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Does Industrial Structure Upgrading Promote China's Outward Foreign Direct Investment (OFDI) in ASEAN Countries? Evidence from Provincial Panels

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Abstract: Numerous studies have explored the impact of Outward Foreign Direct Investment (OFDI) on upgrading industrial structures in home countries. However, a notable gap exists in the literature regarding the reverse relationship. Based on the cross-border greenfield investment data of Chinese provinces in Association of Southeast Asian Nations (ASEAN) countries from 2003 to 2021, this study employed the Ordinary Least Squares (OLS) model to evaluate the impact of industrial upgrading in each province on OFDI to address this gap. The findings suggest that China's industrial structure upgrading significantly promotes OFDI toward ASEAN countries, though the effect varies by region within China and by the income levels of host countries. Regionally, industrial upgrading in eastern China notably stimulates OFDI growth, while the effect is not significant in the central and western regions, reflecting inconsistent evolution of industrial structures in various regions. Regarding host country income levels, the promotion effect of industrial structure upgrading on OFDI is influenced by the economic development level of the host country. Furthermore, we find that R&D intensity acts as a moderator that links industrial structural upgrading to OFDI responses. These findings withstand robustness checks, including tests for endogeneity. Ultimately, this study provides policy insights for strengthening the virtuous cycle between industrial upgrading and OFDI.

Keywords: industrial structure upgrading; OFDI; ASEAN; regional heterogeneity; R&D intensity

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1. Introduction

There is general agreement that a sustainable industrial structure is the fundamental driver of a regionally growing economy (Jiao et al. 2024; Zhu et al. 2019). China, as the world's largest developing nation, has undergone significant transformations in its industrial structure since its reform and opening to the outside world. The tertiary industry has progressively gained prominence, replacing the secondary industry's dominant position in the national economy and serving as a new engine for China's economic growth (You and Zhang 2022). This transformation promotes the sustainable development of the Chinese economy (Yu and Wang 2021), but also has a positive impact on China's economic interactions with other countries.

As an important region for China's new round of opening to the outside world, Association of Southeast Asian Nations (ASEAN) countries have become an important destination for China's Outward Foreign Direct Investment (OFDI) (Tong 2021). In recent years, China's investment in ASEAN countries has shown a steady growth trend. By the end of 2022, China's OFDI stock in ASEAN countries will be USD 154.66 billion, and ASEAN has become China's second largest investment economy.

Relevant policies and industrial structure adjustments both play a significant role in shaping the scale of China's OFDI (Zhang et al. 2024). This raises the question: is the

development of OFDI in ASEAN countries driven by the upgrading of the home country's industrial structure? Addressing this question not only deepens our understanding of China's OFDI dynamics but also provides crucial insights into the OFDI behavior of firms from emerging economies.

Industrial structure upgrading often accompanies technology and science innovation, enhanced production efficiency, and optimized resource allocation (Gong et al. 2023; Wu and Liu 2021; Zhu et al. 2022). This process has improved domestic industry competitiveness and provided enterprises with a broader international market and development space. However, industrial structure upgrading also entails a shift toward more technology-intensive industries (Tang et al. 2023), which requires a large amount of R&D innovation (Wu and Liu 2021), thereby imposing short-term financial pressure on enterprises. Such funding restrictions will cause enterprises to give up opportunities for foreign investment and prioritize domestic industry operations (Eskandar and Hadadi 2022). Accordingly, the process of industrial upgrading may, at some level, constrain the scope for firms to engage in OFDI.

The above discussion illustrates that the impact of industrial structure upgrading on OFDI is multidimensional. However, most existing research predominantly examines the reverse influence of OFDI on industrial structure change, with relatively few studies exploring the direct relationship between industrial structure upgrading and OFDI. Notably, the limited studies that do investigate this relationship tend to focus on how ownership restructuring affects overseas investment in developed economies (Cho and Lee 2020), often overlooking the unique context of developing countries. Given that developing countries possess distinct industrial structure foundations and paths to industrial upgrading (Liao et al. 2021), the interaction between industrial structure upgrading and OFDI in these nations significantly differs from that in developed countries. Nonetheless, the relationship between industrial structure upgrading and OFDI activities in developing countries remains under-explored.

To correct this research imbalance, this paper examines China—a representative developing country—as a case study to analyze the relationship between home-country industrial restructuring and OFDI in ASEAN countries. ASEAN is selected for this analysis due to its geographic proximity to China and the expanding scale of China's OFDI in the region (Zhao et al. 2024).

This paper makes four key contributions to existing research. First, it investigates the impact of home-country industrial structure upgrading on OFDI, offering new empirical insights into the relationship between these two variables. Second, by utilizing provincial-level panel data from China, the paper analyzes regional disparities in industrial structure upgrading and OFDI, thereby elucidating how regional industrial upgrading influences resource allocation within the context of globalization. Third, with a focus on ASEAN countries, the paper examines the differential effects of China's industrial structure upgrading on OFDI in host countries across varying income levels, contributing to a better understanding of how to foster economic and trade cooperation with different income profiles. Fourth, this study explores the mechanism by which home-country industrial structure upgrading influences OFDI from the perspective of home-country R&D intensity. It expands the theoretical framework on the interaction between industrial upgrading and OFDI, offering new insights into the complex relationship between technological progress and international investment behavior in developing countries.

The rest of the paper is organized as follows: Section 2 will systematically review the previous research literature to establish a solid theoretical foundation framework. Subsequently, Section 3 will describe the research design and the methodology it employs. Moving on to Section 4, we will present the specific findings of the empirical analysis, and finally, in Section 5, we will summarize the research results and provide relevant analysis and insights.

2. Literature Review

In the research examining the connection between home country industrial structure adjustment and OFDI, researchers commonly employ the product lifecycle theory and comparative advantage theory to analyze international investment dynamics (Cao and Folan 2012; Do et al. 2016).

The product lifecycle theory explains how a product affects a company's production and investment behavior across its lifecycle stages (Ma 2015). As the home country's industrial system undergoes upgrading and enhancement, there is a notable improvement in technological capabilities and significant gains in production efficiency (Chen et al. 2020a). This improvement is significant not only in the booming development of high-end manufacturing and technological innovation but also in its profound impact on the transformation and upgrading of traditional industries (Su and Fan 2022; Zhu et al. 2021). Therefore, domestic enterprises exhibit strong competitiveness at any stage of the product lifecycle, enabling them to better adapt to market changes and meet consumer demands (Tkachuk 2023).

However, concerns arise over domestic market saturation as the product reaches maturity and standardization. At this stage, companies tend to seek new market opportunities to maintain their product vitality and preserve market share. At this point, OFDI emerges as a critical strategic choice, helping companies to not only explore new markets (Tang et al. 2020) and extend product lifecycles but also expand global market shares (Liu et al. 2023). ASEAN, characterized by its diverse economy and growing consumer base (Wang and Chien 2007), stands out as an appealing destination for Chinese enterprises seeking to diversify their market presence and leverage comparative advantages derived from domestic industrial upgrading. The upgrading of industrial structure across China's provinces enhances the global competitiveness of local enterprises (Zhu et al. 2021), thus strongly driving OFDI and fostering mutually beneficial economic ties with ASEAN countries (Zheng et al. 2024).

The theory of comparative advantage advocates that countries should specialize in producing and exporting products in which they have a greater comparative advantage based on unique resource endowments and technological levels (Costinot 2009). As industrial systems evolve and improve, industries reliant on low value-added activities lose their comparative advantage (Lin and Wang 2012), while high-tech industries can cultivate new advantages with the support of strategic investment and other conducive factors (Zhao 2023). This shift in comparative advantage influences enterprises' global positioning within industrial chains and their strategic decisions regarding OFDI.

Specifically, as industrial structure upgrading progresses, enterprises may be more inclined to direct investments toward regions or sectors where they can leverage comparative advantages, aiming to seek greater profit margins and market share. Particularly in developing countries, domestic technological advancements prompt enterprises to occupy high value-added segments in the global division of labor (Li et al. 2021). Taking China as a case study, its industrial structure has shifted from low-end manufacturing to high-tech and service industries over recent decades, propelling its industries to higher positions in the global value chain (Ling and Li 2021) and fostering an enabling environment for its enterprises to engage in international operations.

Numerous scholars have employed time series data or panel data to expand on these theories. They have discovered that the home countries can transfer relatively disadvantaged industries overseas through OFDI, concentrating production factors in higher-level industries and optimizing domestic industrial structures. The findings of these studies affirm the view that OFDI plays a conducive role in promoting the optimization and restructuring of the country's industrial structure (Barrios et al. 2005; Jiang et al. 2020; Ling and Li 2021; Zheng et al. 2024). Although research generally supports the positive impact of Chinese OFDI on upgrading industrial structures, its significance needs to be further examined (Huang 2021). Moreover, some academics point out that OFDI may limit the upgradation of the operational structure. In the process of OFDI and transferring industries

abroad, enterprises may heighten competition between host and home countries' similar industries, potentially impacting employment and the home country's balance of payments negatively (Hiley 1999). Additionally, Zheng et al. (2024) highlight that while China's OFDI significantly enhances industrial structure upgrading in the eastern region, its impact is not pronounced in the central and western regions. Current research predominantly focuses on how OFDI can reverse industrial structural changes, while the exploration of how industrial structural upgrading can influence OFDI remains relatively limited. This article aims to address this research gap by examining the effects of China's industrial structure upgrading on OFDI, aiming to broaden perspectives in this field.

China's vast territory and diverse economy contribute to significant regional disparities in the adaptation and enhancement of industrial structures. Eastern provinces lead in both the level and pace of industrial upgrading compared to central and western regions (Wang 2004). This difference not only affects the overall industrial structure but also the comparative advantages of different provinces in sectors such as services, agriculture, forestry, and animal husbandry (Zhao and Guo 2018). Such regional disharmony in the industrial structure may influence provincial investment choices and partner selection when engaging in OFDI with ASEAN countries.

Based on the above analysis, this paper then proposes two hypotheses:

H1: *The advancement of industrial upgrading in China's provinces will further energize their outward FDI to ASEAN member countries*.

H2: *Chinese provinces show different geographical characteristics in the process of industrial upgrading and its impact on their direct investment in ASEAN countries*.

3. Research Design

Considering data availability, this study utilizes panel data on OFDI in ASEAN countries from 30 provinces in mainland China, covering the period from 2003 to 2021, resulting in 507 sample observations[1]. Tibet was excluded from the quantitative analysis due to a significant lack of data (Yu and Wang 2021). To address missing data for individual countries and variables, we employed the linear interpolation method following the approach by Zhang et al. (2021).

3.1. Data Source

The dependent variable in this study is greenfield OFDI data from 30 provinces in China targeting the ten ASEAN countries. These data are sourced from *fDi Markets* database compiled by FDI Intelligence, and we can obtain the latest data up to the end of 2021. The *fDi Markets* database is currently the most comprehensive source of project-level cross-border greenfield investment available (Desbordes and Wei 2017), covering data on OFDI from various countries and sectors around the world since 2003. It provides detailed information at the enterprise level, allowing us to distinguish investment source provinces and host countries.

The *fDi Markets* database focuses on greenfield FDI, which refers to capital flows for new investment projects, excluding cross-border mergers and acquisitions (M&A) activities. This feature helps mitigate component bias that may be introduced due to the inclusion of mixed investment forms (Desbordes and Wei 2017).

For provincial-level explanatory variables (including those used in endogeneity testing and mechanism analysis), we rely on authoritative sources such as the China Statistical Yearbook. This yearbook is officially published by the National Bureau of Statistics of China, ensuring the accuracy and reliability of the data. As for the explanatory variables at the host country level (including those used in robustness tests), we collected information from the World Bank and the World Governance Indicators (WGI) database. These sources provide comprehensive data essential for robust empirical analysis.

Table 1 presents the descriptive statistics for each variable.

Table 1. Descriptive statistics.

Variables	Obs	Mean	S.D.	Min	Max
LOFDI	507	4.105	1.981	−1.609	9.521
LStr	507	0.908	0.075	0.764	1.042
LFDI	507	−3.738	0.637	−7.131	−2.502
LER	507	−1.731	0.890	−4.768	0.511
IQ	507	−0.011	0.797	−1.752	1.651
LTec	507	2.940	1.366	−2.390	4.205
LRes	507	2.360	1.305	−2.521	4.566

3.2. Variable Description

3.2.1. Dependent Variable

There is a core effect variable of interest in this study in the form of the natural logarithm of the total amount of OFDI flowed to ASEAN countries by each province annually. This variable serves as an indicator designed to quantify changes in the scale of investment outflows.

3.2.2. Independent Variables

The key independent variable in this research is the degree of industrial structure upgrading at the provincial level, denoted as (*LStr*). Industrial structure upgrading refers to the process of reallocating factor endowments from less productive sectors to more productive ones within a country or region (Yu and Wang 2021). Drawing on the methods of scholars such as Xu et al. (2021), Yu and Wang (2021), and Zhao and Guo (2018), we derived this index. Specifically, we constructed a hierarchical score of industrial structure by taking the proportion of GDP contributed by the three major industries in each province and applying weights. Finally, we use this coefficient's natural logarithm as a quantitative measure of the level of industrial structure upgrading in each province. The formula for assessing the degree of industrial structure upgrading is shown below:

$$Str_{jt} = \sum_{i=1}^{3} \left(y_{jit} \times i \right) = y_1 \times 1 + y_2 \times 2 + y_3 \times 3 \quad (1)$$

where, Str_{jt} represents the industrial structure hierarchy coefficient, and y_{jit} denotes the proportion of added value of industry i in GDP of province j in year t, which reflects the optimization degree of the industrial structure of the province. It is worth noting that the larger the index value of the industrial structure hierarchy coefficient, the higher the proportion of the province's income in high value-added industries. This directly reflects the development of the province's industrial structure toward higher levels and optimization (Yu and Wang 2021). Therefore, *LStr* is an effective tool to quantitatively assess the status of industrial structure upgrading of provinces.

3.2.3. Control Variables

LFDI. FDI inflows reflect regional economic openness and attractiveness to foreign investment. These inflows can affect local firms' internationalization strategies, including decisions regarding OFDI, through mechanisms such as technology spillovers and market expansion (Chen et al. 2020b). We use the natural logarithm of the percentage of FDI to regional GDP as the measurement indicator (Buchanan et al. 2012).

LER. Industrial structure upgrading in home countries often accompanies increased environmental standards (Du et al. 2021). To manage high environmental costs, enterprises may relocate production activities to countries with more lenient environmental regulations through OFDI (Zhao et al. 2024). Consequently, this study uses the natural logarithm of industrial pollution control expenditures as a share of the secondary industry's value-added to assess the stringency of environmental regulations in each province and explore their potential impact on OFDI (Liu et al. 2024).

IQ. Institutional quality in the host country is a key factor influencing the level and mobility of FDI (Buchanan et al. 2012; Santos 2023). Following the methodology of Wang et al. (2015), this study measures institutional quality in ASEAN countries by averaging six indicators from the World Governance Indicators (WGI) database: voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption.

LTec. Countries with advanced science and technology capabilities tend to be more innovative and able to attract OFDI seeking technological upgrading (Chen et al. 2023). Here, we introduce the natural logarithm of the host country's share of high-tech exports to manufactured exports as a proxy for the host country's technology level (Zhao and Lee 2021).

LRes. China's OFDI to host countries often seeks to meet increasing natural resource demands (Amighini et al. 2014). We express the natural resource endowment of the host country using the natural logarithm of fuel and ore exports as a share of merchandise exports (Zhao and Lee 2021).

Table 2 summarizes a detailed summary of all data sources.

Table 2. Data interpretations and sources.

Variables	Description	Measurement	Source
LOFDI	Outward foreign direct investment flow	The natural logarithm of annual OFDI flows from provinces in China to ASEAN countries	*fDi Markets*
LStr	Provincial industrial structure upgrading index	The natural logarithm of assigning and weighting the proportion of added value of three industries to GDP	China Statistical Yearbook National Bureau of Statistics
LFDI	Provincial scale of foreign direct investment	Calculation of the natural logarithm of the share of FDI in regional GDP	China Statistical Yearbook National Bureau of Statistics
LER	Provincial environmental regulation intensity	Natural logarithm of the amount of completed investment in industrial pollution control as a percentage of the value-added component of the secondary sector	China Statistical Yearbook National Bureau of Statistics
IQ	Institutional quality	Average of six sub-scores (voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption)	World Governance Indicators (WGI) database
LTec	The technological level of the host country	The natural logarithm of high-tech exports as a percentage of manufacturing exports	World Bank
LRes	Abundance of natural resources in the host country	The natural logarithm of the sum of fuel exports (% of commodity exports) and ore and metal exports (% of commodity exports)	World Bank

3.3. Model Settings and Methodology

This paper uses a high-dimensional panel fixed effects model to examine the impact of industrial structure upgrading in Chinese provinces on OFDI toward ASEAN countries. Apart from possessing the attributes of traditional fixed-effects models, the high-dimensional fixed-effects model also offers high computational efficiency (Correia 2016). The specific model is constructed as follows:

$$\ln OFDI_{jt} = \beta_0 + \beta_1 \ln Str_{jt} + \beta_2 X_{jt} + \beta_3 X_{pt} + k_t + u_p + \varepsilon \quad (2)$$

where $\ln OFDI_{jt}$ represents the natural logarithm of OFDI flow from each province j to ASEAN countries in year t; β_1 signifies the effect of the industrial structure upgrading index $\ln Str_{jt}$ in province j in China for year t, which is the central focus of the model; X_{jt} and X_{pt} represent control variables for provinces and host countries characteristics, respectively; k_t and u_p represent year fixed effects and host country fixed effects, respectively; ε is an error term clustered by province.

3.4. Preliminary Tests

Prior to empirical analysis, we conducted descriptive statistics. We conducted a correlation matrix check aimed at scrutinizing whether there is a potential problem of multicollinearity among the variables. According to the demonstration in Table 3, the correlation coefficients between the variables were maintained below 0.6, indicating a low risk of multicollinearity. To further ensure the robustness of the analysis, we calculated the variance expansion factor (VIF) for each variable. As seen in Table 4, the VIF values for all explanatory variables did not exceed 2, which is well below the conventional threshold (VIF less than 10) that is usually considered to raise concerns about multicollinearity (Zhao and Lee 2021), which reconfirms that there is no significant multicollinearity problem in our data.

Table 3. Correlation coefficient matrix.

	LOFDI	LStr	LFDI	LER	IQ	LTec	LRes
LOFDI	1						
LStr	0.113 **	1					
LFDI	−0.055	0.372 ***	1				
LER	0.117 ***	−0.405 ***	−0.047	1			
IQ	−0.112 **	0.0620	0.002	−0.081 *	1		
LTec	−0.094 **	0.008	0.022	−0.034	0.574 ***	1	
LRes	0.075 *	−0.050	0.016	0.075 *	0.194 ***	0.272 ***	1

Note. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4. VIF test.

Variable	VIF	1/VIF
LTec	1.560	0.643
IQ	1.510	0.662
LStr	1.410	0.708
LER	1.230	0.816
LFDI	1.180	0.847
LRes	1.090	0.915
Mean	VIF	1.330

4. Empirical Analysis

4.1. Baseline Regression

Our first step is to explore how indicators of industrial transformation and upgrading in Chinese provinces influence OFDI toward the ten ASEAN countries. Table 5 presents the results of this baseline regression analysis.

In column (1), we focus solely on analyzing the impact of provincial industrial structure upgrading indicators on OFDI toward ASEAN countries. The coefficient for *LStr* is statistically significant at the 1% level, which implies that the optimization and upgrading of the industrial structure of provincial industrial structures in China significantly stimulate direct investment flows toward ASEAN, with high reliability.

Recognizing the importance of incorporating time and host-country fixed effects in studying enterprise overseas investment decisions (Blyde and Molina 2015; Yang and Zhang 2023), we introduced time fixed effects and host-country fixed effects in column (2). Despite this adjustment, industrial structure upgrading in China provinces continues to exert a significant promoting effect on OFDI toward ASEAN countries. The coefficients of *LStr* in columns (3), (4), and (5) exhibit a statistically significant correlation. This finding further reinforces our view that the optimization and upgrading of industrial structure at the provincial level has a positive effect on enhancing direct investment to ASEAN countries, providing strong empirical support for hypothesis H1.

Table 5. Benchmark regression results.

Variables	(1)	(2)	(3)	(4)	(5)
LStr	2.996 ***	3.034 **	6.826 ***	6.327 ***	6.413 ***
	(0.928)	(1.101)	(1.412)	(1.589)	(1.578)
LFDI			−0.442 **	−0.396 **	−0.377 **
			(0.136)	(0.145)	(0.127)
LER			0.439 **	0.505 **	0.478 **
			(0.136)	(0.159)	(0.158)
IQ			−0.244	−0.280 *	−2.039 **
			(0.139)	(0.131)	(0.804)
LTec			−0.088	−0.084	−0.306
			(0.094)	(0.095)	(0.175)
LRes			0.168 *	0.208 *	−0.109
			(0.087)	(0.096)	(0.186)
_cons	1.385	1.350	−3.126 *	−2.491	−1.163
	(0.891)	(1.044)	(1.501)	(1.705)	(1.850)
Year FE	No	Yes	No	Yes	Yes
HC FE	No	Yes	No	No	Yes
Cluster	Yes	Yes	Yes	Yes	Yes
N	507	507	507	507	507
R^2	0.013	0.117	0.085	0.134	0.174

Note. HC = host country; Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Additionally, when considering control variables, the estimated coefficients of *LFDI* in columns (3) to (5) show a statistically significant negative correlation. This suggests that a large influx of foreign capital would limit the province's overseas direct investment into ASEAN countries. Foreign investment brings capital, technology, and managerial expertise (Child et al. 2000; Lipsey et al. 1999; Liu and Wang 2003), which local firms tend to utilize these readily available resources, and accordingly reduces the need for OFDI. As for the estimated coefficient of *LER*, which is significantly positive, it suggests that strict environmental protection regulations in the home country can stimulate the behavior of firms to invest directly abroad. This aligns with China's trend of stricter environmental protection governance in recent years (Liu et al. 2022), increasing firms' costs and prompting investments in neighboring ASEAN countries with abundant resources, ensuring cost-effectiveness (Zhang et al. 2022). The estimated coefficient of *IQ* is significantly negative. This is because countries with lower institutional quality tend to have less stringent regulatory frameworks, thereby providing a more flexible investment environment for Chinese companies. Consequently, Chinese companies are inclined to invest in these countries to maximize their investment outcomes while facing fewer regulatory constraints (Saha et al. 2022). The negatively correlated and significant estimated coefficient of *LTec* suggests that ASEAN countries' technological capabilities are not conducive to attracting China to the region. The logic behind this may be that as the host country's technological capabilities increase, local firms become more competitive (Guan et al. 2006), weakening the competitive advantage of Chinese firms. At the same time, high levels of technology may also be accompanied by stronger protection of intellectual property rights and higher standards of innovation (Bayar et al. 2020), creating higher thresholds and costs for Chinese firms. Finally, the positive and significant estimated coefficient of *LRes* proves the importance of rich natural resources in host countries in attracting overseas FDI from Chinese provinces. This is in line with previous studies showing that Chinese firms tend to choose resource-rich countries to invest in to ensure stable resource supply chains and opportunities in resource-intensive industries (Feng and Ge 2022; Yang et al. 2018).

4.2. Robustness Tests

To guarantee the robustness and reliability of the outcomes of the regression analyses, we took measures to validate them by adding relevant control variables and excluding possible abnormal sample data.

4.2.1. Add Relevant Control Variables

To further test the robustness of our baseline regression findings, we employ the gravity model (Shahriar et al. 2020), which is widely recognized in the field of investment. This model incorporates key variables commonly utilized in both traditional and extended applications of the investment gravity framework. Specifically, these variables include: the economic size of the investment region ($LPES_{jt}$), the economic size of the host country ($LHES_{pt}$), the distance between the two countries ($LDis_{jt}$), the infrastructure quality of the host country ($LInfra_{pt}$), and the trade openness of the host country ($LTra_{pt}$) (Chang 2014; Falk 2016). The economic size of the investment region ($LPES_{jt}$) is measured by the natural logarithm of each province's GDP in the current year, reflecting its economic strength and market potential. The economic size of the host country ($LHES_{pt}$) is expressed by the natural logarithm of each ASEAN country's GDP in the current year, reflecting its market size and attractiveness. Infrastructure quality ($LInfra_{pt}$) is measured by the natural logarithm of fixed-line telephone users per 100 people in each ASEAN country, serving as an indicator of information and communication infrastructure popularity. Trade openness ($LTra_{pt}$) is measured by the percentage of total imports and exports in GDP for each ASEAN country (Chen et al. 2020b). For the distance between the two countries (LDisjt), considering the uneven distribution of population in the country, we followed the method of Falk (2016), not only considering the physical distance but also introducing the host country population size as weights, calculating the weighted distance transformed into its natural logarithm for final inclusion as an indicator. The regression results of the investment gravity model are shown in column (1) of Table 6. Notably, the coefficient of the provincial industrial structure upgrading is still significantly positive, which is consistent with the conclusion of the baseline regression.

Table 6. Robustness tests.

Variables	(1)	(2)	(3)
LStr	6.172 ***	5.670 ***	7.239 ***
	(1.558)	(1.453)	(1.467)
LPES	−0.078		
	(0.158)		
LHES	0.192		
	(1.050)		
LDis	−2.790		
	(1.882)		
LInfra	0.123 *		
	(0.067)		
LTra	0.211 *		
	(0.102)		
_cons	65.382	−0.196	−2.522
	(54.619)	(2.214)	(1.553)
Control	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
HC FE	Yes	Yes	Yes
Cluster	Yes	Yes	Yes
N	507	483	461
R^2	0.177	0.156	0.189

Note. HC = host country; Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.2.2. Remove Interfering Samples

Considering that the 2008 world economic crisis may have interfered with firms' OFDI strategies (Liu et al. 2022), we decided to exclude the data for that year as a strategy to minimize the bias caused by this event. Looking at the results in column (2) of Table 6, we note that the coefficients on the industrial upgrading indicators remain significantly positive even after this adjustment, which is confirmed by statistical tests. This evidence of

persistence strongly supports the robustness and reliability of the conclusions of our initial regression analysis.

Moreover, the COVID-19 pandemic has profoundly influenced the industrial system and economic growth (Duan et al. 2020). To mitigate this impact, we exclude 2020 and 2021, the years most severely affected by the epidemic, from our sample and re-estimate. Column (3) in Table 6 shows the results of this adjusted analysis. Notably, the coefficient of the industrial structure upgrading remains significantly positive. This finding once again verifies the robustness of our baseline regression results.

4.3. Endogeneity Test

Some scholars have identified that OFDI can positively impact the industrial structure upgrading of the home country (Li and Wu 2023). To address potential endogeneity arising from bidirectional causality, this paper employs the instrumental variable method for testing. We select the urbanization level and the unemployment rate of each province as instrumental variables. These variables are not only correlated with the upgrading of each province's industrial structure but also have no direct correlation with OFDI, ensuring the effectiveness of the instrumental variables. First, urbanization advancement contributes to changes in the labor market, talent aggregation, urban infrastructure enhancement, and increased consumer demand, jointly promoting the optimization and upgrading of the industrial structure. In addition, as a relatively objective indicator, urbanization levels are mainly affected by exogenous factors such as national development policies and urban planning, and have no direct correlation with OFDI, thus ensuring the exogeneity of the instrumental variable. Second, the unemployment rate serves as a reasonable instrumental variable. On the one hand, in the process of industrial structure upgrading, the decline of traditional industries may cause some laborers to temporarily lose their jobs, thereby increasing the unemployment rate, which shows the correlation between the unemployment rate and the upgrading of industrial structure. On the other hand, the unemployment rate is mainly influenced by exogenous factors like macroeconomic policies, economic cycle fluctuations, and labor market supply and demand dynamics, with no direct link to OFDI, ensuring its exogeneity as an instrumental variable. The result if the Endogeneity test is presented in Table 7.

Table 7. Endogeneity test.

Variables	(1) First Stage	(2) Second Stage
LStr		5.776 ***
		(1.411)
IV1	0.170 ***	
	(0.014)	
IV2	−0.070 ***	
	(0.020)	
LM Statistic		8.674
		(0.013)
Cragg-Donald Wald F		694.278
Hansen J statistic		0.956
		(0.328)
Control	Yes	Yes
Year FE	Yes	Yes
HC FE	Yes	Yes
Cluster	Yes	Yes
N	507	507
R^2	0.851	0.174

Note. HC = host country; Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The F-statistic values of both the Lagrange multiplier (LM) test and the Cragg–Donald–Wald test indicate that the instrumental variables we chose to use successfully address the

challenges of weak instrumentation and insufficient identification power, and empirically verify the applicability and validity of these instrumental variables. Additionally, the value of the Hansen J statistic is 0.956 with an accompanying *p*-value of 0.328. This result enables us to statistically accept the null hypothesis that "all instrumental variables are exogenous", thereby verifying that the exogeneity condition of the instrumental variables is met. Moreover, by implementing the instrumental variables regression analysis, we reconfirm our conclusion that there is a positive relationship between industrial upgrading in Chinese provinces and direct investment in ASEAN, a finding that is consistent with the trend of the preliminary regression analysis, thus adding additional robustness and certainty to the findings of the basic regression analysis.

4.4. Heterogeneity Analysis

4.4.1. Regional Heterogeneity in the Home Country

To perform a more thorough analysis of the deeper implications of industry upgrading on the variations in China's OFDI across the ten ASEAN countries, this study relies on the research conducted by Liu et al. (2022), and categorizes the sample data into three regions based on their geographical characteristics, namely, the eastern, central, and western regions, for detailed analysis. Figure 1 visualizes the trends and differences in the upgrading indicators of China's national and regional industrial structure over time from 2003 to 2021.

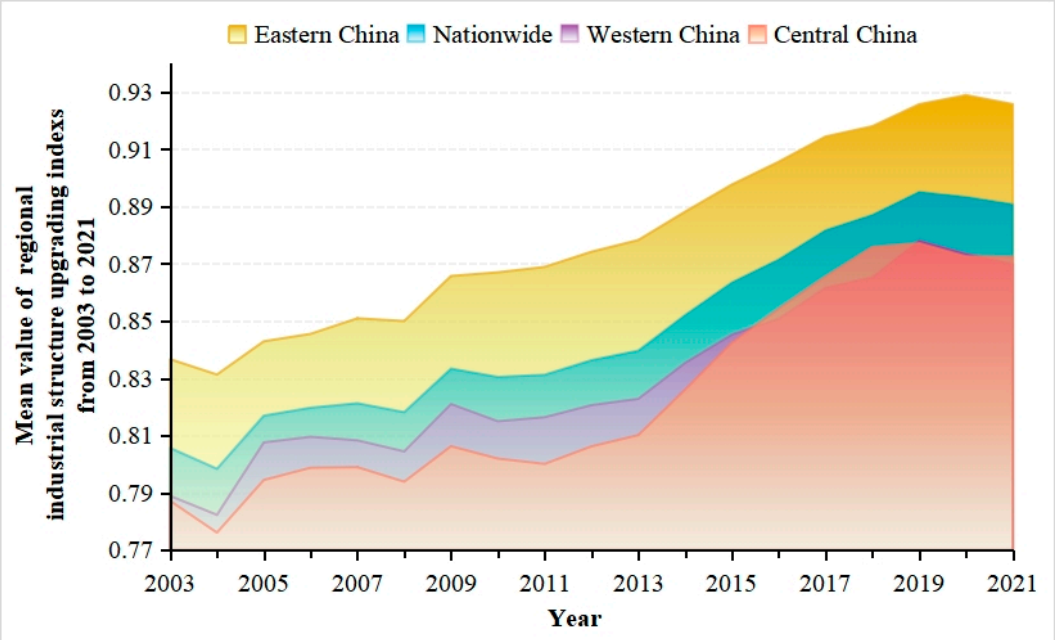

Figure 1. Changes and development of indicators of industrial structure upgrading in China and its regions between 2003 and 2021. Source: Own calculations based on China Statistical Yearbook and National Bureau of Statistics.

Comprehensive observations show that China has shown an overall upward trend in the key indicators that drive industrial structure upgrading. However, this progress is unevenly distributed among different regions, showing obvious differences. The eastern regions are particularly prominent in this regard, with their indicators of industrial structure optimization and upgrading exceeding the national average, making them significantly greater than those of the central and western areas. It is worth noting that, nevertheless, the gap between the central and western regions in terms of industrial upgrading is gradually narrowing at a slow but determined pace. Detailed analysis points out that between 2003 and 2016, the western region briefly led the central region in the industrial upgrading index. The turning point came after 2017 when the central region began to accelerate its catch-up

and make progress. This interregional imbalance can be partly attributed to the failure of the western region to keep pace with the eastern and central regions in accelerating industrial restructuring and modernization (Yu and Wang 2021).

In the overall review, China shows an upward trend in the core indicators for promoting industrial structural upgrading. However, this progress is unevenly distributed across regions, with significant differences. The eastern region, in particular, not only outperforms the country as a whole in terms of industrial upgrading indicators but also far outperforms the central and western regions. It is worth emphasizing that the gap in industrial upgrading between the central and western regions is gradually diminishing, albeit in a slow and steady process. To analyze the data specifically, from 2003 to 2016, the western region once held the lead over the central region in the industrial upgrading index. However, since 2017, the central region has begun to rebound strongly and make significant progress. Much of this interregional imbalance stems from the fact that the western region has not been able to keep moving at the same pace as the eastern and central regions in the process of industrial restructuring and modernization. This finding strongly supports hypothesis H2 that the driving effect of industrial upgrading on direct investment varies substantially across regions.

The observed regional heterogeneity can be ascribed to various factors. Firstly, the eastern area has established a rather comprehensive industrial chain and cluster, making the enterprises in the region more competitive in the international market. This heightened competitiveness prompts enterprises to actively seek overseas markets and resources through OFDI. In addition, enterprises in eastern provinces often possess advanced technological levels, robust capital strength, and mature internationalization experience, which gives them a competitive edge in foreign investment. In comparison, the pace of industrial structure upgrading in the central and western regions is lagging, and they face some constraints during the upgrading process, such as inadequate technological innovation, deficient supporting infrastructure, and serious talent loss. Consequently, enterprises in these regions may prioritize using funds toward enhancing local infrastructure and industrial chain construction, rather than directly investing overseas. Therefore, although these regions are also undergoing industrial structure upgrading, their promoting effect on OFDI may not be significant. Table 8 presents the results of the analysis of regional heterogeneity in the home country.

Table 8. Analysis of regional heterogeneity in the home country.

Variables	(1) Eastern Region	(2) Central Region	(3) Western Region
LStr	9.423 ***	−10.420	−44.003
	(2.693)	(18.541)	(29.275)
_cons	−5.270	16.228	44.039 *
	(3.588)	(15.266)	(23.633)
Control	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
HC FE	Yes	Yes	Yes
Cluster	Yes	Yes	Yes
N	404	55	48
R^2	0.202	0.745	0.647

Note. HC = host country; Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.4.2. Heterogeneity of Income Levels in Host Countries

Enterprises investing in countries with varying income levels face significant differences in productivity, institutional quality, technology acquisition, etc. (Barcenilla et al. 2019; Matsuyama 2014). This study categorizes ASEAN countries into three subsamples: high-income countries, upper-middle-income countries, and low-middle-income countries based on the World Bank's classification standards for income levels[2]. Regression analyses were conducted separately for each subsample.

The regression results are detailed in Table 9. The results show significant heterogeneity in the impact of China's industrial structure upgrade on OFDI across ASEAN countries with different income levels. For high-income ASEAN countries (column (1) of Table 9), the coefficient of *LStr* is significantly positive, indicating that the upgrading of China's industrial structure significantly boosts OFDI in these countries. This may be because high-income countries usually have well-developed infrastructure and mature market mechanisms (Rasiah 2004), which provides a favorable investment environment for Chinese companies. Additionally, the high consumption potential in these countries enhances the appeal of Chinese industrial products. For lower middle-income ASEAN countries (column (3) of Table 9), the coefficient of *LStr* is also significantly positive, indicating that the upgrading of China's industrial structure also promotes OFDI in lower middle-income countries. This can be attributed to the comparative advantages these countries offer in production factors, such as lower labor costs (McCaig and Pavcnik 2018), which provide Chinese enterprises with more cost-effective investment options. In contrast, the sample of upper middle-income countries (column (2) of Table 9) shows a positive but statistically insignificant coefficient for *LStr*. This indicates that the upgrading of China's industrial structure does not significantly influence OFDI in these countries. This may be because upper middle-income countries neither provide well-developed infrastructure and high-end markets to high-income countries nor have significant advantages in the factor cost of labor like lower middle-income countries do, thus diminishing the impact of industrial structure upgrading on OFDI.

Table 9. Analysis of the Heterogeneity of Host Country Income Levels.

Variables	(1) High Income	(2) Upper Middle Income	(3) Lower Middle Income
LStr	13.690 ***	4.414	5.788 **
	(0.158)	(2.588)	(1.530)
_cons	73.619 **	−8.077	−0.975
	(1.994)	(8.739)	(1.893)
Control	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
HC FE	Yes	Yes	Yes
Cluster	Yes	Yes	Yes
N	87	226	194
R^2	0.537	0.286	0.206

Note. HC = host country; Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.5. Mechanism Analysis

Based on the previous research, this thesis further incorporated interaction term variables to deepen the analysis ($LnStr_{jt} \times RD_{jt}$) between the industrial structure upgrading index and R&D intensity for mechanism analysis. Firstly, with the optimization of industrial structure, enterprises will pay more attention to investment and intensity in research and development (Li et al. 2022). Additionally, upgrading the industrial structure can improve the innovation environment, attract greater innovation resources and talents, and help to enhance the research and development level and intensity of each province. Secondly, a high level of R&D intensity indicates that the home country possesses abundant resources and capabilities in technology and innovation, which in turn will enhance the competitive strength of their companies on the global stage (Rasiah 2011). However, it remains uncertain whether this increase in R&D intensity has a positive effect on corporate OFDI. This requires further exploration. Drawing on the studies of Bayar et al. (2020), Chen et al. (2020b), and Qiao et al. (2020), we measure R&D intensity use by taking the natural logarithm of each province's internal research and development (R&D) expenditure as a percentage of the region's GDP to (RD_{jt}). This article uses the natural logarithm of the percentage of R&D

expenditure to regional GDP within each province to measure R&D intensity (RD_{jt}). The specific model is as follows:

$$\ln OFDI_{jt} = \beta_0 + \beta_1 \ln Str_{jt} + \beta_2 \ln Str_{jt} \times RD_{jt} + \beta_3 X_{jt} + \beta_4 X_{pt} + k_t + u_p + \varepsilon \quad (3)$$

The results of the regional characterization, reflected in the first three columns of Table 10, demonstrate an interesting pattern: restricted to the Eastern region data, the industrial structure upgrading index and its interaction effect with R&D intensity, as well as the industrial structure upgrading index itself, show statistically significant results. The regression analysis reveals that the intensity of R&D activities actually moderates the tightness of the positive correlation between industrial upgrading and foreign direct investment inflows to ASEAN in the Eastern region context, playing a constraining role. In other words, the increase in R&D intensity seems to mitigate the positive effect of industrial upgrading in promoting OFDI by firms in the Eastern region. This may be due to the fact that the large amount of resources being directed to R&D indirectly results in a reduction in the amount of funds that firms have to spend on overseas expansion, coupled with the fact that firms face financial constraints, and thus may miss out on opportunities for internationalization and development.

Table 10. Mechanism analysis of moderating effect.

Variables	(1) Eastern Region	(2) Central Region	(3) Western Region
LStr	18.086 ***	−6.989	−43.388
	(3.716)	(11.943)	(24.694)
LnStr × RD	−1.005 *	−2.659 **	−0.056
	(0.457)	(0.997)	(1.554)
_cons	−12.877 ***	14.943	43.542 *
	(3.524)	(9.077)	(20.087)
Control	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
HC FE	Yes	Yes	Yes
Cluster	Yes	Yes	Yes
N	404	55	48
R^2	0.207	0.771	0.647

Note. HC = host country; Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5. Conclusions

5.1. Key Findings

After a comprehensive empirical analysis, this study thoroughly explores how industrial structure upgrading in Chinese provinces influences OFDI in ASEAN countries and summarizes several core insights:

First and foremost, the continued upgrading of the industrial structure within China is the key driver in stimulating OFDI towards the ASEAN region, highlighting the tendency of firms to leverage advanced industrial structures to actively pursue broader overseas markets through internationalized investment paths.

Second, the impact of industrial structure upgrading on outward investment varies significantly based on both the geographical location of the home country and the income level of the host country. Eastern provinces directly benefit the most from industrial structure upgrading, with a particularly robust correlation between industrial structure upgrading and OFDI. In contrast, central and western regions fail to show similar positive trends. Regarding the income level of host countries, the promotion effect of industrial structure upgrading on OFDI is significant in high-income and lower middle-income countries, but this effect is not evident in upper middle-income countries.

Lastly, the study finally clarifies the important moderating function of R&D intensity in linking industrial upgrading and outward FDI, especially in the Eastern region. While

high R&D intensity is expected to accelerate overseas investment driven by industrial structure upgrading, the concentrated allocation of funds to R&D inadvertently disperses capital, constraining firms' potential for overseas expansion. This finding sheds light on the complex ways in which resource allocation tactics can shape the formulation of international investment strategies.

5.2. Significance and Inspiration

5.2.1. Theoretical and Practical Significance

This study provides a deeper understanding of the relationship between industrial structure upgrading and OFDI by applying product lifecycle theory and comparative advantage theory. Through empirical analysis, we verify the role of industrial structure upgrading in promoting China's OFDI to ASEAN countries and highlight the significant impact of regional heterogeneity in the home country and heterogeneity in the income level of the host country. This contribution enriches the theoretical framework on international investment and industrial structure upgrading, while also deepening our understanding of the interaction between international investment and economic development of host countries. Additionally, the study provides a novel theoretical perspective and empirical evidence for analyzing the OFDI behavior of developing countries represented by China. Specifically, in the context of continuous upgrading of industrial structure, Chinese enterprises can rely on technological innovation to establish a market-leading position in the early stages of the product lifecycle. As products reach the mature and standardized stage, these enterprises can apply the principle of comparative advantage to transfer production activities to regions with lower costs or greater market potential, such as ASEAN countries, through OFDI, effectively extending the product lifecycle and achieving global optimization of resource allocation and extensive market coverage.

In addition, this study also analyzes in depth the regulatory mechanism of R&D intensity behind the interaction between industrial upgrading and outward FDI and enhances our understanding of the function and importance of R&D investment in the blueprint of firms' globalization and expansion by deconstructing how R&D intensity subtly alters the path of industrial upgrading in the promotion of outward FDI.

Finally, given the status of ASEAN as a crucial trading partner and investment destination for China, investigating China's OFDI behavior toward ASEAN holds significant practical implications. This study not only enriches the understanding of the commercial and economic collaboration between China and ASEAN but also provides a reference for strengthening investment cooperation and deepening cooperation levels and fields for both sides in the future.

5.2.2. Policy Implications

First, from a macroeconomic perspective, the government should capitalize on the chance to upgrade the industrial structure and take the initiative to guide and expand the scale of OFDI. Especially in the central and western regions, the government needs to implement a set of refined "overseas expansion" strategies, carefully adjust and improve the industrial layout, and strengthen the synergies between regional industries, with the aim of promoting a balanced and comprehensive prosperity of OFDI at the national level.

Second, considering the varying levels of economic development within ASEAN countries, it is essential to adopt differentiated investment strategies. The upgrading of industrial structure plays a significant role in boosting OFDI in high-income countries, and investment in these countries should continue to be increased, especially in high-tech industries and service industries. For lower middle-income countries, their abundant resources and cost advantages can be used to implement strategies of industrial transfer and cooperation, fostering the development of mutually beneficial industrial chains. For upper middle-income countries, a thorough analysis of their economic characteristics and market needs is necessary to identify appropriate investment areas and strategies.

5.3. Limitations and Prospects

While this study has made several significant findings, it has also revealed three limitations that need to be further deepened, leaving room for further research.

First, in terms of data adoption, the dataset on which this study is based focuses on greenfield investment as a type of OFDI and does not take into account other FDI modes, such as multinational mergers and acquisitions (M&As). This limitation may pose some restrictions on the generalizability of the study's findings, although some studies such as Dong et al. (2022) results show that the trend of China's greenfield FDI flows coincides with the overall FDI direction officially released. Future research could explore the integration of multiple forms of FDI into the analytical framework with a view to obtaining a more global perspective. Additionally, due to data limitations, the study uses the most comprehensive and recent dataset available, covering the period from 2003 to 2021. As data availability improves, future research can extend the analysis to a broader time frame.

Second, involving sample categorization, this study does not delve into the various industry segments of OFDI for differentiation and exploration. Since the effect of industrial upgrading on FDI and its mechanism are likely to be influenced by the characteristics of industries, future scientific research should be devoted to refining the sample classification system and carefully exploring and comparing the differences in the specific performance and response of OFDI behaviors of different industrial sectors in the context of industrial upgrading.

Finally, the geographic focus of the study is limited to China's direct investment in ASEAN countries. Although ASEAN is a key region in China's overseas investment map, the complexity and variability of the global investment environment as well as the significant differences in investment drivers and policy frameworks across countries and regions should not be ignored. Subsequent investigations should therefore seek to broaden the boundaries of the study to include more countries and regions in the analysis and conduct a comprehensive cross-country and cross-geographical study to enhance the depth and breadth of understanding.

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Notes

1 The data structure is organized by Province-Year-Host Country, with the "Host Country" referring to the 10 ASEAN member nations: Brunei, Cambodia, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand, Myanmar, and Vietnam. The host country fixed effect used in the model refers to a corresponding ASEAN country that receives inflows of OFDI from a China province in that year. Additionally, not all provinces were involved in investment activities targeting all ASEAN member countries every year during the survey period.

2 The World Bank divides the world's economies into four income groups: High-income, upper middle-income, lower middle-income, and low-income countries. This classification system is designed to reflect a country's level of development. In the latest classification standards released by the World Bank in 2024, ASEAN countries are classified as follows: Singapore and Brunei are upper middle-income countries, Indonesia, Malaysia, and Thailand are upper middle-income countries, and Cambodia, Laos, Myanmar, the Philippines, and Vietnam are low middle-income countries.

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