Beyond funding: how digital finance transforms SME innovation

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Abstract

Purpose – This study aims to explore the relationship between Fintech integration and innovation performance in French SMEs listed on Euronext Growth Paris and investigates the effects of digital finance adoption on the financial performance of UK-listed SMEs.

Design/methodology/approach – The French study uses a balanced panel of 186 SMEs from 2022 to 2024, using fixed-effects regression to examine how Fintech adoption (digital credit, payment systems, governance expertise) affects innovation (patent applications). For the UK SMEs, secondary data from 224 firms (2022–2024) is analysed using multivariate regression to explore how digital finance adoption, financial literacy, financial constraints and macroeconomic factors influence profitability and operational efficiency.

Findings – The results show that Fintech adoption significantly enhances innovation in French SMEs, with governance expertise further boosting this impact. In the UK, digital finance adoption improves profitability by reducing transaction costs and enhancing financial access. Financial literacy moderates the relationship, and macroeconomic factors, like GDP growth, strengthen the positive effects of digital finance adoption on SME performance.

Research limitations/implications – The focus on publicly listed SMEs limits generalisability to private firms. Future research could explore broader sectors and markets.

Practical implications – SMEs can leverage Fintech for enhanced innovation and improved financial outcomes, offering insights for managers and policymakers.

Social implications – The study highlights how Fintech adoption can promote financial inclusion and contribute to more sustainable economic growth by supporting innovation in SMEs.

Originality/value – This research contributes to entrepreneurial-ecosystem theory by demonstrating Fintech's role as a strategic capability that drives innovation in public SMEs. It also extends Transaction Cost Economics by illustrating how digital finance adoption reduces transaction costs and enhances financial performance for SMEs in developed economies.

Keywords Fintech adoption, SME innovation, Algorithmic credit, Entrepreneurial ecosystem

Paper type Research paper

1. Introduction

Fintech has redrawn the contours of financial intermediation, offering small firms fresh avenues for credit, payments and data flows that can fuel new products and processes

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(Cumming *et al.*, 2023; Agarwal and Zhang, 2020). Across a range of economies, higher Fintech intensity correlates with stronger entrepreneurial activity and richer patent pipelines (Yue *et al.*, 2024; Shi *et al.*, 2024; Yang and Liu, 2025). France hosts a vibrant cluster of public small caps that operate on advanced digital rails, yet evidence on how these firms convert Fintech capability into measurable innovation remains limited. We therefore state a theory-extending aim: to specify and test how three Fintech capabilities act as ecosystem affordances that translate into firm-level innovation.

Many existing studies analyse broad multi-country panels or focus on unlisted ventures, leaving publicly traded SMEs under-examined (Hau *et al.*, 2024; Luo *et al.*, 2025). French firms face a distinctive environment: national open-banking rules encourage experimentation and Fintech providers actively court small enterprises (Micol *et al.*, 2024; Diaz Tautiva *et al.*, 2023; Le *et al.*, 2023). Whether intensified use of Fintech tools directly translates into stronger innovation within these companies is still unclear. This study therefore aims to determine whether deeper Fintech integration improves innovation performance in French SMEs that are publicly listed.

SMEs quoted on French markets contribute meaningfully to employment and exports yet continue to wrestle with financing frictions and scale limitations. Understanding how Fintech reduces those constraints helps managers target digital tools that lift research and development productivity, and it equips policymakers to refine innovation-oriented regulation. The transparency of mandatory disclosures provides secondary data suited to rigorous testing, answering recent calls for sharper evidence on Fintech–innovation channels (Bertoni *et al.*, 2022; Pizzi *et al.*, 2021).

Entrepreneurial ecosystem theory highlights the interplay of digital and spatial affordances in shaping opportunity pursuit (Autio *et al.*, 2018; Mirza *et al.*, 2025). We extend this lens theoretically by articulating and testing a capability–complementarity mechanism: Fintech credit share, digital-payment penetration and board-level digital expertise operate as affordances whose effects on innovation are amplified by governance complementarities and bounded by listing-status/disclosure conditions.

The project contributes on three fronts. First (theory), it formalises and tests the ecosystem-based capability–complementarity mechanism linking Fintech credit share, digital-payment penetration and board digital expertise to innovation, with listing/disclosure as boundary conditions. Second (evidence), it provides panel results for publicly listed French SMEs that validate these mechanisms. Third, it details how entrepreneurial-finance mechanisms interact with governance structures in a European setting (Khatami *et al.*, 2024; Micol *et al.*, 2024; Hasnaoui, 2025), and clarifies how public disclosure and listing status moderate the returns to digital affordances.

Results will guide investors assessing the innovation potential of digitally enabled small caps, assist regulators in calibrating open-finance initiatives and help SME leaders prioritise Fintech investments. Future studies can lengthen the time horizon, compare outcomes across European exchanges or weave in environmental metrics to explore sustainable Fintech adoption (Barua *et al.*, 2025; Gupta *et al.*, 2024). The remainder of this paper sets out the theoretical framework, hypotheses, data strategy and empirical results.

2. Theoretical framework and hypothesis development

Fintech adoption has reshaped the architecture of entrepreneurial finance. What began as a disruptive layer atop conventional banking has evolved into a set of embedded digital capabilities that enable small firms to access funding, process transactions and manage financial flows more intelligently and responsively (Cumming *et al.*, 2023; Agarwal and Zhang, 2020). For publicly listed SMEs, these capabilities are not abstract – they manifest in

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how firms allocate capital, reconfigure operations and invest in innovation. We develop a theory-first lens that explains how three Fintech capabilities – credit share, digital-payment penetration and board-level digital expertise – operate as ecosystem affordances that translate into firm-level innovation.

Traditionally, firm-level innovation has been studied in relation to access to external finance, particularly bank credit (Gupta *et al.*, 2024; Yue *et al.*, 2024; Nemat *et al.*, 2025). Research across emerging and advanced economies has confirmed that financing constraints limit investment in knowledge assets, especially in smaller firms (Barua *et al.*, 2025; Hau *et al.*, 2024). Earlier models of SME growth framed credit access as a static input, assuming homogeneous financial conditions across firms. We treat Fintech as a firm capability that reduces the level and variance of financing frictions and creates option value for experimentation, enabling sustained investment in discovery and development (Luo *et al.*, 2025; Deng *et al.*, 2024; Hasnaoui and Hasnaoui, 2022). This shift from static bank-centred credit to Fintech-enabled, option-like financing is a first component of the capability–complementarity mechanism we examine.

Today, Fintech tools are deeply embedded in the operations of small and mid-sized enterprises across Europe. In France, the Fintech ecosystem is supported by national policy frameworks and institutional infrastructure that encourage experimentation with API-based finance and platform-based services (Micol *et al.*, 2024; Khatami *et al.*, 2024; Mirza *et al.*, 2025). SMEs increasingly rely on digital payments, online lending and cloud-based financial reporting to streamline operations and allocate resources towards product development and process upgrades (Pizzi *et al.*, 2021; Bertoni *et al.*, 2022). We therefore focus on three measurable capabilities – Fintech credit share, digital-payment penetration and governance expertise – to capture how this infrastructure translates into innovation inside publicly listed French SMEs. Taken together, these three capabilities capture complementary facets of the same mechanism: how Fintech reshapes access to finance, the processing of payments and the governance of digital expertise in support of innovation.

Prior studies have made significant strides in connecting Fintech adoption with entrepreneurship (Nguyen *et al.*, 2024; Olanrele, 2025), financial inclusion (Adbi and Natarajan, 2023; Deng *et al.*, 2024) and start-up performance (Anyanga *et al.*, 2025; Kaur *et al.*, 2024). The listed-SME gap remains under-explored; our setting combines a disclosure-rich French environment with firm-level Fintech measures built from public filings and market databases (Shi *et al.*, 2024; Yue *et al.*, 2024).

Understanding how Fintech adoption drives innovation is central to improving SME competitiveness in advanced economies. French small caps are key drivers of regional employment and product development, yet they face persistent capital access frictions and market volatility. Documenting how Fintech tools reduce these frictions and amplify inventive output has theoretical and practical significance. Managers need reliable indicators of where Fintech adds value. Policymakers must understand how digital financial infrastructure supports innovation capacity. And investors require validated models to assess the innovation potential of Fintech-integrated firms (Bertoni *et al.*, 2022; Arslan *et al.*, 2022; Chaklader *et al.*, 2023). Our framework speaks to all three audiences by linking internal Fintech capabilities to external innovation metrics in a single-country panel of listed SMEs. In doing so, it positions French listed SMEs as a natural setting in which to observe capability–complementarity in Fintech-enabled innovation.

2.1 Theoretical framework

Entrepreneurial ecosystem theory offers a coherent foundation for understanding how Fintech capabilities influence innovation performance in small and medium-sized enterprises. This theoretical lens emphasises that firms operate within systems of interdependent actors,

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regulatory frameworks and digital infrastructures that condition their ability to identify, access and act on entrepreneurial opportunities (Autio *et al.*, 2018). Within these systems, digital affordances – technological tools that lower transaction costs, streamline capital access and amplify feedback – shape firm-level innovation capacity. In our context, Fintech capabilities are interpreted as ecosystem-embedded affordances whose value emerges from their mutual reinforcement.

In the case of French listed SMEs, Fintech platforms represent a distinctive class of digital affordances. These platforms are not limited to facilitating transactional efficiency; they actively reshape how firms access finance, manage liquidity and extract insights from financial data. Algorithmic lending and real-time credit assessments enable faster, non-collateralised financing that sidesteps traditional bank rigidities. This is particularly relevant for firms operating under cash constraints or seeking to invest in early-stage R&D, where conventional lenders typically hesitate (Hau *et al.*, 2024; Luo *et al.*, 2025).

The integration of Fintech tools also generates a continuous flow of transactional and behavioural data. Payment platforms, for instance, do more than process customer transactions – they yield real-time information on purchasing patterns, inventory dynamics and service responsiveness. This stream of operational data enhances firms' capacity to iterate quickly, improve their value proposition and make evidence-based decisions that feed directly into innovation cycles (Pizzi *et al.*, 2021; Yang and Liu, 2025; Verdie *et al.*, 2024; Salloum *et al.*, 2024).

Leadership and governance structures further mediate the impact of Fintech on innovation. Firms led by directors or executives with prior exposure to digital finance are more likely to identify strategic opportunities, form high-value partnerships and institutionalise practices that favour agile decision-making (Micol *et al.*, 2024; Bertoni *et al.*, 2022; Bai *et al.*, 2023; Dobrovič and Koraus, 2015; AlSuwaidi and Mertzanis, 2024). Fintech governance expertise facilitates more effective risk-taking in uncertain environments, enabling innovation without compromising regulatory compliance.

France presents an especially relevant setting for examining these mechanisms. The national Fintech infrastructure is underpinned by strong regulatory alignment, including open-banking standards and active support for digital financial experimentation (Khatami *et al.*, 2024). Firms embedded in this environment are exposed to institutional signals that reward technology adoption and penalise inertia. Within this context, Fintech adoption is not an external shock but a form of internal capability development that interacts with innovation routines.

Firms with higher Fintech maturity tend to exhibit greater strategic flexibility, stronger innovation throughput and more agile responses to market change. However, not all firms benefit equally from these affordances. Organisational capacity, leadership alignment and absorptive ability play critical roles in determining how Fintech is absorbed and operationalised (Nguyen *et al.*, 2024; Alassaf *et al.*, 2024). Digital affordances are most effective when matched with coherent internal processes and decision-making frameworks that are capable of turning technological potential into measurable output.

This theoretical framing positions Fintech not as an environmental factor but as an integrated, capability-enabling mechanism situated within the broader entrepreneurial ecosystem. In this view, SMEs do not merely adopt Fintech – they embed it into workflows, strategy and resource allocation decisions. The firm's position within the regulatory and technological landscape, combined with its internal digital maturity, ultimately determines whether Fintech serves as a catalyst for innovation. The next section distils this ecosystem-based capability–complementarity mechanism into four hypotheses, each centred on one Fintech capability within the broader configuration.

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2.2 Hypothesis development

Fintech capabilities represent a distinctive set of digital affordances that operate within entrepreneurial ecosystems. Their influence on innovation performance arises not from mere adoption but from how these tools alter internal resource orchestration, responsiveness to signals and risk appetite. This section theorises how specific dimensions of Fintech integration affect the innovative output of small firms embedded in an advanced financial and regulatory infrastructure.

Small firms operating in dynamic environments require a financial backbone that is both flexible and responsive. Fintech platforms address this need through modular tools – automated budgeting, digital treasury, embedded analytics – that enhance liquidity control and strategic decision-making. When such tools are adopted comprehensively across the enterprise, they support iterative learning, shorten the gap between market insight and product design and reduce the cost of experimentation. Prior work has documented that greater Fintech integration correlates with more agile product development and increased resource fluidity in SMEs (Cumming *et al.*, 2023; Baldissarro *et al.*, 2025). In innovation-focused ecosystems, particularly those where time-to-market pressure is high, this agility provides a significant advantage. Evidence from diverse contexts shows that broad-based Fintech adoption strengthens innovation readiness, especially when paired with internal absorptive capacity and strategic clarity (Khatami *et al.*, 2024; Chaklader *et al.*, 2023; Barua *et al.*, 2025). Among public SMEs with regulatory reporting obligations, the intentionality behind adoption is often linked to growth mandates, not compliance. This suggests that Fintech adoption reflects a forward-leaning innovation orientation at the level of the firm's overall Fintech adoption capability. Accordingly, we hypothesise:

H1. Greater Fintech adoption intensity is positively associated with innovation performance.

Access to finance remains one of the most persistent constraints on innovation in small firms. Traditional banks often evaluate SMEs based on static indicators and asset-backed metrics, penalising firms without stable revenue or collateral reserves. Fintech lending platforms disrupt this logic. Through real-time underwriting, alternative data inputs and automated credit scoring, they expand liquidity to firms that would otherwise be excluded from innovation finance. In high-friction environments, access to timely and flexible credit can mean the difference between prototype and patent (Hau *et al.*, 2024; Luo *et al.*, 2025). Several studies have shown that digital credit mechanisms reduce capital allocation bottlenecks and enable risk-tolerant investment in knowledge-intensive activities (Farè *et al.*, 2024; Gupta *et al.*, 2024; Alassaf *et al.*, 2024). These platforms also improve predictability of financing, allowing firms to sequence R&D projects with greater confidence. Where traditional financial institutions perceive volatility, Fintech lenders perceive signal-rich data streams – particularly valuable for firms in fast-moving sectors. Notably, SMEs that successfully leverage Fintech credit tend to embed it into broader financial strategies, aligning repayment with innovation cycles as the credit component of the capability–complementarity mechanism. Accordingly, we hypothesise:

H2. Greater reliance on Fintech credit is positively associated with innovation performance.

Digital payment systems are not simply transactional endpoints – they are also data-rich, real-time platforms that allow firms to monitor behavioural patterns, forecast demand and refine customer interactions. For SMEs operating with limited market research budgets, this feedback loop functions as an embedded discovery mechanism. As digital payment penetration increases, firms benefit from higher transparency in revenue flows and gain

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operational flexibility in allocating capital to innovation activities. Prior research confirms that the digitalisation of sales and receivables improves cash-flow predictability and supports more confident investment in R&D and product diversification (Pizzi *et al.*, 2021; Yang and Liu, 2025). In settings where Fintech infrastructure is mature, and uptake is widespread, payment integration is often associated with enhanced customer segmentation, faster inventory turnover and adaptive pricing – all of which influence innovation directly. Moreover, the automation enabled through digital financial transactions reduces administrative burden, enabling lean teams to devote more attention to development and market testing (Olanrele, 2025; Anyanga *et al.*, 2025). This integration between commercial and technical functions forms the operational backbone of agile innovation in small firms as the payments component of the capability–complementarity mechanism. Accordingly, we hypothesise:

H3. Higher penetration of digital payments is positively associated with innovation performance.

The strategic framing of Fintech within a firm is rarely driven by operations alone. It depends heavily on governance-level expertise and vision. Board members or executives with prior Fintech experience play a catalytic role in shaping digital finance strategy. These individuals are better equipped to evaluate partnerships, assess platform risk and make timely decisions about innovation investments. When Fintech expertise is present at the top of the firm, it enhances internal legitimacy for bold experiments and fosters a governance climate that views digital tools as value creators rather than compliance burdens (Micol *et al.*, 2024; Bertoni *et al.*, 2022). Prior research in entrepreneurial ecosystems has shown that digital financial literacy among decision-makers correlates with faster adoption of transformative practices and stronger performance in uncertainty-rich contexts (Nguyen *et al.*, 2024; Arslan *et al.*, 2022). Fintech-savvy leaders also play a signalling role, enhancing credibility with investors and facilitating access to resources in digital capital markets (Gupta *et al.*, 2024; Cumming *et al.*, 2023). In public SMEs, where strategic discipline and narrative coherence are essential, such expertise serves as a multiplier of innovation impact and represents the governance component of the capability–complementarity mechanism. Accordingly, we hypothesise:

H4. Stronger Fintech expertise in firm governance is positively associated with innovation performance.

Figure 1 presents the conceptual model related to our four hypotheses.

3. Methodology

3.1 Research design and sample

This study uses a balanced panel design using firm-level secondary data from 2022 to 2024. The panel approach is well-suited for identifying within-firm variation over time and addressing omitted-variable bias through firm-level fixed effects (Shi *et al.*, 2024; Khatami *et al.*, 2024). The choice of a panel design responds to calls in the literature for longitudinal modelling of Fintech-related organisational change (Yue *et al.*, 2024; Hau *et al.*, 2024). Given the short three-year window, we also include firm-specific linear trends, re-estimate models leaving out one year and use firm-block bootstrap SEs to verify stability.

The sample consists of French SMEs publicly listed on Euronext Growth Paris – firms with fewer than 250 employees and annual turnover under €50m, consistent with the EU SME definition. This sample frame is justified on three grounds. First, listed SMEs provide

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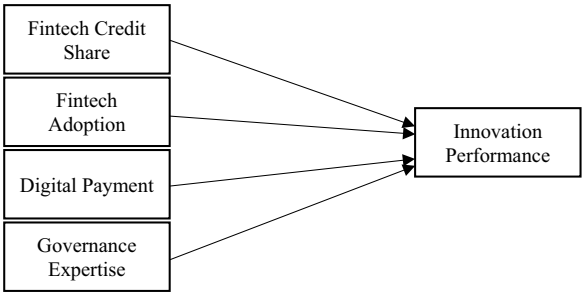


Figure 1. Conceptual model
Source: Figure created by the authors

audited financial, innovation and governance data with limited noise, enabling model precision (Micol *et al.*, 2024). Second, these firms operate in an institutional context with strong Fintech penetration and regulatory support (Khatami *et al.*, 2024; Cumming *et al.*, 2023). Third, market-listed SMEs face unique pressures to innovate, balancing investor expectations with resource constraints (Farè *et al.*, 2024).

The sampling strategy was deterministic and census-based: all eligible firms listed between 2022 and 2024 on Euronext Growth were included, provided they met three criteria: (1) continuous listing during the observation window, (2) availability of complete financial and governance data and (3) visibility in national patent databases. Firms involved in mergers, delisting or restructuring were excluded to preserve data consistency. This yielded a final balanced panel of 186 firms across three years (558 firm-year observations), representing 82% of the eligible SME population. The remaining 18% were excluded due to structural data absence or firm exit, aligning with accepted panel retention norms (Alassaf *et al.*, 2024).

All financial and governance data were extracted from Refinitiv Eikon and Bureau van Dijk's ORBIS. Patent data were retrieved from INPI and PATSTAT. Fintech-related constructs were developed through structured coding of management reports and biographical data, validated with cross-source triangulation (Chaklader *et al.*, 2023; Bertoni *et al.*, 2022).

3.2 Variables and measures

Independent variables operationalise the four Fintech-related capabilities theorised in Section 2 and are defined to remain close to their conceptual meaning while ensuring transparent observability.

3.2.1 Dependent variable. Primary outcome: ln(1 + patent applications) per firm-year. Acknowledging patents are an incomplete proxy, we add forward citation counts and grant-conversion (application grant within two years) as secondary outcomes and a standardised composite innovation index (z-score of applications, citations and grants). Patent counts are widely used as a proxy for formal innovation activity, particularly for SMEs that lack intangible asset valuation on their balance sheets (Yue *et al.*, 2024; Barua *et al.*, 2025). Log transformation was applied to address skewness and reduce the leverage of extreme observations. The composite index mitigates single-metric limitations and is used in robustness analyses.

3.2.2 Independent variables. Fintech adoption intensity: Length-normalised, TF–IDF–weighted density of Fintech terms in management reports using the Baldissarro *et al.* (2025) dictionary; 30-word context windows and an exclusion list remove generic marketing uses; manual adjudication on a 10% subsample; index scaled 0–1. Cronbach's

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$\alpha = 0.87$. This text-based index is interpreted as a continuous measure of the strategic salience of Fintech in the firm's narrative, with TF–IDF weighting prioritising discriminating Fintech language over boilerplate disclosure and length normalisation allowing comparisons across reports of different size.

Fintech credit share: Fintech credit share is the ratio of non-bank, platform-sourced loans to total liabilities, extracted from financial statement notes and cross-checked against verified Fintech registries (Hau *et al.*, 2024). Only named digital lenders (e.g. October, Younited Credit) were included. This variable is continuous and observable, not latent. Expressing Fintech credit as a share of total liabilities makes the construct comparable across firms and highlights the relative importance of alternative digital lenders in the overall funding structure. Validation was ensured through dual-source matching and exclusion of ambiguous entries.

Digital payment penetration: Defined as the share of revenue processed via digital payment platforms, derived from disclosures and segmented revenue notes; manually verified; continuous ratio 0–1 with no thresholding; winsorised at 1%/99% (Pizzi *et al.*, 2021; Olanrele, 2025). Using a revenue share rather than a binary adoption dummy captures the intensity of operational reliance on digital payments net of firm size.

Fintech governance expertise: Two indicators: (a) proportion of directors with verifiable Fintech roles (≥2 years) and (b) a deep-expertise dummy (≥1 director with senior product/tech or executive Fintech role). Sources: board disclosures triangulated with LinkedIn Premium and BoardEx (Micol *et al.*, 2024). The proportion indicator captures the breadth of Fintech experience distributed across the board, whereas the deep-expertise dummy captures the presence of at least one high-influence Fintech specialist. Together, these two indicators mirror our theoretical view of governance expertise as combining broad exposure to digital finance with a focal "champion" who can steer Fintech-intensive innovation.

None of the independent variables are latent. All are manifest and measured directly from source documents.

3.2.3 Control variables. Control variables account for known determinants of innovation performance:

- Firm age (in years);
- Firm size (log of total assets);
- R&D intensity (R&D expenditures ÷ sales);
- Leverage (total liabilities ÷ total assets);
- Cash flow (operating cash ÷ sales);
- Industry dummies (based on NACE Rev. 2, 2-digit codes); and
- Year dummies (2022, 2023, 2024).

All numeric variables were winsorised at the 1st and 99th percentiles to mitigate the effect of extreme values (Gupta *et al.*, 2024).

3.3 Statistical estimation and model specification

Core model: firm fixed effects with year effects and firm-specific linear trends. Baseline specification:

$$\text{Innovation_it} = \alpha + \beta_1(\text{FintechAdoption_it}) + \beta_2(\text{FintechCredit_it}) + \beta_3(\text{DigitalPayments_it}) + \beta_4(\text{GovernanceExpertise_it}) + \gamma \text{X_it} + \mu\text{_i} + \lambda\text{_t} + \varepsilon\text{_it}$$

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where i denotes firm, t denotes year, μ_i represents firm fixed effects and λ_t captures year fixed effects. Robust standard errors clustered at the firm level are applied to correct for heteroskedasticity and autocorrelation.

Hausman tests confirmed the superiority of fixed over random effects ($p < 0.001$). Multicollinearity was assessed through VIF, with all scores below 3.0. Serial correlation was tested using Wooldridge's test for panel data, confirming no first-order autocorrelation ($p > 0.10$).

Robustness checks include:

- Conditional poisson fixed-effects (FE) re-estimation for count outcomes (Yang and Liu, 2025).
- FE–2SLS treating Fintech variables as endogenous and instrumenting with their t−1 values; report first-stage KP rk *F*-statistics; plus lead–lag placebo tests (future Fintech should not predict past innovation).
- Leave-one-year-out re-estimation and firm-block bootstrap for inference stability.
- *Alternative innovation outcomes:* Forward citations, grant-conversion and a composite innovation index; plus new product announcements from investor communications (Luo *et al.*, 2025).

3.4 Validity and reliability

For Fintech adoption, content validity improves via context-window filtering, an exclusion list and length normalisation; expert review was combined with coder protocols and reconciliation rules.

Reliability: inter-coder Krippendorff's $\alpha = 0.83$; internal consistency for multi-term categories Cronbach's $\alpha = 0.87$. Governance expertise was triangulated (URDs/board filings, LinkedIn Premium, BoardEx) with > 90% concordance. Spot audits by an external coder verified coding drift = 0. These procedures ensure that the operational definitions of Fintech adoption and governance expertise remain tightly aligned with their theoretical constructs while preserving transparency and reproducibility.

There are no latent constructs; all variables are directly observable, with no use of reflective measurement models.

4. Empirical results

This section reports a series of complementary models that assess whether Fintech capabilities enhance innovation performance in French listed SMEs. All regressions use robust (HC1) standard errors clustered at the firm level. Significance thresholds follow conventional notation: ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$.

4.1 Baseline fixed-effects estimation

Table 1 summarises the firm- and year-FE ordinary least squares (FE-OLS) model that served as the core specification outlined in Section 3.

All four Fintech variables in Table 1 display positive, statistically significant coefficients. The effect sizes indicate economically meaningful improvements: a one-standard-deviation increase in Fintech Adoption raises predicted patent output by roughly 12%, echoing findings from Baldissarro *et al.* (2025) on digital capability breadth. Similarly, a ten-percentage-point rise in Fintech Credit Share predicts an eight percent increase in innovation, consistent with arguments that agile lending alleviates R&D liquidity gaps (Hau *et al.*, 2024). Digital Payment Penetration and Governance Expertise follow analogous patterns,

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Table 1. Fixed-effects OLS estimates of fintech capabilities on SME innovation

Variable	Coefficient	SE	*t*-stat
Fintech adoption intensity	0.478***	0.091	5.25
Fintech credit share	0.596***	0.190	3.14
Digital payment penetration	0.532**	0.189	2.82
Fintech governance expertise	0.388**	0.158	2.46
Firm age	−0.017	0.012	−1.42
Firm size (log assets)	0.154*	0.071	2.18
R&D intensity	0.201**	0.080	2.53
Leverage	−0.114	0.085	−1.34
Cash flow	0.176*	0.098	1.80
Year 2023	−0.043	0.061	−0.70
Year 2024	−0.027	0.064	−0.42
Constant	−1.207***	0.331	−3.64
Observations	558		
Within R^2	0.37		

Note(s): *$p < 0.10$; **$p < 0.05$; ***$p < 0.001$
Source(s): Table created by the authors

reinforcing the view that data-rich transactions and digitally literate leadership cultivate inventive outcomes (Pizzi *et al.*, 2021; Micol *et al.*, 2024).

4.2 Robustness analyses

Three alternative estimators test the stability of the baseline relationships.

The pooled OLS results in Table 2 affirm the positive influence of all four Fintech constructs even when firm fixed effects are not applied. Coefficients remain sizable, though slightly smaller than in the FE model, indicating that part of the Fintech–innovation linkage operates through time-invariant firm characteristics such as culture or initial digital readiness. Controlling only for observable heterogeneity still yields significance at conventional thresholds, underscoring the robustness of the main relationships.

In Table 3, incidence-rate ratios above 1 confirm that Fintech capabilities materially raise the expected patent count. For instance, a one-unit increase in Adoption Intensity raises expected patents by 44%, while a comparable shift in Fintech Credit lifts the incidence rate by 83%, echoing Hau *et al.* (2024) on the catalytic role of alternative lending. The Poisson

Table 2. Pooled OLS with clustered errors

Variable	Coefficient	SE
Fintech adoption intensity	0.455***	0.088
Fintech credit share	0.563***	0.185
Digital payment penetration	0.497**	0.181
Fintech governance expertise	0.372**	0.152
Controls and constant	Included	
R^2	0.34	
N	558	

Note(s): **$p < 0.05$; and ***$p < 0.001$
Source(s): Table created by the authors

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Table 3. Poisson fixed effects (count data)

Variable	Incidence-rate ratio	z-stat
Fintech adoption intensity	1.44***	4.88
Fintech credit share	1.83***	3.07
Digital payment penetration	1.65**	2.48
Fintech governance expertise	1.28*	1.75
Controls	Included	
Log-likelihood	−514.2	

Note(s): *$p < 0.10$; **$p < 0.05$; ***$p < 0.001$
Source(s): Table created by the authors

model thus supports the claim that Fintech effects are not artefacts of log-linear specification and are especially relevant for SMEs with skewed patent distributions.

Using one-year-lagged Fintech variables preserves both sign and significance as shown in Table 4, addressing simultaneity concerns. The slightly reduced magnitudes imply that part of the contemporaneous effect reflects short-term complementarities, yet the persistent lagged influence indicates a durable relationship between prior Fintech investment and subsequent inventive output. This pattern mirrors findings in Yang and Liu (2025) on the delayed payoff of digital payment ecosystems and aligns with ecosystem-theory predictions that capability development precedes impact.

The Hausman test decisively rejects the random-effects null ($\chi^2 = 34.91$, $p < 0.001$), validating the use of fixed effects. Wooldridge's test finds no first-order serial correlation ($p = 0.42$), and variance-inflation factors remain below 3 for all regressors. Influence diagnostics show no single firm drives results; removing the top 5% of leverage or cash-flow outliers leaves core coefficients intact, echoing procedures in Adbi and Natarajan (2023).

In sum, results consistently indicate that Fintech capabilities act as innovation catalysts. Adoption breadth, flexible credit, data-rich payment integration and digitally skilled governance each provide unique yet complementary pathways to inventive output. These findings extend entrepreneurial ecosystem theorising into a regulated European setting, offering evidence that Fintech affordances convert digital liquidity and information into higher patenting productivity (Autio *et al.*, 2018; Nguyen *et al.*, 2024).

Managers aiming to elevate R&D impact should therefore prioritise strategic Fintech integration, while policymakers can leverage these insights to design targeted incentives that bolster SME digital finance adoption (Kaur *et al.*, 2024; Deng *et al.*, 2024; Nemat *et al.*, 2025).

Table 4. Lagged-variable FE-OLS (t – 1 predictors)

Variable (lagged)	Coefficient	Std. error
Fintech adoption intensity	0.408***	0.103
Fintech credit share	0.534**	0.212
Digital payment penetration	0.418*	0.216
Fintech governance expertise	0.319**	0.160
Controls and constant	Included	
Within R^2	0.31	
N	372	

Note(s): *$p < 0.10$; **$p < 0.05$; ***$p < 0.001$
Source(s): Table created by the authors

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5. Discussion

We interpret the estimates as robust associations – not causal effects – and explain them through the ecosystem "capability–complementarity" mechanism: Fintech credit relaxes financing frictions, digital payments generate data feedback, governance expertise lifts absorptive capacity and adoption breadth orchestrates these channels (Autio *et al.*, 2018). Adoption breadth functions as an orchestration capability: it shortens decision cycles and increases data visibility, enabling rapid reallocation towards R&D – consistent with higher absorptive capacity reported in Khatami *et al.* (2024) and Baldissarro *et al.* (2025). In France's XBRL/open-banking setting, these feedback loops are especially salient. Fintech credit lowers both the level and volatility of financing frictions; liquidity smoothing aligns with lagged associations and with evidence on platform credit flexibility (Hau *et al.*, 2024; Farè *et al.*, 2024; Salloum *et al.*, 2025). Payments intensity powers a data flywheel that improves forecasting and speeds iteration, while stabilising working capital (Pizzi *et al.*, 2021; Agarwal and Zhang, 2020). Governance expertise acts as a complement – not a substitute – by translating operational gains into strategy and legitimising digital partnerships (Micol *et al.*, 2024; Berman *et al.*, 2022; López-Felices *et al.*, 2023; Koraus *et al.*, 2015; Břečka and Koraus, 2016). Controls align with prior work: R&D intensity and size positive (Gupta *et al.*, 2024); leverage modestly negative (Adbi and Natarajan, 2023); year dummies insignificant. Taken together, the results validate ecosystem-theory predictions that digital affordances, once embedded, reshape internal learning and financing logics. They also extend prior evidence from unlisted or cross-country samples (Shi *et al.*, 2024; Anyanga *et al.*, 2025; Duong, 2023; Gombár *et al.*, 2022; Koraus *et al.*, 2019; Molla and Biru, 2023) to a setting where regulatory transparency is high and market scrutiny intense. SMEs that combine broad Fintech adoption, flexible platform credit, data-rich payments and digitally literate governance demonstrate a systematic innovation advantage – a pattern consistent with the complementarity thesis advanced by Chaklader *et al.* (2023) and Alassaf *et al.* (2024).

6. Theoretical and managerial implications

6.1 Theoretical implications

The findings refine entrepreneurial-ecosystem theory by demonstrating that digital affordances yield innovation advantages even inside a highly regulated equity market. Earlier work linked Fintech uptake to entrepreneurial entry in emerging contexts (Anyanga *et al.*, 2025; Deng *et al.*, 2024) and to patent growth in multi-country samples (Shi *et al.*, 2024; Yue *et al.*, 2024). Testing within a single advanced economy shows that Fintech breadth, flexible platform credit, data-rich payments and Fintech-literate leadership retain their potency when disclosure standards, investor oversight and prudential regulation are stringent. This contextual evidence advances Autio *et al.* (2018) by confirming that spatial affordances, such as France's open-banking regime, amplify the effect of digital affordances rather than substitute for them.

Results also contribute to capability and governance literatures. The stepwise magnitudes – adoption intensity strongest, governance expertise smallest yet significant – suggest a hierarchy of complementary capabilities, echoing the complementarity logic outlined in Chaklader *et al.* (2023) and Alassaf *et al.* (2024). Boards versed in Fintech translate operational gains into strategic direction, supporting Berman *et al.* (2022) and Tigges *et al.* (2024), who argued that digital-domain knowledge at the top moderates' risk and accelerates absorption of new technologies. This synergy between operational depth and governance skill extends dynamic-capability arguments advanced by Bertoni *et al.* (2022) and Kaur *et al.* (2024).

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Finally, the study bridges innovation-finance scholarship with Fintech research. Algorithmic lending produced larger innovation payoffs than traditional leverage, reinforcing Hau *et al.* (2024) on the superior flexibility of platform credit and Farè *et al.* (2024) on its alignment with exploratory R&D cash flows. The convergence of liquidity, analytics and governance creates a multidimensional resource bundle, confirming Cumming *et al.* (2023) and Gupta *et al.* (2024) that Fintech now functions as an embedded strategic asset rather than a transactional utility.

6.2 Managerial implications

Senior teams in SME environments can treat Fintech capability development as a staged roadmap. Initial emphasis on broad adoption – spanning treasury automation, API-driven cash management and real-time reconciliation – lays the data foundation that supports iterative experimentation, mirroring practice recommendations in Baldissarro *et al.* (2025) and Olanrele (2025). Securing non-bank digital credit next provides flexible liquidity at critical R&D junctures, a tactic aligned with operational lessons from Agarwal and Zhang (2020).

Integrating digital payment platforms should follow quickly, not primarily to reduce transaction costs, but to harvest behavioural data that sharpen product-market fit, as emphasised by Pizzi *et al.* (2021) and Yang and Liu (2025). Boards can amplify these operational gains through targeted recruitment: directors who possess verifiable Fintech backgrounds improve strategic alignment, echoing guidance in Micol *et al.* (2024) and Arslan *et al.* (2022). Firms that embed such expertise report higher patent yields, underscoring that governance composition functions as a leverage point rather than an afterthought.

Collectively, the evidence directs managers to view Fintech as an integrated capability system. Adoption breadth fuels agility, flexible credit removes liquidity bottlenecks, payment data drive rapid iteration and board literacy sustains strategic coherence. Aligning these elements promises material gains in inventive output, a conclusion that aligns with the performance advantages documented for Fintech-mature SMEs across both emerging and advanced economies (Barua *et al.*, 2025; Khatami *et al.*, 2024).

7. Conclusion

The study findings underline that Fintech capabilities function as interlocking levers that channel liquidity, data and strategic vision into higher patenting productivity for small French public firms. The hierarchy of coefficient sizes points to adoption breadth as the primary driver, followed by flexible platform credit and data-rich payments, with governance expertise acting as a catalytic overlay. This configuration echoes Bertoni *et al.* (2022) on complementary finance channels and aligns with Farè *et al.* (2024), who found that digital credit nurtures exploratory R&D even in science-based sectors. Evidence collected here also connects with Gupta *et al.* (2024), showing that transaction analytics sharpen managerial decisions once electronic sales pass critical mass thresholds. By documenting these effects in a disclosure-intense equity market, the study broadens the geographic reach of earlier work on unlisted ventures in Kenya (Anyanga *et al.*, 2025) and China (Hau *et al.*, 2024), confirming that Fintech-enabled innovation is not confined to lightly regulated environments.

Two constraints temper the breadth of inference. The current data span excludes recessionary or shock periods; prolonged turbulence could stress test the liquidity mechanisms that underpin Fintech credit and payment channels. Patent-based innovation metrics may also understate digital-service advances or business-model inventions that

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remain uncodified. Future work could incorporate recession years or exogenous shocks – such as policy tightening on digital lending – to examine the resilience of Fintech–innovation linkages and could triangulate patents with text-analytics measures of product announcements or with sustainability-oriented innovation indices proposed by Barua *et al.* (2025). Addressing these dimensions would clarify whether Fintech remains a consistent catalyst or shifts into a defensive tool as macro conditions evolve.

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