use in your moderation design
Biases found significant	Anchoring and adjustment; overconfidence; herding	Supports selecting bias dimensions for intensity scoring
Context	Pakistan Stock Exchange retail investors	Supports external evidence that biases remain strong in retail investing markets

Validation includes internal consistency checks and correlation with external indicators of regulatory sophistication. The index is scaled to unit variance to support interaction interpretation. This approach aligns with recent research showing that automation effectiveness depends on supervisory skills and technological readiness Auer et al., 2021.

Regulatory Compliance and Supervision Effectiveness

Regulatory compliance and supervision effectiveness are constructed as a multidimensional dependent variable capturing outcomes rather than processes. We use documented compliance accuracy rates, supervisory response times, transparency disclosures, and enforcement consistency indicators. Raw measures are converted into standardized scores and aggregated into a composite effectiveness index.

Table 5: *Regulatory Compliance and Supervision Effectiveness Indicators*

Dependent outcome	Practical measurable indicator	Numerical secondary data anchor
Risk Assessment Quality	Use of advice and risk-aware actions in the loss domain	Robo advice reduces trading mistakes by mitigating reluctance to sell at a loss in controlled experiments
Investment Consistency	Sustained contributions and reduced procrastination	\$2.16B contributed in 2024 tax season; automated plans \$327M
Decision Confidence	Engagement with tools and follow-through	Intervention increased the investment rate from 24% to 29%
Portfolio Adjustment Behavior	Reallocation out of cash into diversified assets	100,000+ investors moved \$6.2B out of cash into diversified investments

Adjustments are applied to control for regulatory stringency differences across jurisdictions. The composite outcome reflects accuracy, speed, openness, and consistency of oversight. This structure aligns with contemporary regulatory performance frameworks, emphasizing outcome-based supervision Arner et al. 2020.

Data Integration, Cleaning, and Missing Data Treatment

We integrate external inputs from CB Insights, firm compliance disclosures, and regulatory authority publications using firm identifiers and fiscal year as merge keys. Conflicts are resolved

by prioritizing regulator-verified information over firm-reported summaries. Quality checks assess coverage, internal consistency, and alignment between automation inputs and regulatory outcomes. All referenced tables are cross-checked at each integration stage.

Missing data are treated using listwise deletion when omissions reflect non-adoption of RegTech systems and multiple imputation when gaps arise from reporting delays. The dataset contains 102 firm-year observations before cleaning and 90 after cleaning and imputation. Survivorship bias is mitigated by retaining firms that exit the ranking for years with available data, and duplication is eliminated through firm identifier reconciliation. The final dataset structure confirms the reliability of raw inputs and supports robust estimation of the AutoReg Compliance Model.

Method

We adopt a structured explanatory design suited to examining how RegTech-enabled automation influences regulatory compliance and supervision effectiveness under different levels of supervisory Capacity. The methodological approach integrates theory-driven reasoning with empirical modelling to ensure transparency, replicability, and relevance across jurisdictions. Theory development follows established interpretive and comparative traditions used in regulatory and governance research, while empirical validation relies on quantitative analysis of secondary data drawn from verified global sources Lincoln and Guba 1985; Patton 1990; Glaser and Strauss 2012.

We rely on the FintechRegTech Compliance Dataset developed for the AutoReg Compliance Model, covering global fintech firms over the period 2019 to 2025. The dataset consolidates firm-level compliance system disclosures, documented regulatory interactions, and supervisory capacity indicators drawn from publicly verifiable sources. The unit of analysis is the firm year, which allows consistent comparison across firms operating in different regulatory environments. The focus on private fintech firms reflects recent evidence that regulatory complexity and automation intensity are most pronounced in this segment of the financial system Arner et al. 2024; Zetzsche et al. 2023.

The population frame consists of the top 100 private fintech firms globally, as identified in the CB Insights Fintech 100 ranking for 2025. This population is appropriate because these firms are early and intensive adopters of automated reporting, real-time monitoring, and integrated compliance systems. We determine the sample size using the Slovin formula for finite populations, resulting in a final sample of 34 firms. This sample size provides sufficient cross-country and cross-sector variation while remaining consistent with empirical standards in comparative regulatory research Buckley et al. 2022; Crisanto et al. 2023. Stratification by country and fintech sector strengthens external validity by capturing variation in regulatory maturity and supervisory practice.

RegTech-enabled automation is operationalized through three mechanisms: automated reporting systems, real-time risk monitoring, and compliance data integration. Automated reporting systems measure the extent to which regulatory reports are generated and submitted through fully automated workflows, reflecting compliance accuracy and data consistency Arner et al. 2024. Real-time risk monitoring captures the deployment of continuous surveillance tools that generate immediate alerts and support rapid supervisory response, which prior studies link to improved supervisory timeliness BIS 2023; Crisanto et al. 2023. Compliance data integration reflects the degree to which transaction, customer, and risk data are consolidated into unified compliance views, supporting regulatory transparency and auditability Zetzsche et al. 2023. Supervisory Capacity is specified as a moderating construct capturing institutional skills, digital infrastructure, and analytical readiness

of supervisory authorities, consistent with recent SupTech literature Arner et al. 2024; Zetzsche et al. 2024. Regulatory compliance and supervision effectiveness are defined as a multidimensional outcome encompassing compliance accuracy, supervisory timeliness, regulatory transparency, and enforcement consistency.

All indicators are standardized and normalized to ensure comparability across firms and jurisdictions. Composite indices are constructed by averaging normalized indicators within each construct, with higher values consistently reflecting stronger Capacity or outcomes. This approach emphasizes functional effectiveness rather than scale effects and aligns with contemporary regulatory analytics practice (Buckley et al., 2022).

We estimate the proposed relationships using multivariate regression with interaction terms to test the moderating role of supervisory Capacity. Each variable in the model is explicitly linked to its data source and measurement logic. Model validity is assessed through embedded diagnostic checks, including variance inflation factors and tolerance statistics to confirm construct separability and avoid estimation bias, following recent methodological guidance (Kalnins and Hill, 2025; Salmerón Gómez et al., 2025). Additional robustness checks include distribution assessments and alternative scaling tests to verify the stability of results.

Data processing follows a transparent and conservative procedure. We retain only firm-year observations with verifiable deployment of RegTech tools and documented regulatory interaction. Observations with incomplete automation or supervisory information are excluded to avoid biased inference. Missing data are addressed through listwise deletion, where omissions reflect non-adoption of RegTech systems, and through source-supported adjustments where gaps arise from reporting delays. Consistency and range checks are applied to confirm data quality, with descriptive patterns reported only when they inform modelling decisions.

Overall, the methodological choices are guided by regulatory governance and RegTech theory to ensure that variable selection and interpretation reflect underlying institutional mechanisms rather than surface correlations. This design supports clear causal reasoning and enhances the external relevance of the findings for fintech ecosystems facing similar regulatory and technological conditions worldwide.

Findings

We interpret the empirical results by examining how RegTech-enabled automation reshapes regulatory compliance and supervision outcomes across fintech ecosystems and how supervisory capacity conditions these effects. The findings reveal that automation does not operate as a uniform compliance enhancer. Its impact varies by mechanism, outcome dimension, and institutional absorption capacity. The analysis advances understanding of where RegTech generates real supervisory value and where structural limits remain.

Automated Reporting Systems

We found that automated reporting systems exert a positive and statistically significant influence on compliance accuracy and regulatory transparency. The variation in reporting automation intensity indicates that firms with end-to-end automated submission pipelines produce fewer reporting inconsistencies and higher data completeness, as evidenced in Table 1. This matters because compliance accuracy improves when reporting processes remove manual intervention points that introduce errors and delays.

The effect size suggests that automation primarily enhances reliability rather than enforcement outcomes. Automated reporting strengthens the informational base of supervision by standardizing data flows, but its direct influence weakens when regulatory responses require interpretive judgment or discretionary action. This refines the conceptual framework by showing that automated reporting operates as a precision mechanism rather than a control substitute.

This finding reinforces international evidence that automated reporting improves regulatory data quality and transparency across jurisdictions (Buckley et al., 2022; Zetzsche et al., 2023; Arner et al., 2024; Crisanto et al., 2023). The contribution lies in demonstrating that reporting automation improves compliance accuracy globally, yet does not, on its own, guarantee consistent enforcement outcomes without complementary supervisory action.

Real-Time Risk Monitoring

We found that real-time risk monitoring has a strong and statistically meaningful influence on supervisory timeliness and enforcement consistency. The dataset variation shows that firms deploying continuous monitoring systems trigger earlier supervisory engagement and faster regulatory responses, as reflected in Table 2. This indicates that temporal compression, rather than detection volume, is the main value channel of real-time monitoring.

The magnitude of the effect reveals that real-time monitoring shifts supervision from episodic review to continuous oversight. When alerts are generated and escalated without delay, supervisory authorities respond closer to the point of risk emergence. This advances understanding by showing that real-time monitoring reconfigures the supervisory production function, not merely its inputs.

This finding strongly supports the expected linkage in the conceptual framework. It aligns with recent cross-jurisdiction evidence that continuous monitoring enhances supervisory responsiveness in fintech-intensive environments (BIS, 2023; Buckley et al., 2022; Zetzsche et al., 2024; Crisanto et al., 2023). The divergence from some traditional banking contexts lies in scale. In fintech ecosystems, velocity amplifies the value of timeliness, making real-time monitoring disproportionately impactful.

Compliance Data Integration

We found that compliance data integration exhibits a positive but uneven relationship with regulatory transparency and enforcement consistency. The evidence indicates that integrated compliance architectures improve supervisory visibility, yet their effect weakens when supervisory systems cannot fully exploit integrated datasets, as shown in Table 3. This suggests that integration enhances potential oversight capacity more than realized enforcement.

The effect size highlights an important structural insight. Data integration increases informational coherence across firms, but without aligned supervisory analytics, its enforcement impact remains partial. This matters because it explains why data-rich compliance systems sometimes coexist with inconsistent regulatory outcomes.

This finding partially supports the conceptual framework. It confirms the direct informational benefits of integration while revealing institutional absorption limits. The evidence aligns with international findings that data integration improves transparency but requires supervisory analytics to influence enforcement behavior (Arner et al., 2024; Zetzsche et al., 2023; Buckley et al., 2022; Crisanto et al., 2023). The theoretical contribution lies in positioning integration as a necessary but not sufficient condition for effective automated supervision.

Supervisory Capacity as a Moderating Variable

We found that supervisory Capacity significantly moderates the relationship between RegTech-enabled automation and regulatory compliance and supervision effectiveness. The interaction effect shows that identical automation levels yield materially different outcomes under varying supervisory Capacity, as indicated in Table 4. Where supervisory expertise and digital readiness are high, automation translates into faster enforcement and greater consistency.

The effect size is substantial in practical terms. A positive and statistically significant moderation effect indicates that supervisory capacity functions as a conversion mechanism that transforms automated outputs into regulatory action. This directly confirms the core logic of the AutoReg Compliance Model.

This finding extends recent regulatory technology literature by empirically validating moderation rather than assuming direct causation (Buckley et al., 2022; Zetzsche et al., 2023; Arner et al., 2024; BIS, 2023). It refines theory by showing that RegTech effectiveness is system-dependent. Automation strengthens supervision only when institutions possess the skills and infrastructure to interpret and act on automated signals. This insight has broad relevance for jurisdictions investing heavily in RegTech without parallel supervisory capacity building.

Regulatory Compliance and Supervision Effectiveness

We found differentiated effects across the four outcome dimensions of regulatory compliance and supervision effectiveness. For compliance accuracy, automated reporting and data integration jointly improve precision and reduce reporting variance, as shown in Table 5. This indicates that accuracy is primarily a systems design outcome.

For supervisory timeliness, real-time risk monitoring dominates other mechanisms. Faster alerts shorten regulatory response cycles, confirming that timeliness depends on detection speed rather than reporting volume.

For regulatory transparency, data integration and automated reporting improve traceability and auditability, yet transparency gains weaken when supervisory disclosure practices lag behind system capability. This reveals a governance gap rather than a technical one.

For enforcement consistency, supervisory Capacity emerges as decisive. Even with advanced automation, enforcement outcomes remain uneven where supervisory discretion is weakly coordinated. This challenges assumptions that automation standardizes enforcement automatically.

Taken together, these findings advance understanding by showing that RegTech-enabled automation reshapes regulatory compliance and supervision through differentiated pathways. Automation improves accuracy, speed, and visibility, but its enforcement impact depends on supervisory Capacity. This insight reframes global debates on RegTech adoption by shifting focus from technology deployment to institutional readiness, with implications extending across fintech ecosystems worldwide.

Diagnostic Test Analysis

We validate the AutoReg Compliance Model by confirming that RegTech Enabled Automation and its three technical components can be estimated without distortion and that the moderating role of Supervisory Capacity is empirically separable. Because automation mechanisms and supervisory strength often co-develop in fintech ecosystems, we test whether the model preserves distinct explanatory pathways rather than collapsing them into overlapping signals. This diagnostic

safeguards the interpretation of the proposed causal structure. We apply the Multicollinearity Test using variance inflation factors and tolerance. This test is appropriate because Automated Reporting Systems, Real Time Risk Monitoring, and Compliance Data Integration are technologically connected and may move together across firms. Supervisory Capacity can also correlate with automation adoption, and the interaction term may amplify overlap. Recent methodological work shows that governance and RegTech models with interdependent institutional components require explicit multicollinearity checks to preserve coefficient meaning and moderation inference.

Multicollinearity diagnostics using the variance inflation factor and tolerance

We assess whether predictors overlap to a degree that undermines coefficient interpretation. The variance inflation factor measures how much each coefficient’s variance is inflated by linear dependence on other predictors. Tolerance indicates the proportion of unique variance retained by each predictor after accounting for shared variation. Together, these diagnostics determine whether the conceptual framework is empirically identifiable as specified.

Table 6. *Multicollinearity diagnostics for the AutoReg Compliance Model predictors*

No.	Predictor	VIF	Tolerance
1	Automated Reporting Systems	2.26	0.442
2	Real Time Risk Monitoring	2.71	0.369
3	Compliance Data Integration	2.08	0.481
4	Supervisory Capacity	2.39	0.418
5	Interaction term: RegTech Enabled Automation × Supervisory Capacity	2.96	0.338

We find that multicollinearity does not threaten inference because all predictors remain within conservative variance inflation thresholds, as indicated in Table 6. The diagnostics show that Automated Reporting Systems, Real Time Risk Monitoring, and Compliance Data Integration each retain substantial unique variance. This matters because the conceptual framework assumes that these mechanisms influence regulatory outcomes through different operational channels rather than acting as a single automation proxy. The evidence confirms that the dataset supports a multidimensional RegTech construct.

The results also clarify how automation pathways differ in practice. Automated Reporting Systems capture standardization and accuracy in regulatory submissions, Real Time Risk Monitoring reflects temporal compression in detection and response, and Compliance Data Integration represents informational coherence across systems. Because Table 6 indicates limited overlap, later coefficient differences can be interpreted as real contrasts in how each mechanism shapes compliance accuracy, supervisory timeliness, transparency, and enforcement consistency. This supports the expected linkages in the conceptual framework.

We also find that Supervisory Capacity is empirically distinct from automation mechanisms. Its VIF and tolerance values indicate that it does not simply mirror technology adoption. This is theoretically important because the model positions Supervisory Capacity as a moderator that conditions how automation translates into regulatory action. The stability of the interaction term

in Table 6 confirms that the model can distinguish between direct automation effects and their amplification under stronger supervisory skills and infrastructure.

Finally, the diagnostic evidence refines the interpretation of uneven outcome effects. Because multicollinearity is not inflating uncertainty, weaker relationships with enforcement consistency reflect genuine institutional constraints rather than estimation artifacts. This advances understanding by showing that RegTech improves accuracy and timeliness directly, while consistent enforcement depends more heavily on supervisory absorption capacity. The finding reinforces emerging international evidence that automation delivers regulatory value only when institutions can interpret and act on automated signals, thereby extending the theoretical contribution of the AutoReg Compliance Model.

Correlation Coefficient Matrix

We examine how RegTech-enabled automation mechanisms co-move with regulatory compliance and supervision outcomes across global fintech firms. Correlation analysis is used to validate whether the empirical relationships align with the structure proposed in the AutoReg Compliance Model. Interpretation focuses on effect magnitude and theoretical meaning rather than mechanical significance testing.

Correlation coefficient matrix for AutoReg Compliance Model constructs.

We estimate Pearson correlation coefficients among the three RegTech-enabled automation mechanisms, the moderating supervisory capacity construct, and four outcome dimensions of regulatory compliance and supervision effectiveness. The matrix evaluates whether automation intensity and supervisory readiness jointly shape compliance accuracy, timeliness, transparency, and enforcement consistency as theorized.

Table 7. *Correlation coefficient matrix for key constructs*

No.	Construct	ARS	RTRM	CDI	SC	CA	ST	RT	EC
1	Automated Reporting Systems (ARS)	1.000							
2	Real Time Risk Monitoring (RTRM)	0.49** (0.003)	1.000						
3	Compliance Data Integration (CDI)	0.44** (0.007)	0.46** (0.005)	1.000					
4	Supervisory Capacity (SC)	0.38* (0.024)	0.41** (0.014)	0.36* (0.031)	1.000				
5	Compliance Accuracy (CA)	0.57** (0.001)	0.52** (0.002)	0.48** (0.004)	0.43** (0.010)	1.000			
6	Supervisory Timeliness (ST)	0.46** (0.006)	0.61** (0.000)	0.40** (0.016)	0.55** (0.001)	0.49** (0.003)	1.000		
7	Regulatory Transparency (RT)	0.54** (0.002)	0.47** (0.005)	0.58** (0.000)	0.45** (0.008)	0.51** (0.002)	0.46** (0.006)	1.000	
8	Enforcement Consistency (EC)	0.39* (0.021)	0.50** (0.003)	0.42** (0.012)	0.62** (0.000)	0.47** (0.005)	0.58** (0.001)	0.53** (0.002)	1.000

Notes

- $p < .05$
** $p < .01$

We find that the three RegTech-enabled automation mechanisms are positively associated yet empirically distinct, supporting their separate specification under the independent variable. The moderate association between automated reporting systems and real-time risk monitoring, $r = 0.49$, implies that roughly one quarter of their variation overlaps, while the remainder reflects different operational functions. This confirms that reporting automation improves data reliability, whereas real-time monitoring accelerates detection and response, consistent with recent RegTech theory emphasizing functional differentiation within automated compliance architectures (Arner et al., 2024; Zetzsche et al., 2023).

Supervisory Capacity shows stronger correlations with downstream outcomes than with automation mechanisms themselves, validating its role as a moderator rather than a proxy for technology adoption. Its association with enforcement consistency, $r = 0.62$, indicates that nearly 38 percent of enforcement reliability variation aligns with supervisory readiness. This supports the conceptual framework by demonstrating that automation alone does not standardize enforcement. Instead, institutional Capacity determines whether automated signals translate into consistent regulatory action, reinforcing recent global evidence on SupTech absorption constraints (BIS, 2023; Crisanto et al., 2023).

Outcome relationships reveal differentiated pathways. Compliance accuracy is most strongly associated with automated reporting systems, $r = 0.57$, indicating that error reduction and data completeness are primarily design-driven outcomes. Supervisory timeliness shows its strongest association with real-time risk monitoring, $r = 0.61$, confirming that continuous monitoring compresses supervisory response cycles. Regulatory transparency aligns most closely with compliance data integration, $r = 0.58$, reflecting the role of unified data environments in auditability and disclosure. These patterns reinforce the proposed direct effects in the AutoReg Compliance Model and extend existing literature by mapping which RegTech mechanisms influence which regulatory outcomes.

Enforcement consistency exhibits the strongest relationship with supervisory Capacity rather than with any single automation mechanism. This finding refines the theory by locating enforcement reliability at the intersection of technology and institutional readiness. It challenges technology-centric assumptions by showing that automation enhances regulatory effectiveness only when supervisory systems can interpret, prioritize, and act on automated outputs. This insight advances international understanding of RegTech by shifting emphasis from adoption to absorption, with implications for regulators and fintech ecosystems across jurisdictions.

Discussion

We interpret the results as evidence that RegTech-enabled automation reshapes regulatory compliance through differentiated mechanisms rather than a single technological effect. Correlation patterns in Table 7 show that automated reporting systems align most strongly with compliance accuracy, while real-time risk monitoring aligns with supervisory timeliness. This matters because it shifts understanding away from general claims that automation improves compliance overall. We show that distinct automation functions target specific regulatory outcomes, revealing a

mechanism-level structure that earlier studies treated as homogeneous. The evidence clarifies why some RegTech investments deliver accuracy gains without improving enforcement consistency.

The diagnostic results in Table 6 strengthen this interpretation by showing that the automation components retain independent explanatory power. Low multicollinearity confirms that automated reporting, real-time monitoring, and compliance data integration operate through separate channels. The so what is clear. The model isolates functional pathways that regulators and firms can target deliberately rather than assuming that any automation investment yields broad compliance benefits. This advances theory by validating a multidimensional RegTech construct and challenges prior work that inferred effects from aggregated technology indices.

Supervisory Capacity emerges as the pivotal conditioning factor. Correlations in Table 7 and interaction effects reported in Table 4 indicate that enforcement consistency depends more on supervisory readiness than on automation intensity alone. This reveals an institutional mechanism that earlier scholarship largely assumed rather than tested. The evidence shows that automation generates actionable signals, but only supervisory Capacity converts those signals into consistent regulatory outcomes. This finding reframes debates on SupTech by positioning institutional absorption as a core determinant of regulatory effectiveness rather than a background condition.

The results also expose practical and theoretical challenges that add value rather than weaken inference. Uneven effects of compliance data integration, as reflected in Table 3 and Table 7, point to regulatory gaps where data-rich environments coexist with limited enforcement impact. This highlights a structural barrier. Data integration expands transparency potential, yet enforcement gains stall when supervisory analytics and decision frameworks lag. We interpret this not as a limitation of integration, but as evidence that governance design mediates how information becomes action. This insight was not visible in earlier studies that focused on technology adoption rates alone.

Internationally, the findings matter because they diverge from patterns often reported in advanced regulatory systems. In several mature markets, enforcement consistency is assumed to follow from standardized reporting and integrated data. Our global fintech sample shows that velocity and cross-border complexity weaken that assumption. The closing insight is that RegTech effectiveness is context sensitive and institution-dependent. We extend theory by showing where automation works, where it stalls, and why. Future research can build on this by examining how supervisory learning, analytics maturity, and cross-jurisdiction coordination alter these relationships over time.

Conclusion and Implications

We show that regulatory effectiveness in fast-evolving fintech systems no longer depends on isolated tools, but on how multiple technological mechanisms interact with institutional readiness to shape real outcomes. When automation operates through complementary channels and is absorbed by capable oversight structures, regulatory processes become more accurate, faster, more transparent, and more consistent across jurisdictions. Our core contribution lies in introducing a unified model that explains how layered technological functions combine with institutional strength to transform regulatory supervision beyond the firm level or country-specific settings. We uncover a clear pattern where technological intensity alone improves information quality, but stable and credible oversight emerges only when institutional Capacity converts automated signals into action. This insight expands global regulatory governance debates by moving the focus from adoption to absorption.

The findings refine established regulatory and governance frameworks by demonstrating that effectiveness is staged rather than automatic. Theory advances by clarifying that technology reshapes supervision through differentiated pathways, while institutions determine whether these pathways converge into enforceable outcomes. For managers, the results provide a basis for aligning compliance investments with supervisory expectations rather than pursuing automation for signaling purposes. Leaders can strengthen performance by prioritizing systems that shorten detection to response cycles and integrate compliance data across functions. For policymakers, the evidence supports strategies that pair digital regulation with sustained investment in supervisory skills, analytics, and coordination mechanisms. Practically, operational routines improve when compliance workflows are automated end-to-end and linked to decision structures that act on real-time insights. Socially, stronger and more consistent oversight supports financial stability, protects users, and reinforces trust in digital financial systems across markets.

We acknowledge boundaries that also signal opportunity. The analysis relies on a defined global fintech sample and structured secondary indicators, which limits observation of informal practices and emerging hybrid models. Measurement focuses on observable compliance and supervisory outputs, leaving behavioral adaptation over longer horizons open for deeper exploration. These boundaries highlight the need for future work that traces dynamic learning effects, cross-jurisdiction coordination, and evolving institutional responses.

Future research can extend this framework by examining longitudinal adjustment, advanced supervisory analytics, and cooperative oversight architectures. This paper provides new evidence on how technological capability and institutional absorption jointly determine regulatory effectiveness, reinforcing its global relevance and strengthening the foundation for future theoretical and applied research.

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