

# The Relationship between Trade Freedom and Gender Discrimination in Industrial Employment - Based on the Research of Multinational Panel Data

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**Abstract.** This paper is based on the multinational panel data of 226 countries and regions from 1985 to 2016, using the ratio of industrial female employees to industrial male employees to measure gender discrimination in industrial employment, measuring the degree of trade freedom forwardly and reversely by foreign trade dependence and MFN weighted average tariff rate respectively, analyzing the impact of trade freedom on the ratio of industrial employment of women to men by empirical test. The lag phase of foreign trade dependence and weighted MFN weighted average tariff rate are used as the instrumental variables of the two models to deal with the endogeneity problem. The empirical result shows that increasing the degree of trade freedom will reduce the ratio of industrial female employees to industrial male employees, so trade freedom aggravates the gender discrimination in industrial employment.

## 1. Introduction

Foreign trade cannot only stimulate economic growth, but also allow enterprises to obtain high profit margins and improve production efficiency. Throughout the world, most of the governments are trying to use foreign trade to develop its economy. Nowadays, the research on the impact of trade on employment of labor market has become a hot issue.

The degree of trade freedom is an effective indicator to measure the regional foreign trade, which is used to measure the intensity of regional foreign trade. The degree of trade freedom will affect the industrial structure through the impact of trade structure. When the industrial structure changes, the number of employment and gender ratio will be affected. Therefore, the degree of trade freedom will eventually affect the number of industrial employment and gender ratio.

As one of the three industries, industry is the pillar of the national economy, and the employment of the labor market in industry is also widely concerned. Due to the special nature of the industry and the employment discrimination against women for a long time, men of industrial sector is far more than women. However, with the development of technology and productivity, the sex ratio of employment in the industrial sector is changing continuously. The realization of the goal of gender equality is critical for social equality and economic development. It is of great theoretical and practical significance to promote the efficiency and fairness. At present, the relationship between gender discrimination in industrial employment and trade is not clear. Therefore, it is necessary to study the impact of trade liberalization on gender discrimination in industrial employment.



## 2. Literature review

Related literature can be divided into the following two categories, one is to discuss the phenomenon of gender discrimination in employment, and the other is to study the impact of trade on industrial employment.

Concerning the phenomenon of gender discrimination in employment, Koontz (1971), Terborg and Ilgen (1975) showed that the number of female labor force has been increasing, however, the survey shows that gender discrimination still exists. Niemi (1974) pointed out that since 1948, the female unemployment rate has greatly exceeded the male unemployment rate, and the gap in the business cycle peak is the largest. Terborg and Ilgen (1975) found that women work more than men, while their wages are lower than men. On the contrary, Dipboye et al (1975) found that male candidates were more favoured than female applicants.

With regard to the impact of trade on industrial employment, Krueger (1970) believed that the neutral trade policy would increase the production of labour-intensive products and the level of employment. M Bella, B Quintieri (2000) found that employment and wages in Italy's industrial sector fell because of the manufacturing sector's participation in foreign competition.

Y Dadgar, M Nadiri (2006) using Iran industrial ISIC code and panel data study found that there was a negative correlation between trade globalization and industrial employment. While ZVM Hadi, FS (2009) showed that export promoted the growth of employment and reduced wage gap in Iran's industrial sector, while the increase in imports led to a decrease in employment opportunities.

Between 1986 and 1990, the Mexico government cut tariffs and import license coverage by more than 50%. ZM Feliciano (2001) analysed the impact of trade reform on wages and employment in Mexico by using micro level data. It was found that the proportion of low skilled workers was larger in the industries with lower protection level and the decline of import license coverage did not affect the relative employment, and the tariff reduction had no significant effect on the relative employment.

Compared with foreign countries, domestic scholars pay more attention to the static employment effect of trade. Zhaoling Hu, Xu Liu (2007) used the panel data of China's 32 industrial sectors from 1998 to 2003 to conduct an empirical study on the employment effect of industrial trade. It was found that export promotes employment, and the overall impact of import on employment was uncertain. Bin Sheng, Rui Niu (2009) used the panel data of China's 28 industrial sectors during the period of 1997-2006 to examine the effects on labor employment from the two aspects of trade flows and trade policies. The research showed that trade liberalization had a negative effect on the employment of the medium and high technology sector, but it also promoted the employment of the low and medium technology sectors.

In summary, regarding the research on gender discrimination in employment and the relationship between international trade and industry department of employment, economists have made great achievements in research methods, research perspectives and research scope, but it is worth noting that the previous studies on the impact of trade openness on the gender discrimination of industrial employment did not draw specific conclusions, so it is worthy of further research and exploration.

## 3. Data description and modelling

### 3.1. Data description

In this paper, we use the panel data of 226 countries in 1985-2016 to study the relationship between trade freedom and industrial gender employment, all of which are from the World Bank's World Development Index database. Among them, the ratio of industrial female employees and industrial male employees is the explained variable, and the degree of dependence on foreign trade and MFN weighted average tariff rate are the main explanatory variables, which can forwardly and reversely measure the trade freedom respectively.

### 3.2. Model setting

We want to study the impact of trade freedom on gender discrimination in industrial employment of a country or a region, so we need to establish the following empirical models.

$$\text{Ratio}_{it} = \alpha + \beta * \text{trade}_{it} + \gamma * \text{tariff}_{it} + \theta * z_{it} + v_i + \varepsilon_{it}$$

$\text{Ratio}_{it}$  represents the ratio of industrial female employees to industrial male employees of  $i$  countries in the  $t$  period.  $\text{trade}_{it}$  represents the degree of dependence on foreign trade,  $\text{tariff}_{it}$  represents the MFN weighted average tariff rate,  $z_{it}$  represents a set of control variables, including the rate of urbanization ( $\text{city}_{it}$ ), the ratio of female to male enrollment in Higher Education ( $\text{edu}_{it}$ ), and the proportion of female legislators, senior officials and managers ( $\text{off}_{it}$ ).  $v_i$  are associated with country specific unobserved factors, controlling the differences that cannot be observed and do not change with time of countries.  $\varepsilon_{it}$  is a random disturbance.

### 3.3. Indicator Selection

1. The ratio of industrial female employees to industrial male employees ( $\text{ratio}_{it}$ ):  $\text{ratio}_{it}$  represents the ratio of industrial female employees to industrial male employees of  $i$  countries in the  $t$  period, used to measure sex discrimination in industrial employment. The higher the value of  $\text{ratio}_{it}$ , the smaller the discrimination against women in industry.

2. The degree of dependence on foreign trade ( $\text{trade}_{it}$ ):  $\text{trade}_{it}$  represents the degree of dependence on foreign trade, equal to the ratio of a country's total import and export volume, the higher the value, the greater the degree of trade freedom. It is used to measure of trade freedom positively. Because under any other unchanged conditions, any trade cost will affect the actual import and export by affecting the commodity price, so we can indirectly calculate the trade cost and the degree of freedom of trade through the degree of foreign trade dependence.

3. MFN weighted average tariff rate ( $\text{tariff}_{it}$ ): The higher the value of  $\text{tariff}_{it}$ , the higher the degree of trade protection, that is, the smaller the degree of trade freedom. It is used to measure the degree of trade freedom reversly.

4. Urbanization rate ( $\text{city}_{it}$ ): The rate of urbanization equals the ratio of a country's urban population to the total population. The level of urbanization is closely related to the economic development of a country. The higher the urbanization rate and the higher the level of economic development. It will help adjust and upgrade industrial structure, thus affecting the gender structure in the industry.

5. The ratio of female to male enrollment in Higher Education ( $\text{edu}_{it}$ ): The ratio of female to male enrollment in higher education reflects the difference of education level between women and men. The larger the ratio, the more general education level of women is higher than that of men. As a result of higher education, women's industries are also prone to change and are more likely to shift from industry to other industries.

6. The proportion of female legislators, senior officials and managers ( $\text{off}_{it}$ ): The ratio of female legislators, senior officials and managers can measure the status of women in modern society. The higher the proportion, the higher the status of women. This will have a positive impact on the elimination of gender discrimination.

Because  $v_i$  are unobserved variables, and they may be related with the explanatory variables, so the usual estimation method is to estimate all the variables after taking the mean value of them within the group, obtaining the Fixed Effects Model. If the  $v_i$  are not associated with the explanatory variables, then the Random Effects Model can be used. After Hausman test, the two models reject the original hypothesis, therefore, the two equations should choose the Fixed Effects Model.

According to the model, it can be inferred that in the regression results, if the coefficient in front of the  $\text{trade}_{it}$  is positive, and the coefficient in front of the  $\text{tariff}_{it}$  is negative, namely, trade freedom will reduce industrial employment gender discrimination. On the other hand, if the coefficient in front of model  $\text{trade}_{it}$  is negative, and the coefficient in front of the  $\text{tariff}_{it}$  is positive, that is to say, trade freedom will aggravate the industrial employment discrimination.

## 4. Empirical results and analysis

### 4.1. Benchmark regression results

Table 1 reports the descriptive statistics of the main variables. Table 2 reports the regression results of the model, using cluster robust standard errors to eliminate the possibility of heteroscedasticity, after testing, the results of the two models are very significant. By calculating the correlation coefficient, the multicollinearity between the explanatory variables is excluded. Figure 1 shows the correlation coefficient of the explanatory variables of equation. As can be seen from Figure 1, the correlation coefficients between the explanatory variables of the equation are very small, all of which are less than 0.5, so there is no correlation between the explanatory variables.

**Table 1.** Descriptive statistics of variables

Variable		Mean	Std. Dev.	Min	Max	Observations
ratio	overall	52.69079	28.33802	2.304147	409.6296	N = 2982
	between		35.04387	5.714286	256.9157	n = 202
	within		15.4169	-100.0232	253.9795	T-bar = 14.7624
trade	overall	73.96444	49.18022	.0209992	531.7374	N = 9527
	between		41.43395	13.87521	330.4279	n = 227
	within		23.06995	-86.06148	400.86	T-bar = 41.9692
tariff	overall	7.202873	8.862873	0	254.58	N = 2743
	between		5.761846	0	38.833	n = 202
	within		7.095431	-16.44013	249.0221	T-bar = 13.5792
edu2	overall	.9327973	.5493628	0	6.89494	N = 5620
	between		.5457036	.0623	4.106017	n = 223
	within		.2819858	-1.016431	5.097389	T-bar = 25.2018
city	overall	48.87753	24.86715	2.077	100	N = 13266
	between		23.52994	5.993709	100	n = 243
	within		8.061996	6.714989	76.56777	T-bar = 54.5926
off	overall	29.03104	10.26193	2.095001	64.23994	N = 1326
	between		11.62311	2.704944	57.40568	n = 137
	within		3.988102	5.867568	56.26591	T-bar = 9.67883

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. pwcorr trade tariff city edu2 off
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	trade	tariff	city	edu2	off
trade	1.0000				
tariff	-0.0892	1.0000			
city	0.1786	-0.1078	1.0000		
edu2	0.1511	-0.1005	0.2948	1.0000	
off	0.0002	-0.0267	-0.0085	0.0801	1.0000

**Figure 1.** Correlation coefficient of each explanatory variable of the equation

The equation reflects the impact of dependence of foreign trade on the employment ratio of industrial female workers to industrial men. Table 2 shows the coefficient of the dependence on foreign trade is -0.0701611, indicating when the freedom of trade increases by 1%, the ratio of industrial female

employees to industrial male employees will decrease by 0.0701611%. Therefore, the impact of trade openness on sex discrimination in industrial employment is negative. This may be due to with the deeper degree of trade liberalization, female employees tend to shift from industry to other industries. The coefficient of MFN weighted average tariff rate is 1.140592, indicating when the MFN weighted average tariff rate increases by 1%, the ratio of industrial female employment to industrial male employment will increase by 1.140592%. Therefore, the impact of trade protection on industrial sex discrimination in industrial employment is positive. The determination coefficient of this model is 0.4240, it also meets the requirements of the panel data on  $R^2$ . Because of the use of micro data, and the larger sample size, heterogeneity is also relatively large, it cannot explain the model is not good. As a result of the two  $P=0.0000$ , this shows that the overall model and the parameters are very significant.

The model contain three control variables: higher education enrolment ratio of women to men, ratio of urbanization and the proportion of female legislators, senior officials and managers. The results show that the effect of the three control variables on gender discrimination in industry employment is negative. The first result of control variables may be due to when women's education level is higher, more are willing to work in education industry which belongs to service industry from the industry; or because the university education of middle-low technological economy has a preference for man than high technology economy. The reason of urbanization aggravating industrial sex discrimination in employment may be urbanization is conducive to the optimization and upgrading of industrial structure, can accelerate industrial transfer; at the same time, industrial transfer can promote urbanization, the higher urbanization rate is perhaps because the second industry transfers to the third industry, women are more inclined to the third industry, so the ratio of female workers to male workers in industry declines. As for the proportion of women legislators, senior officials and managers have a negative impact on gender discrimination in industrial employment, perhaps because the higher social status of women is usually engaged in the tertiary industry, the higher the female social status, the more will attract and encourage other women from industry to the third sector employment.

**Table 2.** The relationship between trade liberalization and industrial gender employment

variable	ratio <sub>it</sub>
trade <sub>it</sub>	−0.070161*** (0.024119)
tariff <sub>it</sub>	1.140592*** (0.317230)
edu <sub>it</sub>	−13.127680*** (1.904991)
city <sub>it</sub>	−0.618192*** (0.136461)
off <sub>it</sub>	−0.629746*** (0.090489)
R-squared	0.4240
P	0.0000

\*\*\*, \*\*, \*respectively represent 1%, 5%, and 10% of the significance level, the numbers in brackets represent the cluster robust standard errors.

#### 4.2. Robustness test

The robustness of the regression results depends on whether the explanatory variables and the explained variables are endogenous, and whether the regression results of the key variables vary with the variables. If this problem is not solved, the result may be biased. There are two reasons for the existence of endogenous problems. One is that there is reverse causality between explanatory variables and explained variables, and the other is that the explanatory variables are related to the unobserved variables. The

dependence on foreign trade and the MFN weighted average tariff rate are likely to be affected by unobserved variables, which leads to inaccurate empirical results.

*4.2.1. Endogeneity test.* According to the Hausman test results, The P value is 0, and can reject original hypothesis at the 1% significant level. That is to say, there is Existence of endogenous variables. To solve the endogeneity problem, the lag term of the endogenous variable or the lag term of other variables can be used as the tool variable. According to this principle, the foreign trade dependency degree and weighted most favored nation tariff rate all lag behind one stage, respectively, as the tool variables of the model, and then make regression. The result is shown in Table 3. After considering the endogeneity problem, the symbol in front of each explanatory variable does not change. The estimated coefficients of the dependence of foreign trade is still significantly negative and the estimated coefficient of MFN weighted average tariff rate is significantly positive. At the same time, the coefficient of the three control variables are still negative, the regression results also passed the significant test, solving the endogeneity problem.

**Table 3.** Endogenous test

variable	ratio <sub>it</sub>
mtrade <sub>it</sub>	—0.0598785* (0.0451742)
mtariff <sub>it</sub>	0.5352789** (0.2146287)
edu <sub>it</sub>	—14.07675** (6.116498)
city <sub>it</sub>	—0.7411034* (0.4633729)
off <sub>it</sub>	—0.6656185** (0.29955)
R-squared	0.4677
P	0.0000

\*\*\*, \*\*, \*respectively represent 1%, 5%, and 10% of the significance level, the numbers in brackets represent the cluster robust standard errors. mtrade<sub>it</sub> represents the lagged one period of the degree of dependence on foreign trade, mtariff<sub>it</sub> represents the lagged one period of MFN weighted average tariff rate.

#### *4.2.2. Robustness test*

##### 1) Robustness test of replacement variables

The robustness of the main explanatory variables is verified by replacing key variables with regression. The industrial gender wage gap (iwageit) (data from the OECD database) is used instead of the explained variable. Using the difference between the median income of industrial men and women to median income for men to represent the industrial gender wage gap. The larger the value, the greater the gap between the industrial sex wage, the more serious the sex discrimination in industrial employment is. On the contrary, the degree of sex discrimination in industrial employment is less. The regression results are shown in Table 4. From table 4, we can see that the coefficient in front of dependence on foreign trade is positive, indicating that the impact of trade openness on the gender wage gap in industry is positive, that is, the degree of freedom of trade has increased the industrial gender wage gap, which has intensified the discrimination of industrial sex employment. However, the coefficient before the most favoured nation tariff rate is negative, which indicates that trade protection has narrowed the industrial sex wage gap, and is conducive to eliminating gender discrimination in industrial employment. The ratio of female to male enrollment in higher education and urbanization rate, as well as the proportion of female legislators, senior officials and managers are all positive, indicating

the three variables will also aggravate gender discrimination in industrial employment. The above results are consistent with the previous verification, and the regression results are also significant. It shows that the model has passed the robustness test, and the conclusion is steady, that is, the degree of freedom of trade has a negative impact on gender discrimination in industrial employment.

**Table 4.** Robustness test of replacement variables

variable	iwage <sub>it</sub>
trade <sub>it</sub>	0.0133983** (0.026976)
tariff <sub>it</sub>	-0.1584307** (0.0792956)
edu <sub>it</sub>	3.032798* (1.794096)
city <sub>it</sub>	0.4655705*** (0.0865531)
off <sub>it</sub>	0.145453* (0.087485)
R-squared	0.6576
P	0.0000

\*\*\*, \*\*, \*respectively represent 1%, 5%, and 10% of the significance level, the numbers in brackets represent the cluster robust standard errors.

## 2) Robustness test in sub regions

Due to the existence of absolute and comparative advantages, the degree of freedom of trade in different regions may have different effects on gender discrimination in industrial employment, which will affect the robustness of the conclusion. In order to make the analysis process more detailed and the conclusion of analysis more robust, this paper makes regression in different sample countries in different regions, so as to draw more pertinent conclusions. This paper divides the sample countries into seven regions: South America, North America, Southeast Asia, East Asia, West Asia, Europe and Africa. The regression results are shown in table 5. Table 5 shows that coefficient of the dependence on foreign trade in seven areas is still negative, the coefficient of the MFN weighted average tariff rate is still significantly positive, and have passed the significance test. So it can be said that trade liberalization exacerbated the region's industrial employment discrimination. Although in different areas, the numeric size of regression coefficient of trade dependence degree and MFN weighted average tariff rate is slightly different, showing that the extent of the impact of trade freedom on sex discrimination in industrial employment varies in different regions, it may be affected by many factors such as historical culture, resource endowment and comparative advantage effect in different regions.

**Table 5.** Relationship between trade freedom in different regions and sex discrimination in industrial employment

variable	South America	North America	Southeast Asia	East Asia	West Asia	Europe	Africa
	ratio <sub>it</sub>	ratio <sub>it</sub>	ratio <sub>it</sub>	ratio <sub>it</sub>	ratio <sub>it</sub>	ratio <sub>it</sub>	ratio <sub>it</sub>
trade <sub>it</sub>	-0.4364*** (0.0768)	-0.5087** (0.3676)	-0.0894** (0.0479)	-0.0361* (0.4441)	-0.0789** (0.1195)	-0.2077*** (0.0540)	-0.0790* (0.0899)
tariff <sub>it</sub>	0.3562** (0.3180)	0.5896* (0.7984)	0.4724* (0.7006)	1.0844*** (1.0260)	0.1509** (0.2586)	0.0332* (0.2555)	-0.7446** (0.2570)
edu <sub>it</sub>	-3.8691 (0.41528)	-22.7854*** (0.6643)	-3.0687 (0.5832)	- 11.2452*** (1.4061)	-9.5428** (0.7087)	- 15.5202*** (0.2416)	-16.9646* (1.0510)
city <sub>it</sub>	-0.8299*** (0.1282)	-0.9863 (0.9765)	0.0250** (0.3372)	-0.1850* (0.3366)	-0.6577** (0.3590)	-0.5469*** (0.1285)	-0.1604* (0.1156)
off <sub>it</sub>	0.5110* (0.4494)	0.0506 (0.1907)	-5.1768*** (0.4804)	3.6361*** (0.6151)	- 0.6207*** (0.1931)	0.3068* (0.2512)	- 0.4623*** (0.1822)
R-squared	0.6954	0.5887	0.5690	0.8028	0.2212	0.5038	0.1853
nations	12	3	11	5	20	42	56

\*\*\*, \*\*, \*respectively represent 1%, 5%, and 10% of the significance level, the numbers in brackets represent the cluster robust standard errors.

To sum up, the model has passed the robustness test. Therefore, it can be concluded that improving trade freedom will aggravate gender discrimination in industrial employment. On the contrary, trade protection can improve gender discrimination in industrial employment.

## 5. Conclusion

At present, the trade openness can bring more cheap goods and competitive mechanism, at the same time, it also affects the employment situation of the world's labor market including different sex workers in different industries. This paper uses the data of 226 countries in the world bank WDI database from 1985 to 2016, using the ratio of industrial female employees to industrial male employees as the explained variable, the dependence on foreign trade and the MFN weighted average tariff rate as explanatory variables, to measure the impact of trade freedom on gender discrimination in industry employment. We assume that trade freedom will aggravate the industrial employment gender discrimination, the final results also confirmed our hypothesis. The conclusion is that trade openness does not reduce industrial sex discrimination in employment, on the contrary, trade protection can improve gender discrimination industrial employment. There are several possible reasons for this phenomenon: firstly, due to the cost of asymmetric information brings to the enterprise is too high, the gains from trade cannot replace "discrimination" to the employer benefits in a short period of time; secondly, due to the growth of capital has a negative impact on the employment of the industry, as a whole, capital substitutes labor in industry; thirdly, the efficiency of labor market matching industry is too low. Hope further study on the issue will be deeper. To sum up, there are still many points worthy of further study in the field of trade freedom and the labor market in the industrial sector, we should improve and develop the research system and content of the problem.

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