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The Impact of Input and Output Tariffs on Domestic Employment across Industries: Evidence from Korea

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Abstract

Purpose – This paper examines how differently output and input tariffs affect domestic employment across industrial characteristics of comparative advantage such as labor quality and capital intensity.

Design/methodology – The paper focuses on 453 Korean industries from 2007 to 2014 because Korea is a typical example of a natural resource-scarce open economy and experienced the transition of the export pattern from labor intensity to technology intensity during this period.

Findings – The results show that input tariff reduction stimulated total employment, focusing on the early 2010s, while the effects of output tariff reduction were statistically insignificant in general. However, the stimulation effects of output tariff reduction on employment were found in comparative advantage industries with greater labor quality and capital intensity. As for input tariff reduction, its stimulation effects on employment were more prominent in comparative disadvantage industries with lower labor quality and capital intensity.

Originality/value – These results provide significant implications for natural resource-scarce open economies which are experiencing the transition of the export pattern from labor intensity to technology intensity and the unequal distribution of income after trade liberalization: imported intermediate inputs has become increasing important, leading to trade effects on employment and alleviation of income inequality.

Keywords: Comparative Advantage, Employment, Imported Intermediate Inputs, Tariff
JEL Classifications: F14, F15, F16, F66

1. Introduction

The Korean government recognized the importance of international trade for its trade-dependent small economy and has entered 16 free trade agreements (FTAs) as of 2020. Accordingly, Korea's international trade with FTA member countries has greatly enlarged, and many studies have analyzed the effects of FTAs and tariff reductions on economic performance. However, they have primarily focused on the link between exports and sector- or firm-level productivity in final goods (Aw et al., 2000; Hahn Chin-Hee, 2004; Jang Yong-Joon et al., 2015). In practice, imports as well as exports greatly increased in Korean FTAs; total import share from member countries rose from 0.9 percent in 2004 to 62.8 percent in 2015 (Kim Young-Gui et al., 2017). Addressing that imports from member countries have increased by an annual average of 12.8 percent and exports to them have increased by 10.7 percent, protectionists criticize that free trade has further widened the trade deficit with FTA member countries and thus worsened the Korean economy. They especially attribute the rise of unemployment to free trade policies (Bae Chan-Kwon et al., 2012).

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The protectionists' arguments overlook the true features of Korean trade. As a country with natural-resource scarcity, Korea mostly imports raw materials and intermediate inputs, which make up over 70 percent of total imports, to use for domestic productions and exports. Since the early 2010s, intermediate goods imports have further increased despite a slight decline in total imports in Korea, deepening the global value chains (GVCs) (Kim Young-Gui et al., 2017).[1] Hence, it is very important for the Korean economy to have better access to imported intermediate inputs as well as greater export opportunity and thus to consider the effects of free trade on economic performances as two aspects of tariff reduction: input tariff on intermediate goods and output tariff on final goods. The situation of Korean trade will be in line with that of other developing countries with an open economy: Ma and Dei (2009) and Yu (2014) for China, Fernandes (2007) for Colombia, Goldberg et al. (2010), Topalova and Khandelwal (2011) for India, and Amiti and Konings (2007) for Indonesia. These studies find that economic gains from input tariff reduction are much greater than those from output tariff reduction.

This paper empirically examines how differently input and output tariff reductions on imports affect domestic employment in Korea, depending on industrial characteristics of comparative advantage. Unlike previous related studies, the paper focuses on employment because recently some politicians and protectionists blamed the declines in employment on international trade all over the world (Acemoglu et al., 2016; Rose, 2018). In Korea, the employment issue is also at the center of political and economic dispute, stemming from income-led growth policies and free trade policies. In addition, Whang Un-Jung et al. (2017) argue that export expansion no longer leads to job creation and thus Korea is losing its status as a manufacturing-based export-driven economy. They show that the export pattern of Korea has changed from labor-intensive industry to capital (or technology)-intensive industry under the situation that the former leads to more job creation than the latter. Also, they show that the domestic consumption elasticity of employment is much greater than the export elasticity of employment in input-output analysis (IOA).[2] From these results, it is noted that the importance of exports has become eclipsed and imports of intermediate inputs are leading to a rise in domestic consumption and in trade effects on employment. This phenomenon will especially be more significant for a natural resource-scarce open economy like Korea.

Also, this paper examines the heterogeneous effects of input and output tariff reductions across industrial characteristics of comparative advantage. Amiti and Konings (2007) address that a fall in input tariffs might have quite different effects on users of these inputs. Luong (2011) shows that input and output tariff reductions differently affect firm productivity, depending on the elasticity of substitution among intermediate inputs and import intensity at the sector level. In addition to these findings, this paper focuses on various industrial characteristics of comparative advantage such as labor quality and capital intensity which are major production inputs. The paper finds their significant roles in the connections not only between domestic employment and tariff reduction in imported final goods, but also between domestic employment and tariff reduction in imported intermediate inputs.

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[1] Kim Young-Gui et al. (2017) show that major importing countries of Korea changed from developed countries to natural resource-abundant countries during the period 1988-2015. Kim et al. (2011) also show that the trade deficit in intermediate goods trade enlarged from 29 billion dollars in 2004 to 46.9 billion dollars in 2009.

[2] As of 2014, the former is 11.6 employments, while the latter is 6.5 employments (Whang Un-Jung et al., 2017). Thus, domestic consumption contributes domestic employment two times more than exports in Korea (Whang Un-Jung, 2019). Also, Aw et al. (2000) show that the correlation between export expansion and firm productivity is not strong in the case of Korea, unlike that of Taiwan.

The rest of the paper is organized as follows. Section 2 summarizes previous studies and sets up the research hypotheses. Section 3 provides econometric specifications and data sources. Section 4 reports the empirical results. Finally, Section 5 provides a conclusion and policy implications.

2. Literature Review and Research Hypotheses

Previous studies on the economic effects of imports can be categorized into two groups: those dealing with import competition (i.e., import penetration) and the others dealing with technology transfer (i.e., learning-by-importing) (Amiti and Konings, 2007). The former generally focuses on imported final goods and concludes that tighter competition with foreign firms after trade liberalization or tariff reduction can enhance productivity, economic efficiency and job creation on one side (MacDonald, 1994; Pavnick, 2002), and on the other side generate firm exit and job displacement as side effects (Kletzer, 2001). Accordingly, the aggregate effects seem to be ambiguous due to the tradeoff of tighter market competition above. Following these studies, Bernard et al. (2007) provide a theoretical framework in which this tradeoff appears differently across industries. They find that falling trade costs render an economy vulnerable to import penetration and generate job turnover from low productive firms to high productive firms in all sectors. However, these reallocations of resources are more prominent in comparative advantage industries than in comparative disadvantage industries. The reason is that comparative advantage industries have not only the greater export opportunity of survivors but also the greater exit of nonviable firms after trade liberalization. However, comparative disadvantage industries have fewer opportunity to export with tighter import penetration. Consequently, trade liberalization spurs net job creation and a greater increase in average productivity in comparative advantage industries, but net job destruction and a decrease in average productivity in comparative disadvantage industries.

Meanwhile, previous studies on learning-by-importing regard the role of imported intermediate inputs as important. Addressing better access to foreign technology and economic efficiency through importing intermediate inputs, they conclude that trade liberalization has a positive influence on economic performances by sourcing foreign intermediate inputs with higher quality (Feng et al., 2016), greater variety (Kasahara and Rodrigue, 2008), and lower price (Bernard et al., 2003; De Hoyos and Iacovone, 2013). Accordingly, unlike ambiguous effects of imported final goods, trade liberalization in imported intermediate inputs produces economic benefits in general. Following these studies, Luong (2011) examines that the positive effect of imported intermediate inputs can be different across industries: lowering input tariffs leads to a rise (or decline) in productivity in industries with high (or low) import intensity and low (or high) elasticity of substitution among intermediate inputs on one side. On the other side, lowering output tariffs has the opposite effect: it has a positive (or negative) influence on productivity growth when intermediate inputs are highly (or lowly) differentiated.

Based on these studies, this paper addresses the following research question: *How do output and input tariffs on imports affect domestic employment across industrial characteristics?* In particular, previous studies have examined the role of imported intermediate inputs on economic performances, but ignored their heterogeneous effects across industrial characteristics. The only exception is Luong (2011), but he simply considered import intensity and the elasticity of import substitution as industrial characteristics. Meanwhile, Bernard et al. (2007) considered the role of comparative advantage and comparative

disadvantage in the connection between output tariff reduction and aggregate productivity. However, they did not deal with various industrial characteristics such as import intensity by missing imported intermediate inputs in their theoretical model and thus ignoring technology transfer through imports. Accordingly, when considering both intermediate inputs and final goods in the analysis, it is necessary to consider various characteristics of comparative advantage and comparative disadvantage such as the share of production inputs in final production (Bernard et al., 2007; Whang Un-Jung et al., 2017). To fill in this gap, this paper considers labor quality and capital intensity which are major indicators of comparative advantage and comparative disadvantage, as a medium for the connections between a reduction in input or output tariffs and domestic employment.

For output tariff reduction, I mainly consider Bernard et al.'s (2007) theoretical framework: the aggregate effects on total employment seem to be ambiguous due to the tradeoff of tighter market competition after trade liberalization, but comparative advantage industries have greater resource reallocation and thus net job creation. Meanwhile, in addition to factor abundance of labor and capital in the Heckscher-Ohlin model, there exist various sources of comparative advantage such as more educated workers and better institutions (Costinot, 2009). As a skilled- and capital-abundant country, Korea also has the characteristics of comparative advantage industries such as higher labor quality and capital intensity (Whang Un-Jung et al. 2017)[3].

With these features, I formulate the following hypotheses in Korea in line with Bernard et al.'s (2007) arguments:

H1: The effects of output tariff reduction on employment are ambiguous in general, but the positive effects will appear in comparative advantage industries with higher labor quality and capital intensity.

For input tariff reduction, I mainly consider Luong's (2011) theoretical framework with intensity of imported intermediate inputs: the effects of a decrease in input tariffs on productivity are positive due to technology transfer in general, and these positive effects are more prominent in industries with high intensity of imported intermediate inputs.

Meanwhile, some basic statistics in Korea show that industries with lower labor quality and capital intensity are more likely to depend on imports in intermediate inputs. I calculate the sector-level average value of the import input coefficients from the Economic Statistics System of the Bank of Korea,[4] and then examine how much an industry depends on imported intermediate inputs for final production as their import intensity in Korea. Fig. 1 reveals that import input coefficients and two industrial characteristics, labor quality and capital intensity, are slightly negatively related in Korea: the correlation of coefficients with import input coefficients is -0.141 for average wage which is a proxy for labor quality and -0.122 for capital intensity at 1% statistical significance level. This implies that imported intermediate inputs are a substitute for production factors such as domestic skilled workers and capital for final production. In other words, industries with lower labor quality and/or lower capital intensity depend more on imported intermediate inputs for final production. This feature of Korea is very similar with Liu and Qui's (2016) finding of the substitutive relation between imported intermediate inputs and innovation for Chinese firms. Since lower labor quality and capital

[3] Whang Un-Jung et al. (2017) show that Korea's comparative advantage has transferred from labor-intensive industries to capital-intensive industries since the 1990's with a rapid development of high technology industries such as IT.

[4] The import input coefficients represent the ratio of value of imported intermediate inputs in total input value in a sector.

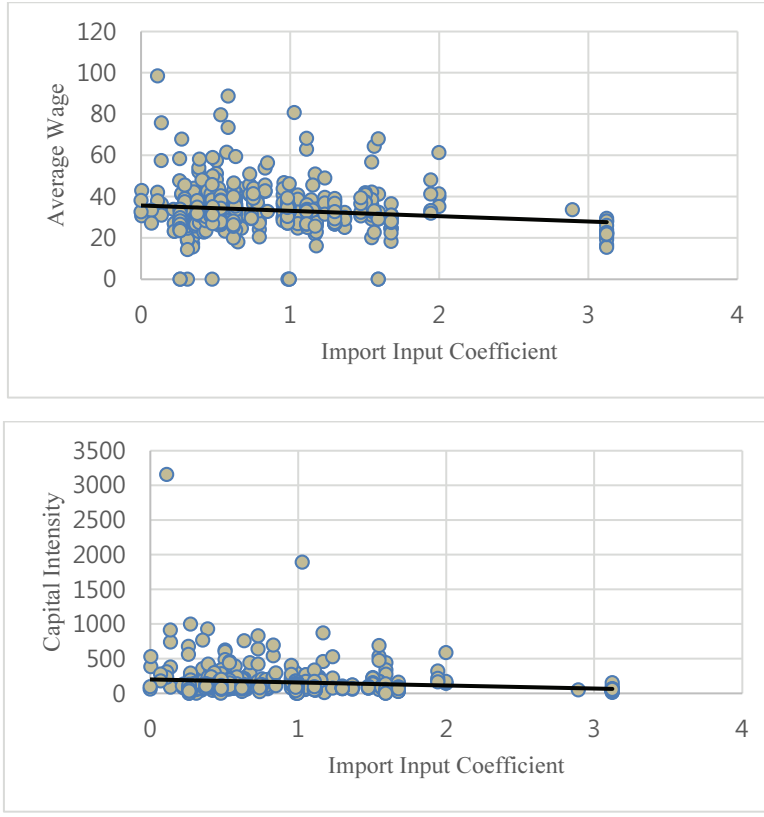
intensity are major characteristics of a comparative disadvantage industry in Korea, I conclude that comparative disadvantage industries are more likely to depend on imports in intermediate inputs as well as final goods.

With these features, I formulate the following hypotheses in Korea in line with Luong's (2011) arguments:

H2: *The effects of input tariff reduction on employment are positive in general, and these positive effects will be more prominent in industries with lower labor quality and capital intensity.*

Overall, the two hypotheses are in line with Luong (2011) and Ma and Dei (2009) in the sense that there are opposite effects between output tariffs and input tariffs on economic performances. Additionally, I expect that the second hypothesis will be more likely to be correct for the early 2010s, when the ratio of intermediate inputs in total imports increased significantly in Korea, deepening GVCs (Kim Young-Gui et al., 2017). Hence in the following empirical analysis I break down the sample period into two parts, based on 2010.

Fig. 1. Correlations between Import Input Coefficients and Industrial Characteristics



Sources: Author's calculation using KOSIS, UN COMTRADE, and BOK.

3. Economic Specifications and Data Sources

3.1. Econometric Specifications

Based on the literature review, I build up the following equation as a main regression model to empirically test the effects of output and input tariffs on total employment:

$$\ln EMP_{it} = \beta_0 + \beta_1 \ln AWG_{it} + \beta_2 \ln EXP_{it} + \beta_3 \ln CAP_{it} + \beta_4 \ln CR3_{it} + \beta_5 \ln OTR_{it} + \beta_6 \ln ITR_{it} + \gamma_i + \tau_t + \varepsilon_{it} \quad (1)$$

where *i* and *t* refer to sectors and years, respectively.

As the dependent variable, $\ln EMP_{it}$ is the log of total employment in *i* at *t*. The two key variables of $\ln OTR_{it}$ and $\ln ITR_{it}$ represent the log of output tariff rate and the log of input tariff rate in *i* at *t*, respectively. An output tariff represents an average tax directly imposed on import goods in *i*, while an input tariff represents an average tax imposed on imported intermediate inputs, which are used to produce goods in *i*. As in Goldberg et al. (2010), I calculate the weighted average value of tariffs on intermediate inputs for producing a final good, based on an import input coefficient.[5] Based on *H1*, I expect β_5 to be ambiguous due to the tradeoff of import penetration. Based on *H2*, I expect β_6 to be negative due to greater efficiency in final production using imported intermediate inputs with lower tariff rate.

As other control variables, $\ln AWG_{it}$ is the log of average wage in *i* at *t*, which is a proxy for labor quality (Trefler, 1993; Song Sang-Yoon, 2018). $\ln CAP_{it}$ is the log of average tangible assets in *i* at *t*, which is a proxy for capital intensity (Leontief, 1953). $\ln EXP_{it}$ is the log of total export value in *i* at *t*, which is for estimating the export elasticity of employment (Whang Un-Jung et al., 2017). $\ln CR3_{it}$ is the log of market concentration in *i* at *t*, which is a proxy for market competition (Bernard et al., 2007; Kim Bae-Geun, 2014). It is noted that the higher market concentration is, the lower market competition is. I expect β_1, β_2, and β_3 to be positive, implying that total employment increases in response to higher labor quality, higher capital intensity, and greater export value at the sectoral level. Meanwhile, I expect β_4 to be ambiguous, implying that the effect of market concentration on total employment is undetermined due to the tradeoff effects of market competition (Bernard et al., 2007).

γ_i is a dummy variable for *i* to control a sector's innate time-invariant characteristics that might affect an employment. τ_t is a dummy variable for *t* to control the macroeconomic environment, which might affect an employment. Finally, ε_{it} denotes an error term.

In addition to (1), I consider the following econometric specification to see how the effects of output tariff or input tariff on total employment varied in sectoral characteristics.

$$\ln EMP_{it} = \beta_0 + \beta_1 \ln AWG_{it} + \beta_2 \ln EXP_{it} + \beta_3 \ln CAP_{it} + \beta_4 \ln CR3_{it} + \beta_5 \ln OTR_{it} + \beta_6 \ln ITR_{it} + \beta_7 (\ln OTR_{it} \times x_{it}) + \beta_8 (\ln ITR_{it} \times x_{it}) + \gamma_i + \tau_t + \varepsilon_{it} \quad (2)$$

In (2), all variables except for the interaction terms are the same as in (1). In the interaction terms, x_{it} consists of the other control variables, $\ln AWG_{it}$ and $\ln CAP_{it}$, and thus the effect

[5] Meanwhile, Luong (2011) divides imported goods into final goods and intermediate inputs, considering tariffs on the former as output tariffs and those on the latter as input tariffs. This is a significant difference between this paper and Luong (2011) in considering tariffs on imported intermediate inputs. It is noted that Goldberg et al.'s (2010) methodology with respect to input tariffs is more apt for the objectives of this paper.

of output tariff or input tariff on total employment can be compared across different sectoral characteristics. For example, considering x_{it} as labor quality (i.e., $\ln AWG_{it}$), if both β_1 and β_7 are negative with statistical significance, then it is concluded that output tariff reduction increases total employment, and these positive effects were more prominent in industries with higher labor quality. Accordingly, based on *H1*, I expect β_7 to be negative for the interaction terms between output tariff and labor quality and between output tariff and capital intensity. Based on *H2*, I expect β_8 to be positive for the interaction terms between input tariff and labor quality and between input tariff and capital intensity, implying that the positive effects of input tariff reduction on total employment were more prominent in industries with lower labor quality and capital intensity.

In the main regression, I considered the fixed-effects model which can alleviate omitted variable bias by eliminating γ_i. I performed the *F*-test and the *Hausman* test to verify the reliability of the fixed-effects: the former tests the null hypothesis that sector dummies are all together zero, while the latter tests the null hypothesis that the covariance between independent variables and γ_i is zero. If the test results reject these null hypotheses, then the fixed-effects model is preferred over the pooled ordinary least squares (OLS) and the random-effects model, respectively. Also, I performed the *F*-test for the null hypothesis that year dummies are all together zero to check whether there exist the year-specific effects during the sample period in all regressions (Cameron and Trivedi, 2005).

While eliminating γ_i, the regression still may show reverse causality between a dependent variable and independent variables. For example, a decline in employment can be logical ground for protectionism and thus affect an increase in tariff rates (Baier and Bergstrand, 2007). To mitigate this, I considered the independent variables lagged by one year as well as those in the current year. Also, while controlling τ_t, the global financial crisis of the late 2000s in the sample period might significantly affect the regression results. In addition, Kim Young-Gui et al. (2017) show that the share of imported intermediate inputs has rapidly increased since the early 2010s in Korea. Hence, in some regressions I divided the entire sample period into two sub-samples: the late 2000s and the early 2010s. Finally, I consider robust standard errors clustered by sectors to control that sectoral unobservable factors inflate the statistical significance of coefficient estimates (Aghion et al., 2003).

3.2. Robustness Check[6]

One of the problems in (1) and (2) is that total employment in previous years might affect that of the current year. Also, control variables in (1) and (2) might not be strictly exogenous. Accordingly, I consider the two-step Arellano-Bond estimator, which is a dynamic panel model using a generalized method of moments (GMM) as a robustness check (Arellano and Bond, 1991)[7]. The Arellano-Bond estimator is a very useful method to control a dynamic panel bias which is caused by autocorrelation of employment and endogeneity problem because it considers first differences of the variables and sets up a two-step estimation procedure with instrument variables consisting of their lagged value. To solve an over-identification problem caused by the fact that the number of instrument variables is greater than that of endogenous variables, the Arellano-Bond estimator considers the GMM estimation.

[6] I referred to Cameron and Trivedi (2005) for the procedure of the Arellano-Bond estimator.

[7] Arellano and Bond (1991) also applied it to the employment equations.

In the procedure of the Arellano-Band estimator, I performed two tests to check whether the instruments are valid: the Arellano-Bond test for autocorrelation (*AB* test for AR) and the *Hansen J* test. The *AB* test for AR(1) (or AR(2)) verifies the null hypothesis that the first-order (or second-order) autocorrelation exists, while the *Hansen J* test verifies the null hypothesis that an over-identification problem exists.

3.3. Data Collection and Summary Statistics

Table 1 lists the variables and their data sources. The database consists of 453 sectors classified by Korea Standard Industry Code (KSIC) at a 5-digit level from 2007 to 2014 in Korea. As a main data source, the Korean Statistical Information Service (KOSIS) of Statistics Korea provides total numbers of employees, total salaries, and values of tangible assets at 5-digits KSIC.[8] The dependent variable in the regressions is defined as the log of total number of employees. Average wage (AWG) is defined as the ratio of total salary in total number of employees (i.e., a per capita salary). Capital intensity (CAP) is defined as the ratio of value of tangible assets in total number of employees (i.e., a per capita capital). Both the monetary unit of total salary and tangible assets are the Korean won and I considered the real values by deflating them by the producer price index (PPI) provided by the Bank of Korea.

Total export values at the 6-digits Harmonized System (HS) code were extracted from UN COMTRADE (United Nations Commodity Trade Statistics Database). As their monetary unit is the US dollar, I converted them into Korean won with the annual average exchange rate of Korean won-US dollar provided by the Bank of Korea and 5-digits KSIC with the correlation tables provided by the KOSIS. Also, they were deflated by the PPI. The market shares of the three largest firms ($CR3$) at 5-digits KSIC represent the level of market concentration provided by the Korea Fair Trade Commission.

Trade-weighted average tariff rates at the 6-digits HS code in Korea were extracted from the World Integrated Trade Solution (WITS) of the World Bank and also converted to a 5-digits KSIC in order to use output tariff rates in the regressions. As in Goldberg et al. (2010), I calculated the level of input tariff rate (ITR) as follows:

$$ITR_{it} = \sum_{j=1}^{n} \alpha_{ji} \, TAR_{jt} \tag{3}$$

where j denotes an intermediate good using in sector i. α_{ji} represents the contribution ratio of an intermediate good in i's total production. Accordingly, ITR_{it} is defined as the contribution-weighted average tariff rate of intermediate goods in i. For α_{ji}, I considered the import input coefficients in the input-output (IO) tables provided by the Bank of Korea, which are defined as the ratio of value of imported intermediate inputs from j to i in total input value in i. The import input coefficients represent the contribution of imported intermediate inputs to produce one unit of products in i. As the IO table has its own classification of 122 sectors, I converted it to a 5-digits KSIC with the correlation tables provided by the BOK. When considering the log values of output tariff rates, input tariff rates, and CR3, I added one to the original values because some of them are zero.

[8] I supplemented the data of the year 2010 by the extrapolation method because the KOSIS did not collect it.

Table 1. Variables and Data Sources

Variable	Source
Number of Employees	
Total Salary	KOSIS
Tangible Assets	
Export	UN COMTRADE
Market Concentration (CR3)	Korea Fair Trade Commission
Weighted Average Tariff Rate	WITS
Import Input Coefficient	Bank of Korea

Table 2 reports summary statistics. I checked correlation coefficients and found no multicollinearity among independent variables, as they all are less than the absolute value of 0.8.

Table 2. Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
$\ln EMP_{it}$	3,562	7.875	1.271	3.497	11.389
$\ln AWG_{it}$	3,562	3.357	0.284	2.418	4.661
$\ln EXP_{it}$	3,624	11.986	2.347	1.627	17.866
$\ln CAP_{it}$	3,562	4.652	0.751	0.946	8.028
$\ln CR3_{it}$	3,624	3.612	0.619	0	4.615
$\ln OTR_{it}$	3,624	1.910	0.900	0	5.427
$\ln ITR_{it}$	3,624	1.904	0.726	0	4.831

4. Empirical Results

4.1. Basic Results

Table 3 reports the regression results for the entire sample period (2007-2014), the late 2000s (2007-2010), and the early 2010s (2011-2014). Columns (2), (4), and (6) show the results with one-year lagged independent variables, while columns (1), (3), and (5) show those with current ones. In all columns, the results from the *Hausman* test and the *F*-test show that the fixed effects model is preferred over the random effects model and the pooled-OLS, respectively. Also, the *F*-test for year-specific effects rejects the null hypothesis at 1 % significant level, suggesting that all regressions include year dummies to control them.

The results in Table 3 are as follows. First, as expected, the coefficient estimates of $\ln AWG$ are positive and statistically significant in general, implying that employment increased when worker quality rose. However, the results find no evidence when considering one-year lagged independent variables in the samples which were divided into the late 2000s and the early 2010s. Overall, it seems that labor quality had only short-term *ex post* effects on employment in Korea.

Second, the coefficient estimates of $\ln EXP$ are also positive and statistically significant in general, representing the positive export elasticity of employment in Korea. However, these positive effects occurred mostly during the late 2000s rather than the early 2010s. In other

words, exports did not influence employment during the early 2010s, which finding is consistent with those of Whang Un-Jung et al. (2017).[9] Hence, in conjunction with Whang Un-Jung et al. (2017), these results confirm that recently export expansion does not lead to sufficient job creation any more in Korea since its industrial structure focuses more on capital and technology rather than labor.

Third, the coefficient estimates of $\ln CAP$ are positive and statistically significant in column (1), implying that the increase in capital intensity positively affected employment over the entire period. The results, however, find no evidence when considering one-year lagged independent variables and dividing the sample period into the late 2000s and the early 2010s. Overall, it seems that capital intensity was not a main determinant of employment in Korea.

Fourth, the coefficient estimates of $\ln CR3$ are negative and statistically significant in general, implying that employment increased as market competition intensified in Korea. These results are consistent with Kim Bae-Geun (2014), showing that a permanent rise in the markup ratio lowered employment in Korea. In conjunction with Kim Bae-Geun (2014), these results confirm that market competition has a positive role in an employment among its trade-off effects in Korea. Hence the government policy as a means to reduce the degree of market concentration (i.e., intensifying market competition level) is important in rising employment.

Fifth, the coefficient estimates of $\ln OTR$ are statistically insignificant in most columns. These results seem to come from the tradeoff between job destruction in comparative disadvantage industries and job creation in comparative advantage industries in response to opening the economy, as mentioned in *H1*. Meanwhile, in column (5) the coefficient estimates of $\ln OTR$ become statistically significant with a negative sign, implying that the pure effects of the tradeoff were positive and thus output tariff reduction rendered employment growth during the early 2010s. These positive effects, however, were not realized in one-year time lag, representing no long-term *ex post* effects.

Lastly, the coefficient estimates of $\ln ITR$ are statistically significant in columns (5) and (6), implying that input tariff reduction raised an employment during the early 2010s, regardless of time lags. Meanwhile, there were no effects of input tariff on an employment during the late 2000s. Hence, the results are consistent with *H2* only for the early 2010s, when imports of intermediate inputs sharply increased. Hence these results are very similar with Luong (2011) which found that the positive effects of imported intermediate inputs on economic performance are more prominent with high import intensity.

Table 3. Main Empirical Results

	Entire Period: 2007-2014		**Late 2000s: 2007-2010**		**Early 2010s: 2011-2014**	
	t	**t-1**	**t**	**t-1**	**t**	**t-1**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$\ln AWG$	0.510***	0.250**	0.469***	-0.026	0.312*	0.199
(Ave.Wage)	(0.116)	(0.097)	(0.130)	(0.093)	(0.160)	(0.155)
$\ln EXP$	0.078***	0.062***	0.063***	0.050***	0.022	0.028
(Export)	(0.016)	(0.016)	(0.018)	(0.019)	(0.016)	(0.021)
$\ln CAP$	0.082**	0.000	0.061	0.000	0.064	-0.000
(Cap. Intens.)	(0.039)	(0.000)	(0.055)	(0.000)	(0.016)	(0.000)

[9] Whang Un-Jung et al. (2017) estimated that export growth by hundred thousand dollars induced 0.19 employments in 2010, which was much lower than 3.32 in 1985 and 1.87 in 1990.

Table 3. (Continued)

	Entire Period: 2007-2014		Late 2000s: 2007-2010		Early 2010s: 2011-2014	
	t	t-1	t	t-1	t	t-1
	(1)	(2)	(3)	(4)	(5)	(6)
ln $CR3$	-0.127***	-0.142***	-0.094**	-0.066**	-0.043	-0.081***
(Mkt. Compet.)	(0.032)	(0.025)	(0.042)	(0.032)	(0.032)	(0.025)
ln OTR	**-0.020**	**0.033**	**-0.029**	**0.056**	**-0.094*** **	**-0.000**
(Output Tariff)	**(0.051)**	**(0.070)**	**(0.099)**	**(0.065)**	**(0.032)**	**(0.045)**
ln ITR	**-0.005**	**0.002**	**0.004**	**0.020**	**-0.080*** **	**-0.054** **
(Input Tariff)	**(0.022)**	**(0.021)**	**(0.014)**	**(0.049)**	**(0.027)**	**(0.027)**
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Overall R^2	0.274	0.362	0.258	0.280	0.108	0.310
F-Test	195.61***	190.92***	135.78***	140.78***	194.97***	179.24***
Hausman Test	528.04***	1,533.5***	281.10***	306.07***	170.26***	1,038.4***
Observations	3,562	3,112	1,777	1,331	1,785	1,781

Notes: 1. *, **, *** denote significance at 1%, 5%, and 10% levels, respectively.
2. Figures in parentheses are robust standard errors clustered by industry (KSIC 5 digits).
3. Year dummies are included in all regressions.

4.2. Heterogeneous Effects across Industries

Tables 4 and 5 report the regression results for interaction terms between industrial characteristics and output and input tariffs. Table 4 shows the results with labor quality, while Table 5 shows those with capital intensity as industrial characteristics of comparative advantage. In all regressions, except for column (1) of Table 5, the *F*-test and the *Hausman* test suggest that the fixed-effects model is preferred over the pooled OLS and the random-effects model, respectively. Also, the *F*-test for year-specific suggests that all regressions include year dummies to control them. Column (1) of Table 5 reports the results from the random effects model followed by the *Hausman* test. Accordingly, I did the Breusch-Pagan LM (Lagrangian Multiplier) test to check whether the random-effects model is preferred over the pooled OLS, which suggested the former.

Table 4. Empirical Results of Interaction Terms: Labor Quality

	Entire Period: 2007-2014		Late 2000s: 2007-2010		Early 2010s: 2011-2014	
	t	t-1	t	t-1	t	t-1
	(1)	(2)	(3)	(4)	(5)	(6)
ln AWG	0.857***	0.209	0.709***	-0.263	0.631***	0.313
(Ave.Wage)	(0.196)	(0.186)	(0.211)	(0.282)	(0.223)	(0.296)
ln EXP	0.079***	0.061***	0.064***	0.048***	0.027*	0.031
(Export)	(0.016)	(0.016)	(0.018)	(0.018)	(0.016)	(0.021)
ln CAP	0.076*	0.000	0.058	0.000	0.055	-0.000
(Cap. Intens.)	(0.039)	(0.000)	(0.053)	(0.000)	(0.039)	(0.000)
ln $CR3$	-0.128***	-0.142***	-0.095**	-0.064**	-0.044	-0.085***
(Mkt. Compet.)	(0.032)	(0.024)	(0.041)	(0.032)	(0.033)	(0.025)

Table 4. (Continued)

	Entire Period: 2007-2014		Late 2000s: 2007-2010		Early 2010s: 2011-2014	
	t	t-1	t	t-1	t	t-1
	(1)	(2)	(3)	(4)	(5)	(6)
ln OTR (Output Tariff)	0.676***	0.207	0.464**	-0.319	0.806**	0.733
	(0.254)	(0.239)	(0.234)	(0.211)	(0.346)	(0.478)
ln OTR × lnAWG	**-0.211*** **	**-0.053**	**-0.147** **	**0.112***	**-0.273*** **	**-0.224**
	(0.075)	**(0.071)**	**(0.069)**	**(0.063**	**(0.105)**	**(0.147)**
ln ITR (Input Tariff)	-0.060	-0.228*	-0.045	-0.042	-0.323	-0.477**
	(0.254)	(0.126)	(0.172)	(0.268)	(0.240)	(0.232)
ln ITR × ln AWG	**0.016**	**0.070** **	**0.014**	**0.018**	**0.071**	**0.126***
	(0.045)	**(0.037)**	**(0.052)**	**(0.077)**	**(0.068)**	**(0.067)**
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Overall R^2	0.291	0.377	0.280	0.235	0.120	0.277
F-Test	193.32***	185.78***	132.65***	137.30***	198.11***	177.30***
Hausman Test	228.73***	681.99***	281.36***	306.15***	245.35***	396.03***
Observations	3,562	3,112	1,777	1,331	1,785	1,781

Notes: 1. *, **, *** denote significance at 1%, 5%, and 10% levels, respectively.
2. Figures in parentheses are robust standard errors clustered by industry (KSIC 5 digits).
3. Year dummies are included in all regressions.

The results in columns (1), (3) and (5) of Table 4 show that the coefficient estimates of ln OTR are positive and statistically significant with current independent variables. However, when considering a one-year time lag, all coefficient estimates of ln OTR become statistically insignificant. Hence the effects of output tariff on an employment were ambiguous due to the tradeoff role of import competition, but only when considering one-year lagged independent variables. In other words, the results imply that output tariff reduction spurs job destruction caused by the exit of nonviable firms in the short run, but over time it is becoming weaker since the survivors start taking the greater export opportunity and create jobs. Some previous studies provide the *ex post* positive effects of trade liberalization on exports in Korea (Jang et al., 2015, Bae et al., 2012).

Meanwhile, the coefficient estimates of ln OTR × ln AWG are negative and statistically significant in current years. These results show that the positive volume of coefficient estimates of ln OTR are less prominent with greater labor quality and imply that the positive effects of output tariff reduction on employment were more prominent in industries with higher labor quality, which is consistent with *H1*. However, the results become statistically insignificant in columns (2) and (6) and change to the positive sign in column (5), implying that the different effects were not sustainable at a one-year time lag.

For ln ITR and ln ITR × ln AWG in Table 4, the coefficient estimates are negative and statistically significant in columns (2) and (6). These results imply that the positive effects of input tariff reduction on employment were more prominent in industries with lower labor quality at a one-year time lag, as expected in *H2*. In addition, the prominently positive effects of input tariff reduction on employment in industries with lower labor quality were greater in the early 2010s.

The results of other independent variables in Table 4 are very similar to those in Table 3.

Table 5. Empirical Results of Interaction Terms: Capital Intensity

	Entire Period: 2007-2014		Late 2000s: 2007-2010		Early 2010s: 2011-2014	
	t	t-1	t	t-1	t	t-1
	(1)	(2)	(3)	(4)	(5)	(6)
ln AWG (Ave.Wage)	0.516*** (0.072)	0.226** (0.094)	0.467*** (0.132)	-0.026 (0.086)	0.257* (0.137)	0.158 (0.135)
ln EXP (Export)	0.112*** (0.011)	0.060*** (0.016)	0.065*** (0.018)	0.050** (0.019)	0.022 (0.016)	0.026 (0.021)
ln CAP (Cap. Intens.)	0.273*** (0.065)	-0.000 (0.000)	0.118 (0.088)	0.000 (0.000)	0.294*** (0.101)	-0.000 (0.000)
ln $CR3$ (Mkt. Compet.)	-0.172*** (0.024)	-0.146*** (0.025)	-0.090** (0.041)	-0.065* (0.034)	-0.046 (0.032)	-0.087*** (0.026)
ln OTR (Output Tariff)	0.513*** (0.134)	0.066 (0.133)	0.077 (0.244)	0.067 (0.307)	0.567* (0.296)	0.161 (0.166)
ln OTR × lnCAP	**-0.103*** (0.021)**	**-0.007 (0.023)**	**-0.147** (0.069)**	**-0.002 (0.060)**	**-0.129** (0.057)**	**-0.032 (0.032)**
ln ITR (Input Tariff)	0.050 (0.066)	-0.155 (0.100)	0.108 (0.099)	0.038 (0.322)	-0.075 (0.162)	-0.359*** (0.130)
ln ITR × ln CAP	**-0.011 (0.021)**	**0.034 (0.022)**	**0.014 (0.052)**	**-0.004 (0.065)**	**-0.001 (0.033)**	**0.064** (0.026)**
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Overall R^2	0.331	0.372	0.277	0.272	0.138	0.274
F-Test (or BPLM)	9,663.8***	185.78***	134.18***	139.83***	199.56***	182.05***
Hausman Test	4.33	227.42***	382.03***	213.53***	445.93***	182.77***
Observations	3,562	3,112	1,777	1,331	1,785	1,781

Notes: 1. *, **, *** denote significance at 1%, 5%, and 10% levels, respectively.
2. Figures in parentheses are robust standard errors clustered by industry (KSIC 5 digits).
3. Year dummies are included in all regressions. 4. In column (1) the result of the Breusch-Pagan LM (BPLM) test are presented, not that of *F*-test.

The results in Table 5 show that the coefficient estimates of ln OTR are very similar to those in Table 4. Meanwhile, the coefficient estimates of ln $OTR \times$ ln CAP are negative and statistically significant in columns (1), (3) and (5). These results imply that the positive effects of output tariff reduction on employment were more prominent in industries with higher capital intensity, which is consistent with *H1*. Again, however, these different effects were not sustainable at a one-year time lag.

The result in column (6) of Table 5 shows that the positive effects of input tariff reduction on employment were more prominent in industries with lower capital intensity at a one-year time lag in the early 2010s. In conjunction with lower labor quality, they all represent the characteristics of comparative disadvantage industries in Korea. Consequently, these results are all consistent with *H2*, especially for the early 2010s when the ratio of intermediate inputs in total imports increased significantly in Korea, deepening GVCs.

The results of other independent variables in Table 5 are very similar to those in Tables 3 and 4.

4.3. Robustness Results

Tables 6 and 7 report the regression results of the Arellano-Bond estimator to support the main results shown in Tables 3, 4 and 5, respectively. Columns (1), (2), and (3) of Table 6

report the results for the entire sample period, the late 2000s, and the early 2010s, respectively. Table 7 reports the results of interaction terms between output or input tariffs and two control variables: columns (1)-(3) for labor quality and columns (4)-(6) for capital intensity. In all regressions, the *AB* test for AR and the *Hansen J* test ensure that the instruments starting with 2 lags are jointly valid and do not have an over-identification problem.

The results in Table 6 show that the decrease in input tariffs stimulated total employment in the early 2010s in Korea, which is consistent with the results shown in Table 3. The coefficient estimates of output tariff, however, become statistically insignificant in the Arellano-Bond estimator. Hence, in conjunction with the results from the fixed-effects model, I conclude that the effects of output tariff reduction on total employment were ambiguous in general, which is consistent with *H1*. The coefficient estimates of other control variables, except for market concentration, from the Arellano-Bond estimator are very similar to those from the fixed-effects model. The coefficient estimates of $\ln CR3$, however, are statistically insignificant.[10] Finally, the results show that employment in the current year decreased while increasing in the preceding year.

Table 6. Main Empirical Results in the Arellano-Bond Estimator

	Entire Period	**Late 2000s**	**Early 2010s**
	(1)	**(2)**	**(3)**
$\ln EMP_{t-1}$	-0.225**	0.008	-0.872**
(Employment at t-1)	(0.103)	(0.041)	(0.357)
$\ln AWG$	0.333***	0.386***	-0.225
(Ave.Wage)	(0.099)	(0.115)	(0.829)
$\ln EXP$	0.022*	0.066*	0.011
(Export)	(0.013)	(0.025)	(0.017)
$\ln CAP$	0.053**	0.311***	0.098
(Cap. Intens.)	(0.026)	(0.106)	(0.090)
$\ln CR3$	-0.011	-0.023	-0.011
(Mkt. Compet.)	(0.017)	(0.023)	(0.046)
$\ln OTR$	**-0.023**	**0.022**	**-0.020**
(Output Tariff)	**(0.014)**	**(0.018)**	**(0.061)**
$\ln ITR$	**-0.003**	**0.006**	**-0.073****
(Input Tariff)	**(0.099)**	**(0.010)**	**(0.035)**
Year Dummies	Yes	Yes	Yes
# of Groups	448	446	447
# of Instruments	27	17	17
AB Test for AR(1)	2.23**	3.53***	1.94*
AB Test for AR(2)	-1.46	-1.20	-1.61
Hansen J Test	9.22	4.17	4.96
Observations	2,663	1,331	1,332

Notes: 1. *, **, *** denote significance at 1%, 5%, and 10% levels, respectively.
2. Figures in parentheses are robust standard errors.
3. AB represents Arellano-Bond.
4. Year dummies are included in all regressions.

[10] Alternatively, I considered the Herfindahl-Hirschman Index (*HHI*) instead of CR_3, but it did not change the results.

The results in Table 7 are also very consistent with those in Tables 4 and 5. The positive effects of output tariff reduction on an employment were more prominent in industries with higher labor quality and higher capital intensity. Especially, these prominent effects occurred mainly in the late 2000s for industries with higher labor quality. Also, as expected, the positive effects of input tariff reduction on total employment were more prominent in industries with lower labor quality and lower capital intensity, mainly in the early 2010s. Hence, I conclude that all results in the main regressions and the robustness checks generally support the hypotheses 1 and 2.

Table 7. Empirical Results of Interaction Terms in the Arellano-Bond Estimator

	Labor Quality			**Capital Intensity**		
	Entire Period	**Late 2000s**	**Early 2010s**	**Entire Period**	**Late 2000s**	**Early 2010s**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
ln EMP_{t-1}	-0.779**	-0.001	-1.164***	-0.273***	0.005	-0.757***
(Employment t-1)	(0.313)	(0.062)	(0.313)	(0.104)	(0.064)	(0.249)
ln AWG	0.798*	0.669***	-0.397	0.294***	0.353***	0.204
(Ave.Wage)	(0.470)	(0.154)	(0.521)	(0.091)	(0.122)	(0.174)
ln EXP	0.012	0.046*	0.005	0.024*	0.041	0.003
(Export)	(0.089)	(0.025)	(0.018)	(0.012)	(0.035)	(0.015)
ln CAP	-0.022	0.318***	0.055	0.228***	0.323	0.059
(Cap. Intens.)	(0.288)	(0.115)	(0.041)	(0.041)	(0.269)	(0.310)
ln $CR3$	0.007	-0.024	0.224	-0.009	-0.002	0.147
(Mkt. Compet.)	(0.138)	(0.024)	(0.157)	(0.017)	(0.021)	(0.119)
ln OTR	1.131**	0.629**	0.774	0.436***	0.534	0.780
(Output Tariff)	(0.501)	(0.262)	(0.560)	(0.100)	(0.684)	(0.817)
ln OTR	**-0.335****	**-0.181****	**-0.208**	**-0.084*****	**-0.090**	**-0.137**
× lnAWG	**(0.155)**	**(0.077)**	**(0.148)**	**(0.018)**	**(0.122)**	**(0.138)**
ln ITR	-0.070	-0.053	-1.166**	0.069	1.113	-0.432*
(Input Tariff)	(0.163)	(0.099)	(0.535)	(0.051)	(0.128)	(0.226)
ln ITR	**0.022**	**0.018**	**0.321****	**-0.015**	**0.023**	**0.086***
× ln AWG	**(0.057)**	**(0.030)**	**(0.155)**	**(0.011)**	**(0.027)**	**(0.048)**
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
# of Groups	448	446	447	448	446	447
# of Instruments	17	19	24	29	19	24
AB Test for AR(1)	2.46**	2.90***	2.49**	2.57**	2.50**	2.42**
AB Test for AR(2)	-0.06	-1.16	-1.47	-1.15	-0.99	-1.32
Hansen J Test	1.55	3.28	4.89	9.17	4.89	9.61
Observations	2,663	1,331	1,332	2,663	1,331	1,332

Notes: 1. *, **, *** denote significance at 1%, 5%, and 10% levels, respectively.
2. Figures in parentheses are robust standard errors.
3. AB represents Arellano-Bond.
4. Year dummies are included in all regressions.

5. Conclusion

This paper empirically examines how differently output and input tariffs affect domestic employment across industrial characteristics. Korea which is a natural resource-scarce open economy has pursued FTAs with other natural resource-abundant countries and thus greatly increased imports of intermediate inputs. Accordingly, better access to imported intermediate inputs as well as export expansion is important when analyzing trade gains in Korea. Based on the Bernard et al.'s (2007) and the Luong's (2011) theoretical frameworks, this paper sets up two research hypotheses regarding the heterogeneous roles of industrial characteristics in the stimulation effects of reductions in output and input tariffs on domestic employment. The sample consists of 453 sectors from 2007 to 2014 in Korea.

The empirical results show that input tariff reduction stimulated total employment, focusing on the early 2010s, while the effects of output tariff reduction were statistically insignificant, especially in the long run. In spite of its ambiguous effects in the entire industries, the stimulation effects of output tariff reduction on employment were found in comparative advantage industries in which labor quality and capital intensity were relatively greater. For input tariff reduction, however, the results were the opposite: its stimulation effects on employment were more prominent in comparative disadvantage industries with lower labor quality and capital intensity. These opposite results between input and output tariffs look very similar to Ma and Dei's (2009) for wage inequality and Luong's (2011) for firm productivity. All these results, including this paper, imply that better access to imported intermediate inputs through free trade policies improves imbalanced welfare across industries as well as production efficiency.

Consequently, this paper provides significant implications for other resource-scarce open economies as well as Korea, which are experiencing the transition of the export pattern from labor intensity to technology intensity and the unequal distribution of income after trade liberalization. For these countries this paper addresses that imported intermediate inputs has become increasing important, leading to trade effects on employment growth and alleviation of income inequality. In particular, the economic benefits from better access to imported intermediate inputs will be greater when considering their linkage effects on service industries. I will leave this topic on industrial linkage between manufacturing and service industries to future work.

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