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Research on the Relationships among Jiangsu's OFDI, Financial Development and Industrial Structure Optimization

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Abstract*—*In recent years, under the policy support of China's implementation of the "going out" strategy, Jiangsu's Outward Foreign Direct Investment (OFDI) has entered a stage of rapid development. At the same time, the optimization of industrial structure and the transformation of development mode have become the key to a new round of economic development in Jiangsu Province. Therefore, this paper empirically studies the impact of OFDI and financial development on industrial structure optimization through Jiangsu's relevant data from 1996 to 2015. The result shows that there is a long-term stable equilibrium relationships among OFDI, financial development and the optimization of industrial structure in Jiangsu Province, but the impact of various variables on the optimization of industrial structure in Jiangsu Province is quite different.

Keywords*—*Optimization of industrial structure, OFDI, Financial development.

I. Introduction

Industrial structure optimization is the core of economic structure optimization. OFDI and Financial development are important drivers to ensure industrial restructuring and promote industrial structure optimization. According to the statistics of outward foreign investment statistics, the average annual growth rate of outward foreign non-financial direct investment from 2003 to 2015 in Jiangsu Province was 60.5%. From the perspective of investment stock, the average annual growth rate of Jiangsu's outward foreign non-financial direct investment stocks from 2003 to 2015 was 63.7%. The scale of outward foreign investment in Jiangsu Province continues to expand and the speed is accelerating. In this context, Jiangsu Province, as China's major outward foreign trade province, how to promote the adjustment and optimization of industrial structure has become a major problem facing the present and future. Studying the relationship among OFDI, financial development and industrial structure optimization has certain practical significance for Jiangsu Province to "accelerate transformation and upgrading and build a strong financial province".

II. Present Situation Analysis

A. The Composition of the Three Major Industries in Jiangsu Province

This paper uses the output value structure indicators to analyze the three major industrial structures in Jiangsu Province. Figure 1 shows the composition ratio of the three major industries in Jiangsu Province in the regional GDP. It can be seen from the figure that the primary industry in Jiangsu has shown a downward trend since the 1970s, and the decline is obvious. The secondary industry is in a state of volatility, but it has always been a pillar industry in Jiangsu Province. Although the tertiary industry is volatile, the overall trend is rising. It can be seen from the above analysis that the current Jiangsu economy is driven by the interaction between the secondary industry and the tertiary industry, and the secondary industry still plays a leading role. Despite the tertiary industry has developed tremendously, Jiangsu Province will not enter the service soon. The industrialization maturity period of the industry, or the post-industrial period dominated by the service industry.

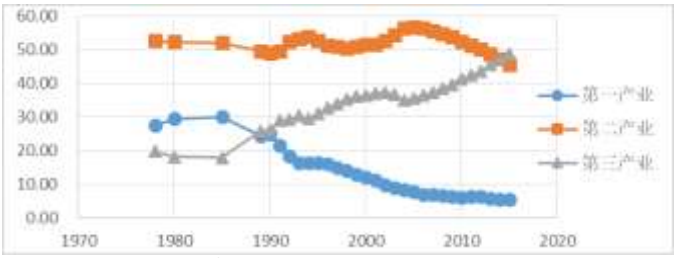

Fig. 1. Composition of the three major industrial output values in Jiangsu Province from 1978 to 2015

B. The Internal Structure of the Three Major Industries in Jiangsu Province

From the perspective of the internal structure development of the primary industry, agriculture, animal husbandry and fishery account for a large proportion, and the proportion of forestry, agriculture, forestry, animal husbandry and fishery services is very small. It can be seen from Table I at the proportion of agriculture in the first industry of Jiangsu Province is relatively large, and the proportion of the industry accounts for a large fluctuation. In 2015, it accounted for 61.67% of the output value of the primary industry. Followed by the fishery, the proportion of the output value of the primary industry is generally on the rise, reaching 20% in 2015. Finally, it is animal husbandry, although its proportion has experienced a process of rising and then falling. The smallest proportion is forestry and agriculture, forestry, animal husbandry and fishery services, with the lowest proportion of forestry but an upward trend. Although the proportion of agriculture, forestry, animal husbandry and fishery services is small, it is relatively stable. In recent years, it has basically

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stabilized at around 5.00%. It can be seen that in recent years, the increase in the output value of Jiangsu's primary industry has mainly come from agriculture.

From the perspective of the internal structure development, the secondary industry mainly includes industry and construction. It can be seen from Table II that the industrial sector is an important pillar of the secondary industry, and its output value accounts for more than 87% of the secondary industry, but the internal structure of the industrial sector is unbalanced. There are three major industries in the industrial sector, of which the manufacturing industry accounts for more than 93% of the total industrial output value, becoming the leading force in Jiangsu's industrial economy. Although the role of electricity, gas and water production and supply in the development of industrial economy has been relegated to the second place, it still plays an important role in the development of Jiangsu's economy. The proportion of mining industry in Jiangsu Province has shown a trend of rising first and then decreasing, and now the proportion is already below 0.8%. It can be seen that the internal structure of the industrial industry presents a huge imbalance.

From the perspective of the internal structure development of the tertiary industry, wholesale and retail, transportation, warehousing and postal services, real estate, and financial industries are still pillar industries, but their respective development capabilities are different. The development of service industries such as public services and cultural creativity is lagging behind. As can be seen from Table IV, the proportion of wholesale and retail, transportation, warehousing and postal services, and real estate accounted for the total value of the tertiary industry declined. However, the financial industry has developed at a faster rate, from 7.30% in 2005 to 15.64% in 2015.

TABLE II. Output Value and Internal Structure of the First Industry in Jiangsu Province (2005-2015) Unit: %

Year	Agricultural output	Forestry output	Pastoral output	Fishery production	Agriculture, forestry, animal husbandry and fishery services
2005	62.02	1.38	15.25	15.25	5.13
2006	63.38	1.41	14.08	15.49	5.63
2007	60.00	1.43	15.71	17.14	5.71
2008	57.35	1.47	17.65	17.65	4.41
2009	60.00	1.54	15.38	18.46	4.62
2010	62.30	1.64	14.75	18.03	4.92
2011	58.73	1.59	15.87	19.05	4.76
2012	60.32	1.59	14.29	19.05	4.76
2013	60.66	1.64	13.11	19.67	4.92
2014	61.02	1.69	11.86	20.34	5.08
2015	61.67	1.67	11.67	20.00	5.00

Source: Jiangsu's Bureau of Statistics, the corresponding data has been compiled.

TABLE II. Output Value and Internal Structure of the Second Industry in Jiangsu Province (2005-2015) Unit: %

Year	Industry	Construction Industry
2005	89.75	10.25
2006	90.27	9.73
2007	90.65	9.53
2008	89.96	10.22
2009	88.68	11.32
2010	88.57	11.43
2011	88.50	11.50
2012	88.05	11.95
2013	87.68	12.32
2014	87.34	12.66
2015	87.31	12.69

Source: Jiangsu's Bureau of Statistics, the corresponding data has been compiled.

TABLE III. Industrial output value and internal structure of Jiangsu Province (2005-2015) Unit: %

Year	Mining industry	Manufacturing	Electricity, Gas and Water Production and Supply
2005	1.77	93.70	4.33
2006	2.55	93.33	4.31
2007	2.18	93.45	4.37
2008	2.03	93.71	4.06
2009	1.46	93.72	4.81
2010	1.51	93.98	4.73
2011	1.32	94.05	4.41
2012	1.36	93.67	4.98
2013	0.94	94.61	4.45
2014	0.97	94.69	4.59
2015	0.75	94.49	4.76

Source: Jiangsu's Bureau of Statistics, the corresponding data has been compiled.

TABLE IV. Output Value and Internal Structure of the Third Industry in Jiangsu Province (2005-2015) Unit: %

Year	Wholesale and Retail Trade	Transportation, Warehousing and Postal Services	Real Estate Industry	Financial Industry
2005	28.37	12.08	12.08	7.30
2006	25.82	12.09	12.91	8.24
2007	25.40	11.23	13.90	10.96
2008	26.30	11.20	13.54	10.94
2009	26.26	10.35	14.90	11.62
2010	25.85	10.39	15.22	12.32
2011	25.71	10.14	13.21	12.50
2012	24.37	10.11	12.64	13.33
2013	22.64	9.01	12.09	14.51
2014	21.49	8.51	11.70	15.53
2015	20.58	8.02	10.91	15.64

Source: Jiangsu's Bureau of Statistics, the corresponding data has been compiled.

III. EMPIRICAL ANALYSIS

A. Selection of Indicators and Setting of Models

In order to test the impact of OFDI and financial development on industrial structure optimization, this paper conducts empirical analysis based on relevant data of Jiangsu Province. Based on the available theory and the availability of data collection, this paper selects the industrial structure optimization index as the explained variable. OFDI, Financial Development (FD), and Human Capital (HUM) are explanatory variables.

The choose of the explanatory variable; according to the

accompaniment-Clark's theorem, along with the economic development, the per capita national income level rises, the relative proportion of labor and national income in the primary industry gradually declines, and the relative proportion of labor and national income in the secondary industry increases relatively. With the further development of the economy, the added value of the third production and the relative proportion of the labor force began to climb. Although the theorem lacks specific proof in theory, it has been verified by experience in various countries. Based on this, in view of the availability of data and the accuracy of calculation, this paper draws on the industrial structure upgrade index proposed by Xu Deyun (2008). The indicator construction is as follows:

$$R=Y_1\times1+Y_2\times2+Y_3\times3,\ (1\ll R\ll3);$$

Among them, Y_1, Y_2 and Y_3 are the proportion of the added value of the first, second and third industries to GDP respectively. As the important sign of industrial structure optimization is the increasingly prominent position of the tertiary industry, the third industry has the largest weight assignment in the indicator design, with a value of 3. The primary industry has the smallest value of 1, and the secondary industry has a median of 2. The closer the R value is to 1, the lower the industrial structure level, and the closer to 3, the higher the industrial structure level and the more optimized the industrial structure.

In the choice of explanatory variables, the following points are mainly considered: First, the OFDI index is selected. In view of the fact that China's foreign direct investment flows are greatly influenced by policy factors, it is not conducive to systematically investigate the interaction between Jiangsu's OFDI and industrial structure optimization. Therefore, this paper selects China's Jiangsu foreign direct investment stock data for research. The second is the selection of financial development indicators (FD). The level of financial development is the basis for the optimization of financial support industry structure. This paper uses the ratio of deposit and loan balance of financial institutions in Jiangsu Province to the regional GDP as an indicator of financial development, in order to reflect the convenience of financial resources supported by unit GDP to support industrial structure optimization. The third is the selection of human capital indicators (HUM). Human capital is the main way to transform technological progress or OFDI reverse technology spillover effects into real productivity. This paper selects the number of employees at the end of the year as an indicator of human capital. Relevant data are derived from the "Statistical Bulletin of China's Foreign Direct Investment" and "Jiangsu Province Statistical Yearbook". In summary, the model is set to:

$$R = \alpha + \beta_1 LNOFDI + \beta_2 LNFD + \beta_3 LNHUM + \varepsilon;$$

Where α is a constant and ε is a disturbance term. Take natural logarithm to outward foreign direct investment, financial development and human capital. Using EViews software to analysis the data from 1996 to 2015.

B. Empirical Test of the Model

Stationarity test. In most cases, the time series data is non-stationary. If the variable is an unstable time series and is regressed, the result of pseudo-regression may occur, making the statistical test meaningless. To this end, this paper uses the ADF unit root test to test the stability of all variables (see Table V).

TABLE V. Results of ADF test for each sequence

Variable	ADF value	1% Threshold	5% Threshold	10% Threshold
R	-2.1644	-4.5326	-3.6736	-3.2774
△R	-5.1412	-3.8574	-3.0404	-2.6606
LNOFDI	-1.7328	-4.6162	-3.7105	-3.2978
△LNOFDI	-4.2539	-3.4232	-3.0638	-2.6780
LNFD	-3.5005	-4.5716	-3.6908	-3.2869
△LNFD	-4.4259	-3.8868	-3.0522	-2.6666
LNHUM	-2.7122	-4.7284	-3.7597	-3.3250
△LNHUM	-4.9885	-3.9668	-3.3421	-2.7865

It can be seen from Table V that the ADF test values of the original variables are greater than the critical values of 1%, 5%, and 10%, so the null hypothesis that there is a unit root cannot be rejected, and each variable is an unstable time series. However, the ADF test statistic of the first-order difference ΔR、ΔLNFD、ΔLNHUM of the variable is less than the critical value of 1%, and the ADF test statistic of the first-order difference ΔLNOFDI of the variable is less than the critical value of 5%, and thus the respective units of the unit root are rejected at the corresponding level. Assume that these variables are considered to be level one.

Determination of the optimal lag period of the VAR model and stability test. The key to the VAR model is to choose the maximum lag order of the explanatory variables. If the hysteresis is too small, the residuals may have auto-correlation and result in non-uniformity in parameter estimates. If the order is too large, there are many parameters to be estimated, and the degree of freedom is seriously reduced, which directly affects the validity of the model parameter estimation. This paper selects according to the five commonly used indicators of LR, FPE, AIC, SC and HQ (see Table VI).

TABLE VI. Selection of lag period of VAR model

Lag	LR	FRE	AIC	SC	HQ
O	NA*	1.25e-12	-16.0600	-15.8639*	-16.0405
1	21.5841	1.45e-12	-15.9763	-14.9960	-15.8788
2	22.7580	8.35e-13*	-16.9390*	-15.1745	-16.7635*

Note: * Item indicates the lag period selected according to the corresponding criteria

In order to examine the overall effectiveness of the VAR(2) model, a stability test of the VAR(2) model is required. In this paper, the AR root graph method is used to verify the stability of the VAR(2) model. If the reciprocal of the model's characteristic equation root is less than 1, that is, within the unit circle, the model is stable. Conversely, the model is unstable and needs further revision. As shown in Fig. 2, the reciprocal of the root of the model characteristic equation is located in the unit circle. Therefore, it can be considered that the construction of the VAR(2) model and the selection of the lag period are reasonable and effective, and the model as a whole has stability.

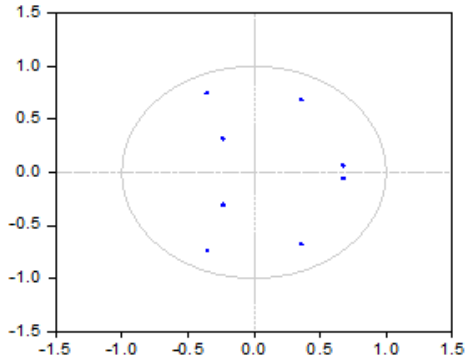

Fig. 2. Inverse Roots of AR Characteristic Polynomial

Co-integration test. In this paper, the Johansen co-integration test method is used to test whether there is a long-term relationship between the variables, that is, the co-integration relationship. Here the lag period of the Johansen co-integration test is determined to be 1. From the test results in Table VII, it can be seen that the trace statistic 58.4386 is greater than the 5% threshold value of 47.8561, so the null hypothesis that there is no co-integration relationship between several variables has been rejected at the 5% significance level. This shows that there is a co-integration relationship between them, that is, a long-term stable equilibrium relationship.

TABLE VII. Johansen cointegration test results

Null hypothesis	Eigenvalues	Trace statistics	5% Threshold	P-value
None*	0.8669	58.4386	47.8561	0.0037
At most1	0.4751	22.1402	29.7971	0.2908
At most2	0.3873	10.5392	15.4947	0.2415
At most3	0.0912	1.7221	3.8415	0.1894

Note: The observation sequence has no trend term for the intercept term in the cointegration equation, and the lag order is (1 1), * indicates that the null hypothesis is rejected at the 5% significance level; and the second row tests whether there is a cointegration relationship. The other lines test whether the cointegration vector exists in the null hypothesis.

Estimation and analysis of VAR models. For the selection of the lag period of the VAR model, according to the principle of selecting the minimum value of the lag period evaluation index such as AIC, SC and HQ, the model lag period is 2, thus establishing the VAR(2) model. The VAR model is estimated using EViews software (Table VIII).

TABLE VIII. VAR model estimation results

Explanatory variable	LNHUM	LNFD	LNOFDI
R	-0.3234	0.0830	0.0133
	(-1.6830)	(3.3221)	(4.539)

Note: The value in the second line without parentheses indicates the regression coefficient estimate of the variable. The value in parentheses below the estimated value of the regression coefficient indicates the value of the t statistic of the estimator of the corresponding regression coefficient. Values of various evaluation statistics in the VAR model: R-squared=0.9571, Adj. R-squared=0.9490, Sum squared resid=0.0009, S.E. of regression=0.0075, F-statistic=118.8815, Log likelihood =71.7846.

It can be seen from Table VIII that the sum of the squares of the residuals of the equation is very small to 0.0009; the standard error of the equation is only 0.0075; the F statistic is very large at 118.8815; and the maximum likelihood test is 71.7846. These diagnostic results show that the setting of the regression equation is correct. From the regression coefficients of the estimated results in Table VIII, it can be further understood that the impact of financial development and OFDI on the optimization of industrial structure in Jiangsu Province is significant, because the respective t statistics are significant at the 1% significance level. This means that with the continuous development and improvement of the financial industry in Jiangsu Province, it will support the industrial transformation of local enterprises in terms of capital accumulation and capital allocation, thus promoting the optimization of industrial structure in Jiangsu Province. However, the impact of human capital on the optimization of industrial structure in Jiangsu Province is not significant.

IV. Conclusion

Through the empirical analysis among Jiangsu OFDI, financial development and industrial structure optimization, this paper believes that there is a stable long-term equilibrium relationship between the three, which provides an effective way for Jiangsu Province to actively optimize the industrial structure. The three variables of financial development, human capital and OFDI have significant impacts on the optimization of industrial structure in Jiangsu Province. The financial development has a positive correlation with the optimization of industrial structure in Jiangsu Province, with a large degree of influence and significant effects; the impact of human capital on the optimization of industrial structure in Jiangsu Province is a negative effect; the impact of OFDI on the optimization of industrial structure in Jiangsu Province is also positively correlated. And the degree of influence is large and the effect is significant. It can be seen that OFDI is an important way to promote the upgrading of industrial structure. The Jiangsu provincial government should attach great importance to the OFDI activities of enterprises in the province, continue to strengthen the support of the “going out” policy, and establish the strategic position of OFDI in industrial development. In the future, it is necessary to further exert the role of OFDI reverse technology spillover effect and financial development to support Jiangsu's industrial structure optimization, and deepen the financial structure reform in the province.

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