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Textile offshoring along global value chains (GVCs): Impacts on employment and gender wage gaps

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ABSTRACT

Globalization has a significant impact on the international distribution of production, which in turn affects the global distribution of employment and income. Yet, previous studies have often overlooked the gender implications associated with the evolution of global value chains (GVCs). In this context, the textile sector is considered critical for explaining the most recent trends in female employment, particularly in developing countries.

The main objective of this paper is to examine the impacts of textile offshoring on female participation in the labor market and on gender employment and wage gaps between 1991 and 2019. Specifically, it aims to understand prior premises as the expected increase in female workers due to the delocalization of the sector, the implications of these premises when countries begin to upgrade and their role in reducing gender inequalities.

To achieve this, we devised a multi-sectoral and multi-regional input-output (MRIO) model with a high level of disaggregation of 189 countries and 26 sectors, expanded to include male and female jobs and wages by sector and country. We also conducted a structural decomposition analysis (SDA) on the forces driving the evolution of gender gaps.

Our findings show that the gender employment gap grew in the global textile sector between 1991 and 2019, caused primarily by the role played by China and India in the textile supply chain. Gender wage gaps continue to linger, however, despite having narrowed in most of the countries analyzed.

1. Introduction

The recognition of gender inequality across various spheres of life and the need to ensure true equal rights have topped international agendas in recent decades. In 1995, the Beijing Declaration and Platform for Action laid the foundation for work towards gender equality so all women can enjoy their freedoms and exercise their rights (such as living free from violence, attending school, participating in decision-making and earning equal pay for equal work). The United Nations later supported this goal with the 2030 Agenda for Sustainable Development, whose benefits are to be shared equally between men and women (UN, 1995; 2015).

Despite this growing concern about gender issues, gender inequality persists, particularly in less developed areas (Jayachandran, 2015). The progress towards full equity is slow, as it must not only overcome societal prejudices and firmly held beliefs, but also critical structural changes (Greenhalgh, 1985). Employment is a major source of gender inequality, as it is how most individuals build their purchasing power and their ability to decide how to live (Sen, 1999).

The distribution and persistence of gender gaps in employment worldwide are due to economic, social, technological and structural factors and vary according to productive specialization and each country's level of development (Bamber and Hamrick, 2019). The internationalization of production in the late 20th century, marked by fragmentation and delocalization, caused major transformations in the world economy and led to the emergence of global value chains (GVCs) (Gereffi, 1999). Thus, integration into GVCs has become one of the most important challenges for growth in developed and developing countries alike (Ojala et al., 2008; Banga, 2012).

This paper analyzes how changes in countries' economic structure, trade specialization and productivity have influenced global gender inequality, given their integration into GVCs. It focuses primarily on the textile sector, whose degree of feminization makes it a bellwether in the study of the most recent trends in female employment worldwide (Kabeer, 2002; Nadvi and Thoburn, 2003; Kucera and Tejani, 2014). The paper, therefore, builds on previous literature to examine the role of the

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textile sector's expansion along GVCs in widening or narrowing gender inequalities worldwide.

To do so, we use a multi-sectoral and multi-regional input-output (MRIO) model for the world economy between 1991 and 2019,[1] with a high level of disaggregation of 189 countries and 26 sectors based on information from the EORA database. We expanded the model with data on female and male employment and wages from the ILO. This methodology is suitable for analyzing GVCs, as it captures all the interrelationships between supply and demand in a country and its transactions with the rest of the world (Isard, 1951; Miller and Blair, 2009). It can also be expanded to cover environmental and social factors, making it a robust tool for economic, social and environmental analysis (Wiedman et al., 2011; Lenzen et al., 2013; Duarte et al., 2013; Ding et al., 2018).

As a novelty, we extended our model to include data on male and female jobs and wages by sector and country in the global economy. Therefore, it not only reflects direct jobs in the textile sector, but all jobs that are directly and indirectly involved in the creation of final textile products, linking the generation of employment and wage and gender gaps to the final goods consumed in countries. We also conducted a structural decomposition analysis (SDA) of employment and wage gaps. To the best of our knowledge, this is the first attempt to use a multi-sector and multi-regional framework focusing on the textile sector that includes gender-specific information about wages. We also believe it is the first analysis of structural, technological and demand-related factors driving the evolution of gender employment and wage gaps. Our aim is to shed light on the responsibilities of countries in relation to a particularly important sector for gender studies.

Our findings reveal a pattern of structural change whereby countries' specialization shifts from lower value-added activities, such as textiles, to higher value-added activities, affecting female participation in the labor market. While the textile industry was initially relocated to China and India, where gender employment gaps first narrowed, it is now being offshored to countries with lower production costs. As these countries are undergoing earlier stages of their own development and industrialization, gender employment gaps are narrowing there. More importantly, we also observe a general decrease in gender pay gaps linked to the textile sector, which is more notable in countries that were integrated into its GVC earlier.

These findings also indicate that the feminization of the labor force changes with countries' positions along GVCs. They also reveal that narrowing the wage gap takes longer than reducing inequality in employment. This stresses the importance of policies focused on maximizing potential gains from integration into these chains.

The rest of the paper is structured as follows: Section 2 reviews the previous literature on gender inequality in the world, paying special attention to the textile sector. Section 3 outlines the methodology used. Section 4 presents and discusses the results and Section 5 summarizes the main conclusions.

2. Literature review

The main changes in gender gaps associated with the textile sector worldwide from the 1990s to the present can be understood as part of the expansion of GVCs and the sector's feminization, which has occurred in many developing countries linked to the expansion of those chains and is increasingly explored in the literature. While previous research has focused on the anatomy and evolution of GVCs (Gereffi, 1999; Escaith and Inomata, 2013), the consequences of specialization in a given sector (Antràs and Chor 2013) and some countries' increasing turn towards exports (Baldwin, 2011), much less attention has been paid to their gender-related impacts.

This is of the utmost importance because the opportunities associated with GVCs differ between men and women (Bamber and Staritz, 2016). Therefore we cannot assume that the benefits will be shared equally (Seguino, 2020). Though new paid employment opportunities for women have arisen, they come with new challenges, as much of this work is informal, unstable and must be juggled with family responsibilities (Barrientos et al., 2004).

This situation may also influence women's intra-household bargaining power, which is crucial not only for meeting their needs, but also for ensuring a more equitable distribution of household responsibilities (Molina, 2015). The growth of women's bargaining power is related to a greater accumulation of human capital by children. This benefits the growth of developing countries by making better use of their population's talent (Duflo, 2012; Anghel et al., 2019).

Thus, it is important to analyze whether textile offshoring is related to a reduction or an increase in gender inequalities, given the potential economic and social benefits that may arise (Bussolo, 2009). The textile sector is also especially significant for gender studies, not only due to its high degree of feminization (Fontana, 2009; Kucera and Tejani, 2014), but also because it is one of the sectors with the most fragmented production along the GVC covered by this methodology (Gereffi and Memedovic, 2003).

2.1. Understanding textile offshoring along GVCs and the feminization of the sector

The Heckscher-Ohlin-Samuelson theory holds that international trade, which facilitates the movement of factors of production, causes unskilled labor-intensive industries to relocate to places with an abundant supply of unskilled labor and vice-versa (Krugman, 2006). This is a reality in many developing countries. Therefore, trade liberalization intensifies competition between unskilled workers in developed and developing countries and may boost employment opportunities in the latter (Ghose, 2000). Moreover, since women make up a disproportionately larger share of the unskilled labor force in developing countries, they may benefit comparatively more in particular contexts and sectors, potentially narrowing gender employment gaps (Berik, 2000).

Increased exposure to international competition may also prompt firms to engage in more gender discrimination to lower labor costs (Seguino, 2000; Berik et al., 2004). Women's "comparative advantage," which has boosted female employment in Asian, Latin American and African countries in recent decades, is not solely due to their lower wages, but also, among other reasons,[2] to their lower capacity for agency and cooperation (Davin, 2001).

The nature of the labor market will determine whether changes in the structure of production result in changes in employment, wages or both. As many Asian countries specialize in unskilled labor-intensive manufacturing to compete in international trade, many African countries specialize in exporting agricultural products, benefiting female employment in Asia, but not as much in Africa (Joekes, 1999) .[3] Since women have greater control over their labor than over their access to natural resources, they are more likely to benefit from specialization in

[1] The year 1991 was the first for which employment and wage data by gender and economic activity were available. The year 2019 was the latest. Although China, India and Thailand had been integrated into textile GVCs earlier, another wave of textile offshoring started in the 1990s. The period from 1991 to 2019 therefore deserves to be analyzed, as it is when many developing countries started their industrialization and integration into GVCs, with textiles playing a major role.

[2] Women were also considered particularly well suited to the textile and apparel sector because they were viewed as "more skilled, careful and patient in repetitive tasks than men" (Elson and Pearson, 1981, Jansen et al., 2011).

[3] African countries also have a tradition of textile and apparel activity, though it is less visible in the data. This may indicate that a large share of this employment is informal or poorly documented in the available statistical databases. This is also the case for the agricultural sector.

textiles than in agriculture (Wood, 1994).

These findings are consistent with research by Fontana (2009) and by Kucera and Tejani (2014), who observe feminization in the labor force caused by trade in developing countries specialized in the export of unskilled labor-intensive manufacturing. Furthermore, Wood (1991) and Standing (1999) find a robust relationship between exports and female manufacturing employment in developing countries during the late 20th century.

However, recent research indicates that such feminization tends to wane, reversing the previous growth in female employment when countries begin to upgrade (Tejani and Kucera, 2021). In other words, as countries develop, they tend to specialize less in sectors such as textile manufacturing and more in higher value-added activities. This erodes the comparative advantage previously enjoyed by the female workforce in a process related to their industrial modernization (Tejani and Milberg, 2016; Saraçoğlu et al., 2018). This hypothetical "de-feminization" of the economy may reverse previous improvements in gender employment and wage gaps (Tejani, 2016).

Gender wage gaps have been particularly studied in countries where the production of labor-intensive industries has been offshored (see Iwasaki and Ma, 2020 and Rustagi, 2005 for China and India, respectively). Overall, studies show that wages are increasing more rapidly for women than for men, though not yet enough to close the existing gaps (ILO, 2018). Still, to the best of our knowledge, very little research has analyzed gender wage gaps from a global and multi-sector perspective (Alsamawi et al. 2014; Duarte et al. 2019a, 2019b).

This paper builds on previous literature to study the role of supply chains in changing gender gaps and how they relate to structural, technological and trade factors. It focuses on an unprecedented period of international trade (1991–2019) in which new industrializing countries were integrated into the textile GVC. Finally, the inclusion of gender-specific wage data and female and male employment represents a significant contribution of this work.

3. Methodology and data

3.1. An extended MRIO model

We use a multiregional input-output (MRIO) model for the world economy to estimate the gender employment and pay gaps directly and indirectly associated with each country's production and final demand (Isard, 1951; Miller and Blair, 2009). Let the world economy consist of m countries and n sectors and let the equilibrium equation be:

$$\mathbf{x} = \mathbf{Ze} + \mathbf{y} \leftrightarrow \mathbf{x} = \mathbf{Ax} + \mathbf{y} \tag{1}$$

where $\mathbf{x}$ is the vector of total production, $\mathbf{Z} = \left(Z_{ij}^{rs}\right)$ is the matrix of multiregional intermediate flows, $\mathbf{y}$ is the vector of final demand of countries and $\mathbf{e}$ is the vector of ones of the corresponding dimension. We use $\mathbf{A} = \left(A_{ij}^{rs}\right)$ to denote the matrix of technical coefficients whose elements represent the output of sector i in country r that is used as an input to produce one unit of product j in country s. The equilibrium equation can also be expressed in terms of the well-known Leontief inverse matrix $(\mathbf{I}-\mathbf{A})^{-1}$:

$$\mathbf{x} = (\mathbf{I}-\mathbf{A})^{-1}\mathbf{y} \tag{2}$$

where each element captures all the production generated in sector i and country r to fulfill the demands of inputs directly and indirectly incorporated in each unit of final demand of sector j in country s. As a result, the elements in $(\mathbf{I}-\mathbf{A})^{-1}$relate the final demands of countries with the total production requirements needed globally to meet these final demands. Therefore, changes in the equation's terms report different structural changes: geographical changes, technological changes and changes in countries' positions along GVCs.

This model can be extended to evaluate production flows based on the value added they incorporate, including the GVCs (Dietzenbacher et al., 2007; Antràs and Chor, 2013; Escaith and Inomata, 2013), natural resources (Minx et al., 2009; Bolea et al., 2020) and human capital linked to them (Duarte et al., 2019B). Specifically, we extend the model with jobs and wages by gender for each country and sector to integrate concepts of gender equity into the economic and productive spheres of these chains.

3.1.1. Gender employment gaps: direct (GEG) and embodied (GEEG)

Specifically, we consider male and female employment per unit of output for all sectors and countries $\mathbf{l^m} = \left(L_{mj}^{r}/x_j^r\right)$, $\mathbf{l^f} = \left(L_{fj}^{r}/x_j^r\right)$ where L_{mj}^{r}, L_{fj}^{r} are the men and women employed in sector j and country r, respectively. Given that the Leontief inverse matrix[4] relates all the direct and indirect production necessary to meet the final demand of each country and sector, we can estimate the direct and indirect (or embodied) jobs associated with each final demand (Le_j^r). Thus, we can link the perspectives of production (where the jobs are) and demand (where the production related to those jobs "ends up"). To do so, we evaluate production based on the male and female employment it incorporates with the following matrices :[5]

$$\boldsymbol{\Omega}^{\mathbf{m}} = \widehat{\mathbf{l}}^{\mathbf{m}}(\mathbf{I}-\mathbf{A})^{-1}\widehat{\mathbf{y}} \tag{3}$$

$$\boldsymbol{\Omega}^{\mathbf{f}} = \widehat{\mathbf{l}}^{\mathbf{f}}(\mathbf{I}-\mathbf{A})^{-1}\widehat{\mathbf{y}} \tag{4}$$

The columns and rows of these matrixes provide information on the origins and destinations of employment across global production chains. More specifically, the sum of the rows ($\boldsymbol{\Omega}^{\mathbf{m}}\mathbf{e}$; $\boldsymbol{\Omega}^{\mathbf{f}}\mathbf{e}$)[6] captures the direct jobs per sector and country and the sum of the columns ($\mathbf{e}'\boldsymbol{\Omega}^{\mathbf{m}}$; $\mathbf{e}'\boldsymbol{\Omega}^{\mathbf{f}}$) shows the embodied jobs, meaning the total jobs in the world economy that can be attributed to the different final demands. We can use this model to reveal the structural factors underlying the Gender Employment Gaps (GEG) and the Gender Embodied Employment Gaps (GEEG) from a multi-regional perspective. For a country r, we can define:

$$\mathrm{GEG^r} = (1-\mathrm{R^r}) = \left(1-\frac{\mathrm{L_f{}^r}}{\mathrm{L_m{}^r}}\right) = \left(1-\frac{\sum_j \mathrm{L_{f_j}{}^r}}{\sum_j \mathrm{L_{m_j}{}^r}}\right) \tag{5}$$

$$\mathrm{GEEG^r} = (1-\mathrm{ER^r}) = \left(1-\frac{\mathrm{Le_f{}^r}}{\mathrm{Le_m{}^r}}\right) = \left(1-\frac{\sum_j \mathrm{Le_{f_j}{}^r}}{\sum_j \mathrm{Le_{m_j}{}^r}}\right) \tag{6}$$

where $\mathrm{R^r}$ is the ratio between female and male employment in country r and $\mathrm{ER^r}$ a similar ratio concerning the female and male employment embodied in its final demand, meaning attributed to the global supply chain of that final demand. Thus, these gaps reflect the difference in participation by gender in direct (5) and embodied jobs (6).

As defined, $\mathrm{GEG^r}$ captures the difference in total employment between women and men for each country r. In a country where female and male employment is equal, $\mathrm{GEG^r}$ will be zero. Similarly, for each country r, $\mathrm{GEEG^r}$ captures the gap between female and male employment, considering all the employment generated worldwide and attributed to (embodied in) that country's final demand. In other words, it serves as a proxy for the inequality arising from the specific composition of global supply chains. As demonstrated by Duarte et al. (2019B),

[4] The notation "L" in this paper is reserved for employment, as it is traditionally used for "Labor" in academia. To make the paper more readable, the Leontief Inverse matrix is simply represented as $(\mathbf{I}-\mathbf{A})^{-1}$.

[5] The symbol ˆ denotes a diagonalized vector.

[6] With $\mathbf{e}$ as a unitary vector of the proper dimension.

the MRIO model can reveal these employment gaps for all specific countries and sectors as[7]:

$$\mathbf{GEG} = (\mathbf{e} - \mathbf{r}) \text{ with } \mathbf{r} = \left(\boldsymbol{\Omega}^{\mathbf{f}}\mathbf{e}\right)\left(\widehat{\boldsymbol{\Omega}^{\mathbf{m}}\boldsymbol{e}}\right)^{-1} = \widehat{\mathbf{g}}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} \tag{7}$$

and

$$\mathbf{GEEG} = (\mathbf{e}' - \mathbf{re}) \text{ with } \mathbf{re} = \left(\mathbf{e}'\boldsymbol{\Omega}^{\mathbf{f}}\right)\left(\mathbf{e}'\widehat{\boldsymbol{\Omega}^{\mathbf{m}}}\right)^{-1} \tag{8}$$

where $\mathbf{g}$ is a vector capturing the ratio of female to male participation in employment per unit of output (i.e., the intensity of direct gender inequality in employment) and $g_j^r = \left(\frac{L_{fj}^r}{L_{mj}^r}\right)/x_j^r$ is a representative element of $\mathbf{g}$. Note that we use Eq. (7) to evaluate the changes in the gender gaps in each sector and country and to link those changes to the evolution of the global economy. Changes in specialization, trade and demand patterns will influence the distribution of male and female employment in GVCs and consequently impact gender gaps.

We can construct an additional indicator by focusing on particular sectors. Specifically, following Fana and Villani (2022), we define a Gap-Revealed Sector Advantage Index (GSA), which relates the gender gap in a given sector j and country r (GEG_j^r) to the total gender gap in that country (GEG^r). Thus, this indicator helps to determine whether changes in gender inequality are primarily driven by particular sectors or if they reflect broader economic trends:

$$\mathrm{GSA} = \frac{\mathrm{GEG_j^r}}{\mathrm{GEG^r}} \tag{9}$$

The same will hold for the embodied and pay gaps. Similarly to gender employment gaps, a country's gender pay gap (GPG) and gender embodied pay gap (GEPG) can be determined as follows:

$$\mathrm{GPG^r} = (1 - \mathrm{P^r}) = \left(1 - \frac{\mathrm{w_f{}^r}}{\mathrm{w_m{}^r}}\right) = \left(1 - \frac{\sum_j \left(\left(\mathrm{w_{fj}^r L_{fj}^r}\right)/\mathrm{L_f{}^r}\right)}{\sum_j \left(\left(\mathrm{w_{mj}^r L_{mj}^r}\right)/\mathrm{L_m{}^r}\right)}\right) \tag{10}$$

$$\mathrm{GEPG^r} = (1 - \mathrm{EP^r}) = \left(1 - \frac{\mathrm{we_f{}^r}}{\mathrm{we_m{}^r}}\right) = \left(1 - \frac{\sum_j \left(\frac{\mathrm{w_{fj}^r L_{fj}^r}}{\mathrm{Le_f{}^r}}\right)}{\sum_j \left(\frac{\mathrm{w_{mj}^r L_{mj}^r}}{\mathrm{Le_m{}^r}}\right)}\right) \tag{11}$$

where w_{fj}^r and w_{mj}^r represent the mean nominal monthly earnings of the women and men employed in the production of each sector j and country r, and we_f^r and we_m^r are the average wages along the entire value chain for the final product consumed in country r[8]. Based on these equations, and following a similar approach, we can obtain the global wage gaps for industries and countries in the MRIO framework as follows:

$$\mathbf{GPG} = (\mathbf{e} - \mathbf{s}) = \left(\mathbf{e} - \mathbf{w}_{\mathbf{f}}(\widehat{\mathbf{w}_{\mathbf{m}}})^{-1}\right) \text{ with } \mathbf{s} = \widehat{\mathbf{p}}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} \tag{12}$$

and

$$\mathbf{GEPG} = (\mathbf{e}' - \mathbf{se}) = \left(\mathbf{e} - \mathbf{we}_{\mathbf{f}}'(\widehat{\mathbf{we}_{\mathbf{m}}})^{-1}\right) \tag{13}$$

where $\mathbf{p}$ is a vector capturing the ratio of female to male wages per unit of output ($\left(\frac{w_{fj}^r}{w_{mj}^r}\right)/x_j^r$). This could be understood as a proxy for "direct discrimination" in wages in the different sectors. Furthermore, $\mathbf{we}_f$ and $\mathbf{we}_\mathbf{m}$ are the vectors of embodied wages obtained in this framework.

3.1.2. Structural decomposition analysis (SDA) of employment and pay gaps

In this section we conduct a structural decomposition analysis (SDA) on the two perspectives considered in the paper, supply and demand, to identify the factors contributing to the evolution of gender gaps. Using this approach, we direct a portion of the total observed changes in a target variable to a set of significant factors that may act either as accelerators or as retardants (Dietzenbacher and Los, 1998; Rose and Casler, 1996). Specifically, we analyze the evolution of gender employment and wage gaps by examining changes in three factors: a direct discrimination factor (DDF), a technology factor (TF) and a demand factor (DF).

In other words, we use SDA to disentangle how changes in direct gaps across sectors, countries, technology and trade structure, as well as changes in demand, contribute to the evolution of textile employment and the associated gender gaps. Based on the expressions above, we can analyze changes in gender employment (and pay) gaps by examining the following components (note that GEG is the opposite of R):

$$\boldsymbol{\Delta r} = \mathbf{r}_1 - \mathbf{r}_0 = \boldsymbol{\Delta}\widehat{g}Ly + \widehat{\mathbf{g}}\boldsymbol{\Delta}\mathbf{Ly} + \widehat{\mathbf{g}}\mathbf{L}\boldsymbol{\Delta}\mathbf{y} = \mathbf{DDF} + \mathbf{TF} + \mathbf{DF} \tag{14}$$

The same will hold for **s.** In other words, we can explain the changes observed in the gender gap by a direct discrimination factor (DDF) that reflects the differences in female and male participation in employment per unit of output (the same with wages), a technology factor (TF) that captures the differences induced by changes in the structural, trade and technological composition of the supply chains and, finally, a demand factor (DF) that captures the changes in the studied gaps induced by changes in the final demand (i.e., consumption patterns, income or population size).

Thus, gender gaps may narrow or widen due to various factors, which may include higher demand for female employment over male employment per unit of production due to a productive specialization that favors women (DDF), increased labor requirements to supply a unit of final demand given the current structure (TF) or growing demand in the textile sector (e.g., given the rise of low-cost fast fashion) or in other sectors (DF). Changes in these factors will also affect the distribution of employment, wages and associated inequalities along GVCs. However, reading these factors by column does not fully capture the changes in embodied gender and pay gaps defined above. Therefore, the impact of technological changes on these factors should be interpreted with caution.

In a discrete framework, decomposing changes through SDA without residual terms is not the only solution. To operationalize these changes, Dietzenbacher and Los (1998) demonstrate that the simple average of polar solutions closely approximates the average of all possible n! decompositions of that change, where n is the number of explanatory factors. In this context, the polar solutions are defined as follows:

$$\begin{aligned}\boldsymbol{\Delta r} = \mathbf{r}_1 - \mathbf{r}_0 = \mathbf{DDF} + \mathbf{TF} + \mathbf{DF} \;=\; \\ = \frac{1}{2}\left(\boldsymbol{\Delta}\widehat{\mathbf{g}}\mathbf{L}_0\mathbf{y}_0 + \boldsymbol{\Delta}\widehat{\mathbf{g}}\mathbf{L}_1\mathbf{y}_1\right) + \frac{1}{2}\left(\widehat{\mathbf{g}}_1\boldsymbol{\Delta}L\mathbf{y}_0 + \widehat{\mathbf{g}}_0\boldsymbol{\Delta}L\mathbf{y}_1\right) \\ + \frac{1}{2}\left(\widehat{\mathbf{g}}_1\mathbf{L}_1\boldsymbol{\Delta}y + \widehat{\mathbf{g}}_0\mathbf{L}_0\boldsymbol{\Delta}y\right)\end{aligned} \tag{15}$$

3.2. Database

Our study relies on the multi-sectoral and multi-regional EORA database (EORA, 2019), including empirical data from 187 countries and 26 sectors of economic activity (Lenzen et al., 2012, 2013). For this paper, we include male and female employment by economic activity

[7] Note that we could calculate the gaps in a country with this expression, adding its vector of male and female jobs and calculating the corresponding gap.

[8] The embodied wage is calculated for each category as the total embodied labor compensation in final demand related to the total embodied employment in it. As a result, this embodied wage is a global proxy for how each group (male and female employment) captures the potential benefits of integrating into global supply chains in terms of income. Therefore, GEPG is a relative measurement of inequality between women and men.

data obtained from the ILO, and male and female wages (ILO, 2019).

To obtain compatible data on wages by gender, we first consulted the average earnings by gender and economic activity available from the ILO. After standardizing these data, we constructed a vector of over/under payment coefficients for each sector and country. We then applied this vector to the "compensation of employees" provided by the EORA's MRIO tables[9] to ensure comparability across countries. We then obtained the earnings for each group (male and female employment). When ILO data were unavailable, we turned to alternative sources for the required information, including the Eurostat database, the China Household Income Project (CHIP) and the National Sample Survey Office of the Government of India for Poland, China and India, respectively.

4. Results

4.1. The story behind employment and gender gaps in the textile sector

First, we present an overview of the employment patterns in the main economic sectors between 1991 and 2019 (Table 1[10]). In 1991, as expected, agriculture was the dominant sector, accounting for 40 % of global direct employment, while the textile and apparel sector represented a relatively small share (1.6 % and 1.9 % of male and female employment, respectively). Two remarkable trends have emerged since 1991. First, global employment has increased by nearly 25 %. Second, there has been a structural transformation in several economies, particularly China and India, which have shifted from agriculture to industry and services. As a result, both men and women have become less involved in agriculture (~20 %) as other sectors have become more important. In many developing countries, the textile sector has become increasingly significant, leading to a rise in the number of people employed in the textile sector in absolute terms in 2019.

As highlighted in the literature, this sector has traditionally employed more women and paid them comparatively less (Table 1). However, direct jobs represent only a part of the total employment created by the textile industry. To analyze all the work involved in producing a final textile product, we must consider both the direct and indirect employment involved in producing the goods and providing the services used. For instance, the textile sector does not merely create employment by hiring garment workers, it also generates employment in related industries, such as machinery manufacturing. Thus, a final textile product (such as a sweater) consumed in a country depends on an entire sectoral network that provides employment in different locations and sectors around the world.

The textile sector accounts for over 3 % of all employment worldwide, with similar pay gaps and wider employment gaps. A comprehensive understanding of the textile GVC and its impacts requires examining these relationships in detail. For instance, gender-embodied employment gaps may widen due to other sectors linked to textiles. This is particularly relevant for agriculture, which, despite having lower female representation, plays a significant role in the production of final textile products.

After examining employment trends in the textile sector, we return to the question of how structural change has influenced gender gaps. Between 1991 and 2019, gender employment gaps did not decrease but rather widened, which challenges the feminization hypothesis for this period. However, the absolute number of women employed in the textile sector did increase, accompanied by a significant narrowing in the gender pay gap.[11] This indicates that the sector is integrating women into higher-paying roles or stages with greater value added and earnings and the effects are being reflected throughout the entire production chain.

These trends may be closely related to China and India.[12] First, a significant proportion of women employed directly or indirectly in textiles were already in the sector in 1991, especially in China (Table 3), so the sector may have become feminized earlier in those countries. Second, China has progressively shifted towards higher value-added activities, while gender gaps in India are wide but narrowing. The resulting gender gaps may be heavily influenced by these countries and may not fully represent the rest. To explore this further, we have excluded these countries from the analysis when calculating gender gaps.[13]

Our findings show that if China and India are excluded, employment gaps in the textile sector between men and women narrow, indicating that it may no longer be feminizing in those two countries. As countries develop, they tend to specialize in higher value-added activities, relegating lower ones to countries that began to develop more recently. This is what the data seem to be telling, since gender gaps in employment narrow slightly when we exclude China and India, where textile employment relocated years ago. The following section explores the factors driving these changes.

4.2. Evolution of gender gaps in the textile sector: structural decomposition analysis (SDA)

Table 2 shows the results of our structural decomposition analysis (SDA) on the evolution of gender gaps. The demand factor shows that growing demand worldwide, ceteris paribus, would exacerbate gaps between women and men both in employment and wages, as more production and employment would be created under the same unequal conditions. Likewise, the technology factor demonstrates that changes in technology in the textile sector and its supply chain involve, ceteris paribus, gender inequality. In other words, the growing demand for inputs per unit of final demand in the textile sector could be a source of gender inequality.

Nevertheless, the intensity factor, which provides information about the sectoral share of female and male employment required per unit of output and the sectoral wage gap, is contributing to the narrowing of gender gaps in the textile sector. According to the literature, there is overall less gender inequality per unit of output produced in the textile sector. As previously mentioned, while gender employment gaps in textiles are widening in the global economy, pay gaps are narrowing. Thus, given other upward trends, as factors interact, the intensity factor is not enough to decrease gender employment inequality in textiles, but it is enough to narrow wage gaps.

There are several reasons for this. In recent decades, the demand for textiles has grown in part as a result of the rising incomes and consumption in some large economies, such as in China. Furthermore, a positive value for the technological factor implies that more production is needed to meet one unit of final demand, which may indicate that the demand is becoming more sophisticated. Finally, as economies modernize, they tend to use more capital and less labor per unit of output, which is linked to the intensity factor. However, this transition is slow and has yet to happen in many countries, so the overall impact on employment may not reflect it.

[9] Wages have been deflated using a country-by-country deflator coefficient constructed according to constant 2015 US dollars obtained from the World Bank.

[10] We selected agriculture, construction and education because they are linked to the three main sectoral groups (agriculture, industry, services). They therefore provide insight into structural change and are also among the top five sectors in terms of employment.

[11] Gender pay gaps are positive in almost all sectors considered, thus indicating that women are clearly and significantly underpaid compared to men.

[12] Note that the textile industry had also delocalized to Thailand and Hong Kong before 1991, but we focus here on China and India because they have a greater share of total textile employment (See Table 3).

[13] See Supplementary Information, Table A1.

Table 1
Employment, gender employment and gender pay gaps by sector (thousands of people and % of total employment).

		1991				2019			
		Men	Women	GEG	GPG	Men	Women	GEG	GPG
Direct	Agriculture	556.140 (40.8 %)	344.819 (39.5 %)	0.38	0.25	466.162 (24.0 %)	264.626 (21.9 %)	0.43	0.19
	Construction	82.275 (6.0 %)	9.163 (1.1 %)	0.89	0.11	228.116 (11.7 %)	18.885 (1.6 %)	0.92	−0.01
	Education and health	60.112 (4.4 %)	94.740 (10.8 %)	−0.58	0.27	106.410 (5.5 %)	196.011 (16.2 %)	−0.84	0.18
	Textile and apparel	21.938 (1.6 %)	16.512 (1.9 %)	0.25	0.29	30.321 (1.6 %)	21.109 (1.7 %)	0.30	0.19
TOTAL				**0.36**	**0.27**			**0.38**	**0.23**
Embodied	Agriculture	291.610 (21.4 %)	175.081 (20.0 %)	0.40	0.26	249.376 (12.8 %)	132.805 (11.0 %)	0.47	0.22
	Construction	153.393 (11.3 %)	62.566 (7.2 %)	0.59	0.24	328.553 (16.9 %)	96.307 (8.0 %)	0.71	0.18
	Education and health	94.491 (6.9 %)	111.108 (12.7 %)	−0.18	0.26	155.356 (8.0 %)	210.959 (17.4 %)	−0.36	0.21
	Textile and apparel	50.086 (3.7 %)	33.134 (3.8 %)	0.34	0.27	62.665 (3.2 %)	39.201 (3.2 %)	0.37	0.22
TOTAL			**0.36**	**0.27**			**0.38**	**0.23**	

Table 2
Decomposition of changes in gender gaps (1991–2019).

	Gender Employment Gaps (GEG)		Gender Pay Gaps (GPG)	
	Textile and Apparel	Total Economy	Textile and Apparel	Total Economy
Total Change	**0.06** (0.25–0.30)	**0.02** (0.36–0.38)	**−0.10** (0.29–0.19)	**−0.07** (0.24–0.16)
Intensity	−3.43	−0.10	−0.70	−0.11
Technology	1.09	0.05	−0.17	−0.04
Demand	2.40	0.06	0.78	0.08

Our main conclusion is that the increase in final demand (both for textiles and for the entire economy) and in the demand for inputs per unit of final demand, ceteris paribus, contribute to gender inequality in employment and wages. Although the sectoral ratio of female to male employment and wages per unit of output helps to narrow gender gaps, this trend cannot fully eliminate existing gaps.

4.3. Geographic distribution of employment and gender gaps

Having discussed the main features and drivers of gender gaps in the textile supply chain, we can now explain their geographic distribution in greater detail. Table 3 shows the countries with the largest number of direct and embodied jobs in 1991 and 2019. In 1991, China accounted for 32.22 % and 56.31 % of the world's total direct male and female jobs, respectively. India, in second place, had 13.38 % and 5.08 % of the world's male and female textile jobs.

This pattern was similar in 2019. China remained first, though its share decreased, and other developing countries with low production costs and high export activity became more important in the textile production chain. Although the number of jobs associated with the textile sector did not increase significantly in China,[14] it did rise in many other parts of the developing world, such as Bangladesh, Brazil, Hong Kong,[15] Indonesia, Pakistan, Romania, Russia, Thailand, Turkey and Vietnam[16].

The shares of textile employment compared to total and domestic employment also increased in many of these places. Specifically, it increased in India, Turkey, Indonesia, Bangladesh and China for men and decreased in Thailand, Italy and China for women. The share of embodied employment increased in India and Bangladesh and decreased especially in China, Italy, the USA and Thailand. Thus, textile employment became less important both in developed countries and in developing economies where the sector had previously been offshored, in contrast to countries where industrialization came later (Bangladesh, Indonesia and Vietnam).

The pattern holds for embodied jobs, which again surpass direct jobs, underscoring the interconnectivity of sectors and countries. For example, the embodied employment in China not only includes jobs in Chinese textile factories, but all jobs generated in the world and in China to meet the country's final demand for textiles,[17] expressed in terms of

[14] See the absolute number of textile jobs created by country in Supplementary Information, Table A2.

[15] Although Hong Kong accounts for around 4% of the employment created to meet the final demand for textiles worldwide, the share represents 17% of Hong Kong's employment, revealing the dragging capacity of final textile products there. This is also the case in Thailand, Turkey and Romania, though to a lesser extent.

[16] In fact, during this period, the Agreement on Textiles and Clothing (ATC) favored developing countries by slashing the tariff on textiles they exported (Tabeau et al., 2017).

[17] China's final demand includes products consumed by the Chinese population and exports of final products from China. In other words, if the final stage of production is in China and exported as "Made in China," it represents China's final demand. Thus, we could estimate its embodied production and jobs.

Table 3
Top 10 countries with highest employment (EMP) in the textile sector (% of all textile EMP in the world and total EMP in their own country).

	1991						2019					
	Men	% of the world textile EMP	% of the country total EMP	Women	% of the world textile EMP	% of the country total EMP	Men	% of the world textile EMP	% of the country total EMP	Women	% of the world textile EMP	% of the country total EMP
Direct	China	32.22	2.01	China	56.31	3.20	China	32.62	2.31	China	48.60	3.05
	India	13.38	1.27	India	5.08	1.08	India	17.08	1.38	India	6.36	1.42
	Thailand	3.69	4.95	Thailand	4.96	6.22	Indonesia	4.67	1.79	Indonesia	5.23	2.15
	Turkey	3.36	5.67	Russia	2.08	1.06	Turkey	3.62	5.45	Vietnam	4.43	3.83
	Brazil	3.23	1.80	Romania	1.94	5.86	Pakistan	2.98	1.54	Thailand	3.18	3.66
	USA	3.17	1.00	Brazil	1.84	1.51	BD	2.62	1.61	Brazil	1.87	0.95
	Indonesia	2.75	1.23	Indonesia	1.57	0.93	Vietnam	2.63	2.91	Turkey	1.85	4.01
	Italy	2.49	3.58	Italy	1.40	2.90	Brazil	2.42	1.28	BD	1.82	1.80
	BD	2.01	1.50	Ukraine	1.32	1.70	Thailand	2.42	3.24	Nigeria	1.69	1.38
	Russia	1.92	1.11	Vietnam	1.32	1.24	Mexico	1.76	1.42	Mexico	1.47	1.37
Embodied	China	40.02	4.75	China	54.76	5.44	China	29.76	3.21	China	40.40	3.70
	India	14.61	2.83	India	7.74	2.83	India	18.57	2.32	India	8.97	2.05
	Brazil	4.00	2.24	HK	4.31	18.72	BD	4.90	6.08	HK	4.76	13.13
	HK	3.69	16.99	Thailand	3.67	4.46	Pakistan	4.06	4.16	BD	4.07	7.49
	Italy	3.62	4.64	Italy	2.96	4.20	Brazil	3.96	3.37	Indonesia	3.88	2.56
	BD	2.99	5.03	Brazil	2.50	1.55	HK	3.95	11.90	Brazil	3.90	2.85
	USA	2.92	1.18	Japan	2.08	0.27	Indonesia	3.42	2.30	Vietnam	3.46	5.60
	Thailand	2.84	3.59	USA	2.08	0.74	Italy	3.39	2.13	Thailand	3.31	4.21
	Pakistan	2.58	4.30	South C.	1.91	1.36	Turkey	3.35	5.49	Italy	2.94	1.78
	South C.	2.33	1.60	Russia	1.76	0.22	Thailand	2.57	3.74	Turkey	2.28	4.36

global consumption and employment. Therefore, even though China's textile sector created 9.3 million female jobs in 1991, it accounted for 16.5 million embodied jobs, highlighting its dragging capacity and the employment effects of the penetration of China's textile products in world markets.

By 2019, the absolute number of embodied jobs involved in China's final textile demand had decreased, while the numbers in India, Bangladesh, Indonesia, Pakistan, Vietnam, among others, had increased. This does not mean that the Chinese population is consuming fewer textile products, but that there are fewer textile products whose final production stage is completed in the country (i.e., fewer "Made in China" products) and more of them in other countries.

As before, these results reflect a pattern of structural change in which countries transition from old activities to new ones. As the labor force employed in the textile sector first started to decline in developed countries, due to their tertiarization, some developing countries like China focused increasingly on manufacturing, including the textile sector. Now, China's specialization is gradually shifting from textiles to other higher value-added activities, thereby offshoring part of those production processes to countries in earlier stages of development. To analyze this further, we distinguished how many embodied jobs in a country's demand were domestic and how many were performed abroad.[18]

If embodied jobs exceed direct jobs but are in the same country, their embodied nature is more closely related to interrelations between sectors than between countries. As such, most jobs embodied in the demand for textiles in the countries analyzed were domestic, though these percentages tend to fall.[19] Embodied jobs abroad were only found in significant percentages in Europe, the United States and Hong Kong.[20] While Hong Kong's numbers are explained by its small open economy, we discuss the cases of Europe and the United States in more detail in Section 4.4. The impact on gender inequality is summarized in Table 4.

There are different patterns in gender employment gaps and a general decrease in gender pay gaps. Gender employment gaps have increased in China, leading to more equal participation in the sector. At the same time, pay in the country has become more equal, though not across all sectors involved in meeting China's final demand for textile products. This indicates a greater expansion of gender pay inequality along its chain, not only to other sectors, but also to other countries, as China has gone from having almost 100 % of its embodied employment at home to around 90 % in 2019.[21]

These changes over time confirm the gradual modernization of China, which is offshoring part of its production to other countries such as Bangladesh. In fact, the gender employment gap in Bangladesh is narrowing while its pay gap is widening, possibly due to the outsourcing of lower value-added activities there. This finding is consistent with literature focused on how the establishment of the textile industry may have boosted female participation in the labor market (Kabeer, 2002). However, this could lead to more women working under the same unequal conditions as before, including more underpayment in the country overall.

In India and Thailand, where the textile industry also pre-dates 1991, employment gaps are widening while pay gaps are narrowing. This may indicate a gradual shift in specialization to other sectors instead of textiles and, ultimately, their upgrade. These different paths taken exemplify the effects that productive specialization along the textile supply chain can have on gender inequality in the short, medium and long term. The cases of Europe and the United States are studied in greater detail below.

4.4. *Analysis of employment associated with the final demand for textiles in Europe and the United States*

Europe and the United States present the highest regional employment footprints[22] for the textile sector.[23] Thus, through consumption,

[18] Supplementary Information, Table A3.

[19] For example, China went from ~99% in 1991 to 89-94% of male and female EMP domestically in 2019.

[20] Europe and the United States ~ 50% abroad, Hong Kong ~ 85% abroad. Supplementary Information, Table A3.

[21] Supplementary Information, Table A3.

[22] Proportion of employment generated abroad for a country to meet its demand.

[23] China, India and certain other countries in Table 3 create more jobs due to their final demand. However, most of these jobs are domestic (Table A3). Analyzing the employment footprint in Europe and the United States is more informative when considering the global responsibilities associated with global value chains.

Table 4
Gender textile gaps of the countries whose demand for textile products created more jobs in 2019.

	1991				2019			
	GEG	GEEG	GPG	GEPG	GEG	GEEG	GPG	GEPG
China	−0.32	0.09	0.27	0.21	−0.04	0.15	0.24	0.24
India	0.71	0.65	0.45	0.51	0.74	0.70	−0.19	0.18
Europe	0.49	0.41	0.28	0.27	0.37	0.45	0.20	0.21
Bangladesh	0.86	0.73	0.16	0.26	0.52	0.49	0.19	0.21
Hong Kong	0.21	0.22	0.36	0.29	0.27	0.23	0.30	0.26
Brazil	0.58	0.60	0.43	0.34	0.45	0.39	0.24	0.22
Indonesia	0.57	0.47	0.38	0.28	0.22	0.28	0.28	0.24
Pakistan	0.87	0.86	0.59	0.31	0.75	0.68	0.64	0.34
Turkey	0.73	0.67	0.20	0.22	0.66	0.58	0.17	0.20
Thailand	−0.01	0.12	0.23	0.26	0.05	0.18	0.13	0.19
Vietnam	0.09	0.05	0.25	0.28	−0.20	−0.11	0.14	0.25
United States	0.71	0.53	0.28	0.24	0.62	0.50	0.21	0.22

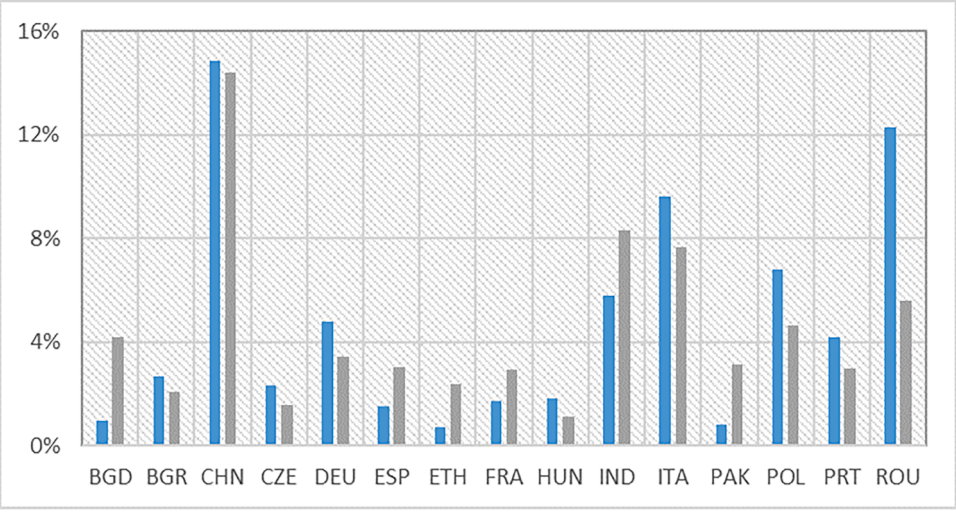

Fig. 1. Country of origin of the female employment embodied in Europe's final demand for textiles (%).

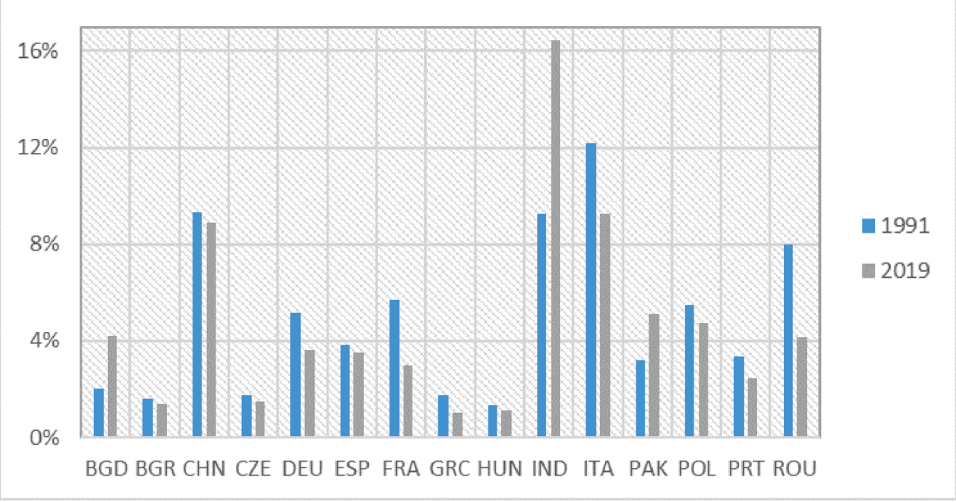

Fig. 2. Country of origin of the male employment embodied in Europe's final demand for textiles (%).

they are importing gender inequality from countries where it is partly driven by foreign demand. Specifically, 2.7 (8.2 %) million female jobs and 4.8 (9.7 %) million male jobs were created worldwide to meet Europe's final demand for textiles in 1991, compared to 3 million female jobs (7.8 %) and 5.5 million male jobs (8.9 %) in 2019. In 1991, over half these jobs were performed in Europe (56–57 %), though that was no longer true by 2019 (42–43 %). Employment to meet Europe's demand was growing, but it was being relocated to non-European regions, primarily Asia.

Figs. 1 and 2 illustrate the countries where most of these jobs were located. The main locations in Europe include Romania, Italy, Poland and Germany, among others. Textile-related jobs declined in these

Table 5
Gap Revealed Sector Advantage Index (GSA).

	1991				2019			
	GEG textile / GEG total	*GEEG textile / GEEG total*	*GPG textile / GPG total*	*GEPG textile / GEPG total*	*GEG textile / GEG total*	*GEEG textile / GEEG total*	*GPG textil / GPG total*	*GEPG textile / GEPG total*
China	−1.82	0.45	1.47	1.09	−0.17	0.57	0.98	1.00
India	1.08	1.00	0.68	0.87	0.99	1.06	−0.98	0.84
Europe	1.67	1.31	0.74	0.84	3.47	1.35	0.95	0.97
Bangladesh	1.15	0.99	1.16	1.11	0.91	0.83	1.23	1.09
Hong Kong	0.52	0.75	1.14	0.99	1.27	0.76	1.15	1.09
Brazil	1.16	1.43	1.81	1.43	1.75	1.41	1.12	1.00
Indonesia	1.32	1.16	3.71	1.52	0.63	0.79	1.21	1.10
Pakistan	1.03	1.03	2.62	1.28	1.00	0.92	1.94	1.14
Turkey	1.34	1.34	2.24	1.35	1.23	1.23	1.99	1.20
Thailand	−0.06	0.40	1.34	0.93	0.32	0.66	1.05	0.96
Vietnam	1.78	0.38	1.23	1.08	−2.35	−0.91	0.74	1.05
United States	3.65	2.04	1.07	0.92	4.23	1.49	0.83	0.87

countries as the sector delocalized,[24] so their gender employment and pay gaps were also affected. However, China absorbed the highest percentage of workers due to Europe's final demand for textiles in 1991, followed by India. By 2019, while the share of employment absorbed by Asia had grown significantly to 30 %, the trend was not headed by China, but by India, Bangladesh and Pakistan, providing evidence of a "second wave" of offshoring in the textile sector.

The same analysis and pattern hold true for the United States. In 1991, more than half the jobs created in the world to meet the United States' demand for textile products were performed in the country, yet that was no longer the case by 2019. Similarly, while China and India were major locations for textile sector jobs in 1991, other countries had grown their share by 2019, such as Pakistan, Mexico and Bangladesh.

Our findings confirm that, in recent decades, many labor-intensive companies have relocated to countries with relatively abundant and cheap labor, such as Asian countries. Still, Europe and the United States continue to play major roles as both consumers and producers. This is in part because some share of a country's final demand always tends to be met domestically or by geographically or culturally close countries, and even more so in the previously studied developing countries.

The effects this has on gender gaps are summarized in Table 4. First, direct gender employment and pay gaps narrowed in both Europe and the United States between 1991 and 2019, meaning that the number of women and men working in the textile sector tended to reach an equal level, as did their pay. While offshoring may create jobs in other countries, as described above, it may also lead to job losses where production was previously located. Thus, while there was less gender inequality in Europe and the United States in 2019 than in 1991, the possible friction caused by the offshoring merits study. Second, the embodied data reveal differences in employment gaps but clear reductions in pay gaps. These findings are related to reductions observed in other developing, export-oriented countries that are main locations for their embodied employment.[25] Indeed, though gender pay gaps have narrowed in Europe and the United States, they have not been eradicated and their embodied employment often exceeds their direct employment. Above all, gender inequality is being expanded along the textile GVC, as this paper attempts to illustrate.

4.5. A textile or a global story?

Finally, it remains to be determined whether changes in gender gaps are specific to the textile sector or simply reflect a more general economic trend. The index presented in Section 3 is useful to address this question. Table 5 shows the results of the GSA, which measures the discrepancy between the gender composition of a sector and that of the total economy.

From a static point of view, the results of the countries in Table 4[26] show that the gender gaps in the textile sector were wider in most countries analyzed in 1991 and were only narrower in China, Hong Kong and Thailand. The textile sector showed wider wage gaps in direct employment everywhere but in India and Europe. In 2019, more countries had values below one, especially considering the jobs connected with a final textile product (embodied). However, many countries had values above one (Europe, Hong Kong, Brazil, Pakistan, Turkey and the United States). The situation is the same for wages, except for China, India, Europe and Vietnam, where the wage gap is narrower.

Aside from simply determining if the textile sector has wider or narrower gender gaps, a more pertinent question is whether they are widening or narrowing now. In other words, it is important to know if inequality in the textile sector is increasing at a comparatively faster or slower rate. To do so, the GSA index is supplemented by a detailed examination of the specific evolution of these gaps, as it can be influenced by changes in gender gaps in the textile sector or in gender gaps overall.

In this context, we find that gender employment gaps in the textile industry are narrowing more rapidly than in all other sectors of the economy in China, Bangladesh, Indonesia, Pakistan, Turkey, Thailand and Vietnam, and widening more slowly in India. While they are widening comparatively faster in Europe and Hong Kong, they are narrowing more slowly in the United States. Considering the embodied gaps, these findings change for China and Thailand, where the associated gaps increase, and even more so in the textile sector. We reach similar conclusions by examining the pay gaps, as they decrease comparatively more in China, India, Brazil, Turkey, Thailand, Vietnam and the United States, and less so in Europe and Hong Kong. They increase more in Bangladesh and China (embodied) and increase less so in Pakistan.

Therefore, these findings suggest different behavior for countries identified as involved in the "second wave" of textile offshoring, as well as India, on the one hand, and developed economies (Europe, Hong Kong and the United States) on the other. In most countries, we see that the gender pay gap is narrowing more in the textile sector than all other sectors of the economy, but not in Europe, Hong Kong or Bangladesh, which may be due to their specialization in production, as discussed above, or to the growth of employment under the same unequal conditions. This helps to build a stronger story about how the textile sector

[24] The regional distribution of employment is included as Supplementary Information, Table A4.

[25] Supplementary Information, Table A5 for Europe and Table A6 for the United States.

[26] The negative values in Table 5 are related to negative gaps (in which women's employment or wages are higher than men's) in the textile sector or in the total economy, but not in both. For example, China has negative gaps in direct textile employment in Table 4 and in Table 5, so the negative gaps do not hold for the total Chinese economy.

evolved during the period studied, as well as its impacts on gender inequality across the countries participating in its chain.

5. Conclusions

This paper analyzes whether the expansion of the textile sector along GVCs has been related to increasing or decreasing gender gaps in the countries involved. We used MRIO methodology to consider not only the jobs created directly in the sector, but all direct and indirect jobs in the world that can be linked to the demand for final textile products. By expanding its scope to include jobs embodied in the GVC, our research provides a more comprehensive view of the situation.

From a methodological perspective, although causal relationships cannot be deduced from the analysis, our MRIO approach captures different interrelated factors driving economic growth, structural and technological change, trade expansion and the evolution of final demand worldwide. These factors influence country specialization, labor intensity and sectoral feminization, which underlie the observed distribution of male and female employment and wages and hence the gender gaps examined in this study.

Our findings indicate that the industrialization that took place in many developing countries between 1991 and 2019 led to an increase in the weight of textile employment in some of them. This change influenced men and women's participation in the labor market and gender inequality. While these changes widened pre-existing gender gaps in employment, they generally narrowed gender pay gaps. In fact, gender gaps in employment also narrowed when China and India were excluded from the sample. This not only demonstrates China and India's leading roles in the global textile chain, but also reveals that they were no longer the main countries undergoing feminization years after they had absorbed most textile sector jobs.

Therefore, we explored the geographical distribution of employment in the textile sector. In addition to China and India, we also identified Thailand, Indonesia, Bangladesh, Pakistan and Vietnam. These countries have low production costs and focus on exporting, thereby confirming a "second wave" in the offshoring of the textile sector linked to countries' industrialization and development. However, to determine whether the feminization of the sector was truly reducing gender inequalities, we had to include information about wages. The study showed a significant reduction of the gender pay gap associated with the textile sector in most countries analyzed. In fact, our SDA analysis found that there is less gender inequality per unit of output related to the sector, directly and along its chain, despite being insufficient to completely eradicate the existing gaps.

We also aimed to identify the countries whose demand for textiles created the most jobs abroad, with a focus on employment created to meet the final demand in Europe and the United States. We found that the increasing demand for textiles in Europe and the United States has indeed led to job creation in other countries. However, these jobs have relocated over time from China to other developing countries. More importantly, this shift has generally coexisted with overall reductions in pay gaps. This perspective underscores the importance of social responsibility based on demand-driven factors. For example, countries must respond to the effects caused by their consumption if their activities widen gender wage gaps. This does not mean that jobs associated with inequality elsewhere should disappear, because they may offer employment opportunities for people. However, it does clearly indicate that everybody is responsible for addressing gender inequality in the labor market. As such, changes should be made wherever it persists.

In short, we observe less gender inequality in employment and wage gaps in some countries that specialized in the textile sector between 1991 and 2019 and find that the sector played a distinct and significant role in the evolution of these gaps. However, since not all employment is equal, we propose future lines of research to investigate the quality of this employment (Bowling et al., 2008).

First, following the approach of Timmer et al. (2019), we propose differentiating the stage of the textile value chain in each country, since specialization in apparel, for example, is not the same as in design. Second, we recommend testing the de-feminization hypothesis with information on qualifications by analyzing the impact of technological modernization on gender inequalities. Third, the inclusion of unpaid work would enable the study of global care chains. Finally, regionalizing the study would also be of great interest. In short, we propose continuing the social expansion of this multi-sector and multi-regional model. These new methodological developments are aligned with the 2030 Agenda for Sustainable Development mentioned in the introduction.

Authors statement

We certify that all authors have seen and approved the final version of the submitted manuscript. We warrant that the article is the original work of the authors, that it has not been previously published, and that it is not under consideration for publication elsewhere.

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CRediT authorship contribution statement

Elena Calvo-Calvo: Writing – review & editing, Writing – original draft, Software, Investigation, Formal analysis, Data curation, Conceptualization. **Rosa Duarte:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization. **Cristina Sarasa:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Data availability

Data will be made available on request.

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Supplementary material

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References

Alsamawi, A., Murray, J., Lenzen, M., 2014. The employment footprints of nations: uncovering master-servant relationships. J. Ind. Ecol. 18 (1), 59–70.
Anghel, B., Conde-Ruiz, J.I., De Artíñano, I.M., 2019. Brechas salariales de Género en España. Hacienda Pública Española (229), 87–119.
Antràs, P., Chor, D., 2013. Organizing the global value chain. Econometrica 81 (6), 2127–2204.
Baldwin, R., 2011. Trade and industrialisation after globalisation's 2nd unbundling: how building and joining a supply chain are different and why it matters (No. w17716). National Bureau of. Economic Research.
Bamber, P., & Hamrick, D. (2019). Gender Dynamics and Upgrading in Global Value Chains: the Case of Medical Devices.
Bamber, P., Staritz, C., 2016. The Gender Dimensions of Global Value Chains. International Center for Trade and Sustainable Development, Geneva.

Banga, R., 2012. Adding value in global value chains. Transnat. Corporat. 21 (3), 33–56.
Barrientos, S., Kabeer, N., Hossain, N., 2004. The gender dimensions of globalization of production. ILO Working Paper (17).
Berik, G., 2000. Mature export-led growth and gender wage inequality in Taiwan. Fem. Econ. 6 (3), 1–26.
Berik, G., van der Meulen Rodgers, Y., Zveglich, J.E, 2004. Does trade promote gender wage equity? Evidence from East Asia. Labor and the Globalization of Production. Palgrave Macmillan, London, pp. 146–178.
Bolea, L., Duarte, R., Sanchez-Choliz, J., 2020. Exploring carbon emissions and international inequality in a globalized world: a multiregional-multisectoral perspective. Resour. Conserv. Recycl. 152, 104516.
Bolwig, S., Ponte, S., Du Toit, A., Riisgaard, L., & Halberg, N. (2008). Integrating poverty, gender and environmental concerns into value chain analysis: a conceptual framework and lessons for action research. DIIS working paper.
Bussolo, M., De Hoyos, R.E., 2009. Gender Aspects of the Trade and Poverty nexus: a Macro-Micro Approach. The World Bank, pp. 1–308, 48455.
Davin, D., 2001. The Impact of Export-Oriented Manufacturing On Chinese women Workers. United Nations Research Institute for Social Development (UNRISD).
Dietzenbacher, E., Los, B., 1998. Structural decomposition techniques: sense and sensitivity. Econ. Syst. Res. 10 (4), 307–324.
Dietzenbacher, E., Romero, I., 2007. Production chains in an interregional framework: identification by means of average propagation lengths. Int. Reg. Sci. Rev. 30 (4), 362–383.
Ding, T., Ning, Y., Zhang, Y., 2018. The contribution of China's bilateral trade to global carbon emissions in the context of globalization. Struct. Chang. Econ. Dyn. 46, 78-88.0.
Duarte, R., Mainar, A., Sánchez-Chóliz, J., 2013. The role of consumption patterns, demand and technological factors on the recent evolution of CO2 emissions in a group of advanced economies. Ecolog. Econ. 96, 1–13.
Duarte, R., Sarasa, C., Serrano, M., 2019a. Economic structure and gender inequality: a global perspective. In: Presented at 28th International Association for Feminist Economics. Glasgow, UK.
Duarte, R., Sarasa, C., Serrano, M., 2019b. Structural change and female participation in recent economic growth: a multisectoral analysis for the Spanish economy. Econ. Syst. Res. 31 (4), 574–593.
Duflo, E., 2012. Women empowerment and economic development. J. Econ. Lit. 50 (4), 1051–1079.
Elson, D., Pearson, R., 1981. 'Nimble fingers make cheap workers': an analysis of women's employment in third world export manufacturing. Fem. Rev. 7 (1), 87–107.
EORA (2019). Internet site https://worldmrio.com/eora26/.
Escaith, H., Inomata, S., 2013. Geometry of global value chains in East Asia: the role of industrial networks and trade policies. Global Value Chains in a Changing World". Fung Global Institute (FGI), Nanyang Technological University (NTU) and World Trade Organization (WTO). Edited by Deborah K. Elms and Patrick Low.
Fana, M., Villani, D., 2022. Decomposing the automotive supply chain: employment, value added and occupational structure. Struct. Chang. Econ. Dyn. 62, 407–419.
Fontana, M., 2009. The gender effects of trade liberalization in developing countries: a review of the literature. Gender Aspects of the Trade and Poverty Nexus. A Macro-Micro Appr. 25–50.
Gereffi, G., 1999. International trade and industrial upgrading in the apparel commodity chain. J. Int. Econ. 48 (1), 37–70.
Gereffi, G., Memedovic, O., 2003. The Global Apparel Value chain: What prospects For Upgrading By Developing Countries. United Nations Industrial Development Organization, Vienna, pp. 2009–2012.
Ghose, A.K. (2000). Trade Liberalization and Manufacturing Employment (p. 324). ILO.
Greenhalgh, S., 1985. Sexual stratification: the other side of" growth with equity" in east Asia. Popul. Dev. Rev. 265–314.
ILO (2019). Employment By Sex and Economic activity, ILO Modelled estimates, Annual. International Labour Organization.
ILO (2018). India Wage report: Wage policies For Decent Work and Inclusive Growth. India: International Labor Organization.
Isard, W., 1951. Interregional and regional input-output analysis: a model of a space-economy. Rev. Econ. Stat. 33 (4), 318–328.
Iwasaki, I., Ma, X., 2020. Gender wage gap in China: a large meta-analysis. J. Lab. Mark. Res. 54 (1), 1–19.
Jansen, M., Peters, R., Salazar-Xirinachs, J.M., 2011. Trade and employment: From myths to Facts. International Labour Office, Geneva.
Jayachandran, S., 2015. The roots of gender inequality in developing countries. Economics 7 (1), 63–88.
Joekes, S. (1999). Gender, property rights and trade: constraints to African growth.
Kabeer, N. (2002). The power to choose: bangladeshi women and labor market decisions in London and Dhaka. Verso.
Krugman, P.R., Obstfeld, M., 2006. Economía Internacional. Pearson Educación.
Kucera, D., Tejani, S., 2014. Feminization, defeminization, and structural change in manufacturing. World Dev. 64, 569–582.
Lenzen, M., Kanemoto, K., Moran, D., Geschke, A., 2012. Mapping the structure of the world economy. Environ. Sci. Technol. 46 (15), 8374–8381.
Lenzen, M., Moran, D., Kanemoto, K., Geschke, A., 2013. Building Eora: a global Multi-Region Input-Output database at high country and sector resolution. Econ. Syst. Res. 25 (1), 20–49.
Miller, R.E., Blair, P.D., 2009. Input-output analysis: Foundations and Extensions. Cambridge university press.
Minx, J.C., Wiedmann, T., Wood, R., Peters, G.P., Lenzen, M., Owen, A., Ackerman, F., 2009. Input–output analysis and carbon footprinting: an overview of applications. Econ. Syst. Res. 21 (3), 187–216. … &.
Molina, J.A., 2015. Caring within the family: reconciling work and family life. J. Fam. Econ. Issues. 36 (1), 1–4.
Nadvi, K., & Thoburn, J. (2003). Vietnam in the global garment and textile value chain: implications for firms and workers. Downloaded as of November.
Ojala, L., Andersson, D., Naula, T., 2008. Linking to global logistics value chains: an imperative for developing countries. Int. J. Technolog. Learn. Innov. Develop. 1 (3), 427–450.
Rose, A., Casler, S., 1996. Input–output structural decomposition analysis: a critical appraisal. Econ. Syst. Res. 8 (1), 33–62.
Rustagi, P., 2005. Understanding gender inequalities in wages and incomes in India. India. J. Lab. Econ. 48 (2), 319–334.
Saraçoğlu, D.Ş., Memiş, E., Voyvoda, E., Kızılırmak, B., 2018. Changes in global trade patterns and women's employment in manufacturing, 1995–2011. Fem. Econ. 24 (3), 1–28.
Seguino, S., 2000. Gender inequality and economic growth: a cross-country analysis. World. Dev. 28 (7), 1211–1230.
Seguino, S., 2020. Engendering macroeconomic theory and policy. Fem. Econ. 26 (2), 27–61.
Sen, A., 1999. Development As Freedom. Oxford University Press, New York.
Standing, G., 1999. Global feminization through flexible labor: a theme revisited. World Dev. 27 (3), 583–602.
Tabeau, A., van Meijl, H., Overmars, K.P., Stehfest, E., 2017. REDD policy impacts on the agri-food sector and food security. Food Policy 66, 73–87.
Tejani, S., 2016. Jobless growth in India: an investigation. Cambrid. J. Econ. 40 (3), 843–870.
Tejani, S., Kucera, D., 2021. Defeminization, structural transformation and technological upgrading in manufacturing. Dev. Change 52 (3), 533–573.
Tejani, S., Milberg, W., 2016. Global defeminization? Industrial upgrading and manufacturing employment in developing countries. Fem. Econ. 22 (2), 24–54.
Timmer, M.P., Miroudot, S., de Vries, G.J., 2019. Functional specialisation in trade. J. Econ. Geogr. 19 (1), 1–30.
UN (1995). Declaración y Plataforma de Acción de Beijing. Reprinted by UN Women in 2014.
UN (2015). Agenda 2030 para el Desarrollo Sostenible.
Wiedmann, T., Wilting, H.C., Lenzen, M., Lutter, S., Palm, V., 2011. Quo Vadis MRIO? Methodological, data and institutional requirements for multi-region input–output analysis. Ecolog. Econ. 70 (11), 1937–1945.
Wood, A., 1991. North-South trade and female labour in manufacturing: an asymmetry. J. Dev. Stud. 27 (2), 168–189.
Wood, A., 1994. North-South Trade Employment and inequality: Changing Fortunes in a Skill-Driven World. Clarendon Press, Oxford.