Journal of Indonesian Economy and Business
Volume 39, Number 1, 2024, 57 – 72

THE IMPACT OF INPUT TARIFFS ON GENDER INEQUALITY: AN EMPIRICAL STUDY IN INDONESIA

Noorish Heldini[1*]

[1] Research Center for Sustainable Production System and Life Cycle Assessment, National Research and Innovation Agency (BRIN) , South Tangerang, Indonesia

ABSTRACT

Introduction/Main Objectives: Discrimination between male and female workers occurs because of the difference in the "endowment" and social and cultural norms, especially in developing countries. This study aims to examine the impact of input tariffs on the ratio of female workers who are differentiated, based on technology-intensity and the labor-intensive sector and the non-labor-intensive sector. **Background Problems:** Trade openness contributes to technological change so companies reallocate resources more efficiently and reduce discrimination. Previous studies have yielded ambiguous results regarding input tariffs and the ratio of female workers. Therefore this study attempts to estimate the impact of input tariffs on the ratio of female workers in Indonesia. **Novelty:** In contrast to the previous studies that did not include the lag-dependent variable, this study includes the lag variable female labor ratio as an exogenous variable in the estimation. **Research Methods:** Using FE-IV, panel data at the company level for the period from 2003 to 2015. **Finding/Results:** The estimation results show that trade openness can eliminate discrimination and increase the ratio of female workers. When firms are differentiated by their technology-intensity, the reduction in input tariffs leads to an increase in the ratio of female workers in medium and high technology-intensity firms, and non-labor-intensive firms, where the impact is the same between importing and non-importing firms. The estimation results show that trade openness can eliminate discrimination and increase the ratio of female workers entering the market. **Conclusion:** Trade openness can have both positive and negative impacts on Indonesian workers, especially female workers. To increase female labor participation, the Indonesian government needs to implement supporting policies, to improve equitable access to education for all citizens in Indonesia, needs to provide child-care facilities around office areas, flexibility in working hours for women, training and skills, and provide opportunities for women to occupy strategic positions.

ARTICLE INFO

Article information:

Received 26 October 2022. Received in revised version 16 March 2023. Received in revised version 18 April 2023. Accepted 27 April 2023

Keywords:

trade, technology-intensity, tariff, labor demand

JEL Code:

F16, F66, J01, J23

ISSN:

ISSN 2085-8272 (print)
ISSN 2338-5847 (online)

[*] Corresponding Author at search Center for Sustainable Production System and Life Cycle Assessment, National Research and Innovation Agency (BRIN) , South Tangerang, Indonesia.
E-mail address: nheldini@gmail.com

https://doi.org/ 10.22146/jieb.v39i1.5948 https://journal.ugm.ac.id/v3/jieb

INTRODUCTION

Discrimination between male and female workers is an interesting issue to study. According to Lang & Spitzer (2020), discrimination occurs because employers perceive there are differences in people's productivity at the same wage level. Therefore, an employer has certain preferences when choosing workers (discrimination). When employers have a greater preference for male workers, employers will ask for more male workers than female workers.

One of the causes of discrimination is the difference in the "endowment" factor between male and female workers. According to Saur & Zoabi (2011) and Juhn, et al. (2014), women have an "endowment" factor in the form of "mental labor" or brain/mental work, while male workers have an "endowment" factor in the form of "mental labor" and "physical labor" or physical work. As long as the "physical" factor has a positive value, male workers than female workers will be hired. The difference in this "endowment" means male and female workers cannot be substituted.

Besides the "endowment" factor, from the labor supply side, married women may decide to leave the market due to social and cultural norms. According to Azis (2020), Gupta (2021), Wuestenenk & Begall (2022), and Ntuli et al. (2023) women are still subservient to men, men is also considered to be the main breadwinners in a household. Along with the increase in income, husbands prioritize housework for women, rather than work. Women are responsible for household, chores such as caring for children, which is considered to be less productive and contributes less to the national economy. Female workers make a trade-off between family and work. Female workers are willing to apply for jobs that offer lower wages, but have more family-friendly working conditions.

According to several previous studies, trade openness policies can provide a gap for female workers to enter the labor market. First, trade liberalization brings cultural and social changes to society. Based on Goldin (1994), women are aware of the importance of education and are starting to invest in education to be able to compete in non-production jobs (white-collar jobs). Job offers and higher incomes provide an attraction for women not to follow the stigmatization or customs/cultures that require married women to work at home. In addition, declining fertility, increasing part-time work, and easy access to childcare facilities have caused women to enter the labor market.

Second, trade openness increases resource efficiency, particularly the use of labor inputs, thereby reducing discrimination between male and female workers. Trade openness can reduce discrimination because it can change product prices by forcing producers to reallocate production factors to sectors that have high labor intensity (Akhtar, 2023). Reducing the costs of discrimination can create job opportunities not only for male workers but also for female workers. so male and female workers compete equally to enter the labor market (Akhtar, 2023; Juhn et al., 2014).

According to previous research, when developing countries trade with developed countries, the gender gap narrows in the developing countries. The model developed by Saur & Zoabi (2011) used three factors of production, namely capital, male labor, and female workers between the "capital-rich economy" countries and the "capital-scarce economy" countries. The difference in capital causes countries to specialize in producing products based on "abundant factors," so that countries with "capital-rich economies" specialize in reducing the female labor force's participation, and vice versa. Next, Mitra &

Hossain (2018) assume a country with a "capital-scarce economy" is a developing country and Mukhopadhyay (2015) assumes that developing countries concentrate on employing unskilled workers (women). From these two assumptions, trade openness between developed and developing countries causes developing countries to specialize in producing goods using unskilled labor. Because female workers are mostly unskilled workers, trade openness also increases the demand for female workers in developing countries.

When trade openness contributes to technological change, the impact of trade openness on the demand for female labor is biased. Trade openness enhances technology transfer (Haseeb et al., 2020). Next, based on Acemoglu & Autor (2011), technology is deliberately created by skilled workers to complement their skills. When low-tech countries (usually developing countries) trade with high-tech countries (usually developed countries), the technology used in the developed countries will enter the developing countries, resulting in technological changes in those developing countries (Rodrik, 2018). Furthermore, Juhn, et al. (2014) argue that technology's adoption causes a change from "physical" jobs to "brain" jobs. This reduces the perpetual advantage of male labor and opens opportunities for women to work. The greater opportunity for women to work in high-tech companies, which offer higher wages, causes women to abandon their stay-at-home habits and start investing in education.

One of the proxies for trade openness is the input tariff policy. Based on research by Amiti & Cameron (2012), when a government implements a reduction in input rates, companies benefit because the price of goods becomes cheaper. Input goods are more skill intensive, so an increase in the import of input goods also causes technological changes in the importing companies. Technology is a positive externality in trade that can increase the demand for skilled labor (Sun, 2019). Apart from that, according to Kis-Katos & Janneke Pieters, et al. (2018), a reduction in input tariffs is able to increase female labor participation due to delays in marriage and decreased household chores. In terms of education, female workers in developing countries have increased their educational attainment in middle and high schools (university graduates)(Goldin, 1994).

Research into trade openness on gender discrimination is interesting, especially in Indonesia (a developing country). Law Number 13 of 2003 states that every worker has the same opportunity and should be treated the same in getting a job. However, based on BPS data, in the formal workforce, according to gender, male workers outnumber female workers. This is appropriate as based on International Labor Organization (ILO) data from 2015, labor in Indonesia is still uneven between men and women. Women still do many jobs that offer lower wages and limited career development.

Empirical research linking trade openness to the number of women in the workforce shows ambiguous results. Trade between America (a developed country) and Mexico (a developing country) from 1990 to 2007 shows that developed countries (America) experienced decreased participation by females in the labor force (Saur & Zoabi, 2011). Further research by Banerjee & Veeramani (2015) shows that a reduction in import tariffs leads to an increase in the ratio of women to the total workforce in India. In addition, the study also shows that companies try to reduce their production costs by replacing male workers with female workers, to increase international competition.

Research related to input tariffs in Indonesia was conducted by Oishi (2018), Jamil &

Damayanti (2018), Jamielaa & Kawabata (2018), and Kis-Katos, Pieters, et al. (2018). Oishi, (2018), using manufacturing sector data from 1993 to 2008 in Indonesia, looked at final and intermediate imported goods. It is known that input tariffs show no significant relationship to the ratio of female workers. However, the interaction variable between input tariffs and dummy imports shows a positive relationship with the labor ratio. Other research conducted by Jamil & Damayanti, (2018), studied import tariffs on unemployment using Sakernas (National Labor Force Survey) - data from the Central Bureau of Statistics of the Republic of Indonesia at the district/city level from 2000 to 2013 found that by controlling for the impact of tariff reductions on inputs not produced by the domestic market, the reduction in tariffs caused an increase in unemployment, both aggregate and individual, and the districts/cities were affected by the decline. Jamielaa & Kawabata (2018) conducted research using panel data from 2008 to 2014 on 34 provinces with OLS regression, and found that in Indonesia the number of female workers was still lower than that for male workers, even though trade openness had reduced discrimination between male and female workers. Finally, research by Kis-Katos, Pieters, et al. (2018), using Susenas (National Socioeconomic Survey) data in 259 regions in Indonesia during 1993, 1996, 1999, and 2002, shows that reductions in input tariffs increase the delay in marriage, women's labor participation, as well as the working hours, but reduced household chores. In addition, the estimation results also show that a reduction in input tariffs tends to increase the participation of women workers in labor-intensive and low-skilled sectors.

Unlike the previous research, this study aims to examine the impact of input tariffs on the ratio of female workers in Indonesia. In contrast to the previous research, the contribution of this research is first that it analyzes the impact of input tariffs on the ratio of female workers, which differs between companies that import and companies that do not import. Second, this study also looks at the ratio of female workers in each sector, based on technology-intensity and differences in the number of workers. Third, This research complements the research conducted by Oishi, (2018), which looked at the impact of input tariffs on the ratio of female workers, using manufacturing data in Indonesia. However, it is different from Oishi, (2018), as that study did not include a lag variable, namely the ratio of female workers to exogenous variables; this study tries to include these variables in the estimation. Based on Charfeddine & Mrabet, (2015), the use of the dependent variable lag, due to the impact of the tariff reduction policy, was not directly responded to by companies in adjusting the use of labor. The use of the endogenous variables' lag as an exogenous variable has a non-labor-intensive endogeneity impact, so this research uses the FE-IV estimator. In addition, this research gap also uses a different period, as the period used in this study is from 2003 to 2015.

The estimation results show that trade openness can eliminate discrimination and increase the ratio of female workers entering the market. In addition, this study also shows that a decrease in input rates causes an increase in the ratio of female workers at medium and high technology-intensity firms, and non-labor-intensive firms, where the impact is the same between companies that import and companies that do not import. On the other hand, input rates show a positive relationship in the labor-intensive sector and do not show an insignificant relationship at low technology-intensity. In the labor-intensive and low technology-intensity sectors, it also shows that the interaction variable

between input tariffs and dummy imports shows a significant negative relationship to the ratio of female workers, where companies that import have a stronger impact than companies that do not import. On the other hand, input rates show a positive relationship in the labor-intensive sector and do not show an insignificant relationship in the low technology-intensity sector.

LITERATURE REVIEW

The following is the framework of this research Autor (2003) using the Backer model. The Backer model assumes that a company maximizes its utility so that the company optimizes the number of workers according to productivity and wages (Equation 1).

$$U = \rho F(N_b + N_a) - \omega_a N_a - \omega_b N_b - dN_b \quad \text{....(1)}$$

a is the majority group and b is the minority group. Each group maximizes its utility function which is the sum of the profits plus the value of the utility from employing a particular group of workers. d is the coefficient of discrimination, ρ is the price. N_a is the number of workers from group a, N_b is the number of workers from group b. ω_a is the wage paid for group a and ω_b is the wage paid for group b. The existence of different wages in each group causes employers to choose certain groups of workers that provide maximum productivity.

From Equation 1, we obtain the optimal number of workers to be employed by the company when the productivity of the labor group is equal to the wages paid by the company:

$\rho F(N_b + N_a) = \omega_a N_a - \omega_b N_b - dN_b$, so that

$$\rho F'(N_a) = \omega_a \quad \text{....(2)}$$

If repaired then $F'(N_a) = \omega_a$, where the wages of the majority group are in accordance with their productivity

$$\rho F'(N_b) = \omega_b + d \quad \text{....(3)}$$

When ρ is fixed and $F'(N_b) = \omega_b + d$, then the productivity of the minority workers equals the wages and costs of discrimination. If each group of workers has the same productivity, then a higher value of d means the company will incur additional costs for hiring minority workers. Furthermore, the demand for labor comes from employers, where employers hire workers depending on the minority group's wages and the discrimination coefficient. If it is assumed that ρ is fixed, then the market demand function is $N_a^d(\omega_a, \omega_b, G(d))$ for the demand for the labor groups of the majority and $N_b^d(\omega_a, \omega_b, G(d))$ for the demand for the labor from minority groups.

$$N_a^d(\omega_a, \omega_b, G(d)) = N_a^s \omega_a \quad \text{.... (4)}$$

$$\text{And } N_a^d(\omega_a, \omega_b, G(d)) = N_a^s \omega_d \quad \text{....(5)}$$

The above two equations represent the balance of supply and demand for majority (Equation 4) and minority (Equation 5) labor. The demand for the majority labor is a function of the wages of the majority group of workers, the wages of minority workers and the costs of discrimination attached to the wages of minority workers. Likewise, the demand for minority workers is a function of the wages of the majority group of workers, the wages of minority workers, and the costs of discrimination attached to the wages of minority workers.

If the employer discriminates against a minority group, the cost of d (d>0) is incurred. The existence of discrimination costs, and wages between groups of workers are different where subscript $\omega_b > \omega_a$. This discrimination causes the wages paid by employers to minority groups to be more expensive. To survive in the labor market, minority groups of workers "compensate" by working more productively for the given wages, or even receiving lower wages but

with the same productivity. When productivity is greater than wages, the allocation becomes inefficient and creates opportunities for non-discriminatory firms to increase their profits. Opportunities to earn higher profits in non-discriminatory companies cause other companies not to discriminate, which eventually takes over the market and eliminates the wage gap between the minority and majority groups.

Open trade can reduce discrimination between the majority and minority groups. The minority group is assumed to employ women while the majority group is assumed to employ men. Pieter (2014) and Banerjee & Veeramani (2015) state that companies participate in trade deals with producers who also offer similar products. As a result, companies seek to increase efficiency; one way is by reducing the cost of discrimination. Reducing the cost of this discrimination increases opportunities for women to work. According to Pieter (2014), countries that have a comparative advantage of excess female labor also benefit from trade. Companies that employ female workers will add more women to their workforce, in line with the increasing output, so that trade also increases the demand for female workers.

One of the reasons for the decrease in discrimination is technological changes. Trade openness causes countries to be integrated and facilitates the transfer of technology from one country to another (Goldberg & Pavcnik, 2007). According to Heath & Jayachandran (2018), the entry of technology into developing countries causes a shift in the work structure from muscle-based to brain-based, which causes the male workforce to lose its comparative advantage. In addition, if it is assumed that male and female workers have the same efficiency in raising children, then men and women have the same opportunity to enter the labor market (Saur & Zoabi, 2011).

In addition, technological change can offer higher wages for tech-savvy workers, thereby helping to reduce the education gap between male and female workers. Based on a study by Figini & Görg, (1998), when a company implements technology, the increase in the company's productivity depends on the ability of the workforce to use the technology. Technology-savvy workers are paid more than non-technological workers. This encourages parents to increase their investment in their sons' and daughters' education. Sulistyaningrum & Michael Tjahjadi (2022) and Goldins (1994) argue When female workers develop their human capital, demand for female workers in the skilled sector (white collar) will rise. Research Wardhani & Supratiwi (2023) shows that women have good communication skills, make strategic decisions that can improve performance. Eventually, outcome or income of the female worker will rise.

One of the open trade policies is input tariffs. When a government stipulates a decrease in input rates, companies can experience two changes. First, the policy of reducing input rates provides an opportunity to increase profits. Amiti & Davis (2011) and Amiti & Cameron (2012) argue that a decrease in input tariffs causes companies to have greater access to foreign goods. Companies that are in the international market compete to gain a broader market share; one way is by setting low prices. Lower prices of input goods will increase a company's profits. In addition, trade openness forces producers to reallocate production factors to sectors that have high labor intensity, which ultimately increases employment opportunities for women in developing countries (Akhtar, 2023).

Second, tariff policies can regulate the workforce used by companies. In addition to lower input prices, a reduction in input tariffs

also leads to technological changes. Trade openness promotes growth through increased technology transfer (Haseeb et al., 2020). This is because trade openness creates opportunities to access goods from outside as well as opportunities to obtain goods, especially high-tech goods, from developed countries. When input goods come from developed countries that use high technology, the company will experience a change in its production process (Charfeddine & Mrabet, 2015). In addition, input goods tend to be more skill-intensive (Amiti & Cameron, 2012). The use of more intensive skill inputs can shift jobs that originally required physical strength to workers who have cognitive abilities (males and females) (Janneke, 2014). As a result, the use of technology can provide equal employment opportunities for men and women.

METHODS, DATA, AND ANALYSIS

This study used panel data that combined time series data and cross section data. The data series used annual data from 2003 to 2015. The cross section data were company level data using ISIC Rev-3. The end of 2015 was selected because this data series were the last data series published by BPS. With the election in early 2003, a 12 year period was considered suitable to capture any trade fluctuations. The data used came from the Central Statistics Agency (BPS) in the form of large and medium industry (IBS) data, with dummy data on labor, capital, value added for exports and imports, the Producer Price Index (IHP), and wholesale trade. The price index data (WPI) had 2003 base year and 2010 input-output tables.

IBS data for 2014 and 2015 did not provide information at the company level. Therefore, the researcher combined the data with the previous period, based on the same 5-digit ISIC code, and in the same district. Then, the researcher aggregated the ISIC code into rev 3 because, during that period, the ISIC code changed, where IBS in 2003 to 2009 used the ISIC Rev 3 (Standard Business Field Classification/KBLI 2015) and IBS in 2010 to 2015 used the ISIC Rev 4 (KBLI 2009).

In addition to using IBS data, this study used tariff data sourced from the Trade Analysis Information System (TRAINS)-UNCTAD through the World Bank's WITS system. The tariff data used in this study were *ad valorem* tariffs that used three types of tariff measures (most favored nation duty rate treatment/MFN for countries without cooperation, ASEAN Free Trade Area/AFTA tariffs for ASEAN countries, and preferential tariffs respectively for China, India, and South Korea). However, in 2008, 2014, and 2015 the tariff data used was only MFN as no information was available regarding the use of tariffs for bilateral, regional, or multilateral cooperation, as well as preferential tariffs for China, India, and South Korea respectively. These three types of tariff measures were combined by sector to obtain a 3-digit ISIC average rate. The data contained tariff information based on the 6-digit harmonized system (HS), then the HS code was concorded by the author to the 3rd digit ISIC Rev.3. Concordations were carried out to adjust the code based on the code presented in the BPS. After that, the researcher weighted the tariff data that had been concordant with the import value (000 US$), which was also concordant with the 6-digit harmonized system (HS) commodity tariff data to the 3-digit ISIC Rev 3 code, and the data were then tariff data outputs. The output tariff data were then reprocessed to obtain input tariff data.

The calculation of input rates is based on research by Amiti & Konings (2007). However, this study used weights based on the input structure in the 2010 Input Output (IO) Table. The use of the 2010 input structure was

considered appropriate because 2010 was in the middle of the research period. The use of IO as a weight was constrained by the difference between the code used in the IO table and the code used in IBS. The difference in these codes caused the researchers to aggregate them into 3-digit ISIC codes so that they could be analyzed together with the other variables.

$$the\ tarifinput_{jt} = \sum i\, W_{ij} x tarifoutput_{it}$$

ij was the proportion of product i used as an input in industry j. The industry input rate j in year t was the proportion of product i used as an intermediate input multiplied by the output level of product i in year t. Therefore, the input rates used were industry input rates. For example, industry A used 60% iron and 40% rubber, then industry A's tariff would be 60% iron output rate plus 40% rubber output rate W_{ij}. Furthermore, the data were analyzed using an empirical model:

$$\ln\left(\frac{TK_w}{\mathrm{Tot_{tk}}}\right)_{i,j,t} = \beta_1 \ln\left(\frac{TK_w}{\mathrm{Tot_{tk}}}\right)_{i,j,t-1} +$$
$$\beta_2 \mathrm{tarif\ input_{j,t}} +$$
$$\beta_3\ \mathrm{dummy\ impor_{i,j,t}} +$$
$$\beta_4 \mathrm{tarif\ input_{j,t}} *\ \mathrm{dummy\ impor_{i,j,t}} +$$
$$\beta_5 \mathrm{tarif\ output_{j,t}} +$$
$$\beta_6 \mathrm{dummy\ ekspor_{i,j,t}} +$$
$$\beta_7 \mathrm{total\ tenaga\ kerja_{i,j,t}} +$$
$$\beta_8\ realoutput_{\mathrm{i,j,t}} +$$
$$\beta_9 realfixedcapital_{\mathrm{i,j,t}} +$$
$$\beta_{10}\ realvalueadded_{\mathrm{i,j,t}} +\ \varepsilon_{\mathrm{i,j,t}}$$

i was company data, j was industry category, and t was time (2003 to 2015). All the variables used in this study used firm-level data, but the variable input rates and output rates were measured based on the 3-digit ISIC. The dependent variable was the ratio of female workers to the total labor force. This study used control variables, namely output tariffs, export dummy, number of workers, real output, real fixed capital, and real added value.

Furthermore, the importer dummy variable was given a value of 1 when at least 10% of the company's inputs are imported. Furthermore, the difference between companies that import and do not import was captured through the interaction variable between input tariffs and the importer's dummy (Oishi, 2018). Likewise, with the export dummy variable, the export dummy variable was worth 1 when the company exports goods. The purpose of using export and import dummies was to determine the difference between a company that was only oriented to local articles and a company that was oriented to the international market (Oishi, 2018).

Furthermore, the control variables used were the number of workers, real output, real fixed capital, and real added value. To eliminate the influence of output variable prices, fixed capital, and added value, the researchers converted the data into real form by using the producer price index deflator, namely the Producer Price Index (PPI). The PPI was considered to be the most appropriate because it reflected price changes at the producer's level. However, because the PPI started in 2010, the years before 2010 were marked using the Wholesale Price Index (IHPB) data, with a base year of 2003.

This study used the lag variable y so that it raised the issue of endogeneity. According to Charfeddine & Mrabet (2015), endogeneity occurs due to the relationship/correlation between exogenous variables (lag variable with error). The use of lag from the dependent variable was because the trade openness policy was not directly responded to by the companies. They needed time to adjust to the costs of a trade openness policy. This caused the ratio of female workers in the previous year to be controlled this

year, because the ratio of female workers in the previous year also affected the ratio of female workers this year. The use of lag has long-term and short-term implications. However, this study only analyzed short-term issues while the long-term implications were captured through a framework that is not discussed in this study.

This study used the lag of the independent variable as the dependent variable. Charfeddine & Mrabet (2015), stated that companies need time to adjust their costs due to changes in costs caused by trade openness policies. As a result, this study used the dependent variable lag as the independent variable. The firm's cost adjustment raised the issue of endogeneity. To overcome this endogeneity, the FE-IV estimator was considered to be an estimator that could obtain consistent parameters (Baltagi, 2005). The use of FE-IV had a consequence in that the researchers had to look for instrument variables. The selection of the instrument variables was based on the values of Cragg-Donald Wald and Keibergen-Paap F-statistics, which had to be greater than the value of Stock Yogo 2005. Based on this information, the instrument variable for the ratio of female workers was the lag (t-1) variable for the ratio of female workers. The FE-IV estimator also had a weakness, namely that the study only analyzed the short-term and the number of observations became smaller due to the use of the instrumental variables.

The coefficient β_1 was predicted to be positive, meaning that a higher female workforce ratio in the previous year would lead to an increase in the workforce ratio this year and vice versa. Predictions were made because positive companies need time to adjust their number of workers due to changes in trade restriction policies. Furthermore, the $\beta 2$ coefficient is predicted to be negative. When the government implements a policy of reducing input tariffs, local companies that produce similar goods compete with foreign companies, so local companies reduce their discrimination costs. Then the coefficient β_3 was predicted to be positive, so that the higher the imported goods were, the higher the ratio of female workers would be. Finally, the coefficient β_4 was predicted to be negative. The reduction in tariffs would cause an increase in the ratio of female workers where the impact was stronger on companies that carry out import activities.

RESULTS AND DISCUSSION

Descriptive statistics were used to provide information about the number of observations, average, standard deviation, minimum value, and maximum value of each variable used in this study. The descriptive statistical values of the research variables were as follows in Table 1.

The summary of the variables in Table 1 provides information regarding the number of observations, the average value, standard deviation, minimum value, and maximum value of each variable used from 2003 to 2015. The variables used in this study were the ratio of female workers (female_share), input tariffs (input rates), the interaction of input tariffs and the import dummy (Input Rate * D_Import), the import dummy (D_import), output tariffs (Output rates), the export dummy (D_export), total workforce, real output, real fixed capital and real value added. The number of companies used in this study was 238,000. They were obtained from the cleaning results using companies' data that only had outputs. In addition, cleaning was carried out using capital information from the previous year when the percentage of capital did not show a value of 100% (sum of domestic capital/PMDN and foreign capital/PMA). The results of the estimation can be seen in Table 2.

Table 1. Summary of variable statistics

Variable	Ob	Means	St. Dev.	Min	Max
Female_share	238,000	0.383	0.276	0	1
Input tariff	238,000	0.029	0.04	0	0.435
Input tariff* Dummy import	238,000	0.007	0.026	0	0.435
Dummy import	238,000	0.167	0.373	0	1
Output rate	238,000	0.045	0.073	0	1,239
Export dummy	238,000	0.225	0.418	0	1
Total workforce	238,000	215,465	685,923	11	56,139
Real output	238,000	167,000	2,060,000	0	8.30e+08
Real fixed capital	238,000	643,000	2.28e+08	0	1.11e+11
Real added value	238,000	65,046.58	688,000	0	1.81e+08

Table 2. Regression results estimate the impact of input tariffs on the female labor ratio

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
L. female_share	0.303***	0.303***	0.301***	0.300***	0.300***	0.300***	0.300***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Input tariff	-0.032***	-0.004	-0.018	-0.018	-0.018	-0.018	-0.018
	(0.012)	(0.014)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Input tariff*Dummy import		-0.097***	-0.086***	-0.086***	-0.086***	-0.086***	-0.086***
		(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Import Dummy		0.016***	0.013***	0.013***	0.013***	0.013***	0.013***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Output Rate			0.010	0.011	0.011	0.011	0.011
			(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Export dummy			0.019***	0.018***	0.018***	0.018***	0.018***
			(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Total workforce				0.000***	0.000***	0.000***	0.000***
				(0.000)	(0.000)	(0.000)	(0.000)
Real output					-0.000	-0.000**	-0.000**
					(0.000)	(0.000)	(0.000)
Real fixed capital							-0.000
							(0.000)
Real added value						0.000**	0.000**
						(0.000)	(0.000)
Obs.	143,362	143,362	143,362	143,362	143,362	143,362	143,362
dummy year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year * island	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors are in brackets
****p<0.01, **p<0.05, *p<0.1*

Column 1 shows that trade openness using only the input tariff variable had a significant negative correlation with the ratio of female workers; the lower the input tariff, the higher the ratio of female workers. These results are in line with those of a study by Aziz (2020), as trade openness helps women to obtain jobs in Indonesia. Trade openness makes workers aware

of the importance of education. When workers have a higher level of education, they increase their chances of getting high-paying jobs, and vice versa (Sehrawat & Singh, 2019). According to Amiti & Cameron (2012), the reduction in input tariffs causes the price of semi-finished goods to become cheaper, so that domestic companies that originally bought local products switch to using imported goods. In addition, imported input goods, which are more skill-intensive and therefore more expensive, also change the structure of the workforce from originally using their physical abilities to using their cognitive abilities. Cognitive abilities are not only possessed by men but also by women, thereby increasing women's opportunities to work.

Furthermore, when the researchers estimated input tariffs with the interaction variable between input tariffs and the import dummy, the effect of the input tariff on the ratio of female workers became insignificant, but the interaction variable between the input tariffs and the import dummy showed a significant negative relationship (columns 2 to 7). This relationship was consistent when including the control variables and excluding them. This result was different from the estimation of Oishi (2018) which showed that the interaction variable between input tariffs and import indicators was positively related to the labor ratio. The negative relationship between the interaction variables between input tariffs and dummy imports on the ratio of female workers indicated that a decrease in tariffs caused an increase in the ratio of female workers; the impact was stronger for companies carrying out import activities than for companies that do not import. Companies responded to the policy of reducing input tariffs by increasing their demand for imported goods. Imported goods from high-tech countries reduced the comparative advantage of men and reduced the costs of discrimination. Conversely, companies that did not import did not feel any change in the input tariff policies.

The dummy variable of import companies was positively related to the ratio of female workers. This positive relationship indicated that companies that import would increase the ratio of female workers, compared to companies that do not import. Imports are the entry point for technology that causes companies to reduce discrimination by specializing in workers who are able to use the technology (Sun, 2019). Importing firms will increase their efficiency by reducing their discriminatory costs. In addition, the reduction in discrimination has also been caused by changes in production methods that use higher technology. Technological changes due to the entry of goods from developed countries caused a decrease in the demand for physical labor, thereby increasing the demand for female workers.

The variable lag in the ratio of female workers was positively related to the ratio of female workers. This showed that the increase in the ratio of female workers last year (t-1) was positively related to the increase in the ratio of female workers this year (t). This positive relationship was also found in research by Charfeddine & Mrabet (2015), who stated that companies need time to adjust their costs due to changes in trade openness policies. When the government sets a tariff reduction policy, companies will try to respond to the use of inputs to provide opportunities for women workers to be employed.

The export dummy showed a positive relationship with the ratio of female workers (columns 2 to 7). This positive relationship indicated that higher exports led to an increase in the ratio of female workers. Based on work by Banerjee & Veeramani (2015), trade openness brings a scale effect due to the market's

expansion. The growing market also increases the demand for products from both domestic and international consumers. To be able to compete with products produced in developed countries, developing countries must improve their technology and try to modernize the goods they produce by changing the technological structure used (Charfeddine & Mrabet, 2015). These technological improvements reduce the requirement for physical labor and reduce the demand for labor. Men have a comparative advantage.

Table 2. The estimation results are based on the intensity of technology and the number of workers

	(10) Low tech intensity	(11) Moderate technology intensity	(12) High tech intensity	(13) Labor intensive	(14) Not labor intensive
L. female_share	0.261***	0.356***	0.351***	0.247***	0.355***
	(0.019)	(0.033)	(0.048)	(0.022)	(0.022)
Input tariff	0.060	-0.065**	-0.108***	0.100**	-0.082***
	(0.038)	(0.028)	(0.039)	(0.041)	(0.020)
Input tariff* Dummy import	-0.293***	0.008	-0.064	-0.384***	0.002
	(0.072)	(0.027)	(0.043)	(0.075)	(0.022)
Import Dummy	0.016***	0.006	0.016***	0.022***	0.007***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)
Output rates	0.053**	0.017*	0.020	0.056**	0.018**
	(0.024)	(0.010)	(0.017)	(0.025)	(0.008)
Export dummy	0.018***	0.012***	0.027***	0.019***	0.018***
	(0.002)	(0.003)	(0.004)	(0.002)	(0.002)
Total workforce	0.000***	0.000***	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Realoutput	-0.000***	-0.000	-0.000	-0.000**	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Real fixed capital	-0.000	-0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Real value added	0.000	-0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Obs.	87,883	29,352	23,051	71,830	70,686
dummy year	Yes	Yes	Yes	Yes	Yes
year * island	Yes	Yes	Yes	Yes	Yes

Standard errors are in brackets

****p<0.01, **p<0.05, *p<0.1*

Note: Technological intensity is categorized based on UNIDO 2006 where sectors are divided into threecategories based on 2-digit ISIC, namely low technology-intensity (low technology-intensity), medium technology-intensity, and high technology-intensity. The labor-intensive sector is based on the category of Industrial Regulation of the Republic of Indonesia No. 51/M-IND/PER/2013, namely industries that fall into this category are the food, beverage and tobacco industry, leather and leather goods industry, footwear industry, children's toy industry, and the furniture industry. While the non-labor-intensive sector is a sector other than the category in the Industrial Regulation of the Republic of Indonesia No. 51/M-IND/PER/2013.

In Table 3, the researcher estimated the input rate and the female workforce ratio based on differences in technology-intensity (low technology-intensity, medium technology-intensity, and high technology-intensity) and the number of workers (labor and non-labor intensity). This difference was meant to see whether the impact of trade openness on the labor ratio differed between the technology intensities and between firms with different numbers of workers.

The estimation results in Table 3 prove that the impact of trade openness (input tariff variable) on the ratio of female workers differed between sectors. The reduction in input tariffs led to an increase in the ratio of female workers at firms that were medium technology-intensity, high technology-intensity, and non-labor-intensive, which had the same impact on companies that were importing and companies that were not importing. Technological changes bring changes in the type of work, so workers need to develop their cognitive abilities and this provides opportunities for female workers to find employment.

Different things are shown in columns 10 and 13. The tariff policy showed a positive relationship in the labor-intensive sector and did not show an insignificant relationship in the low technology-intensity sector. In addition, the interaction variable between input tariffs and dummy imports showed a significant negative relationship to the ratio of female workers, where companies that import had a stronger impact than companies that do not import. The policy of reducing input tariffs led to a strong increase in the demand for female workers in companies importing from labor-intensive and low-tech-intensive industries. This is in line with research by Banerjee & Veeramani (2015), who found that countries that are rich in human resources will specialize and hire more workers. Therefore, the openness of trade in India caused companies to try to increase their competitiveness by producing cheaper goods using cheaper labor. In addition, based on BPS data for 2015, the percentage of male formal workers was still higher than that of women. Labor-intensive sectors that tended to be low-tech meant that male workers would still be needed, as they have a comparative advantage in physical strength.

CONCLUSIONS AND RECOMMENDATIONS

The focus of this research is to estimate trade openness through the variable of the ratio of female workers in both importing and non-importing companies in Indonesia. Based on the literature, trade openness increases competition, so companies try to increase their efficiency by reducing the costs of discrimination. Male workers have their comparative advantage in physical labor reduced by technological changes to the production methods. Both of these have increased opportunities for female workers to enter the labor market.

To answer this, this study uses panel data at the company level for the period from 2003 to 2015. This research was inspired by research undertaken by Oishi, (2018), which measured trade openness through the input tariff variables and the interaction variables between input tariffs and dummy imports. This research gap adds the lag variable from the y variable (the ratio of female workers). This is because companies do not immediately respond to changes in the trade openness policies, but need time to adjust, so this study includes the lag ratio of female workers in the previous year as an exogenous variable. The exclusion of the lag variable as an exogenous variable caused the estimation results of Oishi (2018) to be biased,

so this study adds these variables and estimates through FE-IV.

In contrast to the estimation results from Oishi (2018), this study shows that decreasing the input tariffs increases the ratio of female workers. When using only input tariffs, decreasing the input tariffs increases the ratio of female workers. Furthermore, when researchers estimate input tariffs together with the interaction variables of input tariffs and dummy imports, the input tariff variables become insignificant and the interaction variables show a significant negative relationship with the ratio of female workers. The negative relationship between the interaction variable between input tariffs and dummy imports on the ratio of female workers indicates that a decrease in tariffs causes an increase in the ratio of female workers; the impact is stronger for companies that import than companies that do not import.

In addition, the researcher also estimates the impact of input tariffs on the female workforce ratio based on differences in technology-intensity (low technology-intensity, medium technology-intensity, high technology-intensity) and the number of workers (labor intensity and non-labor intensity). The estimation results show that a reduction in input tariffs causes an increase in the ratio of female workers in medium technology-intensity, high technology-intensity, and non-labor firms, where the impact is the same between companies that import and companies that do not import. Conversely, the level of input shows a positive relationship in the labor-intensive sector and does not show an insignificant relationship at low technology-intensity firms.

This study has limitations, namely it only estimates companies that are in the manufacturing sector and distinguish between male and female workers. If researchers are interested in conducting further research, they can estimate the impact of trade openness on agriculture, services, or other sectors. In addition, researchers can also use the trade openness variables through export, import, and non-tariff variables.

In order to implement trade openness, the Indonesian government needs to implement supporting policies so that Indonesian workers are absorbed into the labor market. The government needs to improve equitable access to education for all citizens in Indonesia, especially in disadvantaged, frontier and outermost regions. In addition to education, the government needs to provide child-care facilities around office areas, flexibility in working hours for women, training and skills, and provide opportunities for women to occupy strategic positions.

REFERENCES

Acemoglu, D., & Autor, D. (2011). Skills, tasks and technologies: Implications for employment and earnings. *Handbook of Labor Economics*. https://www.sciencedirect.com/science/article/pii/S0169721811024105

Akhtar, R. (2023). Economic growth, gender inequality, openness of trade, and female labour force participation: a nonlinear ARDL approach. *Economic Change and Restructuring*. https://doi.org/10.1007/s10644-023-09488-7

Amiti, M., & Cameron, L. (2012). Trade liberalization and the wage skill premium: evidence from Indonesia. *Journal of International Economics*, 87(2), 277–287. https://doi.org/10.1016/j.jinteco.2012.01.009

Amiti, M., & Davis, D. R. (2011). Trade , firms , and wages: Theory and evidence. *Review of Economic Studies*, 79(August), 1–36. https://doi.org/10.1093/restud/rdr016

Autor, D. (2003). Lecture note: the economics of discrimination-theory. *Graduate Labor*

Economics I, Massachusetts Institute of Technology, Cambridge, 1-18.

Azis, A. (2020, March). Gender, globalization and feminization of division of labour. In *Proceedings of the 13th International Interdisciplinary Studies Seminar, IISS 2019, 30-31 October 2019, Malang, Indonesia*. https://doi.org/10.4108/eai.9-3-2020.163839

Baltagi, B. H. (2005). *Econometric analysis of panel data (third*).John Wiley & Sons Ltd, The Atrium, Southern Gate, Chicheste..

Baltagi, B.H. (2008). *Panel data econometric analysis (Vol. 4)*. Chichester: John Wiley & Sons.

Banerjee, P., & Veeramani, C. (2015a). Trade liberalisation and women's employment intensity: Analysis of India's manufacturing industries. *Indira Gandhi Institute of Development Research*, June.

Banerjee, P., & Veeramani, C. (2015b). Trade Liberalization and Women's Employment Intensity: Analysis of India's Manufacturing Industries, *Indira Gandhi Institute of Development Research*

Central Bureau of Statistics. (2022) https://www.bps.go.id/indicator/6/1170/1/persentase-tenaga-kerja-formal-menurut-tipe-kelamin.html

Charfeddine, L., & Mrabet, Z. (2015). Trade liberalization and relative employment: Further evidence from Tunisia. *Eurasian Business Review*, 5(1), 173–202. https://doi.org/10.1007/s40821-015-0020-6

Figini, P., & Görg, H. (1999). Multinational companies and wage inequality in the host country: the case of Ireland. *Weltwirtschaftliches Archiv*, *135*(4), 594-612.

Goldberg, P. K., & Pavcnik, N. (2007). Distributional effects of globalization in developing countries. *Journal of Economic Literature*, 45(1), 39–82. https://doi.org/10.1257/jel.45.1.39

Goldin, C. (1994). The U-shape female labor force function in economic development and economic history. NBER Working Paper Series, 1982, 323.https://www.nber.org/system/files/working_papers/w4707/w4707.pdf

Gupta, A. (2021). Effect of trade liberalization on gender inequality: the case of India. *IMF Economic Review* (Vol. 69, Issue 4, pp. 682–720). https://doi.org/10.1057/s41308-021-00143-7

Haseeb, M., Suryanto, T., Hartani, N. H., & Jermsittiparsert, K. (2020). Nexus between globalization, income inequality and human development in Indonesian economy: Evidence from application of partial and multiple wavelet coherence. *Social Indicators Research*, *147*(3), 723-745.

Heath, R., & Jayachandran, S. (2018). The causes and consequences of increased female education and labor force participation in developing countries. *NBER Working Paper Series*, 22766, 121.

International Labor Organization (ILO). (2015). Labor and social trends in Indonesia 2014 2015. https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-jakarta/documents/publication/wcms_381565.pdf

Jamielaa, M., & Kawabata, K. (2018). Trade openness and gender wage gap: evidence from Indonesia. *Journal of International Cooperation Studies*, *26*(1), 25-40.

Jamil, W. I., & Damayanti, A. (2018). Dampak penurunan tarif impor terhadap pengang-guran di Indonesia: Analisis level regional. *Jurnal Perencanaan Pembangunan*, II(3), 241–258. https://doi.org/10.36574/jpp.v2i3.49

Juhn, C., Ujhelyi, G., & Carolina, V.-S. (2014). Men women and machines: how trade impacts gender inequality. *NBER Working Paper Series*, 01(01), 1689–1699. https://www.nber.org/system/files/working_papers/w18106/w18106.pdf

Kis-Katos, K., Janneke Pieters, & Robert Sparrow. (2018). Globalization and social change: gender-specific effects of trade

liberalization in Indonesia. *IMF Economic Review* (Vol. 66, Issue 4, pp. 763–793). https://doi.org/10.1057/s41308-018-0065-5

Lang, K., & Spitzer, A. K. L. (2020). Race discrimination: An economic perspective. *Journal of Economic Perspectives*. https://doi.org/10.1257/jep.34.2.68

Law of the Republic Number 13 of 2003

Mitra, R., & Hossain, M. S. (2018). Does trade openness increase income inequality in the United States. *The Empirical Economics Letters, 17*(10), 1185-1194.

Mukhopadhyay, U. (2015). Economic liberalization and gender inequality in the labor market: A theoretical approach. *Review of Urban & Regional Development Studies, 27*(1), 68-87.

Ntuli, N., Jili, N. N., & Xaba, M. R. (2023). Women participation in leadership positions in Mtubatuba local municipality, South Africa. *Journal of Leadership in Organizations*, 5(1). https://doi.org/10.22146/jlo.74881

Oishi, Y. (2018). Importing inequality: trade liberalization, technology, and women's employment. GRIPS Discussion Papers 18-16, National Graduate Institute for Policy Studies. https://ideas.repec.org/p/ngi/dpaper/18-16.html.

Pieters, J. (2014). Trade liberalization and gender inequality. *IZA World of Labor*, October, 1–11. https://doi.org/10.15185/izawol.114

Rodrik, D. (2018). *New technologies, global value chains, and developing economies* (No. w25164). National Bureau of Economic Research.

Sauré, P. U., & Zoabi, H. (2011). When Stolper-Samuelson Does Not Apply: International Trade and Female Labor. *Available at SSRN 1939962*.

Sehrawat, M., & Singh, S. K. (2019). Human capital and income inequality in India: Is there a non-linear and asymmetric relationship? *Applied Economics*, 51(39), 4325–4336. https://doi.org/10.1080/00036846.2019.1591605

Stock, JH, and M. Yogo. 2005. Testing for weak instruments in linear IV regression. In Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg, ed. DWK Andrews and JH Stock, 80–108. Cambridge: *Cambridge University Press*.

Sulistyaningrum, E., & Michael Tjahjadi, A. (2022). Income Inequality in indonesia: which aspects cause the most? *Journal of Indonesian Economy and Business*, 37(3), 229–253. https://doi.org/10.22146/jieb.v37i3.2015

Sun, S. Z. (2019). The effects of trade liberalization on skill acquisition: A systematic review. *Journal of International Trade Law and Policy* (Vol. 18, Issue 2, pp. 74–95). https://doi.org/10.1108/JITLP-08-2018-0036

Wardhani, D. K., & Supratiwi, W. (2023). Characteristics of a good board of directors for Indonesian SOEs performance. *Journal of Indonesian Economy and Business*, 38(1), 1–18. https://doi.org/10.22146/jieb.v38i1.4410

Wuestenenk, N., & Begall, K. (2022). The motherhood wage gap and trade-offs between family and work: A test of compensating wage differentials. *Social Science Research*, 106, 102726. https://doi.org/10.1016/j.ssresearch.2022.102726