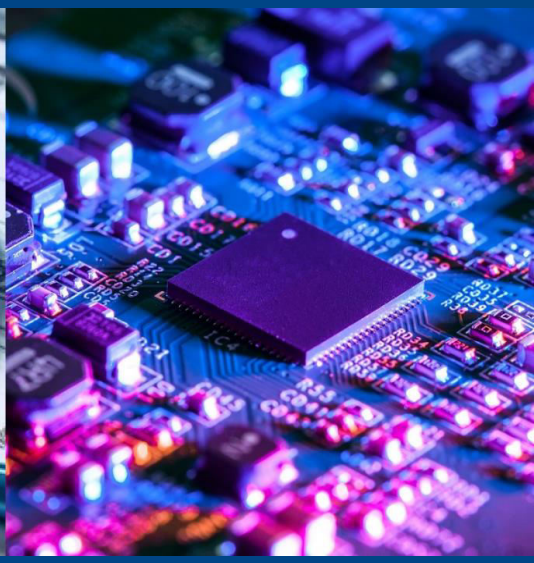
ISSN: 2582-7219





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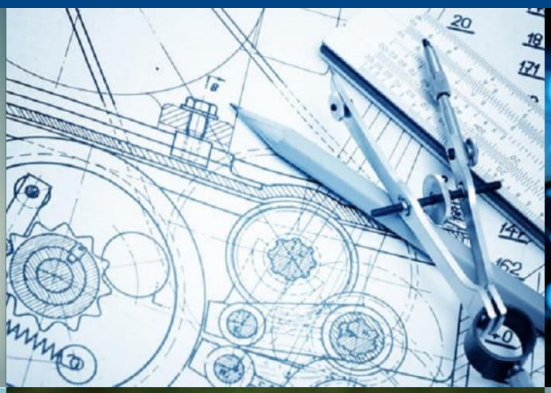

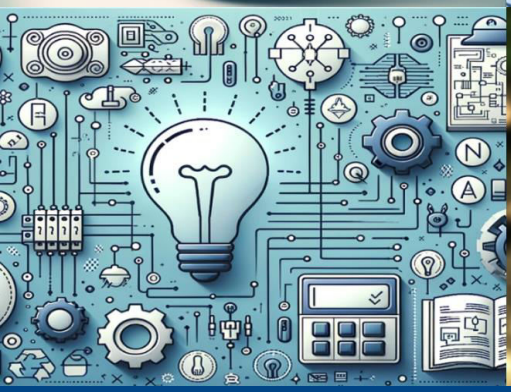

Impact Factor: 8.206 **Volume 9, Issue 4, April 2026**

© 2026 IJMRSET | Volume 9, Issue 4, April 2026| DOI:10.15680/IJMRSET.2026.0904058

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Impact of Technological Investment on Financial Performance of Listed IT Services Companies in India: A Panel Data Analysis (2015–2024)

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ABSTRACT: The present study examines the impact of technological investment on the financial performance of selected listed IT services companies in India over the period from 2015 to 2024. In the evolving digital economy, technological capability has become a core strategic factor for firms, especially in knowledge-driven industries such as IT services. This study is based on a sample of ten major IT services companies selected on the basis of consistent data availability, covering 100 firm-year observations across a decade. Technological investment is measured using Technology Capital Expenditure Intensity and Intangible Asset Ratio, while financial performance is evaluated through accounting-based measures such as Return on Assets (ROA), Return on Equity (ROE), Operating Margin, and the market-based indicator Tobin's Q. Control variables including Firm Size, Leverage, and Sales Growth are incorporated to improve result reliability. The study employs descriptive statistics, correlation analysis, and panel regression models including Pooled OLS, Fixed Effects, and Random Effects. The Hausman test is applied to identify the most appropriate model. Findings reveal that technology capital expenditure does not significantly influence short-term profitability, while intangible assets demonstrate a partial positive influence on financial performance. Firm size and sales growth emerge as strong determinants of performance. The study concludes that technological investment acts as a strategic enabler rather than an immediate driver of profitability, with benefits being gradual and long-term in nature.

KEYWORDS: Technological Investment, Financial Performance, IT Services, Intangible Assets, Panel Data Analysis, India

I. INTRODUCTION

The Information Technology (IT) services sector has emerged as one of the most influential and rapidly expanding industries in the global economy. In India, the IT services industry has played a transformative role in driving economic growth, generating employment, enhancing export earnings, and strengthening the country's position in the global digital marketplace. Over the past two decades, Indian IT services companies have evolved from traditional software outsourcing providers to sophisticated digital solution partners offering cloud computing, artificial intelligence, data analytics, cybersecurity, enterprise transformation, and platform-based services. This transition has fundamentally altered the competitive landscape of the industry, placing technological capability at the core of business strategy.

In knowledge-intensive industries such as IT services, technology is not merely a support function but a primary value-creating asset. Companies continuously allocate substantial resources toward research and development (R&D), acquisition of advanced software tools, digital infrastructure, automation technologies, and the development of proprietary platforms. These technological investments are expected to enhance innovation capacity, improve service efficiency, reduce operational costs, and strengthen customer relationships. However, the relationship between technological investment and financial outcomes is neither automatic nor uniform across firms.

Financial performance remains one of the most critical indicators of corporate success. For listed IT services companies, performance is evaluated not only through accounting-based measures such as Return on Assets (ROA), Return on Equity (ROE), and operating margins, but also through market-based indicators such as firm valuation and investor perception. While technological advancement is often highlighted in corporate strategy statements and annual reports, the actual financial returns generated by such investments require systematic empirical examination.

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The Indian IT services sector presents a unique context for studying this relationship. Unlike manufacturing industries, IT services companies primarily rely on intangible assets, digital capabilities, intellectual capital, and human expertise. The value of these firms is significantly driven by knowledge assets and innovation-based competencies rather than physical infrastructure.

The core research problem of this study is to examine whether technological investment significantly impacts the financial performance of selected listed IT services companies in India and to determine the direction and strength of this relationship. By analyzing firm-level panel data over the period 2015–2024, the study aims to evaluate whether technology-related variables such as Technology Capital Expenditure Intensity and Intangible Asset Ratio significantly influence accounting-based and market-based performance measures.

II. REVIEW OF LITERATURE

A substantial body of research has examined the relationship between technological investment and firm performance across global and Indian contexts. Azhagaiah and Gavoury (2011) examined the impact of capital structure on the profitability of 102 IT firms listed on the Bombay Stock Exchange and found that higher debt levels tend to reduce net profit, though their study primarily focused on leverage rather than technology-specific investment. Dave et al. (2013) examined the impact of R&D expenditure on the financial sustainability of IT companies listed on the S&P 500, finding that R&D intensity significantly affects gross margins and ROA, thereby providing empirical support for technology intensity as a determinant of financial performance in developed markets.

Khan (2018) explored the impact of intellectual capital on financial performance of Indian IT sector firms and found a positive relationship between value-added intellectual coefficient and ROA, drawing attention to the strategic importance of knowledge-based resources. This finding is particularly relevant to the Indian IT services context, where intangible assets constitute a significant portion of firm value. Kaura et al. (2019) examined the impact of corporate governance on IT company performance and found that board composition and transparency influence financial outcomes, highlighting the multidimensional nature of firm performance determinants.

Singh and Sachdeva (2020) applied panel data techniques to analyze financial performance of selected IT companies in India over multiple years and found that firm-specific factors including size and capital efficiency significantly influence profitability, consistent with findings from international literature. More recently, Singh et al. (2022) analyzed financial performance across selected Indian IT firms and highlighted growing heterogeneity in performance patterns, underscoring the need for updated empirical evidence. Santhi et al. (2024) and Vijay and Karthigeyan (2024) further examined Indian IT companies and found that sustainability performance and digital capabilities are increasingly relevant to financial outcomes.

Despite growing interest in this domain, significant gaps remain in the existing literature. First, limited studies have specifically isolated technological investment variables such as Technology Capital Expenditure Intensity and Intangible Asset Ratio as direct explanatory factors of financial performance. Second, most existing studies focus on traditional determinants such as capital structure, liquidity, or governance rather than technology-specific investment. Third, the post-2015 digital transformation phase, characterized by automation, artificial intelligence, and cloud computing, has significantly altered industry dynamics, necessitating updated empirical investigation. The present study addresses these gaps by employing a structured panel data approach with clearly defined technological investment proxies over the period 2015–2024.

III. RESEARCH METHODOLOGY

3.1 Research Design

The study adopts a quantitative research approach based on panel data analysis, combining cross-sectional and time-series dimensions. The cross-sectional component consists of ten selected listed IT services companies in India, while the time-series component covers a period of ten years from 2015 to 2024, yielding 100 firm-year observations. This design enables the study to capture variations both across firms and across time, providing a comprehensive understanding of the relationship between technological investment and financial performance.

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The research follows a causal design, aiming to identify and analyze the cause-and-effect relationship between technological investment (as independent variables) and financial performance (as dependent variables). The sample of ten companies — Tata Consultancy Services, Infosys Ltd, HCL Technologies, Birlasoft Ltd, Tech Mahindra, L&T Technology Services, Mphasis Ltd, Persistent Systems Ltd, Zensar Technologies Limited, and Coforge Ltd — was selected using purposive sampling based on consistent data availability for all variables over the entire study period. The primary source of data is the annual reports of the selected companies, supplemented by market price data collected from Yahoo Finance via Python (Google Colab).

3.2 Analytical Framework

The analytical framework of this study is grounded in three theoretical perspectives: the Resource-Based View (RBV), Dynamic Capabilities Theory, and Knowledge-Based View (KBV). RBV posits that firms achieve sustainable competitive advantage through valuable, rare, and inimitable resources. Dynamic Capabilities Theory emphasizes the firm's ability to reconfigure and deploy technological assets in response to environmental changes. KBV highlights the central role of knowledge assets in value creation, which is especially relevant in knowledge-intensive industries such as IT services.

Based on this theoretical foundation, the study proposes that technological investment — captured through Technology Capital Expenditure Intensity and Intangible Asset Ratio — influences firm-level financial performance both directly and indirectly. The framework acknowledges that technological investments may not yield immediate financial returns due to time lags and implementation costs, but are expected to contribute to long-term competitive advantage and performance improvement. Control variables representing firm size, financial leverage, and sales growth are incorporated to isolate the effect of technological investment from other performance determinants.

3.3 Variables of the Study

Independent Variables (Technological Investment)

Variable	Measurement
Technology Capital Expenditure Intensity	Tech Capital Expenditure / Total Assets
Intangible Asset Ratio	Intangible Assets / Total Assets

Dependent Variables (Financial Performance)

Variable	Measurement
ROA	Net Profit / Total Assets
ROE	Net Profit / Equity
Operating Margin	EBIT / Revenue
Tobin's Q	(Market Capitalization + Total Debt) / Total Assets

Moderating Variables (Control Variables)

Variable	Measurement
Firm Size	Natural Logarithm of Total Assets
Leverage	Total Debt / Total Assets
Sales Growth	(Current Revenue − Previous Revenue) / Previous Revenue

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3.4 Hypotheses of the Study

Based on the research objectives and analytical framework, three key hypotheses were developed:

H_{01}: Technological investment has no significant impact on the financial performance of the selected listed IT services companies in India.

H_{11}: Technological investment has a significant impact on the financial performance of the selected listed IT services companies in India.

H_{02}: Technology capital expenditure intensity has no significant relationship with profitability (ROA and Operating Margin).

H_{12}: Technology capital expenditure intensity has a significant relationship with profitability (ROA and Operating Margin).

H_{03}: Intangible asset intensity has no significant impact on firm valuation (Tobin's Q) and shareholder returns (ROE).

H_{13}: Intangible asset intensity has a significant impact on firm valuation (Tobin's Q) and shareholder returns (ROE).

3.5 Techniques for Data Analysis

The study employs a multi-stage analytical approach. Descriptive statistics are used to characterize the distribution and central tendency of all variables. Correlation analysis examines the degree and direction of linear relationships among variables and identifies potential multicollinearity concerns. Panel regression analysis is conducted using three models: Pooled Ordinary Least Squares (Pooled OLS), Fixed Effects Model (FEM), and Random Effects Model (REM). The Pooled OLS treats the dataset as a cross-section ignoring heterogeneity, the Fixed Effects model controls for time-invariant firm-specific characteristics, and the Random Effects model assumes that individual effects are random and uncorrelated with the regressors.

The Hausman test is applied to determine the most appropriate model between Fixed and Random Effects by testing whether firm-specific effects are correlated with the independent variables. Statistical significance is evaluated at the 5 percent level ($p < 0.05$). Data collection and cleaning were performed using Microsoft Excel, while statistical analysis and graphical representations were generated using Python (Google Colab), employing the linearmodels and statsmodels libraries for panel regression.

IV. DATA ANALYSIS AND INTERPRETATION

4.1 Descriptive Statistics

Table 1 presents the descriptive statistics for all key variables across the 100 firm-year observations.

Table 1: Descriptive Statistics of Key Variables

Statistic	ROA	ROE	Op. Margin	Tobin's Q	Tech CapEx Intensity	Intangible Ratio	Firm Size	Leverage	Sales Growth
Count	100	100	100	100	100	100	100	100	100
Mean	0.1515	0.2286	0.1801	2.1997	0.0128	0.1641	9.4040	0.0342	0.1139
Std Dev	0.0528	0.1132	0.0575	1.7098	0.0675	0.1534	1.5268	0.0773	0.1184
Minimum	0.0556	0.0899	0.0695	0.1862	-0.2771	0.0000	7.4582	0.0000	-0.3223
Maximum	0.3148	1.0298	0.3244	8.4821	0.2414	0.6607	11.8944	0.7127	0.5278

Source: Compiled from Annual Reports of sample companies, analyzed using Python, 2026

The descriptive statistics reveal that the selected IT companies maintained stable profitability levels, with a mean ROA of 0.1515 and mean ROE of 0.2286. The mean operating margin of 0.1801 reflects the sector's ability to sustain healthy operating performance. From a market perspective, the mean Tobin's Q of 2.1997 indicates that firms are, on average, valued above their book value, signaling positive investor expectations. The low mean Technology Capital Expenditure Intensity of 0.0128, alongside the presence of negative values, suggests high variability in technology investment

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decisions across firms and periods. The Intangible Asset Ratio mean of 0.1641 confirms that knowledge-based assets constitute a significant portion of total assets, consistent with the knowledge-driven nature of the sector. Control variables reveal conservatively leveraged firms with moderate growth trajectories.

4.2 Correlation Analysis

Table 2 summarizes the key correlation coefficients among the study variables.

Table 2: Key Correlation Coefficients

Variable Pair	r Value	Strength	Direction
ROA ↔ Operating Margin	0.828	Strong	Positive
ROA ↔ ROE	0.697	Strong	Positive
Tech CapEx Intensity ↔ ROA	0.063	Weak	Positive
Intangible Asset Ratio ↔ ROA	-0.283	Moderate	Negative
Intangible Asset Ratio ↔ Op. Margin	-0.435	Moderate	Negative
Firm Size ↔ Operating Margin	0.758	Strong	Positive
Firm Size ↔ ROA	0.572	Strong	Positive

Source: Compiled from Annual Reports of sample companies, analyzed using Python, 2026

The correlation analysis reveals strong positive associations among profitability measures, particularly between ROA and Operating Margin (r = 0.828) and between ROA and ROE (r = 0.697). Technology Capital Expenditure Intensity exhibits only a weak positive correlation with ROA (r = 0.063), suggesting that short-term technology expenditure does not strongly drive profitability. Notably, the Intangible Asset Ratio shows a moderate negative correlation with ROA (−0.283) and with Operating Margin (−0.435), indicating that higher intangible investments may not yield immediate profitability gains due to their long-term nature. Firm Size demonstrates strong positive correlations with Operating Margin (0.758) and ROA (0.572), confirming scale-driven performance advantages. Importantly, no inter-correlations among independent variables exceed critical multicollinearity thresholds, validating the suitability of the dataset for panel regression.

4.3 Panel Regression Results

Panel regression analysis was conducted across three models — Pooled OLS, Fixed Effects, and Random Effects — for each hypothesis. The Hausman test was applied to determine the most appropriate estimation model.

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Table 3: Panel Regression Results Summary (All Three Models)

Variable	ROA			Operating Margin			ROE			Tobin's Q		
	Pooled OLS	Fixed Effects	Random Effects	Pooled OLS	Fixed Effects	Random Effects	Pooled OLS	Fixed Effects	Random Effects	Pooled OLS	Fixed Effects	Random Effects
Technology Capital Expenditure Intensity	0.707	0.761	0.895	0.836	0.990	0.626	0.957	0.950	0.740	0.894	0.984	0.501
Intangible Asset Ratio	0.348	0.114	**0.021**	0.495	0.955	0.295	0.072	0.706	0.144	0.090	0.954	0.353
Firm Size	**0.000**	0.208	0.114	**0.000**	0.484	**0.000**	**0.001**	0.206	0.066	**0.010**	**0.000**	**0.014**
Leverage	0.101	0.314	0.324	**0.025**	0.948	0.545	0.335	0.643	0.869	0.788	0.171	0.605
Sales Growth	0.168	**0.000**	**0.005**	0.867	0.679	0.650	0.583	0.338	0.615	**0.044**	0.864	0.113

Model 1 (ROA model, H1) reveals that Technology Capital Expenditure Intensity does not achieve statistical significance across any of the three estimation techniques, failing to reject H01. The Intangible Asset Ratio, however, achieves significance in the Random Effects model, providing partial support for H11, indicating that long-term knowledge-based investments contribute to financial performance. Firm Size and Sales Growth emerge as significant predictors, suggesting that scale and expansion play a more direct role in profitability than short-term technology spending.

Model 2 (Profitability model, H2) consistently confirms that Technology Capital Expenditure Intensity does not significantly affect either ROA or Operating Margin across any model, leading to non-rejection of H02. This result is robust across all three estimation approaches. Firm Size retains strong significance in both profitability measures, reinforcing scale as a key performance driver. The Hausman test recommends Fixed Effects for ROA and Random Effects for Operating Margin, indicating different dynamics in how firm-specific effects operate across these measures.
Model 3 (Market Performance model, H3) examining ROE and Tobin's Q as dependent variables finds that Intangible Asset Intensity does not consistently achieve statistical significance. Sales Growth shows weak significance for ROE under the Random Effects model, while Tobin's Q is better explained by the Fixed Effects model, capturing firm-specific market dynamics. The evidence suggests that intangible asset intensity alone is insufficient to drive market-based performance without effective investor communication and strategic utilization.

V. FINDINGS AND DISCUSSION

The empirical analysis yields several important findings regarding the relationship between technological investment and financial performance of listed IT services companies in India. These findings are discussed below in the context of existing literature and theoretical frameworks.

The first and most consistent finding is that Technology Capital Expenditure Intensity does not have a statistically significant impact on any financial performance measure — ROA, Operating Margin, ROE, or Tobin's Q — across any estimation model. This finding is robust and consistent across all three regression approaches. While counterintuitive given the technology-intensive nature of the IT services sector, this result aligns with the concept of technology time lags well established in the innovation economics literature. The benefits of technology capital investments are embedded in infrastructure and platforms whose productivity gains manifest over multi-year horizons, not within annual reporting cycles.

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The second finding concerns the role of intangible assets. The Intangible Asset Ratio achieves partial significance in the ROA model under the Random Effects specification, suggesting that long-term investments in knowledge-based resources — including software assets, intellectual property, and digital capabilities — contribute positively to financial performance over time. This result supports the Knowledge-Based View of the firm and reinforces that in the Indian IT services sector, knowledge assets are more impactful than tangible technology investments. The negative short-term correlation between intangible ratio and profitability observed in the correlation analysis, combined with partial long-term significance in regression, illustrates the characteristic investment-return lag of intangible assets.

The third finding highlights the strong influence of Firm Size and Sales Growth on financial performance. Firm Size is consistently significant in explaining ROA and Operating Margin, indicating that larger firms benefit from economies of scale, cost efficiencies, and stronger client relationships that directly enhance profitability. Sales Growth is significant in multiple models, suggesting that revenue expansion is a more immediate driver of financial performance than technology investment. These results resonate with the Dynamic Capabilities framework, which posits that the ability to grow and scale is itself a dynamic capability that amplifies the returns from technological resources.
The Hausman test results add a layer of nuance to interpretation. The recommendation of Fixed Effects for ROA and Tobin's Q signals that firm-specific, time-invariant characteristics — such as business model, management quality, and historical positioning — significantly influence these performance dimensions. The preference for Random Effects in Operating Margin and ROE models suggests that cross-sectional variation (between-firm differences) is more informative for explaining these measures, highlighting the role of structural differences in operating strategies across sample firms.

Overall, the findings collectively support the conclusion that technological investment functions as a strategic enabler rather than a direct, immediate driver of financial performance in the Indian IT services sector. This conclusion extends and deepens existing literature by providing a disaggregated, longitudinal analysis that distinguishes between different types of technological investment and different dimensions of financial performance. The study's findings are consistent with international evidence from developed markets while adding important context specific to India's rapidly evolving digital economy.

VI. CONCLUSION

The central conclusion is that technological investment does not have a uniform or immediate impact on financial performance. Specifically, Technology Capital Expenditure Intensity does not show a statistically significant relationship with profitability measures in the short term. However, Intangible Asset Ratio demonstrates partial positive influence on financial performance, indicating that long-term investments in knowledge-based resources are more value-generative than tangible technology capital expenditure. Firm size and sales growth emerge as the strongest and most consistent determinants of financial performance, suggesting that scale economies and revenue expansion play a more direct role than short-term technology spending.

From a managerial perspective, the findings counsel IT services firms to adopt a long-term perspective on technology investment planning. Managers should prioritize investments in knowledge-based intangible assets — such as software development, intellectual property, and digital platforms — over short-cycle hardware or infrastructure capex. Growth strategies that expand market presence and scale operations can amplify the financial returns from technological investments. Clear communication of intangible investment value to investors can help bridge the gap between technology deployment and market-based recognition.

The study acknowledges several limitations. The sample is restricted to ten major listed companies and may not fully represent smaller or unlisted IT firms. Proxy-based measurement of technological investment may not capture qualitative dimensions such as innovation efficiency or digital transformation maturity. Time lag effects between technological investment and financial outcomes may not be fully captured within annual data panels. Future research should extend the sample, incorporate R&D expenditure and digital transformation indices as additional technological investment measures, and apply dynamic panel models such as GMM estimators to capture lag effects more precisely.

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