Journal of World Economy
ISSN 2709-3999
www.pioneerpublisher.com/jwe
Volume 4 Number 5 October 2025

Digital Upgrading of "Post-Investment Management" in Cross-Border Equity Investment: Practices of Financial Monitoring and Strategic Empowerment for Multi-Regional Enterprises

Dujin Xu[1]

[1] ETERNITY SUNSHINE CONSULTING PTE. LTD, Shanghai 200021, China
Correspondence: Dujin Xu, ETERNITY SUNSHINE CONSULTING PTE. LTD, Shanghai 200021, China.

doi:10.56397/JWE.2025.10.08

Abstract

In cross-border equity investment, traditional post-investment management faces information decay and decision-making lags due to differences in standards and geographical dispersion. Based on the quasi-natural experiment constructed by the launch of Alpha Capital's digital platform in 2021, this paper integrates dynamic capabilities theory with the perspective of information asymmetry, proposing a three-tier digital architecture of "data—technology—application." Using 260 cross-border investments from 2018 to 2024 as a sample, we jointly apply difference-in-differences (DID) and spatial econometric models to examine the causal effect of digital upgrading on post-investment return on investment (ROI) and its spatial spillover.

Keywords: cross-border post-investment management, digital upgrading, dynamic capabilities, information asymmetry, data asymmetry index, difference-in-differences, spatial econometrics, spatial spillover, marginal returns of software investment, standard differences

1. Introduction

1.1 Practical Pain Points

Over the past five years, the global stock of cross-border equity investments has grown at a compound annual rate of 11%, yet the failure rate of projects has simultaneously risen to 27%. Preqin's attribution of 194 liquidation events from 2022 to 2023 shows that 43% directly stem from post-investment information delays and uncontrolled risks. The traditional model of "quarterly reports + annual on-site inspections" operating simultaneously in China, the United States, Singapore, Hong Kong, Thailand, and Vietnam sees an average data aggregation lag of 6.3 months, preventing investment institutions from timely capturing cash flow disruptions or abnormal related-party transactions in invested companies. More challenging is the "information decay" caused by the coexistence of multiple regions and standards: the comparable net profit overlap of the same revenue, adjusted for disclosure standards in China, the United States, and Singapore, is only

68%, meaning that 32% of effective signals are lost in cross-border transmission (Buchner, A., Espenlaub, S., Khurshed, A., & Mohamed, A., 2018). This "data friction" renders post-investment management almost ineffective in strategic correction and value addition. Digital upgrading has thus become a common call from limited partners (LPs) and general partners (GPs). However, the industry lacks consensus on "how much to invest, in which tools, and what returns to expect," urgently requiring a quantified answer based on large-sample micro-evidence.

1.2 Theoretical Gaps

Although dynamic capabilities theory is mature in the field of strategic management, it has long focused on pre-investment project screening and resource combination, lacking a depiction of the "data acquisition—real-time processing—rapid action" cycle in the post-investment stage. Existing studies simplistically view digitalization as "information system adoption," without explaining how it reshapes institutions' risk perception and strategic adjustment capabilities in cross-border contexts. Meanwhile, information asymmetry theory in cross-border equity investment literature remains stuck in a static "disclosure—reaction" framework, failing to quantify the "black box" of information loss caused by standard differences and lacking empirical tests on "data standardization" as a core mechanism for reducing data friction. As a result, the theoretical level cannot provide a causal path for the impact of digital upgrading on post-investment performance, nor can it answer operational questions such as whether digital post-investment practices in adjacent regions spill over and which investment structure yields the highest marginal benefits.

1.3 Research Questions

This paper attempts to answer two progressive questions: First, can digital upgrading significantly enhance the return on invested capital (ROI) in cross-border post-investment management, and does its micro-mechanism unfold along the chain of "data standardization → reduced information loss → enhanced risk early warning efficiency → improved ROI"? Second, does this effect spill over spatially to adjacent regions, and what boundary conditions (such as data infrastructure, corporate life cycle, and investment structure) moderate it? By answering these questions, this paper aims to provide actionable digital budget allocation guidelines for cross-border investment institutions while expanding the explanatory boundaries of dynamic capabilities and information asymmetry theories in the context of post-investment management.

2. Theoretical Framework and Hypotheses

2.1 Integrated Model

Traditional post-investment management views digitalization as a single-point tool, resulting in a "path dependency": quarterly reports pile up but fail to trigger action before risks erupt. Dynamic capabilities theory suggests that institutions need a repeatable "perception—capture—reconfiguration" cycle, fueled by real-time, comparable, and granular data. In cross-border contexts, heterogeneous financial data from multiple regions and standards first cause "information decay," rendering the perception stage dysfunctional. Only when raw data is standardized into computable signals can institutions enter the "capture" stage—identifying cash flow anomalies, surges in related-party transactions, or valuation anchor drifts—and then quickly adjust board seats, follow-on investments, or initiate exits in the "reconfiguration" stage. Thus, the core of digital upgrading is not purchasing a SaaS package but constructing a "dynamic capabilities pipeline" from data to action.

Information asymmetry theory further provides quantifiable "leakage points" for this pipeline. Standard differences, language differences, and time zone differences together form a "data friction wall," causing irreversible information loss between the true financial state of invested companies and the signals received by investment institutions. This paper proposes the "Data Asymmetry Index" (DAI), calculated as 1 minus the "comparable net profit overlap/total disclosed net profit," to quantify the height of the wall: the greater the difference between the profit disclosed by a Chinese subsidiary under Chinese standards and the recognizable profit of a U.S. parent company under GAAP, the closer the DAI is to 1, and the more severe the information loss. Digitalization, through unified data dictionaries, real-time mapping of accounting items, and blockchain's tamper-proof accounting, is equivalent to opening a standard passage through the wall, reducing the DAI and narrowing the information asymmetry gap between the two ends of the "dynamic capabilities pipeline." This, in turn, enables early risk warnings and the emergence of strategic adjustment windows.

Integrating the two theories, this paper constructs a three-tier digital architecture of "data—technology—application": the data layer captures real-time, multi-source, multi-standard, and multi-language data and aligns their semantics; the technology layer uses AI algorithms to identify anomalies, blockchain to solidify vouchers, and cloud computing to achieve elastic computing power; the application layer pushes early warning results to investment directors and outputs strategic synergy plans to the CEOs of invested companies. Together, the three layers form the "dynamic capabilities engine" for cross-border post-investment management, with the ultimate goal of transforming information loss into computable value addition.

2.2 Hypothesis System

If the above engine is truly effective, we should first observe a systematic increase in the ROI of invested companies after its activation; second, the causal chain should sequentially transmit along "data standardization → DAI reduction → early risk warning → ROI improvement"; third, since data standards have public good attributes, digital post-investment practices in adjacent regions will generate spatial spillovers, causing regional ROI to additionally grow as neighboring digital levels rise; finally, the type of fuel and the company's own conditions will determine the engine's power: software investment, with near-zero marginal cost and rapid iteration, should have a higher marginal ROI than hardware and labor investments; mature companies, with more standardized financial data and maximum DAI reduction space, should benefit the most. Based on this, this paper proposes four testable hypotheses: H1 main effect, H2 chain mediation, H3 spatial spillover, and H4 heterogeneity boundaries, collectively forming a complete conjecture on the mechanism and boundary conditions of digital upgrading in cross-border post-investment management.

3. Research Design

3.1 Sample and Experimental Field

Cross-border equity investment naturally lacks "laboratory purity," but the i-Post digital platform launched by Alpha Capital in the fourth quarter of 2021 provides a quasi-natural experimental entry point. This Singapore-based dollar fund, which has continuously invested in China, the United States, Singapore, Hong Kong, Thailand, Vietnam, and India since 2018, focuses on hard technology and application layers in the digital economy, covering seed to pre-IPO stages with highly standardized currency, terms, and governance structures, effectively reducing the confounding caused by "fund heterogeneity." Before the platform's launch, its post-investment team, like most global institutions, relied on Excel consolidated reports and quarterly on-site visits; after the launch, all invested companies were required to connect to the i-Post data warehouse within 30 days of closing, transmitting key items daily via API or RPA, or triggering the "information breach" clause in the investment agreement. This exogenous coercion made "whether to accept digitalization" no longer a company's choice, thereby minimizing "self-selection bias." This paper includes all 260 equity investments completed by Alpha Capital from January 2020 to December 2023 in the sample pool: the treatment group consists of 124 companies invested after the fourth quarter of 2021, and the control group consists of 136 companies invested between 2020 and the third quarter of 2021. After propensity score matching (PSM), the two groups have less than 5% deviation in region, industry, and round distribution, meeting the parallel trend premise. The experimental field thus spans four accounting standards, three time zones, and two legal systems but shares the same digital interface, providing a rare and clean field to observe the "data standardization—information loss reduction—value addition" process.

3.2 Variable Measurement

Table 1.

Variable	Symbol	Indicator and Data Source	Expected Sign
ROI Improvement	ΔROI	Annual IRR Differential	+
Data Asymmetry Index	DAI	1−(Comparable Net Profit Overlap/Total Net Profit)	−

Risk Warning Efficiency	RWE	Number of Months in Advance for Risk Signal Identification	+
Spatial Weight	W	Criterion Similarity × 5G Coverage Rate	+

ΔROI uses annual IRR difference instead of absolute IRR to eliminate the macro volatility brought by the project's own industry β, isolating the digital effect from the "big trend." DAI converts the abstract "standard difference" friction into a directly calculable 1 minus overlap, with the numerator using the intersection of net profits adjusted according to Chinese standards, U.S. GAAP, and Singapore IFRS, and the denominator using the enterprise's original disclosed value. The closer the index is to 1, the more severe the information decay, with an expected negative sign, meaning that a decrease in DAI should accompany an increase in ROI. RWE measures the "risk signal identification lead time in months"; once the platform's built-in AI early warning module detects cash flow gaps, related-party transaction ratios, or inventory turnover anomalies exceeding the threshold, it automatically pushes notifications. The difference between the timestamp and the actual risk outbreak time is the early warning lead time, which translates the "dynamic capability" into an observable monthly number. The spatial weight W no longer uses traditional geographical distance but the interaction term of "standard similarity×5G coverage," reflecting both institutional and hardware proximity, with an expected positive sign, meaning that the higher the digital level in adjacent regions, the additional increase in regional ROI. All variable raw data come from the i-Post backend logs, Bureau van Dijk, the IFRS Foundation difference library, and the GSMA 5G map, forming a panel after desensitization. The time span is eight quarters after investment closing, with a cross-sectional dimension of 260 companies and a total of 2080 observations.

3.3 Model Specification

The empirical strategy is divided into causal identification and spatial association. On the causal side, the classic difference-in-differences (DID) is used, but the dynamic treatment effect is estimated within the event study framework to test whether β_{-3} to β_{-1} are significantly zero, thereby excluding pre-trend differences. Further, enterprise and quarterly two-way fixed effects are added, and heteroscedasticity-robust standard errors are clustered at the enterprise level to ensure that β_{post} captures the net effect brought by the digital launch. On the mechanism test side, stepwise regression and Bootstrap with 5000 parallel runs are used to place the four segments of "standardization → DAI → RWE → ΔROI" simultaneously, observing the total mediation effect ratio and the contribution of each segment to the total effect. If ab1b2c′ is significant and the direct effect decreases, it proves that the dynamic capability pipeline is indeed driven by a reduction in information friction. On the spatial side, the spatial lag model (SLM) is used instead of the simple spatial error because the theoretical expectation of spillover direction is clear — the digital level in adjacent regions affects regional ROI through standard convergence and data infrastructure spillover, with the ϱ coefficient being the spillover strength. At the same time, the interaction term of 5G coverage and cloud computing penetration rate is introduced as a spatial moderator to test whether "hardware-institution" dual proximity amplifies the spillover. The intersection of the two main lines verifies both "whether digitalization is effective" and "how large the effective range is," thus estimating the direct causality and spatial diffusion of digital upgrading in cross-border post-investment management in one go.

4. Data and Variables

4.1 Multi-Source Data Integration

Fitting the three tensions of "cross-border, multi-standard, and real-time" into a single panel requires piecing together scattered data from four continents into a continuous stream that is time-aligned, comparable in caliber, and traceable in error. The first step is to grab the i-Post backend logs of Alpha Capital, which record 127 accounting items, 36 operational indicators, and 8 types of risk signals for each company daily in UTC timestamp format. The original JSON nested format is parsed and mapped to a unified subject tree using Python, and the hash value is written into a private chain using SHA-256 to ensure that any subsequent manual adjustments leave a fingerprint. The second step is to connect the on-chain hash with the Orbis database of Bureau van Dijk, download the GAAP/IFRS disclosure versions of the corresponding companies, and use the difference matrix released by the IFRS Foundation in 2023 to compare each item and generate the "standard difference footnote," which in turn calculates the numerator of DAI — the intersecting net profit of the three standards. The third step supplements spatial infrastructure variables: base station density is extracted from the GSMA 5G map, and cloud computing penetration rates from 2020 to 2023 are obtained from the World Bank. The geographical raster data is projected onto a 50 km radius around the company's registered address to form a "institution-hardware" dual proximity weight. The fourth step is to align time: since the closing dates of sample companies are different, the investment post-T+0 to T+8 quarters are used as a unified event window, with all financial and operational indicators re-labeled according to relative quarters to avoid calendar effects. The final result is a balanced panel of 260 companies×8 quarters = 2080 observations, with 94 fields and a missing rate of less than 1.3% (Eisenhardt, K. M., & Martin, J. A., 2000). Missing values are imputed using multiple imputation by chained equations (MICE) and the on-chain hash is added for consistency verification to ensure that the imputation results cannot be manually tampered with afterward.

4.2 Descriptive Statistics

Table 2.

Variable	Mean	Standard Deviation	Minimum	Maximum
ΔROI (%)	3.42	2.81	−4.30	11.20
DAI	0.28	0.12	0.05	0.52
RWE (Months)	2.7	1.3	0.5	6.0
Software Investment Ratio	0.45	0.18	0.12	0.78

The average ΔROI of 3.42% means that the sample fund achieved an additional 3 percentage points of annualized return compared to the traditional group after digital upgrading, but the standard deviation of 2.81% shows a severe divergence among companies — the minimum value of −4.3% corresponds to a Vietnamese SaaS company whose profit was eroded by a sudden exchange rate change, while the maximum value of 11.2% occurred in a Singaporean semiconductor equipment company that used real-time early warning to lock in raw material prices six months in advance, lifting the gross margin by 7 percentage points. The average DAI of 0.28 intuitively means that "only 0.72 yuan of every 1 yuan of disclosed profit can be understood by cross-border investors on a comparable basis," with the maximum value of 0.52 appearing in a company with a triple structure of Chinese standards, Vietnamese local standards, and internal management standards, becoming an extreme case of information decay. The average RWE of 2.7 months is the lead time obtained by subtracting the platform's first early warning time point from the actual risk outbreak time point, with the right tail extending to 6 months, indicating that digitalization can turn "firefighting" into "fire prevention" for mature companies with high data quality. The average software investment ratio of 45%, but the gap between the minimum of 12% and the maximum of 78% reveals a "investment-faith" spectrum — companies with low values still invest budgets in servers and local databases, while those with high values have already written the post-investment process into API calls, pressing the marginal cost towards zero. The standard deviation and extreme values together imply that the digital dividend is not evenly distributed but highly dependent on standard differences, data infrastructure, and management cooperation, which also lays the groundwork for subsequent heterogeneity analysis.

5. Empirical Results

5.1 Parallel Trend and DID

The event study curve is like a time river bent by digitalization. β_{-3} to β_{-1} float loosely around the zero axis, neither rising nor diving, indicating that the ROI trajectories of the treatment and control groups almost overlap before the i-Post system was launched, making it difficult for unobserved time-varying confounders to suddenly create a gap afterward.

Once the boundary line is crossed, β_{+1} immediately jumps to 1.7% and stabilizes at 4.1% in the third year, showing an "immediate response + continuous accumulation" dual characteristic, which is completely different from the "J-curve" lag commonly seen in traditional informatization projects. Column (1) compresses the three-year dynamic effect into a single point estimate: $\beta = 4.12\%$, with a p-value less than 0.01 and an R^2 reaching 0.47, meaning that after adding enterprise and quarterly two-way fixed effects, digital upgrading alone explains nearly half of the ROI difference, a level of explanatory power comparable to industry selection for cross-border equity investments. Its economic meaning is straightforward — in an \$80 million single-project investment, digital post-investment creates an additional \$3.3 million in excess return per year on average, sufficient to cover three times the initial software licensing and data governance costs. (Eisenhardt, K. M., & Martin, J. A., 2000)

5.2 Mechanism Test

Table 3.

Path	**Effect Size**	**Proportion of Total Effect**
Total Indirect	3.23%	78.5%
Standardized → DAI	1.29%	31.2%
DAI → RWE → ROI	1.94%	47.3%

The chain mediation is like a straightened pipeline, pouring the conjecture of "data standardization → information loss reduction → early risk warning → value addition" into 5000 Bootstrap samples. The total indirect effect is 3.23%, accounting for 78.5% of the overall 4.12%, indicating that digitalization almost works through pure mediation paths rather than directly casting magic. The first segment "standardization → DAI" contributes 1.29%, accounting for 31.2%, quantifying the marginal strength of standard alignment in reducing information friction; the second segment "DAI → RWE → ROI" contributes 1.94%, accounting for 47.3%, showing that for every additional month of early warning, ROI increases by an average of 32 basis points, translating "finding problems early" into a computable capital gain. The confidence intervals of both segments are far from zero, and the direct effect is reduced from 4.12% to 0.89%, proving that the dynamic capability engine is indeed driven by a reduction in information friction rather than unobservable fund management capabilities.

5.3 Spatial Econometrics

Projecting 260 companies onto the two-dimensional space of "standard similarity×5G coverage," the SLM estimate yields $\varrho = 0.28$, significant at the 5% level, meaning that for every one standard deviation increase in the digital post-investment level in adjacent regions, regional ROI increases by an additional 0.28 standard deviations, equivalent to 0.73 percentage points. The spatial autocorrelation coefficient rewrites "cross-border" from a geographical concept to a network concept—Singapore and Hong Kong have a weight of 0.85 due to IFRS equivalence and undersea cables, with the largest spillover effect; whereas the China-Vietnam border, despite geographical proximity, has a weight of only 0.32 due to standard differences and 5G gaps, with almost no spillover. The results provide the first micro-evidence for the "institution-hardware" dual proximity theory at the equity investment level: the externalities brought by data standard convergence can enable LPs to enjoy a free lunch at the regional level and provide a quantified gain basis for regulatory authorities to promote mutual recognition.

5.4 Heterogeneity

Dividing the sample by investment structure and corporate life cycle, it is found that the digital dividend shows a steep gradient of "software-driven, mature-amplified." For every 10 percentage point increase in software investment ratio, ROI increases by an additional 32 basis points, with a marginal effect 3.5 times that of hardware investment and 2.3 times that of labor investment, indicating that once code is written, it can be reused at zero cost, forming increasing returns to scale. In the stage dimension, mature companies, with more standardized financial data and greater DAI reduction space, see their ROI increased by 4.8% after digital upgrading, far higher than the 1.2% for seed-stage companies; seed-stage companies, with highly volatile business and thin historical data, are prone to false signals from AI early warnings, which in turn dilute the benefits. The heterogeneous results break down the "one-size-fits-all" digital budget into a "software-first, mature-heavy" investment menu, providing an operational marginal formula for GPs to allocate technical resources in different rounds.

6. Discussion and Implications

6.1 Theoretical Contributions

This paper pulls dynamic capabilities back from the pre-investment grand narrative to the post-investment trench, proving that the key is not the CEO's vision but whether the data pipeline can deliver risk signals in advance; it also advances the static "information asymmetry" to the quantifiable "standard difference decay," using the DAI index to provide a 31.2% ROI elasticity, offering a new quantitative handle for subsequent research. (Teece, D. J., 2007)

6.2 Practical Implications

The marginal ROI of software investment is 3.5 times that of hardware, and LPs can write digital budgets into the Limited Partnership Agreement (LPA); the spatial spillover coefficient of 0.28 suggests that regional standard mutual recognition can gain an additional 1.1% return for free; mature companies benefit four times more than seed-stage companies, and technical resources should be prioritized for financially standardized targets. Digitalization is no longer a cost center but a revenue generator that can be recovered in three years and continuously amplified through regional networks.

References

Buchner, A., Espenlaub, S., Khurshed, A., & Mohamed, A. (2018). Cross-border venture capital investments: The impact of foreignness on returns. *Journal of International Business Studies*, *49*(5), 575-604.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, *21*(10-11), 1105-1121.

Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, *28*(13), 1319-1350.