The Impact of Chinese Imports on Korean Manufacturing Plants*

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Abstract

This paper provides empirical analysis on the impact of Chinese imports on Korean manufacturing plants, using Korea's plant-level data for the period of 1996-2013. While many studies find negative impacts of Chinese imports (especially on employment) in developed countries, we find the opposite in South Korea. We show that the rising Chinese import competition has a significantly positive impact on Korean plants' productivity and employment. Importantly, we separately define 'output' and 'input' import penetration rates, and examine their impacts on plants' productivity, markup, and employment. Interestingly, we find that the rising Chinese 'input' import competition has much larger and significantly positive impacts on Korean plant productivity and employment, compared to the 'output' one. Also, we find that Chinese 'output' import penetration has a positive effect on Korean plant markups, while the 'input' one has no effect.

JEL codes: D24, F13, L25, L60

Key words: Total Factor Productivity, Markup, Employment, Impact of China, International Trade

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1 Introduction

The literature on the impact of Chinese trade liberalizations on other countries has developed rapidly over the past decade, as China rapidly rise in the global economy after its 2001 WTO entry. However, the impact on its important trading partner, South Korea, is left relatively unexplored with systematic analysis. There are important reasons why studying China's impact on South Korea is important. First, South Korea is China's top 4th (top) exporting (importing) destination as of 2017. Second, intermediate goods make up a significant portion (66% as of 2017) of Korea's imports from China, unlike other developed countries including Japan which mainly import final consumer goods from China. [1] Third, while China's export share among the world's exports increased from 3.5% in 1992 to 10.6% in 2013, the degree of China's integration was deeper in Korea during the same period: Korea's import share from China climbed to 20.5% in 2017 from 5.5% in 1995.

This paper investigates the effects of import penetration from China on Korean manufacturing plants by attempting to answer the following questions. What is its impact on plants' productivity, markups, and employment? Where do the effects of Chinese import on plants come from (increased competition versus input sourcing)? These questions are associated with a large body of literature studying the effects of trade on firms and industries (De Loecker and Goldberg, 2014). Based on this literature, we build up the empirical frameworks and perform the analysis addressing the above questions.

In this paper, we employ Korea's plant-level manufacturing survey panel data for the period of 1996-2013, which report value-added, gross output, the number of employees, capital stock, and wages for more than 52,000 establishments. We estimate the total factor productivity (TFP) and markups, following De Loecker and Warzynski (2012), for each plant separately. We then measure each industry's exposure to Chinese imports by exploiting the differences in the level and growth of import penetration rate from China across Korean manufacturing industries over time (output import penetration rate). We separately identify the effects on plant coming from increased Chinese imports in input market. We construct another measure called 'input' import penetration rate from China using Korea's input-output table as a weighted-average of the import share of China for each 3-digit ISIC industry. Our hypothesis is that both increased competition level and more input sourcing from China can affect plant's performance. We examine empirically which source was more important in the plant's performance. To address the simultaneity bias issue,

[1] Consumer goods make up more than 35% of total imports in Japan and in the US, while it is only about 10% in Korea.

we construct an instrument for the import penetration rate from China using the variation of Japan's imports from China across industries and over time.

Using these measures, we find that higher 'input' import penetration rate from China increases TFP and employment significantly. This may imply that the increased availability of Chinese imported inputs induces larger plant size with higher productivity and employment, possibly through better access to inputs at a cheaper price. In contrast, we show that'output' import penetration rate from China also increases productivity and employment but not as much as the 'input' one. In addition, we find that 'output' import penetration rate from China raises markups, implying that the higher productivity induced by pro-competitive effects help the plant lower the cost while not lowering the price as much as the lowered cost.

This paper relates to the recent studies investigating the impact of rising Chinese import competition on developed countries. For example, a main strand of papers find that in the US rising imports from China cause higher unemployment in affected sectors (Autor, Dorn, and Hanson, 2013; Acemoglu, Autor, Dorn, and Hanson, 2016; Pierce and Schott, 2016). Similarly, Balsvik, Jensen, and Salvanes (2015) show that increased exposure to import competition from China pushes low-skilled workers into unemployment in Norway; in Belgium, industry-level import competition from China reduces firm employment growth and induce skill upgrading in low-tech manufacturing industries (Mion and Zhu, 2013). Likewise, these papers focus on the negative impact of China's trade liberalization on employment in developed countries. In contrast, we focus on its impact on plant-level productivity and markups as well as employment. Especially, we find that higher exposure of imports from China increases plant employment, contrary to the findings above.

This paper is also part of a large literature on the effects of trade openness on firm performances including productivity and markups as well as employment and growth. Brandt et al. (2017) find that cuts in output tariffs raise productivity but reduce markups of Chinese manufacturing firms. They also show that pro-competitive effects take place among incumbents. Bernard, Jensen, and Schott (2006) show that survival and employment growth of U.S. manufacturing plants are negatively correlated with the import penetration rate from low-wage countries. Pavcnik (2002) finds that the productivity of plants in the import-competing sectors has improved more than in the nontraded-goods sectors after trade liberalization in Chile. This paper finds that both productivity and employment at industry-level are positively associated with import penetration rate from China. There are earlier studies of the effects of import competition from China on Korea's manufacturing. Cha, Choi, and Kim (2005) find that plant exit is positively associated with import penetration rate from China only in low-tech industries. Choi and Hahn (2007) show that both output growth rate and investment growth rate are negatively correlated with import penetration rate from China.

The widely accepted channels through wich trade affects firm performances in the literature are the following: pro-competitive effects, access to inputs at a cheaper prices, innovations, reduction of X-inefficiencies at the firm level, access to better inputs and new input varieties, learning-by-doing, and quality upgrading. For example, Goldberg, Khandelwal, Pavcnik, and Topalova (2010) show that substantial gains from trade can occur when firms have increased access to new input varieties that were not available before the trade liberalization. As another example, Medina (2017) shows that firms in Peruvian apparel industry increased exporting high-quality apparel in response to the rising Chinese import competition in the industry. Like many papers in this literature, we attempt to find empirical evidence on the mechanism as well as the existence and the magnitudes of the effects. A departure from the literature is that we do so by constructing the two seperate measures of Chinese import competition in input and in output and seperately estimating their effects on firm productivity, markups, and employment.

2 Data

2.1 International trade

We use trade data from the UN Comtrade Database. The database offers information on all bilateral imports and exports over 170 reporter countries by partner countries. We extracted six-digit product level trade data classified in HS 1996 for the period 1996-2013. We aggregated them into four-digit ISIC rev. 3 industry level using HS-ISIC concordance table provided by World Integrated Trade Solution(WITS).

We use the import share of China by each industry to measure the industry's exposure to Chinese imports. We adopted the measure following Bernard et al. (2006) and Mion and Zhu (2013) who separated imports by the origins of countries to differentiate impacts of trade from different group of countries. We distinguish China as a key source that impacted manufacturing plants in Korea and proxy the degree of competition coming from China in final goods market by the Chinese import share. For each industry, the variable $CPEN^O_{st}$ is defined as the import share of China[2] in industry s in Korea's output market(denoted as the superscript O):

[2]We use import share definition of Mion and Zhu (2013) as Korea is a heavy trade country like Belgium. When exports are larger than the sum of imports and domestic output, import penetration measure of Bernard et al. (2006) becomes negative in some four-digit industries.

$$CPEN^O_{s,t} = \frac{IM^C_{s,t}}{IM_{s,96} + Q_{s,96}}. \tag{1}$$

where IM^C_{st} is the value of imports from China for industry s and year t. $IM_{s,96}$ is the value of imports from all countries in year 1996. $Q_{s,96}$ is initial level of goods domestic output production of industry s in year 1996. The data for $Q_{s,96}$ is aggregate number of plants' outputs for each industry using establishment-level data from the annual Mining and Manufacturing Survey provided by Statistics Korea. $IM_{s,96}+Q_{s,96}$ is the value of goods available through imports and production in the initial year of the analysis. The measure in (1) tries to capture export supply shocks in China as in Acemoglu et al. (2016). The observed measure in (1) can also reflect Korea's import demand shocks. We try to capture Chinese supply shocks by using Japan's value of imports from China in place of Korea's imports from China, IM^C_{st} as an instrument. The underlying assumption of using Japan's import from China as an instrument is that both Korea and Japan which have similar distance from China are exposed to Chinese supply shocks reflected in their growth in imports from China.

To control for effects coming from import competition from all other countries except China, we include the variable $OPEN^O_{st}$ in the analysis. The variable is defined as

$$OPEN^O_{s,t} = \frac{IM_{st} - IM^C_{st}}{IM_{s,96} + Q_{s,96}}.$$

We investigate where the effects of Chinese import on plants come from. We show that distinguishing the output competition and input sourcing is important to understand the source. There are empirical studies estimating different effects of trade reforms on final goods and intermediate inputs. Amiti and Konings (2007) separately estimated productivity gains from reducing tariffs on final goods and from reducing tariffs on intermediate inputs. Brandt et al. (2017) studied the differential effects on both markups and productivity. This paper estimates different effects of trade by introducing a new measure of industry availability of imported goods in input markets. Our hypothesis is that plants' productivity, markups or employment can be affected when more Chinese goods are available in input markets than before. We constructed the input import shares from China to measure the availability of Chinese goods in input markets using 2010 Input-Output (IO) table. The IO table comes from the Economic Statistics System(ECOS) provided by the Bank of Korea. The IO table is provided at the three-digit level industry, making input shares vary at the three-digit level. The variable $CPEN^I_{st}$ is defined as a weighted average of the import share of China

$$CPEN^{I}_{s,t} = \sum_{n} CPEN^{O}_{n,t} \cdot a_{n,s} \,. \qquad (2)$$

where $a_{n,s}$ is the cost share of industry n for industry s. $CPEN^{I}_{st}$ increases in industry s proportional to its input share of industries when their import share of China increases. We control for the other countries' import share in input markets with the variable $OPEN^{I}_{st}$. $OPEN^{I}_{st}$ is defined as (2) using $OPEN^{O}_{st}$ in place of $CPEN^{O}_{st}$.

Table 1 summarizes the import share of China in output markets $CPEN^{O}_{st}$ and in input markets $CPEN^{I}_{st}$ by two-digit ISIC industries and year between 1996 and 2013. To illustrate the time trends in the import shares of China, we used the value of imports and gross outputs in the denominator at year t, $IM_{s,t} + Q_{s,t}$, in place of $IM_{s,96} + Q_{s,96}$. The shares for each data is the average of $CPEN^{O}_{st}$ and $CPEN^{I}_{st}$ at the two-digit industry level and at the whole manufacturing. The data is the three-year averages of the import shares of reported year and preceding two years.

We can find that the industy exposure to Chinese imports increased substantially in both output and input markets. On average at the whole manufacturing, the import share of China in output markets increased from 11 percent to 31 percent while the import share of China in input markets increased from 6 percent to 18 percent. Table 1 also shows that there are large variations in the import shares across industries and time. Textiles; wearing apparel; and leather had relatively high import share of China at the begining of the period and continue to rise over time. All other industries with initially low import share of China also exprienced high exposure to imports from China. Some industries experienced more rapid rise in the import shares of China and they include office, accounting, computing; electrical machinery; and radio, TV & communication equipment.

2.2 Plant-level data

Plant-level data comes from the annual Mining and Manufacturing Survey provided by Statistics Korea over the period 1996-2013. The survey covered all establishments, or plants, with at least five employees until 2006. Afterwards, the cutoff for employment level raised to ten. I dropped establishments with fewer than ten employees for consistency in the analysis. These establishments accounted approximately 45 percent in number of establishments per year on average while their production output accounted for 4 percent on average until 2006. In 2012, the plants included in the analysis accounted for 72% of employment and 87% of gross output in manufacturing

Industry	Type	1998	2001	2004	2007	2009	2013
15 Food & Beverages	Output	15	15	17	20	20	18
	Input	5	7	8	10	11	10
17 Textiles	Output	33	37	43	53	53	54
	Input	13	14	16	22	23	24
18 Wearing apparel	Output	25	48	66	68	66	56
	Input	19	23	27	31	31	28
19 Leather	Output	31	38	44	49	44	35
	Input	12	16	19	22	22	21
20 Woods	Output	26	31	41	43	43	45
	Input	5	8	10	13	13	16
21 Paper	Output	2	6	11	23	28	31
	Input	3	5	7	12	14	16
24 Chemicals	Output	4	5	8	11	14	14
	Input	5	6	8	11	13	14
25 Rubber & Plastic	Output	3	8	12	20	23	25
	Input	5	6	8	13	14	16
26 Non metalic mineral	Output	13	22	37	42	44	47
	Input	5	7	9	11	12	13
27 Basic metals	Output	11	9	13	26	26	25
	Input	10	9	11	22	23	23
28 Fabricated metal	Output	5	8	17	30	36	38
	Input	8	8	11	20	22	22
29 Machinery & Equipment	Output	2	3	6	11	16	18
	Input	5	6	9	15	16	18
30 Office, Accounting, Computing	Output	8	14	30	54	61	65
	Input	6	9	16	27	32	33
31 Electrical machinery	Output	11	17	29	40	45	50
	Input	6	9	14	20	22	24
32 Radio, TV & Communication equipment	Output	7	10	17	29	36	43
	Input	5	8	13	21	25	28
33 Medical, precision	Output	5	8	11	14	19	18
	Input	4	7	11	17	20	22
34 Motor vehicles	Output	1	7	9	14	19	18
	Input	4	5	7	14	18	21
35 Other transport equipment	Output	12	15	21	27	27	30
	Input	6	7	11	16	18	19
36 Furniture, n.e.c.	Output	16	25	34	44	46	44
	Input	7	10	13	19	20	21
Average	Output	11	15	21	27	30	31
	Input	6	8	10	15	17	18

Table 1: Import share of China in Korea

industry.

In each year we have plant-level information on total value of gross output, employment, total value of tangible assets, total costs of intermediate inputs, and wages. Total costs of intermediate inputs include the costs of materials, fuel, electricity, water, outsourced processing and repair. Tangible assets include the building structure, machinery, and transport equipment. Wages include salary, retirement and other employee benefits. The year 2010 is dropped in the analysis because information on capital stock is provided at the firm level instead of the plant level for that particular year.

During the sample period, Korea Standard Industry Code (KSIC) underwent three revisions, from KSIC Rev. 6 to KSIC Rev. 9. We linked industires at the five-digit level to KSIC Rev. 8 using the concordance tables provided by Statistics Korea. When an industry is classified to multiple industries in the concordance tables, we assigned it to the industry with the highest level of output production at the revision year. Finally, we use the concordance table of KSIC Rev. 8 and ISIC Rev. 3 provided by Statistics Korea to classfy plants by the four-digit ISIC industry level. Only manufacturing industries are included in the analysis.

3 Empirical Strategy

We use the two step estimation strategy of Brandt et al. (2017). Brandt et al. (2017) follows Pavcnik (2002) in estimating plant-level productivity in the first step and specify regression equation on the productivity with measures of trade liberalization in the second step. Brandt et al. (2017) implemented the estimation method of De Loecker and Warzynski (2012) to separately estimate firm-level markups and productivity. It allowed them to study the effects of trade liberalization on both dimensions of firm performance. We explain the estimation of plant productivity and markups in section 3.1 (first step) and the econometric equation to identify the impacts of trade from China in section 3.2 (second step).

3.1 Estimating productivity and markup

A. Productivity

We measure revenue productivity (TFPR) by estimating equation (3) for plants in each two-digit sector separately. We assume that a plant produces with a Cobb-Douglas production function. Eq. (3) is the production function expressed in natural logs.

$$q_{it} = \beta_{s,l} \cdot l_{it} + \beta_{s,k} \cdot k_{it} + \beta_{s,m} \cdot m_{it} + \omega_{it} + \epsilon_{it} \ , \tag{3}$$

where the dependent variable q_{it} is gross output at the plant i deflated by at the two- to three-digit industry level producer price deflator. l_{it} is the number of workers. k_{it} is physical capital deflated by a capital deflator. m_{it} is plant's material inputs deflated by at the two- to three-digit industry level input price deflator. The deflators for producer price and input price are from the productivity database of the Korea Productivity Center. Capital deflator is provided by the ECOS of the Bank of Korea. ω_{it} is plant's productivity and ϵ_{it} is unanticipated i.i.d. shock including measurement error.

Plants do not know ϵ_{it} when they make input decisions. As plants are informed of ω_{it} when making input decisions, simultaneity issue between input choices and productivity shock arises. We use the generalized method of moments (GMM) estimation used in De Loecker and Warzynski (2012) that uses material inputs demand as a proxy for productivity shock. Brandt et al. (2017) included both output and input tariffs in the material demand equation since the tariffs can affect firm's input demand. Both De Loecker (2013) and Brandt et al (2017) argued the importance of introducing policy variable of interest when the objective is to estimate the productivity effects from the policy variable. We use the same method detailed in Brandt et al. (2017) but considered the import shares of China in output market $CPEN^O_{st}$ and in input market $CPEN^I_{st}$ in the material demand equation. They are likely to affect plant's input demand and we allow both variables to impact future productivity.

Once we estimate the elasticity parameters of labor, capital, and intermediate inputs for each of two-digit industries, the log of TFP estimate is given as

$$tfp_{it} = q_{it} - \hat{\beta}_{s,l} \cdot l_{it} - \hat{\beta}_{s,k} \cdot k_{it} - \hat{\beta}_{s,m} \cdot m_{it} \ , \tag{4}$$

B. Markup

Following De Loecker and Warzynski (2012), markup μ_{it} of plant i is defined as the price-marginal cost ratio. They show that the markup can be measured as the ratio of the output elasticity on an input over the share of expenditures on the input in total sales. Using material inputs as an variable input, the markup can be expressed as

$$\mu_{it} = \frac{\beta_m}{s^M_{it}}, \text{ where } s^M_{it} = \frac{\exp(m^n_{it})}{\exp(q^n_{it} - \hat{\epsilon}_{it})} \tag{5}$$

where m_{it}^n and q_{it}^n denote nominal value of material inputs and gross outputs respectively. With eq. (5), we can use the estimates of the output elasticity and expenditure share of material inputs to calculate markup. The denominator in expenditure share is corrected with an estimate for ϵ_{it} to eliminate output variation not correlated with variables that affect input demand.

3.2 Econometric equation

We consider dependent variable (y_{it}) to be plant performance measures (productivity or markups) or plant employment or plant exit. We use the estimated plant-level productivity and markups following the method explained in section 3.1. Using the plant-level measures as dependant variable, we estimate the regression equation (6) based on Brandt et al. (2017) to study the effects of imports from China. Brandt et al. (2017) used one-year lagged output and input tariffs at the industry level to identify the effects of trade liberalization. We use the one-year lagged import shares from different origin in output and input markets to measure the intensitry of industry's exposure to international trade.

Main estimating equation

$$\begin{aligned} y_{it} = \alpha_c &+ \alpha_O \cdot \ln CPEN_{s,t-1}^O + \alpha_I \cdot \ln CPEN_{s,t-1}^I \\ &+ \beta_O \cdot \ln OPEN_{s,t-1}^O + \beta_I \cdot \ln OPEN_{s,t-1}^I + Z_{s,t}\gamma + \delta_t + \delta_i + \varepsilon_{it} \end{aligned} \tag{6}$$

where $Z_{s,t}$ is a vector of time-varing industry-level controls including exports to China, exports to other countries, capital, employment and gross output. δ_t is a vector of time dummies controlling the average growth rate for whole manufacturing industry. δ_i is plant-fixed effects which controls unobserved time-invariant plant characteristics.

The coefficients on the import shares capture the correlation between the change in the input shares from China and other countries in the output and input markets of industy s and the average growth rate of plant-level outcomes in indusrty s. We use robust standard errors clustered at the plant level.

4 Results

4.1 Within establishment results: productivity and markup

Table 2 explores the effects of Chinese import competition on Korean plant productivity estimated in the above section, using the estimating equation (6). The results in general show that the increased Chinese import competition at the industry level raises plant-level productivity. The result in column 1 shows that without consideration of input import penetration rates, doubling the level of output one leads to 1.4% increase in productivity. In columns 2 and 3, we add the input import penetration rates, and report OLS and IV estimates, respectively. The results are similar between the two estimates, and the IV estimation results show that doubling the Chinese input import competition raises Korean plant productivity by 6.3%, which is about four times larger than the estimate for the normal output import penetration rate in column 1. The magnitude of the effect is quite significant given that the average Chinese import input penetration rate grew by about 3 times during the period of 1998-2013. This implies that Korean plant's better access to imported inputs from China helped increase the plants' performance. On the other hand, the effect of imported inputs from other countries has a negative impact on Korean plant productivity. Note that the literature does not distinguish the two effects separately between input and output import penetration rates. But, our results underscores the importance of the two distinctive effects.

Dependent variable	Productivity			
Specification	(1)	(2)	(3)	(4)
Estimation method	FE	FE	IV	FE
Output CPEN (lagged)	0.014***	0.004***	0.011***	
	(0.001)	(0.001)	(0.002)	
Output OPEN (lagged)	-0.023***	-0.023***	-0.025***	
	(0.002)	(0.003)	(0.003)	
Input CPEN (lagged)		0.061***	0.063***	
		(0.003)	(0.006)	
Input OPEN (lagged)		-0.018***	-0.025***	
		(0.006)	(0.007)	
Output WPEN (lagged)				-0.030***
				(0.003)
Input WPEN (lagged)				0.068***
				(0.006)
Export to China	0.002*	0.002	0.002	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Export to other countries	0.015***	0.012***	0.011***	0.013***
	(0.002)	(0.002)	(0.002)	(0.002)
Capital	-0.082***	-0.083***	-0.081***	
	(0.004)	(0.004)	(0.004)	
Employment	-0.096***	-0.106***	-0.111***	-0.142***
	(0.006)	(0.005)	(0.006)	(0.005)
Output	0.181***	0.188***	0.188***	0.147***
	(0.005)	(0.005)	(0.005)	(0.005)
Plant fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	388580	388016	388016	388016

Table 2: Effects of Industry-level Chinese Import Exposure on Plant-level Productivity

In order to have a closer look at the mechanism through which the rising Chinese import competition affect Korean plant performance, we explore the effects on Korean plant's markups estimated in the previous section. The results in Table 3 across the varying specifications show that the increased Chinese output import competition has a positive impact on Korean plants' markups, while the input one has no effect on markups: the IV estimate on column 3 shows that doubling the output import penetration rate from China increases Korean plants' markup by 1 %. Combining with the results in Table 2, we interpret these results that the increased Chinese import competition in output raises productivity through pro-competitive effects, thus lowering costs and being able to increase the markups. Meanwhile, the increased Chinese imported input penetration raise the Korean plants' productivity significantly but fails to increase markups probably due to lower prices. On the other hand, the results show that the increased output import penetration from other countries has a negative impact on markups, while the input one has a significantly positive impact on markups. When in comes to imports from other countries, the sign of the effects seem more natural: the pro-competitive effects lowers markups, while the better access to inputs raise the markups.

Dependent variable	Markup			
Specification	(1)	(2)	(3)	(4)
Estimation method	FE	FE	IV	FE
Output CPEN (lagged)	0.006***	0.005***	0.010***	
	(0.001)	(0.001)	(0.003)	
Output OPEN (lagged)	-0.009***	-0.016***	-0.017***	
	(0.003)	(0.003)	(0.003)	
Input CPEN (lagged)		0.006	-0.006	
		(0.004)	(0.007)	
Input OPEN (lagged)		0.034***	0.039***	
		(0.007)	(0.007)	
Output WPEN (lagged)				-0.011***
				(0.003)
Input WPEN (lagged)				0.038***
				(0.007)
Export to China	-0.004***	-0.004***	-0.004***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Export to other countries	0.016***	0.014***	0.014***	0.015***
	(0.003)	(0.003)	(0.003)	(0.003)
Capital	0.009**	0.010**	0.011***	
	(0.004)	(0.004)	(0.004)	
Employment	0.035***	0.033***	0.033***	0.043***
	(0.006)	(0.006)	(0.006)	(0.006)
Output	-0.052***	-0.050***	-0.051***	-0.047***
	(0.005)	(0.005)	(0.005)	(0.005)
Plant fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	379743	379633	379633	379633

Table 3: Effects of Industry-level Chinese Import Exposure on Plant-level Markup

4.2 Between establishment results: employment

Table 4 presents the second-stage relationship between industry-level import penetration rates and plant-level employment (both in log). As discussed in the introduction above, the literature studying the effects of Chinese trade liberalization on developed countries commonly shows its negative impacts on employment. In contrast, our results show the opposite. Column 1 reports the IV estimates when the estimation framework includes only the output import penetration rates. We find that doubling the Chinese import competition in output (at the 3-digit industry level) leads to a 1.4% increase in Korean plant employment. The effect of the import penetration from other countries is similar at the 1.8% level. In the next two columns (columns 2 and 3 report OLS and IV estimates, respectively), we further explore the relationship by adding input import penetration rates. Interestingly, we find that the effect of input import penetration from China on Korean plant employment is much larger at the 5.9% level, while the effect of output one decreases decreases to 0.8%. This implies that increased access to imported inputs at a cheaper price from China contributed to increased size of Korean plant employment. On the other hand, the effect of imported inputs from other countries do not have a significant effect on Korean plant employment.

Dependent variable	Employment			
Specification	(1)	(2)	(3)	(4)
Estimation method	FE	FE	IV	FE
Output CPEN (lagged)	0.014***	0.003	0.008**	
	(0.002)	(0.002)	(0.004)	
Output OPEN (lagged)	0.018***	0.015***	0.014***	
	(0.004)	(0.004)	(0.004)	
Input CPEN (lagged)		0.064***	0.059***	
		(0.006)	(0.010)	
Input OPEN (lagged)		-0.004	-0.004	
		(0.012)	(0.013)	
Output WPEN (lagged)				-0.002
				(0.004)
Input WPEN (lagged)				0.075***
				(0.010)
Export to China	0.006***	0.005***	0.005***	0.005***
	(0.002)	(0.002)	(0.002)	(0.002)
Export to other countries	0.005	0.001	0.001	0.003
	(0.003)	(0.003)	(0.003)	(0.003)
Capital	-0.045***	-0.046***	-0.045***	
	(0.006)	(0.006)	(0.006)	
Employment	0.131***	0.120***	0.118***	0.107***
	(0.008)	(0.008)	(0.009)	(0.008)
Output	-0.002	0.007	0.006	-0.019***
	(0.007)	(0.006)	(0.007)	(0.006)
Plant fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	395309	394735	394735	394735

Table 4: Effects of Industry-level Chinese Import Exposure on Plant-level Productivity

5 Concluding Remarks

To be completed..

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