

# The Effects of Two-Way FDI on Industrial Structure Development-Evidence From Shandong in China

Jianxia Yu, Xue Wei\*, Qing Xue

*School of International Trade and Economics, Shandong University of Finance & Economics, Jinan, Shandong, 250014, China*

*\*Corresponding author. Email: weixue0102@163.com*

## ABSTRACT

Based on the "Standard Structure Model" of Chenery, we construct an econometric model to examine the effects of two-way foreign direct investment (FDI) on industrial structure development by using panel data of 17 cities in Shandong over 2003-2018. The empirical results show that outward FDI has a significant and positive impact on both industrial structure optimization and industrial structure advancement. While inward FDI can only promote the optimization process of industrial structure at the 10-percent level of significance. Meanwhile, domestic economic factors such as financial support from government, market demand and innovation investments of enterprises also play an important role in optimizing and upgrading industrial structure.

**Keywords:** *Outward foreign direct investment, inward foreign direct investment, industrial structure development*

## 1. INTRODUCTION

As a major economic province in China, Shandong's gross domestic product (GDP) has always ranked among the top in the country and its industrial structure has been developing towards rationalization and optimization over decades. The proportion of output value of tertiary industry has risen steadily from 31.6 percent in 2003 to 49.5 percent in 2018 and been higher than that of secondary industry since 2016. While the size of both outward and inward foreign direct investment (OFDI and IFDI) has been continuously expanding, involving more and more industrial fields since the implementation of the "go global strategy" in 2003.

It is no doubt that economic development of any region is closely related to the flows of FDI. Chen (2018) finds that both OFDI and IFDI have a positive impact on China's provincial economic growth [1]. Yet what we are interested in is what role the two-way FDI has played in the development of Shandong's industrial structure. We expect to find out what relationship between the two through an empirical examination so as to provide some practical evidence and enlightenment for the government to formulate a more reasonable and targeted policy on foreign direct flows and industrial development.

The literature on the impact of foreign direct flows on industrial structure have grown rapidly for the past decades with mixed and often contradictory results.

Regarding OFDI's influence on industrial structure upgrading, Amighini and Padilla-Perez find that less developed countries and regions can acquire advanced technology and valuable strategic assets of the host country through OFDI in developed countries, thus

promoting the upgrading of home country industries [2-3]. Cozza studies the process of China's FDI in developed countries and conclude that Chinese enterprises' FDI can boost domestic labor productivity and industrial scale, thus promote the optimization of industrial structure [4]. Li (2012) makes an empirical study based on China's provincial panels data and points out that the outward investment scale and the degree of upgrading of industrial structure have an obvious positive correlation [5].

However, Wang (2004) believes that OFDI will hinder the upgrading of the industrial structure of the home country through such effect as labor demand transfer [6].

Regarding IFDI's influence on industrial structure upgrading, Kneller and Pisu point out that FDI can promote the optimization and upgrading of the host country's industrial structure by influencing the host country's export structure [7]. From a microscopic point of view, Haskel believes that IFDI can improve the total factor productivity of enterprises, thus driving the industrial upgrading of the host country [8]. Based on either variable coefficient model or vector error correction model, some Chinese studies on the impact of IFDI on China's industrial structure reach a similar conclusion that IFDI has a greater impact on the secondary and tertiary industries than the primary industry, and it can promote the optimization of China's industries under the condition of reasonable allocation among industries [9-10].

Contrary to the above views, some scholars believe that IFDI do not play a role in China's industrial structure development and can't adjust the imbalance of China's industrial structure, but exacerbate the situation [11].

Previous studies have provided valuable references for the relation between international direct investment and industrial structure upgrading, yet most existing literature

studies this issue from the perspective of OFDI or IFDI alone. Therefore, this paper attempts to explore comprehensively the impact of two-way FDI on industrial structure development. By constructing an improved Chenery "standard structure model" and using the panel data of 17 cities from 2003 to 2018, we empirically investigate the relationship between two-way FDI and industrial structure upgrading in Shandong Province. The paper proceeds as follows. The choice of variables is explained in Section 2. Section 3 conducts an empirical analysis on effect of two-way FDI on industrial structure development. Section 4 states conclusions and policy implications.

## 2. CHOICE OF VARIABLES

### 2.1. Dependent Variables

Referring to previous research [12-13], the paper constructs industrial structure optimization index and industrial structure advancement index to measure the upgrading process of industrial structure and serves as the dependent variable. The calculation methods are as follows.

Industrial structure optimization index (*OI*): We give corresponding weight to each industry to construct industrial structure optimization index, which comprehensively reflects the balanced and optimized development of the three major industries.

$$OI = x_1 + 2x_2 + 3x_3 \quad (1)$$

where  $x_i$  is proportion of output value added of each industry to GDP, the coefficient of  $x_i$  is the weight of each industry.

Industrial structure advancement index (*AI*): We take the ratio of the output value of the tertiary industry to secondary industry as a measure of the industrial advancement, which indicates the service-oriented economic structure. The larger the index is, the higher the degree of service in the region is.

$$AI = IND3_{it} / IND2_{it} \quad (2)$$

where subscripts  $i$  and  $t$  denote city and year respectively, *IND2* and *IND3* represent the output value of the secondary and the tertiary industry respectively.

### 2.2. Core Explanatory Variables

We aim to study impacts of two-way FDI on industrial structure development. Therefore, both OFDI and IFDI are taken into account as core explanatory variable. It should be noted that the US dollar value of annual OFDI and IFDI flows are converted into RMB value by using the annual average official exchange rate.

### 2.3. Control Variables

There are many other factors to influence the industrial structure, such as the degree of openness to foreign trade (*EX*, *IM*) expressed by import and export openness respectively considering their different roles in the economy, government financial support (*FN*), innovation investment by enterprises (*RD*) and market demand (*PGDP*), which are set as control variables.

Table 1 describes the meaning and calculation of variables. All data mentioned in the table are from the Shandong Statistical Yearbook 2004-2019.

Table 2 reports summary statistics of all variables. It can be seen that the standard deviations of all variables are small, thus there is no heteroscedasticity theoretically.

## 3. EMPIRICAL ANALYSIS

### 3.1. Model Setting

"Standard Structure Model" of Chanery reveals the determinants for the change and development of industrial structure. The original expression of this model is:

**Table 1** Variable descriptions

Variable	Description
<i>OI</i>	Industrial structure optimization index: calculated by formula (1).
<i>AI</i>	Industrial structure advancement index: calculated by formula (2).
<i>OFDI</i>	Outward direct investment: ratio of outward direct investment to GDP.
<i>IFDI</i>	Inward foreign direct investment: ratio of FDI inflows to GDP.
<i>IM</i>	Import openness: ratio of import amount to GDP.
<i>EX</i>	Export openness: ratio of export amount to GDP.
<i>FN</i>	Government financial support: ratio of government financial expenditure to GDP.
<i>RD</i>	R&D investment: ratio of R&D investment by enterprise to GDP.
<i>LnPGDP</i>	Market demand : Ln(GDP per capita)

**Table 2** Descriptive statistics

Variables	Mean	St.Dev	Min	Max
<i>OI</i>	2.2723	0.1136	1.8271	2.5705
<i>AI</i>	0.7271	0.2575	0.1652	1.6806
<i>OFDI</i>	0.0178	0.0236	0.0001	0.1474
<i>IFDI</i>	0.0309	0.0463	-0.0004	0.2950
<i>IM</i>	0.1476	0.3299	0.0029	3.0984
<i>EX</i>	0.1343	0.1132	0.0279	0.5902
<i>FN</i>	0.0915	0.0281	0.0350	0.1806
<i>RD</i>	0.0137	0.0073	0.0006	0.0271
<i>LnPGDP</i>	10.5809	0.7163	8.1128	12.1649

$$X = \alpha + \beta_1 \ln Y + \beta_2 (\ln Y)^2 + \beta_3 \ln N + \beta_4 (\ln N)^2 + \sum \delta_1 T + \varepsilon F \dots \quad (3)$$

where X represents a certain aspect of industrial structure change, Y is per capita GDP, N is the total population in a specific period, F represents the flow of domestic resources or factors, and T denotes the time trend [14].

In order to investigate the influence of two-way FDI on industrial structure development in Shandong province, this paper improves the model (3) as follows. Firstly, the dependent variable X is replaced by *OI* and *AI*, *OFDI* and *IFDI* are employed as the core explanatory variable. Secondly, some domestic factors are introduced as control variables, yet time trend (T) and total population (N) are ignored due to their small influences for short time and little change in population during the period. In order to prevent the occurrence of multi-collinearity, the quadratic variables are omitted. Thus the econometric models of this paper are as follows.

$$OI_{it} = \alpha_0 + \beta_1 OFDI_{it} + \beta_2 IFDI_{it} + \sum \gamma_j x_{jit} + \varepsilon_{it} \quad (4)$$

$$AI_{it} = \alpha_0 + \beta_1 OFDI_{it} + \beta_2 IFDI_{it} + \sum \gamma_j x_{jit} + \varepsilon_{it} \quad (5)$$

where subscripts *i*, *t* and *j* stand for city, year, and control item respectively,  $x_{jit}$  represents a series of control variables,  $\varepsilon_{it}$  is a random disturbance term.

### 3.2. Empirical Estimation and Robustness Check

Firstly, a unit root test on the data is conducted before the regression because non-stationary variables may lead to a degree of pseudo-regression. The test result, which is not reported in the paper, shows that all variables are stable at the 10-percent level of significance.

Then followed by F test and Hausman test for Model (4) and (5) to select the regression model. The test results, which are not presented in this paper, indicate that whether the dependent variable is *OI* or *AI*, the fixed-effects model should be taken to estimate the parameters with city and year fixed at the same time.

Therefore, a double fixed-effects model is adopted for Model (4) and (5) by Stata15.0 to estimate the effect based on the data of 17 cities over 2003-2018 in Shandong. Table 3 reports the regression results.

It can be seen that the parameter of *OFDI* is positive and significant, indicating that *OFDI* can significantly promote industrial structure upgrading in Shandong province. a 1 percent point increase in *OFDI* is associated with an increase in industrial optimization of 0.17 percentage points and in industrial advancement of 2.44 percentage points. While *IFDI* can only promote the process of industrial optimization significantly at the 10-percent level.

From the perspective of control variables, export openness has a significant negative impact on industrial structure upgrading. An explanation is that with limited resources, enterprises can be rewarded with big profits as they export more, which may restrain their incentive of innovation and not conducive to industrial upgrading. However, the impact of import openness on the industrial optimization

and industrial advancement is not significant. The possible reason is that only by transforming the technologies of imported products into new advantages can we promote industrial upgrading effectively.

On the contrary, all other control variables such as government financial expenditure, enterprises investment

Table 3 Regression results

Variables	Model (4)	Model (5)
	<i>OI</i>	<i>AI</i>
<i>OFDI</i>	0.1742* (0.1336)	2.4356*** (0.4293)
<i>IFDI</i>	0.1008* (0.0591)	0.0842 (0.1864)
<i>IM</i>	-0.0048 (0.0081)	-0.0071 (0.0254)
<i>EX</i>	-0.1316** (0.0575)	-0.6648** (0.1816)
<i>FN</i>	0.7122*** (0.1752)	3.1455*** (0.5528)
<i>RD</i>	1.2401* (0.7084)	9.9467*** (2.2355)
<i>LnPGDP</i>	0.0857*** (0.0095)	0.1022*** (0.0301)
<i>_CONS</i>	1.2952*** (0.0899)	1.4292** (0.2837)
<i>City Fixed Effect</i>	Yes	Yes
<i>Year Fixed Effect</i>	Yes	Yes
<i>Number of observations</i>	272	272
<i>F</i>	169.17***	57.41***
<i>R<sup>2</sup> Adjusted</i>	0.8268	0.6184

Notes: \*\*\*, \*\* and \* represent significance at the level of 1-percent, 5-percent and 10-percent respectively. Standard errors are in parentheses.

Table 4 Robustness check estimation results

Variables	Model (4)	Model (5)
	<i>OI</i>	<i>AI</i>
<i>OFDI</i>	0.1806* (0.1368)	2.4822*** (0.4452)
<i>IFDI</i>	0.0912* (0.0596)	0.0382 (0.1940)
<i>IM</i>	-0.0055 (0.0081)	-0.0149 (0.0264)
<i>EX</i>	-0.1036* (0.0559)	-0.4599** (0.1819)
<i>FN</i>	0.7909*** (0.1703)	3.7777*** (0.5543)
<i>RDP</i>	0.0005* (0.0025)	0.0075* (0.0081)
<i>LnPGDP</i>	0.0955*** (0.0077)	0.0241 (0.0252)
<i>_CONS</i>	1.2025*** (0.0743)	0.5872** (0.2418)
<i>City Fixed Effect</i>	Yes	Yes
<i>Year Fixed Effect</i>	Yes	Yes
<i>Number of observations</i>	272	272
<i>F</i>	166.71***	50.84***
<i>R<sup>2</sup> Adjusted</i>	0.8274	0.5893

Notes: \*\*\*, \*\* and \* represent significance at the level of 1-percent, 5-percent and 10-percent respectively. Standard errors are in parentheses.

and GDP per capita are positively and significantly associated with both *OI* and *AI*, which suggests that economic factors play an important role in optimizing and upgrading industrial structure in Shandong province.

In order to verify the above results, robustness check is made by replacing regression variables. After replacing control variable *RD* with *RDP* (the number of R&D personnel in enterprises using the logarithm form), the estimation results reported in Table 4 are basically consistent with Table 3, which implies that the above conclusions of estimation are robust.

#### **4. CONCLUSIONS AND POLICY IMPLICATIONS**

The main focus of this paper was to explore the link between the size of two-way FDI and industrial structure upgrading to provide further evidence for current research in this field. Our study finds that there exists a positive relationship between the two-way FDI and industrial structure upgrading. In particular, OFDI has a significant positive impact on both industrial structure optimization and industrial structure advancement, while IFDI can only influence the optimization of industrial structure significantly. Besides, the increase of R&D investment and government financial support and the market demand play an important role in upgrading the industrial structure of Shandong province.

Based on the above conclusions, we put forward some policy implications as followed.

Firstly, the government should encourage enterprises to actively invest abroad in different countries according to their own conditions. Enterprises can integrate new advantages benefit for industrial upgrading by investing in developed countries to learn advanced technology. While in less developed areas, they can transfer backward production capacity, release production factors for high value-added industries and promote industrial structure upgrading.

Secondly, IFDI should be guided to invest in finance, education and other service industries in the developed areas. Meanwhile it should be relaxed restrictions on foreign investors' access to infrastructure construction in less developed areas so as to achieve a coordinated development. Finally, the government should provide preferential tax policies and financial support for enterprises while enterprises should take the initiative to innovate independently and cultivate technical talents.

However, there are still some limitations in this study. This paper does not examine empirically the regional effect as well as the impact path of two-way FDI on the upgrading of industrial structure. These issues will be the direction of our further research in the future.

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