Measuring the impact of outward direct investment on home country's employment: The case of China's ODI to the US

Abstract:

China's outward direct investment(ODI) [1]has been growing rapidly in the past few years. Understanding the impact of FDI on home country employment is of vital importance. At present, the research methods are mainly econometric model or Input-output Technology, whereas neither method could consider the lag effect and the interaction effect between industries at the same time. In this paper, a new measurement is proposed based on the state space model and input-output technology. Firstly, the state space model is used to estimate the export-ODI elasticity of China to the United States. Then, based on the elasticity, the input-output model is used to estimate the employment amount of China stimulated by ODI to the United States. The model can not only measure the direct effect of ODI growth on employment, but also take lag effect and the interaction effect of various sectors into account. Using China's ODI and export data to the US and WIOT from 2009 to 2014,we did an empirical study and find that: (1) China's ODI of construction industry and information transmission, computer services and software industry have a negative effect on the export, while in other industries there exists a positive effect; (2) The growth of ODI of single sector has a positive effect on the total employment; (3) China's employment induced by the increase of ODI to the US showed a downward trend from 2010 to 2014; (4) The impact of ODI of some industries on export showed lagging effect.

Key words: Outward direct investment, State space model, Employment effect, Input-output model

[1] In the following sections, ODI will be used instead of outward direct investment.

1. Introduction

With the continuous development of globalization, foreign direct investment has become an important means for multinational enterprises to redistribute their business in the global location, which has played an important role in the flow of resource and factors around world. Such flow has impacts on the demand of factors of both the host country and the home country, among which employment is one of the important factors. Since the 1960s, the impact of FDI activities on employment in home countries has attracted the attention of scholars in Europe and the United States (Jasay, 1960)[1]. They payed special attention on the hollowing out of industries and unemployment caused by manufacturing transfer in Europe and the United States. China used to be an important destination for foreign direct investment, while in recent years, with the strengthening of China's own strength, China's multinational enterprises' foreign business activities have gradually increased. According to the statistical bulletin on outward foreign direct investment issued by the Ministry of Commerce, China's outward direct investment flows have increased year by year, ranking third in the world in 2017, of which China's outward direct investment surpassed the actually utilized foreign capital for the first time in 2015. Previous studies mostly explored the impact of ODI on home countries from the perspective of developed countries. However, ODI in developing countries is quite different from that in developed countries, and its mechanism of impact on employment in home countries is also different. Therefore, it is meaningful to take China as an example to study the impact of ODI on employment in China.

ODI's effect on home country employment can be divided into two parts: one is employment driven by investment behavior itself, such as employment driven by equipment and raw materials imported from home country when establishing enterprises in the host country, employment driven by demand for commercial services; the other one is employment driven by daily business activities of investors after investment behavior occurs. For example, the demand for raw materials and equipment promotes the employment in the home country in daily production. In addition,

Dunning et al.(2008)[2] proposed the Eclectic Theory of International Production, who divided FDI into six types according to the OIL Paradigm established. He indicated that enterprises choose different types of investment according to their own advantages. Subsequently, scholars summarized the types of investment he proposed into four investment motivations (Jiang et. al., 2014)[3], i.e. Resource-seeking ODI, Technology-seeking ODI, Market-seeking ODI and Efficiency-seeking ODI. Resource-seeking ODI aims to seek the resources of the host country; Technology-seeking ODI aims to acquire the technology of advanced countries or carry out technological innovation by using the R&D capability of advanced countries; Market-seeking ODI aims to expand and open up overseas markets by establishing sales organizations; Efficiency-seeking ODI can be further divided into horizontal ODI and vertical ODI. Horizontal ODI refers to replicating the same production behavior in different countries and extending the production of products abroad. Vertical ODI refers to dividing production into different stages and dispersing the production of intermediate products to different countries according to the density of factors.

Based on the four investment motives, we can reasonably infer that, whether directly or indirectly, export is one of the important channels through which ODI affects employment. Hence, we proposed a measuring model in the affecting path mentioned above. Firstly, we estimate the elasticity of export to ODI of all sectors for every year by using state space model, aiming to measure the part of export changes that are related to ODI changes. By comparing the elasticity of different sectors horizontally and the elasticity of the same sector over the years vertically, we can observe the different paths of ODI affecting exports. Then, we use the world input-output table to calculate the total employment changes caused by export changes. Since input-output technology possesses the ability to depict the interdepartmental linkage of factors, our result could contain the direct and indirect effects of exports on employment. Combining this employment change with the elasticity calculated above, we can get the complete employment effects caused by ODI changes.

Empirical evidence is provided with reference to the case of China's ODI to the US throughout the period 2010-2014. Using the model mentioned above, our analysis

shows that (1) China's ODI of construction industry and information transmission, computer services and software industry have a negative effect on the export, while in other industries there exists a positive effect; (2) The growth of ODI of single sector has a positive effect on the total employment; (3) China's employment induced by the increase of ODI to the US showed a downward trend from 2010 to 2014; (4) The impact of ODI of computer services and software industry on export has a lagging effect. These findings are important for our understanding of the effects of outward FDI on the home country's employment.

The remaining of the paper is organized as follows: in section 2 we provide a brief review of the literature on the effects of ODI on domestic employment, and then illustrate our research approach. The third section describes the empirical analysis, getting the measure of employment effect of China's ODI to the US. The fourth Section concludes the paper.

2. Research background

2.1 Previous literature

In the previous literature, there is no consensus on the extent and direction of the impact of ODI on home country employment. Most scholars are concerned about whether ODI has an alternative or complementary effect on home country enterprise employment, which is related to the level of economic development of investment destination and the factor-intensive types of investment industry. From the perspective of research data, the can be divided into micro and macro perspectives. Most studies choose to use micro data. Some studies find that if parent company and subsidiary company are both in developed countries, there exists employment substitution effect in manufacturing sector, while in non-manufacturing sector, in the contrast, there is no substitution effect (see Konings et al. (2001)[4]).Konings also find that if subsidiaries are located in Eastern European countries, there are evidences showing that positive substitution effect exists in the retail and wholesale industry while no substitution effect are in other industries. Blomström et al. (1997)[5] compare the relationship between subsidiary production and parent company employment of multinational manufacturing

enterprises in the United States and Sweden, and find that MNEs in the United States transfer labor-intensive production activities to developing countries, thus reducing the employment of labor-intensive production in their home countries. Sweden's subsidiaries of MNEs are mainly distributed in developed countries, and their production activities abroad have led to the increase of blue-collar labor of home country. However, a small number of subsidiaries located in developing countries have led to the increase of white-collar labor of Sweden. Xiaolan Fu et al. (2005)[6] analyzed the growth of exports and employment in China in the context of the Smith-Myint model of 'vent for surplus', the result show that assisted by FDI and the township and village enterprises, exports have provided an effective vent for the surplus productive capacity and labor. Pushan Dutt et al. (2009) [7]present a model of trade and search-induced unemployment, they consume that trade results from Heckscher–Ohlin (H-O) and/or Ricardian comparative advantage. Using cross-country data and panel data, they find that unemployment and trade openness are negatively related and an unemployment-increasing short-run impact of trade liberalization. Stefano Elia et al.(2009)[8] capture both direct and indirect effects of foreign production on the parent company and its environment, taking the ''industrial region'' as the unit of the analysis . Using the internationalization of production by Italian firms throughout the period 1996–2002, they get the result that foreign activities have a negative impact upon the demand for low skilled workers in the parent company's ''industrial region'', but also on the demand for high skilled workers when FDI are addressed to high income countries. Ludo Cuyvers & Reth Soeng(2011)[9] perform econometric tests for complementarity or substitution between home and affiliate employment by using data of 254 Belgian parent companies with foreign affiliates in low-wage and high-wage European countries. The results indicate that Belgian MNEs with foreign affiliates in higher-wage European countries tend to employ more labor at home, whereas no evidence is found about employment reallocation between parents and affiliates operating in lower-wage European countries. Li et al. (2016)[10] analyse the impact mechanism of FDI with different investment motives on home country employment

theoretically, and then empirically study the impact of Chinese enterprises' FDI on parent company employment by using micro-enterprise level data. Empirical results show that OFDI of Chinese enterprises has a positive impact on domestic employment, and the impact varies with investment motivation. Jiang (2016) [11]uses PSM and DID to test the "employment effect" of ODI. The results reflect that foreign direct investment generally promotes the growth of enterprises' employment of home countries, of which investment in high-income countries promotes the growth of parent enterprises' employment significantly, while investment in low-income or middle-income countries does not significantly replace their own countries employment.

There are relatively few studies using macro data, Huang et al.(2007)[12] used the data of total ODI and employment to analyze the relationship between China's ODI and domestic employment. The results show that ODI has a substitution effect on China's total employment, but it is relatively limited. At the same time, ODI has promoted the optimization of China's employment structure.

2.2 Approach of this paper

It is econometric methods that are mostly used to measure the impact of ODI on home country employment in previous studies, setting different explanatory variables and cross-terms to reflect or control the impact of different factors on employment. Although such method is more intuitive, it still has some shortcomings. On the one hand, its estimation results are greatly influenced by the setting of explanatory variables, also, the selection of control variables cannot exhaust all the influencing factors, and the existence of missing variables will inevitably affect the estimation results. On the other hand, when some factors of one sector change, it will also have an impact on the input and output of other sectors due to the linkage effect of the economy. However, the general econometric methods can not reflect such linkage effect, or may not reflect the complete impact of ODI on home country employment. Based on the above shortcomings, this paper chooses to apply input-output model to measuring the impact of ODI on home country employment. Input-output model is a simplification of Walras general equilibrium model, which can reflect the technological and economic

relationship of various industrial sectors in the national economic system for a certain period of time. Besides, since the input-output coefficient is a technical parameter which is less affected by other social factors, the model can reflect the linkage effect of economy more comprehensively.

At the same time, Input-output model also has its shortcomings. Firstly, the input-output table is divided by year, which cannot reflect the lagging effect of the factor input very well. As we know, the output of a certain year is not entirely generated by the input of that year, but the input-output table can only reflect the correlation of departments within a fixed period of time, and cannot reflect the impact of the input of previous years on the output of that year. For instance, the impact of ODI on employment will not be fully reflected in the employment growth of that year, i.e. there is a lagging effect, which is beyond the scope of the input-output table. Secondly, the input-output table does not consist of outward foreign direct investment, therefore, we could not measure the employment effect of ODI directly by only using IO model. Consequently, considering that reflecting lag effect is the strong point of econometric model, we choose to combine econometric model with input-output model. According to the basic assumption of Input-output model, the same sector among trading countries share the same production function, and export growth will increase demand of production factors according to the domestic production technology. Based on this assumption, we can conclude that the impact of ODI on exports will further affect domestic employment. To begin with, we estimate the elasticity of export to ODI and substitute the estimated elasticity into the export column vector of WIOT to calculate the employment change stimulated by ODI.

When examining the impact of ODI on employment using macro data, most previous studies have either distinguished the host country type or the industry type, but few have distinguished the host country and the industry at the same time. The results of this paper will make up for the blank of such kind of research, and reveal the employment impact of China's ODI to the United States in detail.

3. The empirical analysis

3.1 The framework

(1) Estimation of Elasticity of Export to ODI

The investment motivation of different industries varies with the product characteristics and the demand of production factors, so the impact of ODI on exports of different industries is heterogeneous. As time goes by, the elasticity of export to ODI might also change. It is an ideal circumstance that the elasticity of export to ODI could be estimated for different industries in different years, so that the changes of elasticity over industries and years will be depicted, using existing data information as much as possible. Under such condition, the Time-varying State Space Model is a good choice. State Space Model has the advantages as follows: the model could incorporate the unobservable variables (state variables) into the observable model to obtain the estimation results; besides, Kalman filter iteration algorithm is used to estimate all unknown parameters in the model, and the estimation of state vector can be continuously revised according to the new predicted values.

The time-varying parameter model is set as follows:

Measurement equation: $\log(ex_{it}) = \mathrm{c}(1) + \alpha_{it} * \log(odi_{it}) + u_{it}$ (1)

State equation: $\alpha_{it} = c(2) + \gamma_{it} * \alpha_{it-1} + \varepsilon_{it},\ t = 1, \dots T,\ i = 1, \dots, n$ (2)

Suppose error term $\begin{pmatrix} u_t \\ \varepsilon_t \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_u^2 & 0 \\ 0 & \sigma_\varepsilon^2 \end{pmatrix}\right)$

where i is the industry sector, t is the time, ex_{it} is the export volume of i sector in the year t, odi_{it} is the direct investment of i sector in the year t. After processing export and odi with logarithm, the obtained α_{it} is the export elasticity to ODI of sector i in the year t.

(2) The measure of employment caused by export based on Input-Output technology

Based on the WIOT from World Input-Output database, this paper established a multiregional input-output model (MRIO) to measure the employment caused by export.

According to the Input-output technology, the gross output of a country is given by:

$$X_i = A_{ii}X_i + Y_{ii} + \sum_{i \neq j} e_{ij} \quad (3)$$

where X_i is the gross output of country i, which can be divided into intermediate consumption and final consumption, $A_{ii} = Z_{ii} * \widehat{X_i}^{-1}$ is the domestic direct consumption coefficient matrix of country i, Y_{ii} is the final consumption of country i. e_{ij} is the export of country i to country j, consisting of two parts: intermediate products and final products, which can be expressed as:

$$e_{ij} = A_{ij}X_j + y_{ij} \quad (4)$$

where $A_{ij} = Z_{ij} * \widehat{X_j}^{-1}$ is the direct consumption coefficient matrix of intermediate product imports from country i to country j, X_j is the gross output of country j and absolutely $A_{ij}X_j$ is the export of intermediate products of country i to country j, y_{ij} is the export of final products of country i to country j. Combine equation (1) and equation (2) and we will get:

$$X_i = A_{ii}X_i + Y_{ii} + \sum_{i \neq j} A_{ij}X_j + \sum_{i \neq j} y_{ij} \quad (5)$$

Therefore, by introducing the export-ODI elasticity into MRIO, we can calculate respectively the employment growth caused by the intermediate product export growth and final product export growth induced by ODI.

$$\Delta L^{interm} = \mathrm{A_L}(\mathrm{I} - \mathrm{A_{ii}})^{-1}\Delta E_{ij}^{i} = \mathrm{A_L}(\mathrm{I} - \mathrm{A_{ii}})^{-1}\mathrm{A_{ij}}X_j * \Delta odi * \alpha_t \quad (6)$$

$$\Delta L^{final} = A_L(I - A_{ii})^{-1}\Delta E_{ij}^{f} = A_L(I - A_{ii})^{-1} E_{ij}^{f} * \Delta odi * \alpha_t \quad (7)$$

$$\Delta \mathrm{L} = \Delta L^{interm} + \Delta L^{final} \quad (8)$$

where $\mathrm{A_L} = \frac{L_i}{X_i}$ is the employment coefficient and $\mathrm{L_i}$ is the number of persons engaged.

It can be seen from the equation above that when ODI changes by Δodi(percentage), the intermediate product and final product export will change by $\Delta odi * \alpha_t$(percentage), thus stimulating employment by ΔL(persons).

3.2 Data and variables

To examine the impact of ODI on the home country's employment, we choose the ODI from China to the US as an instance. Although China is not the largest foreign

investor in the United States, against the background of closer Sino-US trade relations and coexistence of constant Sino-US trade frictions, China-US ODI will play an increasingly important role. What's more, statistics on investment and trade between China and the United States are relatively more complete.

Our dependent variable is the logarithmic form of China's ODI stock to the US collected from Chinese Ministry of Commerce (Mof Com) database over the period 2007-2017, covering 14 industries. Logarithm can not only improve the stability of data but also help us get coefficients with economic meaning of elasticity.

The independent variable is the logarithmic form of China's export to the US. Export data can be further divided into exports of goods and exports of services. Data of exports of goods come from China Customs, providing the export data by HS commodity classification. Restricted by the data availability, service export data are derived from the U.S. Bureau of Economic Analysis data on imported services from China, in which tourism import data are divided into different service industries according to the proportion of international tourism income.

As the sector classification of ODI stock is broader than that of the export data, we aggregated the original exports of goods with 98 chapters and the exports of service with 21 sectors into the one with 14 sectors, mainly based on the similarity in the character of the production process of each product.

The 14 sectors are manufacturing; wholesale and retail; leasing and business services; financial (including insurance); scientific research, technical services and geological prospecting; transportation, warehousing and postal; construction; mining; information transmission; computer services and software; real estate; accommodation and catering; residential services and other services; agriculture, forestry, animal husbandry and fisheries; and other industries.

Since the export data of sector Real estate and Wholesale and retail is zero across all the years, we eliminate these two sectors, building a database containing 12 sectors over 2009-2016. To simplify the presentation of departments, we numbered them as follows:

Table 1 Cross-reference of the sector and number

Number	Sector
1	Manufacturing
2	Leasing and business services
3	Financial
4	Scientific research, technical services and geological prospecting
5	Transportation, warehousing and postal
6	Construction
7	Mining
8	Information transmission, computer services and software
9	Accommodation and catering
10	Residential services and other services
11	Agriculture, forestry, animal husbandry and fisheries
12	Other industries

3.3 Results

(1) The estimation result of elasticity of export to ODI

Using the ODI data and export data above mentioned, we can calculate the elasticity of export to ODI for each industry and each year according to equation (1) and (2). The results are shown in Table 2.

Table 2 The elasticity of export to ODI for each industry and each year

	2010	2011	2012	2013	2014	2015	2016
1	0.203182	0.23125	0.240205	0.243126	0.245064	0.245689	0.244377
2	0.232303	0.21952	0.223565	0.220584	0.226381	0.228304	0.227216
3	0.288316	0.313935	0.329486	0.321317	0.32021	0.31666	0.319938
4	0.253324	0.264123	0.290014	0.310753	0.323295	0.333434	0.330232
5	0.34369	0.368075	0.372347	0.373829	0.370842	0.369961	0.370255
6	-0.58555	-0.69105	-0.67706	-0.6961	-0.69131	-0.68335	-0.67254

7	-0.32731	-0.21728	-0.18639	-0.17378	-0.16983	-0.17196	-0.22005
8	-0.1449	-0.13033	-0.11294	-0.09932	-0.08496	-0.09305	-0.09721
9	0.165207	0.16842	0.152056	0.147033	0.143144	0.143257	0.146132
10	0.21813	0.185604	0.16054	0.156721	0.157342	0.162449	0.167729
11	0.28232	0.344742	0.357032	0.348762	0.340052	0.337323	0.360626
12	0.054139	0.153216	0.138436	0.121086	0.113458	0.112871	0.120498

As we can see from the result, the elasticity of Construction, Mining, Information transmission, computer services and software is negative, which means that the ODI growths in these three sectors have a negative impact on their exports. The possible reasons are as follows:

The motivation of ODI of Information transmission, computer services and software sector is mainly technology-seeking. In order to acquire advanced technology of developed country, enterprises of home country usually choose to invest abroad by M&A or joint venture, thus stimulating the local production of host country, whereas having little impact on domestic production in the short run. While in the long run, the technology spillover effect would arise gradually with the development of Chinese enterprises, promoting the production capacity of domestic enterprises. What's more, the inter-industry technology spillover would further promote the upgrading of domestic industrial structure, and promote the export of various sectors.

In terms of construction industry, although ODI in this industry has been on the rise in recent years, there is still a big gap between China's construction multinational corporations and the top international construction MNEs. Especially in the investment in the United States, Chinese corporations have several limitations when competing with American corporations, and it is difficult for them to enter the United States market, which might have a negative effect on domestic exports.

The results show that the elasticity of export to ODI varies relatively little during the year, and fluctuates slightly around the mean value, which indicates that China's ODI to the US has not yet had a significant impact on the export structure and domestic production capacity in the short term. Overall, the positive effect of FDI growth on

exports in most sectors also confirms the theory of ODI export effect mentioned above.

Furthermore, the first-order lag term of ODI stock is added into the independent variable, and the calculated results show that the lag coefficient of most departments is not significant, only the coefficient before the first-order lag term of sector Information transmission, computer services and software is significantly positive, which shows that the industry's ODI has a lag effect on exports. The results are as follows:

Table 3 The elasticity of export to ODI and ODI(-1) of sector Information transmission, computer services and software

	ODI	ODI(-1)
2011	-0.00569	-0.00541
2012	-0.94997	0.988297
2013	-0.47645	0.497824
2014	-0.18001	0.219122
2015	-0.39066	0.425773
2016	-0.42179	0.456739

Where ODI(-1) means the first-order lag term of ODI stock.

(2) The estimation result of employment induced by ODI

Since the latest released world input-output table is of year 2014, we only measured the employment induced by ODI for 2010-2014. Assuming ODI increases by 5%, employment will grow as follows:

Table 4 The number of employment growth in every sector induced by the growth of total ODI (thousand persons)

	2010	2011	2012	2013	2014
1	224.1859	213.8659	204.6132	198.7485	192.2941
5	6.895039	7.06416	6.523529	5.088685	5.608902
2	4.226705	3.886987	3.987871	2.21306	2.235047
11	2.138294	1.919575	2.102808	1.787757	1.730955
10	1.243925	1.015488	0.602572	0.258169	0.230902
12	0.052811	0.08132	0.105796	0.071035	0.078842
4	0.044597	0.042202	0.042502	0.020616	0.018989
3	0.005055	0.003929	0.003792	0.003451	0.002713
6	0	0	0	0	0
9	0	0	0	0	0
8	-0.02521	-0.02339	-0.01826	-0.01407	-0.01072
7	-0.9739	-0.88165	-0.81418	-0.69998	-0.6759

Table 4 implies the number of employment growth in every sector when the ODI in each sector increases by 5%. For example, the first cell in Table 4 means that when ODI increases by 5% in all 12 sectors, employment in the manufacturing sector grows by 224.1859 thousand people. However, the employment growths in the Construction and Accommodation and catering sector are zero, for the export of the two sectors to the US. in the WIOT is zero. The reasons for such circumstance are complex. Firstly, the motivation of ODI in most sectors is market-seeking, i.e. establishing sales agencies or other institutions overseas to expand the market, thus promoting the export of domestic products. Such type of investment may be classified into sector Wholesale and retail or Catering and accommodation. There is no denying that the operation activities of such agencies or institutions will promote the export of the sectors where parent companies locate, while will not be reflected in the export of service industries, leading to the result of zero export of the sectors mentioned above. The possible solution is to divide the motivation of ODI of all sectors, so as to take the mismatch of

the sector between ODI and export into account, which is also the direction of our future efforts. However, limited to the data availability currently, there is still a long way to go.

It is clearly that the employment growths are negative in sector Mining and Information transmission, computer services and software, which is mainly caused by the negative elasticity of export to ODI. When ODI increases, the export of this industry decreases. It might be attributed to the substitution effect of foreign enterprise production on the production of home country enterprises, thus squeezing out domestic employment, which is worthy of our vigilance.

The increase of ODI in sector Manufacturing has the greatest stimulating effect on employment, followed by sector Transportation, warehousing and postal industry, Leasing and business services. When the ODI of manufacturing industry increases, the export of transportation, warehousing, postal, leasing and commercial services will be further promoted by freight and the establishment of enterprises overseas.

Table 5 The number of total employment growth induced by the growth of ODI of a single sector (thousand persons)

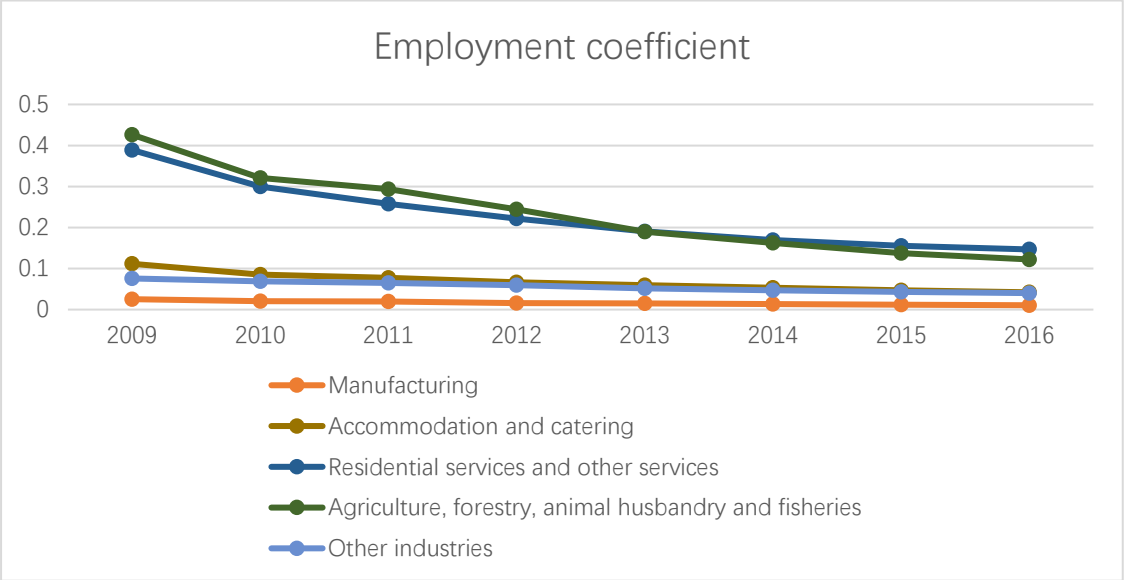
	2010	2011	2012	2013	2014
1	114.1166	114.7999	108.9285	102.3322	95.93226
11	63.47092	51.1572	47.56491	42.06194	39.01143
12	23.9648	24.56234	25.22437	27.41023	28.53593
10	10.2824	9.606909	9.29975	9.467225	10.39135
5	7.683914	7.981846	7.826174	7.381303	7.737049
7	5.01619	6.241801	5.628018	6.069812	6.544165
3	3.947515	3.924389	4.00035	4.276358	4.485207
9	3.550688	3.242433	3.266322	3.049822	3.077479
2	2.956647	2.772606	2.81381	2.561331	2.73326
4	1.348689	1.217923	1.200964	1.31841	1.442176
8	0.900707	0.793874	0.728902	0.800273	0.875066
6	0.554153	0.673318	0.667543	0.748285	0.748492

Table 5 implies the specific number of change in total employment when ODI in a single sector increases by 5%. For instance, the first cell in Table 5 means that when ODI in manufacturing industry increases by 5%, the total employment of all industries will grow by 114,1166 thousand persons. The result indicates that although there exists some negative effects of China's ODI to the US on home country's employment in some sectors, the present impact is generally positive.

However, it is worth noting that from 2010 to 2014, the results in Table 4 and Table 5 all show a declining trend, no matter what the sector is. The reasons may be as follows: Firstly, the employment coefficients of various industries are decreasing year by year during 2010-2014, as shown in Figure 1. This is the consequent of the continuous improvement of domestic labor productivity in recent years, which can be partly attributed to the technology spillover effect of ODI. Secondly, the industrial structure and employment structure of China are also changing, such as the change of direct consumption coefficient. Finally, the department structure of ODI has been changing constantly in recent years, such as the rise of ODI of sector Manufacturing and the decline of ODI of sector Mining. Since the impact mechanism of different motivation types of ODI on employment is different, the fluctuation of the intensity of substitution effect and complementarity effect will have an impact on overall employment.

Detailed data on employment driven by ODI growth in each sector for year 2010-2014 are listed in the appendix, see Table 6-10. For instance, the first cell in Table 6 means that when ODI in sector Manufacturing increases by 5%, the employment of sector Manufacturing will grow by 2.0411 thousand persons.

Figure 1 The change of employment coefficients of various industries



4. Conclusion and discussion

In this paper, a new measurement model is proposed to measure the specific impact of ODI on employment based on the state space model and input-output technology, which can take the interaction effect between industries and the change of the elasticity of export to ODI into account at the same time. Firstly, the export-ODI elasticity is estimated using the state space model. Then, by introducing the calculated elasticity into the input-output model, we can get the employment amount stimulated by ODI with the help of world input-output table. The model can not only measure the direct effect of ODI growth on employment, but also take lag effect and the interaction effect of various sectors into consideration. Using China's ODI and export data to the US and WIOT from 2009 to 2014, we did an empirical study and the result shows that China's ODI of sector Construction, Mining and Information transmission, computer services and software have a negative effect on the export, while in other industries there exists a positive effect; the above results may be attributed to the different influencing mechanism of ODI with different investment motives. The result also implies that the growth of ODI of single sector has a positive effect on the total employment, while China's employment induced by the increase of ODI to the US shows a downward trend from 2010 to 2014, which is worth putting attention to. Our further test shows that ODI

in the information transmission industry has a lagging effect on exports.

Admittedly, more empirical analysis is needed on the issue of measuring the employment effect of ODI in the future study. For example, ODI in manufacturing industry should be described more carefully. Current data failed to distinguish different types of manufacturing industry and reflect the changes in the internal structure of manufacturing industry. In addition, we will try to divide ODI into different classifications according to investment motivation, and calculate the impact of ODI on employment from different types of ODI's influence mechanism. Furthermore, later estimation should embrace a longer time span to reflect the change of elasticity of export to ODI with time varying.

Appendix

Table 6 Employment growth driven by ODI growth in each sector for year 2010 (thousand persons)

	1	2	3	4	5	6	7	8	9	10	11	12	total
1	2.0411	-0.1120	59.4293	0.0000	1.1802	0.0000	-0.0026	0.0010	0.8450	0.0126	0.0689	0.0075	63.4709
2	0.0052	-0.4250	4.9747	0.0000	0.3686	0.0000	-0.0003	0.0000	0.0832	0.0006	0.0045	0.0047	5.0162
3	0.0362	-0.1533	112.4340	0.0000	0.9785	0.0000	-0.0040	0.0004	0.7635	0.0057	0.0468	0.0089	114.1166
4	0.0005	-0.0041	0.5132	0.0000	0.0279	0.0000	-0.0001	0.0000	0.0137	0.0002	0.0022	0.0005	0.5542
5	0.0068	-0.0350	5.0227	0.0000	2.5431	0.0000	-0.0005	0.0001	0.1363	0.0010	0.0076	0.0018	7.6839
6	0.0033	-0.0225	3.0648	0.0000	0.2455	0.0000	-0.0007	0.0006	0.2461	0.0018	0.0100	0.0017	3.5507
7	0.0011	-0.0045	0.8416	0.0000	0.0485	0.0000	-0.0107	0.0001	0.0221	0.0002	0.0019	0.0005	0.9007
8	0.0044	-0.0280	3.6414	0.0000	0.1994	0.0000	-0.0007	0.0014	0.1211	0.0005	0.0057	0.0024	3.9475
9	0.0015	-0.0108	1.7562	0.0000	0.0726	0.0000	-0.0006	0.0001	1.1331	0.0005	0.0076	0.0013	2.9617
10	0.0016	-0.0062	0.8096	0.0000	0.0171	0.0000	-0.0001	0.0000	0.0086	0.0005	0.0033	0.0006	0.8349
11	0.0102	-0.0689	8.5354	0.0000	0.4446	0.0000	-0.0013	0.0006	0.2974	0.0034	1.0532	0.0078	10.2824
12	0.0041	-0.0293	2.9439	0.0000	2.4404	0.0000	-0.0005	2.4034	0.1126	0.0002	0.0055	0.0112	7.8917
total	2.1157	-0.8995	203.9670	0.0000	8.5663	0.0000	-0.0219	2.4079	3.7827	0.0271	1.2172	0.0490	221.2114

Table 7 Employment growth driven by ODI growth in each sector for year 2011 (thousand persons)

	1	2	3	4	5	6	7	8	9	10	11	12	total
1	1.8149	-0.0813	47.6563	0.0000	1.0200	0.0000	-0.0021	0.0007	0.6793	0.0106	0.0491	0.0096	51.1572
2	0.0069	-0.4210	6.0789	0.0000	0.4622	0.0000	-0.0003	0.0000	0.1001	0.0008	0.0046	0.0096	6.2418
3	0.0407	-0.1419	113.0239	0.0000	1.0536	0.0000	-0.0041	0.0003	0.7651	0.0060	0.0417	0.0146	114.7999
4	0.0006	-0.0043	0.6237	0.0000	0.0346	0.0000	-0.0001	0.0000	0.0155	0.0003	0.0021	0.0009	0.6733
5	0.0072	-0.0299	5.1362	0.0000	2.7238	0.0000	-0.0005	0.0001	0.1342	0.0010	0.0069	0.0029	7.9818
6	0.0031	-0.0171	2.8032	0.0000	0.2245	0.0000	-0.0006	0.0005	0.2166	0.0018	0.0080	0.0023	3.2424
7	0.0009	-0.0036	0.7345	0.0000	0.0491	0.0000	-0.0098	0.0001	0.0202	0.0002	0.0015	0.0007	0.7939
8	0.0047	-0.0252	3.6069	0.0000	0.2116	0.0000	-0.0007	0.0013	0.1167	0.0005	0.0049	0.0038	3.9244
9	0.0015	-0.0094	1.6702	0.0000	0.0707	0.0000	-0.0005	0.0001	1.0361	0.0005	0.0069	0.0022	2.7782
10	0.0014	-0.0048	0.7275	0.0000	0.0155	0.0000	-0.0001	0.0000	0.0074	0.0005	0.0027	0.0008	0.7510
11	0.0092	-0.0544	8.1149	0.0000	0.4144	0.0000	-0.0011	0.0004	0.2515	0.0033	0.8586	0.0101	9.6069
12	0.0035	-0.0211	2.4861	0.0000	2.1027	0.0000	-0.0004	2.0626	0.0913	0.0002	0.0040	0.0175	6.7464
total	1.8946	-0.8139	192.6623	0.0000	8.3827	0.0000	-0.0201	2.0662	3.4339	0.0254	0.9910	0.0750	208.6972

Table 8 Employment growth driven by ODI growth in each sector for year 2012 (thousand persons)

	1	2	3	4	5	6	7	8	9	10	11	12	total
1	1.9770	-0.0768	43.9245	0.0000	0.9597	0.0000	-0.0016	0.0007	0.7271	0.0106	0.0295	0.0143	47.5649
2	0.0076	-0.3802	5.5086	0.0000	0.3866	0.0000	-0.0002	0.0000	0.0937	0.0007	0.0025	0.0087	5.6280
3	0.0492	-0.1313	107.2374	0.0000	0.9661	0.0000	-0.0033	0.0003	0.7597	0.0061	0.0255	0.0187	108.9285
4	0.0007	-0.0041	0.6181	0.0000	0.0321	0.0000	-0.0001	0.0000	0.0178	0.0003	0.0012	0.0015	0.6675

5	0.0088	-0.0278	5.1942	0.0000	2.5044	0.0000	-0.0004	0.0001	0.1377	0.0010	0.0044	0.0038	7.8262
6	0.0037	-0.0157	2.8463	0.0000	0.2086	0.0000	-0.0004	0.0005	0.2125	0.0019	0.0051	0.0039	3.2663
7	0.0010	-0.0033	0.6682	0.0000	0.0474	0.0000	-0.0074	0.0001	0.0208	0.0002	0.0009	0.0010	0.7289
8	0.0058	-0.0252	3.6775	0.0000	0.2092	0.0000	-0.0006	0.0013	0.1240	0.0005	0.0031	0.0047	4.0003
9	0.0019	-0.0097	1.7130	0.0000	0.0660	0.0000	-0.0004	0.0001	1.0396	0.0005	0.0040	0.0028	2.8178
10	0.0016	-0.0044	0.7122	0.0000	0.0139	0.0000	-0.0001	0.0000	0.0074	0.0005	0.0017	0.0011	0.7339
11	0.0103	-0.0501	8.1651	0.0000	0.3770	0.0000	-0.0008	0.0004	0.2719	0.0034	0.5056	0.0171	9.2997
12	0.0037	-0.0175	2.3008	0.0000	1.9776	0.0000	-0.0003	1.9423	0.0973	0.0002	0.0025	0.0193	6.3258
total	2.0713	-0.7461	182.5660	0.0000	7.7485	0.0000	-0.0156	1.9458	3.5096	0.0258	0.5860	0.0969	197.7880

Table 9 Employment growth driven by ODI growth in each sector for year 2013 (thousand persons)

	1	2	3	4	5	6	7	8	9	10	11	12	total
1	1.6699	-0.0603	39.3708	0.0000	0.6945	0.0000	-0.0011	0.0006	0.3629	0.0047	0.0115	0.0086	42.0619
2	0.0072	-0.3331	6.0247	0.0000	0.3073	0.0000	-0.0002	0.0000	0.0553	0.0004	0.0011	0.0071	6.0698
3	0.0444	-0.1094	101.1760	0.0000	0.7756	0.0000	-0.0025	0.0003	0.4216	0.0029	0.0106	0.0127	102.3322
4	0.0007	-0.0038	0.7120	0.0000	0.0272	0.0000	-0.0001	0.0000	0.0104	0.0002	0.0006	0.0010	0.7483
5	0.0081	-0.0235	5.3870	0.0000	1.9268	0.0000	-0.0003	0.0001	0.0781	0.0005	0.0019	0.0027	7.3813
6	0.0032	-0.0125	2.7897	0.0000	0.1516	0.0000	-0.0003	0.0005	0.1125	0.0009	0.0020	0.0023	3.0498
7	0.0010	-0.0029	0.7555	0.0000	0.0389	0.0000	-0.0057	0.0001	0.0123	0.0001	0.0004	0.0007	0.8003
8	0.0056	-0.0222	4.0450	0.0000	0.1699	0.0000	-0.0004	0.0012	0.0723	0.0003	0.0014	0.0035	4.2764
9	0.0019	-0.0087	1.9245	0.0000	0.0554	0.0000	-0.0003	0.0001	0.5866	0.0002	0.0016	0.0019	2.5633
10	0.0015	-0.0039	0.7886	0.0000	0.0117	0.0000	0.0000	0.0000	0.0045	0.0002	0.0008	0.0008	0.8042
11	0.0098	-0.0437	8.8164	0.0000	0.3031	0.0000	-0.0007	0.0004	0.1518	0.0017	0.2177	0.0108	9.4672
12	0.0033	-0.0142	2.3329	0.0000	2.0267	0.0000	-0.0002	1.9896	0.0546	0.0001	0.0010	0.0123	6.4061
total	1.7565	-0.6382	174.1230	0.0000	6.4888	0.0000	-0.0119	1.9927	1.9229	0.0122	0.2505	0.0643	185.9608

Table 10 Employment growth driven by ODI growth in each sector for year 2014 (thousand persons)

	1	2	3	4	5	6	7	8	9	10	11	12	total
1	1.6046	-0.0552	36.3602	0.0000	0.7306	0.0000	-0.0008	0.0004	0.3488	0.0041	0.0096	0.0091	39.0114
2	0.0082	-0.3227	6.4407	0.0000	0.3504	0.0000	-0.0001	0.0000	0.0579	0.0004	0.0011	0.0084	6.5442
3	0.0443	-0.0996	94.7385	0.0000	0.8246	0.0000	-0.0018	0.0002	0.4012	0.0026	0.0089	0.0134	95.9323
4	0.0007	-0.0036	0.7094	0.0000	0.0298	0.0000	0.0000	0.0000	0.0104	0.0001	0.0005	0.0011	0.7485
5	0.0089	-0.0232	5.5639	0.0000	2.1019	0.0000	-0.0002	0.0000	0.0806	0.0005	0.0017	0.0030	7.7370
6	0.0036	-0.0120	2.8036	0.0000	0.1656	0.0000	-0.0002	0.0003	0.1115	0.0008	0.0017	0.0025	3.0775
7	0.0011	-0.0030	0.8208	0.0000	0.0458	0.0000	-0.0044	0.0001	0.0134	0.0001	0.0004	0.0008	0.8751
8	0.0062	-0.0220	4.2256	0.0000	0.1944	0.0000	-0.0003	0.0009	0.0750	0.0003	0.0013	0.0040	4.4852
9	0.0021	-0.0090	2.0743	0.0000	0.0653	0.0000	-0.0002	0.0001	0.5988	0.0002	0.0014	0.0020	2.7349
10	0.0019	-0.0040	0.8584	0.0000	0.0141	0.0000	0.0000	0.0000	0.0048	0.0002	0.0007	0.0010	0.8771
11	0.0117	-0.0456	9.6832	0.0000	0.3664	0.0000	-0.0005	0.0003	0.1659	0.0017	0.1955	0.0128	10.3913
12	0.0038	-0.0143	2.5696	0.0000	2.2572	0.0000	-0.0002	2.2173	0.0656	0.0001	0.0010	0.0126	7.1127
total	1.6970	-0.6143	166.8482	0.0000	7.1460	0.0000	-0.0091	2.2197	1.9339	0.0111	0.2238	0.0708	179.5272

References

[1] Jasay, A.E. The Social Choice between Home and Oversea Investment, Economic Journal 1960, vol.70, No. 277.

[2] Dunning, J. H., Lundan, S. (2008). Multinational enteprises and the global economy, 2nd ed. Cheltenham: Edward Elgar.

[3] Jiang Guanhong. 2016.Employment Effect of Outward Direct Investmen, Statistical Research, Vol.33, No.8: 55- 62.

[4] Konings, Jozef and Murphy, Alan. 2001. Do Multinational Enterprises Substitute Parent Jobs for Foreign Ones? Evidence from European Firm Level Panel Data. CEPR Discussion Paper, No. 2972.

[5] Blomström, Magnus; Fors, Gunnar; Lipsey, Robert E. 1997. Foreign Direct Investment and Employment: Home Country Experience in the United States and Sweden, IUI Working Paper, No. 490, The Research Institute of Industrial Economics (IUI), Stockholm.

[6] FU X-l, BALASUBRAMANYAM V N. 2005.Exports, foreign direct investment and employment: The case of China[J]. World Economy, 28(4): 607-625.

[7] DUTT P, MITRA D, RANJAN P. 2009. International trade and unemployment: Theory and cross-national evidence[J]. Journal of International Economics, 78(1): 32 - 44.

[8] STEFANO E, MARIOTTI I, PISCITELLO L. The impact of outward FDI on the home country's labour demand and skill composition[J]. International Business Review, 2009, 18(4): 357 - 372.

[9] CUYVERS L, SOENG R. The effects of Belgian outward direct investment in European high-wage and low-wage countries on employment in Belgium[J]. International Journal of Manpower, 2011, 32(3): 300-312.

[10] Li Lei， Bai Daohuan, Xian Guoming.2016. How Does Outward Foreign Direct Investment Affect Home- country Employment: Based on China’s Micro- level Enterprises Database. Economic Research. Vol.8: 144- 158.

[11] Jiang Guanhong. 2016.Employment Effect of Outward Direct Investment, Statistical Research, Vol.33, No.8: 55- 62.

[12] Huang Xiaoling, Liu Huizheng. 2007. An Employment Effect Analysis of China's Foreign Direct Investment. Modernization of Management. Vol.1: 45-48.