

FDI Impact on China's Sectoral Performance: A Panel Cointegration and Causality Analysis

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ABSTRACT

This study provides a thorough examine the influence of FDI inflows and outflows on China's economic growth across three major sectors. Using panel data from 1997 to 2022 in China, it utilizes tests for unit roots and cointegration to investigate the enduring connection between FDI and economic growth. The research results validate the existence of a long-standing cointegration relationship between FDI and economic expansion. Additionally, this research employs the Granger causality test to ascertain the direction of causality between FDI and economic growth. The study reveals a two-way causality between foreign direct investment (FDI) inflows and overall economic growth, which supports the hypothesis of feedback causality. Additionally, there exists a one-way causality originating from FDI inflows across various sectors, suggesting that growth attracts FDI. The government should encourage foreign investment to enhance the industrial structure and boost economic growth.

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Contribution/Originality: This study contributes to the current research by delving into the significance of FDI inflows and outflows for China's economic growth, with a spotlight on the heterogeneous effects across its three major sectors, offering new perspectives regarding multifaceted aspect of FDI in the Chinese economy.

1. Introduction

Foreign Direct Investment (FDI) plays a pivotal role in shaping the global economy, and its impact on economic growth is well recognized. Scholars have thoroughly investigated the bond among FDI and economic expansion, which can be divided into two main theoretical frameworks. The initial one pertains to the hypothesis of growth driven by

FDI, which posits that FDI fosters technological innovation and human capital development, thereby stimulating economic growth (Dinh et al., 2019). The alternative view is the hypothesis that growth attracts FDI, which argues that economic growth attracts FDI due to expanded markets and improved economic conditions (Rashid et al., 2017).

Empirical studies have been conducted to explore the ongoing relationship and causality between FDI and economic expansion, yielding mixed results. Certain studies indicate that there is a durable cointegration bond between FDI and the economic development of a country, with FDI identified as a precursor to economic growth according to Granger causality. The evidenced by studies such as those by Mykytiuk et al. (2020) and Pradhan et al. (2018), additionally, findings from Raza et al. (2021) endorse the notion that FDI drives economic growth. Conversely, other researchers contend that economic growth is a more significant driver of FDI inflows. For instance, Dar et al. (2016) in their study on Pakistan, show a stable long-term relationship between the GDP growth rate and FDI. Similarly, Pečarić et al. (2021) in their examination of EU countries, find that economic improvement positively influences FDI inflows, thus supporting the growth-led FDI hypothesis in both instances.

The scholarly discussion over FDI and its economic consequences is intricate and complex, illustrating the delicate relationship between investment flows and economic dynamics. As the literature on this topic develops, it is crucial for academics to carefully examine the subtle impacts of FDI on economic growth, while considering the unique conditions and characteristics of the host nations.

China's perspective highlights the crucial impact of FDI in driving the rapid growth of its economy. Several scholarly works, such as those authored by Du and Lin (2018) have put out this proposition, emphasizing the importance of both inflow and outflow of FDI. These studies suggest that FDI has helped China to reduce its surplus production capacity and improve its industrial structure, resulting in an increased position in the global value chain.

When studying the tie that joins FDI to economic growth in China, previous research has primarily concentrated on either FDI inflow (IFDI) or FDI outflow (OFDI), or from the viewpoint of a particular industry. Ali et al. (2021) investigated the correlation between the OFDI from China in the logistics services sector and the corresponding rise in productivity levels. Ran and Wang (2023) studied the influence of external investment in the primary sector on agricultural development, whereas Chen (2018) analyzed the consequences of OFDI on regional economic growth.

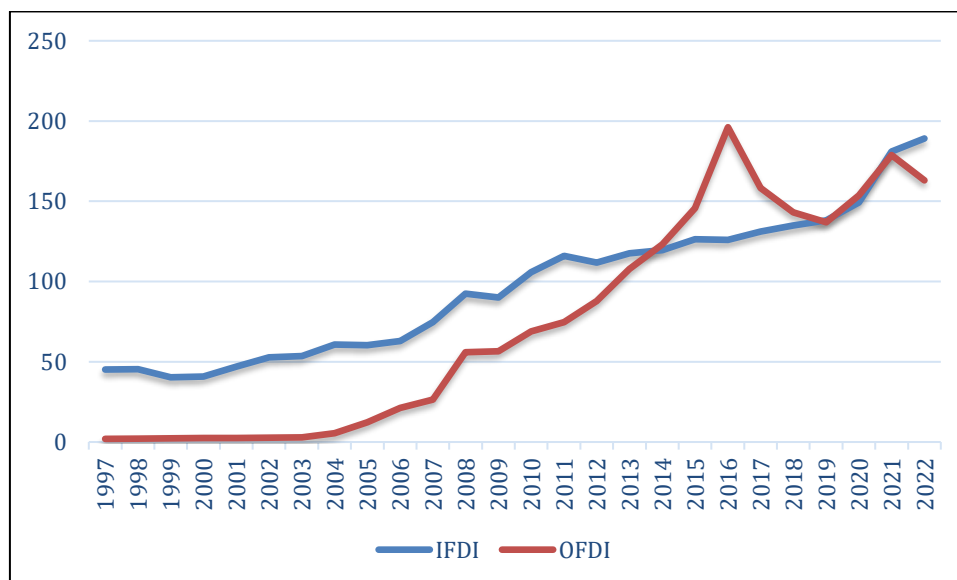
However, there is a scarcity of research that simultaneously analyze the correlation between both IFDI and OFDI, as well as the three main sectors, and their combined influence on economic growth. The absence of studies in this field emphasizes the need for a thorough analysis into the various and complex functions that FDI serves in China's economic environment. To achieve a more thorough understanding, knowledge of how FDI contributes to China's economic vitality, future research should adopt a more integrated approach that takes into account the interaction between IFDI, OFDI, and the wider industrial sectors.

1.1. The trends of inflow (IFDI) and outflow of FDI (OFDI) by sectors in China

The following analysis examines the patterns of increase in China's total IFDI and OFDI as well as the trends in IFDI and OFDI within the three main industries, from 1997 to 2022. During this time, both IFDI and OFDI in China have shifted from a period of fast expansion to a more stable growth pattern.

The IFDI has been instrumental in promoting the economic transformation initiatives in China and its participation among the global economic system. The International IFDI has made a tremendous contribution to economic development by attracting huge amounts of foreign money. Between 1997 and 2001, China's IFDI rose from \$45.227 billion to \$46.878 billion. Following its accession to the WTO, China experienced a substantial boost in economic openness, achieving an average yearly growth rate of over 20% (China Trade and Foreign Economic Statistics Yearbook, 2023). The peak was reached in 2011, following which there was a slowdown in growth due to the outcomes resulting from the financial crisis. On the other hand, OFDI reflects the growth and strategic placement of Chinese companies in the global market. Between 1997 and 2001, Chinese companies started investing in foreign countries with a relatively small amount of direct investment, showing a general yearly expansion rate of around 5%. Spanning 2002 to 2008, Chinese businesses gradually adjusted to global markets and were supported by the government's "Going Global" plan, resulting in an average yearly growth rate of OFDI ranging from 15% to 20%. Between 2009 and 2017, the "Belt and Road Initiative" (BRI) significantly accelerated the expansion of OFDI, with an average yearly growth rate ranging from 20% to 40%. Since 2018, the rate of growth in OFDI has slowed down (China Trade and Foreign Economic Statistics Yearbook, 2023). As seen in Figure 1:

Figure 1: Trends in FDI Inflows and FDI outflows (1997 – 2022) (billion dollars)

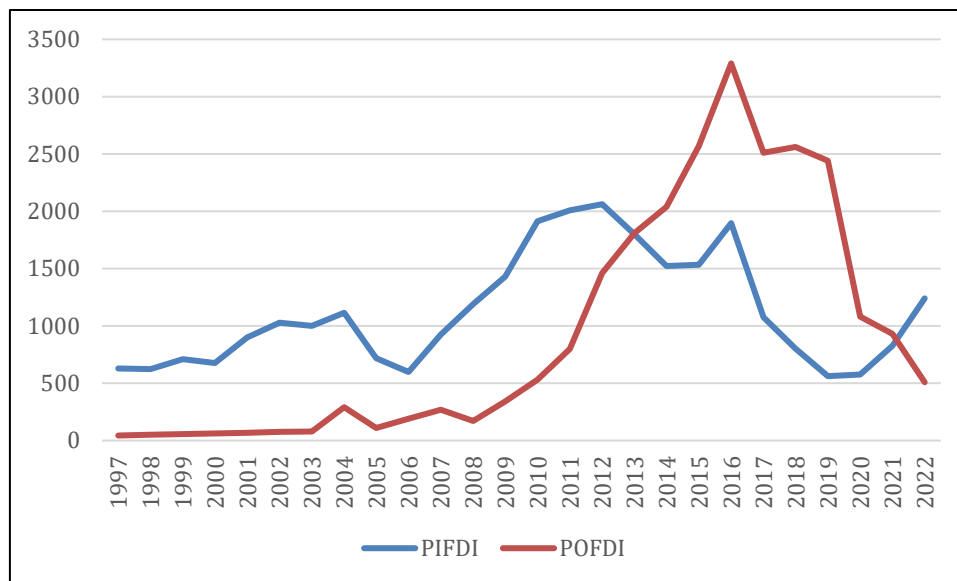


Source: China Trade and Foreign Economic Statistics Yearbook (2023)

Between 1997 and 2022, China has undergone a change in the primary sector's FDI inflow (PIFDI) and FDI outflow (POFDI), shifting from a period of progressive growth to a phase of stabilization. The PIFDI, which stood at \$628 million in 1997, experienced slow growth to reach \$1114 million by 2004, with an average yearly rise of less than

\$100 million. After 2016, due to changes in global supply chain dynamics, there was a sharp decrease to \$262 million by 2019, followed by a gradual increase to reach \$1240 million by 2022. Simultaneously, the POFDI stood at a modest \$44 million in 1997, to its highest point at \$329 million in 2016, driven by the influence of the BRI. Drawn from [Figure 2](#), as a result of the pandemic and other causes, the company's value decreased and reached \$510 million by 2022 ([China Trade and Foreign Economic Statistics Yearbook, 2023](#)).

Figure 2: Trends in Primary sector FDI Inflows and Primary sector FDI outflows (1997 – 2022) (million dollars)



Source: [China Trade and Foreign Economic Statistics Yearbook \(2023\)](#)

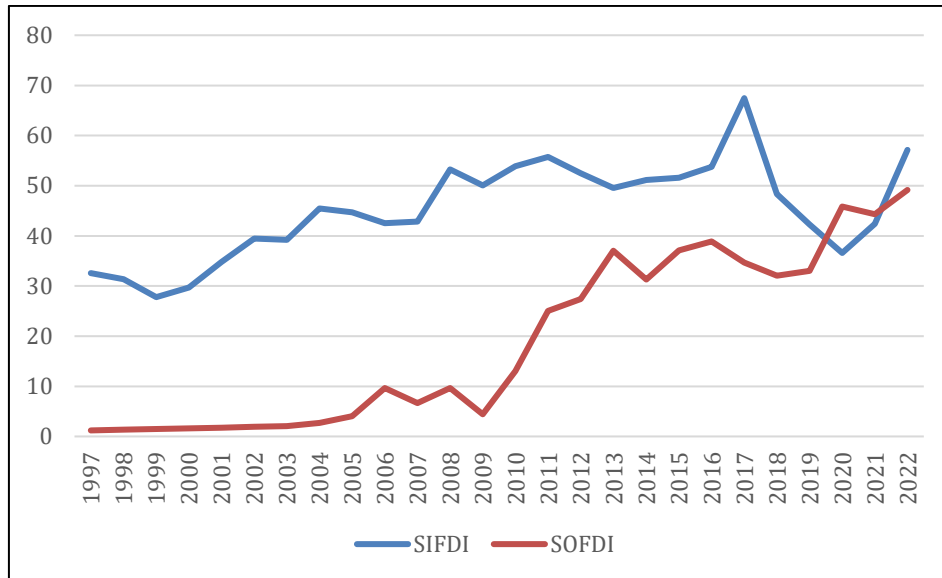
China's IFDI and OFDI in the secondary sector (SIFDI, SOFDI) have had a pattern of rapid expansion followed by a period of stability from 1997 to 2022. The attractiveness of China's manufacturing capabilities and market potential to global investors has resulted in an increase in the size of investments in SIFDI. The original investment of \$32.57 billion in 1997 experienced a significant increase, reaching a peak of \$67.456 billion by 2017. Nevertheless, due to the reorganization of industries in China, SIFDI encountered a decrease, reaching a final value of \$57.15 billion by 2022 ([China Trade and Foreign Economic Statistics Yearbook, 2023](#)).

In contrast, OFDI from the secondary sector, also known as SOFDI, started at a low \$1.204 billion in 1997 and showed a steady growth until 2005. As a result of the "Going Global" strategy and the Belt and Road Initiative, SOFDI had a quick increase, reaching a total of \$49.15 billion by 2022 ([China Trade and Foreign Economic Statistics Yearbook, 2023](#)). The depicted pattern is exemplified in [Figure 3](#).

From the perspective of tertiary sector, the starting point of TIFDI and TOFDI is relatively low compared with that of secondary industry, but the growth is faster, the TIFDI was only 12.06 billion US dollars in 1997, and it reached 30.983 billion US dollars in 2007, with a mean yearly expansion rate of 14.26%, and the yearly mean growth rate of TIFDI reached more than 60% from 2007. In 1997, the TOFDI was only 452 million US dollars, which was much lower than that of secondary industry, but the amount in 2008 was 46.1 billion US dollars ([China Trade and Foreign Economic Statistics Yearbook,](#)

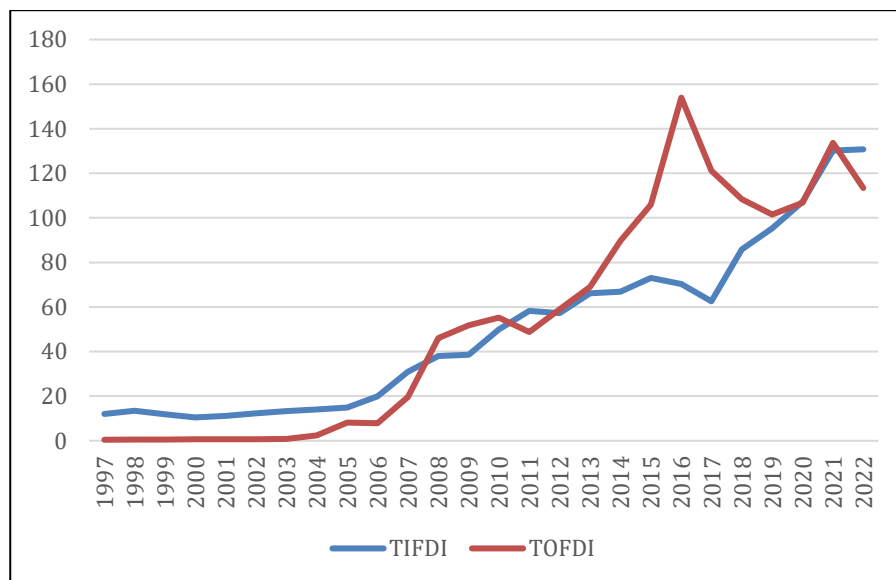
2023), which exceeded TIFDI for the first time and was much higher than that of secondary sector (9.64 billion US dollars), and the absolute value of TIFDI and TOFDI were much higher than that of SIFDI, SOFDI and POFDI and POFDI, as shown in Figure 4.

Figure 3: Trends in Secondary sector FDI Inflows and Secondary sector FDI outflows (1997 – 2022) (billion dollars)



Source: China Trade and Foreign Economic Statistics Yearbook (2023)

Figure 4: Trends in tertiary sector FDI Inflows and tertiary sector FDI outflows (1997 – 2022) (billion dollars)



Source: China Trade and Foreign Economic Statistics Yearbook (2023)

Many studies have looked at how FDI affects economic progress. But there are big gaps in what we know, especially about FDI's impact on the economic landscape of China. by sector. More studies on China's FDI being done by Chen (2018) and Ali et al. (2021). Yet, we still lack detailed analysis on how FDI comes in and goes out of different sectors in

China and how this affects economic growth. Given China's unique economy and its changing role in global investment, this gap in knowledge is very important to fill.

This paper addresses the aforementioned gap by focusing on China's provincial-level administrative regions and employing a panel data quantitative analysis method. This study innovatively dissects FDI into inflows and outflows across the three major sectors, enabling a more refined investigation into the impact of FDI. By adopting an innovative approach to capture the directionality and sector-specific nuances of FDI, this study offers a more detailed and sophisticated insight into how FDI relates to economic growth specifically within China.

1.2. Research Objectives

The primary aim of this research is to assess the extent to which FDI contributes to the economic expansion of China and its effects on the country's three major sectors.

- i. To quantify the long-run and short-run between both of IFDI and OFDI on China's economic growth.
- ii. To establish the causal link between IFDI and OFDI on China's economic growth.

2. Literature Review

The debate on the economic impact of FDI inflows is broad and multifaceted. A central argument is that FDI carries capital, technology and expertise that can accelerate economic activity and promote growth (Ibrahim & Acquah, 2021; Karahan & Çolak, 2024). However, this argument is not without its critics. Some scholars have argued that FDI may promote dependency, crowd out domestic industries, and exacerbate income inequality (Ingham et al., 2020).

The current collection of literature largely examines the correlation between FDI and economic expansion from both long-term and short-term viewpoints. Pradhan et al. (2018) used the Vector Error Correction Model (VECM) for analysis a dataset of G20 countries spanning from 1970 to 2016. Their findings revealed a persistent cointegration link among financial sector growth, FDI, and economic expansion. Liu and Lee (2020) utilized the Vector Autoregression (VAR) model to analyse the influence of FDI on China's economic development from 1981 to 2018. Their research uncovered a favorable and steady the influence of FDI on economic growth of China. Owusu-Nantwi and Erickson (2019) examined the link among FDI and economic growth in 10 South American nations. They used a Pedroni cointegration test for their analysis, covering the period from 1980 to 2015. They discovered that FDI and economic growth share a durable, long-term association in these nations. The research by Kalai and Zghidi (2019) employed the Autoregressive Distributed Lag (ARDL) and Vector Error Correction Model (VECM) approaches to identify a persistent, one-way relationship between FDI and economic expansion in countries within the Middle East and North Africa region.

Several studies have also delved into causal relationship. Ibrahim and Acquah (2021) conducted a Granger causality test on panel data from 45 African countries from 1980 to 2016, which revealed a cause-and-effect relationship between FDI and the host country's gross domestic product (GDP). Furthermore, the study identified statistical evidence of a bidirectional causal relationship between FDI and the economy in these countries, according to the Granger causality analysis. In a similar vein, Owusu-Nantwi and Erickson (2019) employed the vector error correction model (VECM) to examine

the long-term causal connection between FDI and economic growth. Their findings indicated a short-term two-way causal link between FDI and economic development. [Emako et al. \(2022\)](#) conducted research that revealed that FDI in the manufacturing and service sectors may exert a beneficial effect on economic development, but when FDI in the agricultural sector could engender adverse effects. This suggests that the long-run growth impacts of FDI are differentiated across various sectors.

In the discourse on the relationship between FDI and economic development, the characteristics and contributions of different industrial sectors have garnered considerable scholarly attention.

Furthermore, [Chandio et al. \(2019\)](#) in their study on Pakistan, employed cointegration analysis and causality tests to reveal a long-run correlation between FDI in the agricultural sector and economic expansion. They also determined that FDI had a notably favorable effect on economic growth in the immediate term.

The sectoral analysis of FDI inflows and outflows adds another layer of complexity to the discussion. Research by [Liu \(2019\)](#) highlights the varying impacts of FDI across three major sectors, emphasizing the need for sector-specific policies to maximize the benefits of FDI. The literature suggests that while the tertiary sector often attracts the lion's share of FDI, the primary and secondary sectors also stand to benefit significantly from targeted investments ([Chen, 2018](#)). This calls for a more granular examination of FDI distribution and its sectoral effects on economic expansion.

An analysis of the existing literature indicates that scholars mostly focus on studying foreign investment from a national standpoint, while there are comparatively less studies that take into account the perspective of industry growth. Since China's economic reforms and its initiation of the BRI action, there has occurred a significant transformation in the country's attraction of foreign capital and its outward investment. Therefore, it is highly important to comprehend the internal rationale behind the utilization of foreign capital and outward investment from the viewpoints of China's general economy and its three major sectors. This study utilizes inter-provincial panel data to empirically examine the impact of inflow and outflow FDI on China's economic expansion, using both macro and industry-specific perspectives. This serves as a benchmark for comprehending the present condition of China's economic progress and the creation of suitable policy suggestions.

2.1. The Hypothesis of Economic Growth Driven by FDI

The concept that FDI can act as an economic growth accelerator is deeply rooted in the structure of endogenous growth models. This hypothesis postulates that the inflow of FDI can result in a number of economic benefits, including capital accumulation, technology transfer, and improvements in management practices. Collectively, these factors enhance the productivity and output of the host country's economy.

Many studies have tried to prove if FDI really drives economic growth, and some have found support for this idea. [Karahan and Çolak \(2024\)](#) used a special kind of analysis for countries in the RCEP area and found that more FDI helps these countries grow economically. [Rashid et al. \(2017\)](#) also found that when a country is politically stable and has a good economy, it gets more FDI, which helps it grow. [Ahmed and Ibrahim](#)

(2019) looked at rich and poor countries and said that both getting and giving FDI helps them grow, especially in the US and the UK.

2.2. The Hypothesis of FDI Driven by Economic Growth

The hypothesis that economic growth propels FDI is grounded in [Dunning's \(1998\)](#) eclectic paradigm, which integrates ownership, location, and internalisation (OLI) advantages to explain the flow of FDI [Dunning \(1998\)](#). This paradigm posits that a country's economic growth can enhance its locational advantages, such as market size, infrastructure, and skilled labor force, thereby increasing its attractiveness to foreign investors. The economic growth-led FDI hypothesis asserts that robust and expanding economies signal profitable investment opportunities and lower risks, thereby stimulating greater inflows of FDI.

Several studies have provided empirical evidence supporting the growth-led FDI hypothesis. [Pečarić et al. \(2021\)](#) discovered that the expansion rate of the gross domestic product (GDP) has a favorable impact on the overall IFDI as well as sectoral inflows in Central and Eastern European Union countries. This indicates that economic growth is an important attractor for FDI. Similarly, [Dar et al. \(2016\)](#) reported that various factors, including the GDP growth rate, are cointegrated with FDI in Pakistan, indicating a long-run equilibrium connection and supporting the growth-led FDI hypothesis.

Furthermore, [Luo et al. \(2021\)](#) examined the influence of IFDI and OFDI on the standard of Chinese economic expansion. The study found that both types of capital flows contribute positively, with the impact of FDI being more pronounced. This study emphasises the role of economic growth in attracting inward and outward investments, which in turn can stimulate further economic expansion through various spillover effects.

2.3. Feedback causality hypothesis

FDI and economic growth are enmeshed in a positive feedback loop, wherein FDI enhances market competitiveness and efficiency in host countries, and concurrently, economic growth stimulates an increased inflow of FDI, establishing a feedback causality relationship.

[Chanegriha et al. \(2020\)](#) conducted a study, drawing on information from a sample of 136 nations, encompassing both developed and developing economies, spanning the years from 1970 to 2006, that reveals the potential reciprocal causality between FDI and economic development. The study posits that FDI helps host country firms to penetrate global markets and supply chains, thereby enhancing the competitive landscape of the host market and stimulating domestic firms to improve their efficiency. Moreover, as GDP increases, the rise in national income levels and consumer purchasing power may attract foreign firms to invest in the local market. Therefore, given the interdependent connection among FDI and economic expansion, it is not surprising to conclude that there is a positive feedback loop between the two.

3. Method and Data

This research analyzes data across 31 Chinese provinces to explore the enduring and causal links between IFDI, OFDI, and economic development over the period from 1997 to 2022. The data were gathered from the [China Trade and Foreign Economic Statistics Yearbook \(2023\)](#). As shown in [Table 1](#), the independent variable FDI inflow denotes the inflow of foreign direct investment, which is calculated as the ratio of the actual utilisation of foreign investment to GDP for each province ([Pradhan et al., 2018](#); [Raza, 2021](#)). The other independent variable which is FDI outflow indicates the outflow of foreign direct investment in each province and city, which is determined by the proportion of foreign investment in each province relative to its GDP ([Chen, 2018](#); [Liu, 2019](#)). The GDP is dependent variable denotes the per capita GDP growth rate ([Abbes et al., 2015](#); [Amin et al., 2022](#); [Mykytiuk et al., 2020](#)). The dependent variable is expressed as a natural logarithm. Therefore, the natural logarithms of FDI inflow, FDI outflow and GDP are used as proxies for IFDI, OFDI and economic growth, respectively.

Table 1: Data

Variable	Proxy	Description
FDI inflow	IFDI	Net inflows (ratio to GDP)
FDI outflow	OFDI	Net outflows (ratio to GDP)
FDI inflow in primary sector	PIFDI	Net inflows (ratio to GDP in primary sector)
FDI outflow in primary sector	POFDI	Net outflows (ratio to GDP in primary sector)
FDI inflow in secondary sector	SIFDI	Net inflows (ratio to GDP in secondary sector)
FDI outflow in secondary sector	SOFDI	Net outflows (ratio to GDP in secondary sector)
FDI inflow in tertiary sector	TIFDI	Net inflows (ratio to GDP in tertiary sector)
FDI outflow in tertiary sector	TOFDI	Net outflows (ratio to GDP in tertiary sector)
Economic growth	GDP	GDP per capita growth rate

Source: [China Trade and Foreign Economic Statistics Yearbook \(2023\)](#)

Researchers used panel cointegration tests to explore the enduring connection between IFDI, OFDI, and economic growth across 31 provinces and cities in China. As [Granger \(1969\)](#) suggested, these tests are crucial for confirming whether there's a lasting link between economic expansion and the flow of FDI.

Before conducting the panel cointegration test, we pre-processed the variable with order of integration one I(1). First, we tested stationarity level of all the variables using unit root tests namely ([Breitung, 2001](#); [Levina et al., 2002](#); [Im et al., 2003](#)). The next step is to investigate the cointegration relationship between the same-order integration variable.

Variations might arise from the disparities in economic standards and developmental circumstances among provinces. According to [Owusu-Nantwi and Erickson \(2019\)](#), which applied the Pedroni test to study the long-term connection between FDI and economic growth in 10 South American countries, this study similarly applies ([Pedroni, 2004](#)) to develop a residuals cointegration panel method that can accommodate the variations in individual impacts, slope coefficients, and individual linear trends due to

provincial heterogeneity. [Kao \(1999\)](#) cointegration test was also applied in this study, which is predicated on the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests, with the null hypothesis indicating the absence of cointegration among the data series. The empirical models of this study follow several previous studies handled by [Raza et al. \(2021\)](#) and [Amin et al. \(2022\)](#), which relates both inflow and outflow of FDI and economic expansion. The model regression shown as below:

$$GDP_{it} = a_{i0} + \beta_1 FDI_{it} + \varepsilon_{it} \quad (1)$$

where GDP is the per capita GDP growth rate, FDI consists of both inflow and outflow of FDI, ε is the error terms, i and t represents the province and period of time, respectively.

Equation (2) and (3) examines the long-term effect of both FDI inflow and outflow on economic growth from three major sectors:

$$GDP_{it} = a_{i0} + \beta_1 FDI_{inflow}_{it}^s + \varepsilon_{it} \quad (2)$$

$$GDP_{it} = a_{i0} + \beta_1 FDI_{outflow}_{it}^s + \varepsilon_{it} \quad (3)$$

where s are the three major industries namely primary, secondary and tertiary sectors in China.

The research employs the panel Granger causality method, as outlined by [Dumitrescu and Hurlin \(2012\)](#), drawing on the foundational Granger causality test developed by Granger in 1969. This method is utilized to examine the causal links between China's aggregate FDI inflows and outflows and the economic expansion within the three major sectors.

$$Y_{it} = \alpha_0 + \sum_{k=1}^p \gamma_i^k Y_{i,t-k} + \sum_{k=1}^p \delta_i^k X_{i,t-k} + \varepsilon_{i,t} \quad (4)$$

where i and t represent different individuals and years respectively, Y and X are stationary sequences, α_0 is a constant term, γ_i^k is the coefficient of Y 's lagged variable, δ_i^k is the coefficient of X variable with different lag periods, $\varepsilon_{i,t}$ is the residual term. The null hypothesis of no causal relationship can be specified as follow:

$$H_0: \delta_i^k = 0, \forall i = 1, \dots, N \quad (5)$$

If the null hypothesis is not rejected, it suggests that there is no evidence of a causal link between X and Y . Conversely, rejecting the null hypothesis implies that a causal relationship exists between the two variables.

With the aim of test for the panel causality effect between both FDI inflow and outflow and economic growth among the provinces in China, the following equation is specified:

$$GDP_{it} = \alpha_0 + \sum_{k=1}^p \gamma_i^k GDP_{i,t-k} + \sum_{k=1}^p \delta_i^k FDI_{i,t-k} + \varepsilon_{i,t} \quad (6)$$

where i represents different provinces, t represents different years, GDP represents per capita GDP growth rate in the region, and FDI represents both inflow and outflow of FDI.

Equation (7) and (8) examines the causal link of both FDI inflow and outflow on economic development from three major sectors:

$$GDP_{it} = \alpha_0 + \sum_{k=1}^p \gamma_i^k GDP_{i,t-k} + \sum_{k=1}^p \delta_i^k FDI_{inflow}_{i,t-k}^s + \varepsilon_{i,t} \quad (7)$$

$$GDP_{it} = \alpha_0 + \sum_{k=1}^p \gamma_i^k GDP_{i,t-k} + \sum_{k=1}^p \delta_i^k FDI_{outflow}_{i,t-k}^s + \varepsilon_{i,t} \quad (8)$$

where s are the three major industries namely primary, secondary and tertiary sectors in China.

4. Results

Table 2 offers a succinct overview of the descriptive statistics for total GDP and aggregate FDI inflows and outflows across provinces, as well as sector-specific movements within the primary, secondary, and tertiary sectors. The mean GDP is 0.112, with extremes at -0.039 and 0.285. The inflow of FDI (IFDI) significantly outpaces outflows (OFDI), averaging 0.647 compared to 0.019, respectively. In the primary sector, a higher inflow is observed with PIFDI averaging 0.030 and POFDI at 0.007. The secondary sector shows a balanced FDI dynamic with SIFDI and SOFDI averaging 0.639 and 0.019, respectively. The tertiary sector mirrors the primary with a substantial inflow, TIFDI at 0.580, against a lower outflow, TOFDI at 0.018. These statistics reveal a pronounced preference for FDI inflow across all sectors, particularly in the primary and tertiary sectors.

Table 2 The descriptive statistics results

Variable	Obs	Mean	Std.Dev.	Min	Max
GDP	806	0.112	0.057	-0.039	0.285
IFDI	806	0.647	2.955	0.022	58.216
OFDI	806	0.019	0.036	0.000	0.255
PIFDI	806	0.030	3.971	0.032	16.741
POFDI	806	0.007	0.027	0.000	0.398
SIFDI	806	0.639	2.997	0.023	64.876
SOFDI	806	0.019	0.036	-0.002	0.255
TIFDI	806	0.580	2.661	0.009	55.714
TOFDI	806	0.018	0.035	0.000	0.263

The results of correlation statistics show in the **Table 3**. The correlation coefficients vary between -1 and 1. The correlations between GDP and other variables are generally weak, with the majority of coefficients falling within the interval of 0 to -0.3, indicating no significant linear link between GDP growth and the inflow and outflow of FDI in most cases. Only the correlation coefficients between GDP and OFDI, POFDI, SOFDI, and TOFDI slightly exceed 0.3 but remain below 0.4, classifying them within the weak correlation category. These findings suggest that GDP growth does not directly foreshadow considerable changes in the inflow and outflow of FDI.

Table 3: Results of correlation statistics

	GDP	IFDI	OFDI	PIFDI	POFDI	SIFDI	SOFDI	TIFDI	TOFDI
GDP	1								
IFDI	-0.057	1							
OFDI	-0.277	0.251	1						
PIFDI	-0.055	0.976	0.266	1					
POFDI	-0.124	0.503	0.466	0.528	1				
SIFDI	-0.055	0.993	0.243	0.947	0.478	1			
SOFDI	-0.280	0.245	0.993	0.266	0.492	0.235	1		
TIFDI	-0.060	0.997	0.257	0.959	0.489	0.996	0.249	1	
TOFDI	-0.267	0.217	0.990	0.227	0.364	0.213	0.971	0.226	1

Table 4 examines whether the GDP, IFDI, and OFDI for China as a whole have a stable value over time. The results indicate that GDP is stable, or "stationary," without needing any adjustments. However, IFDI and OFDI initially show variability, suggesting they are

not stable on their own, which is indicated by being I(1). But once we account for changes over time (first differencing), these variables also become stable and significant. With this stability established, we can then conduct a cointegration test to see if there's a long-run connection between OFDI and IFDI and how they influence economic growth.

Table 4: Outcome of panel unit root test for IFDI, OFDI&GDP

Variables		LLC	IPS	Breitung
		t-statistic	t-statistic	t-statistic
level T&C	GDP	-9.049	-8.163	-5.547
		0.000***	0.000***	0.000***
	IFDI	2.967	2.410	-2.007
		0.999	0.992	0.022
	OFDI	4.642	8.814	-1.355
		1.000	1.000	0.088
First Difference	GDP	-24.763	-27.674	-4.761
		0.000***	0.000***	0.000***
	IFDI	-18.095	-17.551	-3.685
		0.000***	0.000***	0.000***
	OFDI	-13.701	-13.371	-6.785
		0.000***	0.000***	0.000***

Note: ***, **, * denoted 1%, 5%, and 10% significance levels, correspondingly. The numbers in brackets are the P-value. T&C means the model is performed with a trend and is constant.

Table 5 presents the results of the unit root test for primary FDI inflows and outflows. All variables demonstrate statistical significance at the first level of differencing. Following this, a cointegration test should be performed to ascertain whether there exists a long-term relationship between PIFDI, POFDI, and their influence on economic growth.

Table 5: Outcome of panel unit root test for PIFDI&POFDI

Variables		LLC	IPS	Breitung
		t-statistic	t-statistic	t-statistic
level T&C	PIFDI	-1.003	-3.142	-2.620
		0.158	0.001***	0.004***
	POFDI	2.8455	6.061	0.808
		0.998	1.000	0.791
First Difference	PIFDI	-28.1244	-29.790	-2.252
		0.000***	0.000***	0.012**
	POFDI	-28.8539	-28.887	-7.580
		0.000***	0.000***	0.000***

Note: ***, **, * denoted 1%, 5%, and 10% significance levels, correspondingly. The numbers in brackets are the P-value. T&C means the model is performed with a trend and is constant.

Table 6 shows that FDI inflow in the secondary sector is significant in the Breitung test and insignificant in all other tests. SOFDI is insignificant in all tests but after first order differencing, the whole variables are significant at statistical level. Consequently, a cointegration analysis can be utilized to determine if there exists a long-term correlation between SIFDI and SOFDI with respect to GDP.

Table 6: Outcome of panel unit root test for SIFDI & SOFDI

Variables		LLC	IPS	Breitung
		t-statistic	t-statistic	t-statistic
level T&C	SIFDI	2.768	0.933	-2.368
		0.9972	0.825	0.009**
	SOFDI	4.843	8.541	-0.136
First Difference		1.000	1.000	0.446
		SIFDI	-20.518	-23.233
		0.000***	0.000***	0.001***
	SOFDI	-20.056	-20.002	-7.498
		0.000***	0.000***	0.000***

Note: ***, **, * denoted 1%, 5%, and 10% significance levels, correspondingly. The numbers in brackets are the P-value. T&C means the model is performed with a trend and is constant.

Both tertiary FDI inflows (TIFDI) and outflows (TOFDI) are not significant in the unit root test, which is indicated as I(1), but show statistical significance after first order differencing. Subsequently, the cointegration test can be conducted to examine whether a long-term relationship exists between TIFDI and TOFDI and their impact on economic growth (Table 7).

Table 7: Outcome of panel unit root test for TIFDI & TOFDI

Variables		LLC	IPS	Breitung
		t-statistic	t-statistic	t-statistic
level T&C	TIFDI	3.409	2.231	-1.741
		0.100	0.987	0.041
	TOFDI	2.998	7.255	0.094
		0.999	1.000	0.538
First Difference	TIFDI	-24.78	-25.537	-3.751
		0.000***	0.000***	0.000***
	TOFDI	-18.124	-19.260	-7.947
		0.000***	0.000***	0.000***

Note: ***, **, * denoted 1%, 5%, and 10% significance levels, correspondingly. The numbers in brackets are the P-value. T&C means the model is performed with a trend and is constant.

In Table 8, Models 1 and 2 encapsulate the cointegrating connection between total IFDI and OFDI with economic growth. The Pedroni (2004) and Kao (1999) tests yield p-values for all statistics that approach insignificance, indicating a strong and statistically significant long-term relationship at the 1% level.

Table 8: Outcome of cointegration test of IFDI & OFDI & GDP

	Pedroni			Kao	
	Statistic	p-value		Statistic	p-value
Model 1 IFDI- GROWTH					
Modified Phillips-Perron t	-5.343	0.000***	Modified Dickey-Fuller t	-7.504	0.000***
Phillips-Perron t	-8.283	0.000***	Dickey-Fuller t	-7.669	0.000***
Augmented Dickey-Fuller t	-8.158	0.000***	Augmented Dickey-Fuller t	-4.117	0.000***
			Unadjusted modified	-18.005	0.000***

Model 2 OFDI-GROWTH					
			Dickey-Fuller t		
			Unadjusted Dickey-Fuller t	-10.914	0.000***
Modified Phillips-Perron t	-6.157	0.000***	Modified Dickey-Fuller t	0.724	0.234
Phillips-Perron t	-10.167	0.000***	Dickey-Fuller t	-1.341	0.090
Augmented Dickey-Fuller t	-11.374	0.000***	Augmented Dickey-Fuller t	0.972	0.166
			Unadjusted modified Dickey-Fuller t	-19.464	0.000***
			Unadjusted Dickey-Fuller t	-11.961	0.000***

The symbols ***, **, and * correspond to the statistical significance levels of 1%, 5%, and 10%, respectively.

This finding show there is a long-term cointegration with IFDI, OFDI, and GDP. The economic interpretation posits that FDI inflows and outflows serve as a catalyst for sustained growth rates, culminating in long-term economic expansion. The findings of this research support the conclusions reached by Pradhan et al. (2018) and Ayomitunde et al. (2019) when looking at G20 countries, as well as some emerging and BRICS nations. Nevertheless, these results diverge from the study by Bashir and Shakir (2012), which examines developing economies in Bangladesh and Maldives, presenting a contrasting viewpoint.

In Table 9, Model 3 (PIFDI-GROWTH) and Model 4 (POFDI-GROWTH), the result indicate a significant co-integration link between PIFDI, POFDI and the economic expansion of China. The possible reason could be foreign investors usually bring advanced agricultural technologies and management know-how, the diffusion of which helps to enhance the productivity of agriculture. This is consistent with Chandio et al. (2019) and Ran and Wang (2023) based on Pakistan and China, respectively, but this finding contradicts (Epaphra & Mwakalasya, 2017) in a related study focusing on Tanzania.

Table 9: Outcome of the co-integration test of PIFDI & POFDI

Pedroni			Kao		
	Statistic	p-value	Statistic	p-value	
Model 3 GROWTH-PIFDI					
Modified Phillips-Perron t	-4.712	0.000***	Modified Dickey-Fuller t	0.291	0.385
Phillips-Perron t	-7.678	0.000***	Dickey-Fuller t	-1.525	0.064
Augmented Dickey-Fuller t	-7.682	0.000***	Augmented Dickey-Fuller t	0.871	0.192
			Unadjusted modified Dickey-Fuller t	-17.118	0.000***
			Unadjusted Dickey-Fuller t	-10.518	0.000***
Model 4 GROWTH-POFDI					
Modified Phillips-Perron t	-5.295	0.000***	Modified Dickey-Fuller t	1.209	0.113
Phillips-Perron t	-8.924	0.000***	Dickey-Fuller t	-0.537	0.296
Augmented Dickey-Fuller t	-9.999	0.000***	Augmented Dickey-Fuller t	1.544	0.061

Dickey-Fuller t	Fuller t		
	Unadjusted modified		
	Dickey-Fuller t	-17.629	0.000***
	Unadjusted Dickey-Fuller t	-10.895	0.000***

The symbols ***, **, and * correspond to the statistical significance levels of 1%, 5%, and 10%, respectively.

In [Table 10](#), Models 5 and 6 demonstrate a significantly correlated over the long-term relationship between the inflow and outflow of FDI with China's secondary sector and the country's economic growth. The Possible reason is FDI brings advanced technology and the industrial sector is usually closely associated with technological advancement, the application of which improves production efficiency and product quality, thereby boosting growth of GDP. This aligns with the findings of [Miteski and Stefanova \(2017\)](#) based on CEE countries respectively.

Table 10: Outcome of the co-integration test of SIFDI & SOFDI

	Pedroni	p-value		Kao	p-value
	Statistic			Statistic	
Model 5 SIFDI-GROWTH					
Modified Phillips-Perron t	-5.131	0.000***	Modified Dickey-Fuller t	-7.446	0.000***
Phillips-Perron t	-7.659	0.000***	Dickey-Fuller t	-7.637	0.000***
Augmented Dickey-Fuller t	-7.473	0.000***	Augmented Dickey-Fuller t	-4.089	0.000***
			Unadjusted modified Dickey-Fuller t	-18.002	0.000***
			Unadjusted Dickey-Fuller t	-10.913	0.000***
Model 6 SOFDI-GROWTH					
Modified Phillips-Perron t	-6.180	0.000***	Modified Dickey-Fuller t	0.612	0.270
Phillips-Perron t	-10.107	0.000***	Dickey-Fuller t	-1.481	0.069
Augmented Dickey-Fuller t	-11.289	0.000***	Augmented Dickey-Fuller t	0.842	0.200
			Unadjusted modified Dickey-Fuller t	-19.499	0.000***
			Unadjusted Dickey-Fuller t	-11.981	0.000***

The symbols ***, **, and * correspond to the statistical significance levels of 1%, 5%, and 10%, respectively.

In [Table 11](#), Model 7 (TIFDI-GROWTH) and Model 8 (TOFDI-GROWTH) also show a significant co-integration link with FDI inflows and outflows during the tertiary sector and China's economic expansion. Since the service sector is a labor-intensive industry, and the increase in FDI can produce many employment chances for the local labor market, thus increasing consumption and investment. This also increased income of residents, which in turn increases consumption and investment and promotes the growth of economic. This aligns with [Miteski and Stefanova \(2017\)](#) and [Pečarić et al.](#)

(2021) studies based on CEE and EU countries respectively, but Susilo (2018) reached opposite conclusions.

Table 11: Outcome of the co-integration test of TIFDI & TOFDI

	Pedroni			Kao	
	Statistic	p-value		Statistic	p-value
Model 7 TIFDI-GROWTH					
Modified Phillips-Perron t	-5.906	0.000***	Modified Dickey-Fuller t	-4.764	0.000***
Phillips-Perron t	-8.752	0.000***	Dickey-Fuller t	-6.005	0.000***
Augmented Dickey-Fuller t	-8.612	0.000***	Augmented Dickey-Fuller t	-2.654	0.004***
			Unadjusted modified Dickey-Fuller t	-17.995	0.000***
			Unadjusted Dickey-Fuller t	-10.910	0.000***
Model 8 TOFDI-GROWTH					
Modified Phillips-Perron t	-6.206	0.000***	Modified Dickey-Fuller t	0.775	0.219
Phillips-Perron t	-10.195	0.000***	Dickey-Fuller t	-1.263	0.103
Augmented Dickey-Fuller t	-11.351	0.000***	Augmented Dickey-Fuller t	1.063	0.144
			Unadjusted modified Dickey-Fuller t	-19.419	0.000***
			Unadjusted Dickey-Fuller t	-11.920	0.000***

The symbols ***, **, and * correspond to the statistical significance levels of 1%, 5%, and 10%, respectively.

To figure out how FDI inflows and outflows, as well as those in the three main industries, affect China's overall GDP, the panel Granger causality test was used in this study. The findings are shown in Table 12 to Table 15.

Table 12 indicates that there is a reciprocal relationship between IFDI, OFDI and economic growth. FDI and OFDI promote economic development, and in turn, a growing economy attracts more FDI and increases foreign investment.

Table 12: Results of panel Granger causality test for IFDI & OFDI

Null hypothesis	Z-bar	P-value
IFDI \nrightarrow GDP	15.158	0.000***
GDP \nrightarrow IFDI	5.902	0.000***
OFDI \nrightarrow GDP	5.259	0.000***
GDP \nrightarrow OFDI	17.414	0.000***

The symbols ***, **, and * correspond to the statistical significance levels of 1%, 5%, and 10%, respectively.

This supports the feedback causality hypothesis, aligning with Caesar et al.'s (2018) study on China. However, it challenges (Abbes et al., 2015; Pradhan et al., 2018) their

studies identified a unidirectional causality between IFDI, OFDI and economic growth across 65 countries and the G20 nations.

Table 13 indicate that PIFDI is not a Granger cause of GDP growth, which may be owing to the lower technological of the agricultural sector and the weak technological spillover effect of foreign investment. But GDP is a Granger cause of PIFDI, A possible reason is modernisation of China's primary sector attracts huge of foreign investment, and there is a bidirectional causality between POFDI and GDP. This may be because foreign investment in the agricultural sector can help firms develop international markets, increase export channels for agricultural products, and increase international market share, thereby increasing economic returns (Javorcik, 2004). This supports the growth-led FDI hypothesis for FDI inflows into the primary sector, but not the feedback causality hypothesis for FDI outflows from the primary sector. This finding is consistent with Chandio et al.'s (2019) study based on Pakistan, in contrast to Awunyo-Vitor and Sackey (2018) studies based on Ghana respectively, which argue that there is no causality between PIFDI and economic growth.

Table 13: Results of panel Granger causality test for PIFDI & POFDI

Null hypothesis	Z-bar	P-value
PIFDI \nRightarrow GDP	-0.516	0.606
GDP \nRightarrow PIFDI	4.347	0.000***
POFD \nRightarrow GDP	3.350	0.001***
GDP \nRightarrow POFDI	18.114	0.000***

The symbols ***, **, and * correspond to the statistical significance levels of 1%, 5%, and 10%, respectively.

Table 14 show a unidirectional causality between SIFDI and GDP, which supports the growth-led FDI hypothesis, and a bidirectional causality between SOFDI and GDP, which supports the feedback causality hypothesis. This suggests that FDI outflows from the manufacturing sector not only contribute to economic growth but are also driven by it, which is consistent with the study of Wang et al. (2023) based on Korea. This may be because foreign firms in the manufacturing sector are advanced in production technology and management, which has a strong demonstration and competitive effect on local firms (Wu et al., 2020), while economic growth in the manufacturing sector also provides a capital and market base for firms to expand overseas.

Table 14: Results of panel Granger causality test for SIFDI & SOFDI

Null hypothesis	Z-bar	P-value
SIFDI does not Granger-cause \nRightarrow GDP	-0.747	0.455
GDP does not Granger-cause \nRightarrow SIFDI	5.513	0.000***
SOFDI does not Granger-cause \nRightarrow GDP	11.827	0.000***
GDP does not Granger-cause \nRightarrow SOFDI	19.869	0.000***

The symbols ***, **, and * correspond to the statistical significance levels of 1%, 5%, and 10%, respectively.

Table 15 indicates that there is a one-way causal relationship between TIFDI and GDP. The GDP is the Granger cause of TIFDI, that support the growth-led FDI hypothesis. There is a bidirectional causality between TOFDI and GDP, supporting the feedback causality hypothesis. This may be due to FDI outflows from the tertiary sector promote the internationalisation of firms' operations, improve the quality and efficiency of

services, and thus boost economic growth. That finding is consistent with the China-based study by [Ali et al. \(2021\)](#), which concluded that there is a long-run causality between outward investment in the service sector and economic growth, while the US-based study by [Susilo \(2018\)](#) reached the opposite conclusion.

Table 15: Results of panel Granger causality test for TIFDI&TOFDI

Null hypothesis	Z-bar	P-value
TIFDI \nrightarrow GDP	-0.200	0.841
GDP \nrightarrow TIFDI	4.048	0.000***
TOFDI \nrightarrow GDP	5.014	0.000***
GDP \nrightarrow TOFDI	9.328	0.000***

The symbols ***, **, and * correspond to the statistical significance levels of 1%, 5%, and 10%, respectively.

5. Conclusion

This paper provides an in-depth discussion of the impact of IFDI, OFDI of Chinese three major industries on China's economic growth by employing causality analysis and panel cointegration test. The results show a long-term cointegration link with China's total FDI inflows and outflows. In addition to the FDI inflows and outflows of the three major industries, and China's economic growth. While the causality manifests itself in a more complex manner, in particular, China's overall FDI inflows and outflows have a two-way impact on economic growth. In contrast, the inflow of FDI into the primary industry has a one-way effect on economic growth. However, there's a two-way relationship between the inflow and outflow of FDI in the primary industry and economic growth. FDI outflows have a two-way influence on economic growth across all sectors: primary, secondary, and tertiary. This consistency across sectors suggests that the impact of FDI outflows on China's economic growth is more substantial compared to that of FDI inflows.

Drawing on prior research, this paper offers new perspectives by deeply examining the link between IFDI, OFDI and economic growth within China's primary, secondary, and tertiary sectors. Unlike previous studies that focus on the national level or a single industry, this paper refines the perspective to the industry level, reveals the sector heterogeneity of FDI flows and their differential influence of economic growth. The study also enriches the body of knowledge on the link of FDI and economic growth. The findings of this study partly back up the idea that there's a two-way relationship, or feedback causality, between overall FDI coming in and going out, and economic growth. This is especially true for FDI outflows in the three main industries. However, FDI inflows in these sectors seem to follow the growth-led FDI hypothesis.

The study's findings have significant consequences for China's economic and sector-specific policies. Firstly, the beneficial impact of FDI inflows on economic growth highlights the importance of continuously improving the environment for foreign investment, with a particular focus on sectors that are heavy on technology. Secondly, the positive link between FDI outflows and economic growth in the secondary and tertiary sectors indicates that encouraging domestic companies to expand abroad not only aids them in securing international resources and markets, but also fosters domestic sector advancement and economic expanse.

Although this study provides valuable insights, there are some limitations. First, this paper focuses on the direct economic impact of FDI and does not fully consider the impact of FDI on non-economic factors such as the environment and society. Second, this paper has not yet explored in depth the interaction between FDI flows and macroeconomic variables such as industrial policy and international trade in terms of theoretical dialogue.

To address the above limitations, future research can be expanded in the following ways: first, to include the environmental and social impacts of FDI in the analytical framework in order to obtain a more comprehensive assessment; second, to deepen the theoretical research on the interaction between FDI flows and macroeconomic variables in order to better understand the economic mechanisms and policy implications of FDI flows. The deepening of these research directions can provide more scientific and precise guidance for FDI policy-making and industrial development strategies.

Ethics Approval and Consent to Participate

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Conflict of Interest

The authors declare no conflict of Interest.

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