The Impact of FinTech on Corporate Innovation

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Abstract. Innovation is critical to economic development and business competition, and given rapid development of FinTech, we examine the effects of FinTech on corporate innovation. Analyzing a comprehensive sample of specialized and sophisticated enterprises, we find that FinTech benefits corporate innovation. Examining several dimensions of FinTech, such as breadth of coverage, depth of use, and degree of digitization, we find that all associate positively with corporate innovation. These findings have implications for government policies and firms' strategies that promote innovation.

Keywords: FinTech, Corporate innovation, Specialized and sophisticated enterprises.

1   Introduction

Innovation is crucial for national advancement and business sustainability. As a high-risk investment, enterprise innovation faces challenges due to capital requirements and reporting ambiguities[1]. The central government has emphasized specialized and sophisticated enterprises, highlighting the importance of innovation within these sectors.

The enduring deficit of formal financial services in China and the relaxed regulatory setting are, to some extent, essential requirements for the rapid growth of FinTech[2]. In the dynamic financial and technological landscape, the role of FinTech as a driver of innovation in these enterprises is significant. Researchers have differing opinions on FinTech's impact. Mainstream research suggests that FinTech mitigates information asymmetry between financial institutions and micro-entities , aiding efficient resource allocation based on enterprise risk profiles and reducing moral hazards and adverse selection[3]. Li discovered that the utilization of FinTech enhances the dissemination of information and transparency within the financial market, diminishes information asymmetry, and streamlines the process of financing, ultimately elevating the scientific

and innovative capabilities of SMEs through amplified financial resources[4]. Conversely, some researchers express concerns about excessive FinTech expansion and financial globalization, which might hinder optimal resource allocation and increase instability[5]. The integration of new information technologies suggests FinTech's future will enhance consumer experiences and daily life applications, with major enterprises increasingly investing in it to foster innovation. However, FinTech disrupts traditional financial models and regulatory frameworks, posing risks. Therefore, it is crucial to investigate how FinTech contributes to enterprise innovation and mitigate its adverse impacts.

This study uses FinTech indices and patent data from specialized and sophisticated enterprises across various regions to show that FinTech enhances innovation capabilities. The findings, robust during sensitivity analysis, indicate that three dimensions of FinTech positively associate with firm innovation. These insights are valuable for government policy and serve as lessons for Chinese enterprises aiming to boost their innovation capabilities.

2   Hypotheses Development

The emergence of contemporary technologies, particularly in the field of financial technology (FinTech) such as digital finance and inclusive finance, has brought about a significant transformation in traditional financial systems[6]. This transformation has led to a decrease in transaction costs associated with financial activities. The progress in technology has facilitated the transfer of knowledge in information technology, resulting in a closer integration of technology and finance, thereby enhancing information exchange. As a result, FinTech promotes innovation within organizations at various levels and has the potential to alleviate financial constraints and encourage innovation by reducing information disparities between banks and businesses. High-risk innovation projects that require substantial capital investment put pressure on enterprises' financial capabilities. The integration of finance with technology improves the efficiency of funding for enterprise innovation, with researchers often finding solutions through practical applications. For example, Tobias et al. examined digital footprints to assess credit information in conjunction with credit bureau scores, discovering that the incorporation of artificial intelligence (AI), big data, blockchain, and other financial technologies enhances the efficiency of automated customer service and credit systems, while simplifying loan application processes for businesses[7]. Similarly, Lin et al. showcased that incorporating borrowers' social network connections in credit evaluations, using data from the Prosper lending platform, increases the likelihood of obtaining loans, reduces financing costs, and mitigates default risks, highlighting the role of FinTech in reducing information asymmetries[8]. Moreover, the advent of new financial and technological funding platforms has expanded the scope of financial services, diversified funding sources for enterprise innovation, simplified funding complexities, and improved accessibility[9]. Online financial services have the potential to reduce human and material costs while expanding service coverage. The rapid advancement of

internet information technology has deeply integrated financial and technological sectors.

However, the rise of FinTech also poses systemic risks to corporate innovation. FinTech facilitates transactions among numerous unfamiliar parties, and the anonymity that the internet provides challenges establishment of trust among participants in the FinTech ecosystem. Riggins and Weber investigated Kiva, an online lending platform, finding that participants in online financial markets lack adequate access to borrower information, and cognitive biases influence their investment choices as a result[10]. Adverse selection is also evident in conventional financial markets. Emekter et al.'s study of FinTech firm Lending Club suggests that investors access high-interest rates by investing in borrowers with lower credit ratings[11]. However, borrowers also had high default rates, diminishing investors' effective rate of return. Considering these contrasting perspectives, we propose:

H1. FinTech benefits corporate innovation.

H2. FinTech impedes corporate innovation.

3   Methods

3.1   Sample Selection

This study assesses specialized and sophisticated enterprises listed on A-shares in Shanghai and Shenzhen from 2018 to 2021. We selected A-share listed companies manually from a list of four batches of specialized and sophisticated enterprises identified by the Ministry of Industry and Information Technology (MIIT). The sample period began in 2018 to account for the cultivation of specialized and sophisticated enterprises since that year, with the intention of selecting them in 2019. FinTech indicators were sourced from the fourth digital financial index that was created by the Digital Finance Research Centre at Peking University. Patent information included in innovation indicators and data related to control variables came from the Cathay Pacific and the CNRDS databases. One-thousand three-hundred eighty initial cases from specialized and sophisticated listed enterprises across four years were obtained after processing principles were applied. Winsorization was used to substitute initial data by compressing continuous data into 1st and 99th percentiles.

3.2   Variable Definition

We use the provincial digital financial inclusion index that spans 2011 to 2021, provided by digital financial research conducted at Peking University, to assess the extent of FinTech advancement in each province. Assessment was grounded on several rationales. First, FinTech and digital financial inclusion interconnect and share similarities. Xue Hongyin, assistant director of the Suning Financial Research Institute, highlighted at the 2019 China Financial Services Innovation Forum that FinTech is crucial to promoting inclusive financial development. In contrast, inclusive finance bases FinTech innovation. These two aspects are complementary and inseparable. Research-

ers emphasize that FinTech comprises technologies such as the internet, artificial intelligence, blockchain, cloud computing, and Big Data. When integrated with inclusive finance, they collectively form a digital inclusive financial system, and they thus reduce costs, enhance efficiency, increase vitality, improve services, and boost China's financial competitiveness. The assessment framework includes three regional levels—provinces, cities, and counties—and it uses hierarchical analysis based on a composite index that comprises three indicators—breadth of coverage, depth of use, and degree of digitization. Figure 1 shows the framework of the Digital Financial Inclusion Index system. The index represents a comprehensive indicator of the advancement of financial technology in a region. Extant literature supports use of the index as a point of reference for the current study's topic.
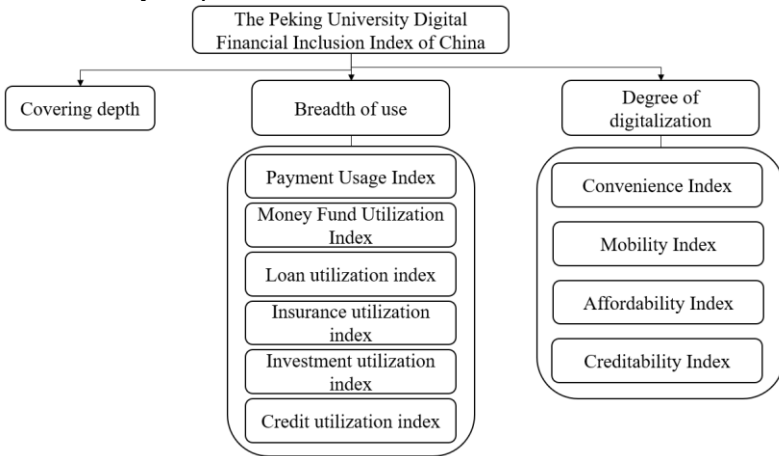
Fig. 1. The Peking University Digital Financial Inclusion Index of China.

The Peking University Digital Financial Inclusion Index can be derived through a series of four steps:

- Building a digital financial inclusion index system: In order to capture the complex and varied landscape of digital financial services, a digital financial inclusion index system should be developed that considers both vertical and horizontal comparability. This system should be constructed based on the extent of coverage, level of usage, and extent of digitization within the digital financial services sector.

- Non-quantitative treatment of indicators using efficacy functions: In conjunction with the swift growth of digital finance, the logarithmic efficiency function approach is utilized to reduce the influence of outliers and uphold the continuity of the index. More precisely, the equation for the logarithmic efficiency function is outlined as:

$$d = \frac{logx - logx'}{logx^h - logx'} \times 100 \tag{1}$$

where x' and x^h thresholds are determined by smoothing and winsorization through the base year.

- Determining weights for composite indicators using analytic hierarchy process.

- Final index synthesis by arithmetic weighted average method: The formula for the weighted arithmetic mean synthesis model is as shown below:

$$d = \sum_{i=1}^{n} w_i \, d_i \tag{2}$$

The composite index, denoted as d, is determined by the normalized weight of each evaluation indicator, w_i, the score of a single indicator, d_i, and the number of evaluation indicators, n.

This study evaluates the influence of FinTech on innovation in specialized and sophisticated enterprises listed on the stock exchange, using three indicators: coverage, use, and digital. Commonly, enterprise innovation is measured through R&D investments and patent counts[12], with patents categorized into applications, grants, and licenses. While patent applications are often used to gauge innovation, they might not accurately reflect the number of held patents or their practical value. To evaluate enterprise innovation, we used a logarithmic transformation of the augmented patent count. Chinese patents are divided into inventions, utility models, and designs, and we consider the combined total of these patent types to represent innovation output. We also employed log-transformed R&D expenses to assess upstream innovation input, recognizing that innovation encompasses both upstream R&D and downstream marketing stages.To analyze the impact of FinTech on enterprise innovation, we conducted regression analyses on two innovation measures (Innovation1 and Innovation2), controlling for variables that might influence innovation. These variables are detailed in Table 1.

Table 1. Variable Definition.

Variable	Symbol	Definition
Corporate innovation	*Innovation1*	Ln(Total number of patents of the enterprise in the current year+1)
	Innovation2	Ln(R&D expenses of the enterprise in the current year)
FinTech	*FinTech*	The Peking University Digital Financial Inclusion Index at the municipal level
Covering depth	*Coverage*	Breadth of coverage of the PKU Digital Financial Inclusion Index at the municipal level
Breadth of use	*Usage*	Depth of use of PKU Digital Financial Inclusion Index at municipal level
Degree of digitalization	*Digital*	Level of digitalization of the Peking University Digital Financial Inclusion Index at the municipal level
Ownership concentration	*Equity*	The largest shareholder's shareholding
Cash flow	*Cash*	Cash flow from operations to year-end assets
Asset-liability ratio	*Lev*	The ratio of year-end liabilities to total assets at year-end
Return on total assets	*ROA*	Total profit for the year/total assets at year-end

Proportion of fixed assets	*PPE*	Total fixed assets at year-end/total assets at year-end
Enterprise growth	*Grow*	Revenue growth rate
Age of business	*Age*	Age of business listed
Enterprise size	*Size*	Log of total assets of the enterprise at year-end
City GDP	*GDP*	Urban GDP for the year
Urban population	*Population*	Urban population for the year

3.3   Regression Model

To test the hypotheses, we use models that includes all variables in Table 1:

$$Innovation1(Innovation2)_{i,t} = \alpha_0 + \beta_1 Fintech_{i,t} + \beta_2 \sum Controls + \beta_3 \sum Industry + \beta_4 \sum Year + \varepsilon_0 \tag{3}$$

$$Innovation1(Innovation2)_{i,t} = \alpha_0 + \beta_1 Coverage_{i,t} + \beta_2 \sum Controls + \beta_3 \sum Industry + \beta_4 \sum Year + \varepsilon_0 \tag{4}$$

$$Innovation1(Innovation2)_{i,t} = \alpha_0 + \beta_1 Usage_{i,t} + \beta_2 \sum Controls + \beta_3 \sum Industry + \beta_4 \sum Year + \varepsilon_0 \tag{5}$$

$$Innovation1(Innovation2)_{i,t} = \alpha_0 + \beta_1 Digital_{i,t} + \beta_2 \sum Controls + \beta_3 \sum Industry + \beta_4 \sum Year + \varepsilon_0 \tag{6}$$

The model (1) examines a hypothesis that suggests an influence of FinTech on innovation in small and medium-sized enterprises that are specialized and sophisticated, and that are listed on the stock market. Model (2)-Model (4) subsequently alters the independent variable from FinTech to a measure of its three aspects: breadth of coverage, depth of use, and level of digitalization. Controls represents control variables in the model, comprising eight variables at the firm level and two variables at the city level, discussed in the previous section. ε denotes random error. Year and industry-fixed effects are used to control for potential influences from industry-specific characteristics and temporal variations.

4   Results

4.1   Descriptive Statistics

Table 2 presents descriptive statistics for the study variables. The mean for corporate innovation (Innovation1) is 4.485, with a median of 4.511, a range from 2.303 to 6.501, indicating significant variation in innovation among small and medium-sized listed companies in specialized and sophisticated sectors. The median exceeding the mean suggests left skewness, indicating a substantial proportion of enterprises exhibit high innovation capacity. The average FinTech value is 292.3, with a range from 222.8 to 351.5, highlighting advanced FinTech in cities hosting these enterprises, characterized by extensive coverage, broad usage, and high digitization. For control variables, equity

ranges from 11.7% to 83.2%, with a mean of 36.3%, indicating that dispersed equity influences corporate innovation. ROA, PPE, and enterprise growth are significant control variables, with values closer to the minimum than the second quartile, suggesting these enterprises are smaller in these aspects.

Table 2. Descriptive Statistics.

Variable	Mean	p50	SD	Min	p25	p75	Max
Innovation1	4.485	4.511	0.891	2.303	3.871	5.112	6.501
Innovation2	17.470	17.470	0.825	15.750	16.870	18.030	19.620
FinTech	292.262	291.443	30.552	222.816	272.521	311.958	351.532
Coverage	289.748	290.317	38.111	201.648	265.561	313.360	361.651
Usage	286.982	286.756	30.303	218.617	266.466	308.160	350.019
Digital	310.295	311.664	15.772	271.779	298.955	322.769	336.469
Equity	0.363	0.343	0.158	0.117	0.236	0.460	0.832
Cash	0.065	0.059	0.080	0.136	0.018	0.108	0.330
Lev	0.313	0.296	0.160	0.0500	0.181	0.430	0.705
ROA	0.099	0.087	0.077	0.148	0.054	0.136	0.357
PPE	0.167	0.142	0.115	0.008	0.078	0.233	0.511
Grow	0.268	0.195	0.362	0.413	0.072	0.369	2.137
Age	1.701	0.000	4.055	3.000	1.000	4.000	16.000
Size	20.944	20.916	0.848	19.048	20.375	21.491	23.224
GDP	15721.365	12371.500	12392.223	1097.720	5068.350	24222.977	43215.850
Population	798.599	722.600	412.796	130.600	494.643	1039.890	1556.200

Note. N = 1380.

4.2   Results of Regression Analysis

Table 3 reports the regression outcomes of the models. Columns 1 and 2 report findings from using the number of patents and R&D expenses as indicators of innovation capacity, respectively. Firms' innovation indices returned positive values, suggesting that FinTech influences the innovation capacity of publicly traded companies positively, including those that are highly specialized and sophisticated, irrespective of whether they are in the initial stages of R&D or in the later stages of marketing. Columns 3 through 8 report findings regarding breadth of digital financial coverage, depth of use, and degree of digitization, with results suggesting a positive impact concerning promoting enterprise innovation, supporting the hypothesis.

Table 3. FinTech and Innovation.

Dependent variable	(1) Innovation1	(2) Innovation2	(3) Innovation1	(4) Innovation1	(5) Innovation1	(6) Innovation2	(7) Innovation2	(8) Innovation2
FinTech	0.0061***	0.0026***						
	(0.0014)	(0.0009)						
Coverage			0.0059***			0.0019***		
			(0.0012)			(0.0007)		
Usage				0.0023*			0.0018**	
				(0.0012)			(0.0007)	
Digital					0.0056***			0.0057**
					(0.0021)			(0.0022)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
_cons	-0.7813	1.5162**	-0.7219	0.2472	-0.8526	1.6970**	1.7554***	-1.2590
	(1.1324)	(0.6909)	(1.1103)	(1.1133)	(1.2426)	(0.6797)	(0.6762)	(1.2898)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1380	1380	1380	1380	1380	1380	1380	1380
R^2	0.2734	0.6847	0.2771	0.2654	0.2672	0.6842	0.6841	0.2693
Corrected R^2	0.2500	0.6745	0.2538	0.2418	0.2436	0.6741	0.6739	0.2452

$*p < 0.05. **p < 0.01. ***p < 0.001.$

5   Conclusion

In recent years, the state has focused on specialized and sophisticated enterprises and the increasing integration of FinTech into daily life. This study examines the influence of FinTech on innovation using data from specialized and sophisticated listed enterprises from 2018 to 2021 and the Peking University Inclusive Digital Finance Index. Findings indicate that FinTech drives innovation in these enterprises and is becoming more integrated into everyday life. FinTech enhances the innovation advantages of publicly traded specialized and sophisticated enterprises, with consistent influence across breadth of coverage, depth of use, and degree of digitization.

This study addresses the lack of focus on specialized and advanced small and medium-sized enterprises (SMEs) in the FinTech industry, presenting new research areas in FinTech and corporate innovation. Enhancements in innovation capacities within these businesses have fostered policy harmonization and resource cooperation across governmental departments, promoting high-quality societal advancement and creating a new development framework. To further understand the role of diverse financing systems (such as angel investment, venture capital, and private equity) in S&T innovation, future research should investigate the impact mechanisms of different financing methods at various innovation stages and analyze their roles in resource allocation, risk management, and enterprise growth. This approach will clarify the pivotal role of diverse financing systems in advancing S&T innovation.

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