

Boosting Sustainability in Healthcare Sector through Fintech: Analyzing the Moderating Role of Financial and ICT Development

INQUIRY: The Journal of Health Care Organization, Provision, and Financing
Volume 58: 1–11
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DOI: 10.1177/00469580211028174
journals.sagepub.com/home/inq



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Abstract

Healthcare organizations are setting new targets of sustainable practices to improve their financial performance without depleting social and natural capital. Maintaining a sustainable, resilient, and durable healthcare system facilitate economies to achieve sustainable competitiveness. Thus, it is important to address and fill the knowledge gap by identifying factors that improve a firm's sustainability. Drawing on technological knowledge spillover theory, this study investigates the effect of FinTech development on the sustainable performance of healthcare firms using panel data comprised of 11 Asia-Pacific countries. By applying the 2-step GMM technique, we find a robust estimate that digital financial technologies improve the sustainable performance of the firms. Contrary to the substitution effect, our results further indicate that financial institutions are collaborating with FinTechs to facilitate financing at the individual and firm-level. We also find that financial and ICT development positively moderates the relationship between FinTech development and sustainable performance.

Keywords

FinTech, sustainable performance, ESG, financial development, ICT development

What do we already know about this topic?

In recent years, financial technology has proved to be an efficient mechanism that mitigates income inequality and poverty around the globe. Fintech startups also facilitate healthcare systems by accelerating payment processes. To access loans and make simple payments, patients now no longer need to navigate complex systems. Thus, FinTech development is directly associated with the sustainability of the healthcare industry.

How does your research contribute to the field?

Drawing on technological knowledge spillover theory, this study is the first attempt to examine the effect of FinTech development on the sustainable performance of Asian-Pacific healthcare firms along with the moderating role of financial and ICT development.

What are your research's implications toward theory, practice, or policy?

At the firm-level, FinTechs improve the sustainability of the healthcare sector by encouraging the firms to maintain ESG standards. Our study also clarifies that FinTech startups and formal financial institutions complement each other to facilitate the healthcare industry of the Asia-Pacific region. Policymakers should also emphasize the essence of ICT development for more functional and expeditious utilization of FinTech platforms.

Introduction

The sustainable development of the healthcare industry is a critical stimulant of human capital, thus, a crucial aspect of economic growth. A substantial body of microeconomic literature argued that healthier citizens or workers are more

productive, more energetic, more mentally stable, and less likely to get absent from work due to illness.¹⁻³ Therefore, the financial sustainability of the healthcare system is essential for macroeconomic stability, labor market efficiency, and social cohesion.⁴ Owing to the paramount significance of the inviolable healthcare system, researchers are very keen to



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evaluate certain mechanisms to enhance the survival and sustainability of this industry.^{4,5}

The rapid industrial revolution has transformed information technology (IT) value to business value which facilitates healthcare information management and integration of healthcare systems.⁶ Especially financial technology (FinTech) changed the business processes by assimilating finance to technological advancement.⁷ Owing to the high unit cost of financial intermediation, FinTech platforms have promised to improve consumer welfare by overcoming financial contracting frictions.⁸ Despite the wide use of the term, its interpretation varies across the literature.⁹ At the macro-level, a broader definition by Financial Stability Board (FSB) found global recognition that defines FinTech as, “technologically enabled financial innovation that could result in new business models, applications, processes, or products with an associated material effect on financial markets and institutions, and the provision of financial services.”

The financial technology substantially covers insurance, management services, digital payments, settlement services, capital-raising, deposits, and credit services which also facilitates and streamlines healthcare processes by lowering the cost of financial services compared to the conventional financial sector.¹⁰ Through robotic investment advice, peer-to-peer (P2P) lending, mobile payments, artificial intelligence, machine learning, and blockchain technologies, FinTech gives a boost to the healthcare sector by mitigating inefficiencies in their payment plans.^{11,12} Financing solutions by FinTech are reducing income inequality, financial exclusion,¹³ and enabling low to moderate-income individuals to afford and access healthcare services.¹²

At the macro and micro level, evidence shows that FinTech development plays a vital role in curbing poverty,¹⁴ mitigating the fragility of financial institutions in emerging markets,¹⁵ decreasing bank’s credit risk,¹⁶ facilitating urban development,¹⁷ increasing bank’s credit supply to small and medium enterprises (SMEs),¹⁸ and improving the efficiency of SMEs.¹⁹ Not only the technological progression of financial instruments have built just and equitable societies,²⁰ but they also provide ecological benefits by accelerating the resource allocation to environmental infrastructure and renewable energy leading to sustainable development.²¹

One of the main reasons that FinTechs are rigorously enlightening the aspects of socio-economic well-being, is their independence from financial intermediaries to formally build borrowing-lending relationships.²² Since borrowing

has been made easier by Fintechs and P2P lending, the challenges and burdens related to healthcare payments have been reduced. Fintech solutions not only expedite and simplify the health payment process for the users but also low-interest loans and mobile-based health saving accounts have increased the affordability of healthcare for lower or middle-income groups of the society.²³

Despite the direct influence of blockchain-based FinTechs platforms on healthcare consumers’ and patients’ wellbeing, there is a lack of empirical evidence that how FinTechs are contributing to the sustainability of the healthcare industry. We also explore the role of information and communication technology (ICT) infrastructure and financial development in reinforcing the FinTech-Sustainability nexus. Grounded on prior studies, we assert that ICT maturity may catalyze economic growth, social cohesion, and environmental sustainability.²⁴⁻²⁶ ICTs enable firms to be more productive at the fundamental level and improve the level of healthcare delivery.²⁷ Similarly, financial development may reduce pollutant emissions,²⁸ increase consumption of renewable energy,²⁹ and trade openness.³⁰ In terms of healthcare development, financial development uses healthcare expenditures as a transmission channel to improve the healthcare system in the region.³¹ Thereby both ICT and financial development support economies to achieve sustainable competitiveness.^{32,33}

Our study fills the gap by examining the effect of FinTech development on the sustainable performance of healthcare firms in the Asia-Pacific region along with the moderating role of financial development and ICT infrastructure. Previous studies on the relationship between Fintech and sustainability are scarce. Deng et al²¹ analyzed the link between FinTech and sustainable performance at the provisional level in China. By further extending the literature, we investigate the underexplored effect of FinTechs on the sustainable performance of healthcare firms in Asia-Pacific. We further contribute to the literature by examining the moderating role of ICT and financial development on the relationship between FinTechs and sustainable performance. This is the first attempt to apply knowledge spillover theory to explain how collective growth in financial innovation improves individual well-being and organizational effectiveness. Lastly, we have utilized the system GMM model to control for endogeneity (reverse causality and omitted variable bias) issues.

The paper proceeds as follows. The second section discusses the literature review, theoretical framework, and hypothesis are developed accordingly. The third section

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Received 16 February 2021; revised 28 May 2021; revised manuscript accepted 7 June 2021

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explains the research methodology and empirical model in detail. The fourth section of the study exhibits results and discussion. The last section concludes the study along with the limitations, policy implications, and future recommendations.

Theoretical Framework and Hypotheses Development

The endogenous growth theory considers both finance and technology as important drivers of economic growth.³⁴ According to Solow's³⁵ growth model, labor, and capital may not contribute to economic output in the absence of positive technological spillovers and technology transfer. In the provision of financial services, technology reduce information asymmetry between lenders and borrowers.³⁶ Especially in the context of FinTech, big data analytics and machine learning algorithms allow borrowers to acquire an easy assessment of credit, provide financing opportunities, and allow peers to track investments that build a trustworthy environment among the FinTech stakeholders.^{37,38} FinTechs with scarce resources efficaciously competes with incumbents through less complex, more flexible, faster, and affordable financial services. Grounded on disruption theory, it is believed that FinTechs (as a disruptor) targeted low-end consumers initially and absorbed mainstream customers after gaining traction.³⁸⁻⁴⁰

Since FinTech platforms have the capability to improve the local currency value and reduce the inflation rate, the overall cost of business has reduced giving more opportunities to the traditional industries to prosper and grow.⁴¹ The phenomenon that how FinTechs influence other industries can be explained by knowledge spillover theory. Rather than underpinning our idea with "MAR spillover" that explains technological knowledge spillover within the industry, our study is more inclined toward the "Jacobs spillover."⁴² Jacobs asserted that knowledge flows between complementary industries, customers, and suppliers. The cross-enriching, mutual spillovers by diversified industries drive new applications, techniques, and flow of ideas.⁴³ Knowledge spillover theory also expounds that firms absorb knowledge from other industries to reduce the uncertainty and challenges of exploring unfamiliar knowledge domains to gain sustainable competitiveness.⁴⁴

In the context of healthcare industries, technological knowledge spillovers may arise from FinTechs to the healthcare industry. Digital innovation of financial technologies has made the patients capable of paying their medical expenditures in an emergency through accessible and affordable lending methods that not only saving precious human lives but also facilitating the financial stability of healthcare systems.⁴⁵ The digital transformation of the FinTech industry has provided trusted financial services to remote and underserved communities through a combination of technology (mobile wallets) and offline services (finance agents). The challenges and excessive costs (manpower costs, transportation costs, third party payments) faced by healthcare providers due to cash-based payment methods are subsequently reduced.¹² Through

financial inclusiveness and affordable health insurance, FinTech platforms are providing high-quality healthcare to the low-income population.^{46,47} Al-Hanawi et al⁴⁸ further confirmed that financially included individuals are more likely to come up with emergency funds and have a higher conditional probability of borrowing for medical purposes.

Hence, Fintechs are facilitating society by reducing income inequality,¹³ providing better healthcare services to underprivileged groups,²³ and improving the financial performance of the healthcare industry by bringing more patients to the mainstream amenities. Besides revitalizing societal and economic goals of sustainability, FinTech innovations are nurturing the environmental quality and slowing down climate change.^{21,49} Owing to the high energy-consuming blockchain, technology is not usually associated with ecological agendas. Nonetheless, the FinTech innovations with DLT networks, P2P, and types of "direct finance" present continuity and coherence with the environmental, social, and governance (ESG) world that apprehends a more eco-friendly, circular, ESG resilient, and inconclusive financial system to support sustainable development.⁵⁰ Although empirical evidence is available that linked FinTech development with sustainable performance,^{21,49} there is a need to further explore if FinTechs facilitate sustainable performance or responsible investment at the corporate level. Over the period, the healthcare sector has substantially improved ESG standards to meet the UN's sustainable goals.⁵¹ Thus, we believe FinTechs initiatives are significantly contributing to the sustainable performance of the healthcare industry. Consequently, the following hypothesis is developed:

H₁: There is a positive relationship between FinTech development and sustainable performance of healthcare firms

There are 2 different perspectives regarding the disruptive role of FinTech development, that is, substitution effect and complementary effect. The substitution effect may occur when the value of banks decreases with the development of efficient and cost-effective FinTechs compared to incumbent banks. On the other hand, a complementary effect may arise when traditional banks collaborate with venture capital funding, outsourcing services, and FinTech start-ups that increase bank performance.⁵² While advocating the complementary role of FinTechs, Li et al⁵² found an increase in the value of the US retail banking industry with the growth of FinTech platforms. Iman⁵³ assessed the certain dynamics of FinTechs in Indonesia and argued that FinTech startups need to collaborate with traditional banks to survive in the competitive markets.

Grounded on technological knowledge spillover, Wang et al⁵⁴ investigated the effect of FinTech development on bank risk-taking in China over the period 2011 to 2018. They found the disruptive effect of FinTech development in the early years which transformed into complementary effects when traditional financial institutions optimize their service, bring more

innovation, and upgrade technology that improves profitability but reduces the motivation to take excessive risk. In the same lines, Cheng and Qu¹⁶ argued that Fintechs using big data technology, cloud computing technology, blockchain technology, and artificial intelligence technology stimulate financial development by reducing the credit risk of banks. A wide range of literature also supported the role of financial development in improving sustainable growth.^{28,55-57} Especially in the context of Asia, financial development is proved to be an important catalyst to improve ESG performance.⁵⁸

The incumbent financial institutions are preferring to collaborate with FinTech startups proactively to speed up innovation and create new value for ecosystem partners.³⁹ The development of financial technologies has reduced the market risks of commercial banks, decrease the cost of information, and increase the transparency of market information.⁵⁹ By supporting the complementary effect of FinTechs, we posit that they are more likely to influence the sustainable performance of a firm in the presence of higher financial development. The following hypothesis is designed accordingly:

H₂: Financial development positively moderates the relationship between FinTech growth and sustainable performance of healthcare firms

The digital revolution has radically transformed economies and help societies to develop new mechanisms for human wellbeing, national wealth, natural resources, and sustainability.^{60,61} Drawing on the complexity theory, Delgosha et al³³ argued that ICT usage, adoption, capabilities, and infrastructures encourage countries to achieve sustainable competitiveness without compromising social and natural capital. Using a global panel data of 107 countries, Laidroo and Avarmaa⁶² revealed that FinTech establishment intensity is stronger in countries with greater ICT readiness and service clusters. Studies also find that ICT development is positively associated with financial inclusion and income equality.^{13,63-65} Krishna and Krishnan⁶⁶ used a generalized linear mixed model to analyze the country-level and individual-level factors that influence the adoption of FinTech services. They assert ICT competitiveness as a prerequisite for FinTech services diffusion in a country. In tandem with previous studies, it is argued that FinTech development is more likely to influence the sustainable performance of the firms in more technologically driven societies. Consequently, the following hypothesis is developed:

H₃: ICT development positively moderates the relationship between FinTech growth and sustainable performance of healthcare firms

Methodology

Our sample is comprised of 59 healthcare firms¹ in Asia-Pacific. The sample countries include Australia, China, Hong

Kong, India, Indonesia, Malaysia, New Zealand, Philippines, Singapore, South Korea, and Thailand while the industries include pharmaceutical, biotechnology, medical supplies, medical equipment, and healthcare service providers. Although the companies share similar characteristics, Asia-Pacific countries vary across culture, technology, and financial development level. In line with the previous studies on FinTech,^{19,67} the study period is comprised of 2011-2018. After excluding outliers and missing values, the final sample is comprised of 424 firm-year observations.

The data of sustainable performance is collected from the Sustainalytics Platform database which developed the ESG scores based on 199 items for 8 sections including the community, customers, supplier, controversial activities, the environment, employees, corporate governance, and business ethics. A wide range of studies has used Sustainalytics to measure the sustainability practices of a firm.⁶⁸⁻⁷⁰ The methodology for computing ESG by Sustainalytics can be considered vigorous and reliable as it averages every item by using sector and country-specific weights.¹¹ The data related to FinTech is retrieved from Crunchbase, following previous relevant studies.^{19,20}

The Crunchbase database includes comprehensive information on FinTechs, their financing, and their types (loyalty programs, insurance, asset management, payment, financing, and other business activities) assembled by millions of web data points, 2000 venture partners, and more than 200 000 corporate contributors. Although payment, financing, and insurance categories of FinTechs are more relevant to our study, we use a single proxy of FinTech (ie, the number of fintech startup formations in a given year and country) likewise Abbasi et al¹⁹ due to the time lag issue and missing information.¹¹ We obtained the data of ICT and financial development from the World Bank database.

The number of mobile and internet users are considered for ICT development⁷¹ while a composite index using principal component analysis (PCA) is developed to measure financial development based on 3 proxies, that is, commercial bank assets relative to central bank assets plus commercial bank assets, domestic credit to the private sector as a percentage of GDP, and liquid liabilities of the financial system as a percentage of GDP.⁷² This composite indicator of financial development covers a household's savings allocations with financial institutions, financial intermediation, and financial depth. We use both firm-specific and country-level variables as control variables. The data related to firm size, financial leverage, and firm growth are obtained from COMPUSTAT. On the other hand, the foreign direct investment (FDI), GDP growth, and healthcare expenditures related data are retrieved from the World Bank database.

We explicitly choose these control variables due to underlying reasons. Small firms are constrained of capabilities and resources while large enterprises are more conducive to the firm's productivity and benefit from economies of scale. Furthermore, large firms more consciously fulfill their

corporate environment and social responsibility.⁷³ Additionally, a firm with more growth opportunities may disclose more information related to their sustainable performance to manage their risk and secure multiple interests.⁷⁴ On the other hand, financial leverage is negatively associated with socially responsible disclosure.⁷⁵

The FDI also explains a substantial amount of variation in sustainable performance.⁵⁸ The global flow of FDI may lead to better environmental quality, energy efficiency, and more R&D expenditures.⁷⁶ Moreover, firms in more developed countries disclose more information regarding their ESG performance.⁵⁸ Since the healthcare industry is a highly regulated sector, its performance is somewhat dependent on healthcare expenditures by the government. Previous studies also find a causal relationship between healthcare expenditures and environmental sustainability.^{77,78} The following dynamic models are developed to test the hypotheses of our study:

$$SP_{i,t} = \beta_1 SP_{i,t-1} + \beta_2 FinT_{i,t} + \beta_3 Controls_{i,t} + Industry + Country + Year + \varepsilon \quad (1)$$

In the first equation, the effect of FinTech on sustainable performance is examined along with control variables and fixed-effect dummies. Where SP is the sustainable performance, FinT is the FinTechs, FD is the financial development, ICT is the information, communication, and technology. The Industry, Country, and Year indicate industry, country, and year fixed-effects while ε is the error term. The subscripts *i* and *t* represent firm/country and a year respectively.

$$SP_{i,t} = \beta_1 SP_{i,t-1} + \beta_2 FinT_{i,t} + \beta_3 FD_{i,t} + \beta_4 FinT * FD_{i,t} + \beta_5 Controls_{i,t} + Industry + Country + Year + \varepsilon \quad (2)$$

The direct effect of financial development and the interaction term is added in the second equation.

$$SP_{i,t} = \beta_1 SP_{i,t-1} + \beta_2 FinT_{i,t} + \beta_3 ICT_{i,t} + \beta_4 FinT * ICT_{i,t} + \beta_5 Controls_{i,t} + Industry + Country + Year + \varepsilon \quad (3)$$

Lastly, we examine the direct and moderating effect of ICT development in the third equation. Before creating interaction terms, variables were mean-centered to avoid multicollinearity issues. Additionally, we log-transformed the FinTech variable to mitigate heteroscedasticity.^{19,54}

In order to deal with several statistical biases, we find the Generalized Method of Moments (GMM) an appropriate technique for our empirical model. Previous studies suggested using the GMM estimator in the case of short panels

(fewer periods and greater individual units).⁷⁹ This technique is also useful in dealing with endogeneity and firm-specific heterogeneity.^{80,81} Especially for the dynamic models, GMM produces unbiased estimates in the presence of autocorrelation and unknown heteroscedasticity.⁸² Furthermore, we have considered 2-step GMM compared to 1-step GMM due to the smaller asymptotic variance of the former model.⁸³ However, 2-step GMM sometimes produces downwardly biased estimates especially in the presence of omitted time-varying variables,^{81,84} thus, finite-sample correction proposed by Windmeijer⁸³ is applied.

Additionally, we use system GMM instead of difference GMM as the latter model magnifies gaps in unbalanced panels and eliminate time-invariant regressors.⁸² We ensured the validity of instruments through the Hansen-*J* test while the insignificant AR(2) test shows that model may not suffer from second-order autocorrelation.⁸⁵ There is also no issue of instrument proliferation as the number of instruments is less than the number of groups.⁸⁶ Since our study combines macro-level and firm-level data, GMM is also appropriate for such types of datasets.^{87,88}

Results and Discussion

Main Results

The descriptive statistics of the study are presented in Table 1. The mean value of sustainable performance is 58.28 with a standard deviation of 21.04, suggesting variation in ESG disclosure among Asia-Pacific countries. The number of FinTech startups also varies across the region. The results also show that the average ICT development is 3.96 with the highest value in New Zealand. Furthermore, Indonesia is the least financially developed while Australian financial development is highest among selected countries. The descriptive statistics for control variables are also shown in Table 1.

The system GMM results are reported in Table 2. Model 1 indicates the significant and positive effect of FinTechs on sustainable performance suggesting the acceptance of the first hypothesis. Especially in the context of Asia-Pacific, financial technologies allow healthcare users to borrow more easily at a lower cost³⁸ and facilitate the timely treatment of patients. Our results also support technological knowledge spillover theory that FinTechs reduce the cost of doing business⁴¹ and expedite the flow of ideas, techniques, and new applications to other industries that gain sustainable competitiveness by reducing technical uncertainty.^{43,44} Our estimates reveal that the FinTech-Sustainability nexus does not only exist at the country-level.^{21,49} but also at the corporate level. The evidence related to control variables shows a positive effect of healthcare expenditures, GDP growth, and firm size but an insignificant effect of FDI, firm growth, and financial leverage. Consistent with the propositions, large firms invest more responsibly and disclose more information related to their sustainable performance,⁷⁴ companies in

Table 1. Descriptive Statistics.

Variables	Mean	SD	Min	Max
Sustainable performance	58.277	21.038	0.000	100
Fintechs	2.337	1.228	0.000	12.310
ICT	3.958	0.601	2.310	4.109
Financial development	0.608	0.190	0.317	0.939
Healthcare Exp	5.189	2.241	2.868	9.469
FDI	7.200	11.821	-0.041	58.519
GDP growth	4.583	1.903	0.840	9.551
Firm size	3.841	1.035	1.557	8.206
Leverage	0.668	5.215	0.018	12.083
Firm growth	0.093	0.751	-2.037	8.266

Table 2. GMM Estimations.

Variables	1	2	3
Sustainable performance _{t-1}	0.313** (0.315)	0.217** (0.293)	0.624** (0.226)
Fintechs	0.025** (0.117)	0.022* (0.094)	0.031** (0.148)
FD		0.001* (0.002)	
ICT			0.012** (0.004)
FD × FinTechs		0.002** (0.003)	
ICT × FinTechs			0.007* (0.013)
Healthcare Exp	0.005** (0.018)	0.010* (0.027)	0.003 (0.011)
FDI	0.001 (0.007)	0.001 (0.009)	0.006 (0.005)
GDP growth	0.140* (0.094)	0.123** (0.105)	0.110* (0.082)
Firm size	0.037* (0.104)	0.029 (0.095)	0.032** (0.116)
Leverage	0.001 (0.000)	0.003 (0.002)	0.005 (0.001)
Firm growth	0.031 (0.012)	0.029 (0.012)	0.030 (0.011)
Constant	1.022** (0.224)	0.992*** (0.159)	0.928** (0.115)
Year effect	Yes	Yes	Yes
Industry effect	Yes	Yes	Yes
Country effect	Yes	Yes	Yes
Instruments	26	30	28
AR(2): P-value	.552	.938	.620
Hansen J test: P-value	.304	.179	.226

Note. Standard errors in parentheses.

* $p < .1$, ** $p < .05$, *** $p < .01$.

developed countries more likely to maintain ESG standards,⁵⁸ and the sustainability of healthcare firms improve when government allocates more budget to the healthcare system of the country.

We have tested the moderating effect of financial development in Model 2. The results show that financial development has a positive and significant effect on sustainable performance. This evidence is consistent with previous studies^{28,56,57} that formal financial institutions support sustainable growth and raise ESG standards of the firms especially operating in Asia.⁵⁸ Our empirical results also indicate the positive moderating effect of financial development on the relationship between FinTech development and sustainable performance that support our second hypothesis. Contrary to the disruptive effect of FinTech, we reveal that financial

development and FinTechs complement each other to improve the sustainability of the healthcare firms. This evidence is in line with Li et al⁵² Our empirical estimates also support the notion of Zalan and Toufaily³⁹ that FinTech startups and incumbent banks are mutually creating innovative solutions for sustainable growth.

In the third model, we entered ICT and its interaction with FinTech. The direct effect of ICT development is positive and significant on sustainable performance which supports the evidence of Delgosha et al³³ that digitalization is essential for sustainable competitiveness without compromising governance quality, human welfare, and environmental quality. Since the interaction term (ICT × FinTechs) is also positive and significant, it can be purported that ICT development strengthens the link between FinTech growth and the

Table 3. GMM Estimations (Alternative Proxies of Financial Development and ICT Development).

Variables	1	2	3
Sustainable performance _{t-1}	0.241* (0.207)	0.228** (0.316)	0.460* (0.215)
Fintechs	0.018** (0.104)	0.018** (0.109)	0.033** (0.137)
FD		0.003** (0.011)	
ICT			0.008 (0.005)
FD × FinTechs		0.001* (0.006)	
ICT × FinTechs			0.003* (0.009)
Healthcare Exp	0.004* (0.013)	0.009 (0.031)	0.002* (0.012)
FDI	0.000 (0.001)	0.003 (0.004)	0.002 (0.001)
GDP growth	0.058** (0.083)	0.092** (0.095)	0.090 (0.091)
Firm size	0.022** (0.098)	0.018* (0.092)	0.035** (0.092)
Leverage	0.001 (0.000)	0.000 (0.001)	0.001 (0.002)
Firm growth	0.024 (0.010)	0.025 (0.013)	0.031 (0.009)
Constant	0.989*** (0.196)	1.135** (0.168)	1.092** (0.177)
Year effect	Yes	Yes	Yes
Industry effect	Yes	Yes	Yes
Country effect	Yes	Yes	Yes
Instruments	24	32	31
AR(2): P-value	.474	.866	.701
Hansen J test: P-value	.338	.256	.313

Note. Standard errors in parentheses.

* $P < .1$. ** $P < .05$. *** $P < .01$.

sustainable performance of the firms. Our results also support the third hypothesis. In tandem with Krishna and Krishnan,⁶⁶ more technologically driven countries with advanced and smart ICT systems more likely to stimulate financial technologies to influence a firm's sustainability.

Robustness Checks

As a robustness check, the same regression models were applied with alternative proxies of ICT and financial development. We used the financial market development index (FMDI) developed by World Economic Forum. This index provides a comprehensive view of the country's financial system by including affordability of financial services, regulation of securities exchanges, soundness of banks, venture capital availability, ease of access to loans, financing through local equity market, availability of financial services, and legal rights. The FMDI is the eighth pillar of the global competitiveness index (GCI) used as a financial development proxy in previous studies.^{89,90} For ICT development, we utilize secure Internet servers per 1 million people as an alternative proxy. The estimation results largely remain the same and consistent with the main findings. However, the direct effect of ICT development on sustainable performance is insignificant as shown in Table 3.

Conclusion

Digital financial transformation is playing a major role in facilitating government, firms, and regulators to achieve the

UN's sustainable development goals (SDGs) by balancing the exploration and exploitation of financial resources.⁴⁹ In the context of public health, FinTechs enable healthcare users to access funds faster at a lower interest rate which fulfills the medical needs of patients. Digital financial technologies have also improved environmental health by assisting ESG-related opportunities and risk management and identification, encouraging information symmetry, and allocating capital for sustainable investments.⁵⁰ Given the scarcity of literature on digital finance and sustainable growth, this study attempts to fill the knowledge gap by empirically examining the relationship between FinTech development and the sustainable performance of healthcare firms operating in the Asia-Pacific region.

The results show that FinTech development significantly enhances the sustainable performance of the healthcare sector after controlling for firm-level and country-level variables. Digital finance and related platforms have enabled the underprivileged population to invest and save small amounts of money that can be retrieved in case of emergency. Bringing money through FinTechs supports the financial system of the country and wider social objectives to achieve SDGs. Thus, sustainable digital finance technologies especially FinTechs can unlock the transition to low-carbon intensive economies. Our findings also confirm that this link is stronger for more financially developed and more technology-driven countries. Contrary to substitute effect, FinTechs and formal financial institutions in Asia-Pacific collaborate to pressure firms to robust governance structures, investor protection and expand their efforts to

improve environmental quality. From the viewpoint of ICT development, smartphones with internet access are transforming all aspects of society and development.

Our study has important practical and managerial implications. Digital financial technologies along with strong financial institutions and technology advancement can serve as efficient mechanisms to finance higher ESG performance projects at the firm-level. At both the micro and macro-level, the government should adequately allocate public funds to the FinTech startups should be adequately allocated public funds by government and support the joint platforms between financial and non-financial institutions to explore and broaden opportunities in ESG activities. Policymakers should highlight the essence of strengthening ESG governance frameworks so that financial institutions will consider the sustainability ratings of the firm for credit evaluation. If the financial market is adequately efficient, FinTechs may proactively support financial inclusion, insurance services, long-term financing, and investment opportunities, and provide payment services that sufficiently contribute to UN SDGs.

There are certain limitations of the study leaving research avenues for future studies. The sample of the study is limited to the healthcare of the Asia-Pacific region only. Future studies are advised to consider more sectors, other regions, and differentiate sub-panels based on energy demands, clean energy consumption, country risks, governance quality, etc. Additionally, we analyze the effect of financial development using bank-based proxies only. The effect can be robust by incorporating stock market- and insurance-based proxies in the index. The inclusion of FinTech Type (ie, asset management, payment services, loyalty program, insurance, financing, etc.) in the analysis may provide a more explicit generalization of the results.

Although we found the complementary effect of FinTechs in the region, they may still be too small to affect incumbent retail banks despite their rapid growth. Especially in the developed countries with a lower level of governance quality, building trust in the automatic and online services of new FinTech ventures is difficult. Thus, complementary and substitute effects may partially offset each other and vary across the region. This issue can be addressed in future studies with more detailed geographical analysis. Lastly, an alternative econometric technique can be utilized to validate the results as GMM may provide less accurate estimations in the presence of omitted time-varying variables.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The

fourth author (Dr. Zhang Shaohua) thanks partial financial support from Project “China’s ‘Missing Middle’: Typical Facts, Formation Mechanism and Macro Effects” (Grant No.71673253) and Project “China’s ‘Missing Middle’: Typical Facts, Formation Mechanism and Macro Effects” (Grant No.72073038) supported by the National Natural Science Foundation of China.

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Notes

- I. Although there are 56 countries in Asia-Pacific region, we were able to retrieve the data for 11 countries only. Owing to the lack of ESG disclosure by Asian firms, the sample size of our study is limited.
- II. Owing to different governmental and industrial regulation in different countries and sectors, averaging every item by country-specific and sectoral weights enhance the reliability of index.
- III. Please note that less developed countries especially in South Asian region (eg, Pakistan, Sri Lanka, and Bangladesh) still have fewer FinTech startups and some of the categories are not even available. Thus, lack of data restricted us to test all FinTech categories separately.

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