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Empirical Study on the Technical Linkage and Spread Effect of China's Construction Industry

Mingyuan Liu
School of Economics and Trade
Fujian Jiangxia University
Fuzhou, China 350108

Minshu Lin
School of Economics
Xiamen University
Xiamen, China 361005

***Abstract*—The construction industry is one of the investment-driven final demand industries that plays a significant role in China's economic growth in terms of its huge scale of investment in fixed assets and the accelerated growth of added value. This paper makes an in-depth analysis of the cross-industrial technical linkage and spread effect based on the Input-Output model. The model measurement results show the years from 2000 to 2014 has witnessed the yearly increase of China's construction industry backward linkage effect and spread effect, as well as the improving of the industrial strategic position. But as final demand industry, its influence and reaction coefficient is less than the intermediate demand industry, and the forward linkage effect is not significant. Through international comparison, it is discoved in the high income level countries like the United States, Germany, Japan, the spread effect is less than in china, and that the dependence coefficient of all representative countries is ranked first in all industries. In order to adapt to the new normal of China's economic development, we should strengthen the technical linkage between the construction industry and other industries, improve the total factor productivity and production quality of construction industry.**

Keywords—construction industry; industrial technical linkage; industrial spread effect; input-output model

I. INTRODUCTION

The construction industry is an economic activities collection of the company which engages in the structures, housing construction and equipment installation and related activities, and is the secondary industry the same as the mining and quarrying, electricity, gas, steam and air conditioning supply industry. The construction industry usually has the characteristics of strong radiation, weak restriction and long industrial chain (Tiantu Liao, et al, 2012)[1],becomes one of the pillar industries and is becoming more and more important to the national economy development in the evolution process of the industrial structure.

As regards china's construction industry and its technical linkage problems, many scholars have paid attention to and obtained lots of research achievements from. Shenjun Qi, Yunbo Zhang (2012) thought the construction industry was a typical strong impact and high emission industry which made other industries produce huge carbon emissions [2]. Yujie Lu, et al(2016), Jingke Hong, et al (2017), Mohammed, et al(2017) analyzed the characteristics, energy consumption, development driving power of the construction industry from the perspectives of carbon emissions and its policy, energy demand, linear and circular supply chain[3,4,5]. Bingsheng Liu and Bin Xue (2015) analyzed the regional spatial differences of China's construction industry based on such three dimensions as development, competition and cooperation association [6].Ying Liu, et al (2016) empirically analyzed the linkage between the construction industry and other industries by grey relational model. The results showed that the construction industry has a high linkage with other 17 industries [7]. These research achievements provide a good way of thinking and methods for future studies in construction industry, especially for the industrial technical linkage.

Under the new normal of China's economic development, Chinese industry development speed has slowed down and industry structural problems have become increasingly prominent. Therefore, on the basis of the existing research, this paper will use the Input-Output model to make an in-depth analysis of the technical economic linkage and spread effect between construction industry and other industries, and puts forward a new idea and countermeasures in order to promote the industrial development and improve the construction industry production quality, so as to increase its contribution to the national economy development.

II. DEVELOPMENT AND CHARACTERISTICS OF CHINA'S CONSTRUCTION INDUSTRY

China's GDP was 74.41 trillion yuan in 2016, of which the fixed capital formation was 31.89 trillion yuan, accounting for 44.2 percent of China's GDP. Obviously the investment-driven was the main mode of China's economic growth. The data show that the scale of total fixed assets investment was 60.69 trillion yuan in 2016, an increase of 7.9%, of which the scale of the urban fixed assets investment was 59.65 trillion yuan, the secondary industry was 23.20 trillion yuan, the construction industry was 0.46 trillion yuan, respectively accounting for 98.35 %, 38.25 %, 0.76 % of the total fixed asset investment. As one of the investment-driven industries, to a certain extent, the construction industry's contribution to China's economic growth depends on the scale of its investment demand.

With the expansion of the construction industry scale and the advancement of the industrialization process, the investment demand of the construction industry is increasing, and the internal economic relationship between the construction industry and other industries as well as the contribution power of the construction industry to national economic growth is enhancing. In order to deal with the global economic crisis erupted in 2008 and its impact on economic development, Chinese government launched a "four trillion" investment plan. Under the stimulus of the "four trillion" investment plan, Chinese construction industry have grown rapidly, in 2009 the growth rate was 18.9 % that reached the highest point, and since then the growth rate has declined. The data also show the total output, the added value, the number of employees and company of the construction industry continued to develop during the period of 2008-2016 in "Table I". As of 2016, the total output reached 19.36 trillion yuan, the added value 4.95 trillion yuan, and the number of employees 51.85 million, the number of companies 83 thousand, of which the added value accounted for about 6.6 % of the GDP.

TABLE I. CHINA'S CONSTRUCTION INDUSTRY DEVELOPMENT SITUATION

Year	Total output value (Trillion)	Added value (Trillion)	Added value percent of GDP (%)	Growth rate (%)	Employees (Ten thousand)	Number of company (Ten thousand)
2008	6.20	1.88	5.9	9.5	3315.0	7.1
2009	7.68	2.27	6.5	18.9	3672.6	7.1
2010	9.60	2.73	6.6	11.3	4160.4	7.2
2011	11.65	3.29	6.7	9.7	3852.5	7.2
2012	13.72	3.69	6.8	9.8	4267.2	7.5
2013	16.04	4.09	6.9	9.7	4528.4	7.9
2014	17.67	4.49	7.0	9.1	4537.0	8.1
2015	18.08	4.65	6.8	6.8	5093.7	8.1
2016	19.36	4.95	6.6	6.7	5184.5	8.30

[a.] Data source: Chinese Statistical Yearbook (2017)

In order to have more insight into the development of the construction industry, the paper will solve the first and second order difference of the total output and the added value of the construction industry to analyze the growth trend and speed change. The analysis results show that during the period of 2008-2016, the first order difference of the total output and the added value is greater than zero, indicating that the construction industry maintained a steady growth trend in this period. The second order difference of the total output was greater than zero during 2008-2013, indicating that the growth speed of the total output accelerated, but the growth speed began to decline from 2014. The second order difference of the added value is greater than or equal to zero except 2012 and 2016, indicating that the added value growth speed accelerated overall.

III. THE THEORETICAL MODEL CONSTRUCTION AND DATA PROCESSING

A. Input-output Model

The input output model that is composed of the coefficient and variable function is an important tool to measure the industrial technical linkage and spread effect. According to the input-output table in value form, row vector indicates that the industrial total output is composed of intermediate and final demand, while column vector indicates that the industrial total input consists of intermediate and initial inputs. So according to the equilibrium relationship of the input-output table, the input-output model is constructed as follows:

$$\begin{cases} x_{11}+x_{12}\cdots+x_{1n}+y_1=x_1 \\ x_{21}+x_{22}\cdots+x_{2n}+y_2=x_2 \\ \cdots\cdots \\ x_{n1}+x_{n2}\cdots+x_{n}+y_n=x_n \end{cases};\quad Z=\begin{bmatrix} x_{11}+x_{12}+\cdots\cdots+x_{1n} \\ x_{21}+x_{22}+\cdots\cdots+x_{2n} \\ \cdots\cdots \\ x_{n1}+x_{n2}+\cdots\cdots+x_{nn} \end{bmatrix}_{n\times n};\ X=\begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix}_{n\times 1};\ Y=\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}_{n\times 1}$$

Here Z refers to the intermediate demand matrix, X,Y respectively refers to the total output and final demand vector, x_i refers to the total output of the i industry, y_i refers to the final demand of the i industry. If the direct requirements coefficient matrix A is introduced, the input-output model can be expressed as follows:

$$Y=(I-A)X \quad \Rightarrow X=(I-A)^{-1}Y$$

$$A=\begin{bmatrix} a_{11}+a_{12}+\cdots\cdots+a_{1n} \\ a_{21}+a_{22}+\cdots\cdots+a_{2n} \\ \cdots\cdots \\ a_{n1}+a_{n2}+\cdots\cdots+a_{nn} \end{bmatrix}_{n\times n};I=\begin{bmatrix} 1 & 0\cdots 0 \\ 0 & 1\cdots 0 \\ \vdots & \vdots \quad \vdots \\ 0 & 0\cdots 1 \end{bmatrix}_{n\times n};C=(I-A)^{-1}=\begin{bmatrix} b_{11}+1 & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22}+1 & \cdots & b_{2n} \\ \vdots & \vdots & & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{nn}+1 \end{bmatrix}_{n\times n}$$

a_{ij} refers to the elements of the direct consumption matrix that illustrates the direct consumption of i industry for production of j industry, I is $n \times n$ order unit matrix, $(I-A)^{-1}$ is $n \times n$ order Leontief inverse matrix that also known as the input-output multiplier or full demand coefficient matrix to be used for empirical evaluation of industrial linkage and spread effect, b_{ij} is the complete consumption coefficient that includes direct and indirect consumption value and illustrates the complete consumption of i industry for production of j industry. Thus, based on the complete consumption coefficient matrix, the input-output model in matrix form can be expressed as follows.

$$X = (I-A)^{-1}Y \Leftrightarrow \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} b_{11}+1 & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22}+1 & \cdots & b_{2n} \\ \vdots & \vdots & & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{nn}+1 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}$$

B. Measure Indicators

1) Industrial linkage measurement indicators: As development economist, Albert O Hirshman put forward the concept of industrial linkage effect in 1958.Based on the industrial chain principle, the industry usually affects and promotes the development of related indus tries through forward and backward linkage, which strengthens the economic interdependence between industries.

As shown in "Fig. 1", the A industry provides intermediate products to the B industry, the B industry is the intermediate inputs of the C industry. The linkage between the A industry and the B industry is named the industrial backward linkage, while the linkage between the B industry and the C industry is named the industrial forward linkage.

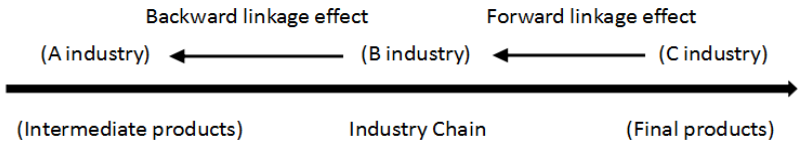


Fig. 1. Industrial chain and industrial linkage.

From the perspective of industrial inputs, consumption coefficient reflects the industrial pulling power for other industries. The distribution coefficient is the proportion of the intermediate demand part of the total output, which reflects the industrial driving power for other industries. In order to more fully reflect the industrial backward and forward linkage effects, we use the complete consumption coefficient and complete distribution coefficient to measure it. The complete consumption coefficient and the complete distribution coefficient matrix are as follows:

$$B = \begin{bmatrix} b_{11} & b_{12} & \cdots & +b_{1n} \\ b_{21} & b_{22} & \cdots & +b_{2n} \\ \vdots & \vdots & & \vdots \\ b_{n1} & b_{n2} & \cdots & +b_{nn} \end{bmatrix}; \quad R = \begin{bmatrix} r_{11} & r_{12} & \cdots & +r_{1n} \\ r_{21} & r_{22} & \cdots & +r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{n1} & r_{n2} & \cdots & +r_{nn} \end{bmatrix}; \quad \begin{cases} b_j = \sum_{i=1}^{n} b_{ij} & j = 1, 2.....n \\ r_i = \sum_{j=1}^{n} r_{ij} & i = 1, 2.....n \end{cases}$$

Here, the b_j and r_i indicators can be used to measure the forward and backward linkage effect of different industries. The b_j indicator reflects the pulling power of the final demand of different industries, If $b_{j=1} > b_{j=2}$, it shows that the backward linkage effect of the first industry ($j=1$) is greater than that of the second industry ($j=2$), which is more significant to pulling other industries development. The r_i indicator reflects the driving power of the final demand of different industries, If $r_{i=1} > r_{i=2}$, it shows that the forward linkage effect of the first industry ($r=1$) is greater than that of the second industry ($r=2$), which is more significant to driving other industries development.

2) Industrial spread effect measurement indicator: Industrial spread refers to that the changes in the industrial scale, technology, influencing factors cause the changes in other related industries. The industrial spread effect can be measured by the industrial influence coefficient, reaction coefficient, dependence coefficient and induced coefficient. The four statistical indicators are as follows:

$$R_i = \frac{\frac{1}{n}\sum_{j=1}^{n}(I-A)^{-1}{}_{ij}}{\frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n}(I-A)^{-1}{}_{ij}} \qquad E_j = \frac{\frac{1}{n}\sum_{i=1}^{n}(I-A)^{-1}{}_{ij}}{\frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n}(I-A)^{-1}{}_{ij}}$$

$$L_{il} = \frac{Z_{il}}{Y_l} \qquad Q_{il} = \frac{Z_{il}}{\sum_{i=1}^{n} Z_{il}} \qquad i, j, l = 1, 2, ..., n$$

In the formula, the R_i indicator is the reaction coefficient of the i industry, the E_j indicator is the influence coefficient of the j industry, the L_{il} indicator is the induced coefficient of the final demand item l of the i industry, the Q_{il} indicator is the dependence coefficient of the final demand item l of the i industry , $(I-A)^{-1}{}_{ij}$ is the elements of the Leontief

inverse matrix , Z_{il} is the induced amount of the final demand item l of the i industry, $\sum_{i=1}^{n} Z_{il}$ is the total induced amount of the final demand item l of all industries, l refers to the final demand items of consumption, exports, investment and government spending, i *and* j refer to industrial type.

3) Data sources and interpretation: The model data are from world input output database (WIOD). In order to make a more comprehensive analysis of the industrial linkage and spread effects of China's construction industry, the latest input-output data in 2014 about the United States, Germany, Japan and India, as well as China's input-output data from 2000 to 2014 will be selected, so as to do horizontally and vertically comparison of the measurement results and analyze the national differences and evolution of China's construction industry linkage and spread effect.

The Leontief inverse coefficient matrix is the coefficient condition to measure the industrial linkage and spread effect. According to the properties of the inverse matrix, if the N order matrix is invertible, the inverse matrix must be unique. The necessary and sufficient condition for the invertibility of N order matrix is that the determinant of N order matrix is not equal to zero, and that the matrix is a full rank square matrix which can be transformed into a unit matrix by elementary row transformation. In order to meet the solving requirements of the Leontief inverse matrix, the data need to be preprocessed, which eliminate the industries with zero data and avoid the problem of pseudo inverse matrix. The original data of input-output table has 56 industries. According to the research needs and the basic requirements of Leontief inverse matrix solving conditions, the 47 effective data industries will be finally selected from 56 industries, as shown in "Table II".

TABLE II. THE 47 EFFECTIVE DATA INDUSTRIES

Ser.	Code	Name of industry	Ser.	Code	Name of industry
1	A01	Crop and animal production, hunting and related service activities	25	E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
2	A02	Forestry and logging	26	F	Construction
3	A03	Fishing and aquaculture	27	G46	Wholesale trade, except of motor vehicles and motorcycles
4	B	Mining and quarrying	28	G47	Retail trade, except of motor vehicles and motorcycles
5	C10-C12	Manufacture of food products, beverages and tobacco products	29	H49	Land transport and transport via pipelines
6	C13-C15	Manufacture of textiles, wearing apparel and leather products	30	H50	Water transport
7	C16	Manufacture of wood and of products of wood and cork	31	H51	Air transport
8	C17	Manufacture of paper and paper products	32	H52	Warehousing and support activities for transportation
9	C18	Printing and reproduction of recorded media	33	H53	Postal and courier activities
10	C19	Manufacture of coke and refined petroleum products	34	I	Accommodation and food service activities
11	C20	Manufacture of chemicals and chemical products	35	J61	Telecommunications
12	C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	36	J62_J63	Computer programming, consultancy and related activities; information service activities
13	C22	Manufacture of rubber and plastic products	37	K64	Financial service activities, except insurance and pension funding
14	C23	Manufacture of other non-metallic mineral products	38	K65	Insurance, reinsurance and pension funding, except compulsory social security
15	C24	Manufacture of basic metals	39	L68	Real estate activities
16	C25	Manufacture of fabricated metal products	40	M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities
17	C26	Manufacture of computer, electronic and optical products	41	M72	Scientific research and development
18	C27	Manufacture of electrical equipment	42	M74_M75	Other professional, scientific and technical activities; veterinary activities
19	C28	Manufacture of machinery and equipment n.e.c.	43	N	Administrative and support service activities
20	C29	Manufacture of motor vehicles, trailers and semi-trailers	44	O84	Public administration and defence; compulsory social security
21	C30	Manufacture of other transport equipment	45	P85	Education
22	C31_C32	Manufacture of furniture; other manufacturing	46	Q	Human health and social work activities
23	D35	Electricity, gas, steam and air conditioning supply	47	R_S	Other service activities
24	E36	Water collection, treatment and supply			

IV. EMPIRICAL MEASUREMENT AND RESULTS ANALYSIS

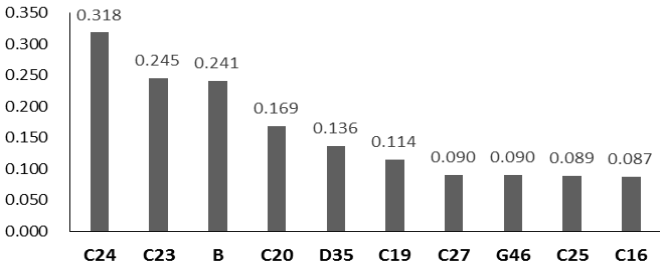
A. Results Analysis of Industrial Linkage Effect

The column sum of the complete consumption coefficient matrix indicates the pulling effect of a unit of the industrial final demand to incremental value of total output for all other industries that is the backward linkage effect. As shown in "Table III", the industries ranked the top ten backward linkage effects are as follows: C26, C27, C29, C30, C22, C20, C23, C24, C28, F industries. The largest backward linkage effect industry is C26 industry that its backward linkage effect coefficient is 3.021, the smallest is L67 that its backward linkage effect coefficient is 0.397. For construction industry, its backward linkage effect coefficient is 2.533, ranking the 10th, which indicates that if the final demand of the construction industry is increased by 1 unit, the total output of other industries will be increased by 2.533 units. By the vertical comparison, it is discoved that the backward linkage coefficient of China's construction industry increased from 2.083 in 2000 to 2.533 in 2014, an increase of 0.45. This indicates the construction industry is playing a more and more important role in pulling and promoting the other industries, especially the backward related industries development.

TABLE III. CHINA'S TOP TEN LINKAGE EFFECT INDUSTRIES IN 2014

Industrial backward linkage effect coefficient			Industrial forward linkage effect coefficient		
Rank	Idustry	Coefficient	Rank	Idustry	Coefficient
1	C26	3.021	1	B	5.475
2	C27	2.989	2	A02	4.388
3	C29	2.926	3	D35	3.851
4	C30	2.827	4	C20	3.795
5	C22	2.813	5	C19	3.720
6	C20	2.808	6	C17	3.584
7	C25	2.787	7	H52	3.073
8	C24	2.730	8	E37-E39	3.061
9	C28	2.720	9	C24	3.034
10	F	2.533	10	M69_M70	2.997
47	L68	0.397	46	F	0.167

From the perspective of different industry, the largest pulling effect of the construction industry is for C24 industry which its backward linkage effect coefficient is 0.318, indicating if the final demand of the construction industry is increased by 1 unit, the total output of C24 industry will be increased by 0.318 units. The smallest pulling effect is for H53 industry which its backward linkage effect coefficient is only 0.002. As shown in "Fig. 2", the top ten backward linkage effects industries are as follows: C24, C23, B, C20, D35, C19, C27, G46, C25, and C16. Obviously the backward linkage industries mainly are manufacturing industry.



a. Data source: WIOD database

Fig. 2. Top ten backward linkage industries of China's construction industry in 2014.

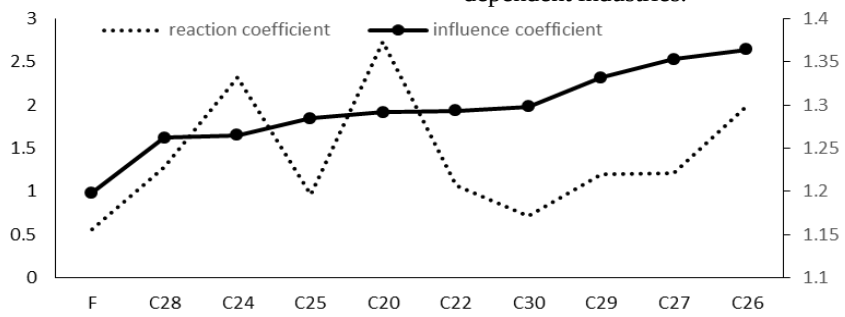
The forward linkage effect refers to that the industrial development causes the change of the related industries, or the formation of new industries, or the application of new technologies and new materials. Compared with the backward linkage effect, the forward linkage effect is not significant, its forward linkage effect coefficient is only 0.167, that is to say if the initial inputs of the construction industry is increased by 1 unit, the total output of all other industries will be increased by 0.167 units. But the impact of the initial inputs of other industries on the construction industry is very significant. The measurement results show that the total output of the construction industry will be increased by 11.695 units if all industries increase 1 unit of initial inputs. That is because the construction industry is a typical investment-driven final demand industry, and the low intermediate demand rate of construction industry also directly affects the forward linkage effect.

B. Results Analysis of Industrial Spread Effect

Industrial spread intensity and path determine the position and function of the industry in the whole national economy. Practice shows if a certain industrial influence and reaction coefficient is greater than 1 at the same time, the industry affects other related industries directly or indirectly, or significantly affected by other industries. The industry will become the strategic industry, plays an important role on the national economic growth. As shown in "Fig. 3", the results show that the influence coefficient of the construction industry is greater than 1, to be ranked at the top of the list of the 47 selected industries by tenth. The largest influence coefficient industry is C26 industry which influence coefficient is 1.364. Relative to the influence coefficient, the reaction coefficient is less than 1, that is to say the construction industry is less affected by other industries. In

China, the largest reaction coefficient industries are the manufacturing industry. There are C28, C24, C20, C22, C29, C27, C26 industries which its influence and reaction coefficient are greater than 1. Difference from the construction industry, these industries are not the final demand industry but the intermediate demand industries. The results indicate that as for the influence and reaction coefficient, the final demand industry is generally smaller than the intermediate demand industries.

Investment-driven economic growth mode makes the investment become the core power to promote national economic growth. Data show the proportion of China's capital formation increased from 38.21% in 1978 to 46.03% in 2015 in "Fig. 3". So we use the indicator of the industrial dependence and induced coefficient to further analyze the spread effect of the construction industry from the perspective of investment demand. The results show the dependence and induced coefficient of the construction industry respectively is 0.185 and 0.644. It is the construction industry that whether the induced coefficient or the dependence coefficient are the highest. This further proves the construction industry is the largest investment-dependent industries.



a. Data source: WIOD database

Fig. 3. The influence and reaction coefficient of China's construction industry.

In 2002, China's per capita GNI was US$1100, and economic development stage has evoluted from the low income level to the middle income level. In the process of industrialization and economic development, the construction industry has gradually developed into a pillar industry in china. On the one hand it is to adapt to the needs of China's investment-driven economic development, on the other hand it shows that the construction industry has a significant backward linkage effect that produce a strong pulling effect on the development of other related industries. With the development of China's economic development, the scale and influence of the construction industry is yearly increasing. The data show the total output increased from US$248.69 billion in 2000 to US$30339 billion in 2014, with an average annual growth rate of 9.80%, accounting for 7.24% in 2000 to 9.56% in 2014 of the total output of all the industries.

The results also show that from 2000 to 2014, the influence coefficient, reaction coefficient, dependence coefficient, induced coefficient of china's the construction industry are continuously increasing in "Table IV". From the aspect of countries, India's per capita GNI is $1590 in 2015, according to the GNI standard, India was just across the low income trap into the lower middle income development stage, and the construction industry is becoming the strategic industry that its influence and reaction coefficient are higher than 1.The total output of the construction industry accounts for more than 10.22 % of all the industries, which is higher than 9.56% of China's total output. The high income developed countries like the United States, Germany and Japan, its industrial structure is led by the tertiary industry. The spread effect coefficient of the construction industry of these countries is smaller than China, ranked after China, and the proportion of total output is lower than China. The results show that the influence coefficient of the United States, Germany and Japan respectively ranked the 22th, 22th, 24th, while China is the tenth. The proportion of total output of construction industry respectively accounts for 4.19%, 5.49%, 7.33% of all the industries, far lower than China. However, the construction industry as an investment-driven final demand industry, whether in middle income level countries like China and India or in high income level countries like the United States, Germany and Japan, the dependence coefficient is ranked first in all industries.

TABLE IV. CONSTRUCTION INDUSTRIAL SPREAD EFFECT OF CHINA AND REPRESENTATIVE COUNTRIES

Country	Year	Influence coefficient	Reaction Coefficient	Dependence Coefficient	induced Coefficient
China	2000	1.142	0.593	0.188	0.578
China	2014	1.199	0.567	0.185	0.644
United States	2014	0.967	0.730	0.180	0.331
Germany	2014	1.031	1.294	0.204	0.409
India	2014	1.173	1.191	0.290	0.684
Japan	2014	1.022	0.864	0.236	0.541

a. Data source: WIOD database

V. CONCLUSION

Research shows that there is a significant backward linkage effect between the construction industry and other industries, especially for the intermediate demand manufacturing industries. There is a strong technical and economic relationship between them. Relative to backward linkage effect, the forward linkage effect is weaker, and the reaction coefficient is smaller. Construction industry as investment-driven final demand industry, whether in middle income level countries or in high income level countries, it is the construction industry that the dependence on investment is the highest, so the rapid development of the construction industry can drive investment demand and expand domestic demand. The impact of the construction industry on the national economy is gradually weakened with the economic development, the more developed countries, the lower and the degree of dependence on the construction industry. Accordingly, in order to adapt to the new economic norm and accelerate the transformation and upgrading of the industrial structure, first of all, we should strengthen the technical and economic linkage between the construction industry and other industries, especially the manufacturing industry. Secondly, we should optimize the initial input elements structure through the distribution of products in different industries, make the initial inputs directly or indirectly into the different industrial production process, so as to improve the total factor productivity of the construction industry.

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