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FinTech-Driven Transformation of Financial Management: Evaluating Digital Innovation, Risk Management, and Strategic Decision-Making

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ABSTRACT

This research explores the impact of digital innovation, risk management, strategic decision-making and firm performance on financial management through the lens of FinTech adoption. Based on the establishment level data from the World Bank Firm Adoption of Technology Survey for India, this study formulates indices of FinTech adoption, digital financial management capability, digital innovation, strategic decision making and financial-risk exposure. Descriptive, correlation, diagnostic and robustness analyses are used in conjunction with weighted least-squares regressions using HC3 robust standard errors. The findings indicate that there is a significant link between the use of FinTech and digital financial-management capability, as well as broadened digital innovation and advanced strategic decision making. Annualised sales growth is also shown to be positively related to the adoption of FinTech, while the direct relationship of operating margin and labour productivity is not statistically significant. Importantly, financial-risk exposure is positively related to adoption of FinTech – specifically credit constraints – suggesting that not all digitalisation leads to lower financial vulnerability. The relationship between strategic capability and labor productivity is positive and that between financial-risk exposure and labor productivity is negative. The results place FinTech within an embedded financial information and decision support infrastructure where organizational value relies on complementary digital capacities and managerial information practices, as well as financial resilience. The study provides empirical evidence at the firm level and is useful for making intelligent decisions and managing finance in the modern companies in India, in an emerging market scenario.

1. Introduction

1.1 Digital Transformation of Financial Management

Digital technologies are changing the architecture of financial management, both in terms of the way firms conduct transactions and in how they process financial information, coordinate administrative activities and monitor performance. Financial technology (FinTech) has evolved from a collection of niche innovations in

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financial services to a comprehensive digital ecosystem comprising payment, platforms, software, data and company processes [1]. At the same time, digital transformation has evolved from simply digitising analogue activities. It progressively entails "reconfiguration" of organizational processes, resources, structures, and value-creation mechanisms – with digital technologies at the centre [2,3]. The difference is relevant to financial management as technology does not have to be adopted in order to be strategic in value. Whether digital tools are integrated into managerial practices and information flows.

Digital financial transformation can thus involve electronic payments, platform-based payments, dedicated business software, enterprise resource planning systems and digitally aided administrative processes for companies. The technologies have the potential to reduce transaction cycles, enhance information accessibility and facilitate more comprehensive financial oversight. They also can add new dependencies, capability requirements, financing requirements, and risk of technology uncertainty. Digital transformation should, therefore, be seen as an organizational change process that enables and restricts, as reported by [4]. This wider view is particularly relevant if we consider FinTech in a broader context, beyond banking and consumer-finance applications.

1.2 FinTech as an Information and Decision-Making Capability

Information processing is tightly coupled with organizational value of FinTech. Digital payment and administrative systems produce structured transaction records, facilitate quicker information exchange, and can link operational activities to financial monitoring. Digital innovation research also highlights the impact of digital technologies on product and service innovation but also processes, organizational boundaries and the way firms coordinate innovation [5]. The added value of such technologies ranges from transaction efficiency to planning, monitoring and decision support capabilities when linked to managerial systems.

This view takes a broader organizational capability approach to the adoption of FinTech. Research on dynamic capabilities in the context of digital transformation indicates that companies benefit more from the technology if they acquire complementary capabilities to sense changes, understand information, coordinate resources, and reconfigure routines [6]. These skills apply to financial management in areas of key performance indicators, setting targets, accessing information, allocation of resources and reacting to constraints. Therefore, a holistic view of the transformation of financial management can only be gained by considering the interplay between FinTech, digital innovation and strategic decision-making.

1.3 Research Problem and Gap

Although digital finance research is rapidly growing, there are still some gaps. Most of the literature related to the FinTech has focused on financial institutions, payment systems, lending platforms, financial inclusion, or consumer adoption [1,9]. The works related to enterprise digital transformation have been investigated respectively from the perspective of enterprise change and enterprise performance. More recent studies have also started to link corporate finance digitalization with firm performance, although there is comparatively limited literature at the firm level on financial management and the performance effect reported is not always positive [7,8]. Such a disintegration also makes it challenging to gauge if FinTech adoption is related only to transaction modernization, or if it is also correlated with other factors such as innovation in the organization, managerial decision capability, financial-risk exposure, and measurable business outcomes.

A second gap is in regard to risk. While digital finance can enhance traceability, information availability and operational efficiency, the challenge remains that vulnerability cannot be completely eradicated with greater digital and financial integration. Digital finance can have positive impacts, but also bring stability and risk issues [9]. Firms that are digitally active can have both better management and be more needy for financing or credit at the same time. If digitalization is seen as a risk reducing process, it may thus mask key trade-offs. A third gap is related to strategic decision-making. The information-use and managerial-monitoring practices that may impact choices through technology adoption are not directly assessed in existing studies, and are too often overlooked in the analysis of technology impacts for financial outcomes.

1.4 Research Purpose and Objectives

This study focuses on these gaps and explores the impact of FinTech on the financial management transformation in four interrelated dimensions: digital innovation, risk management, strategic decision making, and firm performance. It relies on the establishment-level information available from World Bank Firm Adoption of Technology Survey for India that captures micro-level information on the use of technology across business functions and managerial and financial details [10]. The study assesses the relationship between greater adoption of FinTech and digital financial-management skills and digital innovation across the entire organization. It also explores the correlation between strategic capabilities of decision making and financial-risk exposure with financial performance, in the context of adoption of FinTech. Lastly, it examines whether strategic decision

capability and financial-risk exposure are independent predictors of firm productivity and performance, once organizational characteristics are controlled for.

The empirical goals then go beyond the question of whether firms have embraced digital financial technologies. It investigates whether the extent of adoption is systematically associated with the sophistication of financial-management technologies, with other aspects of organizational digitalization, with practices that depend heavily on information, with financial-risk conditions, and with visible performance outcomes. This method allows the evaluation of digital transformation as an organizational phenomenon, not just a binary event.

1.5 Research Contribution

The study is of three types of contribution. First, it broadens the scope of FinTech literature from mainly a financial-service or transactional focus to an organizational information and decision-capability focus. This way of thinking takes into account the fact that the strategic outcomes of FinTech will be influenced by the manner of the integration of the technology into administration, information systems and management practices. Second, it brings together the concepts of digital innovation, financial risks, strategy and performance in an integrated empirical framework at the level of the firm. This integration enables the analysis to reflect the potential advantages, as well as the complexities and challenges associated with digital financial transformation that involve risk.

Thirdly, the study provides a contribution to intelligent decision-making research by investigating the relationship between the features of management practices, such as information use, performance monitoring and planning horizons, and the adoption of FinTech, instead of assuming that merely adopting digital tools leads to better managerial decisions. This is crucial as research into digital transformation has shown that investments in technology do not necessarily yield uniform results in terms of improved organizational performance [7,8]. Complementary managerial and organizational skills are likely to be important factors influencing the effectiveness of digitalization. From this perspective, financial digitalization is a socio-technical change where the technological adoption, information management, managerial competency, risk environment, and financial results are tightly interwoven.

The rest of the article examines the theoretical connections between these dimensions and the hypotheses were formulated. It then introduces the research design, operationalization and empirical methods. The results are reported in the following sections and the implications for intelligent financial decision-making and risk management are discussed, and theoretical, managerial and research implications are made.

2. Literature Review and Hypothesis Development

2.1 FinTech and the Transformation of Financial Management

FinTech has come a long way from being a very specific group of "tech-enabled" financial services to a large and diverse group of digital payments, platforms, software, data infrastructure, and financial interactions using technology. It is therefore relevant to more than just the financial-services industry. Digital payment methods and technologies are becoming a vital part of firms' execution of transactions, recording financial activities, managing administrative process, and integrating financial information into broader operational systems [1]. The development has changed the role of financial management by improving the availability, timeliness and integration of information for monitoring and resource allocation.

There has been a distinction between the adoption of single technologies and greater organizational transformation in digital transformation literature. Digital transformation is a process that takes place when technology resources are integrated into the processes, structures, capabilities and value creation mechanisms of an organization [2,3]. At the firm level, this separation is relevant because use of electronic payments or electronic platforms does not automatically imply that firms have an advanced financial-management skill. The strategic value is dependent on the way these technologies are used in conjunction with special business software applications, enterprise resource planning systems, planning technologies and managerial routines.

Empirical data from the past few years corroborate this general view. Firm digitalization has been linked to better financial performance, with the strength of this relationship varying based on the complementary management resources and organization context [16]. Evidence gathered from SMEs also shows that the successful application of digital technologies needs to be complemented with the right skills, organizational readiness and strategic alignment [18]. Financial management using FinTech must thus be understood as a progressive transformation that involves the interaction of financial technologies with more general digital and managerial capabilities.

2.2 Information Processing and Dynamic Capabilities as Theoretical Foundations

The first theoretical basis of this study is the Organizational Information Processing Theory. The theory suggest

that uncertainty raises the demands of information processing of the organization and that the organizational structure and information systems must have enough capacity to meet demands of information processing [11]. Digital technologies are especially relevant because they are technologies that amplify the capacity to capture, transmit, integrate and analyze information. Payment platforms, administrative software, and information systems integrated into payment processes in financial management can, as a result, enhance the amount and timeliness of information for managers.

This thinking is extended to evidence-based decision making in contemporary times. Colombari et al. [13] demonstrate that the digitalisation and data-based decision making are complementary; data integration and technology breadth have an impact on value added through data-based managerial practices. In the same way, Szukits and Móricz [14] claim that analytical culture and the quality of data are tightly intertwined with organizational decision making based on data. Business analytics systems can also help in strategic planning by providing better information availability, scenario assessment, monitoring and knowledge integration [15]. The results suggest that the informational outputs of digital financial technologies can generate value when embedded in the decision-making process of managers.

The second complementary view comes from Dynamic Capabilities Theory. Dynamic capabilities are the ability of an organization to perceive opportunities and threats, to make resource investments to exploit them, and to adjust its resources and routines when the environment changes [12]. Digital transformation can enhance these processes by boosting connectivity, information transparency, and organizational agility [6]. But technology is just part of the ability. Firms need to also have managerial processes that transform technological resources to coordinated action.

The combination of these perspectives is particularly appropriate for the present study. Organizational Information Processing Theory helps to understand the capacity extension of information processing through FinTech and digital technologies.Organizational Information Processing Theory is an explanation of how FinTech and digital technologies can expand information-processing capacity. Why firms vary in their capacity to transform that knowledge into management, innovation, and performance is analyzed using Dynamic Capabilities Theory. They co-create a conceptual path in which the uptake of FinTech drives digital financial capability and digital innovation in general, which are linked to information rich strategic decision-making and outcomes of the organization.

2.3 FinTech Adoption and Digital Financial-Management Capability

The level of digital financial-management capability indicates how well companies leverage sophisticated digital capabilities to execute and manage financial and administrative operations. These might include ERP systems that tie financial data into broader organizational operations, specific software, and digital platforms. These systems can minimize reliance on manual processes and enhance the reliability and accessibility of financial data.

These technologies are expected to be complemented with the adoption of FinTech. The more the firms can process and integrate a variety of electronic and platform-based payment methods, the more their transactions will be structured, and the more they will have to rely on these types of payment methods. Continued use of digital financial infrastructure can also enhance organizational familiarity with technologic and boost incentives to invest in complementary administrative systems. The connection will thus be expected to go beyond mere payment adoption.

This conclusion aligns with the evidence that digital technology can provide more organizational value when complemented by other capabilities [6,18]. It further underscores the overall result that there are financial benefits to realize from the firm's digitalization when managerial and technological resources are geared towards it [16]. Based on this, the first hypothesis is suggested:

H1: FinTech adoption is positively associated with digital financial-management capability.

2.4 FinTech Adoption and Broader Digital Innovation

Digital technologies are frequently not standalone, but are part of a system of technologies within the firm. Digital innovation is the way the digital technologies are used, to change process, organizational practice, product, services, and value-creation arrangements [5]. An organization that uses digital technologies in one business function can build up knowledge, infrastructure and organizational practices that can be transferred to other functions.

This complementarity applies to the connection between financial technologies and broader digital transformation. Companies with several digital payment methods might more likely have more advanced technology in business administration, production planning, procurement or other operational function. Digital transformation can also boost success with innovation by making it more efficient and efficient enough to

restructure the organization [17]. In addition, evidence from the firm level suggests that digitalization can benefit productivity and performance by complementing other organizational resources when the technology is applied in a transformation process.

As such, the breadth of FinTech is not only a financial decision, but could also be read as a technology mindset. Firms that are more sophisticated in their use of FinTech should be more sophisticated in other business processes as well.

H2: FinTech adoption is positively associated with broader organizational digital innovation.

2.5 FinTech Adoption and Strategic Decision-Making

Strategic decision making requires acquiring, interpreting and using information in situations of uncertainty. Digital systems can change this process by providing more and more timely data, better integration of information sources, and making organizational performance more visible. These capabilities can help to bridge the information shortfall between information needed for the decision and information provided to managers (information processing view) [11].

Recent research sheds light on the close linkage between digitalization and data-driven managerial practices. Complementarities between digitalization and data-driven decision-making in the operations of firms are identified by Colombari et al. [13]. When creating an analytical environment, Szukits and Móricz [14] demonstrate that a supportive environment increases the use of data in decision-making. Kurpiela and Teuteberg [15] also list several business-analytics affordances relevant to strategic planning: information provision, monitoring, scenario developing and performance assessment.

The arguments apply to the strategic variables measured in this study: the number of key performance indicators, monitoring systems, and information sources employed in decision making, in addition to planning periods. Such measures do not represent subjective perceptions of decision quality. Rather, they record the volume and form of information contained in managerial decision processes. Those firms that have more advanced strategic information and planning capacities should exhibit more advanced capacities of adopting FinTech if it is part of a broader information infrastructure.

H3: FinTech adoption is positively associated with strategic decision-making capability.

2.6 FinTech Adoption and Risk Management

The link between FinTech and financial risk is, theoretically, less direct. Digital financial technologies can mitigate some types of risk by making transaction more traceable, information more available, operational efficiency more efficient, and providing access to financial services. Based on the evidence from China, FinTech development can help alleviate the financing constraints faced by the firms, as it can improve financing channels [19] and mitigate information frictions [11]. Changes in debt structure and reduced refinancing or bankruptcy risks have also been linked to digitalization, under certain conditions [21].

But, financial and organizational resources are needed for digital transformation. For technology-intensive companies, they may be forced to invest more in technology, leverage more, or face harsher credit market conditions. Financial resources can therefore have an impact on digitalization capacity, as well as on the performance gains from digital transformation. Financing constraints are found to have a significant influence on the relationship between DT and enterprise growth by Li and Wei [20]. Overall, the literature reveals that the impacts of digitalization on the firms' financial outcomes depend on the characteristics of the firms and the conditions for digitalization implementation [7,8].

The present study does not presume that the adoption of FinTechs leads to a reduction in risk by itself. From an empirical perspective, risk management is analysed by means of the financial-risk exposure and the resilience conditions that are observable in the marketplace, such as credit constraints, financing difficulties, demand uncertainty and related barriers. This is because digital transformation can go hand-in-hand with increased risk levels even when enhancing other business functions.

Considering these conflicting theoretical processes, one should have a non-directional hypothesis:

H4: FinTech adoption is significantly associated with firms' financial-risk exposure.

2.7 FinTech Adoption and Firm Financial Performance

There are various ways in which FinTech can drive performance. Digital payment technologies can make transactions smoother, faster, better documented and better informed, and can contribute to the documentation of transactional processes in administrative or managerial processes. These enhancements, along with other digital skills, can contribute to better utilization of resources and teamwork within organizations.

Empirical studies tend to agree that there are positive effects on performance when it comes to digitalisation, but these are not consistent. Zeng, et al., [16] identify that a strong link exists between financial performance

and firm digitalisation, and that the former is reinforced by having more experience of the top management team. Zhai et al. [17] also claim that digital transformation can improve performance through reduced costs, increased operating efficiency and increased innovation success. Results of the SMEs highlight the need to match technology with skills and organizational circumstances for digitalization to have a positive impact on performance [18].

Other studies show why it is not advisable to have only a positive assumption. Digital transformation can include significant implementation, coordinating and managerial expenses, which can result in a digitalization paradox, where investment is not aligned, too little or too much [8]. The present study, therefore, anticipates a positive relationship, and acknowledges that the observational research design does not provide causal evidence of how the use of FinTech leads to performance improvement.

H5: FinTech adoption is positively associated with firm financial performance.

2.8 Strategic Decision-Making, Financial Risk, and Performance

Whether or not information is transformed into managerial action is what makes digital technology valuable. A second way that firms can leverage information is by using their strategic decision making capability to track operations, establish goals, make resource allocation and adjustments, and react to changes in circumstances. Managers, therefore, should have routines to convert information into information-based decisions, to increase the organizational value of information processing capacity [13-15].

It is, therefore, hypothesized that the strategic decision-making capability would be positively related to performance. Companies that rely on a wider set of relevant measures and who make use of formal planning periods might be more likely to detect deviations, to orchestrate a suitable reaction and to manage resources properly. This relationship is similar to the dynamic-capability view since sensing and seizing opportunities require managerial interpretation and action [12].

H6: Strategic decision-making capability is positively associated with firm performance.

The financial risk exposure should go in the opposite direction. Access to finance may be limited, limiting investments, access to technology, working capital flexibility and the ability to tap new opportunities. There is recent evidence that financing constraints have reduced the benefits of digital transformation with respect to growth [20]. Uncertainty and financial constraints also affect companies' capacity to apply digitalization to enhance financing structures and risk of refinancing [21]. Other factors being equal, the weaker performance is expected from firms that have higher financial-risk exposure.

H7: Financial-risk exposure is negatively associated with firm performance.

Combined, the hypotheses form a multi-dimensional understanding of the phenomenon of financial transformation through a FinTech, which is an organizational process. Digital financial-management capability, a broader digital innovation, and advanced strategic decision-making will be linked with the adoption of FinTech. The relationship between it and financial risk is left in an ambiguous theoretical state and empirically assessed. Finally, the performance of the firm is analyzed in the context of the adoption of FinTech and strategic decision making capabilities and financial-risk exposure. This framework establishes a separation between technological adoption and organisational capability, and embeds financial digitalisation in the information and decision-making processes at the heart of intelligent decision-making.

3. Materials and Methods

3.1 Research Design

The study used quantitative and explanatory research design, using the secondary firm level survey data. The empirical analysis focused on relationships between the adoption of FinTech, the capability of digital financial management, the overall digital innovation, strategic decision making, financial-risk exposure and firm performance. Design: observational. Estimated relationships were thus interpreted as associations not effects, and therefore as conditional relationships.

The analysis was done at establishment level. The development and statistical specifications were based on the variables available in the Firm Adoption of Technology (FAT) survey, and were maintained throughout the empirical analysis. As there are no psychometric survey items used to measure the technology use and management practices, the principal constructs were defined as formative indices. Formative measurement is measurement in which a set of indicators together define a construct, and do not need to measure "interchangeable" manifestations of a single latent trait [22].

3.2 Data Source and Analytical Sample

The data was taken from World Bank's India: Firm Adoption of Technology Survey (2021-2023) [10]. The Fat programme has a standardised establishment level questionnaire and a stratified random sampling design. It

includes formal private-sector agriculture, manufacturing, and services and includes measures of technology adoption in over 60 business functions. Survey also includes data on management characteristics, technology-adoption barriers, employment and financial performance [10].

The public-use data set was composed of 1,519 establishments and 987 variables. No exact duplicate records were found and there were 1,519 observations with different public-use firm identifiers. According to the World Bank metadata list Gujarat, Maharashtra, Tamil Nadu and Uttar Pradesh are under the geographic coverage of India survey [10]. But the state variable in the public use analytical file provided identified observations only for Tamil Nadu and Uttar Pradesh. The categories in the supplied file were assumed to represent the true state and no attempt was made to infer any state that was not observed in the supplied file.

The same distinction was kept for the temporal information. The catalog lists the period of data collection (2021-2023), but the financial reference year variables in the provided file were coded as 2019 and 2017. Therefore, changes in financial growth measures were based on the reference years as shown in the analytical file and not the dates of the survey.

3.3 Data Preparation

A reproducible analytical script was used for all analyses (in Python). Special response codes with negative numbers were assumed to represent missing and the numbers were omitted from all numerical analyses. The answers to the technology-adoption question were recoded, with a score of 1 indicating adoption and a score of 2 indicating non-adoption. No statistical imputation was done. Thus the observations with missing information for the variables in the specification were not used in estimating the regression models.

Continuous outcome variables which could have influential extreme observations were handled conservatively. The sales growth and operating-margin proxy were winsorized at the 1st and 99th percentiles. The number of credit constraints that were used to calculate the risk index was also winsorized prior to normalization. Weighted descriptive and regression analyses were kept using sampling weights.

3.4 Measurement of FinTech Adoption

The adoption of FinTech was assessed based on three types of payment technologies: card payments (b14a4), online / electronic payments (b14a5) and online / platform-based payments (b14a6). Adoption of each indicator was coded 1 if they adopted and 0 if they did not. The indicators were added up to create an index of the breadth of FinTech ranging from 0 to 3.

This was transformed to a 0-100 index for multivariate analysis:

$$\text{FinTech Index}_{\text{i}} = \left(\frac{\text{Card Payment}_{\text{i}} + \text{Electronic Payment}_{\text{i}} + \text{Platform Payment}_{\text{i}}}{3}\right) \times 100$$

A cryptocurrency-payment variable was included for descriptive analysis but not the primary index since there was very limited adoption of it in the sample.

3.5 Digital Financial-Management Capability

The technological sophistication of business administration was digital financial-management capability. It included three of the FAT indicators: utilization of mobile applications or electronic platforms (b8a3); utilization of specialized business software (b8a4); and enterprise resource planning systems (b8a5). These were each coded as a binary 'adoption' indicator.

The index was calculated as an average of the three indicators, multiplied by 100. The higher values thus indicated higher advanced digital technologies use in the administrative and financial-management processes.

3.6 Digital Innovation

The overall digital innovation index was created independent of FinTech and business-administration technologies to minimize the conceptual overlap. Indicators of advanced technology were obtained from five organizational functions – production planning, supplier management, marketing, sales and quality control – with a total of 15 indicators.

Mobile and digital planning applications, specialized planning software, ERP-supported planning, social-media and supplier-relationship-management technologies, online marketing, customer relationship management, big-data analytics, digital sales channels, electronic orders, statistical quality control, and automated quality control were the indicators. The index was derived from an average of the adoption rates, and scaled from 0-100, for the indicators relevant to the topic.

The central variables of the study were operationalized as can be seen in Table 1.

Table 1. Operationalization of the Main Study Constructs

Construct	FAT variables	Operationalization	Analytical role

FinTech adoption	b14a4, b14a5, b14a6	Card, electronic/online, and platform-payment adoption; breadth converted to 0–100	Core predictor
Digital financial-management capability	b8a3, b8a4, b8a5	Mean adoption of digital platforms, specialized software, and ERP × 100	Transformation outcome/predictor
Digital innovation	b9a3–b9a5, b10a3–b10a5, b11a2, b11a4–b11a5, b13b3–b13b6, b15a3–b15a4	Mean adoption of 15 advanced technologies × 100	Innovation outcome/predictor
Strategic decision-making capability	d4b, d4c, d4d	Normalized KPI breadth, KPI-monitoring frequency, and target horizon; mean × 100	Strategic outcome/predictor
Financial-risk exposure	d3c, d8a–d8f	Credit-constraint severity, financing barriers, and demand uncertainty; mean × 100	Risk outcome/predictor
Sales growth	e6a, e6b	Two-year annualized sales growth, winsorized at 1st/99th percentiles	Performance outcome
Operating-margin proxy	e6a, e7d	(Sales − operating cost)/sales, winsorized at 1st/99th percentiles	Performance outcome
Labor productivity	e6a, e1a–e1d	Natural log of sales per total worker	Performance outcome

3.7 Strategic Decision-Making Capability

Three observable managerial practices were used to capture the notion of strategic decision-making capability. The four category response structure of KPI breadth (d4b) was first rescaled to a 0–1 measure. Secondly, the frequency of KPI monitoring (d4c) was transformed to an ordered intensity score with a 0 denoting no monitoring, and a 1 indicating the highest monitoring frequency. Third, the production – target horizon (d4d) was scored to differentiate between the absence of targets and short-term, long-term and combined short and long-term target setting.

Multiplication of the three normalized components by 100 and averaging them. The higher scores signaled more structure and intensity of performance monitoring and decision making with targets. For decision-making purposes the firm's primary information source (d2a) was analyzed as a nominal variable and was not included in the composite index, as these categories are not considered to be defendable ordinal categories.

3.8 Financial-Risk Exposure

An enterprise risk-management system is not measured in the FAT survey, per se. Risk management became observable then in terms of indicators of financial-risk exposure and resilience. This difference was maintained to prevent exaggerating the measurement of the secondary data.

There were three components used. The severity of credit constraint was based on the number of times a firm required a finance that it could not acquire (d3c). The count was winsorised and standardised between a 0–1 scale. Financing barriers were quantified as the percentage of responses to six technology-adoption barrier questions (d8a – d8f) that indicated difficulties obtaining finance. Demand uncertainty was built up similarly from responses that referenced uncertainty of demand.

The financial-risk exposure index was calculated as:

$$\text{Risk Exposure}_{\text{i}} = \left(\frac{\text{Credit Constraint}_{\text{i}} + \text{Financing Barrier}_{\text{i}} + \text{Demand Uncertainty}_{\text{i}}}{3}\right) \times 100$$

Higher values represented greater financial-risk exposure and lower financial resilience. For supplementary interpretation, financial resilience was defined as (100-RiskExposure_i).

3.9 Firm Performance Measures

Three performance outcomes were examined. Sales growth was calculated using the two financial reference years contained in the public-use file. Because the recorded years were 2017 and 2019, annualized sales growth

was calculated as:

$$\text{Sales Growth}_{\text{i}} = \left(\frac{\text{Sales}_{2019,\text{i}}}{\text{Sales}_{2017,\text{i}}}\right)^{\frac{1}{2}} - 1$$

The operating-margin proxy was calculated as:

$$\text{Operating Margin}_{\text{i}} = \frac{\text{Sales}_{\text{i}} - \text{Operating Cost}_{\text{i}}}{\text{Sales}_{\text{i}}}$$

Labor productivity was measured as the natural logarithm of sales per worker. Total employment represented the sum of permanent full-time, permanent part-time, temporary or seasonal full-time, and temporary or seasonal part-time workers.

3.10 Control Variables

The multivariate models adjusted for characteristics that might be related to technology adoption and/or organizational outcomes. These included number of employees, age of the firm, sector experience of top managers, manager gender, manager education and percentage foreign ownership. Categorical controls included sector, and observed state. Firm age was measured on the assumption that it was the number of years that had elapsed between the year of the first financial reference and the year the firm reported it had started up.

3.11 Statistical Analysis

The empirical analysis took place in a number of stages. The weighted descriptive statistics and adoption rates were initially computed using the World Bank sampling weight (base_wt). Next, weighted correlations were calculated between the key constructs and performance measures. Survey-weighted means and standard deviations were used to standardise the indices which have been included in the core regression models.

For the main hypotheses, probability-weighted least-squares regressions were estimated. To minimize sensitivity of statistical inference to non-constant residual variance [23] HC3 heteroskedasticity-consistent covariance estimates were used. The first models investigated digital financial-management capability and digital innovation as the results of the FinTech adoption. Strategic decision-making was then modelled as a function of FinTech adoption, capability in digital financial-management, and the overall digital innovation.

Financial-risk analyses were done on credit constraints, financing barriers, and composite risk-exposure index. For the performance models, the dependent variable was sales growth, the operating margin proxy and logged labor productivity. All of these models incorporated FinTech adoption, digital financial-management capability, digital innovation, strategic decision-making and financial-risk exposure along with the controls mentioned.

Another interaction model was used to examine the interaction between financial-risk exposure and FinTech adoption on operating performance. At the component level, the following factors have been studied separately: KPI breadth, KPI-monitoring frequency, target horizon and demand uncertainty. All the principal transformation models were estimated by unweighted regressions as sensitivity checks. Multicollinearity of the central predictors and continuous controls was assessed with variance inflation factors. Statistically significance was tested at the 5% level and exact p values and 95% confidence intervals were kept to aid interpretation.

There were no imputations for missing observations, which resulted in a different number of observations available for each outcome. In the case of financial-performance specifications, there are approximately 1,328–1,339 establishments, and in the case of core digital-transformation models, there are approximately 1,496 establishments. This was an approach that retained as much information as possible from the observed data while simultaneously being transparent with the missing data, specifically for this model.

4. Results

4.1 Sample Characteristics and Technology Adoption

There were 1,519 establishments in the analytical data set. There were differences between weighted and unweighted composition of the samples because the analysis used the sampling weight provided by the World Bank. The weighted sample of Tamil Nadu was about 74.0% and that of Uttar Pradesh was 26.0%. Small establishments (5-19 workers) accounted for 61.2% of the weighted sample while medium establishments (20-99 workers) accounted for 33.2% of the weighted sample. 5.5% of the establishments were large. The three largest sectoral groups were other manufacturing, wholesale and retail trade, and other services. These characteristics indicate that the analysis is mainly of small and medium enterprises in a variety of economic activities instead of only financial sector enterprises [10].

There was a high penetration of digital payment. Around 66.8% of companies adopted online/electronic payments, 64.2% adopted online/ platform-based payments and 59.1% adopted card payments. There was

virtually no adoption of cryptocurrencies as a means of payment. By contrast, higher level business-administration technologies were much less common. 22.1% of the establishments utilized specialized business software and 19.4% used mobile applications or platforms for managing their businesses, while 10.9% used ERP systems.

Table 2. Weighted Sample Composition and Digital Technology Adoption

Indicator	Weighted percentage (%)
Sample composition	
Tamil Nadu	74.0
Uttar Pradesh	26.0
Small firms, 5–19 workers	61.2
Medium firms, 20–99 workers	33.2
Large firms, ≥100 workers	5.5
Other manufacturing	33.6
Wholesale and retail	26.8
Other services	18.3
Other sectors combined	21.4
Technology adoption	
Card payments	59.1
Online/electronic payments	66.8
Online/platform payments	64.2
Cryptocurrency payments	0.0
Business-administration digital platform	19.4
Specialized business software	22.1
ERP	10.9

Source: Authors' analysis of the FAT India dataset [10]. Percentages incorporate base_wt sampling weights.

The difference in the rate of payment adoption and advanced administrative-system adoption suggests a wider diffusion of digital financial transactions compared to integrated digital management systems.

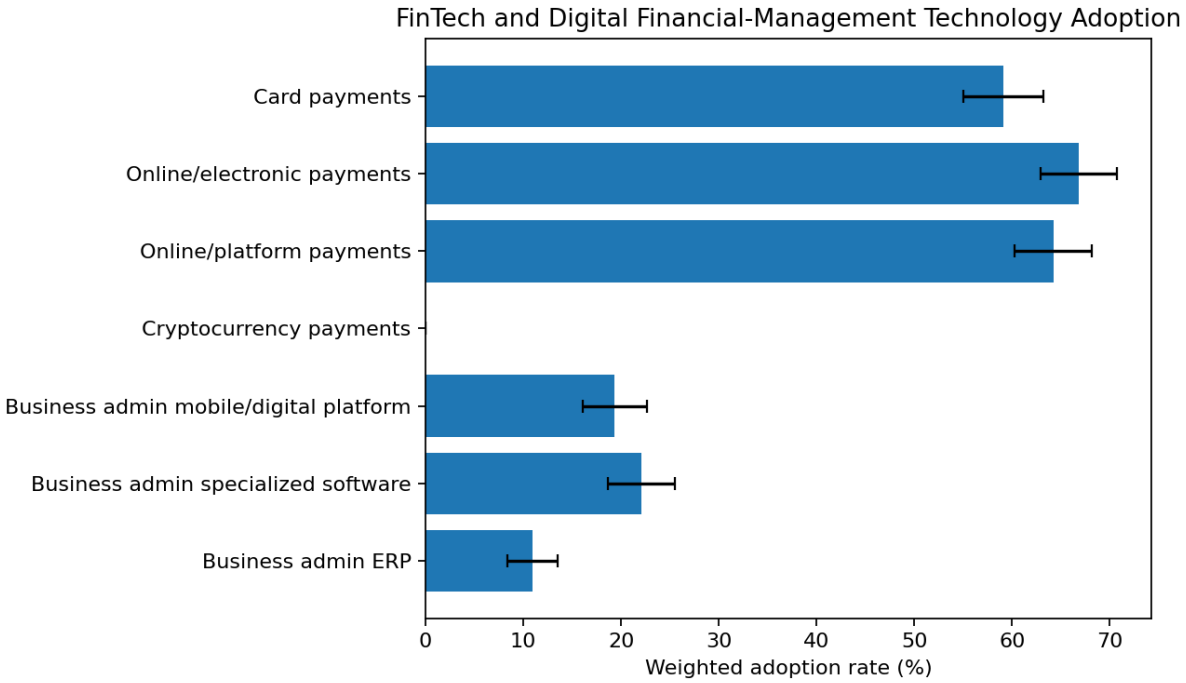


Figure 1. Weighted Adoption Rates of FinTech and Digital Financial-Management Technologies
Source: Authors' analysis of the FAT India dataset [10].

4.2 Descriptive Statistics and Correlation Patterns

The FinTech adoption index on a 0-100 scale was 63.39 (weighted mean). The weighted mean of digital financial-management capability was considerably lower at 17.45, and the wider digital innovation index, averaged 13.62. The strategic decision making index was on average 42.07. The mean financial-risk exposure was 13.40 and 46.5% of the firms that provided borrowing information had at least one credit-constraint experience.

The annual sales growth rate was 7.53% on average. The average for the operating-margin proxy was 0.335 and for mean logged labor productivity, 2.874. The main descriptive statistics and their weighted bivariate correlations with FinTech adoption are shown in Table 3.

Table 3. Descriptive Statistics and Selected Weighted Correlations

Variable	Valid N	Weighted mean	Weighted SD	Correlation with FinTech
FinTech adoption index	1,515	63.388	32.389	1.000
Digital financial-management capability	1,519	17.447	28.409	0.156
Digital innovation	1,519	13.624	16.110	0.218
Strategic decision-making	1,519	42.072	13.411	0.194
Financial-risk exposure	1,519	13.402	9.193	0.115
Annualized sales growth	1,334	0.075	0.141	0.204
Operating-margin proxy	1,345	0.335	0.252	-0.032
Log labor productivity	1,345	2.874	1.355	0.066

Source: Authors' analysis of the FAT India dataset [10].

Digital financial-management capability, digital innovation, strategic decision-making and sales growth were positively weighted correlated with FinTech adoption. Digital financial-management capability and digital innovation had a high correlation (r = 0.740), which demonstrates the synergies between digital capabilities within the various business functions. But later variance inflation diagnostics were not at traditionally problematic levels.

Variations among FinTech breadth categories also showed a gradual increase in digital capabilities. The mean digital financial-management score of the firms that adopted none of the three FinTech technologies was 8.74, whereas that of the firms that adopted all three of the technologies was 21.42. The digital innovation scores were also up, from 4.57 to 16.69. The number of strategic decision making rose from 37.92 to 44.53.

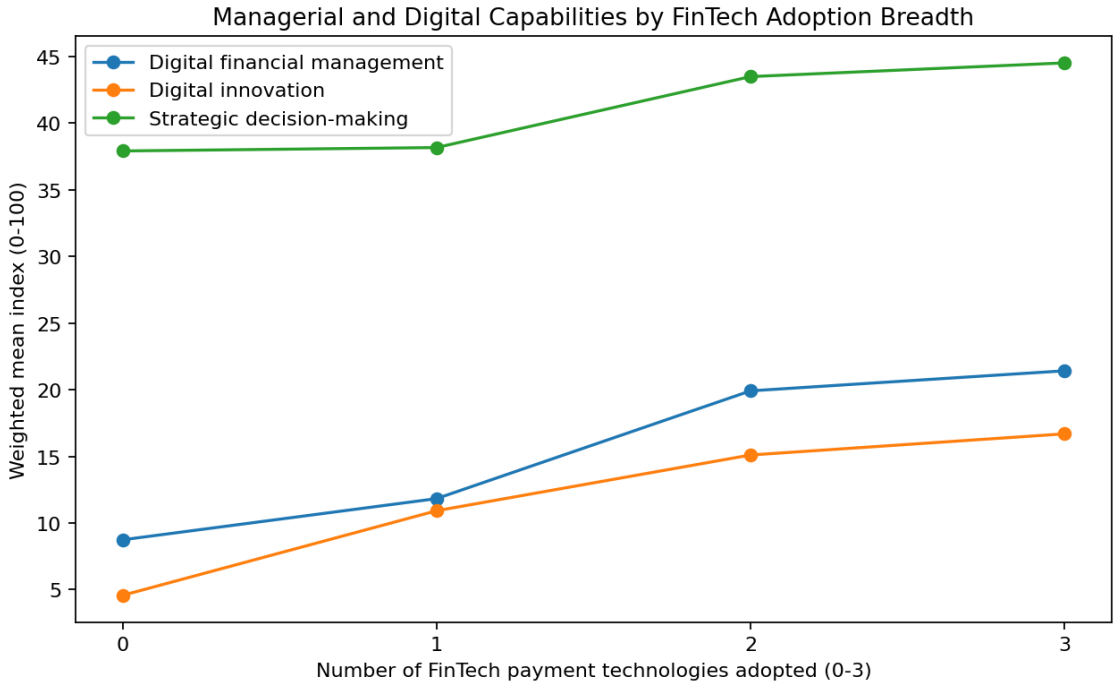


Figure 2. Digital and Strategic Capabilities by FinTech Adoption Breadth

4.3 FinTech, Digital Financial Management, and Digital Innovation

Table 4 shows the multivariate results. All models included sampling weights and robust standard errors (HC3), firm-level controls, sector indicators, and state indicators.

There was a positive relationship between FinTech adoption and digital financial-management capability. The FinTech index was positively associated with digital financial-management capability, with a 1 SD increase in the FinTech index positively related to an increase in digital financial-management capability (conditional) by 0.110 SD (β = 0.110, SE = 0.032, p < .001, 95% CI [0.047, 0.172]). The model accounted for 38.0% of the variance of the standardized outcome. H1 was thus accepted.

The tie-up with the wider digital innovation was more solid. FinTech adoption was associated with a 0.226 standard-deviation increase in the digital innovation index (β = 0.226, SE = 0.028, p < .001, 95% CI [0.172, 0.281]). The model accounted for 48.5% of the variation in the outcomes. H2 was supported.

4.4 FinTech and Strategic Decision-Making

Strategic decision-making capability (β = 0.162, SE = 0.037, p < .001) was also positively related to FinTech adoption. A 95% confidence interval for the mean estimated to be (0.090, 0.234). Thus, H3 was supported.

This association did not exist across the other digital-capability predictors. Digital financial-management capability (β = -0.153, p = .016) was found to be a significant conditional coefficient whereas broader digital innovation was not (β = 0.039, p = .561). This finding indicates that the financial digitalization – strategic decision practices association can not be described as a linear progression going through all levels of technological sophistication.

These findings of a "multidimensional" pattern were reinforced by component-level analyses. FinTech adoption was positively associated with KPI breadth (β = 0.0508, p < .001) and target horizon (β = 0.0252, p = .008). However, there was a negative relationship with the coded KPI-monitoring frequency (ß = -0.0149, p = .013). In other words, the greater the adoption of FinTech, the more pervasive the performance measurement and the more advanced the target horizons, but not necessarily the higher the value in each of the decision-management indicators.

4.5 FinTech and Financial-Risk Exposure

The FinTech and risk dynamic was found to be different from the traditional risk reduction assumption. FinTech adoption was positively associated with the financial-risk exposure index (β = 0.147, SE = 0.044, p < .001, 95% CI [0.060, 0.234]). There was an association (r>0.05) that was significant (H4 stated that it was significant without stating it was positive), so the hypothesis was accepted.

Table 4. Core Weighted Regression Results

Outcome	Predictor	β	Robust SE	p	N	R^2
Digital financial-management capability	FinTech adoption	0.110	0.032	<.001	1,496	0.380
Digital innovation	FinTech adoption	0.226	0.028	<.001	1,496	0.485
Strategic decision-making	FinTech adoption	0.162	0.037	<.001	1,496	0.238
Strategic decision-making	Digital financial management	-0.153	0.063	.016	1,496	0.238
Strategic decision-making	Digital innovation	0.039	0.067	.561	1,496	0.238
Financial-risk exposure	FinTech adoption	0.147	0.044	<.001	1,496	0.101
Financial-risk exposure	Digital financial management	-0.064	0.059	.281	1,496	0.101
Financial-risk exposure	Strategic decision-making	-0.013	0.043	.763	1,496	0.101

Note: Core construct variables are standardized in these models. Models include firm size, age, manager experience, manager gender, manager education, foreign ownership, sector, and state controls. HC3 robust standard errors are reported.

The component analysis was used to elucidate the source of the positive risk association. Results from the weighted linear-probability specification show that a one standard-deviation rise in FinTech adoption was

related to about a 11.8 percentage point rise in the likelihood of experiencing a credit constraint. (β = 0.118, p < .001). However, the financing-barrier rate (p = .276) and the demand-uncertainty rate (p = .455) did not significantly affect the adoption of FinTech. Thus, the overall performance outcome was largely the result of the observed credit restrictions and not necessarily of an increase in the exposure of all the risk components.

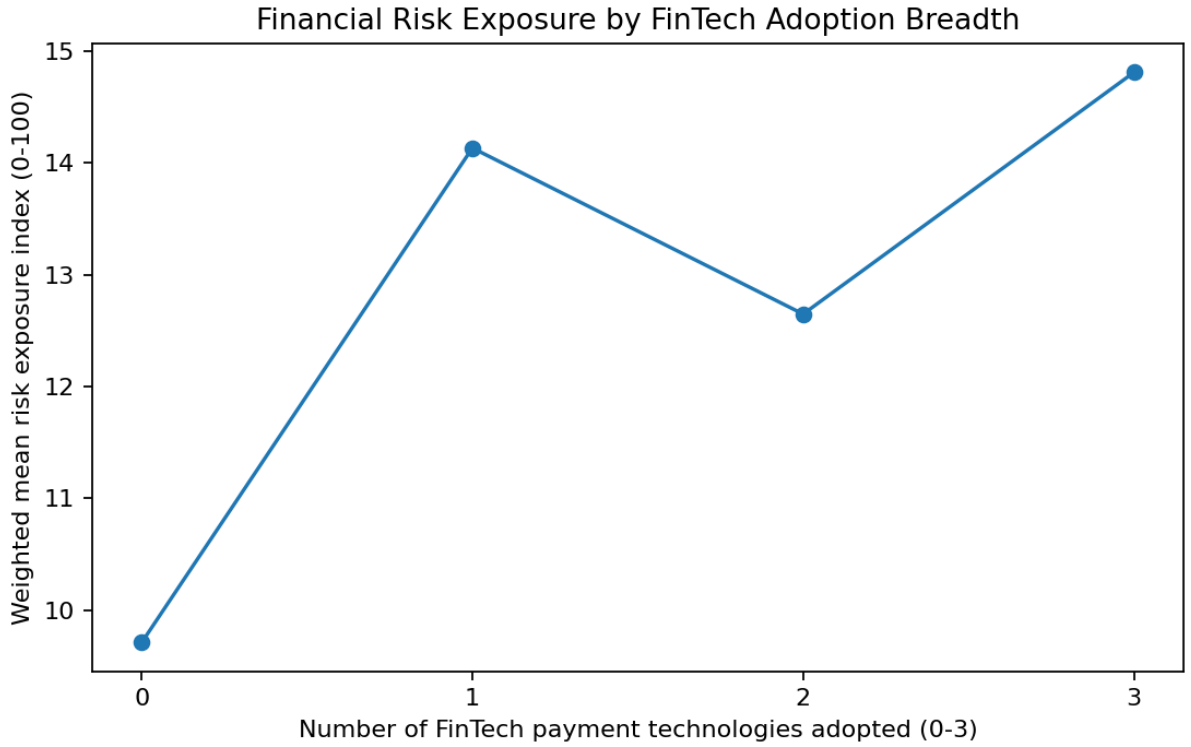


Figure 3. Financial-Risk Exposure by FinTech Adoption Breadth

4.6 FinTech, Strategic Decision-Making, and Firm Performance

The use of FinTech showed the most obvious performance correlation with sales growth. The results indicated that the annualized sales growth increased by 0.0319 (about 3.19 percentage points, SE = 0.0073, p < .001, 95% CI [0.0176, 0.0462]) for a one-standard-deviation increase in FinTech adoption. For this reason, H5 got support for the sales-growth outcome.

But the direct FinTech coefficients were not significant for operating margin (β = -0.003, p = .792) and labor productivity (β = -0.030, p = .616). Thus, H5 was partially supported when all three outcomes were taken into account in regard to financial performance.

A similar differentiated relationship with performance was found for strategic decision-making. It was positively related to logged labor productivity (β = 0.196, p < .001), but negatively related to the operating-margin proxy (β = -0.0247, p = .029). The relationship of its with sales growth was not significant. Hence, H6 was not uniformly supported.

There was a negative relationship between financial-risk exposure and labor productivity (β = -0.240, p < .001). It did not have a negative relationship with sales growth (p = .200) and operating margin (p = .098) which are not statistically significant at the 5% level. Evidence for H7 was thus limited.

Table 5. Performance Models and Conditional Risk Results

Outcome	FinTech adoption	Strategic decision-making	Financial-risk exposure	N	R^2
Annualized sales growth	0.0319***	-0.0101	-0.0106	1,328	0.104
Operating-margin proxy	-0.0032	-0.0247*	-0.0181	1,339	0.196
Log labor productivity	-0.0299	0.1961***	-0.2396***	1,339	0.278
Operating margin, interaction model	-0.0070	-0.0243*	-0.0123	1,339	0.211

Note: Predictors are standardized. For the interaction model, FinTech × financial-risk exposure = -0.0332, SE = 0.0110, p = .0026. *p < .05; **p < .01; ***p < .001.

The relationship between the FinTech adoption and financial-risk exposure was negative and significant for operating margin (β = -0.0332, p = .0026). This finding suggests that the relationship between FinTech use and operating performance is less positive with greater financial-risk exposure. As it is an observationally designed study, it is interpreted as a conditional association rather than a causal moderation.

The same degree of complexity was found for weighted group patterns. The number of firms with a negative annualized sales growth dropped from -0.4% for firms with no FinTech technologies to 10.5% for firms with two and 9.0% for firms with all three FinTech technologies. There was no clear positive relationship between operating margin and adoption category, and no clear positive relationship between labor productivity and adoption category.

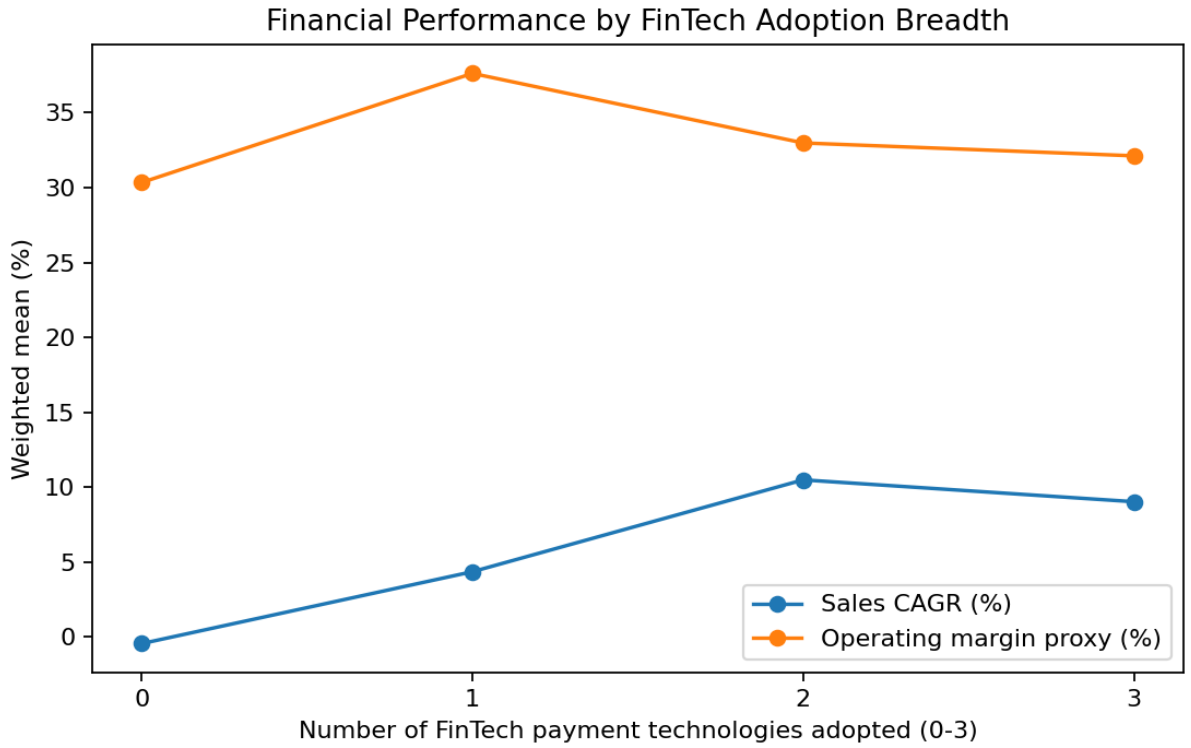


Figure 4. Financial Performance by FinTech Adoption Breadth

4.7 Robustness and Diagnostic Assessment

There were no issues with multicollinearity. Digital innovation had the highest VIF of 2.96, while the VIF of 2.58 was found for digital financial-management capability. VIF values of all other principal predictors were found to be < 1.3.

The same directionality results were given by unweighted sensitivity models for the leading FinTech relationships. FinTech remained positively associated with digital financial-management capability (β = 0.158, p < .001), digital innovation (β = 0.279, p < .001), strategic decision-making (β = 0.192, p < .001), financial-risk exposure (β = 0.141, p < .001), and sales growth (β = 0.0207, p < .001). The similarity of the results obtained by using weights and unweights suggests that the main results were not solely driven by the use of survey weights.

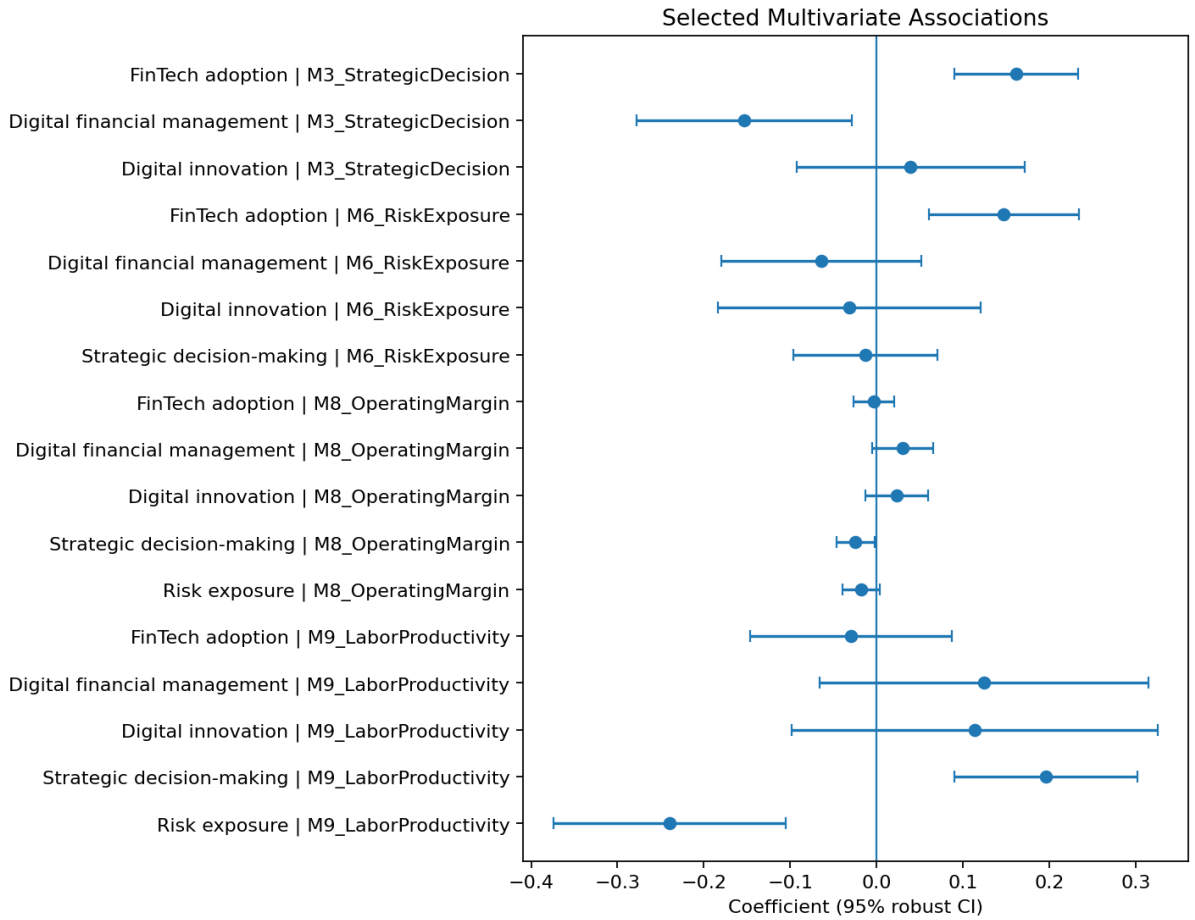


Figure 5. Standardized Coefficients Across the Core Multivariate Models

Overall, there was support for H1, H2, and H3. The four categories of financial-risk exposure were also supported as non-directional associations, with higher FinTech adoption correlated with higher financial-risk exposure. Partial support was provided for H5 because the positive performance evidence was in the growth of sales. Evidence is mixed for H6, which has a positive relationship with labor productivity and a negative relationship with operating margin. H7 was given partial support with higher level of financial risk exposure significantly associated with lower level of labor productivity but not with sales growth at the 5% level.

5. Discussion

5.1 FinTech as a Financial Information Infrastructure

Results show that FinTech adoption is linked to a more comprehensive change of organizational financial management, not just digitalization of payments. There were strong positive correlations with the FinTech adoption with both digital financial-management capability as well as with the overall digital innovation. The findings prove H1 and H2 and indicate that organizations with more than one digital payment technology are more likely to have more advanced administrative and operational technologies.

This is in line with the concept that digital technologies add more value to an organization if they are complementary resources [6]. It also further proves that the development of FinTech can be a tool for corporate digital transformation [24]. The present results are unique in that they show that this relationship exists at the establishment level based on observed technology-adoption practices. Payment technology seems to be a component of a larger digital system, including specific software, digital platforms, administration with ERP, and operation functions that are digitally enabled.

The results thus confirm the difference between the adoption of FinTech and the development of digital financial-management capability. The first one is about the use of technology, while the second one shows the level of integration of digital technologies in administration. This separation is of importance because firms with similar access to digital financial services can achieve different outcomes in their organisations.

5.2 FinTech and Intelligent Strategic Decision-Making

The positive relationship between the FinTech adoption with strategic decision making capability directly supports H3. Considering the breadth of FinTech, there was a tendency toward more structured managerial

information practices in the firms that reported more FinTech. Adoption of FinTech was specifically associated with breadth of KPIs and more advanced target horizons. This finding is in line with the information-processing argument that was discussed earlier in the study. While digitalization can increase the amount of information to which an organisation has access, strategic value lies in the fact that the information will be integrated into monitoring and planning activities [13-15].

The results do show, however, that this is a multi-faceted relationship. The coded KPI-monitoring frequency measure had a negative association with FinTech adoption and the coded digital financial-management capability had a negative conditional coefficient in the overall strategic decision model. The results are a warning against assuming a digital sophistication is the same as a steady increase in managerial monitoring. Technologically more advanced companies might use integrated systems, selective performance measures or other reporting intervals instead of an escalation of monitoring.

The finding is aligned with recent research in the field of decision-science that reveals that technology resources need to be used in conjunction with the right managerial capabilities if they are to enhance organizational decisions. The research on AI-driven decision-making also shows that the added value of advanced technologies is the complementary decision capabilities rather than the technology itself [30]. The current results can be carried over to the area of FinTech and financial-management information systems.

5.3 The Financial-Risk Paradox of Digitalization

An important discovery relates to financial risk. There was a positive correlation between the composite financial-risk exposure measure and FinTech adoption. This relationship was found to be mainly due to credit constraints and not uncertainty in demand or perceived financing constraints, based on the component analysis. H4 was, therefore, supported but not in a risk reduction sense.

This finding is contrary to studies that have found FinTech development leads to a decrease in financing constraints [19,24]. The size of the difference could be due to the point of measurement in the FinTech measurement. Development of FinTech at the regional level could lead to greater financial infrastructure, and firm level adoption might pick up firms that are more financially active, growing, or reliant on outside funding. Digital firms may therefore be more likely to report higher unmet needs for loans, despite enhancements in other aspects of financial management arising from their use of digital technologies.

Evidence from MSMEs also shows that the linkages between digitisation and credit constraints vary based on the specific credit constraint examined as well as the type of credit product [27]. The present results favour this more conditional interpretation. Adopting FinTech does not necessarily mean that an organisation is financially resilient.

This conclusion is confirmed by a negative relationship between FinTech and financial-risk exposure in the operating-margin model. Financial-risk exposure and FinTech adoption were not independently associated with higher operating margins and the conditional relationship between them became less favorable at higher levels of financial-risk exposure. Digital capability also can go hand in hand with resource constraints that limit the ability to translate technological sophistication into operating results immediately.

5.4 FinTech and Firm Performance

Partial support for H5 is found in the results of the performance. The annualized sales growth was significantly and positively related to the adoption of FinTech with a one-s.d. increase in FinTech adoption leading to an about 3.19 percentage point higher annualized sales growth after control. But the relationships with operating margin and labour productivity were not significant.

This is a substantive difference. Digital financial technology can help in the markets, transaction capacity, customer access, and business growth but does not necessarily yield immediate margin and productivity gains. Implementation, coordination, training and complementary investment costs are also part of digital transformation [8]. Recent evidence shows that the economic potential of digital transformation can vary significantly depending on a company and its performance [28]. Thus, because of the advantages of growth, it must not be presumed that they will automatically lead to profit.

Another differentiated pattern was observed for strategic decision-making. It was negatively associated with the operating-margin proxy, and positively associated with labor productivity. Thus, H6 was supported in some aspects and not others. A more structured decision system can be helpful in coordinating the resources and maximizing output per person, but it will involve investments in the monitoring system, information system, managerial processes or restructuring of the organization. The discovery adds weight to the importance of separating productivity from short-term profit.

There was partial support that financial-risk exposure was significantly negatively associated with labor productivity. This finding is in line with the hypothesis that financing constraints can be binding in the sense that

they constrain the flexibility for investment. The overall empirical evidence, however, also shows a significant heterogeneity in the relation between financial constraints and performance using different measures, samples and model specifications [29]. It is important to note that, therefore, the current findings are not necessarily indicative of a general financial-risk mechanism but rather of a specific firm-level association.

5.5 Theoretical Contributions

The results make two key theoretical contributions. First, they work to build on Organizational Information Processing Theory to define FinTech adoption as a component in the information infrastructure used to create and structure financial and operational information for firms. The positive relationship with digital financial management and digital innovation, as well as strategic decision-making, suggests that FinTech use is related to capacity of information within the organization, not just transactional efficiency.

Second, the results provide clarifications to the Dynamic Capabilities view of Digital Transformation. While technology adoption seems to be correlated with increased organizational capacities, increased organizational capacities do not have the same effect on growth, profitability, productivity and financial risk. Thus, results are compatible with a capability-contingent view in which digital resources provide strategic value through combinations of information processing, managerial practices, complementary technology and financial conditions [6].

5.6 Implications for Intelligent Financial Decision Support

The result could have a direct application in the fields of intelligent decision making and information systems. While financial technologies produce transactional information, it is strategically valuable when it is linked to administrative systems, performance indicators and planning routines. In recent years, financial decision-support systems are integrating digital finance along with analytical/computational aspects to enhance financial operations and risk assessment [26].

This means that for companies, investments in payment technology must go hand in hand with investments in data integration, ERP (enterprise resource planning) or dedicated management systems as well as decision-support practices. Digital transactions with no managerial information systems have a limited capability; transaction information with performance monitoring and resource allocation has a larger capability.

This is especially true regarding SME financing in India. Digitalization can facilitate the gathering, sharing and transformation of the financial and qualitative data that are necessary to evaluate credit [25]. The integration of firms' digital financial information and lenders' decision systems is therefore likely to be able to improve the process of turning transaction histories into useful information to assess credit.

5.7 Managerial and Policy Implications

Managers need to consider FinTech as an investment in an organisational ability, not as a payment solution on its own. There is evidence that the benefits of wider adoption relate to stronger digital and strategic capability, but there can be a financial exposure to the benefits of operation. Therefore, a digitalization strategy shall be composed of technology adoption, financial planning, credit-capacity assessment, information integration and managerial capability development.

Higher levels of FinTech adoption and credit constraints indicates that there may be an opportunity for financial institutions to better leverage digital business information in lending. Digital transaction histories, administrative records, and operational information can help decrease information opacity if included in proper systems for credit evaluation [25].

Simply encouraging the adoption of digital technology could not be enough for policy makers. Policies aimed at expanding infrastructure for FinTechs should be complemented by policies that enhance access to the relevant business finance, the management use of information and to digital-management. The underlying message is that digital transformation of finance is most strategically valuable when digital adoption, decision capability and financial resilience go hand in hand.

6. Conclusion

This study explored the relationship between adoption of FinTech and the transformation of financial management in terms of digital innovation, risk management, strategic decision-making and firm performance. The results, based on firm-level data from FAT India, reveal that adoption of FinTech is significantly linked to increased digital financial-management capability, increased organizational use of digital innovation and increased strategic decision-making practices. There is also a positive correlation between the use of FinTech and the growth of annualized sales, but not with the operating margin and labor productivity. The analysis also reveals that digital transformation is not necessarily associated with a decrease in financial risk. Financial-risk exposure, especially credit constraints, are positively correlated with FinTech adoption, and higher financial risk

exposure is negatively correlated with labor productivity. The strategic decision-making capability is positively associated with labor productivity, whereas it is negatively associated with the operating margin, which means that digitalisation has various organizational benefits that are dimensionally different. Overall, the research shows that it is necessary to consider FinTech as part of a financial information and decision-support infrastructure, and not as a standalone payment technology. It is important to understand that its strategic value hinges on complementary digital capabilities, managerial information practices and on financial resilience. Thus, firms and policymakers should look to integrate the use of digital tools with more effective decision systems, financial support, and risk management capability for sustainable performance outcomes.

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