Global Value Chains Trade and the Demand for Chinese Labor

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Abstract: *Developed countries have recently expanded the outsourcing production to China by transferring intermediate inputs with lower value-added, given the abundant and low-cost labor resources in China. Therefore, intermediate products trade is increasing rapidly, which is major composition of global value chains trade. The change of trade pattern not only increases the demand for various labors in China, but also leads to the change of labor demand and employment stability in labor market. This paper aims to study the effect of intermediate products trade on labor demand in total Chinese industry and sub-sectors by using dynamic panel data model. The results indicate that the intermediate product exports increase the labor demand, while the impact of intermediate product imports on labor demand is negative. Meanwhile, intermediate products trade has increased employment instability and unemployment risk in Chinese manufacturing sector.*

Keywords*: Global Value Chains; Intermediate Products Trade; Labor Demand; Dynamic Panel Data*

1. Introduction

With the deepening of international vertical specialization, developed countries gradually outsourced some products with low comparative advantage to developing countries，given their abundant and low cost labor resources. It is now common that developing countries export mainly labour-intensive products and assemble intermediate inputs to final goods, so global value chains trade increases dramatically. Multinational enterprises in developed countries kept some technology-intensive headquarter production in home countries, such as R&D, advertising and marketing and so on. These new production patterns and labor division systems have a deep impact on labor market of each country, including the labor demand level, income distribution, employment risks and stability.

In the field of global value chains trade and its influence on labor demand, Feenstra and Hanson (1996) defined outsourcing as the share of intermediate products in domestic imported materials, and studied the impacts of intermediate inputs imported on labor demand and income distribution in US. Meanwhile, Anderton and Brenton (1998) analyzed the impacts of intermediate products on employment and income of low skilled

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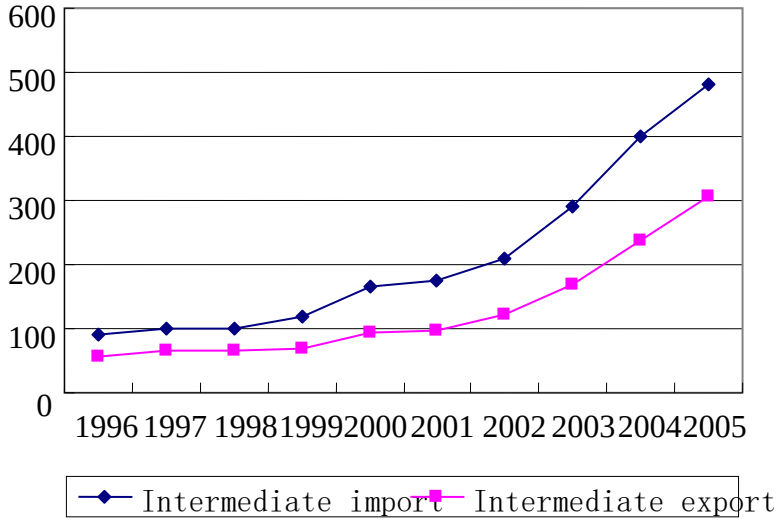
workers in the United Kingdom. Greenaway, Hine and Wright（1998's empirical study showed that increasing imports and exports will reduce the labor demand due to a higher openness, that can promote the labor efficiency. Rodrik (1997) explained that the improvement of trade openness can influence the wage elasticity of labour demand, which reflects the change of employment risks. In addition, Chinese scholars also contributed to the literature with many ideas and produced many articles in the field of trade openness and labor demand, and carried out a number of empirical studies on China.

2. The stylized facts of China: intermediate products trade, output, employment and wages

This paper uses data for employment, output and wages of 31 manufacturing sectors of China for 1996-2005 period. Looking at these data, one can notice the employment decline in most sectors, except, for few industries: stationery and sporting goods; electronics and telecommunications equipment; electricity and heat production Industrial employment was shrinking, on average by 33.69%. The chemical fiber and non-metallic mining sectors, that are all primary product sectors, had the largest declines. The output of the 31 sectors increased at high growth rates (on average by 260.87%), electronics and telecommunications equipment manufacturing and mining sector having the fastest growth rates. The industry average wages in the same period increased significantly (by 152.57%), while the metal products, wood processing and bamboo, rattan industries have particularly high wage growth rates.

Fig. 1 China's intermediate products trade of manufacturing sectors (billion dollars)



Source: Calculated based on United Nation COMTRADE Database.

Figure1 depicts the growth of total imports and total exports of intermediate products from 1996 to 2005 in Chinese 31 manufacturing sectors. The total imports and exports have an average growth rate of 21.5 percent over this period and especially after 2001, the growth is particularly rapid. The growth rate of exports and imports of intermediate products in the same period were 21.94% and 21.32% respectively, and the deficit increased from 35.1 billion dollars in 1996 to 176.5 billion dollars in 2005.

Table 1 Imports and exports of intermediate products manufactured by China's six sectors（100 million dollars）

	A、primary product sector	B、labor and resources-intensive sector	C、low technology sector

	Import value	Export value	Import value	Export value	Import value	Export value
1996	144.91	87.06	224.00	150.04	88.53	65.84
1997	171.46	101.68	247.89	177.92	84.16	80.96
1998	145.82	81.62	225.02	161.77	82.26	72.02
1999	188.40	77.62	241.93	165.26	92.02	68.06
2000	345.02	100.22	292.59	219.38	127.44	93.67
2001	323.70	105.94	287.91	242.67	157.79	51.17
2002	365.71	117.21	308.97	282.22	163.25	78.08
2003	540.56	156.59	370.23	374.30	259.19	137.03
2004	892.50	221.09	451.06	494.96	286.40	270.45
2005	1184.66	259.16	472.92	609.50	324.19	375.46
	D、medium-tech sector		E、high-tech sector		F、non-classified sector	
	Import value	Export value	Import value	Export value	Import value	Export value
1996	171.05	89.71	256.64	140.62	13.41	14.75
1997	202.46	114.21	285.45	169.53	18.79	20.48
1998	236.31	128.63	300.31	184.68	14.21	19.80
1999	308.93	167.09	352.33	197.23	13.57	20.29
2000	424.40	232.62	463.63	256.25	16.92	21.61
2001	471.66	248.01	502.99	307.59	14.93	22.44
2002	638.04	318.41	604.40	406.02	16.35	24.16
2003	937.67	429.33	782.79	550.40	12.88	27.07
2004	1284.01	623.42	1056.35	737.38	14.93	31.59
2005	1558.85	817.56	1268.46	960.86	16.31	37.49

Source：Author's calculation based on UNCOMTRADE dataset and UNCTAD (2002).

Table 1 calculates the intermediate goods trade value of six sectors in detail. The results show that among the intermediate imports, the following sectors have larger growth rate: primary products, medium-technology and high-tech. But medium-technology sector has the highest share in total imports. Among the intermediate exports, labor and resource-intensive sector, medium-technology sector and high-tech sector have higher growth rate, the latter accounting also for the largest proportion in total exports.

3. The dynamic panel data regression for estimating the labor equation

Our model is based on Greenaway, Hine and Wright (1998). We assume that industry *i* has a Cobb-Douglas production function in the period *t*:

$$Y_{it} = A^{\gamma} K_{it}^{\alpha} L_{it}^{\beta} \qquad (1)$$

Where Y is the real output，K is the capital stock, L is the use of labor. α and β are the coefficients of factors' proportions, γ allows for factors changing the efficiency of the production process. A profit-maximizing industry will employ labor and capital at such levels that the marginal revenue product of labor equals the wage (w) and the marginal revenue product of capital equals its user cost (c).

According to the equilibrium condition of producers，replacing $K = \frac{\alpha L_{it}}{\beta} \cdot \frac{w_i}{c}$ into（1）we get:

$$Y_{it} = A^{\gamma}\left(\frac{\alpha L_{it}}{\beta}\cdot\frac{w_i}{c}\right)^{\alpha}\cdot L_{it}^{\beta} \qquad (2)$$

Taking logarithms and rearranging (2)，we can get industry *i*'s labor demand function:

$$\ln L_{it} = \phi_0 + \phi_1 \ln(w_i / c) + \phi_2 \ln Y_{it} \qquad (3)$$

Where $\phi_0 = -(\gamma \ln A + \alpha \ln \alpha - \alpha \ln \beta)/(\alpha+\beta)$, $\phi_1 = -\alpha/(\alpha+\beta)$, $\phi_2 = 1/(\alpha+\beta)$

Generally speaking, technological efficiency is increasing with time t, meanwhile is depending on the intermediate products trade. So the coefficient A in the production function depends on the following determinant equation:

$$A_{it} = e^{\delta_0 T_i} M_{it}^{\delta_1} X_{it}^{\delta_2} \quad \delta_0, \delta_1, \delta_2 > 0 \qquad (4)$$

Here T is time trend; M is import penetration ratio, namely the ratio of the intermediate import on consumption, expressed as imports/(output+imports-exports); X is export-orientation ratio, namely the ratio of intermediate exports on output. Putting （4） into（2）, taking logarithms and rearranging, we get：

$$\ln L_{it} = \phi_0^* + \mu_0 T + \mu_1 \ln M_{it} + \mu_2 \ln X_{it} + \phi_1 \ln(w_i / c) + \phi_2 \ln Y_{it} \qquad (5)$$

where $\phi_0^* = -(\alpha \ln \alpha - \alpha \ln \beta)/(\alpha+\beta), \mu_0 = \mu\delta_0, \mu_1 = \mu\delta_1, \mu_2 = \mu\delta_2, \mu = \gamma/(\alpha+\beta)$

Considering the intertemporal effect of Independent variables on dependent variable, estimating equation can be converted into a dynamic form:

$$\ln L_{it} = \lambda_i + \mu_0 T + \sum_j \mu_{1j} \ln M_{i,t-j} + \sum_j \mu_{2j} \ln X_{i,t-j} + \sum_j \phi_{0j} \ln L_{i,t-j} + \sum_j \phi_{1j} \ln w_{i,t-j} + \sum_j \phi_{2j} \ln Y_{i,t-j} + \varepsilon_{it} \qquad (6)$$

Where L_{it} is the employment of industry *i* in year *t*; w_{it} is average real wage for industry *i* in year *t*（nominal industrial wage divided by CPI）; Y_{it} is the real output of industry *i* in period t（industry output divided by GDP deflator）; λ_i is the industry fixed effect; ε_{it} is the error term.

For a better estimation, we take the first differences in the employment equation to eliminate the industry specific fixed effect. The dynamic equation becomes:

$$\Delta \ln L_{it} = \mu_0 + \sum_j \mu_{1j} \Delta \ln M_{i,t-j} + \sum_j \mu_{2j} \Delta \ln X_{i,t-j} + \sum_j \phi_{0j} \Delta \ln L_{i,t-j} + \sum_j \phi_{1j} \Delta \ln w_{i,t-j} + \sum_j \phi_{2j} \Delta \ln Y_{i,t-j} + \varepsilon_{it} \qquad (7)$$

4. The regression results

4.1. General regression results

Table 2 shows the general regression results with dynamic panel data model based on 31 sectors in China. The first estimation's results indicate the impact of basic variables on employment demand in labor market. Lagged employment variable, lagged and current wage and output variables pass significance test and meet the expectations. The relationship between the lagged labor demand and the current period employment, which is positive, indicates the employment trend and the demand inertia. Labor demand is negatively related with current period average wage, but is positively related with lagged wage, which shows a price effect existing in labor market generally.

The second estimation includes intermediate products import and export variables. Meanwhile, the variables, such as lagged employment, current period and lagged wages and outputs pass t statistics. The signs of the import and export variables in current period and lagged period are exactly the same as expected, but most of the variables are not statistically significant.

The third estimation adds the intersection variable of wage and intermediate products trade based on the second group. The intersection variable can explain the interacted effect of both the above two variables on labor demand. In principle, the effect includes not only the influence of import and export on labor demand, but also the impact of trade change caused by wage change on employment. All coefficients are consistent with expectations and most of them pass the t-statistics test.

Table 2 Dynamic panel data regression results of intermediate products

Independent variables	Estimation 1		Estimation 2		Estimation 3	
	coefficient	t statistic	coefficient	t statistic	coefficient	t statistic
$\Delta lnL_{i,t-1}$	0.41	5.95***	0.56	6.77***	0.27	2.71***
$\Delta lnw_{i,t}$	-0.78	-11.79***	-1.00	-11.99***	-0.86	-3.94***
$\Delta lnw_{i,t-1}$	0.43	3.85***	0.58	4.85***	0.47	2.09**
$\Delta lnY_{i,t}$	0.13	6.91***	0.14	4.01***	0.14	4.17***
$\Delta lnY_{i,t-1}$	0.04	1.19	0.11	2.58**	0.15	3.23***
$\Delta lnX_{i,t-1}$			-0.01	-1.00	-1.28	-3.33***
$\Delta lnM_{i,t}$			-0.005	-0.28	-1.52	-1.79*
$\Delta lnM_{i,t-1}$			0.05	2.38**	1.24	1.51
$\Delta lnw_{i,t} \cdot \Delta lnX_{i,t}$					-0.08	-2.31**
$\Delta lnw_{i,t-1} \cdot \Delta lnX_{i,t-1}$					0.13	3.24***
$\Delta lnw_{i,t} \cdot \Delta lnM_{i,t}$					0.16	1.78*
$\Delta lnw_{i,t-1} \cdot \Delta lnM_{i,t-1}$					-0.13	-1.47
Adjusted R^2	0.41		0.42		0.44	
J statistics	30.26		115.98		122.96	
observation	248		246		246	

Notes: Instrumental variables are used in the regression. *** is 1% significant level，** is 5% significant level，* is 10% significant level.

4.2. Sub-sector regression results

Due to the data inadequacy of low-technology sector and not classified sector, the regression was run for the other four sectors. Overall, the regression results of the four sectors are more consistent with the regression run at whole industry level, but the impact of trade variables are not the same. Labor lagged variables, the average wage and output have significant effects on the labor employment of the various sectors, which shows the existence of trend effect, price effect and scale effect in the labor market. The exports of intermediate products have a positive impact on the labor demand of primary product sector, labor and resource-intensive sector and high-tech sector. The employment in the high-tech sector has the largest exports elasticity, but on the medium-technology exports have a negligible effect. Intermediate products imports have a substitution effect on labor employment in the sectors of labor and resource-intensive and medium-technology, the latter having a larger elasticity, while on the other two sectors imports have no significant effect.

Table 3 Dynamic panel data regression results for intermediate products of four types of sectors

	primary product sector	labor and resources intensive sector	medium-tech sector	high-tech sector
$\Delta lnL_{i,t-1}$	0.26 (4.43)***	0.11 (2.0)**	0.59 (4.93)***	0.77 (43.73)***
$\Delta lnw_{i,t}$	-0.57 (-6.16)***	-1.78 (-13.77)***	-0.99 (-12.52)***	-0.99 (-21.18)***
$\Delta lnw_{i,t-1}$	-0.05 (-0.34)	0.22 (2.12)**	0.8 (4.06)***	0.91 (13.07)***
$\Delta lnY_{i,t}$	0.15 (7.8)***	0.20 (7.39)***	0.1 (1.17)	0.11 (1.74)*
$\Delta lnY_{i,t-1}$	0.05 (1.45)	0.25 (4.53)***	0.04 (0.50)	-0.06 (-1.15)
$\Delta lnX_{i,}$	0.04 (2.07)**	0.07 (2.74)***	0.06 (1.06)	0.14 (2.9)***
$\Delta lnX_{i,t-1}$	-0.08 (-3.4)***	-0.18 (-6.77)***	-0.11 (-2.0)**	-0.1 (-2.35)**
$\Delta lnM_{i,t}$	-0.03 (-1.25)	-0.05 (-2.39)**	-0.22 (-3.99)***	0.09 (1.25)
$\Delta lnM_{i,t-1}$	0.06 (2.71)***	0.04 (1.38)	0.12 (1.91)*	0.03 (0.45)
Adjusted R^2	0.11	0.53	0.88	0.56
J statistics	39.14	35.95	16.33	14.25
observations	64	56	40	40

Notes: t statistics are in parentheses. *** is 1% significant level，** is 5% significant level，* is 10% significant level.

4.3. Wage elasticity of labor demand in China

Further, we can analyze the impact of intermediate products trade on the wage elasticity of labor demand. Wage elasticity reflects the sensitivity of labor demand to wage changes. Rodrik (1997) pointed out that the impact of international trade on labor demand reflect the changes of labor demand elasticity rather than the price of labor. The changes of total factor productivity and output can result in the change of wages and labor demand, also lead to the employment instability in labor market and income instability.

According to the test results of the basic equation (Table2 column1), labor demand elasticity is -0.78 and is statistically significant (with t-statistic -11.79). Putting the cross variables of intermediate products trade and wage in the equation (Table 3 column3), the judgment of the labor demand elasticity will become more complex, because it also depends on the value of the intermediate goods trade. From the regression results, we can recalculate the labor demand elasticity (-0.85) by taking the intermediate product trade into consideration.[2] We find the elasticity is higher than the elasticity not considering the effect of intermediate product trade, which show that intermediate products trade has increased employment instability and unemployment risk. The elasticity of labor demand was -0.8596 in 1997, -0.8613 in 2001, and then increased to -0.8656 in 2004. The increasing elasticity brings more risks to the labor market.

[2] The elasticity of labor demand equation containing the intersection variables is $\eta = \frac{\partial \Delta \ln L}{\partial \Delta \ln w} = \alpha + \beta \overline{\Delta \ln X} + \lambda \overline{\Delta \ln M}$.

With the sub-sector test results, we can get the labor demand elasticity in primary product sector, labor and resource-intensive sector, medium-technology sector and high-tech sector as -0.57, -1.78, -0.99, -0.99 respectively. The impact of wage changes on labor demand can be seen negative in all sectors, while the elasticity of labor demand in labor and resource-intensive sector is the largest; it has also the highest employment risk and volatility, and also the most likely to be influenced by intermediate goods trade.

4.4. The decomposition of factors affecting the labor demand

Based on the third group results in Table 2, we can analyze the structural factor decomposition effect of each explanatory variable affecting labor demand change. This paper found five factors affecting labor demand, according to regression results of the third column in Table 2 (see Table 4 for results).

In the structural decomposition of 31 sectors in China, the share of wage impact is the most important, accounting for 70.51 percent, and then is lagged employment occupying 63.81 percent. The output and intermediate trade account for -56.48 percent and 22.23 percent respectively. The results show that the wage, output and intermediate products trade have an important impact on the labor demand changes in overall manufacturing sectors of China.

Table 4 Decomposition of independent variables affecting labor demand（average percent）

	lagged employment	wage	output	Intermediate goods trade	Other variables
Average of 31 sectors	63.81	70.51	-56.48	22.23	-0.07
Primary product sector	9.34	43.46	-41.89	90.09	-0.99
Labor and resource intensive sector	5.65	-0.91	24.16	71.7	-0.58
Low tech sector	13.49	30.18	-4.11	60.87	-0.44
Medium-tech sector	53.89	-363.06	375.95	34.08	-0.85
High-tech sector	12.05	35.76	-28.91	81.95	-0.85
Non-classification	-346.70	-576.15	579.82	448.51	-5.49

Source: Calculated based on simulation of the regression.

5. Conclusions

This paper focused on the impact of intermediate products trade on the demand change for Chinese labour. We use export orientation and import penetration of intermediate products, real wage and output as independent variables to explain labour demand in total Chinese industry and sub-sectors by using dynamic panel data model. The results suggest several conclusions. First, intermediate goods exports have a significant stimulating effect on the Chinese demand for labour (elasticity is 0.8), which can be explained by vertical specialization in the international production system, namely outsourcing production transfers the production of many intermediate products to China in order to use the abundant and cheap labour for manufacturing and export. Second, intermediate goods imports have a negative effect on the Chinese demand for labour (elasticity is -1.52), which shows the substitution effect of the imports, this can bring a shock to the labour market of

China. Finally, the tests on either aggregate or sub-sector suggest that the output have a positive effect on labor demand, but the relation between real wage and labor demand is negative.

The test results of sub-sectors according to technology and factor intensity is similar to that of the basic equation. With respect to the labour demand elasticity, the elasticity of intermediate products trade has more significant effect than that of the total trade, which suggests that intermediate products trade has increased China's manufacture employment risk and instability. The sub-sectors elasticity estimation shows that labor-intensive sector has the largest labor demand elasticity, which is consistent with actual observation.

According to the empirical study, we can find that intermediate products exports greatly promote China's manufacturing employment, which is based on the comparative advantage of Chinese employees' low wages and skills. However, we need to note that, recently, Cai Fang, Chinese famous scholar who studies the labour transfer from rural to urban and from agricultural to industry and services, suggests that in the process of the transformation from a dual economy to one economic structure, the unlimited supply of labour resources will not be the case, and the wage and other employee benefits will increase inevitably. So the comparative advantage of Chinese labour will face enormous challenges, which has a major impact on the production of intermediate goods and the specialization path.

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