

Does Fintech Strengthen Sustainable Competitiveness? Nonlinear Links between Environmental Globalization and Industrial Growth in China

*YanJun Zhang, JiaJia Xi, Gonghang Chen**

Abstract

Industrial growth is a central driver of economic development, but its contribution to sustainable competitiveness depends on whether expansion is supported by financial innovation, environmental integration, and technological capability. China has experienced rapid industrialization over recent decades; therefore, identifying the determinants of sustainable industrial growth is important for both economic and environmental policy. This study examines the asymmetric effects of financial technology and environmental globalization on industrial growth in China from 1995 to 2022. Industrial growth is used as the empirical channel through which sustainable competitiveness is assessed. Using linear ARDL and nonlinear ARDL frameworks, the study evaluates both symmetric and asymmetric relationships among financial technology, environmental globalization, technological capital, human capital, economic instability, and industrial growth. The symmetric results indicate that financial technology and environmental globalization promote long-run industrial growth. The asymmetric results show that positive changes in financial technology and environmental globalization support industrial growth, whereas negative changes weaken it. Overall, the findings suggest that fintech development, environmental globalization, technological capability, and human-capital upgrading can help strengthen sustainable competitiveness in China.

Keywords: Fintech, environmental globalization, sustainable competitiveness, industrial growth, China, nonlinear ARDL

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1 INTRODUCTION

Since adopting reform and opening-up policies in 1978, China has achieved substantial economic progress. However, the earlier growth model based on high development rates has become less suitable for the requirements of modern economic society because of the gradual weakening of the demographic dividend and declining marginal investment efficiency (Liu & Lim, 2023). Challenges such as an unbalanced economic structure, excess capacity, and inadequate factor input-output transformation have increased the need to shift from extensive growth toward high-quality and efficient development (Zheng et al., 2009). At this stage of socioeconomic transformation, economic restructuring, and growth upgrading, Xi Jinping emphasized the need to deepen financial-system reform, strengthen financial services for the real economy, and support innovative regulatory strategies in the report of the 19th Party Congress (Li, 2018; Garrick & Bennett, 2018). The report also emphasized that innovation is the first driving force of development and a strategic support for building a modern economic system. Although China has made progress in innovation and reform, its independent innovation capacity still requires further improvement. The Fifth Plenary Session of the 19th

Central Committee also emphasized science and technology self-reliance and self-improvement as strategic support for national development (Li & Zhu, 2021). Business innovation is therefore central to industrial growth, total factor productivity, and sustainable competitiveness. Nevertheless, information asymmetry between banks and firms still constrains the ability of China's financial sector to support corporate innovation and the real economy (Chou & Shao, 2014).

Frontier technologies such as big data, cloud computing, artificial intelligence, blockchain, and mobile internet technology continue to interact with traditional financial institutions and create new forms of financial services (Awotunde et al., 2021). Fintech, which is built around big data, artificial intelligence, blockchain finance, and quantitative finance, has expanded the scope and function of the financial sector. Because fintech is a relatively recent development, existing research has mainly examined industrial strategy, market conditions, firm characteristics, and corporate management (Ozturk & Ullah, 2022; L. Wang et al., 2023; Y. Wang et al., 2023). However, broader analytical frameworks and empirical evidence on fintech-driven challenges and opportunities for corporate technological innovation remain limited. In this context, it is important to examine whether fintech, with its potential for efficiency and lower transaction costs, can support business innovation and sustainable industrial growth (Karim et al., 2022).

According to Liu et al. (2022), fintech is a modernized form of traditional finance supported by digital technology. It has changed the conventional financial system, created an internet-based financial environment, and accelerated innovation in financial markets (Li et al., 2022). Fintech can increase financial access, stimulate employment, and support consumer spending (Liu et al., 2022). At the same time, fintech firms face systemic challenges, including evolving regulations and the need for strong compliance systems (Saci & Jasimuddin, 2025). These features suggest that fintech may influence economic growth and industrial-sector development. It has changed how consumers and firms interact with financial systems and is increasingly used to support economic development (Xu & Ullah, 2023). Fintech emerged in the early internet era, when firms began to provide financial services through online platforms (Qiu et al., 2022). In the 2000s, fintech firms expanded rapidly, especially in online lending and payment services (Merello et al., 2022). More recently, fintech firms have offered a broader range of services, including wealth management, insurance, and investment management (Yap, 2023). Theoretically, fintech can influence industrial growth through several channels (Zhao et al., 2022). First, it improves access to financial services for individuals and enterprises, particularly small firms that face difficulties obtaining credit from traditional banks. Second, it can reduce the cost of financial services, freeing resources for growth-related investment. Third, it can improve the efficiency of financial services and increase productivity and profitability. Fourth, it can enhance customer experience, satisfaction, and loyalty. Although these channels indicate a strong theoretical link between fintech and industrial growth, the empirical relationship for China remains an important research question.

The internet revolution has also transformed the financial sector and deepened international interconnections, contributing to globalization. Globalization has significantly influenced industrial development by changing how industries operate and expanding their reach beyond national borders (Xu et al., 2021). Reduced trade barriers, improved communication and transportation, and integrated global supply chains have created opportunities for firms to expand. The opening of new markets and customer bases allows industries to scale production and benefit from wider consumer demand (Zhang, 2010). Globalization also facilitates the transfer of technology, knowledge, and best practices across borders, which encourages

innovation and industrial development (Biemann et al., 2011). At the same time, greater global competition pushes firms to improve productivity, quality, and product offerings, thereby accelerating industrial growth. Overall, globalization can drive industrial expansion by helping sectors grow, diversify, and benefit from economies of scale (Agba & Odu, 2013). However, it also creates challenges that must be managed to ensure sustainable and inclusive growth.

Environmental globalization has led to the international diffusion of environmental governance language, rules, and practices. Although globalization has many dimensions, economic globalization has received the most attention (Park et al., 2008). Different dimensions of globalization may interact with each other, but environmental globalization is conceptually distinct from economic globalization. It concerns the cross-border diffusion of environmental standards, environmental ideas, green technologies, and governance practices. Despite its importance, the literature on environmental globalization remains relatively limited. Early work by Li et al. (2019) focused mainly on environmental regulation and green transformation, while broader research has examined flows of resources, energy, biological systems, and global environmental governance ideas across national boundaries.

The effect of environmental globalization on industrial growth has not been sufficiently examined empirically. However, several mechanisms suggest that environmental globalization can shape industrial growth. Global environmental change affects industrial development by altering business models and encouraging the adoption of sustainable practices (Figge et al., 2017). Concerns about resource depletion, climate change, and environmental degradation have become increasingly important as countries become more interconnected (Usman et al., 2022). These concerns have encouraged industries to review their processes and adopt cleaner strategies. Environmental globalization has also contributed to the development of stricter guidelines and standards for limiting pollution, reducing carbon emissions, and supporting sustainable resource management. Firms increasingly use renewable energy sources, waste-reduction strategies, and eco-friendly industrial methods (Chen et al., 2023). In addition, the rising demand for environmentally friendly products has encouraged firms to innovate and provide greener alternatives. Therefore, environmental globalization may create both constraints and opportunities for industrial growth by linking economic expansion with environmental responsibility (Jänicke, 2008). This connection makes environmental globalization relevant for sustainable competitiveness.

In light of the above discussion, this study asks whether fintech and environmental globalization strengthen sustainable competitiveness through industrial growth in China. The literature has not sufficiently examined the combined effects of fintech and environmental globalization on China's industrial growth. This study contributes to the literature in three ways. First, it examines whether fintech and environmental globalization influence industrial growth in China, using industrial growth as the empirical channel through which sustainable competitiveness is evaluated. Second, it identifies asymmetric determinants of industrial growth using nonlinear ARDL method. Third, the findings clarify the role of fintech and environmental globalization in supporting China's long-term economic and environmental transition. The following hypotheses guide the analysis:

H1: Financial technology has a significant effect on industrial growth in China.

H2: Environmental globalization has a significant effect on industrial growth in China.

2 MODEL AND METHODS

In recent years, rapid advances in fintech and deeper integration through environmental globalization have attracted considerable attention from researchers, policymakers, and industry practitioners. Both fintech and environmental globalization can shape industrial growth and contribute to sustainable competitiveness. Financial technology refers to the innovative use of technology in the provision of financial services, including banking, lending, payment systems, and insurance. The rise of fintech has transformed traditional financial systems by improving efficiency, accessibility, and convenience (Palmié et al., 2020). It has also supported new business models, enhanced financial intermediation, and expanded financial inclusion. Therefore, fintech may influence industrial growth by improving access to finance, strengthening capital allocation, encouraging entrepreneurship, and supporting innovation in the industrial sector (Vives, 2017).

Environmental globalization refers to the increasing interconnectedness of countries and regions in addressing environmental challenges, promoting sustainable practices, and managing natural resources (Figge et al., 2017). The need for environmental sustainability has led to international agreements, initiatives, and regulations aimed at mitigating climate change, protecting ecosystems, and promoting environmentally friendly practices (Hu et al., 2020). Environmental globalization includes the transfer of knowledge, green investment, and clean technologies across borders, all of which may affect industrial growth. Industries that adopt environmentally friendly practices, invest in clean technologies, and comply with international environmental standards are more likely to achieve sustainable growth and gain competitive advantages in global markets (Brandi et al., 2020). Based on this theoretical background, the following empirical framework is specified:

$$IG(t) = \delta_0 + \delta_1 FT(t) + \delta_2 EG(t) + \delta_3 TC(t) + \delta_4 HC(t) + \delta_5 EIS(t) + \varepsilon(t) \quad (1)$$

Equation (1) specifies industrial growth (IG) as a function of financial technology (FT), environmental globalization (EG), technological capital (TC), human capital (HC), and economic instability (EIS). The coefficient of financial technology is expected to be positive, indicating that fintech supports industrial growth. Environmental globalization is also expected to influence industrial growth by encouraging cleaner production, green technologies, and compliance with international environmental standards. The coefficients in Equation (1) represent the long-run effects.

$$\Delta IG(t) = \alpha_0 + \sum \phi_{1k} \Delta IG(t-k) + \sum \phi_{2k} \Delta FT(t-k) + \sum \phi_{3k} \Delta EG(t-k) + \sum \phi_{4k} \Delta TC(t-k) + \sum \phi_{5k} \Delta HC(t-k) + \sum \phi_{6k} \Delta EIS(t-k) + \rho ECM(t-1) + \varepsilon(t) \quad (2)$$

Specification (2) is the error-correction representation of the long-run model in Equation (1), following Pesaran et al. (2001). It represents the ARDL framework and includes both short-run and long-run coefficients. The coefficients attached to differenced variables capture short-run effects, while the normalized level variables capture long-run effects. To avoid spurious long-run relationships, cointegration among the variables must be established. The ARDL framework uses the bounds F-test and the error-correction term to assess cointegration. Unlike some alternative cointegration techniques, ARDL can be applied when the variables are I(0),

I(1), or a mixture of both, provided that none is I(2). ARDL is also appropriate for relatively small samples and can help address endogeneity and serial-correlation concerns (Ullah et al., 2021).

Because this study examines asymmetric relationships, the main regressors, FT and EG, are decomposed into positive and negative partial sums following Shin et al. (2014). The partial-sum decomposition is expressed as follows:

$$FT_POS(t) = \sum \max[\Delta FT(k), 0] \quad (3)$$

$$FT_NEG(t) = \sum \min[\Delta FT(k), 0] \quad (4)$$

$$EG_POS(t) = \sum \max[\Delta EG(k), 0] \quad (5)$$

$$EG_NEG(t) = \sum \min[\Delta EG(k), 0] \quad (6)$$

Specifications (3) and (5) show the positive changes in FT and EG, respectively, while Specifications (4) and (6) show their negative changes. To convert the linear ARDL specification into a nonlinear specification, the original FT and EG series are replaced by their positive and negative partial-sum components:

$$\Delta IG(t) = \alpha_0 + \sum \phi_k \Delta X(t-k) + \theta_1 FT_POS(t-1) + \theta_2 FT_NEG(t-1) + \theta_3 EG_POS(t-1) + \theta_4 EG_NEG(t-1) + \theta_5 TC(t-1) + \theta_6 HC(t-1) + \theta_7 EIS(t-1) + \varepsilon(t) \quad (7)$$

Specification (7) represents the nonlinear ARDL framework of Shin et al. (2014). The estimation steps are similar to those of the linear ARDL model, but additional tests are needed to validate asymmetry. Short-run asymmetry is examined using the Wald test by comparing the sums of the short-run coefficients attached to positive and negative changes in FT and EG. Long-run asymmetry is also examined using the Wald test by comparing the long-run coefficients attached to the positive and negative components. The remaining diagnostic tests are the same as in the linear ARDL model, including the bounds F-test and ECM tests of cointegration, LM test for serial correlation, RESET test for misspecification, and CUSUM and CUSUM-sq tests for parameter stability.

3 DATA AND DESCRIPTIVE ANALYSIS

To investigate the influence of financial technology and environmental globalization on industrial growth, this study uses annual time-series data for China from 1995 to 2022. The dependent variable is industrial growth (IG), measured as industrial value added as a percentage of GDP, obtained from the World Development Indicators (WDI). The main explanatory variables are financial technology (FT) and environmental globalization (EG). Financial technology is measured by the number of ATMs per 100,000 adults, obtained from the Global Financial Development Database (GFDD) (Zhang et al., 2026; Akbar et al., 2024). Environmental globalization is measured by trade in environment-related goods, with data collected from the OECD. The model also includes three control variables: technological capital (TC), human capital (HC), and economic instability (EIS). Technological capital is measured

by resident patent applications and is obtained from WDI. Human capital is measured by average years of schooling for individuals aged 15 and above, obtained from the Barro-Lee dataset. Economic instability is measured using inflation based on the annual GDP deflator. These control variables are included because previous studies identify them as important determinants of industrial growth.

Table 1 presents the descriptive statistics, including the mean, median, standard deviation, Jarque-Bera statistic, kurtosis, and skewness. The mean values of IG, FT, EG, TC, HC, and EIS are 3.783, 2.860, 8.701, 12.50, 7.362, and 0.002, respectively. The corresponding standard deviations are 0.073, 1.372, 0.612, 1.452, 0.480, and 3.423. The skewness results indicate that all series are negatively skewed except EIS. The Jarque-Bera test confirms that all variables are non-normally distributed.

Tab. 1 – Descriptive statistics. Source: authors' calculations

	Mean	Median	Max	Mini	S.D	Skewness	Kurtosis	Jarque-Bera	Prob.
IG	3.783	3.817	3.863	3.630	0.073	-0.786	2.021	16.00	0.000
FT	2.860	2.873	4.594	-0.238	1.372	-0.257	1.890	6.978	0.031
EG	8.701	8.955	9.286	7.233	0.612	-0.993	2.646	18.98	0.000
TC	12.50	12.61	14.25	9.739	1.452	-0.332	1.773	9.091	0.011
HC	7.362	7.444	8.055	6.274	0.480	-0.568	2.362	7.921	0.019
EIS	0.002	-0.719	13.38	-5.162	3.423	1.144	4.732	38.41	0.000

4 RESULTS AND DISCUSSION

The first step in time-series analysis is to determine whether the selected variables are stationary, since non-stationary data can lead to invalid estimates. This study uses the DF-GLS test (Elliott et al., 1996) and the Phillips-Perron test (Phillips & Perron, 1988). The results are reported in Table 2. The DF-GLS results show that all variables except HC become stationary after first differencing. This implies that HC is $I(0)$, while the remaining variables are $I(1)$ under the DF-GLS test. In contrast, the PP test suggests that most variables are stationary at level, except IG and EIS, which are stationary after first differencing. Because long time-series data may contain structural breaks that are not captured by DF-GLS and PP tests, the study also applies unit-root tests with structural breaks.

Tab. 2 – Unit-root tests without structural breaks. Source: authors' calculations

	DF-GLS			PP		
	I(0)	I(1)	Decision	I(0)	I(1)	Decision
IG	-0.744	-3.578***	I(1)	-0.404	-3.630***	I(1)
FT	0.532	-1.895*	I(1)	-2.865*		I(0)
EG	-0.954	-2.032**	I(1)	-6.022***		I(0)

	DF-GLS			PP		
TC	-0.716	-2.514**	I(1)	-2.711*		I(0)
HC	-3.205***		I(0)	-6.325***		I(0)
EIS	-1.023	-2.655***	I(1)	-0.325	-4.033***	I(1)

The results are reported in Table 3 and show that FT, EG, and HC are I(0), while IG, TC, and EIS are I(1). These findings confirm that the variables are a mixture of I(0) and I(1), supporting the use of the ARDL framework. Table 4 reports the BDS test results (Broock et al., 1996), which reject the null hypothesis of linearity for IG, FT, and EG. This confirms the presence of nonlinear features and supports the use of nonlinear ARDL approach.

Tab. 3 – Unit-root tests with structural breaks. Source: authors' calculations

	I(0)	Break date	I(1)	Break date	Decision
IG	-3.589	2013	-4.368*	2020	I(1)
FT	-7.658***	2007			I(0)
EG	-6.022***	1998			I(0)
TC	-3.112	2010	-6.325***	2018	I(1)
HC	-6.025***	2002			I(0)
EIS	-1.023	2011	-5.032***	2004	I(1)

Tab. 4 – BDS test results. Source: authors' calculations

	IG			FT			EG		
Dimension	BDS-Stat	S.E	z-Stat	BDS-Stat	S.E	z-Stat	BDS-Stat	S.E	z-Stat
2	0.144***	0.012	12.23	0.200***	0.008	24.91	0.211***	0.014	14.73
3	0.223***	0.019	11.70	0.332***	0.013	25.64	0.359***	0.023	15.36
4	0.240***	0.023	10.38	0.421***	0.016	26.98	0.462***	0.029	16.10
5	0.205***	0.025	8.316	0.479***	0.017	28.99	0.533***	0.031	17.36
6	0.141***	0.024	5.811	0.514***	0.016	31.79	0.582***	0.031	19.08

After confirming that the variables are a mixture of I(0) and I(1), the ARDL model is applied because it can estimate both short-run and long-run relationships in such settings. Table 5 reports the ARDL estimates and results show that FT and EG have favorable long-run effects on IG in China. A 1% increase in FT and EG is associated with a 0.140% and 0.247% increase in long-run industrial growth, respectively. The long-run coefficient of EIS is negative, indicating that economic instability reduces industrial growth by 0.019%.

In the short run, the coefficient of EIS is positive, indicating that a 1% increase in EIS is associated with a 0.007% increase in IG. The remaining short-run estimates are generally insignificant, except for the second lag of TC, which is negative and significant. Several diagnostic tests, including the LM, RESET, CUSUM, and CUSUM-sq tests, support the reliability of the model. The LM and RESET tests indicate that serial correlation and model

misspecification are not serious concerns. The CUSUM and CUSUM-sq tests confirm parameter stability. The bounds F-test and the error-correction term confirm the existence of a long-run relationship among the variables.

Tab. 5 – ARDL estimates. Source: authors' calculations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long-run				
FT	0.140*	0.079	1.756	0.082
EG	0.247*	0.116	2.119	0.056
TC	0.164	0.100	1.642	0.127
HC	0.129	0.250	0.517	0.615
EIS	-0.019***	0.006	-3.075	0.010
Short-run				
FT	0.007	0.032	0.214	0.834
EG	-0.098	0.153	-0.645	0.531
EG(-1)	0.213	0.145	1.472	0.167
TC	-0.017	0.029	-0.604	0.557
TC(-1)	0.002	0.031	0.053	0.959
TC(-2)	-0.060*	0.034	-1.800	0.097
HC	0.510	0.362	1.409	0.184
HC(-1)	-0.052	0.542	-0.096	0.925
EIS	0.007***	0.002	3.294	0.006
EIS(-1)	0.001	0.001	-0.329	0.748
EIS(-2)	0.003**	0.001	2.266	0.043
C	1.186	0.775	1.531	0.152
Diagnostics				
F-test	5.985***			
ECM(-1)*	-0.464***	0.068	-6.868	0.000
LM	1.025			
RESET	2.054			
CUSUM	S			
CUSUM-sq	S			

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

The main objective of this study is to examine whether the effects of financial technology and environmental globalization on industrial growth are symmetric or asymmetric. The BDS test

confirms nonlinear behavior in FT and EG; therefore, the nonlinear ARDL method is applied. Table 6 reports the NARDL results. The results show that FT_POS, EG_POS, and TC have positive long-run effects on IG in China. Specifically, a 1% increase in FT_POS, EG_POS, and TC is associated with increases in IG of 0.399%, 0.721%, and 0.127%, respectively. Because FT_NEG and EG_NEG represent negative changes in the respective variables, their estimates imply that declines in financial technology and environmental globalization reduce industrial growth. The results therefore suggest that positive movements in fintech and environmental globalization strengthen sustainable competitiveness, while negative movements weaken it. This finding is consistent with Karim et al. (2022), who argue that fintech innovations such as mobile banking, peer-to-peer lending, and online payment systems expand access to financial services for firms, particularly small and medium-sized enterprises. By reducing traditional financing barriers, fintech helps firms secure capital more efficiently, expand operations, and adopt innovative technologies, thereby supporting industrial growth.

Financial technologies also improve the availability of financial resources for firm innovation, increasing investment in R&D and ultimately supporting industrial performance. Yao et al. (2018) show that financial technologies, particularly third-party payment, credit, and insurance services, improve enterprise performance and growth in China. Hu and Li (2023) also confirm a positive relationship between financial technology and total factor productivity. Fintech may contribute to economic efficiency and reduce environmental harm by easing financial constraints and lowering agency costs (Akbar et al., 2024). These mechanisms can raise firm productivity and contribute to industrial-sector progress. Recent evidence also suggests that fintech can support sustainable energy development (Zhang et al., 2026). Overall, the findings highlight the importance of fintech for industrial growth and sustainable competitiveness in China.

Environmental globalization can support the eco-friendly transformation of markets by encouraging changes in economic, political, and social systems. It can help improve economic policies, optimize resource use, and strengthen institutional responses. Environmental innovations, patents, and environment-related technologies are important for achieving green growth in the BRICS region (Chen et al., 2023). Environmental globalization can therefore foster firm productivity, sustainable industrial growth, technological progress, and green innovation (Elfaki & Ahmed, 2024). It also encourages firms to develop ecologically responsible products and services that comply with international standards. This process may promote R&D investment and technological development, which are essential for industrial efficiency, performance, growth, and competitiveness. Ashford and Hall (2011) similarly argue that environmental globalization contributes to industrial growth by broadening the economic base, fostering technological progress, and facilitating sustainable development.

Nathaniel et al. (2023) support this view by arguing that environmental globalization opens new markets for environmentally friendly products and services. As countries become more aware of environmental challenges and adopt sustainable practices, demand grows for eco-friendly technologies, renewable energy solutions, and green products. Industrial sectors aligned with these trends can expand their customer base and support industrial growth (Huang et al., 2026; Aslam et al., 2021). Suki et al. (2022) also show that environmental globalization encourages technological innovation and progress in green technologies. International cooperation and knowledge sharing can increase research and development in environmentally friendly technologies, cleaner production processes, renewable energy, waste management, and sustainable resource use. Such technological development supports industrial growth by

improving productivity, reducing costs, and enhancing environmental performance. Environmental globalization also encourages international agreements, standards, and regulations that incentivize firms to reduce greenhouse gas emissions, improve waste management, and conserve natural resources. Figge et al. (2017) further note that environmental globalization can attract green investment toward sustainable projects. These investments provide financial resources for adopting clean technologies, implementing eco-friendly practices, and developing green infrastructure.

The findings also show that EIS has a negative long-run effect, reducing IG by 0.016%. In the short run, most estimates are insignificant, while the estimates for FT_POS, FT_NEG, and EG_NEG are mixed and inconclusive across lags. Because the diagnostics for the linear model are also applicable to the nonlinear model, they are not repeated. The long-run and short-run Wald tests are then used to confirm the asymmetric effects of financial technology and environmental globalization on industrial growth. The results indicate that industrial growth responds asymmetrically to both financial technology and environmental globalization, mainly in the long run.

Tab. 6 – NARDL estimates. Source: authors' calculations

Variable	Coef.	S.E	t-Stat	Prob.
Long-run				
FT_POS	0.399*	0.169	2.356	0.100
FT_NEG	0.892	0.435	2.053	0.132
EG_POS	0.721**	0.203	3.553	0.038
EG_NEG	4.811*	1.846	2.606	0.080
TC	0.127	0.071	1.804	0.169
HC	0.436	0.303	1.436	0.247
EIS	-0.016	0.009	-1.813	0.168
Short-run				
FT_POS	0.491***	0.106	4.623	0.001
FT_POS(-1)	-0.366**	0.110	-3.330	0.045
FT_NEG	0.252	0.202	1.247	0.301
FT_NEG(-1)	-0.951	0.515	-1.846	0.162
EG_POS	0.589	0.546	1.080	0.359
EG_POS(-1)	0.248	0.440	0.564	0.612
EG_NEG	0.413	0.700	0.590	0.597
EG_NEG(-1)	-3.267**	0.883	-3.701	0.034
EG_NEG(-2)	2.738**	0.773	3.541	0.038
TC	0.102	0.117	0.865	0.451
TC(-1)	0.058	0.041	1.438	0.246
HC	0.546	0.423	1.290	0.287

Variable	Coef.	S.E	t-Stat	Prob.
HC(-1)	0.869	0.454	1.912	0.152
EIS	0.012	0.007	1.656	0.196
EIS(-1)	-0.004	0.003	-1.432	0.248
EIS(-2)	-0.002	0.002	0.912	0.429
C	6.503*	2.200	2.956	0.060
Diagnostics				
F-test	5.923***			
ECM(-1)*	-0.625***	0.070	-8.091	0
LM	1.025			
RESET	0.325			
CUSUM	S			
CUSUM-sq	S			
Wald-LR-FT	8.065***			
Wald-SR-FT	0.325			
Wald-LR-EG	5.658***			
Wald-SR-EG	1.025			

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

5 CONCLUSION AND IMPLICATIONS

Over the past few decades, China has experienced rapid industrial expansion and has become the world's largest manufacturing hub and a key participant in global supply chains. This growth has been supported by technological progress, infrastructure development, and market reform. However, the emergence of fintech and the increasing importance of environmental sustainability have introduced new dimensions to China's industrial-growth trajectory. Fintech has transformed the financial sector by changing how individuals and firms access and use financial services. Mobile payments, peer-to-peer lending, and other fintech innovations have expanded financial inclusion, improved efficiency, and facilitated access to capital for entrepreneurs and firms. At the same time, China's commitment to environmental sustainability and participation in global environmental initiatives highlight the importance of environmental globalization. Through international cooperation, China has adopted sustainable development practices, promoted clean-energy transitions, and implemented stricter environmental regulations. These developments have implications not only for industrial growth but also for sustainable competitiveness. This study contributes to the literature by examining the effects of financial technology and environmental globalization on industrial growth in China using linear ARDL and nonlinear ARDL models. The main findings are as follows: first, the symmetric analysis shows that FT and EG promote long-run industrial growth; second, the asymmetric analysis shows that FT_POS, EG_POS, and TC support industrial growth, while FT_NEG and EG_NEG weaken it; third, most short-run estimates are insignificant in both the symmetric and

asymmetric models; and fourth, the asymmetric effects of FT and EG on industrial growth are confirmed mainly in the long run. Based on these findings, several implications emerge.

- i. First, to harness the potential of fintech for sustainable industrial growth, policymakers should create a supportive regulatory and policy environment. This includes simplifying licensing procedures, strengthening consumer protection, and promoting competition and innovation. Encouraging fintech start-ups and collaboration between traditional financial institutions and fintech firms can accelerate the development and adoption of innovative financial technologies, thereby supporting industrial growth and sustainable competitiveness.
- ii. Second, promoting financial inclusion through fintech initiatives is important for fostering industrial growth. Policymakers should expand access to affordable financial services, especially in underserved areas and among small and medium-sized enterprises. By reducing barriers to financial inclusion, policymakers can unlock entrepreneurial potential, encourage innovation, and support broader economic development.
- iii. Third, environmental globalization requires international cooperation and knowledge sharing. Policymakers should actively participate in global environmental initiatives and promote cooperation between domestic and international stakeholders. Multilateral agreements, best-practice sharing, and research collaboration can support the transfer of environmentally friendly technologies and practices.
- iv. Fourth, policymakers should establish strong environmental regulations and incentives that encourage industries to adopt sustainable practices. Stricter emission standards, circular-economy principles, and resource-efficiency incentives can support the transition toward cleaner industrial processes.
- v. Fifth, policymakers should encourage collaboration between industrial sectors and fintech firms to use technological advances for sustainable industrial growth. Such collaboration can promote financial technologies that optimize resource use, improve supply-chain efficiency, and support sustainable production processes.
- vi. Finally, policymakers should prioritize skills development and education to equip workers with the competencies required in an evolving industrial landscape. This includes digital literacy, vocational training, and education programs focused on emerging technologies and sustainable practices.

This study has several limitations that should be addressed in future research. First, the analysis examines the relationships between financial technology, environmental globalization, and industrial growth using ARDL and NARDL models. Although these methods are suitable for the research objective, endogeneity and reverse-causality concerns may still exist because the relationships among the variables may be bidirectional or influenced by unobserved factors. Future studies should use alternative approaches, such as instrumental-variable methods and broader datasets, to validate causal mechanisms more rigorously. Second, this study focuses on China. Although China is an important case, the findings may not be directly generalizable to other countries or regions because institutional frameworks, policy environments, and economic conditions differ. Future studies should examine similar relationships in other contexts. Third, this study focuses on overall industrial growth. Future research can examine sector-specific industrial growth and explore additional nonlinear determinants of sustainable industrial competitiveness.

REFERENCES

1. Agba, A. M. O., & Odu, E. (2013). Globalization and the challenge of industrialization in developing nations: The Nigeria experience. *IOSR Journal of Humanities and Social Science*, 12(4), 41–47. <http://doi.org/10.9790/0837-1244147>
2. Akbar, N., Hafeez, M., Ghafoor, A., & Saman, M. (2024). The impact of FinTech on environmental degradation: An empirical evidence from APEC economies. *NICE Research Journal*, 17(4). <http://doi.org/10.51239/nrjss.v17i4.496>
3. Ashford, N. A., & Hall, R. P. (2011). *Technology, globalization, and sustainable development: Transforming the industrial state*. Yale University Press. <http://doi.org/10.12987/9780300177602>
4. Aslam, B., Hu, J., Hafeez, M., Ma, D., AlGarni, T. S., Saeed, M., Abdullah, M. A., & Hussain, S. (2021). Applying environmental Kuznets curve framework to assess the nexus of industry, globalization, and CO₂ emission. *Environmental Technology & Innovation*, 21, 101377. <http://doi.org/10.1016/j.eti.2021.101377>
5. Awotunde, J. B., Adeniyi, E. A., Ogundokun, R. O., & Ayo, F. E. (2021). Application of big data with fintech in financial services. In *Fintech with Artificial Intelligence, Big Data, and Blockchain* (pp. 107–132). Springer Singapore. http://doi.org/10.1007/978-981-33-6137-9_3
6. Biemann, T., Fasang, A. E., & Grunow, D. (2011). Do economic globalization and industry growth destabilize careers? An analysis of career complexity and career patterns over time. *Organization Studies*, 32(12), 1639–1663. <http://doi.org/10.1177/0170840611421246>
7. Brandi, C., Schwab, J., Berger, A., & Morin, J.-F. (2020). Do environmental provisions in trade agreements make exports from developing countries greener? *World Development*, 129, 104899. <http://doi.org/10.1016/j.worlddev.2020.104899>
8. Broock, W. A., Scheinkman, J. A., Dechert, W. D., & LeBaron, B. (1996). A test for independence based on the correlation dimension. *Econometric Reviews*, 15(3), 197–235. <http://doi.org/10.1080/07474939608800353>
9. Chen, R., Ramzan, M., Hafeez, M., & Ullah, S. (2023). Green innovation-green growth nexus in BRICS: Does financial globalization matter? *Journal of Innovation & Knowledge*, 8(1), 100286. <http://doi.org/10.1016/j.jik.2022.100286>
10. Chou, Y.-C., & Shao, B. B. M. (2014). Total factor productivity growth in information technology services industries: A multi-theoretical perspective. *Decision Support Systems*, 62, 106–118. <http://doi.org/10.1016/j.dss.2014.03.009>
11. Elliott, G., Rothenberg, T. J., & Stock, J. H. (1996). Efficient tests for an autoregressive unit root. *Econometrica*, 64(4), 813–836. <http://doi.org/10.2307/2171846>
12. Elfaki, K. E., & Ahmed, E. M. (2024). Digital technology adoption and globalization innovation implications on Asian Pacific green sustainable economic growth. *Journal of Open Innovation: Technology, Market, and Complexity*, 10(1), 100221. <http://doi.org/10.1016/j.joitmc.2024.100221>

13. Figge, L., Oebels, K., & Offermans, A. (2017). The effects of globalization on ecological footprints: An empirical analysis. *Environment, Development and Sustainability*, 19, 863–876. <http://doi.org/10.1007/s10668-016-9769-8>
14. Garrick, J., & Bennett, Y. C. (2018). ‘Xi Jinping Thought’: Realisation of the Chinese Dream of National Rejuvenation? *China Perspectives*, 2018(1–2), 99–105. <http://doi.org/10.4000/chinaperspectives.7872>
15. Hu, W., & Li, X. (2023). Financial technology development and green total factor productivity. *Sustainability*, 15(13), 10309. <http://doi.org/10.3390/su151310309>
16. Hu, X., Pollitt, H., Pirie, J., Mercure, J.-F., Liu, J., Meng, J., & Tao, S. (2020). The impacts of the trade liberalization of environmental goods on power system and CO₂ emissions. *Energy Policy*, 140, 111173. <http://doi.org/10.1016/j.enpol.2019.111173>
17. Huang, J., Zhou, L., & Yi, S. (2026). Has the integration of digital and real economies promoted green innovation in the Yangtze River Economic Belt? *Journal of Financial and Economic Dynamics*, 1(1), 1–20. <http://doi.org/10.66361/jfed.46>
18. Jänicke, M. (2008). Ecological modernisation: New perspectives. *Journal of Cleaner Production*, 16(5), 557–565. <http://doi.org/10.1016/j.jclepro.2007.02.011>
19. Karim, S., Naz, F., Naeem, M. A., & Vigne, S. A. (2022). Is FinTech providing effective solutions to small and medium enterprises (SMEs) in ASEAN countries? *Economic Analysis and Policy*, 75, 335–344. <http://doi.org/10.1016/j.eap.2022.05.019>
20. Li, D., & Zhu, C. (2021). Logical interpretation of China’s science and technology development strategy in the new era. *Philosophy Study*, 11(9), 677–682. <http://doi.org/10.17265/2159-5313/2021.09.004>
21. Li, H. L., Zhu, X. H., Chen, J. Y., & Jiang, F. T. (2019). Environmental regulations, environmental governance efficiency and the green transformation of China’s iron and steel enterprises. *Ecological Economics*, 165, 106397. <http://doi.org/10.1016/j.ecolecon.2019.106397>
22. Li, L. (2018). China’s manufacturing locus in 2025: With a comparison of ‘Made-in-China 2025’ and ‘Industry 4.0’. *Technological Forecasting and Social Change*, 135, 66–74. <http://doi.org/10.1016/j.techfore.2017.05.028>
23. Li, X., Shaikh, P. A., & Ullah, S. (2022). Exploring the potential role of higher education and ICT in China on green growth. *Environmental Science and Pollution Research*, 29(43), 64560–64567. <http://doi.org/10.1007/s11356-022-20292-0>
24. Liu, D., Zhang, Y., Hafeez, M., & Ullah, S. (2022). Financial inclusion and its influence on economic-environmental performance: Demand and supply perspectives. *Environmental Science and Pollution Research*, 29(38), 58212–58221. <http://doi.org/10.1007/s11356-022-18856-1>
25. Liu, H., & Lim, G. (2023). When the state goes transnational: The political economy of China’s engagement with Indonesia. *Competition & Change*, 27(2), 402–421. <http://doi.org/10.1177/10245294221103069>
26. Merello, P., Barberá, A., & De la Poza, E. (2022). Is the sustainability profile of FinTech companies a key driver of their value? *Technological Forecasting and Social Change*, 174, 121290. <http://doi.org/10.1016/j.techfore.2021.121290>

27. Nathaniel, S. P., Solomon, C. J., Ajide, K. B., Ahmed, Z., & Fakher, H. A. (2023). Striving towards carbon neutrality in emerging markets: The combined influence of international tourism and eco-friendly technology. *International Journal of Sustainable Development & World Ecology*, 30(7), 760–775. <http://doi.org/10.1080/13504509.2023.2195831>
28. Ozturk, I., & Ullah, S. (2022). Does digital financial inclusion matter for economic growth and environmental sustainability in OBRI economies? An empirical analysis. *Resources, Conservation and Recycling*, 185, 106489. <http://doi.org/10.1016/j.resconrec.2022.106489>
29. Palmié, M., Wincent, J., Parida, V., & Caglar, U. (2020). The evolution of the financial technology ecosystem: An introduction and agenda for future research on disruptive innovations in ecosystems. *Technological Forecasting and Social Change*, 151, 119779. <http://doi.org/10.1016/j.techfore.2019.119779>
30. Park, J., Conca, K., & Finger, M. (Eds.). (2008). *The crisis of global environmental governance: Towards a new political economy of sustainability*. Routledge. <http://doi.org/10.4324/9780203929100>
31. Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289–326. <http://doi.org/10.1002/jae.616>
32. Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, 75(2), 335–346. <http://doi.org/10.1093/biomet/75.2.335>
33. Qiu, Z., Huo, X., & Dai, Y. (2022). The development of FinTech in China. In *Fintech and Financial Risk in China* (pp. 1–21). Springer Singapore. http://doi.org/10.1007/978-981-19-0288-8_1
34. Saci, F., & Jasimuddin, S. M. (2025). Emergence of Fintech in the financial landscape: Stakes of Fintech and competition with traditional banks. *FinTech and Sustainable Innovation*, 1–12. <http://doi.org/10.47852/bonviewFSI52025824>
35. Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In W. Horrace & R. Sickles (Eds.), *Festschrift in Honor of Peter Schmidt: Econometric Methods and Applications* (pp. 281–314). Springer. http://doi.org/10.1007/978-1-4899-8008-3_9
36. Suki, N. M., Suki, N. M., Sharif, A., Afshan, S., & Jermisittiparsert, K. (2022). The role of technology innovation and renewable energy in reducing environmental degradation in Malaysia: A step towards sustainable environment. *Renewable Energy*, 182, 245–253. <http://doi.org/10.1016/j.renene.2021.10.007>
37. Ullah, S., Ozturk, I., & Sohail, S. (2021). The asymmetric effects of fiscal and monetary policy instruments on Pakistan's environmental pollution. *Environmental Science and Pollution Research*, 28(6), 7450–7461. <http://doi.org/10.1007/s11356-020-11093-4>
38. Usman, A., Ozturk, I., Naqvi, S. M. M. A., Ullah, S., & Javed, M. I. (2022). Revealing the nexus between nuclear energy and ecological footprint in STIRPAT model of advanced economies: Fresh evidence from novel CS-ARDL model. *Progress in Nuclear Energy*, 148, 104220. <http://doi.org/10.1016/j.pnucene.2022.104220>

39. Vives, X. (2017). The impact of FinTech on banking. *European Economy*, 2017(2), 97–105. <https://european-economy.eu/2017-2/the-impact-of-fintech-on-banking/>
40. Wang, L., Gu, Y., Sha, L., & Guo, F. (2023). How does Fintech affect green innovation of Chinese heavily polluting enterprises? The mediating role of energy poverty. *Environmental Science and Pollution Research*, 30(24), 65041–65058. <http://doi.org/10.1007/s11356-023-26929-y>
41. Wang, Y., Hu, J., & Chen, J. (2023). Does Fintech facilitate cross-border M&As? Evidence from Chinese A-share listed firms. *International Review of Financial Analysis*, 85, 102435. <http://doi.org/10.1016/j.irfa.2022.102435>
42. Xu, L., & Ullah, S. (2023). Evaluating the impacts of digitalization, financial efficiency, and education on renewable energy consumption: New evidence from China. *Environmental Science and Pollution Research*, 30(18), 53538–53547. <http://doi.org/10.1007/s11356-023-25888-8>
43. Xu, X., Abbas, H. S. M., Sun, C., Gillani, S., Ullah, A., & Raza, M. A. A. (2021). Impact of globalization and governance determinants on economic growth: An empirical analysis of Asian economies. *Growth and Change*, 52(2), 1137–1154. <http://doi.org/10.1111/grow.12475>
44. Yao, M., Di, H., Zheng, X., & Xu, X. (2018). Impact of payment technology innovations on the traditional financial industry: A focus on China. *Technological Forecasting and Social Change*, 135, 199–207. <http://doi.org/10.1016/j.techfore.2017.12.023>
45. Yap, S. T. L. (2023). Fintech market development in China. In *Contemporary Strategic Chinese American Business Negotiations and Market Entry* (pp. 471–493). Springer Nature Singapore. http://doi.org/10.1007/978-981-19-6986-7_15
46. Zhang, C., Zafar, M. G. R., Hafeez, M., & Nie, H. (2026). Financial technology and nuclear energy development: The moderating role of institutional quality in driving a sustainable future. *Environment, Development and Sustainability*, 1–28. <http://doi.org/10.1007/s10668-026-07352-y>
47. Zhang, K. H. (2010). How does globalization affect industrial competitiveness? *Contemporary Economic Policy*, 28(4), 502–510. <http://doi.org/10.1111/j.1465-7287.2009.00153.x>
48. Zhao, J., Li, X., Yu, C.-H., Chen, S., & Lee, C.-C. (2022). Riding the FinTech innovation wave: FinTech, patents and bank performance. *Journal of International Money and Finance*, 122, 102552. <http://doi.org/10.1016/j.jimonfin.2021.102552>
49. Zheng, J., Bigsten, A., & Hu, A. (2009). Can China's growth be sustained? A productivity perspective. *World Development*, 37(4), 874–888. <http://doi.org/10.1016/j.worlddev.2008.07.008>

Contact information

YanJun Zhang

School of International Business,
Qingdao Huanghai University

<https://doi.org/10.7441/joc.2026.SI.19>

Qingdao, China

E-mail: superlz@126.com

ORCID: 0009-0004-0216-9587

Jiajia Xi

Business College,

Jiangxi Institute of Fashion Technology

Nanchang, China

E-mail: 993279231@qq.com

ORCID: 0009-0002-6465-9720

Gonghang Chen* (corresponding author)

School of Business,

Guilin Tourism University

Guilin, China

E-mail: chengonghang@gltu.edu.cn

ORCID: 0009-0004-9534-8313