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Does trade favor women? The effect of international trade on the gender wage gap and female labor force participation

Abstract

Using panel fixed effects, this paper aims to estimate the effect of international trade on the gender wage gap and female labor force participation. Economic theory generally suggests a narrowing effect of trade openness on gender disparities in wages and labor force participation, but preceding empirical literature gives mixed results. For a large selection of middle- to high-income countries, this paper finds (1) a significant negative relationship between international trade and female labor force participation, and (2) no significant association between trade and the gender wage gap at various percentiles of the income distribution.

Name student: Mark Hulsbos

Student ID number: 498608

Supervisor: dr. V. Karamychev

Second assessor: dr. L. Hering

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1. Introduction

Against the backdrop of an increasingly globalized world economy, women are swimming upstream against the tide of global rising income inequality. In most OECD countries, the gap between the top and the bottom of the income distribution is at its highest level since 30 years (Cingano, 2014). Furthermore, the world's richest 10% are estimated to now earn more than half of global income (Chancel et al., 2022). In the meantime, however, the gender wage gap has fallen considerably in almost all economically advanced countries over the past fifty years, and female labor force participation has experienced a gradual upward shift (Blau & Kahn, 2017; Goldin, 2014). In light of the UN's sustainable development goals, this movement toward gender wage equality seems to be good news for policymakers and societies alike. However, the COVID-19 crisis has illustrated how this progression toward gender equality remains sensitive to global developments (Dang & Nguyen, 2021). Furthermore, gender convergence in labor income and labor force participation has slowed down significantly since the late 2000s, indicating that there is still a great deal to be done to achieve the UN's goal of gender equality by 2030.

Interestingly, this period of slowed gender convergence coincides with an analogous slowdown in globalization (Antràs, 2020). Hence, the question arises to what extent globalization and gender income inequality are interrelated. Standard economic literature generally suggests a narrowing effect of international trade on the gender gap in wages and labor force participation. However, empirical literature often reports mixed results. Despite its clear policy relevance, the amount of academic literature investigating this topic is surprisingly limited. This paper therefore aims to contribute to this existing literature by further investigating the research question: *what is the effect of international trade on the gender wage gap and female labor force participation*? Whereas most of the preceding literature focuses on individual countries or the effects of bilateral free trade agreements, this paper uses a panel fixed effects approach for a large selection of middle- to high-income countries for the years 1995-2022. By applying a broader scope, the results of this paper are arguably more generalizable. Furthermore, this method provides a clear perspective on how international trade, the gender wage gap, and female labor force participation are related on an international level.

In the context of income inequality, it is further interesting to investigate whether the effect of trade on the gender wage gap varies for different percentiles of the income distribution. Common trade models – like the Heckscher-Ohlin theorem – suggest that international trade can have varying effects on the owners of different production factors. Hence, if different

income percentiles correspond to different production factors, international trade could affect the wage gap in each income percentile differently. Current academic literature remains largely silent on this issue, however. This is, again, surprising due to its clear policy relevance. Voitchovsky (2005), for instance, finds that the shape of the general income distribution is significantly associated with economic growth. To fill this gap in the existing academic literature, this study tries to answer a second research question, namely: *does the effect of trade on the gender wage gap vary for different percentiles of the income distribution*?

This paper is structured as follows. Section 2 aims to categorize much of the existing theoretical literature into three main (partly complementary) strands of theory, and tries to connect all theories to relevant empirical research. Section 3 discusses this study's methodology and empirical models, and thoroughly analyzes the data. More specifically, this section examines the converging trends that are exhibited by both the gender wage gap and female labor force participation. Lastly, section 4 reports and interprets the results of the panel fixed effects regression analysis for all empirical models.

To improve readability, this paper will hereinafter sometimes refer to 'gender labor inequality' when talking about the combined gender gap in labor force participation and wages. Likewise, female labor force participation will henceforth be abbreviated by FLFP.

2. Literature review

Current economic literature offers a variety of explanations regarding the effect of international trade on the gender wage gap and FLFP. This section aims to compress much of the existing literature into three most common theories. The theoretical literature generally suggests a positive effect of international trade on female relative wages and female labor force participation, suggesting that trade openness has a narrowing effect on gender labor inequality. Empirical evidence for this hypothesis, however, is mixed.

2.1 Labor market discrimination

The first main theoretical underpinning comes from Becker's (1971) theory of costly discrimination. In Becker's model, employers have a 'taste for discrimination'. Instead of strictly maximizing profits, firms optimize a utility function that also values the demographic composition of its labor force. In the context of gender discrimination, firms might incur non-pecuniary 'psychic' costs when employing female workers. Mathematically, if the money cost of employing a regular labor hour (i.e., the wage rate) is π, then the net cost of one female labor hour equals $\pi(1 + d)$, where the discrimination coefficient d reflects the value of the employer's

distaste for hiring women. This has the implication that men earn $\pi + d$, while women only receive π even though both genders' productivity are assumed to be homogenous. As a consequence, discrimination has a 'costly' character due to the monetary inefficient hiring choices of firms.

A key feature of Becker's model is that employers' discrimination coefficients, i.e. the degree to which employers value discrimination, are heterogenous. As long as there are employers with a discrimination coefficient that is lower than that of their peers, equilibrium discrimination will decrease. This is a result of discrimination's costly character; firms with a strong taste for discrimination incur higher wage costs than their less discriminating counterparts, and are therefore less competitive. Using this logic, increased import competition will decrease gender discrimination in two ways. For perfect markets, trade openness will likely introduce new firms into the domestic market with lower discrimination coefficients. This decreases domestic discrimination by pushing more discriminating (less efficient) firms out of the market. For concentrated industries, increased import competition will decrease a firm's profit, thus limiting its luxury to discriminate and prompting it to save on production costs by hiring more women. Either way, international trade will close the gender wage gap and promote FLFP.

There are a few papers that explicitly evaluate Becker's theory using empirical data. Black and Strahan (2001) focus on an era of U.S. banking history where deregulation gradually made it easier for banks to enter markets in different states. They find, consistent with Becker's theory, that the resulting increase in competition limited individual employers' ability to freely distribute rents among both genders according to their preferences, and that the gender wage gap consequently declined. Furthermore, women also became more likely to hold managerial positions. Similarly, Black and Brainerd (2004) find that increasing import penetration in the U.S. manufacturing industry from 1976 to 1993 narrowed the gender wage gap by reducing employers' ability to discriminate. Moreover, Ederington et al. (2009) show that a period of trade liberalization in Colombia induced affected manufacturing plants to employ more women by as much as 6.9 percent relative to unaffected industries. Artecona and Cunningham (2002) also find suggestive evidence that import competition discouraged discrimination in Mexico, although the gender wage gap actually rose. These studies indicate that Becker's theory applies to both developing and developed countries.

Becker's theory is not entirely uncontested, however. For instance, Berik et al. (2004) focus on South Korea and Taiwan during the 1980s and 1990s, and show that increased competition from foreign trade actually widened the residual wage gap (i.e., the gender wage

gap that is not attributable to observed gender productivity differences). They attribute this to increased wage discrimination and argue that trade adversely affected women's relative employment prospects, diminishing women's bargaining power. Besedeš et al. (2021) also find that increased Chinese import competition due to tariff reductions widened the residual wage gap in the U.S., but argue that this is suggestive of selection effects rather than discrimination. They argue that the quality of male labor improved due to less educated men leaving the labor force. Lastly, Polachek (2007) argues that the role of discrimination in the gender wage gap is often overemphasized. He asserts, for instance, that tastes for discrimination cannot explain why corporations seem to discriminate considerably more against married women.

2.2 Hecksher-Ohlin theorem

In addition to Becker's model of discrimination, the Heckscher-Ohlin (H-O) theorem is commonly used to predict a narrowing effect of trade on the gender labor gap. In its most basic form, the model predicts that international trade will increase the relative domestic price of the production good in which the home country has a comparative advantage. This has two consequences. Firstly, the sector in which the home country's relatively abundant production factor is used most intensively will expand due to export demand, while the sector that uses the relatively scarce production factor intensively will shrink. Secondly, the real relative returns to the abundant production factor used intensively in the export sector will increase, while that of the scarce production factor will decrease. Therefore, if male and female labor are assumed to be imperfect substitutes (i.e., different factors of production), trade openness can improve women's real relative wages if the export sector is more female labor-intensive than the import-competing sector.

To illustrate, the H-O model predicts that international trade expands the capital-intensive export industries of developed countries, which are relatively capital-abundant. These industries are also likely to be female-labor-intensive (see Sauré & Zoabi, 2014). Trade will push up the domestic relative price of the female-labor-intensive export good, and Stolper-Samuelson logic requires that women's real relative wages rise correspondingly. As women's relative wage rise, more women are prompted to enter the labor force, thus promoting FLFP. In developing economies, women tend to be overrepresented in relatively low-skilled export sectors (Rocha & Winkler, 2019). Using the same logic as before, international trade will increase the export demand of the low-skilled good. This will, again, lead to an increase in FLFP and the relative wages of women in developing economies. These predictions rely on the assumption that male and female labor are imperfect substitutes. Current literature supports this

assumption. Sauré and Zoabi (2014), for instance, argue that there is a strong complementarity between capital and female labor. It also often suggested that, due to physiological differences between genders, women have a comparative advantage in 'brain'-intensive labor as opposed to men's comparative advantage in 'brawn'-intensive labor (Heath & Jayachandran, 2017; Rendall, 2017; Bacolod & Blum, 2010).

Despite its intuitive features, empirical evidence on the H-O model in the context of gender inequality is mixed. In favor of the model, Brussevich (2018) finds a narrowing effect of trade liberalization on the occupational gender wage gap and attributes this effect partly to Stolper-Samuelson forces. Using similar logic, Besedeš et al. (2021) also find that Chinese import competition decreased the U.S. gender wage gap and promoted FLFP. However, they also show that the residual wage gap actually widened as a result of trade. Taken together, they argue that these findings are likely the result of selection effects in the sense that less educated men exited the labor force, and more educated women entered it. This conclusion is supported by the findings of Mansour et al. (2022), who find that, analogously, Chinese import penetration decreased FLFP during the same period by forcing less-educated American women out of the labor market. Lastly, one caveat of this version of the H-O model is that it does not take into account equal pay regulations. Sauré and Zoabi (2014) include these wage restrictions by assuming that increased trade does not only raise female wages, but male wages as well. As a consequence, the gender wage gap and FLFP initially remain constant. However, as trade expands the export sector, male workers will be prompted to migrate from the male-intensive import-competing sector to the female-intensive export industry. As a developed countries' export sector is also capital-intensive, the result of this influx of male workers is a dilution of capital. Because female workers are assumed to have a relatively high complementarity with capital, this inflow of male workers decreases the relative marginal productivity of women. As a result, women's relative wages decline, the wage gap increases, and FLFP declines. This diluting effect is especially pronounced for high-skilled women, for whom capital complementarity is particularly strong.

2.3 Labor force flexibility and technical growth

Standing (1989, 1999) proposes a complementary theory regarding the relationship between trade and the gender labor gap. Standing's papers focus on the last two decades of the twentieth century, a time period characterized by global trade liberalization as export-led growth strategies became increasingly popular among countries. He suggests that this increase in trade openness prompted two developments which increased women's relative wages and labor force

participation.

Firstly, as trade led to intensified competition, cost competitiveness became increasingly important. This spawned a supply-side push toward labor market deregulation and increased the demand for alternative forms of employment, like temporary or parttime labor. This arguably had a positive effect on FLFP, because gender roles often prevent women from working fulltime. The importance of flexible job structures is echoed by Goldin (2014), who argues that the 'last chapter' in reducing the gender pay gap "must involve changes in the labor market, especially how jobs are structured and remunerated to promote temporal flexibility". Related to this view are the findings of Bøler et al. (2018), who suggest that exporting industries are more likely to reward round-the-clock work due to the fact that firms need to communicate with costumers in different time zones. They find empirical evidence for their theory and show that the gender wage gap is three percentage points higher for exporting firms than import-competing firms.

Secondly, it is argued that 1980s trade liberalization led to a surge in technical change. To what extent trade promotes technical change is still subject to debate (e.g., Bloom & Van Reenen, 2016; Autor et al., 2017), but there is some evidence that trade can narrow the gender labor gap by inducing technological innovation. Juhn et al. (2014), for instance, show that a reduction in tariffs spurred computerization in some firms. This improved labor force participation and relative wages of female blue-collar workers by lowering the need for physically demanding skills. Black and Spitz-Oener (2010) also find a narrowing effect of technological progress on the gender wage gap, although they do not link this to international trade. These finding are consistent with the notion that women have a comparative advantage in 'brain'-based labor rather than 'brawn'-based labor. To this extent, Rendall (2017) shows that recent technical change has led to a demand shift in favor of 'brain-based' labor, thus benefiting women. Along these lines, Bacolod and Blum (2010) argue that an increase of the prices of cognitive skills, in which women possess a comparative advantage, is an important force behind the narrowing wage gap.

2.4 Gender wage inequality and the income distribution

There are well-documented differences in both the size and trend of the gender wage gap for different percentiles of the wage distribution. As will become evident in section 3.2, gender wage inequality is considerably higher for incomes at the top 10% of the income distribution than for those at the lower income percentiles. Furthermore, gender wage convergence has remained particularly stagnant for the ninth decile relative to lower income deciles. This

indicates that the forces driving the gender wage gap are not necessarily homogenous for different income percentiles. It seems possible that the effect of international trade on the gender wage gap might therefore also be dependent on the wage gap's relative position within the income distribution. For instance, the H-O theorem suggests that international trade can have varying effects on the owners of different production factors. Hence, if different income percentiles correspond to different production factors, international trade could affect the wage gap in each income percentile differently. Current academic literature remains largely silent on this issue, however.

Currently, the only empirical evidence in this regard comes from Sauré and Zoabi (2014). By testing an adapted H-O model, they find that trade liberalization actually widened the wage gap the most for high income percentiles. As the complementarity between female labor and capital is especially strong for high-skilled women, the dilution of capital resulting from a trade-induced inflow of male workers affected women at the top of the distribution disproportionally.

Secondly, Blau and Kahn (2017) argue that the lesser progress of women at the top of the income distribution since 2010 is likely partly the result of particularly intense gender discrimination for high-skilled labor; often labeled as the 'glass ceiling'. This is an interesting suggestion, because it implies, based on Becker's discrimination model, that firms employing especially high-skilled labor incur relatively large discrimination premiums. In contrast to Sauré and Zoabi (2014), trade liberalization would then theoretically lead to a particularly large decrease in the gender wage gap at the top income decile.

Lastly, a trade-induced demand shift from 'brawn' to 'brain'-intensive labor might disproportionately benefit women at the top of the wage distribution if high-paying labor is assumed to be relatively 'brain'-intensive. However, when combined with the fact that trade-induced technical change particularly promotes female labor productivity for physically demanding jobs, it is also possible that gender wage convergence is strongest at the bottom of the distribution. Juhn et al. (2014), for instance, show that trade-induced computerization benefited blue-coller workers, but they found no similar effects for white-collar workers.

In sum, applying the most common theories in literature thus gives an ambiguous answer to the question whether the effect of trade on gender relative wages varies along the income distribution.

3. Methodology and data

Based on the preceding theorization, it seems likely that international trade leads to a decrease in the gender wage gap, and an increase in FLFP. This provides a clear and testable hypothesis regarding the main research question of this paper: *international trade decreases the gender wage gap and improves FLFP*. Theoretical literature does not, however, provide a coherent hypothesis on whether the effect of trade on the gender wage gap differs along the income distribution. Using a fixed effects approach, this section will analyze whether this prediction holds on an aggregate level for a large selection of middle- to high income countries. Furthermore, this section will conduct separate regressions to analyze the differences in the effects of trade along the income distribution.

3.1 Data sources and definitions

This paper uses unbalanced panel data for all OECD countries, consisting of both high-income nations and a selection of (mostly Latin American) middle-income countries. For a full list of included countries, see table A3 in the appendix. The entire dataset covers 38 countries for the years 1960 to 2022, but due to the existence of large data gaps for some variables and for some countries, and to minimize noise, only data for the years 1995-2022 will be used during the analyses. During this period, data on all variables is present for all 38 countries with decent coverage. The only notable exception is Japan, for which data on non-tertiary educational attainment is missing. Furthermore, data availability on the various measures of the gender wage gap is somewhat limited, due to the fact that some countries' observations are biennial, are only present from the early 2000s onwards, or both.

Annual data on the gender wage gap measures and female labor force participation are borrowed from the OECD data warehouse. The gender wage gap is measured in percentages, and is defined as the difference between the earnings of men and women relative to the earnings of men. It is computed using full-time-equivalent hourly wages. Data is available for three different levels of the income distribution: at the first decile, at the median, and at the ninth decile. FLFP is defined as the percentage of women aged 15 to 64 that are either employed or actively seeking employment. The main independent variable of interest, trade openness, is sourced from the World Bank, and is proxied by the sum of imports and exports of goods and services measured as a percentage of GDP. Data on all other control variables, which will be discussed in section 3.4, come from the OECD's database. Data on France's union density rate for the years 2010-2019 are supplemented using ILOSTAT's unionization rate estimates.

3.2 Descriptive statistics

In anticipation of the succeeding analyses, it may be useful to examine the available data and to study the time trends that the gender wage gap and FLFP exhibit. Table 1 gives the aggregate descriptive statistics for all 38 countries included in the empirical analyses for the period 1995-2022. This table provides two striking observations. Most importantly, the gender wage gap seems to differ considerably for the various income deciles. At 22.6%, the average gender wage gap for the top 10% of the total wage distribution is considerably higher than those at the median (16%) and at the bottom decile (13.6%) of incomes. Secondly, the comparatively large standard deviations of most variables signify a strong heterogeneity both among countries and within countries over time. This heterogeneity is advantageous, as it provides a lot of useful variation for regression analysis.

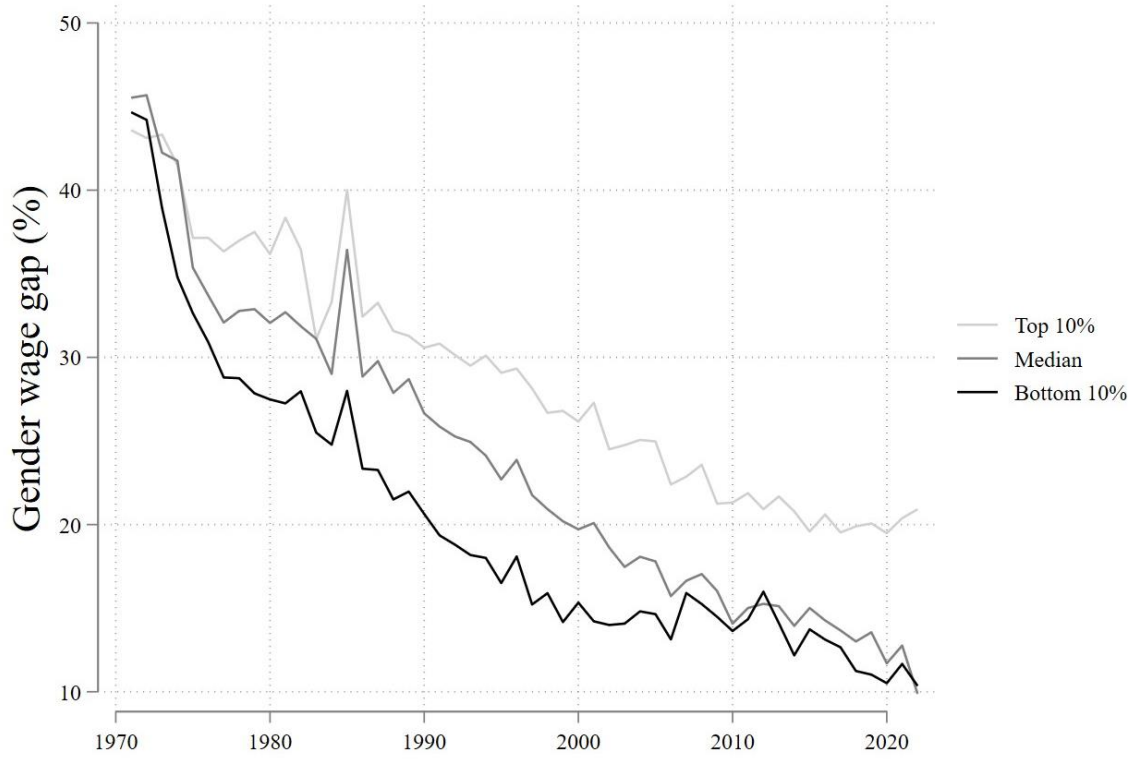
Table 1: Descriptive sample statistics

	Number of observations	**Mean (SD)**	**Min**	**Max**
Gender wage gap				
at the 1st decile	587	13.6 (8.7)	0.8	50.0
at the median	613	16.1 (8.2)	0.4	44.2
at the 9th decile	605	22.6 (8.0)	0.4	47.8
Female labor force participation	1041	53.2 (9.1)	23.3	77.6
Trade openness	1026	89.8 (52.7)	16.4	388.1
Female educational attainment rate				
ISCED 0-2	834	28.5 (19.0)	4.1	83.2
ISCED 3-4	835	41.0 (14.8)	8.5	74.6
ISCED 5-8	860	30.9 (12.8)	5.7	68.4
Services sector as a share of GDP	1034	68.8 (6.5)	45.6	88.1
Female unemployment rate	976	8.1 (4.6)	1.6	31.7
Union density	829	29.3 (21.2)	4.5	93.3
GDP per capita	1064	33,340 (18,361)	5,518	143,394

Notes: This table shows the descriptive aggregate statistics for all 38 countries for the years 1995-2022. All values are denoted in percentages, with the exception of GDP per capita, which is reported in USD. Means and standard deviations are computed using the overall data, so they do not distinguish between countries or years.

The differences of the gender wage gap among different income deciles are also clearly made visible in figure 1, which shows how all measures of the gender wage gap have experienced a similar downward trend since 1970. Women's relative wages have greatly risen during the last decades; more than a 30 percentage point decrease in the average gender wage gap from 1970 (45%) to 2022 (14%). This gender wage convergence seems to have slowed down considerably since 2010, however. As is also pointed out by Blau and Kahn (2017), the gender wage gap at the top of the income distribution has decreased much more slowly than those at the median and the bottom 10%. While the gender wage gap has converged for the latter two, the wage gap at the ninth decile has remained relatively stagnant since 2010 at an average of 20%. This wage gap is almost twice as large as those at the other two income deciles. If this asymmetry is partly the result of varying sensitivities of the gender wage gaps to external factors, then it seems plausible that the effect of trade should also differ along the income distribution. Furthermore, as will be discussed in section 3.3, figure 1 shows the importance of detrending the data to avoid spurious regression by using first-differenced variables.

Figure 1: Development of the gender wage gap

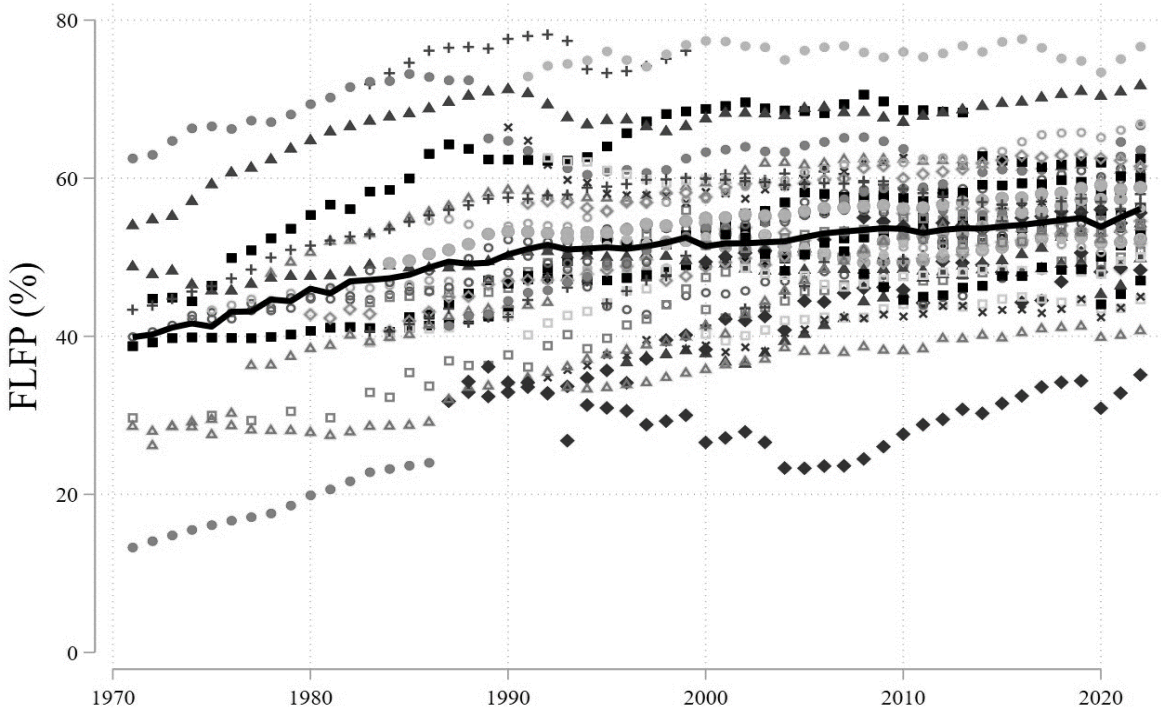


Notes: This graph shows the development of the gender wage gap for the years 1970-2022. The shaded lines each

reflect the gender wage gap at a certain decile of the income distribution. Note that data on the gender wage gap before 1990 is scarce, so the large fluctuations before this are the result of only a few individual country shocks.

Figure 2 shows how the average female labor force participation rate has gradually risen since at least the 1970s. As observed by Blau and Kahn (2008), the rise in FLFP is found to have been the strongest during the 1980s while the upward trend since 1990s has been modest at best. This trend in FLFP seems to have been relatively homogenous among countries, but there is no sign of any cross-country convergence. Together, this could indicate that (1) country-specific time-invariant variables are an important determinant of a country's female labor force, and (2) that trends exhibited by FLFP are largely driven by sources that affect all countries homogenously. Both of these observations are in favor of the country and time fixed effects approach employed in section 4. Again, the stochastic trend shown in figure 2 illustrates the importance of detrending the data to avoid spurious regression. This is also true for almost all independent variables, which exhibit similar trends during the time period analyzed in this study. Hence, as will be discussed more elaborately in section 3.3, only first-differenced values of all variables are used during the following regression analyses.

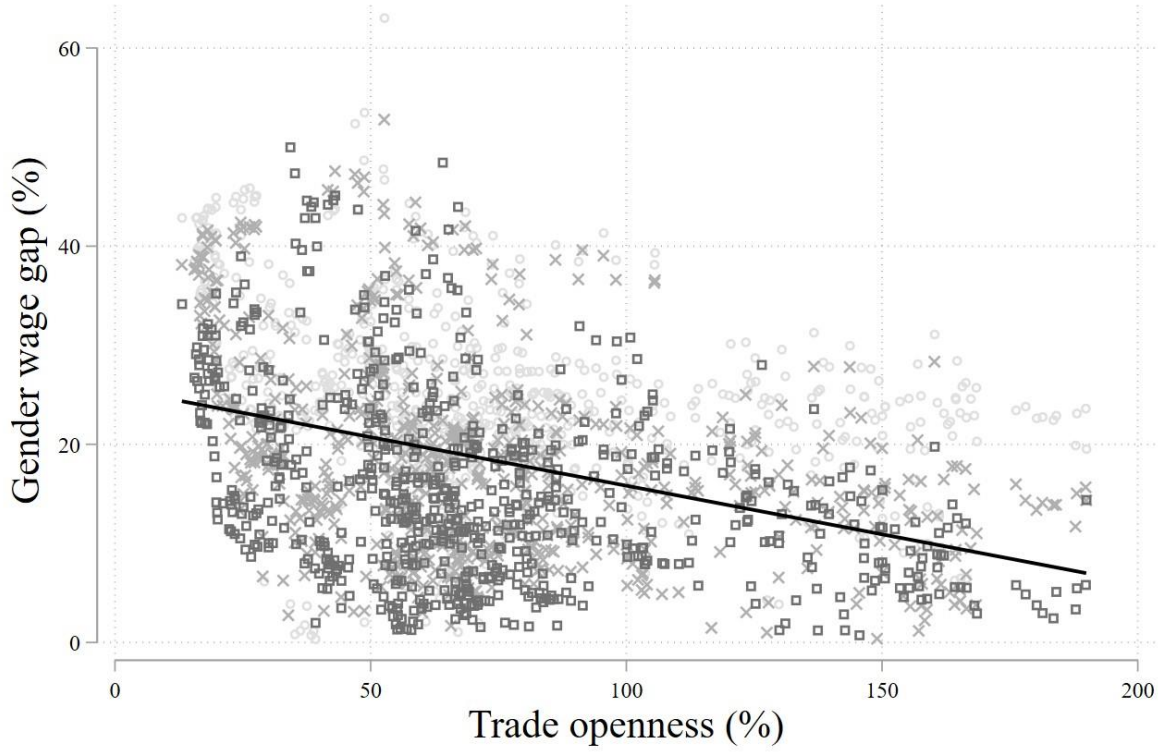
Figure 2: Development of mean female labor force participation



Notes: This figure shows the upward trend of female labor force participation in many countries for the period 1970-2022. Grayscale is used to denote individual country trends. The overall mean for FLFP in each year is emphasized in black.

To provide a preliminary view on the relationship between the gender wage gap and international trade, figure 3 plots all three gender wage measures against trade openness. Inspecting this figure yields two valuable observations. Firstly, consistent with economic theory, the data shows a negative relationship between the degree of trade openness and all measure of the wage gap. Secondly, this relationship seems to be the same for all measures of the gender wage gap. However, this negative pattern is not completely evident, suggesting that there are many other factors besides international trade that could likely affect the gender wage gap. The data is also somewhat suggestive of a nonlinear relationship between trade and the gender wage gap. However, this is the result of between-country variation, as individual countries generally display a linear negative link between both variables. Taken together, this preliminary investigation is modestly supportive of the hypothesis that trade narrows the gender wage gap.

Figure 3: Trade openness and the gender wage gap

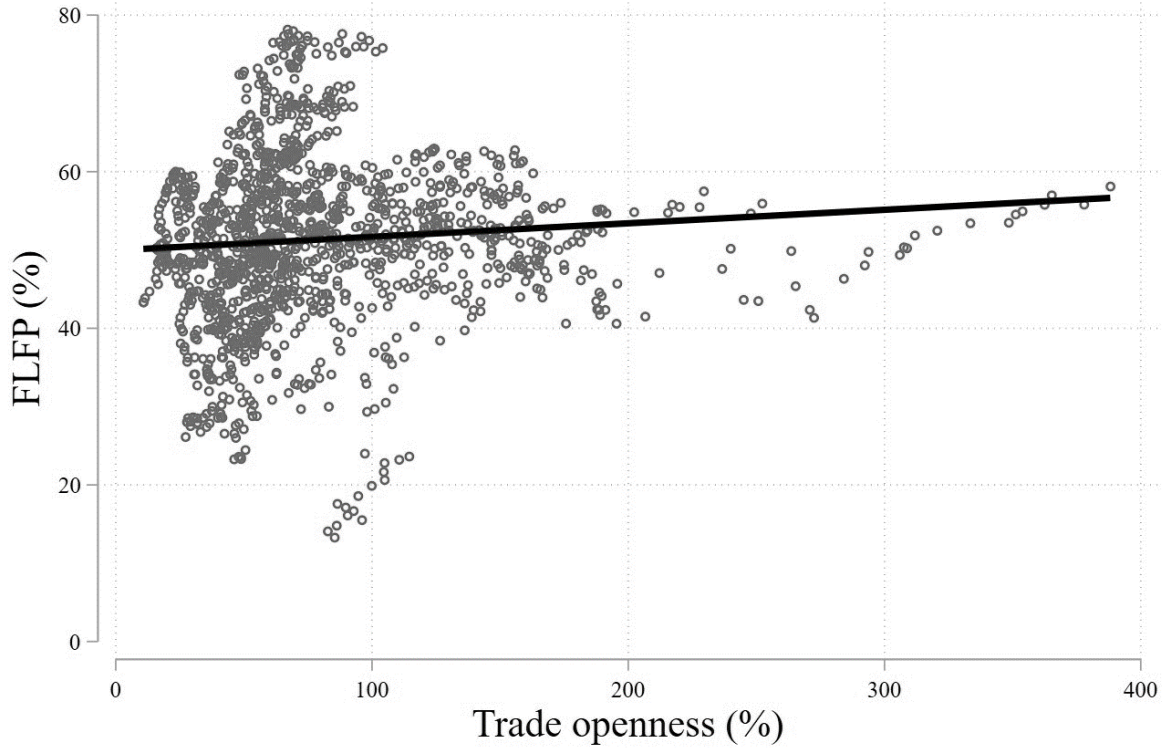


Notes: This graph shows the relationship between all three measures of the gender wage gap and trade openness. The various wage gap measures are differentiated using grayscale. An OLS regression line is superimposed on the figure indicating the general relationship between all three measures and trade. Note that a handful of data points beyond 200% trade openness have been omitted to keep the graph comprehensive.

Similarly, figure 4 reports the relationship between FLFP and trade openness. The upward slope implies that, as international trade increases relative to GDP, FLFP is expected to

rise. However, similar to the gender wage gap, this relationship does not seem particularly clear. Nonetheless, this figure supports the hypothesis that international trade promotes FLFP.

Figure 4: Female labor force participation and the gender wage gap



Notes: This graph shows the relationship between female labor force participation and trade openness. An OLS regression line is superimposed on the figure indicating the general relationship between both variables. Note that the cluster of high FLFP countries below 100% trade openness consists entirely of Scandinavian countries.

3.3 Methodology

To estimate the effect of trade openness on FLFP and the gender wage gap for all three income deciles, country and year fixed effects is used. In total, four separate country and year fixed effects models are estimated. An attractive feature of this approach is that it inherently controls for (un)observable time-invariant country-specific confounders. This is essential in the context of gender inequality, as there are many country-specific characteristics, e.g. religion and cultural norms, that are likely to influence the results and are fairly constant over time. Data availability on these types of variables is often limited or non-existent, while the omission of these characteristics would lead to biased results. The additional inclusion of time fixed effects means that also time-varying effects are implicitly controlled for, insofar as these effects are the same for all countries. This is, again, crucial for two reasons. Firstly, as discussed in section 2.3, time fixed effects accounts for the homogenous shift toward gender labor equality that was

brought about by technical change and a supply-side push toward labor market deregulation. Secondly, it also implicitly controls for the effects of international gender equality conventions and other transnational efforts to reduce the gender labor gap. These international efforts are meant to streamline progress toward gender equality and can therefore be expected to have a homogenous effect on the gender labor gap in participating countries over time.

This paper aims to evaluate the impact of trade on both the gender wage gap and FLFP, so there are two general empirical models that need to be estimated. Equation (1) shows the model used to estimate the effect of trade openness on female labor force participation:

$$FLFP_{it} = \alpha_i + \beta_1 Trade_{it} + \beta_2 GWG_{it} + \beta_3 X_{it} + \lambda_t + \varepsilon_{it}\ , \qquad (1)$$

where α_i and λ_t are the country and year fixed effects, respectively, and ε_{it} is the error term. β_1 is the country-demeaned estimate of the direct effect of trade openness on FLFP, and is hence the coefficient of interest in this model. X_{it} is a vector of country-specific time-varying control variables. The gender wage gap (GWG) at the median is separately added into the model to control for possible endogeneity at the cost of a drastically reduced sample size. However, the inclusion of the gender wage gap might also introduce bias itself, as it can be regarded as a mechanism through which international trade affects FLFP.

Similarly, equation (2) gives the generalized empirical model used to estimate the effect of trade on the gender wage gap:

$$GWG_{itd} = \alpha_i + \beta_4 Trade_{it} + \beta_5 X_{it} + \lambda_t + \varepsilon_{it}\ , \qquad (2)$$

where, out of simplicity, subscript d represents for which income decile the model is estimated. Equivalently, β_4 is the coefficient of interest as it reflects the effect of trade on the gender wage gap. FLFP is not included as an independent variable in this model, due to concerns of reversed causality.

Lastly, to correct for the stochastic trends governing the data, as illustrated by figures 1 and 2, both models will use the first-differenced values of all variables. This detrends the data and thus prevents biased results due to spurious regression. Without detrending the data, model estimations may find significant results that are likely driven by simultaneous trends rather than actual causal effect. However, one caveat of this approach is that it substantially limits the sample size as a result of missing values.

3.4 Control variables

Despite using panel fixed effects, there are still many time-varying country-specific confounders that need to be included in the model to obtain reliable results. Failure to include these variables will likely lead to an under- or overestimation of the trade coefficients in equations (1) and (2) due to omitted variable bias.

Most importantly, female labor productivity is an important determinant of the gender labor gap in multiple ways. Neoclassical economics – and the Heckscher-Ohlin model – posit that wages are equal to the value of a laborer's marginal productivity. Hence, when productivity rises, wages are expected to rise. Higher relative productivity will also likely be translated into a higher demand for female labor, which can incentivize FLFP. Furthermore, a more productive female labor force may also affect a country's comparative advantage, and consequently its patterns of trade if the export sector is more female-labor-intensive or vice versa. In this regard, Busse and Spielmann (2006) find that the gender wage gap is positively associated with a comparative advantage in labor-intensive goods. To account for this, and in accordance with the related literature, female labor productivity is proxied for by including female educational attainment rates into the empirical models.

Another important source of the gender labor gap is the size of the service industry relative to its total output. It is often argued that women have a comparative advantage in jobs associated with the service sector (e.g., Olivetti & Petrongolo, 2016), so an expansion of the service industry is likely to increase FLFP. For example, Heath and Jayachandran (2017) show that this has been the case in recent years for most developing countries. This assumption is based on the notion that, due to physiological differences between both genders, men have an absolute advantage in 'brawn'-based skills, but that 'brain'-related capabilities are the same for both genders. Based on this idea, a relatively larger service sector will thus also narrow the gender wage gap by making women relatively more productive compared to men. Moreover, the services sector is less likely to be negatively impacted by trade compared to the manufacturing industry in most developed countries. Hence, an expanding service sector might mitigate trade-induced wage cuts for female workers if it induces relatively more women to migrate to the services industry. The growing importance of the service sector in most high-income countries might also affect international trade patterns and volume of trade due to the fact that services are gradually becoming increasingly tradable (Spatafora et al., 2012).

A third variable that needs to be considered is the female unemployment rate. Namely, a large unemployment rate could inhibit women's ability to negotiate higher wages. In this

context, Heath and Jayachandran (2017) argue that a tight labor market for female labor strengthens women's bargaining power by improving their outside options. Using similar reasoning, the unionization rate should also be accounted for in both models. The positive effect of unionization on women's relative wages are illustrated by Blau and Kahn (2017), who reason that union-negotiated wage floors can decrease the gender pay gap even if these union agreements are not gender-specific. On the other hand, because of these high wage floors, a high unionization rate is likely to increase female unemployment and discourage FLFP. Both of these variables can also affect international trade patterns by increasing unit labor costs, and consequently a country's comparative advantage.

Lastly, there is a distinctive relationship between GDP and FLFP. Namely, it is often documented that FLFP is U-shaped in development (e.g., Goldin, 1995). As GDP increases, either comparatively between countries or for a single country over time, FLFP is expected to fall during the transition from low to middle income status, and to rebound when reaching high-income status. This is the result of microeconomic household decisions. As a country progresses into middle-income status, labor tends to shift from agriculture to the manufacturing industry. This discourages FLFP due to the existence of social stigma, the lesser dependence on dual incomes, and the fact that manufacturing jobs are often harder to combine with household production. As the country proceeds into high-income territory, however, the increased importance of light manufacturing and services will lead to an upward swing in FLFP through a strong substitution effect. Apart from the gender pay gap, GDP is also a well-known determinant of international trade, as corroborated by its function as the basis of the gravity model of trade (Tinbergen, 1962). Furthermore, GDP has direct computational relevance for trade openness, which is measured as the value of trade divided by GDP.

An important caveat with the inclusion of these control variables is the risk of simultaneity. For example, if a narrowing wage gap reflects improved labor market opportunities for female workers, women might be incentivized to invest in their education as the returns to human capital increase. Similarly, if female relative wages rise, this might induce more women to enter the labor market, which could tighten the labor market and increase the female unemployment rate. Lastly, it is also likely that GDP increases with FLFP, as a larger labor force will naturally be materialized into higher output. Moreover, it could be argued that some of these control variables are mechanisms or colliders. For instance, if trade leads to economic growth, and GDP affects FLFP through their U-shaped relationship, GDP is a mechanism and should not be controlled for. This is because controlling for GDP introduces

bias that was not there before. An instrumental variable approach could be adopted to avoid many of these issues, but, unfortunately, this goes beyond of the scope of this paper.

4. Results

This section presents and discusses the results of the country and time fixed effects estimation of the FLFP and gender wage gap models discussed in the previous section. This section will further provide intuition by discussing the economics behind the results and interpreting relevant coefficients

4.1 FLFP regression results

The first part of this analysis focuses on the effect of trade openness on FLFP as modeled by equation (1). The results are reported in table 2. Model (1) only applies country fixed effects and is hence likely to suffer from omitted variable bias. However, it profits from a relatively large sample size compared to the other two models due to the fact that it is not affected by some control variable's missing observations. Furthermore, it does not suffer from any of the endogeneity issues that plague many of the control variables. Models (2) and (3) add control variables and year fixed effects, respectively. Note that female unemployment rate is lagged by one year to prevent obvious simultaneity. Contrary to the hypothesis that international trade promotes FLFP, the sign of the trade openness measure is negative in all three models. Surprisingly, the coefficients for trade openness together suggest that a percentage point increase in trade openness is associated with a 0.01 – 0.02 percentage point decrease in FLFP. Interestingly, statistical significance disappears with the addition of control variables and reappears with the inclusion of year fixed effects. This could indicate that omitted variable bias is driving the results of models (1) and (2). Finally, model (4) also includes the gender wage gap as an independent variable. This aims to further reduce omitted variable bias, as a narrow gender wage gap may incentivize FLFP as a result of less (perceived) labor market discrimination (Jones et al., 2015). Statistical significance is lost with the addition of the gender wage gap. However, there is likely strong simultaneity between FLFP and the gender wage gap; as FLFP rises, the relative supply of female labor will increase and relative wages will naturally fall. The gender wage gap may also function as a mechanism through which trade affects FLFP, so including it as a control variable introduces bias. Furthermore, the sample size is drastically lower in model (4). Hence, model (3) is arguably the most appropriate.

Thus, focusing on model (3), the results show a significant negative relationship between trade and FLFP ($p = 0.06$). This finding is perhaps the most important result of this

paper, as it suggests – but certainly does not prove – that international trade can significantly decrease FLFP. However, due to the endogeneity issues discussed in section 4.3, it is not possible to interpret this as a causal relationship. Nonetheless, this significant negative relationship is a compelling result, as it is inconsistent with most theoretical literature. Empirical literature, on the other hand, gives at least two possible explanations for this counterintuitive result. Firstly, Sauré and Zoabi (2014) show that a trade-induced expansion of the female-labor-intensive export industry may prompt a cross-sector migration of male workers. As the export industry in most high-income countries is capital-intensive, the result of this influx is a dilution of capital. As female workers are assumed to have a relatively high complementarity with capital, this inflow of male workers decreases the relative marginal productivity of women. As a result, women's relative wages decline, the wage gap increases, and FLFP declines. Another possible explanation comes from Berik et al. (2004), who found that trade might increase gender discrimination by worsening women's employment prospects. If women are segregated into jobs that are characterized by low bargaining power, employers may exploit their stronger negotiating position to better satisfy their tastes for discrimination. This increased discrimination may discourage women from entering the labor force.

Despite its statistical significance, this negative relationship is quantitatively small; to offset the average sample increase in FLFP over the last 20 years (5%), trade openness has to increase by an unrealistic 250 percentage points. The importance of other factors that explain gender wage inequality is also signified by the reported R^2, which shows that model (3) only accounts for approximately 10 percent of the within-country variation in FLFP.

Table 2: FLFP regression results

	Country fixed effects (1)	**Country FE with added controls (2)**	**Complete model with time FE (3)**	**Complete model with GWG (4)**
Trade openness	-0.02**	-0.01	-0.02*	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Female education				
ISCED 0-2		0.00	0.02	-0.01
		(0.06)	(0.05)	(0.05)
ISCED 5-8		0.05	0.03	0.04
		(0.08)	(0.07)	(0.06)
Services		0.05	0.02	-0.04

		(0.05)	(0.05)	(0.09)
Female unemployment		-0.08	-0.07	-0.11
		(0.06)	(0.06)	(0.13)
Union density		-0.03	-0.01	-0.04
		(0.03)	(0.03)	(0.13)
GDP per capita		0.00**	0.00	0.00
		(0.00)	(0.00)	(0.00)
Gender wage gap				0.02
				(0.03)
Year fixed effects	No	No	Yes	Yes
Constant term	0.20***	-0.04	0.58**	0.06
	(0.01)	(0.10)	(0.25)	(0.39)
R^2	0.01	0.03	0.10	0.15
Number of observations	994	541	541	302

Notes: This table reports the results of country- and time fixed effects regression analysis for FLFP. Clustered standard errors are reported between brackets. All of the independent variables, except GDP per capita, year fixed effects and the constant term, are denoted in percentages, which means that the coefficients are interpreted as the percentage point increase in the gender wage gap corresponding to a percentage point increase in the independent variable. Also note that the female unemployment rate variable is lagged by one year. R^2 reflects how much of the within- country variation is explained by the model. * indicates $p < 0.1$, ** indicates $p < 0.05$, and *** indicates $p < 0.01$.

4.2 Gender wage gap regression results

The second half of this analysis focuses on the effect of trade openness on the various measures of the gender wage gap as modeled by equation (2). Table 3 reports the model estimation results for the gender wage gap at the first decile, the median, and the ninth decile, respectively. For the sake of brevity, only the equivalent of table 2's model (3) are reported for each of the wage gap measures. See tables A1 and A2 in the appendix for the results of the incomplete model estimations. Consistent with economic literature, the trade openness coefficients are negative for all three measures. This implies that the gender wage gap is expected to narrow during a period of trade liberalization. Interestingly, this negative relationship is strongest for the gender wage gap at the top of the wage distribution. This is in stark contrast to the results of Sauré and Zoabi (2014), who found that international trade actually widened the wage gap the most for high income percentiles in the U.S. following NAFTA. It is, however, consistent with the notion of particularly intense gender discrimination at the top of the wage distribution (Blau & Kahn, 2017), and a potential trade-induced demand shift from 'brawn' to 'brain'-intensive labor as

discussed in section 2.4. The relationship remains modest in magnitude; to close the ninth decile gender wage gap in the sample in 2022 (10.4%), trade openness has to increase by more than 170 percentage points. More importantly, however, is the loss of statistical significance when controlling for confounders and time-fixed effects for all deciles of the wage gap. This plausibly indicates that omitted variable bias is driving the initially significant results. This statistical insignificance can also be the result of strong heterogenous effects of international trade on the gender wage gap, as is illustrated by the mixed results obtained by previous papers. Based on these results, there is therefore no evidence that international trade significantly narrows the gender wage gap, irrespective of its relative position in the income distribution. Even if the trade openness coefficients were significant, endogeneity concerns would prohibit causal inference. This is partly because there are still (un)observable confounders affecting FLFP and trade openness that are not accounted for. The relatively low R^2 for all models also indicates that there are many more variables driving FLFP besides those that are included in the model, although it does not say anything about the appropriability of causal inference.

It seems difficult to reconcile the results of table 3 with the previous finding that trade is negatively related to FLFP. For instance, if trade is assumed to increase women's relative wages, FLFP is expected to rise rather than to decrease. Therefore, the question arises through which other causal pathways trade affects FLFP other than through female relative wages. It can be guessed that there are at least three reasons for this discrepancy. Firstly, trade might negatively affect wages of both men and women in some sectors, but it may have a disproportionally adverse effect on men. These lower wages may thus discourage FLFP while narrowing the gender wage gap at the same time. Some evidence for this comes from Brussevich (2018), who finds that male manufacturing workers experience higher trade-induced wage losses compared to women as a result of heterogenous mobility costs. Secondly, trade may increase female relative wages, but it may also discourage FLFP by worsening women's quality of employment. Besedeš et al. (2021), for instance, find a narrowing effect of trade on the gender wage gap, but also an increased reliance of female workers on part-time jobs. Lastly, if trade decreases the relative supply of female labor through its effect on FLFP, women's relative wages may increase as a natural result if male and female labor are assumed to be imperfect substitutes.

Table 3: Gender wage gap regression results

	GWG at the 1st decile (1)	GWG at the median (2)	GWG at the 9th decile (3)
Trade openness	-0.02	-0.00	-0.06
	(0.03)	(0.03)	(0.04)
Female education			
ISCED 0-2	-0.13	0.10	0.05
	(0.14)	(0.13)	(0.09)
ISCED 5-8	-0.08	0.08	0.23**
	(0.26)	(0.21)	(0.11)
Services	0.16	0.08	-0.08
	(0.17)	(0.12)	(0.13)
Female unemployment	-0.26	-0.08	-0.01
	(0.26)	(0.09)	(0.19)
Union density	-0.38*	-0.39**	-0.50**
	(0.20)	(0.16)	(0.21)
GDP per capita	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)
Year fixed effects	Yes	Yes	Yes
Constant term	-1.61	-1.30***	-0.10
	(1.03)	(0.45)	(1.69)
R^2	0.09	0.12	0.15
Number of observations	302	304	298

Notes: This table reports the results of country- and time fixed effects regression analysis for various measures of the gender wage gap. Clustered standard errors are reported between brackets. All of the independent variables, except GDP per capita, year fixed effects and the constant term, are denoted in percentages, which means that the coefficients are interpreted as the percentage point increase in the gender wage gap corresponding to a percentage point increase in the independent variable. The constant term is indicative of the average negative trend exhibited by countries in the sample. Note that Greece has been omitted in this analysis, due to the fact that its complete data was limited to one year only. R^2 reflects how much of the within- country variation is explained by the model.
* indicates $p < 0.1$, ** indicates $p < 0.05$, and *** indicates $p < 0.01$.

4.3 Methodological limitations and bias

The results of the preceding analyses cannot be interpreted as causal effect due to the existence of a variety of underlying issues. Perhaps most importantly, despite controlling for a large number of (un)observable confounders, omitted variable bias cannot be ruled out. Other variables, like industry concentration (Berik et al., 2004), are likely to act as confounders, but are omitted in all of the preceding models. Also, the possibility of cross-country dependence cannot be rejected. Furthermore, female productivity – arguably the most important determinant of the gender labor gap – is very crudely proxied by female educational attainment rates. This can be improved upon by adopting more sophisticated decomposition techniques such as Mincer and Polachek (1974), and by including a greater amount of productivity-related characteristics in the model, like potential work experience.

Moreover, nonrandom selection effects are likely to play an important role in determining the gender labor gap, as the data only reflects those women that have actually chosen to join the labor force. Selection effects are especially important with regard to female labor, as a comparatively low FLFP means that only a relatively small portion of the entire female working age population is used to compute the gender wage gap. This limits external validity, because the wage gap could be different for women that are currently not part of the labor force. As emphasized by Kunze (2017), the composition of the female labor force may also differ both between countries and within a country over time. The preceding analyses do not take this into account, however, despite making use of cross-country panel data.

Furthermore, apart from omitted variable bias, and simultaneity bias as discussed in section 3.4, internal validity is further limited by strong multicollinearity between independent variables. Most obviously, trade and GDP per capita are positively correlated due to fact that GDP is an explicit computational determinant of trade openness. More subtly, union density and female unemployment are likely to be positively related, as union-negotiated wage increases naturally decrease the demand for labor.

Lastly, due to limited data availability, some countries have few complete observations that are included in the analysis. This shortage of data is further exacerbated by the use of first differences to detrend the data. Missing observations in the dataset prevent the computation of first differences, thus creating even more missing values. The total amount of observations is therefore limited in relation to the amount of countries that are included. More sophisticated detrending methods or the use of a dynamic panel regression could possibly fix this issue.

5. Conclusion

This study tries to estimate the effect of international trade on FLFP and the gender wage gap. To do this, country and year fixed effects regression analysis is used. In addition, this paper analyzes how the relationship between trade and the gender wage gap varies for different percentiles of the income distribution. Theoretical literature generally suggests a narrowing effect of trade on the gender gap in wages and labor force participation, but empirical literature shows mixed results. Consistent with economic theory, this study finds a negative relationship between trade openness and the gender wage gap at various deciles of the income distribution. However, this relationship is statistically insignificant and cannot be interpreted as a causal effect due to several methodological limitations. Most notably, omitted variable bias is likely to influence these results. There is therefore no evidence for the hypothesis that international trade narrows the gender wage gap. This result does not differ depending on the wage gap's relative position in the income distribution. In contrast, contrary to the hypothesis that international trade promotes female labor force participation, this paper finds a significant negative relationship between female labor force participation and international trade. Once again, however, methodological limitations prevent causal inference. Nonetheless, this is a compelling result, because there is currently little economic literature available that can explicitly explain why trade should discourage female labor force participation. One possible explanation comes from Sauré and Zoabi (2014), who argue that a trade-induced expansion of the female-labor-intensive export industry leads to an influx of male workers. The resulting dilution of capital disproportionally affects women, who are assumed to have a relatively high complementarity with capital. Consequently, female workers are pushed out of the market as women's relative productivity declines. Alternatively, Berik et al. (2004) argue that international trade may exacerbate gender discrimination by worsening women's employment prospects. This increased discrimination may discourage women from entering the labor force and thus discourages FLFP.

Based on the results of this study, the question arises through which other mechanisms trade affects FLFP other than through female relative wages. Further research is needed to properly investigate this issue. This future research could further expand on this study by using instrumental variables to avoid many of the methodological limitations of this paper, or by identifying the causal pathways through which trade affects the gender labor gap. Arguably the largest obstacle for any study that analyzes the gender wage gap is the lack of frequent and reliable data for most countries. For instance, data on the gender wage gap for most low-income

countries is either obtained using crude estimates, or is missing altogether. To make continued progress on the topic of gender income equality, further efforts to obtain reliable data is crucial. Lastly, while it is tempting to derive policy implications from the results of this paper, statistical limitations prohibits doing so. Furthermore, this paper does not in any way investigate the effect of trade on job quality or female welfare. Therefore, if it could be concluded that international trade favors women, the question remains in what way it also improves women's welfare.

References

Antràs, P. (2020) *De-globalisation? Global value chains in the post-COVID-19 age*. NBER Working Paper No. 28115. https://doi.org/10.3386/w28115

Artecona, R. & Cunningham, W. (2002). *Effects of trade liberalization on the gender wage gap in Mexico*. Policy research report on gender and development working paper series no. 21, World Bank.

Autor, D., Dorn, D., Hanson, G.H., Pisano, G. & Shu, P. (2020). Foreign Competition and Domestic Innovation: Evidence from US Patents. *American Economic Review: Insights*, *2*(3), 357-74. https://doi.org/10.1257/aeri.20180481

Bacolod, P.M. & Blum, B.S. (2010). Two Sides of the Same Coin: U.S. "Residual" Inequality and the Gender Gap. The Journal of Human Resources, 45(1), 197–242. https://doi.org/10.3368/jhr.45.1.197

Becker, G. S. (1971). The Economics of Discrimination. Chicago: University of Chicago Press.

Berik, G., Rodgers, Y. & Zveglich, J. E. (2004). International Trade and Gender Wage Discrimination: Evidence from East Asia. Review of Development Economics, 8(2), 237-254. https://doi.org/10.1111/j.1467-9361.2004.00230.x

Besedeš, T., Lee, S.H. & Yang, T. (2021). Trade liberalization and gender gaps in local labor market outcomes: Dimensions of adjustment in the United States. Journal of Economic Behavior & Organization, 183, 574-588. https://doi.org/10.1016/j.jebo.2020.12.020

Black, S.E. & Brainerd, E. (2004). Importing Equality? The Impact of Globalization on Gender Discrimination. Industrial and Labor Relations Review, 57(4), 540-559. https://doi.org/10.2307/4126682

Black, S.E. & Spitz-Oener, A. (2010). Explaining Women's Succes: Technological Change and the Skill Cotent of Women's Work. The Review of Economics and Statistics, 92(1), 187-194. https://doi.org/10.1162/rest.2009.11761

Black, S.E. & Strahan, P.E. (2001). The Division of Spoils: Rent-Sharing and Discrimination in a Regulated Industry. American Economic Review, 91(4), 814-831. http://dx.doi.org/10.1257/aer.91.4.814

Blau, F.D. & Kahn, L.M. (2008). Women's Work and Wages. In S.N. Durlauf & L.E. Blume (Eds.), The New Palgrave Dictionary of Economics: second edition (pp. 762-772). London: Palgrave Macmillan. https://doi.org/10.1057/978-1-349-95121-5_2207-1

Blau, F.D., & Kahn, L.M. (2017). The Gender Wage Gap: Extent, Trends, and Explanations. Journal of Economic Literature, 55(3), 789–865. https://doi.org/10.1257/jel.20160995

Bloom, N. Draca, M. & Reenen, J. van. (2016). Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity. *The Review of Economic Studies*, *83*(1), 87-117. https://doi.org/10.1093/restud/rdv039

Bøler, E.A., Javorcik, B. & Ulltveit-Moe, K.H. (2018). Working across time zones: Exporters and the gender wage gap. Journal of International Economics, 111, 122-133. https://doi.org/10.1016/j.jinteco.2017.12.008

Brussevich, M. (2018). Does trade liberalization narrow the gender wage gap? The role of sectoral mobility. European Economic Review, 109, 305-333. https://doi.org/10.1016/j.euroecorev.2018.02.007

Busse, M. & Spielmann, C. (2006). Gender Inequality and Trade. Review of International Economics, 14(3), 362-379. https://doi.org/10.1111/j.1467-9396.2006.00589.x

Chancel, L., Piketty, T., Saez, E. & Zucman, G. (2022). World inequality report 2022, World Inequality Lab.

Cingano, F. (2014). *Trends in Income Inequality and its Impact on Economic Growth*. Social, Employment and Migration Working Papers No. 163, OECD. https://dx.doi.org/10.1787/5jxrjncwxv6j-en

Dang, H.H. & Nguyen, C.V. (2021). Gender inequality during the COVID-19 pandemic: Income, expenditure, savings, and job loss. *World Development*, *140*. https://doi.org/10.1016/j.worlddev.2020.105296

Ederington, J., Minier, J. & Troske, K.R. (2009). Where the Girls are: Trade and Labor Market Segregation in Colombia. IZA Discussion Paper No. 4131, IZA Institute of Labor Economics. https://dx.doi.org/10.2139/ssrn.1395078

Goldin, C. (1995). The U-Shaped Female Labor Force Function in Economic Development and Economic History. In P. Schultz (ed), Investment in Women's Human Capital and Economic Development (pp. 61-90). Chicago: University of Chicago Press.

Goldin, C. (2014). A Grand Gender Convergence: Its Last Chapter. American Economic Review, 104(4), 1091-1119. http://dx.doi.org/10.1257/aer.104.4.1091

Heath, R. & Jayachandran, S. (2017). The Causes and Consequences of Increased Female Education and Labor Force Participation in Developing Countries. In S.L. Averett, L.M. Argys & S.D. Hoffman (eds), The Oxford Handbook of Women and the Economy (pp. 345-368). New York: Oxford University Press. https://doi-org.eur.idm.oclc.org/10.1093/oxfordhb/9780190628963.013.10

Jones, L.E., Manuelli, R.E. & McGrattan, E.R. (2015). Why are married women working so much? *Journal of Demographic Economics*, *81*(1), 75-114. https://doi.org/10.1017/dem.2014.7

Juhn, C., Ujhelyi, G. & Villegas-Sanchez, C. (2014). Men, women, and machines: How trade impacts gender inequality. Journal of Development Economics, 106, 179-193. https://doi.org/10.1016/j.jdeveco.2013.09.009

Kunze, A. (2017). The Gender Wage Gap in Developed Countries. In S.L. Averett, L.M. Argys & S.D. Hoffman (eds), The Oxford Handbook of Women and the Economy (pp. 369-394). New York: Oxford University Press. https://doi-org.eur.idm.oclc.org/10.1093/oxfordhb/9780190628963.013.11

Mansour, H., Medina, P. & Velásquez, A. (2022). Import competition and gender differences in labor reallocation. Labour Economics, 76, 1-14. https://doi.org/10.1016/j.labeco.2022.102149

Mincer, J. & Polachek, S. (1974). Family Investments in Human Capital: Earnings of Women. In T.W. Schultz (ed), Marriage, Family, Human Capital, and Fertility (pp. 76-110). Chicago: The University of Chicago Press. https://doi.org/10.1086/260293

Olivetti, C. & Petrongolo, B. (2016). The Evolution of Gender Gaps in Industrialized Countries. Annual Review of Economics, 8, 405-434. https://doi.org/10.1146/annurev-economics-080614-115329

Polachek, S. W. (2008). Earnings Over the Life Cycle: The Mincer Earnings Function and Its Applications. Foundations and Trends in Microeconomics, 4(3), 165-272. http://dx.doi.org/10.1561/0700000018

Rendall, M.P. (2017). *Brain versus Brawn: The Realization of Women's Comparative Advantage*. IEW Working Paper No. 491, Institute for Empirical Research in Economics University of Zurich. https://dx.doi.org/10.2139/ssrn.1635251

Rocha, N. & Winkler, D. (2019). *Trade and Female Labor Participation: Stylized Facts Using a Global Dataset*. Policy Research Working Paper No. 9098, World Bank. http://dx.doi.org/10.1596/1813-9450-9098

Sauré, P. & Zoabi, H. (2014). International trade, the gender wage gap and female labor force participation. Journal of Development Economics, 111, 17-33. https://doi.org/10.1016/j.jdeveco.2014.07.003

Spatafora, N., Anand, R. & Mishra, S. (2012). *Structural Transformation and the sophistication of Production.* IMF Working Paper No. 59, International Monetary Fund. http://dx.doi.org/10.5089/9781463937775.001

Standing, G. (1989). Global Feminization through Flexible Labor. World Development, 17(7), 1077-1095. https://doi.org/10.1016/0305-750X(89)90170-8

Standing, G. (1999). Global Feminization Through Flexible Labor: A Theme Revisited. World Development, 27(3), 583-602. https://doi.org/10.1016/S0305-750X(98)00151-X

Tinbergen, J. (1962). Shaping the world economy; suggestions for an international economic policy. New York: The Twentieth Century Fund.

Voitchovsky, S. (2005). Does the Profile of Income Inequality Matter for Economic Growth? *Journal of Economic Growth*, *10*(3), 273–296. https://doi.org/10.1007/s10887-005-3535-3

Appendix

Table A1: Gender wage gap regression results without any control variables

	GWG at the 1st decile (1)	**GWG at the median (2)**	**GWG at the 9th decile (3)**
Trade openness	0.03	0.02**	0.02*
	(0.03)	(0.01)	(0.01)
Control variables	No	No	No
Year fixed effects	No	No	No
Constant term	-0.39***	-0.34***	-0.35***
	(0.02)	(0.01)	(0.01)
R^2	0.00	0.01	0.00
Number of observations	470	491	474

Notes: This table reports the results of country fixed effects regression analysis for various measures of the gender wage gap without the inclusion of any controls or time fixed effects. Clustered standard errors are reported between brackets. All of the independent variables, except GDP per capita, year fixed effects and the constant term, are denoted in percentages, which means that the coefficients are interpreted as the percentage point increase in the gender wage gap corresponding to a percentage point increase in the independent variable. Note that Greece has been omitted in this analysis, due to the fact that its complete data was limited to one year only. R^2 reflects how much of the within- country variation is explained by the model. * indicates $p < 0.1$, ** indicates $p < 0.05$, and *** indicates $p < 0.01$.

Table A2: Gender wage gap regression results without time fixed effects

	GWG at the 1st decile (1)	GWG at the median (2)	GWG at the 9th decile (3)
Trade openness	0.01	0.00	-0.01
	(0.02)	(0.02)	(0.02)
Educational attainment %			
ISCED 0-2	-0.10	0.13	0.07
	(0.14)	(0.11)	(0.09)
ISCED 5-8	-0.07	0.07	0.18*
	(0.26)	(0.17)	(0.10)
Services	0.07	0.07	-0.13
	(0.17)	(0.14)	(0.19)
Female unemployment	-0.42*	-0.10	-0.10
	(0.21)	(0.08)	(0.09)
Union density	-0.34	-0.38**	-0.50**
	(0.21)	(0.17)	(0.22)
GDP per capita	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)
Gender wage gap	No	No	No
Year fixed effects	No	No	No
Constant term	-0.61*	-0.55*	-0.53**
	(0.31)	(0.28)	(0.23)
R^2	0.04	0.05	0.04
Number of observations	302	304	298

Notes: This table reports the results of country fixed effects regression analysis for various measures of the gender wage gap without time fixed effects. Clustered standard errors are reported between brackets. All of the independent variables, except GDP per capita, year fixed effects and the constant term, are denoted in percentages, which means that the coefficients are interpreted as the percentage point increase in the gender wage gap corresponding to a percentage point increase in the independent variable. Note that Greece has been omitted in this analysis, due to the fact that complete data was limited to one year only. R^2 reflects how much of the within-country variation is explained by the model. * indicates $p < 0.1$, ** indicates $p < 0.05$, and *** indicates $p < 0.01$.

Table A3: List of countries included in the sample

Countries	**Notes**	**Countries**	**Notes**
Australia		Japan	No data on below-tertiary female educational attainment.
Austria		Korea	
Belgium		Latvia	
Brazil	Omitted altogether due to missing data	Lithuania	
Canada		Luxembourg	Limited data on the gender wage gap measures.
Chile	Limited data on female educational attainment	Mexico	
Colombia		Netherlands	
Costa Rica		New Zealand	Limited data on female educational attainment
Czech Republic		Norway	
Denmark		Poland	
Estonia		Portugal	
Finland		Slovakia	
France	Data on trade union density supplemented using ILO's estimates for the missing years 2010-2019	Slovenia	Limited data on the gender wage gap measures.
Germany		South Africa	Omitted altogether due to missing data
Greece	Not included in the gender wage gap analysis due to data gaps for both the gender wage gap measures and trade union density that did not overlap. Complete data was therefore limited to only one year.	Spain	
Hungary		Sweden	
Iceland	Limited data on the gender wage gap measures.	Switzerland	
Ireland	Limited data on the gender wage gap measures.	Türkiye	Limited data on the gender wage gap measures.
Israel	Limited data on trade union density.	United kingdom	
Italy		United States	

Notes: This table shows the list of countries included in the dataset used in this analysis. If applicable, data limitations are discussed. 'Limited data' refers to less than 6 observations during the years 1995-2022.