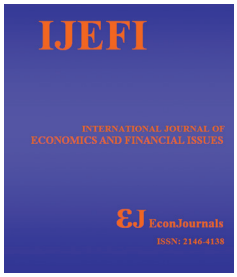

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Does Foreign Direct Investment Foster China's Economic Growth?

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ABSTRACT

China is a developing country that has attracted the most foreign direct investment (FDI), making full use of the technology spillover effect. This study investigates the impacts of FDI and technology spillover on China's economic growth, focusing on its direct and indirect effects. Based on neoclassical and endogenous growth theories, FDI and technology spillover are the key variables, with trade openness, government expenditure, and total population as control variables, and economic growth as the dependent variable. This study employs a panel dataset from 30 Chinese provinces spanning 2000-2022. Methodologically, the Cross-Section Dependence test and Augmented Mean Group (AMG) model are used. Findings of direct effects confirm that research and development (R&D) and government expenditure significantly drive economic growth, while FDI and trade openness are both insignificant and negatively correlated. Indirect effects highlight R&D's significant role in the relationship between FDI and economic growth. Furthermore, there is significant heterogeneity between Eastern, Central and Western regions. The implications of these findings are: first, fostering R&D investment is critical to magnifying the benefits of FDI and enhancing economic growth. Second, institutional innovations can attract high-quality foreign investment. Finally, aligning a high level of trade openness with growth policies is important.

Keyword: Foreign Direct Investment, Technology Spillover, Direct and Indirect Effects, Regions, Economic Growth, China
JEL Classifications: O3, R1

1. INTRODUCTION

China has consistently attracted the highest foreign direct investment (FDI) inflows among developing nations for three decades (Han and Wu, 2024). However, transitioning to a high-income economy requires a shift from relying on FDI for poverty alleviation to leveraging it for wealth creation. China, the largest developing nation in the world, benefits from FDI and technology spillover in the process of economic globalisation. Moreover, China contributes to the sustainable growth and resilience of the global economy due to its market size and industrial upgrading (Li et al., 2024; Yue et al., 2024; Morita and Nguyen, 2021).

The enormous achievements of China's economy since the implementation of the reform and opening up policy in 1979 and China's entry into the World Trade Organisation (WTO) in 2001 are attributed to the transfer of industrial capital caused by globalisation and the transfer of technology and knowledge embedded in the industrial capital (Feng and Li, 2021). In just 30 years, China has advanced to become the world's factory. China's manufacturing sector's quick growth, its service sector's rapid development, its status as the largest trading nation in the world, and the establishment of its significant place in the value chain are all directly tied to FDI (Linglin and Ghosh, 2024).

Even in 2020, when global FDI dropped sharply due to the impact of the global COVID-19 pandemic, China's FDI bucked the trend and surpassed the United States to become the world's largest FDI recipient for the first time (Fang et al., 2021; Kalai et al., 2025). However, it is necessary to take into account the complex and severe international political and economic situation in recent years, and the triple pressure of domestic demand contraction,

supply shock and weakening expectations is relatively large, which brings certain tests to China's economic growth, attracting FDI and promoting technology spillover (Zhu and Zhao, 2022).

One of the important channels of technology spillover is FDI, and the quantity and quality of FDI are the basis and guarantee of technology spillover respectively, which has a profound impact on China's economic growth (Zhu and Zhao, 2022). FDI is an important carrier for China to deeply embed into the global value chain and industrial chain system, and also an important link for foreign high-quality factors to promote the economic growth (Wang et al., 2019). China's economy has entered a critical period of replacing old drivers of growth with new ones, gradually transiting from high-speed development to high-quality development (Qin etal., 2022; Gao et al.,2024; Guo et al., 2024).

However, it is worth noting that the longstanding comparative cost advantage of relying on cheap labour and abundant natural resources is being lost in China (Zhang and Dai, 2023). The factor-driven model is shifting to an innovation-driven model, and the competitive advantage of high-quality economic development has not yet been formed. However, from the perspective of global value chain, Multinational Enterprises (MNEs) began to deploy in Southeast Asia, such as Vietnam and Indonesia, where the cost advantage is lower (Hoang et al., 2022; Yasin and Safdar, 2024). FDI can transfer and spread advanced technology and management experience for the host country, but the core technology is still unique to the home country and MNEs (Kanval et al., 2024; Sunde, 2023; Behera, 2023).

At the same time, FDI may bring a series of negative impacts, such as the lack of motivation for independent innovation of domestic enterprises, high external dependence, influence of government control, environmental pollution, etc (Epor et al., 2024; Yasin and Safdar, 2024; Hoang et al., 2022). In the complex situation of economic de-globalisation, the global COVID-19 pandemic, geopolitical tensions and the resurgence of trade protectionism, China's adherence to a high level of opening-up and stable foreign investment has become an important challenge for economic growth (Zhu and Zhao, 2022).

It is worthwhile to pay attention to how to make better use of foreign investment and actively guide foreign investment into key areas to promote China's economic growth under the dual circulation new development paradigm. Nevertheless, studies on the relationship between FDI, technology spillover and economic growth in China become scarce in the literature in recent years. Hence, this study aims to investigate the direct and indirect effects of FDI and technology spillover on China's economic growth over the study period of 2000 to 2022.

There are two novel contributions of this study. Firstly, most scholars choose to study the direct effects of FDI or technology spillover, while ignoring the indirect effects and regional differences in their interactions. As the most attractive economy among Brazil, Russia, India, China and South Africa (BRICS), FDI has contributed significantly to China's economic growth through technology transfer, capital accumulation and market expansion (Kalai et al., 2025). It is necessary to introduce FDI, digest and absorb advanced technologies from developed countries, utilise the technological spillover effects, and eventually develop independent R and D capabilities (Adilla, 2024). Meanwhile, FDI significantly enhances enterprises' new quality productivity by strengthening regional intellectual property protection in China (Huang, 2025). A very different view is that as GDP per capita rises, the reliance of GDP on FDI diminishes (Fang et al., 2021). As the world's largest developing country, there is great heterogeneity in the economic level, industrial structure and technology absorption capacity of China's three major regions, so there are also significant regional differences in the interaction effects of FDI and technology spillover. Hence, this study investigates the indirect effects of FDI on China's economic growth and regional heterogeneity.

Secondly, the past studies tended to focus on the aggregate effects of FDI or technology spillover, thereby neglecting the presence of FDI and technology spillover across regions evolve over time in a long-term perspective in China. FDI promotes high-tech industry output and technological innovation in the Eastern region, while boosts output but inhibits innovation in Central and Western (Zhao et al., 2024). In contrast, another view suggested that FDI inhibits industrialisation in the Eastern region and is not significant in the Central and Western regions (Yang et al., 2025). Furthermore, FDI has a significant positive impact on green technology innovation in Chinese cities, especially in resource-based regions, regions with favourable institutional environments, and regions with abundant human capital (Yan et al., 2025). Meanwhile, FDI has significantly contributed to the green economy, with provinces along the Belt and Road policy benefiting more (Yi et al., 2025). However, this study assessed the direct effect of FDI and technology spillover on economic growth and regional heterogeneity from the perspective of the dual circulation new development paradigm.

The organisation of this study is as follows. Next section provides the review of theoretical and empirical studies; followed by the methodology section to discuss the variable employed, the methodology used as well as the description of data. The subsequent section presents the discussion of the empirical findings, and the final section offers the conclusion of this study.

2. LITERATURE REVIEW

Since the 1960s, with the continuous enrichment of international direct investment practice and the improvement of relevant theories, scholars have made many explanations on the causes, locations, behaviours and functions of FDI. The Solow growth model (Solow, 1956) first suggested that capital is an endogenous variable and technological progress is exogenous. The endogenous growth theory (Romer, 1986; Romer, 1994) suggested that the fundamental source and driving force of sustained economic growth is endogenous technology. According to the competitive advantage of nations theory, the economic development of a country can be divided into four progressive stages, namely, factor-driven, investment-driven, innovation-driven and wealth-driven (Porter, 2001).

A typical pessimistic view is that FDI makes national economies dependent on foreign investment. The core and periphery theory suggests extension of developing countries' dependence on developed countries from economic dependence to cultural and ideological dependence (Prebisch, 1950). The theory of underdevelopment suggests that under the secure-satellite international pattern, satellite countries could not achieve truly independent development (Frank, 1966).

The other view is more optimistic and emphasises the internal causes of economic development in developing countries. The development theory of dependence suggests that the economy of developing countries reflects the dual characteristics of dependence and development on developed countries, with an eventual transition to an independent stage of development (Cardoso, 1982). The above FDI and economic growth theories provide a theoretical basis for technology spillovers in developing countries.

For a long time, foreign scholars have been controversial about FDI technology spillovers, and there are generally two views, namely, the existence of positive spillovers and the absence of positive spillovers. Caves (1974) and Globerman et al. (1979) are the pioneers in studying FDI technology spillover effect. Also, they suggested that FDI has significant positive technology spillover effect and can push economic growth.

Empirical studies in some developing countries have shown that FDI has a significant positive effect on economic growth, confirming the FDI-led growth model. FDI inflows in BRICS, Asian economies, Vietnam, as well as Middle East and North Africa countries have positive externalities and boost the local economy (Rehman and Islam, 2023; Bakari and Sofien, 2019; Su et al, 2019; Hamdi and Hakimi, 2022). FDI inflows in India have contributed to economic growth in the long run and seem to have little impact in the short run (Rakshit, 2022). FDI in Pakistan has a positive impact on its economic growth in both the long and short term (Kanval et al, 2024). The East African region has significant spatial spillover effect of FDI, human capital development and government expenditure on regional economic growth over the period of 1992-2019 (Otieno, 2024). Trade and FDI technology spillovers in Organisation for Economic Cooperation and Development (OECD) member countries during the period 1995 to 2018 had a significant positive impact on sustainable economic growth (Zamani and Tayebi, 2022).

However, there is still inconclusive evidence of FDI technolgy spillover in developing countries. There are some countries' FDI technology spillover insignificant and have no impact on host countries' economic growth, such as in Moroccan manufacturing (Haddad and Harrison, 1993), as well as in Brazil, Nigeria, and Vietnam (Epor et al., 2024; Hoang et al., 2022). The positive but insignificant effect of FDI and trade on economic growth in Brazil, Nigeria and Vietnam between 1990 and 2021 is related to the repatriation of profits by MNEs to their home countries (Epor et al., 2024). Amongst them, Vietnam has increasing FDI capital between 1990 and 2020, but its effect is still limited and detrimental to economic growth in the long run (Hoang et al., 2022). In addition, in recent years, more scholars have noticed that MNEs reserve their core technologies when making investments in order to minimise technological spillovers. Northern enterprises strategically reduce the quality of their products to limit the number of technological spillovers (Morita and Nguyen, 2021). Although Vietnamese enterprises have received some modern technologies through large amount of FDI, they have more often received many old and obsolete technologies (Hoang et al., 2021).

The discussion on the impact of FDI and technology spillover on China's economic growth has been a hot research topic, although it started relatively late, and different themes have emerged with the changing times. First, FDI and technology spillovers have a positive impact on economic growth in developing economies, and FDI promotes capital accumulation and innovation in host countries. More than 120 countries have substantially improved their local economies through foreign trade and outward FDI under the Belt and Road Initiative (BRI) between 2013 and 2019, especially in lower-income countries (Ma, 2022). The scale expansion of FDI promotes China's economic growth in terms of increasing employment opportunities, improving labour quality, promoting technological progress, and enhancing innovation capacity (Zhang, 2024; Zhao, 2024; Feng and Li, 2021). In addition, international technology spillover has generally shown an upward trend in China over the period 2003 to 2014 (Liu and Guo, 2019). For example, China's Chery Automobile significantly improved its product quality after hiring engineers who quitted from the Nissan-Dongfeng joint venture (Morita and Nguyen, 2021).

In terms of where FDI is induced, different studies draw inconsistent conclusions. The expansion of FDI in the Eastern region promotes its regional innovation capacity, while it is not significant in the Central and Western regions (Zhao, 2024). However, empirical results based on the C-D production function suggest that FDI has technological spillover and regional heterogeneity for high-tech industries in the Eastern, Central, Western and Northeastern regions between 2012 and 2021 (Zhao et al., 2024). Given that FDI can have a negative impact on economic stability and coordinated social development (Zhang, 2024), all regions should give priority to their respective comparative advantages, deal with the issue of balanced development, and promote FDI and local factor inputs to achieve coordinated regional economic development in China (Zhao et al., 2024). However, existing indicators of FDI technology spillovers suffer from technological difficulties in measurement at the micro level (Yue et al., 2024).

Under the dual circulation new development paradigm, China's economic development mode has transitioned from high-speed growth to high-quality development mode (Zhang and Dai, 2023). So, can foreign investment still drive China's economic growth? Are there still technology spillovers and an interaction between FDI and technology spillovers? How have the differences amongst Eastern, Central and Western regions changed? These research gaps require further systematic and thorough research. This study complements existing theoretical and empirical studies by considering whether the two core explanatory variables (FDI and technology spillovers) are correlated with the outcome

variable (economic growth), respectively. Secondly, the existing literature on the moderating effect of FDI and technology spillover on China's economic growth and sustainable development is relatively scarce, which can be measured from the perspective of endogeneity.

3. METHODOLOGY

This study adopts a balanced panel dataset of 30 provinces, municipalities and autonomous regions in China (hereinafter referred to as provinces) in National Bureau of Statistics from 2000 to 2022, excluding Tibet Autonomous Region, Hong Kong Special Administrative Region, Macao Special Administrative Region, and Taiwan Province of China. According to the provisions of the Foreign Investment Law, Hong Kong, Macao, and Taiwan are all parts of China, investments from these regions are not considered as foreign investment. However, due to Hong Kong and Macao being separate customs territories and free ports, their investments in mainland China have consistently been treated as foreign capital in economic statistics. Similarly, investments from Taiwan in mainland China are governed by the Foreign Investment Law. To align with the current statistical standards, the foreign investment data used in this study included investments from Hong Kong, Macao, and Taiwan in mainland China.

Additionally, the samples were divided into three regions, namely Eastern, Central and Western regions, according to the Statistical Bulletin of FDI in China from Ministry of Commerce of China, based on geographic location. Specifically speaking, the Eastern region includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan. The Central region comprises Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan. The Western region covers Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Xizang, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang.

Real FDI inflows by province were denominated in U.S. dollars as published by the National Bureau of Statistics and converted into CNY according to the annual average exchange rate of CNY against the U.S. dollar for that year, and the GDP deflator was used to consider the elimination of the impact of price level changes. Real GDP, real FDI inflow, research and development (R&D) capital stock and trade openness are calculated according to the data from the National Bureau of Statistics, while real government expenditure and population are adopted directly from National Bureau of Statistics.

3.1. Estimation of Model

The first research objective of this study is to identify the direct effect of FDI and technology spillover on China's economic growth. The direct effect model is constructed as follows:

$$GDP_{it} = \alpha + \beta_1 FDI_{it} + \beta_2 TS_{it} + \beta_3 TO_{it} + \beta_4 GE_{it} + \beta_5 Pop_{it} + \varepsilon_{it} \quad (1)$$

Where,

GDP_{it}: Real GDP for province i in year t.

FDI_{it}: Real FDI inflows for province i in year t.

TS_{it}: R&D capital stock for province i in year t.

TO_{it}: Trade openness for province i in year t.

GE_{it}:Real government expenditure for province i in year t.

POP_{it}: Population of province i in year t.

i = Each province.

t = Each year.

ε_{it} = Error term for province i in year t.

α: Intercept.

β: Coefficient, marginal contribution of variables to GDP_{it}.

In this study, the more popular perpetual inventory method (Zhang et al., 2004) is used to estimate the TS at constant prices after a base year when measuring technology spillover, as there is no direct measurement of technology spillover for each country. This formula of technology spillover can be written as follows:

$$TS_{it} = TS_{it-1}(1-\delta_{it}) + TSin_{it} \quad (2)$$

Where, i refers to ith province, and t refers to tth year. Equation (2) includes two variables of R&D capital stock and R&D input, and one parameter of economic depreciation rate. The R&D capital stock in the basic year is denoted as TS. Due to the difficulty in quantifying its lag effect, existing studies usually assume that its average lag period is one year. And the annual increase in R&D input is expressed in TSin, which is the economic depreciation rate. The depreciation rate of 9.6% derived is adopted in this study (Zhang et al., 2004).

This study aims to assess the indirect effects of technology spillover and FDI on China's economic growth. Liu and Guo (2019) argued that certain drivers positively contribute to the technology spillovers from China's FDI channel, which in turn enhances its technological innovation capacity and its position in the global value chain. In order to achieve the second research objective, this study included an interactive variable, namely FDI*TS. In addition to the direct effect, FDI can influence China's economic growth through technology spillover. The coefficient of the interactive variable determines the moderating role of technology spillover on FDI in affecting China's economic growth. This technique was also adopted by Husaini et al. (2023) and Husaini et al. (2024). Therefore, this study added the interactive variable between FDI and technology spillover in the indirect model as follows:

$$GDP_{it} = \alpha + \beta_1 FDI_{it} + \beta_2 TS_{it} + \beta_3 FDI * TS + \beta_4 Trade_{it} + \beta_5 Gov_{it} + \beta_6 Pop_{it} + \varepsilon_{it} \quad (3)$$

Given that all the variables are in different units, Equation (3) should be transformed into natural logarithmic form in order to achieve an optimal fit (Husaini et al., 2023).

Cross-sectional dependency test is first performed to determine if all units in the same cross-section were correlated prior to performing panel data analysis. In a well-specified balanced panel model, cross-section dependence test is employed (Husaini and

Lean, 2022; Munir et al., 2020). This study employs the Pesaran, Friedman and Frees tests (Pesaran, 2004; Friedman, 1937; Frees, 1995) to assess the presence of cross-sectional dependence. The null hypothesis asserts no cross-sectional dependence on the data.

If there is cross-sectional dependence, then the Augmented Mean Group (AMG) estimator is chosen, which is more suitable for analysing long-term equilibrium relationships and is applicable to balanced panel data with strong heterogeneity. In order to increase model flexibility and robustness against heteroscedasticity, estimating robust standard errors and a time trend are used in direct and indirect models.

4. DISCUSSION OF EMPIRICAL FINDINGS

Firstly, Table 1 presents the details of the variable descriptions showing 690 observations for 30 cross-sections of mainland China over a 23-year period from 2000 to 2022. What attracts attention in Table 1 is that the mean values of the six variables are almost always located in the middle of the minimum and maximum values without much bias. This suggests that China's indicators are in the middle of the range with some volatility. What is more, research and development capital stock have the highest volatility as reflected in the reported standard deviation of 1.8065. Similarly, real GDP and real FDI are more volatile as reflected in the standard deviation of 1.0863 and 1.5622, respectively. In addition, the table reveals that the mean value of trade openness is −1.7133, which is also somewhat volatile, as reflected in the standard deviation of 0.9855. Government Expenditure and population exhibit some volatility and stability in the standard deviation results of 1.0366 and 0.7558, respectively. In summary, Table 1 shows the statistical indicators used in the regression model, which means that there are 690 observations that are acceptable for exploring the nature of this study.

Then, cross-sectional dependence test is used to check for dependencies between observations in cross-sectional dataset (Husaini and Lean 2022; Munir et al., 2020). Table 2 indicates that the six variables of both random and fixed effects are <1% with strong significance, thus reject the null hypothesis. Therefore, there is cross-sectional dependence in the panel dataset of this study. Cross-sectional dependence may lead to pseudo-regression. In other words, the regression model may show results where a relationship appears to exist in the absence of an actual relationship.

Next, the results for each variable in the direct and indirect effects are analyzed in Table 3. The direct model shows that the coefficients of lnTS and lnGE on lnGDP are significant and positively cause real GDP to be at 1% critical value. This result indicates that a 1% increase in technology spillovers and government expenditure would boost economic growth by 0.11% and 0.04%, respectively. The direct model also presents that lnFDI and lnTO are insignificant with negative signs. This result suggests that real FDI and trade openness do not significantly cause economic growth and have a negative impact on it. Ultimately, the direct model displays that lnPop is not significant with positive sign. This result informs us that population is not a significant determinant of economic growth, but there is a positive effect on it. Furthermore, the indirect model illustrates the moderating role of technology spillover on the relationship between real FDI and real GDP. The result indicates that the coefficient for the interactive term of lnFDI_lnTS on real GDP is positive but not statistically significant. This suggests that the interaction between FDI and technology spillover doesn't significantly contribute to China's economic growth.

Table 1: Descriptive statistics

Variable	Mean	Standard deviation	Min	Max	Observations
lnGDP	8.8849	1.0863	5.5748	11.291	690
lnFDI	7.7756	1.5622	3.8662	12.218	690
lnTS	5.7556	1.8065	−0.1627	9.7019	690
lnTO	−1.7133	0.9885	−4.8761	0.5372	690
lnGE	7.2661	1.0366	4.1082	9.3501	690
lnPop	8.1699	0.7558	6.2480	9.4481	690

lnGDP represents log of real gross domestic product; lnFDI represents log of real foreign direct investment; lnR&D represents log of R&D capital stock; lnTO represents log of trade openness; lnGE represents the log of real government expenditure; lnPop represents log of population

Table 2: Cross-sectional dependence test

CSD test	Random effect	Fixed effect
Pesaran (2004)	24.207***	28.111***
Friedman (1937)	155.232***	171.833***
Frees (1995)	4.679***	4.890***

***, ** and * represents significance at the 1%, 5% and 10% significance levels, respectively

Table 3: Full sample for direct and indirect model (AMG)

Variable	Direct	Indirect
lnFDI	−0.0016	−0.0314**
lnTS	0.1091***	0.0992***
lnFDI_lnTS	-	0.0251
lnTO	−0.0045	−0.0060
lnGE	0.0387***	0.0401***
lnPop	0.1656	0.0743

***, ** and * represents significance at the 1%, 5% and 10% significance levels, respectively

Table 4 reports the direct and indirect effects between FDI, technology spillover and China's economic growth by Eastern, Central and Western regions. Firstly, the Eastern region is analysed. In the direct model, the coefficients of lnTS, lnGE and lnPop on lnGDP are positively correlated and significant at the critical values of 1%, 5% and 10% respectively. This result shows that the Eastern region's 1% increase of technology spillovers, government expenditure and population can boost economic growth by 0.38%, 0.05% and 0.35%, respectively, with technology spillovers contributing the most positively to economic growth, followed by government expenditure and population. The coefficients of lnFDI and lnTO on lnGDP in the direct model are positive but insignificant. This result indicates that FDI and trade openness don't significantly promote economic growth in the Eastern region. Meanwhile, the Eastern region's indirect model indicates the presence of interaction effect of lnFDI and lnTS moderating effect on lnGDP. The coefficient of the interaction term lnFDI_lnTSrdcap is positive but not significant. This result shows that

Table 4: Direct and Indirect Model by Region (AMG)

Region	Model	lnFDI	lnTS	lnFDI_lnTS	lnTO	lnGE	lnPop
Eastern	Direct	0.0013	0.3820***	-	0.0108	0.0548**	0.3460*
	Indirect	−0.129	0.2383	0.1382	0.0174***	0.0424*	0.1906
Central	Direct	−0.0100	0.2016***	-	−0.0042	0.052	−0.3173
	Indirect	−0.0649**	0.1361***	0.0818***	−0.0065	0.0369*	−0.2182***
Western	Direct	0.004	0.2302***	-	−0.0046	0.0732**	1.0000***
	Indirect	−0.0245	0.2066***	0.0552**	−0.008	0.0708***	0.7917*

***, ** and * represent significance at the 1%, 5% and 10% significance levels, respectively

lnFDI and lnTS do not significantly interact, which means they do not significantly drive lnGDP. In a word, there isn't enough statistical evidence to prove that FDI and technology spillovers are interacted to cause economic growth in the Eastern region.

Secondly, the Central region's coefficient of lnTS is both positive and significant at 1% critical value in the direct model. The result indicates that a 1% increase in the core explanatory variable lnTS drives economic growth of 0.20% in the Central region. However, the coefficients of lnFDI, lnTO and lnPop show insignificant with negative sign. And lnGE is insignificant with positive sign. The results infer that FDI, trade openness, population and goverment expenditure don't impact Central region's economic growth significantly. Furthermore, the Central region's indirect model presents that the coefficient on lnFDI_lnTS is positive and significant at 1% critical value. This result infers that an increase in lnTS will reduce the negative impact brought by lnFDI. This indicates that there is a significant interaction between FDI and technology spillover to increase Central region's economic growth, and technology spillover moderates the negative impact of FDI on local economic growth.

Finally, the Western region's coefficients of lnTS, lnGE and lnPop is positive and significant at 1% and 5% critical value in the direct model. The result indicates that the Western Region's technology spillovers, government expenditure and population growth by 1% contribute to the local economic growth by 0.23%, 0.07% and 1.00% respectively. Among them, population has the strongest positive effect on local economic growth, followed by technology spillovers, and finally government expenditure. However, the Western region's lnFDI and lnTO are not significant in the direct model, with positive and negative signs respectively. This result indicates that the Western region's lnFDI and lnTO have no significant effect on the local economic growth. Moreover, the indirect model's interaction variable lnFDI_lnTS is significant with positive sign in the Western region. This result is informing us that there is a significant interaction of technology spillover on FDI in affecting economic growth, and technology spillover mitigates the negative impact in the Western region.

4.1. Discussion of the Results

The results for the direct model of FDI on China's economy is insignificant with negative sign. This is similar to the findings of Fang et al. (2021), but contrary to the ideas of Zeng and Zhou (2021). Under the context of the profit-driven nature of FDI superimposes complex high-end technology blockade and trade friction, China's traditional low-cost advantage of FDI introduction is gradually losing (Zhang and Dai, 2023; Jahanger, 2021). Hence, low-quality FDI cannot promote Chinese enterprises' innovation and economic growth (Yue et al., 2024). In the direct model, China's technology spillover plays the largest positive and significant role in promoting economic growth. This is in line with the study of Marascoa et al. (2024). China is pursuing an innovation-driven development policy under dual circulation new development paradigm with technology spillover enhancing the local enterprises' independent innovation and economic growth (Imran and Rehman, 2024; Liu and Guo, 2019). Trade openness has no significant effect on China. This is similar to the findings of the study of India (Rakshit, 2022). The deterioration of the global trade environment, complex geopolitics, the strengthening of the internal circulation economy model and industrial restructuring challenges decline dependence on foreign trade (Pillich, 2024; Mohr et al., 2024; Zhu and Zhao, 2022). Government expenditure has played a positive role in social security, infrastructure construction, consumption, industrial upgrading, scientific and technological innovation, and responding to major challenges, which has directly boosted China's economic growth (Hu and Yang, 2021). The positive effect of population on China's economic growth has not been significant, due to the weakening of the demographic dividend and large geographic differences in the quantity and quality of the population (Xiao and Guo, 2021).

The results for the direct model of the Eastern region's FDI and trade openness on the local economy are insignificant with positive sign. The Eastern region attracts the vast majority of FDI as well as import and export, but with the small technological gap between domestic and foreign enterprises and a strong absorptive capacity of local enterprises, marginal returns gradually decline (Jahanger, 2021). Technology spillovers, government expenditure and population in the Eastern region significantly and positively promote local economic growth. The Eastern region is the most economically and technologically developed region in China, with a strong innovation capacity and the most significant technological spillover, but the marginal effect of government expenditure as well as high population inflow, ageing and high density to growth is not as strong as in the Western region (Li and Wu, 2024; Zhang and Zhang, 2024).

In the Central region, the results for the direct model of FDI, trade openness, government expenditure and population do not significantly affect local economic growth. The Central region has a relatively weak economic foundation and R&D. Its FDI and foreign trade is less than the Eastern region, policy support is not as strong as in the Western region, and the lack of population affects the local industry upgrading as the population migrates to the Eastern for salaries and opportunities (Chi et al., 2024). However, technology spillovers in the Central region contribute significantly to local economic growth in the direct model, which

has the smallest positive effect of the three regions. This is mainly due to the lack of a clear location advantage, a low degree of internationalisation and a relatively weak industrial structure.

In the Western region, the results in the direct model of FDI and trade openness on regional economic growth is also insignificant, for similar reasons as in the Central region. Technology spillover, government expenditure and population in the Western region all significantly contribute to local economic growth, a finding similar to that of the Eastern region. The Western region has an advantageous geographical position along the border, strong national policies support such as the Belt and Road Initiative and Western Development, technology spillover effect is second to the Eastern. The Western region is at the stage of increasing marginal effect due to poor infrastructure, low level of science and technology, and dependence on government expenditure. Population returns flows strengthen (Yan et al., 2023).

This study further finds that the indirect effects of FDI and technology spillovers on China's economic growth are not significant. This result suggests that technology spillovers do not moderate the negative impact of FDI on China's economic growth. FDI in the Eastern region strengthens intellectual property protection, restricts or prohibits high-technology spillovers, and gradually narrows the wage gap with the domestic, with a relatively small marginal contribution to industrial upgrading. Therefore, the indirect effect is not significant in the Eastern region. FDI in the Central region matches well with local industrial upgrading, and local enterprises can absorb advanced technology and management experience. Therefore, technology spillovers reduce the negative impact of FDI on economic growth in the Central region, and the indirect effect is the most significant. FDI in the Western region is the weakest, but it promotes local economic growth under the moderation of technology spillovers, and the indirect effect is significant.

5. CONCLUSION

This study selected the overall sample of China's 30 provincial panel data from 2000 to 2022 and divided it into three sub-samples based on differences in geographic location and quantitatively analysed the effects of FDI and technological spillovers on economic growth, as well as heterogeneity amongst the three regions of China by using the direct model and indirect model. The primary finding of this study is that technology spillover and government expenditure can significantly boost China's economic growth, especially the positive impact of technology spillover in the direct model. Technology spillovers in the Eastern region contribute significantly more to regional economic growth than in the Western and Central regions, and government expenditures in the Western region contribute significantly more to regional economic growth than in the Eastern regions. Additionly, FDI and trade openness in the three regions' economic growth are insignificant. On this note, population on regional economic growth is significantly greater in the Western region than in the Eastern region. Another important finding is that the indirect effect between FDI and technology spillover does not contribute significantly to China's economic growth. However, the three regions are heterogeneous. The indirect effect is significant in the Central region and larger than in the Western region.

This study contributes to three significant policy implications. Firstly, fostering R&D investment is critical to magnifying the benefits of FDI and enhancing economic growth. It is necessary to improve the independent innovation capacity of local enterprises and gradually develop new comparative advantages. In the process of introducing and absorbing foreign technologies, local enterprises should gradually improve their capacity for independent innovation, including product innovation, process innovation, organisational innovation and marketing innovation, so as to gradually form the competitive advantages of enterprises and industries. Secondly, China should explore institutional innovations that suit its national conditions and formulate economic growth policies to attract high-quality foreign investment and maintain economic resilience. A good institutional environment can reduce transaction costs and systemic risks for enterprises, thus providing fair and open market access conditions and a business environment for foreign-funded enterprises, which is conducive to the promotion of a high level of opening-up and integration into a higher level of international circulation. The level of market access has been continuously upgraded and the negative list for foreign investment access has been reduced. Foreign investment enterprises are encouraged to set up research and development centers to attract high-quality foreign investment. Thirdly, China firmly supports and advocates the liberalization of trade and investment and puts forward the advanced concept of building a community of human destiny. As a result of geopolitical tensions, disruptions in trade protectionist supply chains, energy crises and inflation, the trend of counter-economic globalisation has continued to prevail. However, in the long run, peace and development remain the theme of the times, and economic globalisation remains an inevitable trend of historical development and is moving in the direction of greater openness, inclusiveness and win-win situation.

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