Bekkers, Eddy; Jhunjhunwala, Kirti; Metivier, Jeanne; Stolzenburg, Victor; Yilmaz, Ayse Nihal

Working Paper

Trade policy bias and the gender wage gap

WTO Staff Working Paper, No. ERSD-2025-05

Provided in Cooperation with:
World Trade Organization (WTO), Economic Research and Statistics Division, Geneva

Staff Working Paper: Research ERSD-2025-05 **9 July 2025**

World Trade Organization

Economic Research and Statistics Division

TRADE POLICY BIAS AND THE GENDER WAGE GAP*

Eddy Bekkers[a], Kirti Jhunjhunwala[b], Jeanne Metivier[c], Victor Stolzenburg[a], and Ayse Nihal Yilmaz[d]

[a]World Trade Organization
[b]World Trade Organization, World Trade Institute
[c]World Trade Organization, Kedge Business School
[d]World Trade Organization, IHEID

Manuscript date: June 24, 2025

Abstract:
On average, wages of female workers are lower than wages of male workers. In this paper, we explore to what extent a gender bias in trade costs explains this gender wage gap and how different policy reforms could lower it. First, we analyse the relation between various types of trade costs and female labour intensity across sectors. We find that more female labour intensive sectors face both higher tariffs and non-tariff barriers when exporting to other regions and when importing inputs. Second, we explore different trade policy reforms with regards to goods and services trade, and find that services trade policy reform has a more meaningful impact. Third, we simulate trade cost reductions caused by a reduced requirement for face-to-face interaction in services jobs, a phenomenon driven by digitali-sation. This change would generate a much larger reduction of the gender wage gap than trade policy reforms.

Key Words: Trade Policy, Gender wage gap, Labour market discrimination
JEL codes: JEL Codes: F16, F17, J16

∗eddy.bekkers@wto.org, corresponding author. The opinions expressed in this paper are those of the authors. They do not represent the positions or opinions of the WTO or its Members and are without prejudice to Members' rights and obligations under the WTO. Any errors are attributable to the authors.

Trade policy bias and the gender wage gap*

Eddy Bekkers[a], Kirti Jhunjhunwala[b], Jeanne Metivier[c], Victor Stolzenburg[a], and Ayse Nihal Yilmaz[d]

[a]World Trade Organization
[b]World Trade Organization, World Trade Institute
[c]World Trade Organization, Kedge Business School
[d]World Trade Organization, IHEID

June 24, 2025

Abstract

On average, wages of female workers are lower than wages of male workers. In this paper, we explore to what extent a gender bias in trade costs explains this gender wage gap and how different policy reforms could lower it. First, we analyse the relation between various types of trade costs and female labour intensity across sectors. We find that more female labour intensive sectors face both higher tariffs and non-tariff barriers when exporting to other regions and when importing inputs. Second, we explore different trade policy reforms with regards to goods and services trade, and find that services trade policy reform has a more meaningful impact. Third, we simulate trade cost reductions caused by a reduced requirement for face-to-face interaction in services jobs, a phenomenon driven by digitalisation. This change would generate a much larger reduction of the gender wage gap than trade policy reforms.

Keywords: Trade Policy, Gender wage gap, Labour market discrimination

JEL Codes: F16, F17, J16

*eddy.bekkers@wto.org, corresponding author. The opinions expressed in this paper are those of the authors. They do not represent the positions or opinions of the WTO or its Members and are without prejudice to Members' rights and obligations under the WTO. Any errors are attributable to the authors.

1 Introduction

Achieving gender equality constitutes a crucial component of sustainable development (United Nations, 2015). However, removing the gender bias in the labour market poses a challenge for many regions at different levels of development. Experimental evidence shows that gender discrimination across industries and occupations continues to exist (Blau and Kahn, 2017). Recent literature has demonstrated the presence of gender biases in trade barriers. World Bank Group and World Trade Organization (2020) show for a selection of economies that sectors employing more female than male workers in production are facing higher tariffs both when buying intermediate inputs, and when selling output, a finding corroborated by Gailes et al. (2018) for the United States. Given that international trade accounts for nearly half of global GDP, this could have a major impact on the gender wage gap. In line with this, a large number of WTO members agreed to collaborate on making trade and development policies more gender-responsive at the WTO's 11th Ministerial Conference in 2018.

Despite its policy relevance, the literature on the relationship between trade and gender inequality is relatively small. Artuc et al. (2023) show that tariff profiles in 54 developing economies repress real incomes of female headed households by on average 0.6 percentage points relative to those of male headed ones. They show that in developing economies female headed households derive a smaller share of their income from and spend a larger share of their budget on agricultural products, which are usually subject to high tariffs. Other recent work uses firm-level data to show that exporting firms have larger gender wage gaps (Boler et al., 2018, Janse van Rensburg et al., 2020). In the context of NAFTA, trade agreements seem to have benefited gender equality in Mexico but harmed it in the United States (Hakobyan and McLaren, 2018, Juhn et al., 2014, Saure and Zoabi, 2014). Moreover, some studies have used country specific quantitative models to identify impacts of trade liberalisation on labour market outcomes for female workers (Fofana, 2003, Fontana, 2002, Fontana and Wood, 2000, Siddiqui, 2009). They find that trade liberalisation is associated with an increased unskilled labour force participation. Earlier work has examined how increased competition from imports leads to a narrowing of the gender wage gap in concentrated (i.e. non-competitive) industries relative to industries that were competitive before trade liberalisation (Black and Brainerd, 2004). However, to the best of our knowledge, there is no study that examines the systematic bias in trade policy against female labour intensive sectors. Nor have studies evaluated the potential of corresponding trade policy reforms to close gender gaps.

In this paper, we address this research gap by studying the potential impact of trade policy reforms in both the goods and services sectors on global and regional gender wage gaps. We first generalize stylized facts of a gender bias in tariffs for goods and expand the evidence to non-tariff measures (NTMs) for both goods and services. Then, we simulate the potential impact of trade policy reforms on the gender wage gap. In particular, we study whether the removal of the gender bias in goods and services trade costs is effective in lowering gender inequality in the labour market. To do so, we conduct three sets of counterfactual experiments. First, we look at the effects of implementing tariff reforms in the goods sector. Second, we evaluate the impact of reducing iceberg trade costs related to NTMs in the services sectors. Third, we explore the potential impact of a reduction in trade costs of face-to-face intensive sectors due to digitalisation.

To conduct the analysis we expand the model by Aguiar et al. (2019b), a recursive dynamic computable general equilibrium model, with labour supply differentiated by gender based on the World Bank's Gender Disaggregated Labour Database (GDLD). The model has several attractive properties. Firstly, its input-output structure allows us to capture channels operating through tariff differences on inputs. This is particularly important in light of the increase in global value chains over the past decades and has not been assessed in the literature yet. Second, the model allows us to examine the importance of assumptions on substitutability of both production factors (i.e. male and female labour) and products (i.e. substitutability across inputs in production as well as across final goods in consumption), which is critical given the large range of empirical estimates on these parameters.

We find that there is a systematic gender bias in both tariffs and NTMs for goods and services. We observe a positive relationship between tariffs and the female labour share in goods sectors. The relationship holds for tariffs on intermediate inputs (an economy's own tariffs) and on final goods (set by trade partners). There is equally a positive relationship between the estimated ad valorem equivalent trade costs (AVEs) of NTMs, as measured by Kee and Nicita (2022), and the female labour share in the goods sector. Turning our attention to services, we find a positive relation between the AVEs of NTMs in services, as measured by the World Bank-WTO Services Trade Policy Database, and the female labour share. Lastly, we explore the link between sectoral face-to-face intensity and female labour intensity. We find that more female labour intensive sectors require more face-to-face interaction, resulting in higher implicit trade costs.

Simulating the removal of this bias in trade costs provides us with four main results. First, simple tariff reforms have only a marginal impact on the gender wage gap with, counterintuitively, oftentimes the wrong sign. In a number of simulations, a simple tariff reform that reduces tariffs on female intensive sectors is projected to favour male workers. The reason is that universal tariff reform not only increases market access but also raises import competition, thus offsetting favourable impacts of such reforms for women. Second, simple NTM reforms in the services sectors can make a more substantial contribution to the reduction in the gender wage gap. As services sectors are more female-intensive than non-services sectors, simple NTM reforms in services have a larger impact than simple reforms for goods trade. Third, sophisticated tariff reforms in the goods sectors to stimulate the export opportunities of female labour intensive sectors and at the same time protect such sectors from increased import competition are projected to lead to a small reduction in the female wage gap, although the effect is an order of magnitude smaller than a simple reduction of NTMs in services trade. Fourth, the projected reduction in the gender wage gap as a result of lower trade costs due to a reduction in the need for face-to-face interaction in economic transactions is an order of magnitude larger than that of trade policy reform for goods or services trade.

These results are robust to several sensitivity checks. For instance, given the large variation in empirical estimates on elasticities of substitution across different time horizons, we show that although the scope for substitution between intermediate inputs in production and final goods in consumption affects changes in sectoral output and regional gender wage premiums, it does not have a significant impact on the gendered effects of trade policy reform at the global level. The modest impact of trade policy reform can better be explained from the fact that such reform also raises import competition.

The paper makes the following four contributions to the literature. First, it provides a comprehensive analysis of the relationship between the size of trade costs and female labour participation across sectors, both for goods and services trade and for tariffs and NTMs. Second, it offers an in-depth analysis of the potential for trade policy reform to contribute to reducing the gender wage gap. More generally, it contributes to the literature on the distributional effects of trade policy within economies. While this literature has so far mainly studied effects across the income or spatial distribution, we add the gender dimension. We also contribute by studying global effects. Many studies focus on a single economy while we show that distributional gains in one economy can be offset by losses in other economies due to specialization patterns in trade. Third, the paper projects the expected impact of digitalisation through reduced importance for face-to-face interaction in economic transactions on the gender wage gap. Fourth, the paper makes a methodological contribution by developing a framework to analyse the impact of trade policy reform on sectoral outcome variables identifying three channels through which such variables are affected - an export opportunities channel, an intermediate input costs channel, and an import competition channel.

Apart from the literature on trade and gender equality, our work is related to a small strand in the trade literature studying biased trade profiles but with different focuses than ours. Shapiro (2021) shows that tariffs are lower in industries with higher CO2 intensities and finds that addressing this pro-pollution bias in trade policy can lower CO2 emissions. Several papers examine the pro-poor bias of tariffs and assess trade policy reforms taking into account income and consumption patterns (see e.g. Artuc et al., 2019, Nicita et al., 2014, Porto, 2006, Ural Marchand, 2012).[1] This work tends to find relatively small distributional effects since trade liberalization triggers different responses, such as increased import competition and lower consumption prices, that have offsetting distributional implications.

The paper is organized as follows. Section 2 explores the relation between trade costs and female labour intensity, focusing in turn on tariffs, NTMs for goods trade, NTMs for services trade and with face-to-face intensity on an technological aspect of trade costs. Section 3 contains a complete description of the economic model employed for the counterfactual experiments as well as a discussion of the baseline and the behavioral parameters. Section 4 presents the design of all experiments simulated, including the model used to develop the analysis and the description of the different scenarios. Section 5 reports the projected changes in wage premiums for all experiments and contains an analysis of the mechanisms and model features driving the results. Section 6 concludes.

2 Stylized facts: gender biases in goods and services trade costs

We begin our analysis by establishing stylized facts that show the presence of a gender bias in trade barriers in goods and services trade. We first construct female labour shares of different

[1]Since consumption data is typically reported at the household level and, hence, not disaggregated by gender, we focus on the income side only.

sectors at a global level. Then, for both goods and services trade, we establish descriptively and econometrically the relationship between the female labour share and trade costs. For goods, we examine both tariffs and AVEs of NTMs and for services, in the absence of tariffs, only AVEs of NTMs. We also relate the female labour intensity with inferred composite trade costs employing the WTO Trade Cost Index to ensure a greater comparability across sectors. Finally, we relate female labour intensity with an important determinant of inferred services trade costs, the need for physical presence in economic interactions, measured by face-to-face intensity of tasks.

2.1 Data Sources

The analysis requires us to obtain data on female labor shares, tariffs, AVEs of NTMs for goods and services, input-output linkages and a number of other data inputs. We use the GTAP version 11 as primary data source for most variables in the simulations, including its input-output tables. For the remaining variables, we combine the GTAP data with various other sources. To measure female labour shares, we rely on the GDLD, created by the World Bank. While GTAP has gender disaggregation in its labour database, it does not report wage rates and number of people employed separately. Hence, to calculate the number of female workers in the labour force, we employ the GDLD.

For tariff data we rely on WITS. For AVEs of NTMs in goods, we use estimates obtained by Nicita and Kee (2016)[2]. For AVEs of NTMs we employ the Services Trade Policy Database (STPD) by the World Bank and WTO and the Services Trade Restrictiveness Index (STRI) by the OECD. One of the major issues with analysing services trade is that there are no directly observable trade costs in services trade akin to tariffs in goods. To resolve this issue, the World Bank has developed a Services Trade Restrictiveness Index which attempts to convert all policies and regulations governing services trade to an index indicative of the levels of costs faced by various services sectors when being traded by different regions. This index has recently been updated in cooperation with the WTO and is now called the STPD. The STPD uses data from 68 economies for various years and for five major services sectors - finance, business, transport, communication and warehousing - which belong to the more traded services.[3] The OECD has developed a similar index - STRI - but it covers a much smaller sample of economies. Both indices can serve as inputs to estimating AVEs of policies and regulations affecting services trade. While we primarily rely on STPD due to its larger economy coverage, we use both databases to ensure that our results are robust to differences in the methodology for the calculation of AVEs and to differences in the sample.

For additional robustness checks, we employ a composite Trade Cost Index developed by Rubinova and Mehdi (2021) on the basis of Egger et al. (2021), which relies on a structural gravity framework to derive trade costs from observed trade flows. This composite index allows us to assess the relationship between the female labor intensity of sectors and trade costs across

[2]Kee and Nicita (2022) estimate bilateral AVEs of NTMs at a detailed product level, based on gravity regressions. According to their methodology, the AVEs of NTMs on product n between two trading partners are equivalent to ad valorem tariffs that induce the same proportionate change in quantity imported as the presence of the relevant NTMs.

[3]See Borchert et al. (2020) for more details on how the database has been constructed.

all sectors rather than within the two broad sectors goods and services separately.

To capture the level of sectoral face-to-face requirements, we use the O*NET database that builds upon extensive United States survey data to assign tasks to occupations and sectors. We then use the resulting face-to-face intensity index along with the GTAP database to estimate AVEs related to the face-to-face requirement and generate shocks representing digitalisation that are then employed in our simulations.

In order to merge the different data sources, the data is aggregated regionally and sectorally depending on the focus of the descriptive statistics and simulations. For the goods sector analysis, we aggregate the data comprising originally 65 sectors and 158 regions into 26 regions and 28 sectors, which combines all services sector into one sector, while expanding the primary and manufacturing sectors. For the services sector analysis, we use a 23 sector aggregation which combines all primary and manufacturing sectors into bigger groups, while expanding the services sector into its most disaggregated version covering 11 services sub-sectors. Since the NTM data is only available for five of these 11 sub-sectors, stylized facts and simulation shocks will be based on these five sub-sectors only. Finally, when using the WTO's Trade Cost Index we use a 34 sector aggregation provided by the OECD's TiVA database since the index is based on this database.[4]

2.2 Tariffs and non-tariff measures in the goods sector

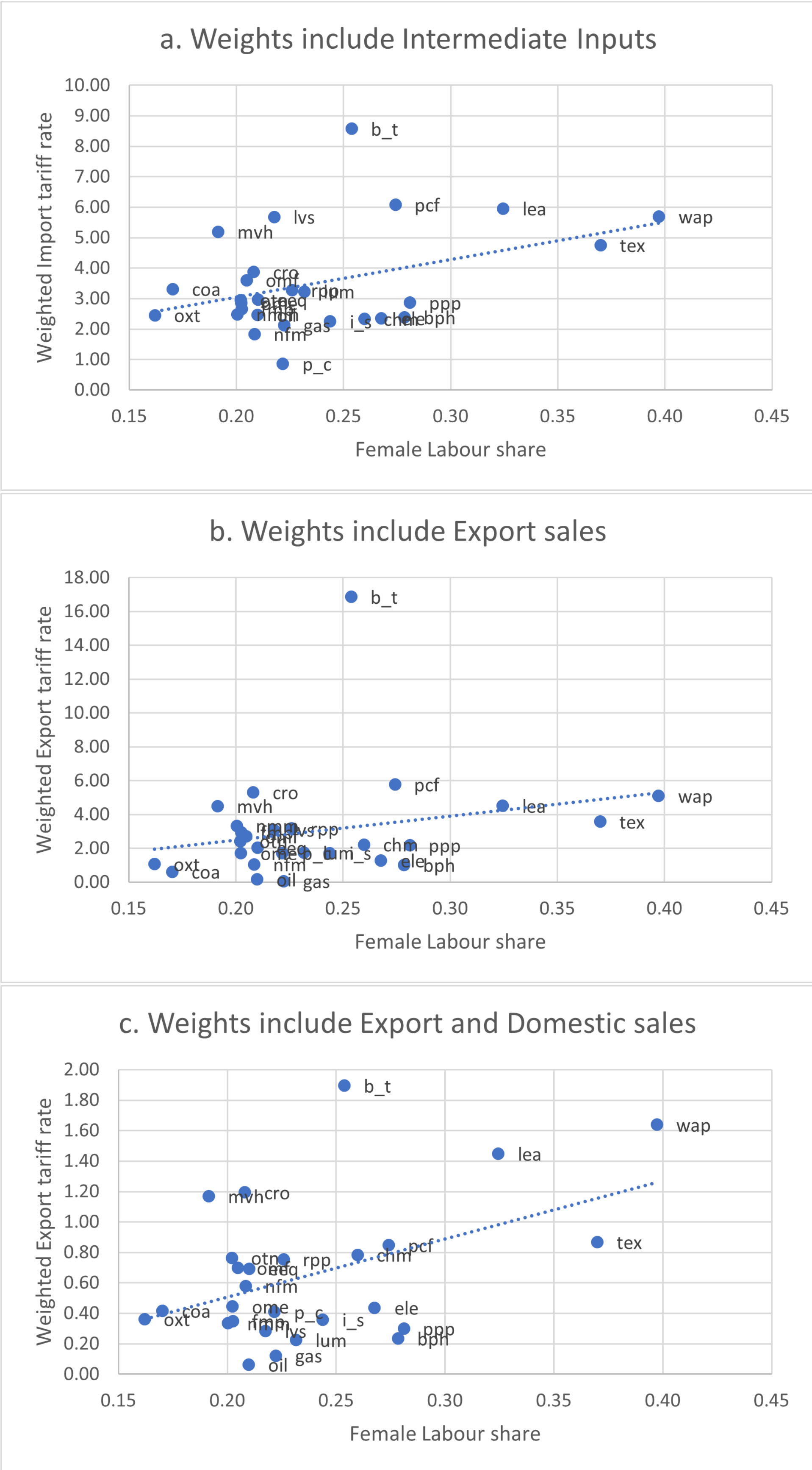
Recent empirical analysis has linked female labour intensity to higher input and output tariffs. World Bank Group and World Trade Organization (2020) observe this relationship for a small set of economies while Gailes et al. (2018) establish similar results specific to the United States. Here, we generalize this finding by greatly expanding the geographical coverage and confirming it econometrically. We then provide novel stylized facts by exploring the relationship between the female labour intensity of sectors and the estimated AVEs of NTMs in goods and services sectors, both on the output and intermediate inputs side.

We begin by combining tariff data from WITS and production data from GTAP's multi-regional input-output tables with the gender-disaggregated labour force data. Figure 1 illustrates our results. Panel a. shows a positive relationship between the average tariffs on intermediate inputs and female labour shares. Sectors with a high female labour share such as wearing apparel (wap) and textiles (tex) face higher tariffs on their inputs than sectors with a lower female share such as petroleum and coal products (p_c) and minerals (oxt). A similar picture arises on the export side. The lower two panels of Figure 1 show that tariffs are higher in exporting sectors which are more female intensive. Panel b. shows the relationship with only exports included in the calculation of the weighted average tariffs while panel c. additionally accounts for the outward orientation of sectors by including domestic sales with tariffs set to zero when calculating the average tariffs faced. Considering only export sales (panel b.), textile (tex), wearing apparel (wap) and leather (lea) all face high tariffs and have a high female labour intensity as in the intermediates case. With both export and domestic sales included (panel c.), the distribution of tariffs faced by exporters changes slightly and the positive correlation becomes even stronger.

Next, we turn to AVEs of NTMs in the goods sector. NTMs considered are sanitary

[4] Sectoral and regional aggregations can be found in Tables B.1, B.2, and B.3 in the Appendix.

Figure 1: Relationship between tariffs and female labour intensity



Source: Authors' calculations based on GTAP multiregional input-output tables, the World Bank's GDLD, and WITS for the most recent available years. Note: Weighted tariffs are calculated as an import-weighted average of 6-digit tariffs. Cross-region averages for each sector are unweighted.

and phytosanitary measures (e.g. hygiene requirements) and technical barriers to trade (e.g. labelling requirements). Compliance with NTMs can be costly such that they can act like tariffs and distort trade flows. In fact, evidence suggests that NTMs by now have a stronger impact on trade than tariffs which have declined significantly over the past decades (UNCTAD and World Bank Group, 2018). As for tariffs, panel a. of figure 2 explores the relationship between the average AVEs on intermediate inputs used by a sector and its female labour share. Panels b. and c. explore the relationship between the average AVEs faced by an exporting sector and the female labour share of the sector using only exports or exports and domestic sales as weights respectively. All panels show that there is a positive correlation between the estimated AVEs of NTMs for goods and the female labour share similar to the results for tariffs.

To explore the link between female labour intensity, $femint$, and tariffs and NTMs more rigorously, we run regressions at the level of sector s and region r. We control for regional fixed effects, a_r, to account for systematic differences in tariffs and NTMs across income and other factors which are also correlated with female labor force participation.[5] Formally, we estimate the following equation:

$$Y_{sr} = \beta_0 + \beta_1 femint_{sr} + a_r + u_{sr},$$

where the dependent variables are either tariffs or AVEs of NTMs.

Table 1 presents the results of the estimation. As in the descriptive statistics, NTMs and tariffs rates are weighted in three different ways. In Column 1 and 2, the dependent variables are in turn the tariffs and the estimated AVEs of NTMs, weighted by intermediate inputs (tar_int and ntm_int, repectively). In column 3 and 4, the dependent variables are in turn the tariffs and AVEs of NTMs, weighted by exports only (tar_exp and ntm_exp, respectively). In column 5 and 6, the dependent variables are in turn the tariffs and AVEs of NTMs, weighted by exports and domestic sales (tar_exd and ntm_exd, repectively). Table 1 shows that the coefficient on the female labour intensity is positive and economically meaningful in all regressions. In addition, the coefficients are all statistically significant at standard confidence levels with the exception of the NTM regression looking at intermediate inputs, which nevertheless has the correct sign.

Table 1: Regressing tariffs and non-tariff measures on female labour intensity

	(1) tar_int	(2) ntm_int	(3) tar_exp	(4) ntm_exp	(5) tar_exd	(6) ntm_exd
femint	4.937***	1.567	3.671*	7.984**	1.552***	3.556***
	(3.84)	(1.30)	(1.70)	(2.05)	(4.00)	(4.06)
constant	2.345***	2.732***	2.279***	2.043**	0.314***	0.0259
	(7.14)	(8.85)	(4.14)	(2.05)	(3.17)	(0.12)
N	702	702	702	702	702	702

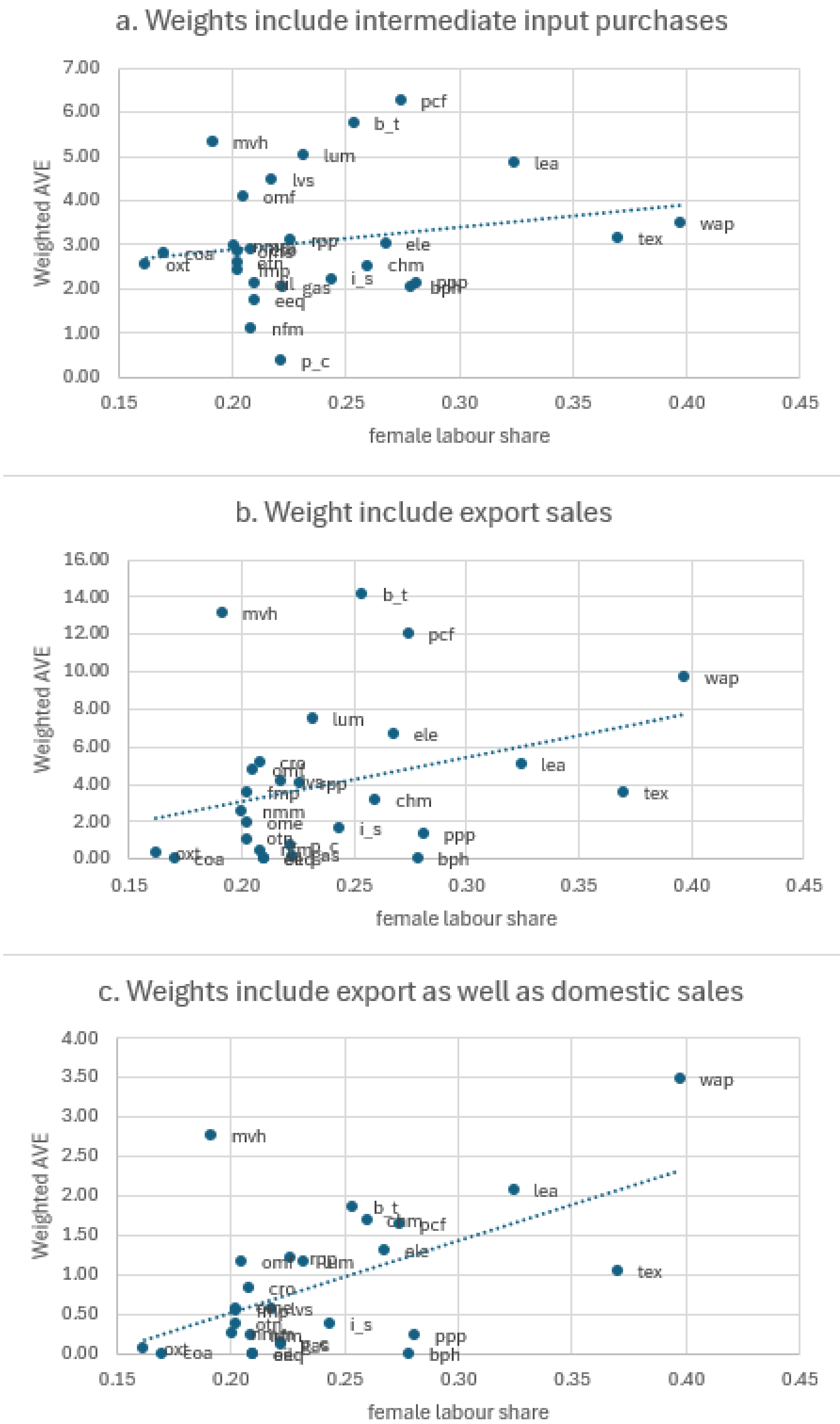
t statistics in parentheses

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

Source: Author‘s calculations based on GDLD and GTAP database
Note: The regression includes region fixed effects.

[5] We cannot control for sector-fixed effects as female intensity of sectors across economies is highly correlated.

Figure 2: Relationship between NTMs and female labour intensity



Source: Authors' calculations based on GTAP multiregional input-output tables, GDLD labour share data, and Kee and Nicita (2022). Note: The Y-axis plots the ad valorem equivalent (AVEs) of trade costs. Global averages across all regions for each sector are unweighted.

Our analysis in this section reveals that there is a systematic gender bias in goods trade costs. While this evidence is not causal and might be related to unobserved factors, it highlights that trade policy is a potential area for intervention by policy makers aiming at achieving gender equality on the labour market.

2.3 Non-tariff measures in services

The services sector accounts for around two thirds of global GDP, a share which is quickly growing. It is also the fastest growing sector in international trade (World Trade Organization, 2019). Baldwin (2022) highlights that the growing importance of trade in services and the role of services in GDP will increase in the future. Different studies highlight that this ongoing structural change has important implications for development and gender equality (see e.g. Fan et al., 2023, Ngai and Petrongolo, 2017, Rodrik and Stiglitz, 2024). Moreover, while services trade is not subject to tariffs like goods trade, it faces myriad trade barriers, such as market access restrictions and strict regulations, which lead to higher total trade costs than in goods trade (World Trade Organization, 2023). Additionally, goods trade is the subject of significantly more analysis, especially in the context of gender inequality, even though the services sector account for 59% of female employment globally as of 2019 (ILOSTAT, 2021).

As a result, any study looking at the impact of trade on gender inequality is incomplete without consideration of the services sector. Hence, in this section, we replicate the analysis done for the goods sectors and study the relationship between trade costs and the female intensity of services sub-sectors.

We use the World Bank-WTO STPD database to construct AVEs for five services sectors based on estimating a gravity equation with both domestic and international sales and a dummy for international trade flows interacted with the STPD score.[6] We then compare the AVEs to female labour shares in sectors using the same methodology as in the goods sector.

Figure 3 shows the relationship between AVEs calculated using data from STPD.[7] Of the five sub-sectors covered by the STPD, we break finance into two sectors - insurance (ins) and other finance (ofi).[8] We remove warehousing as the co-efficient for its estimate is not significant in our AVE regressions. When calculating the AVEs we find that in finance the STPD displays a positive co-efficient in the gravity estimation, suggesting problems in the estimation of barriers related to this sector. Therefore, this sector is excluded from the analysis as well.[9] Hence, we

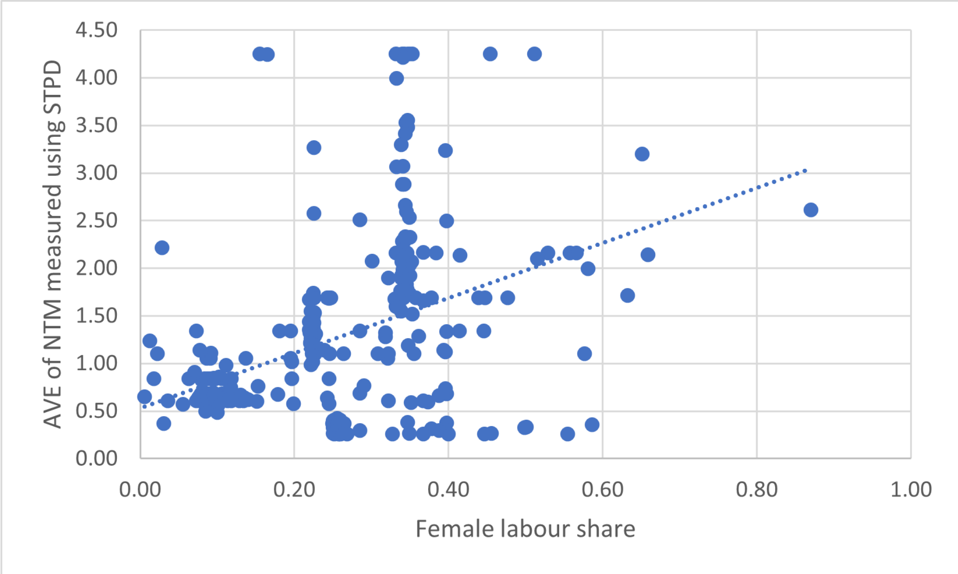
[6]For more details on AVE estimations, see Benz and Jaax (2022).

[7]We use a constant elasticity of substitution of 3.8 and estimate the trade elasticity using a Poisson pseudo maximum likelihood (PPML) estimator, with regressions run separately for each sector. The overall methodology as mentioned earlier follows Benz and Jaax (2022).

[8]The STPD allows to break the five major sub-sectors into 23 smaller sub-sectors. However, the smaller aggregates do not correspond to GDLD sub-sectors with the exception of insurance and other finance so we cannot use this information.

[9]Constructing an index or database that translates policies and regulations to a numeric measurement of barriers to trade is far from easy. The task requires the collation of all legal policies , assigning numeric values to them, and aggregating them in one index. This is based on scores of assumptions and judgement calls one needs to make while constructing these indices and hence, while informative and extremely useful, such datasets are not without flaws. To illustrate such issues, in particular with respect to banking, Shepherd (2020) develops an alternative method to assess cross-border restriction on banking based on machine-learning. He finds relevant differences to OECD‘S STRI which in turn is similar to the STPD used here. Hence, the values of the index in

Figure 3: Relationship between STPD-based AVEs of NTMs on services trade and female labour intensity



Source: Services Trade Policy Database created by World Bank and the World Trade Organization (WTO) and combined with Gender Disaggregated Labour Database by the World Bank Note: Ad valorem equivalent values are estimated using gravity estimation regressions with a border dummy and an interaction term with STPD and dummy.

have AVE estimates for four sectors - Business (bus), Insurance (ins), Communication (cmn) and Transport (trp). Due to this limited set of observations we plot the data at the economy-sector level and refrain from estimating the correlation econometrically. Nevertheless, from Figure 3 we can see that the four sectors display a positive relationship between their AVEs and the female labour share.

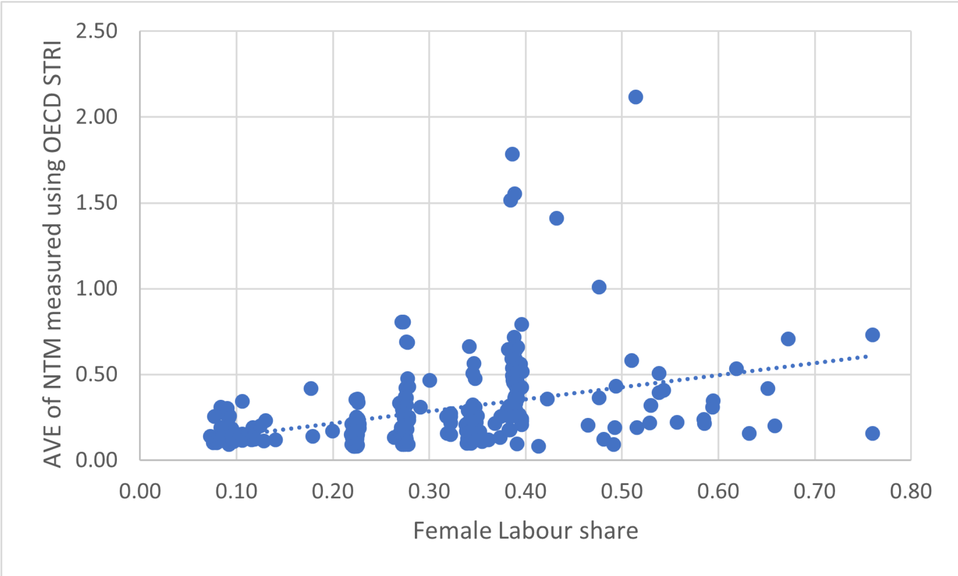
As a robustness check, we construct a similar figure (Figure 4) using data from OECD‘s STRI and find a positive trend here as well. In the calculation of these AVEs, we use elasticities and co-efficients estimated by Benz and Jaax (2022) using STRI data from the OECD.

2.4 WTO Trade Cost Index

AVE estimates linked to regulations or tariffs as used in the previous two sections do not allow us to establish the relationship between trade costs and female labour shares across sectors but only within sectors. However, having comparisons across sectors is useful to interpret the results of the simulations as they can explain why reforms in one sector are more effective than in others. Therefore, as a next step, we analyse the relationship between female labour intensity and a derived measure for total sectoral trade costs. This measure has the added benefit that it is available for a larger number of services sub-sectors so that we can econometrically assess the relationship between female labour shares and trade costs including services. Indirect trade cost estimates infer barriers to trade using inverse gravity estimations, that is by comparing changes in international to domestic trade flows. Different sources for such trade cost estimates are available. We rely on the WTO trade cost index developed by Rubinova and Mehdi (2021)

financial services sector might be unreliable and are removed from our analysis.

Figure 4: Relationship between STRI-based AVEs of NTMs on services trade and female labour intensity



Source: Services Trade Restrictiveness Index created by OECD and combined with Gender Disaggregated Labour Database by the World Bank Note: Ad valorem equivalent values are estimated using gravity estimation regressions in line with Benz and Jaax (2022).

following Egger et al. (2021) as it is based on the most recent advances in structural gravity estimation.[10]

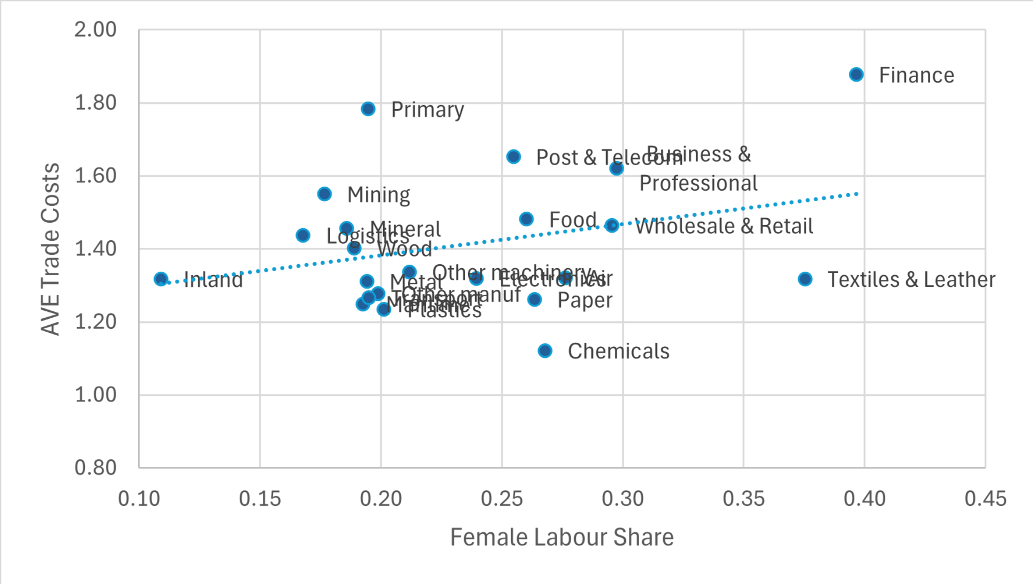
As a result of the inverse gravity approach, such trade cost estimates are inclusive of all factors that impede foreign sales more than domestic ones. However, the WTO trade cost index provides sub-indices, including a policy sub-index, that focus on particular aspects of overall trade costs. The policy sub-index estimates trade costs setting all economies at a minimum geographical, historical and institutional distance to each other. The underlying assumption is that once these factors are excluded, any remaining driver is policy-related. Since our focus is on policy reforms, we select this policy sub-index for our analysis.

Figure 5 shows that yet again there is a positive relationship between the trade costs measured by Rubinova and Mehdi (2021) and the female labour share. Moreover, the upper right quadrant is almost exclusively populated with services sub-sectors. This result suggests that services trade policy reform might be more effective in lowering gender wage gaps, a proposition we will test more formally in section 5.

To establish the relationship between the trade cost index and female labour shares more formally, we next re-run the equation employed to test the link between female intensity and tariffs but with the Trade Cost Index-based AVEs as dependent variable. The co-efficient on female intensity is again positive, large, and statistically significant, further proving that sectors employing more women, face higher trade costs.

[10]While estimates are available for all sub-sectors within the economy, we focus on sub-sectors with relevant trade flows to avoid the results being driven by sectors in which non-policy factors severely limit trade such as construction, health, public administration, real estate, or private services.

Figure 5: Relationship between Trade Cost Index-based AVEs and female labour intensity



Source: Estimated AVEs based on Rubinova and Mehdi (2021) and combined with data from the Gender Disaggregated Labour Database by the World Bank.

Table 2: Regressing Trade Cost Index-based AVEs on female labour intensity

	(1)
	Trade Cost Index - Policy Component
femint	0.405***
	(6.53)
Constant	0.122***
	(7.95)
Observations	1297
Adjusted R^2	0.343

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Author‘s calculations based on GDLD and WTO Trade Cost Index
Note: The regression includes region fixed effects.

2.5 Other components of trade costs: face-to-face intensity

At this stage, it is evident that tariffs as well as NTMs exhibit a gender bias in both goods and services trade. In addition, the evidence so far suggests that the corresponding policy-related trade costs are particularly high in services. However, there are many other components of trade costs. In fact, estimates suggest that policy-related trade costs constitute less than one-fifth of overall trade costs (Rubinova and Mehdi, 2021). Some of these components, while not directly driven by policy, may nevertheless be affected by policy reform. This pertains especially to one component of trade costs that is currently in rapid decline for some sub-sectors and crucial to services trade costs, namely the need for face-to-face interaction.

Services sub-sectors differ from goods sub-sectors in one key aspect - tangibility. Since services are not tangible goods, their exchange often requires face-to-face interaction. While tangible goods may require physical presence or face-to-face interaction to be produced, it generally does not require the same to be transacted. For example, a doctor diagnosing or operating on a patient needs face-to-face interaction for the transaction to be complete. Whereas a pharmacist can simply deliver its medicines and receive payment without necessary face-to-face interaction.

However, with digitalisation, face-to-face interactions would no longer need physical presence. On top of this, new technologies would allow for reduced face-to-face interactions in all sectors - goods and services. For example, the doctor can now diagnose its patient over a video call and the pharmacist can use an app to determine orders of his regular customers, receive payment for the same online and get it delivered to their doorstep. Hence, technology can change the operating environment and affect trade costs in all sectors, albeit particularly in services.

In fact, when Baldwin (2019) argues that the importance of services in the global economy will grow, he also discusses how this growth is led by a wave of digitalisation which makes the trade of these services less dependent on face-to-face interactions. Recent evidence finds that the Covid-19 pandemic has strongly accelerated this trend (Jaumotte et al., 2023). Therefore, given the role that policy can play in digitalization and the importance of services for gender equality, we examine this part of trade costs to inform our final set of simulations.

To explore this, we use a measure of face-to-face requirements developed by Blinder (2009) using data from the American O*NET database,[11] which records data collected by surveys filled by employees for almost 800 different occupations across the United States. The index uses data on the importance scores assigned to various tasks in various occupations and condenses it into a measurement of face-to-face requirement based on task intensities calculated using Oldenski (2012) method for scoring. We then calculate the share of each occupation in a particular sector using labour force data from the United States government,[12] and hence, construct a measure of face-to-face requirements in each sector.

We plot the relationship of this measure with trade costs as measured by another inverse-gravity based trade cost measure, the Head and Ries index (Head and Ries, 2001)[13] (Figure 6) as well as female intensity (Figure 7) in various sectors. We find a positive correlation of face-to-face intensity with both inferred trade costs and female labour intensity, implying that sectors that have a higher face-to-face intensity are not only more female-intensive but also face, as expected, higher trade costs.

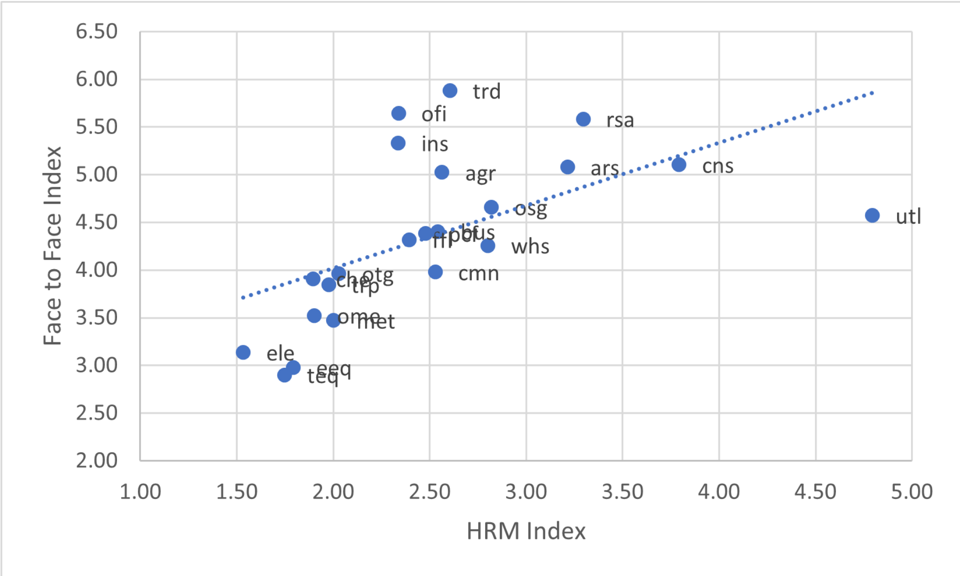
To conclude the stylized facts section, we observe that in i) trade costs in goods and services trade; ii) overall trade costs; and iii) the face-to-face intensity component of trade costs, there is a gender bias with larger trade costs in female labour intensive sectors. In the next section, we explore whether trade policy reforms in both goods and services and changes in trade costs because of digitalisation can help to reduce the gender wage gap.

[11] See O*NET Resource Center (2022).

[12] See Bureau of Labor Statistics (2017).

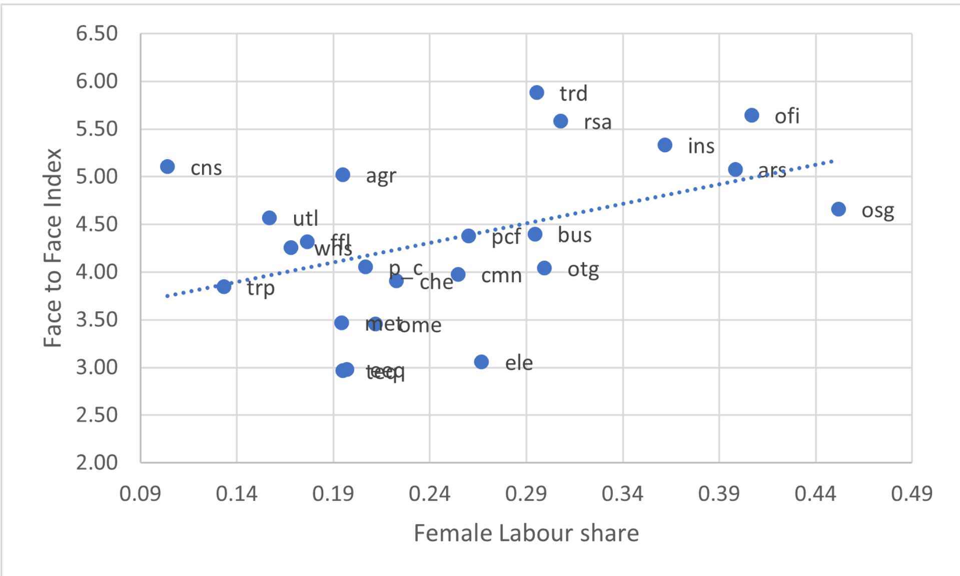
[13] Referred to as HR index by us, this is a similar measure of total trade costs as the WTO trade costs index but can more readily be merged onto O*NET data, which is why we use it here.

Figure 6: Relationship between trade costs measured by the HR Index and face to face index



Source: Author's calculations based on data retrieved from GTAP v11, O*NET 27.0 and United States bureau of labour statistics. Note: Methodology for construction of face-to-face index and HR index are discussed in detail in the appendix.

Figure 7: Relationship between face to face index and female labour share



Source: Author's calculations based on data retrieved from O*NET 27.0, United States bureau of labour statistics and Gender Disaggregated Labour Database by the World Bank. Note: Methodology for construction of face-to-face index and HR index are discussed in detail in the appendix.

3 Economic Model

Establishing a positive relationship between female intensity and the level of trade barriers is only a first step to assess the role of trade policy for gender inequality. The next step is to assess how much these differential trade barriers affect gender wage gaps. To do so, we move to devising policy reforms and analysing their impacts on female and male wages. These counterfactual experiments are conducted with a quantitative trade model that provides a recursive dynamic extension to Corong et al. (2017), a general equilibrium Armington model with input-output linkages,[14] with labour supply differentiated by gender.[15]

The model describes the global economy with multiple regions and multiple sectors. In each region a representative agent allocates her income to three categories of expenditures, private household expenditures, government expenditures, and savings. Income of the representative household consists of the sum of factor income and tax revenues. The model is recursive dynamic and does not feature forward looking intertemporal consumption decisions. Instead, savings are included in the static utility function. This ensures that a reduction in savings and, thus, an increase in current consumption would not generate large welfare effects. The formal underpinning comes from Hertel et al. (2007) who showed that the expressions for consumption in an inter-temporal setting can also be derived from a static utility maximisation problem with savings in the utility function.

Perfectly competitive firms produce employing intermediate inputs and value added with value added consisting of seven factors factors of production, capital, natural resources, land, and four types of labour, high-skilled and low-skilled male and female workers. There is no scope for substitution between the different intermediates and value added (Leontief production function), whereas value added is characterized by a nested constant elasticity of substitution (CES) production function. Capital and labour are mobile, which means that arbitrage equalizes the cost of labour across all sectors. Hence, when output rises in some sectors, but falls in others in a particular region, it is expected that labour from the latter would move to the former. If more sectors face a fall in output in a particular region (e.g., due to an increase in import competition), then factor demand would fall and lead to a fall in wages. The supply of land and natural resources are fixed, whereas capital in period t is a function of capital in period $t-1$ plus investment. Labour supply is described by an isoelastic elasticity supply function. Land and natural resources are imperfectly mobile between sectors, whereas the other production factors are perfectly mobile between sectors.

International trade is modelled with an Armington structure featuring love-of-variety between goods from different economies of origin. The import price is equal to the export price plus the export tax, the cif-fob margin, and the import tariff. The cif-fob margin is used to pay the global transportation sector, which hires transport services from different economies. There are three sets of equilibrium equations, goods market equilibrium factor market equilibrium, and global savings equal to global investment. The ratio of the trade balance to income is fixed.

The next subsections will describe in turn demand, supply, international trade, and equilibrium with some of the details relegated to the appendix.

[14]Corong et al. (2017) serves as standard GTAP model.

[15]See Aguiar et al. (2019b) for details of the version without gender disaggregation.

3.1 Demand

There are $r = 1, .., R$ economies, $c = 1, .., C$ commodities, and $e = 1, .., E$ factors of production. Utility of a representative agent in region r is determined by private household consumption, q_r^{pr}, government consumption, q_r^{go}, and savings, q_r^{sa}, according to a Cobb-Douglas utility function:

$$u_r = (q_r^{pr})^{\kappa_r^{pr}} (q_r^{go})^{\kappa_r^{go}} (q_r^{sa})^{\kappa_r^{sa}} \tag{1}$$

Preferences across different sectors are non-homothetic implying that it is not possible to define a price index for private household consumption. Therefore, we cannot maximise utility in equation (1) subject to a conventional budget constraint with prices. Instead, based on McDougall, Robert (2002) an implicit budget constraint is defined, with income x_r equal to expenditures on category ca goods, e_r^{ca}, which are a function of the quantity of private consumption, q_r^{ca}:

$$\sum_{ca \in \{pr,go,sa\}} e_r^{ca} (q_r^{ca}) = x_r \tag{2}$$

This leads to the following expression for expenditures on category $ca = pr, go, sa$, x_r^{ca}:

$$x_r^{ca} = \kappa^{ca} \left(\frac{\Psi_r^{ca}}{\Psi_r} \right) x_r \tag{3}$$

The difference with a standard Cobb-Douglas expression is the presence of the ratio of Ψ_r^{ca} and Ψ_r. Ψ_r^{ca} is defined as the elasticity of quantity, q_r^{ca}, with respect to expenditure, x_r^{ca}, whereas Ψ_r is the elasticity of utility, u_r, with respect to expenditure, x_r. For goods with homothetic preferences across different sectors or no further allocation across sectors, respectively government consumption and savings, the elasticity is 1 ($\Psi_r^{go} = \Psi_r^{sa} = 1$).

Given non-homothetic preferences for private household consumption across sectors, the share of spending on private goods is larger than the Cobb-Douglas parameter κ^{pr} if the elasticity of private quantity, q_r^{pr}, with respect to private expenditure, x_r^{pr}, is larger than 1.

Ψ_r^{pr} follows from hat differentiating the indirect utility function for private goods defined below in equation (6) below with respect to quantity and expenditure, implying the following expression with s_{rc}^{pr} the share of private consumption allocated to good c:

$$\Psi_r^{pr} = \frac{1}{\sum\limits_{c=1}^{C} s_{rc}^{pr} \eta_{rc}} \tag{4}$$

Ψ_r follows from utility maximization in equation (1):[16]

$$\Psi_r = \Psi_r^{pr} \kappa_r^{pr} + \kappa_r^{go} + \kappa_r^{sa}. \tag{5}$$

Non-homothetic preferences for private household consumption across sectors are characterized by the constant distance elasticity (CDE) utility function. Under this non-homothetic utility function income elasticities differ from 1 and do not converge to 1 as for the more basic linear expenditure system. At the same time the model stays tractable, since a limited number of

[16]The formal derivation is available in Appendix A.3.

parameters can be calibrated from income and own-price elasticities of demand unlike utility functions such as AIDADS which requires a larger number of parameters.

CDE preferences are formally described by the following implicit expenditure function:

$$\sum_{c=1}^{C} \alpha_{rc} \left(q_r^{pr}\right)^{\gamma_{rc}\eta_{rc}} \left(\frac{p_{rc}^{pr}}{x_r^{pr}}\right)^{\gamma_{rc}} = 1 \tag{6}$$

q_{rc}^{pr} and p_{rc}^{pr} are respectively the quantity and price of private household consumption; x_r^{pr} private household expenditure, while α_{rc}, γ_{rc} and η_{rc} are respectively the distribution, substitution and expansion parameters of the CDE utility function. Applying Shepherd's lemma, q_{rc}^{pr} can be derived by differentiating equation (6) with respect to p_{rc}^{pr} and x_r^{pr}:

$$q_{rc}^{pr} = \frac{\alpha_{rc} \left(q_r^{pr}\right)^{\gamma_{rc}\eta_{rc}} \left(\frac{p_{rc}^{pr}}{x_r^{pr}}\right)^{\gamma_{rc}-1} \gamma_{rc}}{\sum_{d=1}^{C} \alpha_{rd} \left(q_r^{pr}\right)^{\gamma_{rd}\eta_{rd}} \left(\frac{p_{rd}^{pr}}{x_r^{pr}}\right)^{\gamma_{rd}} \gamma_{rd}}. \tag{7}$$

Preferences across the different sectors for government consumption are described by a Cobb-Douglas utility function with the quantity of sectoral demand, q_{rc}^{go}, and the price index, p_r^{go}, for government consumption defined as:

$$q_{rc}^{go} = \frac{\beta_{rc}^{go}}{p_{rc}^{go}} p_r^{go} q_r^{go} \tag{8}$$

$$p_r^{go} = \prod_{c=1}^{C} \left(\frac{p_{rc}^{go}}{\beta_{rc}^{go}}\right)^{\beta_{rc}^{go}} \tag{9}$$

3.2 Supply

Perfectly competitive firms produce by combining value added and intermediate inputs without scope for substitution between the inputs. Hence, the quantity of composite input bundles to produce in sector c, q_{rc}^{ib}, is a Leontief function of the quantity of value added, q_{rc}^{va}, and intermediate from sector d (with superscript fi_c for the purchasing sector c) from sector d, $q_{rd}^{fi_c}$:

$$q_{rc}^{ib} = \min\left\{\varpi_{rc}^{va} q_{rc}^{va}, \varpi_{r1}^{fi_d} q_{r1}^{fi_d}, .., \varpi_{rS}^{fi_E} q_{rE}^{fi_E}\right\} \tag{10}$$

The demand for the quantities of value added in purchasing sector c and intermediates purchased by sector c from sector d are thus given by:

$$q_{rc}^{va} = \varpi_{rd}^{va} q_{rc}^{ib} \tag{11}$$

$$q_{rd}^{fi_c} = \varpi_{rd}^{fi_c} q_{rc}^{ib} \tag{12}$$

The price index of input bundles, p^{ib}_{rc}, is a function of the prices of intermediates, $p^{fi_c}_{rd}$, and the price of value added p^{va}_{rc}. Because of the Leontief assumption the equation is additive:

$$p^{ib}_{rc} = \varpi^{va}_{rc} p^{va}_{rc} + \sum_{d=1}^{C} \varpi_{rd} p^{fi_c}_{rd} \tag{13}$$

There are five production factors in the model, capital, land, natural resources, and four types of labour, high-skilled and low-skilled female and male labour. Demand for the different production factors is CES, implying the following expressions for the price of value added, p^{va}_{is}, and demand for factor inputs (endowments e), q^{end}_{ise}:

$$p^{va}_{rc} = \left[\sum_{e=1}^{E} \left(\iota_{rce}\right)^{\chi_c} \left(t^{end}_{rce} \omega_{rce} \right)^{1-\chi_r} \right]^{\frac{1}{1-\chi_c}} \tag{14}$$

$$q^{end}_{rce} = \left(\iota_{rce} \frac{c^{va}_{rc}}{t^{end}_{rce} \omega_{rce}} \right)^{\chi_c} q^{va}_{rc} \tag{15}$$

ω_{rce} and t^{end}_{rce} are respectively the price of and the tax on endowment e and the substitution elasticity between production factors, χ_c.[17] All taxes are expressed in power terms, so as 1 plus the ad-valorem tax rate.

The demand for high-skilled and low-skilled labour, q^{end}_{rce}, are a CES function of the demand for high-skilled and low-skilled male and female labour, q^{gen}_{rcg}:

$$q^{gen}_{rcg} = \left(\varkappa_{rcg} \frac{\omega_{rce}}{t^{gen}_{rcg} \omega^{gen}_{rcg}} \right)^{\upsilon_e} q^{end}_{rce}; e = hs, ls; g = hsm, hsf, lsm, lsf \tag{16}$$

$$\omega_{rce} = \left[\sum_{g \in \{hsm, hsf, lsm, lsf\}} \left(\varkappa_{rcg}\right)^{\upsilon_e} \left(t^{gen}_{rcg} \omega^{gen}_{rcg} \right)^{1-\upsilon_e} \right]^{\frac{1}{1-\upsilon_e}} \tag{17}$$

ω^{gen}_{rcg} is the price of (high-skilled or low-skilled) labour by gender.

For the allocation of production factors across sectors we make a distinction between mobile production factors (capital and labour), immobile production factors (land) and sector-specific production factors (natural resources). For mobile production factors, the factor price w_{rce} (also the nominal rental rate on capital) is equal between sectors implying that total factor supply, q^{end}_{rce}, is equal to the sum of sectoral supplies, q^{end}_{re}:

$$\omega_{rce} = w_{re} \tag{18}$$

$$q^{end}_{re} = \sum_{c=1}^{C} q^{end}_{rce} \tag{19}$$

For immobile production factors a constant elasticity of supply (CET) function is assumed. Hence, the supply of the immobile production factor e in sector c rises with the factor reward of the production factor in sector c, ω_{rce}, relative to the average factor reward, w_{rc}, with the

[17] χ_c is sector-specific to reflect that in some sectors there are sector-specific production factors which drive down the substitution elasticity.

responsiveness governed by the elasticity of transformation, μ_e:

$$q_{rce}^{end} = \left(\frac{\omega_{rce}}{\vartheta_{rce} w_{rc}}\right)^{\mu_e} q_{rc}^{end} \tag{20}$$

$$w_{rc} = \left(\sum_{c=1}^{C} (\vartheta_{rce})^{-\mu_e} (\omega_{rce})^{\mu_e+1}\right)^{\frac{1}{\mu_e+1}} \tag{21}$$

The supply of land and natural resources is governed by an isoelastic supply function with ξ_e the elasticity of supply of production factor e:

$$q_{re}^{end} = w_{re}^{\frac{1}{\xi_e}} \tag{22}$$

The supply of the different types of labour is fixed in the benchmark, whereas in robustness checks we work with an isoelastic supply function as in equation (22).

The supply of capital in period t, $q_{rcap}^{end,t}$, is equal to the supply of capital in period $t-1$ minus depreciation plus the quantity of aggregate investment, q_r^{in}:

$$q_{rcap}^{end,t+1} = (1-\delta)\, q_{rcap}^{end,t} + q_r^{in,t} \tag{23}$$

Investment goods are, like intermediates, a Leontief composite of goods used for investment from different industries, q_{is}^{in}:

$$q_i^{in} = \min\left\{\varpi_{i1s}^{in} q_{i1}^{in}, .., \varpi_{iS}^{in} q_{iS}^{in}\right\} \tag{24}$$

Investment demand in different sectors, q_{rc}^{in}, is a Leontief function of aggregate investment:

$$q_{rc}^{in} = \varpi_{rc}^{in} q_r^{in} \tag{25}$$

$$p_r^{in} = \sum_{c=1}^{C} \varpi_{rc}^{in} p_{rc}^{in} \tag{26}$$

The quantity of investment, q_r^{in}, is determined by the fixed trade balance ratio as discussed in the next subsection.

3.3 International Trade

There are four groups of agents ag demanding commodities: private households, the government, investors, and firms purchasing intermediate inputs. They split their demand, q_{rc}^{ag}, between domestic and imported goods, $q_{rc}^{so,ag}$; $so = d, m$, according to a CES function, reflecting Armington preferences. Import and domestic demand can be summed across the groups of agents to give total importer and domestic demand, q_{rc}^{so} with superscript so the source, $so = d, m$:

$$q_{rc}^{so} = \sum_{ag} q_{rc}^{so,ag} = \sum_{ag} \left(\frac{ta_{rc}^{so,ag} p_{rc}^{so}}{p_{rc}^{ag}} \right)^{-\rho_c} q_{rc}^{ag} \tag{27}$$

$$p_{rc}^{ag} = \left(\left(ta_{rc}^{d,ag} p_{rc}^{d} \right)^{1-\rho_c} + \left(ta_{rc}^{m,ag} p_{rc}^{m} \right)^{1-\rho_c} \right)^{\frac{1}{1-\rho_c}} \tag{28}$$

$ta_{rc}^{so,ag}$ is a group–specific and source-specific tariff; p_{rc}^{ag} and p_{rc}^{so} are respectively the prices corresponding with q_{rc}^{ag} and q_{rc}^{so}. Since total domestic and import quantities, q_{rc}^{so}, are homogeneous across the different agents, they do not have a superscript ag.[18] The price of the domestic good, p_{rc}^{d}, is equal to the production tax, tp_{rc}, times the price of the input bundle defined in the previous subsection, p_{rc}^{ib}:

$$p_{rc}^{d} = tp_{rc} p_{rc}^{ib} \tag{29}$$

Bilateral import demand from source economy s, q_{src}, is a CES function of aggregate import demand, q_{rc}^{m} (Armington preferences):[19]

$$q_{src} = \left(\frac{p_{src}}{p_{rc}^{m}} \right)^{-\sigma_c} q_{rc}^{m} \tag{30}$$

$$p_{rc}^{m} = \left(\sum_{c=1}^{C} p_{src}^{1-\sigma_c} \right)^{\frac{1}{1-\sigma_c}} \tag{31}$$

The landed bilateral price, p_{src}, is equal to the cif-price, p_{src}^{cif} times iceberg trade costs, t_{src}, times bilateral ad valorem tariffs, ta_{src}, whereas the cif-price, p_{src}^{cif}, is equal to the production tax, tp_{sc} times the price of input bundles in the exporting economy, p_{sc}^{ib}, both in the exporting economy, times the export tax, te_{src}, plus the price of transport services, p_{src}^{ts}, divided by a transport services technology shifter, a_{src}^{ts}:

$$p_{src} = ta_{src} t_{src} p_{src}^{cif} = ta_{src} t_{src} p_{src}^{fob} + \frac{p_{src}^{ts}}{a_{src}^{ts}} = ta_{src} t_{src} \left(te_{src} tp_{sc} p_{sc}^{ib} + \frac{p_{src}^{ts}}{a_{src}^{ts}} \right) \tag{32}$$

Firms spend a fixed quantity share of sales on transport services as further discussed in Appendix A.1

[18] The modelling of international trade with aggregate group specific domestic and import demand, but group generic import demand from different sources is chosen, because group-specific aggregate import and domestic spending shares are typically available in national account data, whereas in international trade data group-specific import shares per trading partner are absent. So the data provide for example information on specific import and domestic spending shares of the government, private households, and each of the sectors demanding intermediates, but not on import shares from different trading partners. So called MRIO databases employ the BEC classification to generate group specific bilateral import shares. However, with this approach it is not possible to generate group specific bilateral import shares for each of the sectors purchasing intermediate inputs. Only a split between consumption goods, capital goods, and intermediates is feasible.

[19] In exposition we allow for intra-regional trade. Such trade has to be considered because some regions are aggregates of different economies.

3.4 Goods Market Equilibrium, Household Income, and Trade Balance Closure

Under goods market equilibrium the quantity produced is equal to the quantity of input bundles, q_{rc}^{ib}, in sector c in region r which is equal to the quantity demanded, consisting of domestic demand, import demand, and demand for transport services:

$$q_{rc}^{ib} = \sum_{ag \in \{pr,go,fi,in\}} q_{rc}^{d,ag} + \sum_{c=1}^{C} t_{rsc} q_{rsc} + ts_{rc} \tag{33}$$

Household income x_r is equal to the sum of gross factor income of the different factors of production minus the value of depreciation of capital, $\delta w_{re}^{end} q_{rcap}^{end}$, plus the sum of all indirect tax incomes, tr_r^{ind}, defined in Appendix A.2:

$$x_r = \sum_{e=1}^{E} w_{re} q_{re}^{end} - \delta w_{re}^{end} q_{rcap}^{end} + tr_r^{ind} \tag{34}$$

In equilibrium the global value of savings is equal to the global value of net investments:[20][21]

$$\sum_{r=1}^{R} p_r^{sa} q_r^{sa} = \sum_{r=1}^{R} p_r^{in} \left(q_r^{in} - \delta q_{rcap}^{end} \right) \tag{35}$$

To determine investment in the model, we start with the identity that the value of investment is equal to the value of savings minus the trade balance:

$$p_r^{in} q_r^{in} = q_r^{sa} p_r^{sa} - \left(\sum_{s=1}^{S} \sum_{c=1}^{C} q_{rsc} p_{rsc}^{fob} - q_{src} p_{src}^{cif} \right) \tag{36}$$

Next, we impose that the trade balance to income ratio does not change in $R-1$ regions:[22]

$$\Delta \frac{\sum_{s=1}^{R} \sum_{c=1}^{C} q_{rsc} p_{rsc}^{fob} - q_{src} p_{src}^{cif}}{y_i} = 0 \tag{37}$$

Equations (36)-(37) thus determine the quantity of investment q_r^{in}.

3.5 Calibration of Baseline

We calibrate the model based on the GTAP 11 Data Base, which has 2017 as reference year. As in models employing exact hat algebra the model is calibrated such that baseline values are equal to actual values in the GTAP 11 Data Base. We construct baseline values until 2026 conducting a baseline simulation with the recursive dynamic model targeting GDP, population, and labour force growth rates and changes in savings rates drawn from IMF World Economic Outlook. Counterfactual experiments are introduced in 2022 and results are reported for 2026,

[20] In the model (35) is the omitted equation by Walras' law.

[21] The price of savings is defined in Appendix A.2

[22] The trade balance in the Rth region is determined by equation (35) imposing that the global value of savings is equal to the global value of investment.

thus representing medium-run effects.

3.6 Calibration of Behavioral Parameters

Table 3 displays the behavioral parameters and inputs into behavioral parameters in the described model. The substitution elasticity between goods from different economies of origin, σ_c, is based on Hertel et al. (2007). Assuming a standard nested structure, the substitution elasticity between domestic and imported goods, ρ_c is half the substitution elasticity between goods from different economies of origin. The substitution elasticity between production factors, χ_c, is based on the GTAP Data Base. The table shows that the elasticity is smaller for the agricultural and extraction sectors because these sectors employ a "fixed" factor of production. In the next three columns three statistics characterizing non-homothetic private household demand are displayed, because these statistics are more insightful than the structural parameters of the CDE utility function: the own uncompensated own price elasticity EP, the income elasticity IE, and the Allan partial substitution elasticity.

The constant elasticity of transformation for land allocated to different sectors, μ_e is equal to 1. The elasticity of supply of land and natural resources, $_e$ is equal to 0.5. In the literature on the substitution elasticity between male and female workers in production, υ_e, there is broad consensus that male and female workers are imperfect substitutes. However, different estimates for the elasticity of substitution are reported. De Giorgi et al. (2013) and Acemoglu et al. (2004) both use natural experiments, the former based on Italian province data and the latter on post-war United States data, and find the estimates of elasticity ranging from 1.0 to 1.4 in the former and approximately 3 for the latter. Weinberg (2000) uses United States data to model the effects of increased computer use on the demand for female workers and estimates three elasticities of substitution between males and females - 1.6, 2.4 and 3.2. Given the widely varying range of values across these three papers, we choose to use 1.6 as a benchmark elasticity of substitution. We assess the impact of choosing the upper value estimated in the literature on the simulation results in the robustness checks.

4 Scenario Design

Based on the stylized facts, we design scenarios for counterfactual (trade) policy experiments implying changes in trade costs and simulate their effects. This enables us to shed light on the possible impact of policy changes and identify the policies that are most likely to have a beneficial impact on reducing the gender wage gap. Table 5 summarizes the policy experiments conducted and discussed in the following section.

Two types of trade policy changes can be modelled, tariff and NTM reforms. While the latter can be implemented for both goods and services trade, we examine such reforms only in the services sector. The reason is that NTMs may be implemented for a variety of objectives. For instance, product regulations may be required to ensure minimum health and safety standards, making their removal not desirable. Furthermore, the database on goods NTMs covers only a small share of the economies in our sample. Therefore, we restrict our focus for goods trade on tariff reform and assess NTM reforms only for services trade since we lack an alternative in

Table 3: Behavioral parameters in the model

Sector	σ_c	χ_c	EP	IE	APE
b_t	2.30	1.12	-0.50	0.74	0.52
bph	6.60	1.26	-0.72	1.03	0.70
chm	6.60	1.26	-0.65	1.03	0.69
coa	6.10	0.20	-0.52	1.09	0.68
cro	4.85	0.26	-0.14	0.35	0.10
eeq	8.80	1.26	-0.67	1.00	0.68
ele	8.80	1.26	-0.68	1.04	0.70
fmp	7.50	1.26	-0.69	1.03	0.71
gas	34.40	0.20	-0.71	1.05	0.72
i_s	5.90	1.26	-0.58	1.04	0.70
lea	8.10	1.26	-0.54	0.82	0.59
lum	6.80	1.26	-0.57	1.04	0.70
lvs	4.32	0.24	-0.36	0.78	0.52
mvh	5.60	1.26	-0.72	1.03	0.70
nfm	8.40	1.26	-0.65	1.05	0.70
nmm	5.80	1.26	-0.62	1.03	0.70
oil	10.40	0.20	-0.51	1.02	0.68
ome	8.10	1.26	-0.67	1.03	0.71
omf	7.50	1.26	-0.79	1.02	0.73
otn	8.60	1.26	-0.61	1.02	0.70
oxt	1.80	0.20	-0.55	1.03	0.70
p_c	4.20	1.26	-0.63	1.00	0.65
pcf	5.52	1.12	-0.48	0.72	0.45
ppp	5.90	1.26	-0.64	1.04	0.70
rpp	6.60	1.26	-0.65	1.02	0.70
ser	3.86	1.37	-0.93	1.07	0.72
tex	7.50	1.26	-0.42	0.78	0.56
wap	7.40	1.26	-0.53	0.80	0.57

Source: GTAP Data Base.
Notes: The first and second column display respectively the Armington elasticity of demand between varieties, σ_c and the elasticity of substitution between production factors, χ_c. The third, fourth and fifth column display respectively the uncompensated own price elasticity of demand EP, the income elasticity (IE) of demand, and the Allen Partial substitution elasticity (APE) between sectors, calculated as a consumption value weighted average across regions.

the sector. Importantly, our scenarios for the services sector target the AVEs of these NTMs rather than the NTMs themselves which is critical given that recent evidence shows that many NTMs could be designed less trade-restrictive while still obtaining their objectives (Cali and Montfaucon, 2021, Cali et al., 2022).

We distinguish between simple trade policy reform, such as an equalization or a uniform percentage reduction rule, and sophisticated reforms which are based on the results of the simple reforms and try to isolate certain channels that drive the impact of the reform. Finally, in light of the results in section 2.5 on face-to-face intensity, we simulate a fall in the associated AVEs.

Table 4: Scenario Descriptions

<table>
<tr><th></th><th>Tariff reform</th><th>Non-tariff reform</th><th>Digitalization</th></tr>
<tr><td>Merchandise sector</td><td>Sc1.1 - Equalize tariffs across sectors
Sc1.2 - 50% reduction in tariffs in the five most female intensive sectors
Sc1.3 - Formula based tariff reduction</td><td></td><td rowspan="2">Sc3.1 - 50% reduction in AVE of the face to face requirement in all sectors and regions
Sc3.2 - AVE of the face-to-face requirement reduced to the minimum value across sectors</td></tr>
<tr><td>Service sector</td><td></td><td>Sc2.1 - 50% reduction in AVE of NTMs in all region
Sc2.2 - AVE of NTM reduced to minimum value for all sectors in a particular region</td></tr>
</table>

Although face-to-face intensity does not have a direct policy angle, it does have indirect links. For example, policy measures can affect the level of broadband availability which in turn affects digitalisation and, hence, can result in a reduction of the need for face-to-face interaction.

Based on these different types of policies, we develop three categories of scenarios: tariff reforms for the goods sector (scenarios Sc1.1, Sc1.2 and Sc1.3), NTM reforms for the services sector (scenarios Sc2.1 and Sc2.2), and digitalization-related reforms affecting both sectors (scenarios Sc3.1 and Sc3.2). Scenarios Sc1.1 and Sc1.2 are simple tariffs scenarios for goods trade while Sc2.1 is a simple scenario for services trade. Sc1.3 and Sc2.2 are sophisticated scenarios for respectively goods and services trade.[23]

In Sc1.1, we equalize tariffs across all sectors while requiring revenue neutrality.[24] Thus, the tariff shock is negative for some sectors and positive for others. In Sc1.2, we reduce tariffs by 50% for the five most female-intensive sectors globally - textiles, apparel, leather and related products, pharmaceuticals, and paper. In Sc2.1 AVEs of NTMs in services sectors are reduced by 50%. The AVEs of NTMs are estimated based on the STPD in four service sectors. An equal per cent reduction should lead to a larger reduction in percentage points in the female labour intensive sectors, since Section 2.3 shows that within the service sectors AVEs of NTMs are larger in more female intensive sectors.

Sc1.3 refers to sophisticated shocks in tariff policy in the goods sector. Based on the results of the simple scenarios for tariffs, we develop a formula to identify the effect of different transmission channels, namely - export opportunities, intermediate inputs and import competition. We then construct a shock using a combination of these three metrics to calculate the tariff reduction in each sector.[25] Sc2.2 contains a more sophisticated scenario for services trade. The

[23] Further scenarios are presented in the section on robustness.

[24] For tariff related shocks, we ensure revenue neutrality by keeping the ratio of tariff revenue to income constant.

[25] In Appendix B, we present the detailed formulas that differentiate the three effects included in this shock.

reduction in trade costs is not a simple percent change, but a sector specific change. We identify best practices by calculating the minimum value of STPD for a sector in the world and reduce the STPD of that sector in each region to the world minimum, thus, simulating the effect of implementing global best practices in all regions.

Scenarios Sc3.1 and Sc3.2 are based on a reduction in trade costs due to an increase in digitalisation.[26] Sc3.1 constitutes a simple scenario with the AVEs of face-to-face intensity cut by half. In Sc3.2, the AVEs of face-to-face intensity is reduced to the lowest value across all sectors. These scenarios provide an upper bound as they are based on the assumption that technology growth will provoke drastic reductions in AVEs.[27]

5 Simulation Results

5.1 Wage Premia effects

This subsection describes the projected effects of the trade cost scenarios presented in Section 4 on the gender wage gap. To measure the projected changes, we calculate the percentage change in the wage of male workers relative to female workers, WP, defined as:

$$WP = [\frac{1 + \frac{pe_m}{100}}{1 + \frac{pe_f}{100}} - 1] * 100 \tag{38}$$

pe_m and pe_f represent the changes in factor prices for males (both skilled and unskilled) and females (both skilled and unskilled), respectively. A negative value of WP implies that female wages increase relative to male wages. In the interest of brevity, we present results on the wage premia at the regional and at the global level, aggregating results for skilled and unskilled workers. Regional and global values are weighted averages, using wage bills as weights. Appendix D describes the computation of regional and global averages.

To preview our results, we find that the impact of trade policy reforms on gender wage premia is small in magnitude, both at the regional and global level. Simple tariff reforms in goods even generate an increase in male wages relative to female wages. More targeted tariff reforms in the goods sector raise female wages relative to male wages but only marginally. Simple and sophisticated reforms in services increase female wages relative to male wages, with effects larger compared to reforms in the goods sector but still relatively small. Reducing AVEs linked to face-to-face requirements has by far the biggest impact on lowering the gender wage gap.[28]

[26] See Appendix C.4 for more details.

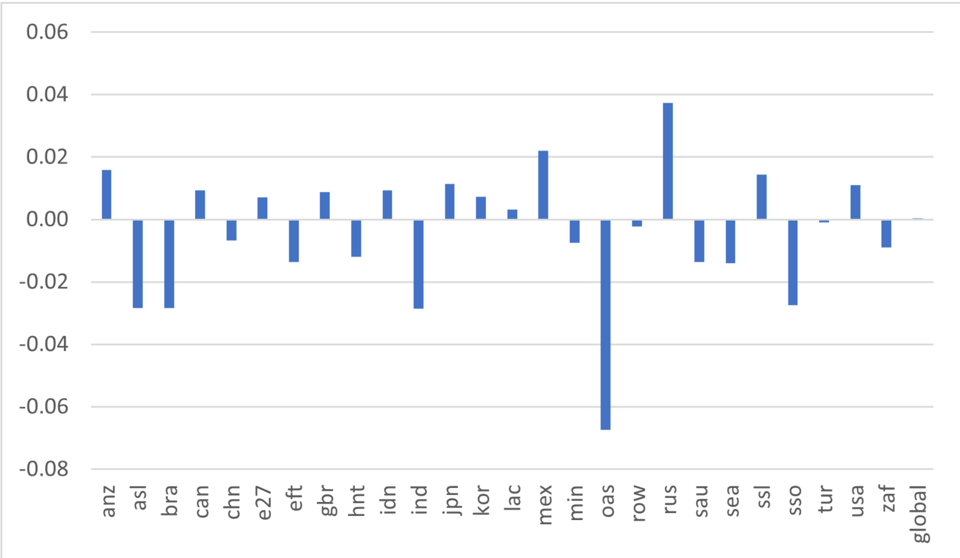
[27] We are unable to follow the best practice approach per economy employed in scenario S2.1 as the face-to-face intensity has only a sectoral and no economy dimension.

[28] The impact of our different trade policy reform scenarios might differ not only because they target different sectors, but also because the size and the coverage of the shock differs. For example, for tariffs, we examine equalizing tariffs across all sectors, whereas in services we cut the AVEs of NTMs by 50%. Since AVEs are larger than tariffs, this implies a larger absolute reduction in trade costs in the services scenario than in the goods scenario (Please refer to Appendix C for a comparison of the size of trade cost changes between scenarios 1.2 and 2.1). That said, when we reduce the AVEs of goods NTMs by 50% in a robustness exercise, we still obtain an effect that is only half as large as in services, reinforcing our finding that services reforms are more promising for gender equality.

5.1.1 Changes in wage premia due to simple tariff reforms for goods

The first counterfactual experiment equalizes tariffs across all sectors (Sc1.1). Figure 8 displays the change in the wage premium by 2026, at a regional and global level. Given the evidence that both tariffs faced by exporters on the output side and tariffs on intermediate inputs on the input side are higher in sectors with a larger share of female workers, this reform is expected to reduce the gender wage gap. However, we observe that equalizing tariffs across all sectors within a region does not have the desired impact on the wage premium globally. The male wage increases relative to the female wage, albeit by a very marginal 0.0003%.[29] This is, first, a very small impact and, second, has the opposite sign relative to what we expect.

Figure 8: Changes in wage premia when tariffs are equalized for all sectors for all regions (Sc1.1)



Source: Authors' calculations based on simulation results.
Note: Calculation for WP is discussed in detail in the text. Global weighted average calculated using total factor prices for labour as weights.

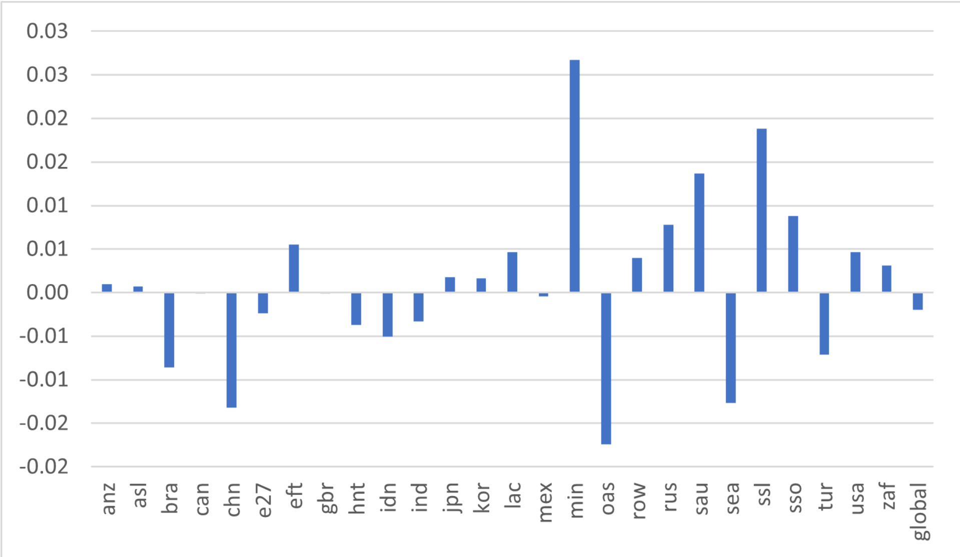
In the next experiment (Sc1.2), we identify the sectors in each region with a female share higher than the median for that region and reduce tariffs by 50% for these sectors. Figure 9 shows that globally, the male wage premium now falls by 0.002% which is of the expected sign and larger in value compared to the previous scenario, but still negligibly small.[30] Thus, a major reduction of tariffs in the most female labour intensive sectors does result in a reduction in the gender wage gap, but to a marginal degree only.

This shows that the positive effects of tariff liberalisation via export opportunities and reduced costs of intermediate inputs in some regions are offset by other effects, in particular increased import competition, in other regions. Higher tariffs in female-intensive sectors serve in some cases as protection for those sectors and may aid female workers. If this protective

[29] Global effect calculated as weighted average of male to female wage premia for each region with the weights given by the regional wage bill in the global wage bill (described in detail in Appendix D).

[30] As mentioned, global wage premia changes are calculated as weighted averages. This implies that the changes observed in large regions have a larger impact on the projected change in the global wage premium. For example, scenario Sc1.2 leads to a marginal drop in the global average male wage premium even though the male wage premium rises in multiple regions, because regions with a large weight in the global wage bill such as the EU and China report falling male wage premia. However, the absolute difference in the effects is with 0.003 very small and for all other scenarios simple averages are of the same sign as weighted averages.

Figure 9: Changes in wage premia when tariffs are removed for the five most female-intensive sectors globally (Sc1.2)



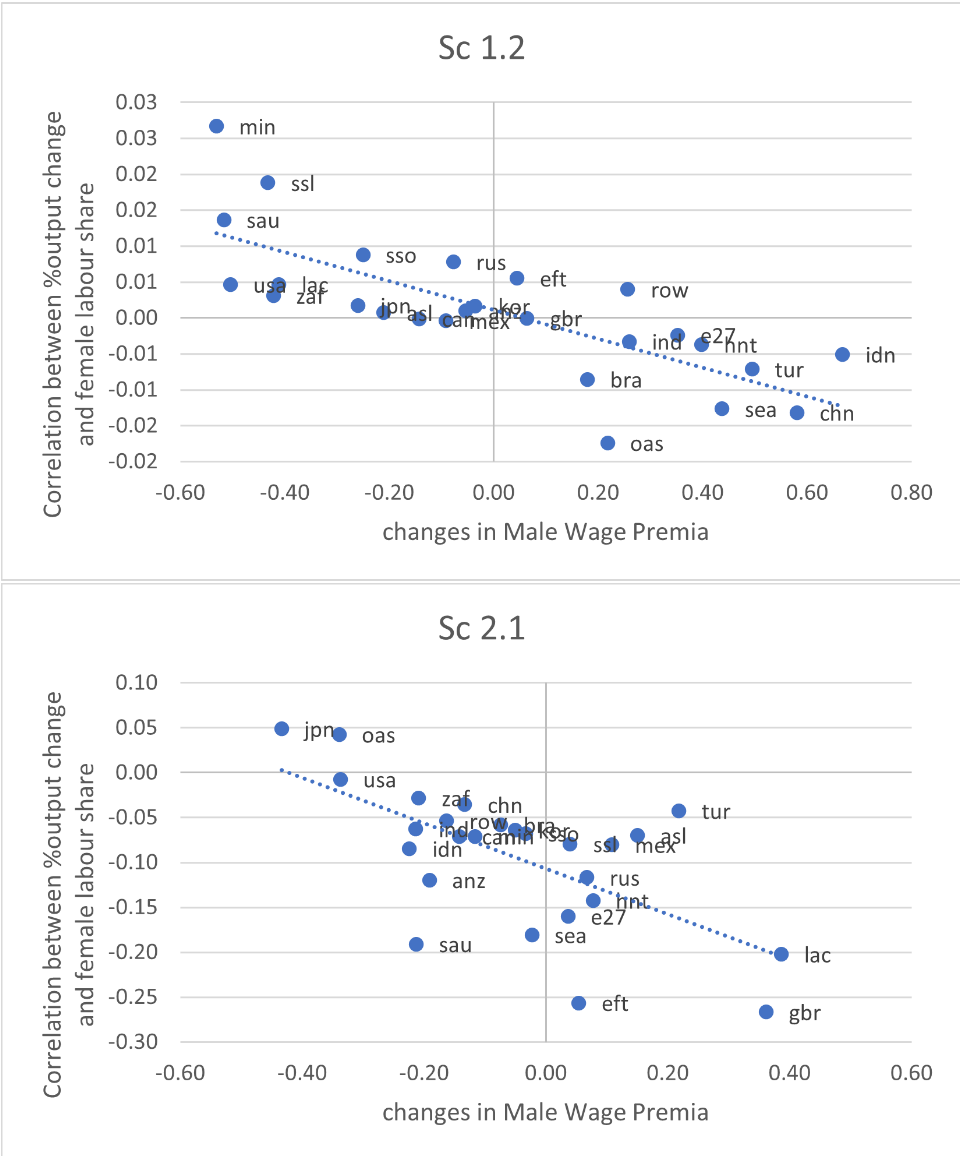
Source: Authors' calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

effect dominates, a tariff reform aimed to eliminate the gender bias of tariffs might lead to an increase in male wage premia.

The results in Figure 10 reflect the net effect of the three channels in different regions. In the figure, we plot the correlation between the female share of a sector in a region and the output change in that sector against the overall wage premia change in that region for scenario Sc1.2. We observe firstly that in many regions the correlation between output change and female labour shares is negative, indicating that tariff liberalization leads to a contraction of liberalized sectors in these regions. Secondly, we find that on average the change in male wage premia is negative wherever the correlation between output change and female share of a sector is positive. Put differently, in regions where export opportunities and cost of intermediates channels are dominant, female sectors expand when tariffs come down leading to a fall in the male wage premium. Instead, in regions where the male wage premium is increasing, the import competition channel leads to a reduction in output in female labour intensive sectors. This leads to a small net effect at the global level.

This result is in line with the literature on pro-poor trade policy of developing economies discussed in section 1, which describes high tariffs as protecting poor households. We examine this potential explanation further using more sophisticated tariff reforms in the following experiment (Sc1.3). That said, the substantially larger reductions in the gender wage gap resulting from the services NTM and digitalisation reforms, which we discuss in the following subsections, suggest that the small impact of tariff reforms is also driven by i) tariffs being relatively low and forming only a small part of overall trade costs and b) female labour shares being lower in the goods than in certain services sectors.

Figure 10: Relationship between correlation of output changes and female labour intensity and change in female relative male wage

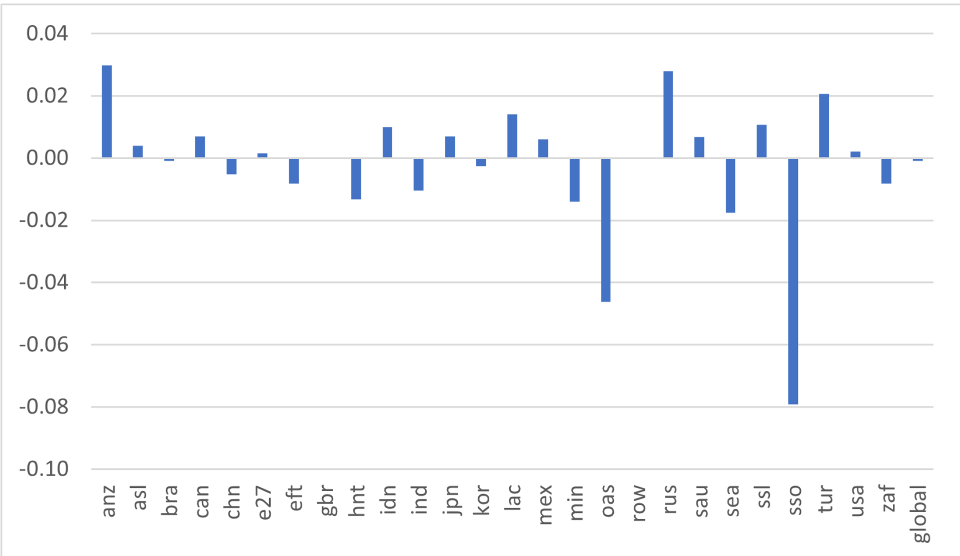


Source: Authors' calculations based on simulation results. Note: We calculate male wage premium as discussed in the text. On the y-axis, we calculate the correlation between the simulation generated % change in a region's output and the base data calculations for female labour share of that region.

5.1.2 Changes in wage premia due to sophisticated tariff reforms for goods

Given that simple tariff reforms in the goods sector do not have relevant wage premium effects, we explore whether more targeted tariff reforms can have a larger impact on reducing the gender wage gap. These reforms are developed to isolate the effects of different transmission channels, namely export opportunities, cheaper intermediate inputs and import competition, such that the former two channels are maximized while the latter one is minimized. The general idea is to build a reform scenario in which (i) an importer will lower its tariffs more towards an exporter-sector pair with particularly high female labour shares, (ii) an importer will lower its tariffs more for inputs particularly important for its sectors employing more women, and (iii) an importer will lower its tariffs less for its sectors employing more women.[31]. Figure 11 shows that compared to previous tariff reform experiments in the goods sector, a reduction in male wage premia is projected in more regions. Globally, the wage premium is projected to fall, but, due to the small reduction in tariffs, only by 0.001% which is marginal.

Figure 11: Changes in male wage premia by region for experiment with sophisticated tariff reform (Sc1.3)



Source: Authors' calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

5.1.3 Changes in wage premia in simple and sophisticated reforms for services

Next, we turn our attention to the scenarios which simulate NTM reforms in the services sector (Sc2.1 and Sc2.2). As described previously, in these scenarios, we restrict our shocks to the estimated AVEs in four services sub-sectors, business services (bus), transport services (trp), communication services (cmn) and insurance services (ins), calculated using the World Bank-WTO Services Trade Policy Database.

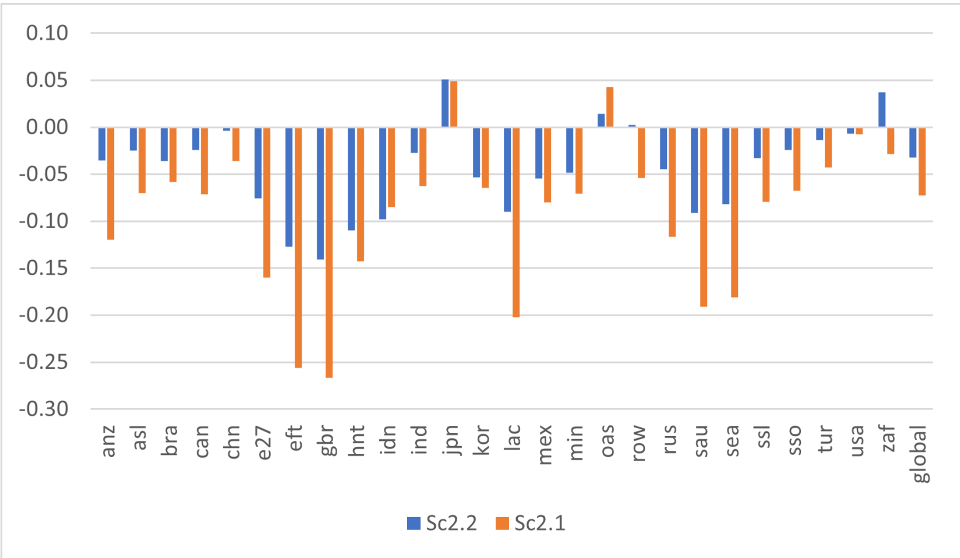
Figure 12 displays the projected change in the male wage premium at a regional and global level. In both scenarios, the projected change in the male wage premium is mostly negative,

[31]The shock design is explained in detail in Appendix C. One issue that arises in this context is that there is substantial overlap between (ii) and (iii) such that the magnitude of the resulting tariff shocks is relatively small.

indicating that female wages rise relative to male wages in most regions. Globally, the average change in the male wage premium is -0.07% in S2.1 and -0.03% in S2.2, implying that the gender wage gap falls as a result of a reduction in services trade restrictiveness. The size of the change in the global male wage premium is substantially larger than under the tariff reform scenarios. This implies that liberalisation in the services sector has a larger impact on female relative to male wages than a liberalisation in the goods sector, according to our projections. However, in absolute terms, the impact of such liberalisation on the size of wage premiums continues to be low: In all regions, the male wage premium falls less than 1%.

Notably, changes are larger for scenario S2.1 than scenario S2.2. This is because, the minimum value of the estimated AVEs across regions is close to the average value. Hence, when the AVEs are reduced to the minimum of the world for each sector in each region, the resulting shock is smaller than in scenario S2.1 which considers a 50% reduction in the AVEs.

Figure 12: Change in male wage premia across the services trade reform scenarios based on the STPD



Source: Author's Calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

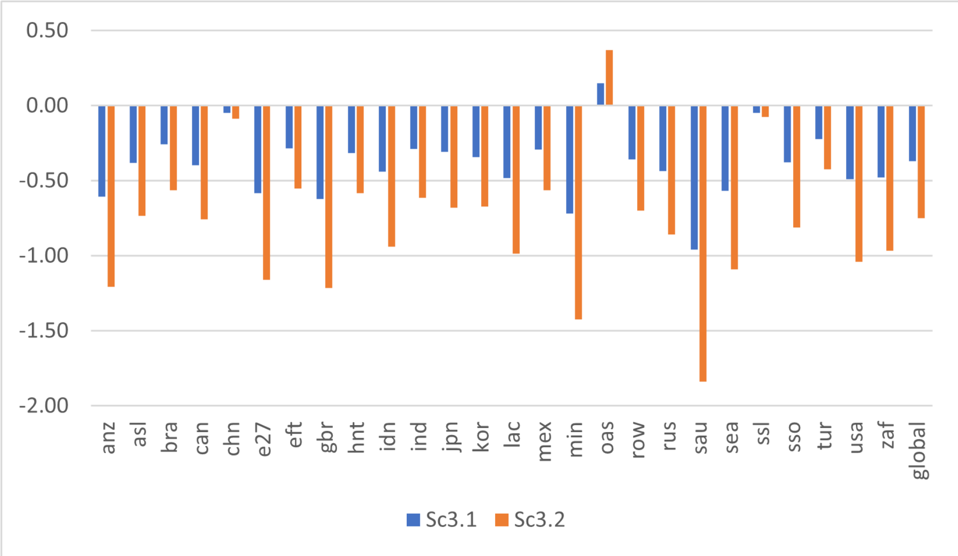
5.1.4 Changes in wage premia in digitalisation scenarios

In the final set of scenarios (Sc3.1 and Sc3.2), we explore the effect of reducing the estimated AVEs associated with the need for face-to-face interaction.

Figure 13 displays the projected change in the male wage premium. In both scenarios, female wages rise more than male wages in most regions. This suggests that a decrease in the face-to-face requirement across all sectors would lead to an increase in female relative to male wages. Moreover, in the digitalisation scenarios, the global increase in female wages is substantially larger than in all other scenarios analysed. In the scenario in which the face-to-face intensity is reduced to the lowest value for that sector in the world (Sc3.2), the male wage premium is projected to fall by up to 0.75 %.

The effect of reducing the estimated AVEs associated with face-to-face requirements of a

Figure 13: Change in male wage premia across the face-to-face requirement reduction scenarios



Source: Author's calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

sector to the minimum level across all sectors (Sc3.2) on the gender wage gap is stronger than the effect of cutting the AVEs by 50% (Sc3.1). This is because the minimum AVE is near zero, implying that some sectors do not have any trade costs due to the necessity of face-to-face interaction. Thus, the scenario with a reduction to the minimum value is similar to a full elimination of face-to-face requirements, which is a much larger shock than a reduction by 50% of the associated AVEs.

5.1.5 Concluding remarks on the effect of trade cost changes on gender wage gaps

Table 5: Global average wage premia and real income changes

Scenario	WP change	Female Income	Male Income
Sc1.1	0.0003	0.0352	0.0355
Sc1.2	-0.0019	0.0149	0.0129
Sc1.3	-0.001	0.0448	0.0438
Sc2.1	-0.0726	1.0672	0.9934
Sc2.2	-0.0321	0.5671	0.5347
Sc3.1	-0.3683	3.5386	3.1549
Sc3.2	-0.7484	7.5343	6.7204

Source: Authors' calculations based on simulation results.

Results on the wage premia across these scenarios presented in Table 5 establish the following insights. First, the simulations suggest that simple tariff reforms eliminating the gender bias in tariffs is not effective in reducing the gender wage gap and could even raise the male wage premium although the effects are very marginal. Second, more sophisticated tariff reforms considering the different channels through which tariffs affect the demand for female relative to male workers also delivers a very marginal contribution to the reduction in the female wage gap. Third, reductions in services trade barriers in four tradable services sub-sectors deliver a more meaningful contribution to the reduction in the gender wage gap by up to 0.07%. Fourth, increased digitalisation leading to a reduced importance of face-to-face interaction in economic transactions results in a higher impact on wage premia globally, mainly driven by changes in the services sector. This is because services sectors currently have a high face-to-face index and a high female labour share (Figure 7), and thus the highest potential to benefit from digitalisation.

Finally, in Table 5, we also show the global average real income changes for females and males resulting from the different reform scenarios. We do find that all shocks increase incomes for both types of labour. The income effects are particularly large in the services NTM reform and digitalisation scenarios. However, since the differences between male and female income responses are small, the wage premia effects are less pronounced,

In the next subsection, we provide a further in-depth analysis of the findings presented here on projected changes in the wage premium to assess to what extent certain underlying modeling assumptions can explain the muted effects.

5.2 Robustness and sensitivity analysis

The projected effects of trade policy reform on the global average female wage gap are small and sometimes have an unexpected sign (i.e. raising the male wage premium). The question is what is driving these results beyond the channels we have already discussed. In this section we assess the impact of certain mechanisms and modelling features that may be driving the results. First, in the benchmark version of the model, and informed by empirical estimates, there is complementarity in production between intermediate inputs from different sectors and near-complementarity between consumption goods from different sectors in private household demand. This implies a lack of scope for substitution towards liberalized sectors which could explain why output in female labour intensive sectors and, thus, demand for female workers does not increase sufficiently.

5.2.1 Complementarity of intermediate inputs and near complementarity of consumption goods

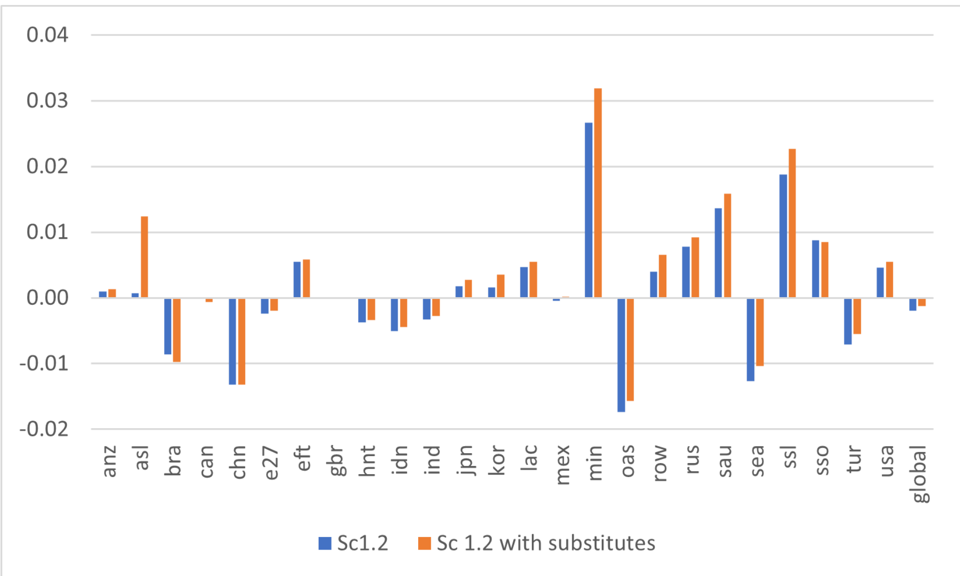
In our benchmark model, intermediate inputs are perfect complements and consumption goods in private household demand are near perfect complements. Technically, this corresponds to a substitution elasticity of zero between intermediate inputs (Leontief specification) and an elasticity close to zero between consumption goods from different sectors. Complementarity of intermediate inputs implies that an increase in output requires a proportional expansion in the intermediate inputs purchased from all sectors. In contrast, if intermediate inputs are substitutable, the demand for intermediate inputs becoming cheaper will increase, with more expensive intermediates substituted for by cheaper intermediate inputs, leading to a net increase in their output. Recent empirical literature finds support for a Leontief specification of intermediate input demand (Atalay (2017) and Cravino and Sotelo (2019)). Nevertheless, we will analyse the impact of shifting away from complementarity to allow for a greater output response following trade liberalisation.

For simplicity, we re-examine only the simple trade policy reform scenarios in goods trade, Scenario Sc1.2 (removing tariffs in five sectors with the highest global female labour share), and in services trade, Scenario Sc2.1 (reducing services trade restrictiveness in five sectors by 50%) to analyse how the substitution elasticity shapes the results.

Table 5 showed that the simple tariff reform scenario, Sc1.2, leads to a marginal decrease in the global average male wage premium. To analyse the role of complementarity, we re-run the simulation with a Cobb-Douglas production function and private household utility function featuring a substitution elasticity of 1. Figure 14 shows that wage premia changes are very similar in both cases. Allowing for substitution leads to a rise in output in the liberalized sectors that is slightly higher than in the case of complementary inputs and utility. However, the difference is very small and its impact on wage premia is negligible. In fact, we find the magnitude of wage premia to be slightly smaller in the scenario with the higher substitution elasticity, showing that this particular assumption does not affect our results in a meaningful way.

One possible explanation for this is that we target the liberalized goods sectors based on their average female intensity globally. However, we note that for almost every individual economy there are other sectors that are even more female intensive. In high-income economies, these are mostly services sectors while in lower-income economies, agriculture tends to be relatively female-intensive. As a result, increased substitutability across sectors might not increase aggregate demand for female labour if the substitution comes at the expense of the even more female intensive sectors. We provide additional evidence to that effect in the following subsection 5.2.3 when limiting labour mobility.

Figure 14: Wage premia effects of scenario Sc1.2 with increased substitutability of inputs and consumption

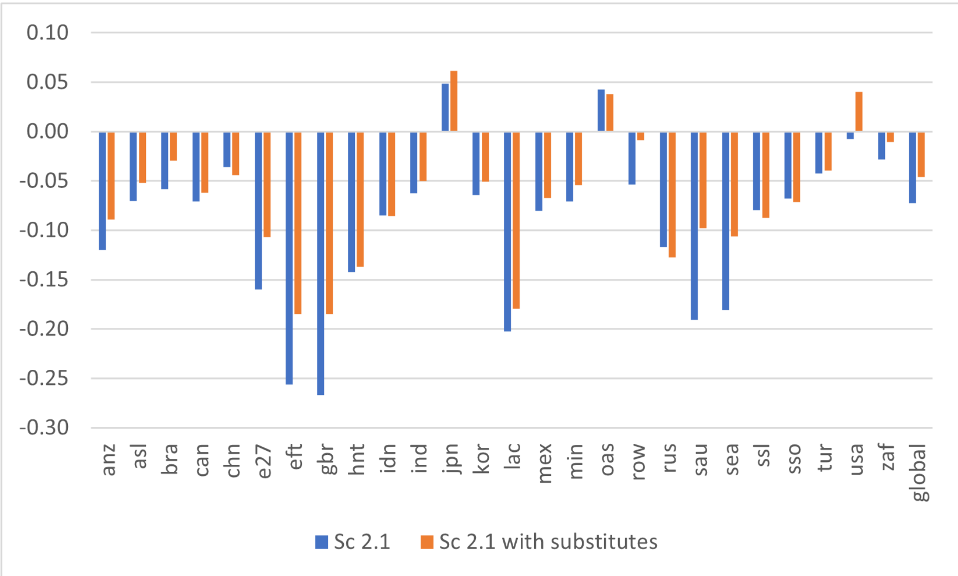


Source: Authors' calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

Next, we analyse the simple services trade reform scenario. In this experiment, services trade costs are reduced globally by 50% in five sectors for which data are available in the WTO and

World Bank STPD. Under this scenario the male wage premium is projected to fall by about 0.07%, which is much larger than under the tariff reform scenarios. Similar to the tariff case, when moving to substitutability, Figure 15 shows that the male wage premium does not fall more and in many economies the improvement in the gender wage gap is actually smaller. The underlying mechanism is the same as for goods as we lower trade costs only in traded services sectors. However, it is in many cases the less traded services sectors, such as health or education, that have the highest female labour shares so that increased substitutability might not raise aggregate female labour demand. This effect becomes particularly clear when we compare the results here with the substantially larger wage premia changes in the digitalisation scenarios (see section 5.1.4) that lower trade costs in the less traded services sectors. Independently of this, the changes are small in absolute terms so that they do not alter our qualitative findings. Hence, we conclude that assumptions as to the substitutability of inputs and consumption are not driving our results.

Figure 15: Wage premia effects of scenario Sc2.1 with increased substitutability of inputs and consumption

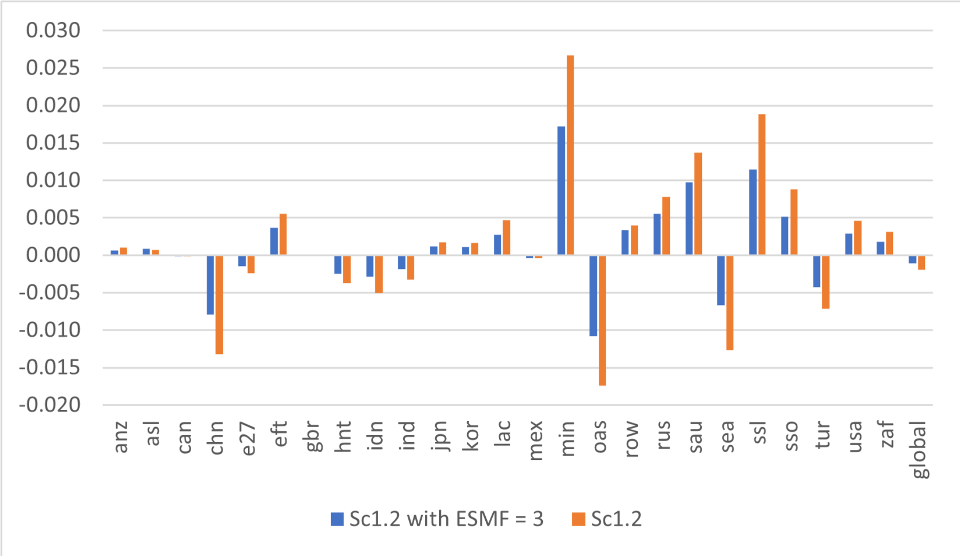


Source: Authors' calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

5.2.2 Increasing the substitution elasticity between male and female workers

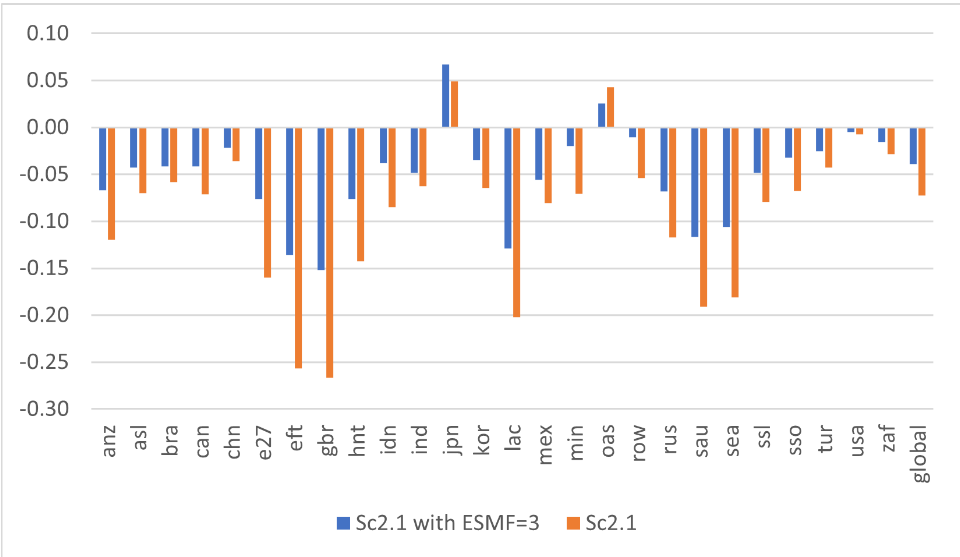
Our model and the results rely not only on substitution elasticities across inputs and consumption, but also on the substitution elasticity between male and female workers. We use an elasticity of substitution between male and female workers of 1.6, as discussed in section 3.1. Given that the literature on this topic is divided with estimated values differing widely across studies, we explore how the size of the substitution elasticity affects the projected male wage premium change. More specifically, we replicate the two experiments discussed in more detail in the above section - Sc1.2 and Sc2.1 - assuming a higher elasticity value of 3, moving towards the upper bound of available estimates. The new wage premia results are reported in Figures 16 and 17.

Figure 16: Wage premia effects of scenario Sc1.2 with increased substitution elasticity between male and female workers



Source: Authors' calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

Figure 17: Wage premia effects of scenario Sc2.1 with increased substitution elasticity between male and female workers



Source: Authors' calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

As is evident from the figures, for both goods and services trade, increasing the substitution elasticity between male and female workers decreases the magnitude of male wage premium changes. As the expansion of female labour intensive industries drives up the wages of women, the higher elasticity of substitution dampens the increase in the demand for female labour. This, in turn, leads to a smaller change in the male wage premium. The difference in absolute terms of the wage premium responses is small and does not alter our general conclusions.

5.2.3 Introducing mobility costs between aggregate sectors

The limited impact of tariff reform could be due to the fact that such reform raises labour demand in the relatively male labour-intensive manufacturing sector relative to the relatively female labour-intensive services sector. That is, reducing tariffs in female labour-intensive manufacturing sectors draws labour from other sectors into the liberalized sectors. However, these sectors are relatively female-intensive only when compared to other manufacturing sectors, not necessarily compared to sectors outside manufacturing. In particular in high-income economies, many services sectors are significantly more female labour-intensive. Hence, in our benchmark model with perfect labour mobility, an expansion of the liberalized manufacturing sectors absorbs labour from even more female labour-intensive services sectors. This could help explain the relatively small effects found for tariff reform and is particularly relevant since empirical research shows that there are large transition costs of moving between aggregate sectors (see, e.g., Artuc et al., 2010).

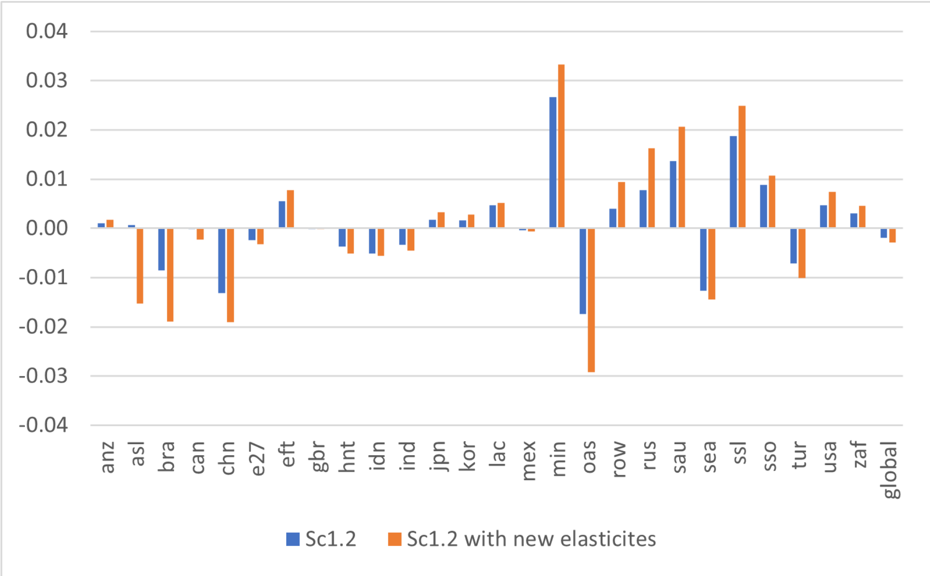
Therefore, we assess the sensitivity of our results to the assumption on perfect labour mobility by re-running scenario Sc.1.2 with high mobility costs across aggregate sectors. We introduce in this robustness check a nested CET function (as in equations (20) - (21)) with labour first being allocated across aggregate sectors (services on the one hand and merchandise sectors on the other hand) with a low transformation elasticity ($\mu_c = 0.5$) and subsequently across detailed sectors with a higher transformation elasticity ($\mu_c = 5$). Figure 18 compares the change in wage premia in the benchmark model and in the model with a nested CET. It shows that the reduction in the male wage premium is indeed about 50% larger in this case. However, while this is a large relative change, the absolute change in the global wage premium is still limited so that our qualitative conclusions continue to hold.

5.2.4 Imposing fixed labour supply

Labour market effects in response to an expansion of female labour intensive-sector can occur along the labour supply or wage margin. Our baseline model includes an upward sloping labour supply curve with labour supply rising if wages increase. This limits a potential wage response. To assess the relevance of this assumption, we explore how the projected wage premium changes across regions change when labour supply is fixed in the counterfactual experiment.

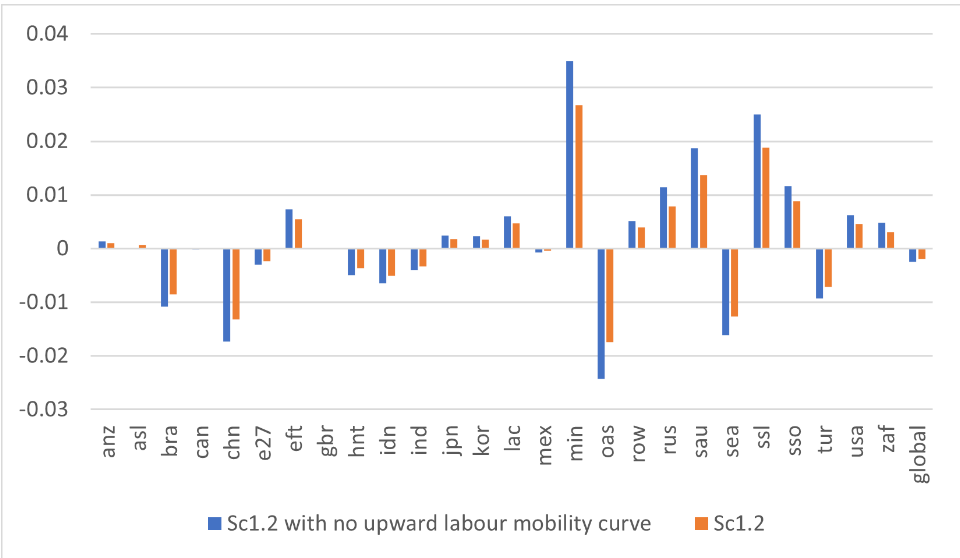
The results presented in Figures 19 and 20 show that the projected changes in the male wage premium increase for both goods and services trade reforms when labour supply is fixed. The reason for this result is that under a vertical supply curve (fixed labour supply) a shift in the labour demand curve generates a larger change in the wage. This contrasts with an upward sloping labour supply curve under which the equilibrium wage rises along the supply curve and

Figure 18: Wage premia effects of scenario Sc1.2 with and without perfect labour mobility



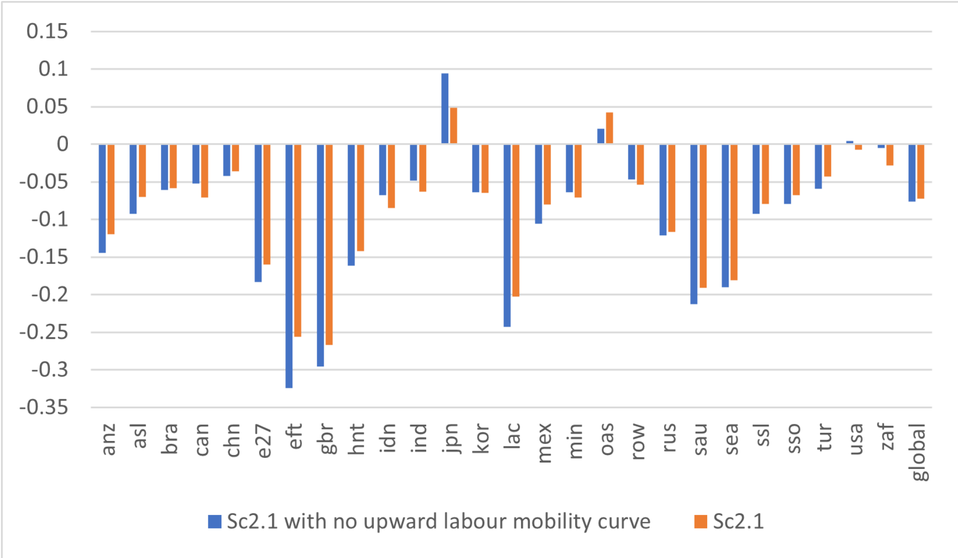
Source: Authors' calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

Figure 19: Wage premia effects of scenario Sc1.2 with labour supply being fixed



Source: Authors' calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

Figure 20: Wage premia effects of scenario Sc2.1 with labour supply being fixed



Source: Authors' calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

both wages and employment increase, implying that wages increase less. However, there are a few regions where this result does not hold.

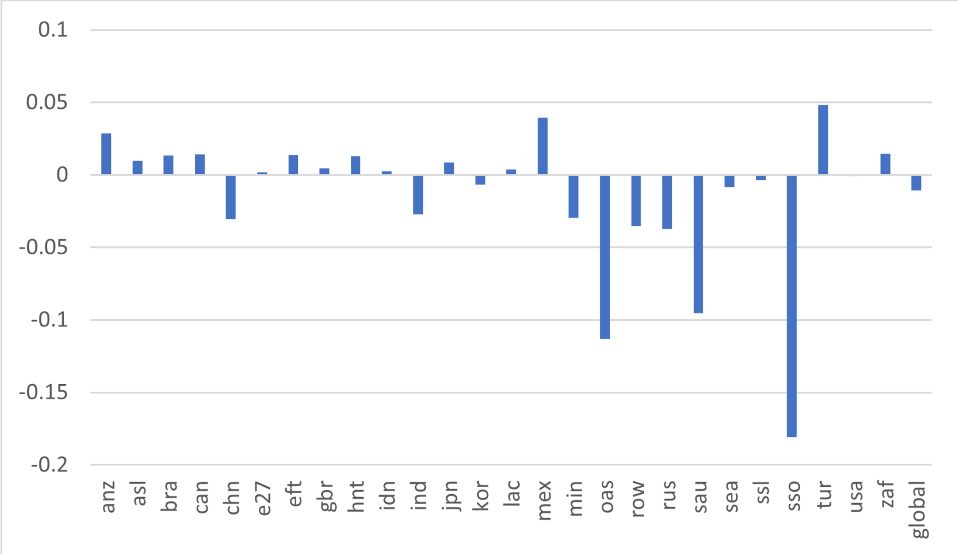
This can be explained from the fact that the change in the male wage premium is determined by the ratio in the change of the female and male wage premium. If both rise and the female wage rises more, the male wage premium will fall more under a fixed labour supply. However, if they both fall and the female wage premium falls less, the reduction in the male wage premium will be smaller.

Although fixed labour supply modifies the size of the projected effects somewhat, the main findings of the analysis do not change as the absolute effects remain small.

5.2.5 Omitting revenue neutrality in the sophisticated tariff experiment

In the tariff reform scenarios, we assume tariff revenue neutrality, i.e. reductions in tariffs in specific sectors are compensated for by generic increases in tariffs rates in all other sectors to keep the revenues from tariffs constant. As a robustness check for our tariff reform simulations, we re-run Scenario Sc1.3, where tariff increases are more frequent, but without keeping tariff revenues constant. Figure 21 shows that the result is qualitatively similar to scenario Sc1.3 with revenue neutrality as shown previously in Figure 11. However, the global weighted average effect on male wage premia is with -0.011% substantially higher in relative terms than the original -0.001%. This suggests that, as in the female labour-intensive sectors, higher tariffs have a protective effect for male workers in several large regions. Nevertheless, the size of the effect in absolute terms reinforces our conclusion that tariff reform has only a limited impact on gender wage gaps.

Figure 21: Wage premia effects of scenario Sc1.3 without keeping tariff revenue constant



Source: Authors' calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

5.2.6 Reduction of the AVEs of NTMs in goods trade by 50%

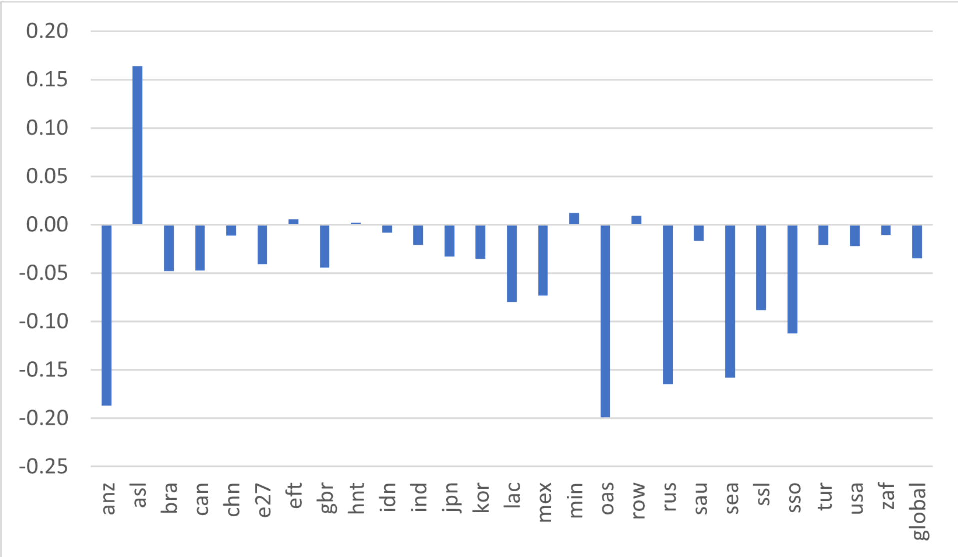
In our benchmark scenarios, the effect of services trade policy reform is significantly larger than that of goods trade policy reform. One reason we have suggested for this is the difference in type and magnitude of the trade cost shocks across the scenarios in the two sectors with services policy reforms targeting NTMs and goods policy reforms targeting tariffs. As mentioned above, data on NTMs in goods is lacking for a substantial share of regions in our aggregation of economies, and, hence, the results of a reduction in AVEs linked to goods NTMs will be distorted by the asymmetry in liberalisation between regions. Nevertheless, to properly evaluate the hypothesis that type and magnitude of the trade cost shocks matter, we run a final simulation for the goods sector in which we shock AVEs of goods NTMs by 50% to have as close a scenario to our services reforms as possible. The shock is equivalent to a reduction in iceberg trade costs at the importer, exporter and product level.

Figure 22 displays the projected change in the wage premium for male workers in this experiment. Contrary to the simple tariff experiments, the global male wage premium falls. The change amounts to -0.03%, which is about half of the effect of the 50% AVE reduction for services NTMs scenario but substantially larger in relative terms to the tariff reform scenarios. This reinforces the findings of recent studies on the growing importance of NTMs vis-a-vis tariffs for trade costs and underlines that the magnitude of the shock matters given that NTMs are much larger than tariffs. That said, as the services policy reform effects remain about twice as large, our previous finding that services policy reforms are more impactful than goods policy reforms holds.

5.2.7 Concluding remarks for the robustness and sensitivity analysis

Results from our benchmark model suggest that trade policy reform has a limited impact on gender wage gaps and that services trade policy reform has a more meaningful impact than

Figure 22: Changes in wage premia when AVEs of NTMs are reduced by 50% for all goods sectors



Source: Authors' calculations based on simulation results. Note: Weighted average across sectors with total value shares for factors as weights. Global wage premia changes are weighted averages across regions.

goods trade policy reform. The previous subsections, in which we have tested the sensitivity of these results to various modelling and parameter choices, reinforce the findings but provide valuable additional insights.

Firstly, the difference in effects across the services trade policy reforms and goods trade policy reforms can largely be explained by the difference in magnitude of the shocks, as can be seen from the experiment reducing AVEs of NTMs in the goods sector, and the higher female intensity of many services sectors, as can be seen from limiting labour mobility. Put differently, services trade policy reform is more promising for reducing the gender wage gap because many services sectors employ more women and because they face larger trade costs.

Secondly, the distributional effects of trade policy are limited. While all robustness and sensitivity checks lead to substantial relative changes in our simulations, they do not turn the initially small effects into meaningful absolute effects as gains in some regions are to a large extent offset by losses in other regions.

6 Conclusion

The primary objective of our paper is to assess the potential of trade policy reform to contribute to a reduction in the gender wage gap and determine in which areas reforms are most effective in reducing the gender wage gap.

We first establish the presence of a gender bias in the current structure of trade costs in both goods and services trade for both tariffs (for goods trade) and for NTMs (for services trade). In addition to this, we find that trade costs related to the need for face-to-face interaction are larger in female labour intensive sectors. The positive correlation between levels of trade costs and female labour intensity is significant in most cases in panel regressions with economy fixed effects.

These results motivate our design of policy experiments attempting to neutralise the gender biases in trade costs, expecting a reduction in the female wage gap. We first equalize tariffs in the goods sectors and then remove tariffs for female-intensive sectors. In both scenarios, the male wage premia are rising globally although marginally, contrary to our expectations. The reason for the counter-intuitive effect on the male wage premium is that, although a reduction in tariff rates increases export opportunities and reduces intermediate input costs, it also increases import competition in female labour intensive sectors. Hence, a reduction in tariffs in female-intensive sectors reduces the protection awarded to them by their respective governments.

To address the problem that increased import competition in female labour intensive sectors reduces demand for female workers on net, we design more sophisticated tariff reform scenarios which aim to provide larger export opportunities and reduce intermediate input costs for female-intensive sectors, while at the same time maintaining protection from import competition. This sophisticated tariff reform leads to a global decline in the male wage premia but only by a very small 0.0001%. We conclude that tariff reform aimed at changing the sectoral incidence of tariffs does not reduce gender inequality in the labour market substantially.

Policy experiments within the services sector generate two main findings. First, trade policy reform through a reduction in NTMs in four tradable services sectors leads to a reduction in male wage premia of a magnitude substantially larger than of tariff or NTM reforms in the goods sector. Second, output effects of the tradable services sectors whose NTMs were reduced are sensitive to the degree of complementarity between intermediate inputs in production and final goods in consumption with output projected to fall under complementarity in these sectors and to rise under substitutability.

Finally, digitalisation, by reducing the need for face-to-face interaction in all sectors, leads to the largest reduction in male wage premia globally by about 0.6%. Since face-to-face requirements are higher in the services than in the goods sectors, digitalisation automatically implies a higher cost reduction for services sectors which are generally more female intensive, which helps explain the global reduction in male wage premia.

To conclude, our policy experiments show that trade liberalisation is expected to deliver only a modest contribution to the reduction in gender inequality on the labour market. The simulations suggest that reform seems most fruitful in the services sector. Moreover, a promotion of digitalisation, which is expected to foster services trade, is projected to promote gender equality by a higher order of magnitude than trade policy reform. This implies that trade policy reform aiming to reduce the gender wage gap should be focused at policies accelerating digitalisation. The mechanisms driving our results, in particular the offsetting effects both within and across economies of import competition versus export opportunities and access to foreign inputs, suggest that our modest results for gender inequality are broadly applicable to studies of the distributional impact of trade policy that examine other inequalities.

Finally, the projected effects of trade policy reform are based on a specific quantitative trade model. Removing biases in trade policy may have benefits that this model fails to consider. These can include, but are not limited to, cultural exchange leading to a reduction in gender discrimination in firm policies, exchange of knowledge allowing adoption of better technology, changes in female bargaining power in the household, upward mobility of females in the next generation and other spillover effects. Studying the impacts of trade liberalisation on such variables can be a focus of future studies. For instance, the employed model can be extended to incorporate knowledge spillovers or household production and a labour-leisure decision as well as bargaining in the household.

References

Acemoglu, Daron, David H. Autor, and David Lyle (2004)."Women, war, and wages: The effect of female labor supply on the wage structure at midcentury.", *Journal of political Economy 112.3 (2004): 497-551.*

Aguiar, A., Chepeliev, M., Corong, E. L., McDougall, R., and Van Der Mensbrugghe, D. (2019)."The GTAP data base: version 10", *Journal of Global Economic Analysis*, 4(1), 1-27.

Aguiar, A., Corong, E. L., Van Der Mensbrugghe, D., Bekkers, E., Koopman, R., and Teh, R. (2019)."The WTO Global Trade Model: Technical documentation", *WTO Staff Working Paper.–2019.–N ERSD-2019-10.*

Arndt, C., Robinson, S., and Tarp, F. (2006), "Trade reform and gender in Mozambique", *Nordic Journal of Political Economy* 32: 73-89.

Artuc, E., Chaudhuri., S., and McLaren, J. (2010), "Trade Shocks and Labor Adjustment: A Structural Empirical Approach", *American Economic Review* 100(June): 1008-1045.

Artuc, E., Porto., G., and Rijkers, B. (2019), "Protectionism and gender inequality in developing countries", *Journal of International Economics* 120: 1-45.

Artuc, E., Porto., G., and Rijkers, B. (2023), "Protectionism and gender inequality in developing countries", *Journal of Globalization and Development* 14(2): 177-222.

Atalay, E. (2017), "How important are sectoral shocks?", *American Economic Journal: Macroeconomics* 9(4): 254-80.

Baldwin, R. (2019), "The Globotics Upheaval: Globalization, Robotics, and the Future of Work", *New York, NY: Oxford University Press.*

Baldwin, R. (2022), "Globotics and macroeconomics: Globalisation and automation of the service sector" (No. w30317), *National Bureau of Economic Research.*

Bekkers, Eddy and So, Yu (in press), "The Trade Effects of a New Agreement on Domestic Services Regulation"

Bekkers et. al. (2018), "Melting ice caps and the economic impact of opening the Northern Sea Route", *The Economic Journal 128.610: 1095-1127.*

Benz, Sebastian, and Alexander Jaax (2022), "The costs of regulatory barriers to trade in services: New estimates of ad valorem tariff equivalents.", *Economics Letters 212: 110057.*

Black, S., and Brainerd, E. (2004), ”Importing Equality? The Impact of Globalisation on Gender Discrimination”, *Industrial and Labor Relations Review, Cornell University* 57(4), 540-559.

Blau, F. D., and Kahn, L. M. (2017). The gender wage gap: Extent, trends, and explanations. *Journal of economic literature, 55(3), 789-865..*

Blinder, A.S. (2009), ”How many US jobs might be offshorable?”, *World Economics, 10(2) 41–78.*

Boler, E., Javorcik, B., and Ullveit-Moe, K. (2018), ”Working across Time Zones: Exporters and the Gender Wage Gap”, *Journal of International Economics, Elsevier* 111, 122-133.

Borchert, I., Gootiiz, B., Magdeleine, J., Marchetti, J. A., Mattoo, A., Rubio, E., and Shannon, E. (2020), ”Applied Services Trade Policy: A Guide to the Services Trade Policy Database and the Services Trade Restrictions Index.”, *World Bank Policy Research Working Paper* 9264.

Bureau of Labor Statistics (2017). Occupational employment statistics [National industry-specific and by ownership]. Retrieved from http://www.bls.gov/oes/tables.htm

Bussmann, Margit (2009), ”The effect of trade openness on women's welfare and work life”, *World Development, Elsevier* 37(6), 1027-1038.

Cali, M. and Montfaucon, A. (2021).”Non-Tariff Measures, Import Competition, and Exports”, *Policy Research Working Paper No. 9801*, World Bank.

Cali, M., Ghose, D., Montfaucon, A. and Ruta, M. (2022).”Trade Policy and Exporters' Resilience: Evidence from Indonesia”, *Policy Research Working Paper No. 10068*, World Bank.

Chen, N., and Novy, D. (2011), ”Gravity, trade integration, and heterogeneity across industries”, *Journal of International Economics*, 85(2), 206–221.

Corong, E. L., Hertel, T. W., McDougall, R., Tsigas, M. E., and Van Der Mensbrugghe, D. (2017), ”The standard GTAP model, version 7”, *Journal of Global Economic Analysis*, 2(1), 1-119.

Cravino, J., and Sotelo, S. (2019), ”Trade-Induced Structural Change and the Skill Premium.”, *American Economic Journal: Macroeconomics*, 11(3): 289-326.

De Giorgi, Giacomo, Marco Paccagnella, and Michele Pellizzari (2013), ”Gender complementarities in the labor market.”, *Bank of Italy Occasional Paper 183 (2013).*

Dixon, P., and Rimmer, M. T. (2002), ”Dynamic general and equilibrium modelling for forecasting and policy: A practical guide and documentation of MONASH”, *Elsevier* 256.

Egger, P., Larch, M., Nigai, S., and Yotov, Y. (2021), ”Trade costs in the global economy: Measurement, aggregation and decomposition”, *WTO Staff Working Papers ERSD-2021-2. WTO, Geneva.*

Fan, T., Peters, M. and Zilibotti, F. (2023), "Growing Like India—the Unequal Effects of Service-Led Growth", *Econometrica*, 91, 1457-1494.

Fofana, I. and Cockburn, J. and Decaluwé, B. (2003), "Modeling male and female work in a computable general equilibrium model applied to Nepal"

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 Approach*, 25-50.

Fontana, M. (2002), "Modelling the effects of trade on women: the case of Zambia", *IDS*.

Fontana, M. and Wood, A. (2000), "Modeling the Effects of Trade on Women, at Work and at Home", *World development, Elsevier* Vol. 28 (7), 1173-1190.

Gailes, A., Gurevich, T., Shikher, S., and Tsigas, M. (2018), "Gender and Income Inequality in United States Tariff Burden", *United States International Trade Commission Working Paper, USITC, Washington, DC.* 2018–08–B.

Gender Disaggregated Labour Database,http://datatopics.worldbank.org/gdld/

Hakobyan, S., and McLaren, J. (2018), "NAFTA and the Wages of Married Women", *NBER Working Paper* 24423. NBER, Cambridge, MA.

Head, K., and Ries, J. (2001), "Increasing returns versus national product differentiation as an explanation for the pattern of US–Canada trade", *American Economic Review* 91(4), 858–876.

Helpman, E. (2018), "Globalization and Inequality", *Harvard University Press, Cambridge, MA*.

Hertel, T., Hummels, D., Ivanic, M., Keeney, R. (2007). How confident can we be of CGE-based assessments of Free Trade Agreements?. Economic Modelling, 24(4), 611-635.

International Labour Organization, ILOSTAT database. Data as of January 2021.

Janse van Rensburg, C., Bezuidenhout, C., Matthee, M., and Stolzenburg, V. (2020), "Globalization and gender inequality: Evidence from South Africa", *UNU-WIDER Working Paper* 2020/97. UNU-Wider, Helsinki, FIN.

Jaumotte, F., Longji, L., Medici, A., Oikonomou, M., Pizzinelli, C., Shibata I., Soh, J., and Tavares, M. (2023), "Digitalization During the COVID-19 Crisis: Implications for Productivity and Labor Markets in Advanced Economies", *IMF Staff Discussion Notes* 2023/003. Washington D.C.: International Monetary Fund (IMF).

Juhn, C. and Ujhelyi, G. and Villegas-Sanchez, C. (2014), "Men, women, and machines: How trade impacts gender inequality", *Journal of Development Economics* 106: 179-193.

Kee, H. L., and Nicita, A. (2022), "Trade fraud and non-tariff measures", *Journal of International Economics* 139: 103682.

Lipowiecka, J., and Kiriti-Nganga, T. (2016), "The gender dimensions of services", *International Centre for Trade and Sustainable Development, Issue Paper, Geneva.*

McDougall, Robert (2002), "A new regional household demand system for GTAP."

Ngai, L. R., and Petrongolo, B. (2017), "Gender Gaps and the Rise of the Service Economy", *American Economic Journal: Macroeconomics* 9(4) : 1-44.

Oldenski, L. (2012), "Export versus FDI and the communication of complex information.", *Journal of International Economics* 87(2): 312-322.

O*NET 27.0, Data retrieved from,http://www.onetcenter.org/database.html?p52

Oostendorp, R. H. (2009), "Globalization and the gender wage gap", *The World Bank Economic Review* 23(1): 141-161.

Nicita, A., Olarreaga, M., and Porto, G. (2014), "Pro-Poor Trade Policy in Sub-Saharan Africa", *Journal of International Economics* 92(2): 252-265.

Porto, G. (2006), "Using Survey Data to Assess the Distributional Effects of Trade Policy", *Journal of International Economics* 70(1): 140-160.

Puri, L. 2004, "Trade in Services, Gender and Development: A Tale of Two Modes", In *Trade and Gender: Opportunities and Challenges for Developing Countries*, edited by A.-N. TranNguyen and A. Beviglia Zampetti. UNCTAD/EDM/2004/2. New York: United Nations

Rodrik, D., & Stiglitz, J. (2024). A New Growth Strategy for Developing Nations. *Initiative for Policy Dialogue Network Paper. Columbia University..*

Rubínová, S., & Sebti, M. (2021). The WTO Trade Cost Index and Its Determinants. *WTO Staff Working Paper.–2021.–N ERSD-2021-6..*

Saure, P., Zoabi, H. (2014), "International Trade, the Gender Wage Gap and Female Labor Force Participation", *Journal of Development Economics* 111: 17-33.

Shapiro, J. (2021), "The Environmental Bias of Trade Policy", *Quarterly Journal of Economics* 136(2): 831-886.

Shepherd, B. (2020), "Quantifying Trade Law: New Perspectives on the Services Trade Restrictiveness Index.", *Trade L. and Dev. 12 (2020): 270.*

Siddiqui, R. (2009), "Modeling gender effects of Pakistan's trade liberalization", *Feminist Economics, Taylor & Francis* 15(3), 287-321.

Sinha, A. and Sangeeta, N. (2001), "Gender in a macro economic framework: a CGE model analysis", *NCAER, New Delhi, IN.*

United Nations (2015), "GA/RES/70/1: Transforming Our World: The 2030 Agenda for Sustainable Development", *United Nations, New York, USA.*

United Nations Conference on Trade and Development (2022). NEUTRAL POLICIES, UNEVEN IMPACTS: Non-tariff Measures through a Gender Lens. *United Nations, Geneva.*

United Nations Conference on Trade and Development and World Bank Group (2018). The Unseen Impact of Non-Tariff Measures: Insights from a new database. *United Nations, Geneva.*

Ural Marchand, B. (2012), "Tariff Pass-Through and the Distributional Effects of Trade Liberalization", *Journal of Development Economics* 99(2): 265-281.

Weinberg, Bruce A. (2000), "Computer use and the demand for female workers.", *ILR Review* 53(2): 290-308.

World Bank Group and World Trade Organization (2020), "Women and Trade: The role of trade in promoting gender equality", *World Bank Group and World Trade Organization, Geneva, CH.*

World Economic Forum (2022), "Global Gender Gap Report 2022", *World Economic Forum, Geneva, CH.*

World Trade Organization (2019), "World Trade Report 2019: The future of services trade", *World Trade Organization, Geneva, CH.*

World Trade Organization (2019), "World Trade Report 2023: Re-globalization for a secure, inclusive, and sustainable future", *World Trade Organization, Geneva, CH.*

Appendix A Further Details of Model Description

Appendix A.1 Transport Services

The cif-quantity q_{src} is a Leontief aggregate of the fob-quantity q_{src}^{fob} and the quantity of transport services ts_{src}:[32]

$$q_{src} = \min\left\{q_{src}^{fob}, \frac{ts_{src}}{a_{src}}\right\} \tag{A.1}$$

So there is no scope for substitution between transport services and fob-quantities and the quantity of transport services is proportional to the quantity traded:

$$ts_{src} = \gamma_{src} q_{src} \tag{A.2}$$

Equation (A.1) implies that the cif-price is additive in the fob-price and implying equation (32) in the main text.

Since transport services are a homogeneous good globally, there is only one price of transport services, p^{ts}, and the price of transport services used between s and r in sector c, p_{src}, is equal to this price:

$$p_{src}^{ts} = p^{ts} \tag{A.3}$$

The demand for transport services on all routes is equal to the supply of global transport services, ts, provided by a global transport sector:

$$\sum_{c=1}^{C}\sum_{s=1}^{R}\sum_{r=1}^{R} ts_{src} = ts \tag{A.4}$$

The global transport sector demands transport services in turn from different economies supplying these services, according to a Cobb-Douglas function:[33]

$$p^{ts} = \prod_{r=1}^{C}\left(p_{rts}^{ib}\right)^{\nu_r} \tag{A.5}$$

By a slight abuse of notation the transport services sector has sector index ts. This sector also produces services sold domestically and to its trading partners. The corresponding demand for transport services from economy r, ts_r, is given by:

$$ts_r = \nu_r \frac{p^{ts} ts}{p_{rts}^{ib}} \tag{A.6}$$

Appendix A.2 Tax Revenues and Price of Savings

Table A.1 gives an overview of the six type of taxes in the model (taken from Bekkers et. al. (2018)). Tax rates are in power terms (as one plus the ad valorem rate).

[32] We assume that there is only one type of transport sector, but this could easily be generalized.

[33] Because more detailed data on transport services are lacking, the supply of transport services first goes into a global transport sector, which in turn distributes these services without a link between the supplying economy and the demanding trade partners

Table A.1: Overview taxes in the model

Power of tax	Tax revenue	Description
tn_{rce}	tnr_{rce}	Tax on use of endowment e in sector c
td_{re}	tdr_{re}	Direct income tax on endowment e
tp_{rc}	tpr_{rc}	Tax on production in sector s
$ta_{rc}^{so,ag}$	$tar_{rc}^{so,ag}$	Tax on purchases by group $ag = pr, go, in, fi$ in sector s from source $so = imp, dom$
ta_{src}	tar_{src}	Tax on imports (tariff) from s to r in sector c
te_{src}	ter_{src}	Tax on exports from s to j in sector c

It is straightforward to calculate the tax revenues for the first three domestic tax rates, since tax bases are unambiguously defined:

$$tnr_{rce} = (tn_{rce} - 1)\,\omega_{rce} q_{rce}^{end} \tag{A.7}$$

$$tdr_{re} = (td_{re} - 1)\,w_{ie} q_{re}^{end} \tag{A.8}$$

$$tpr_{rc} = (tp_{rc} - 1)\,p_{rc}^{ib} q_{rc}^{ib} \tag{A.9}$$

Source-specific import tax revenues, $t_{rc}^{so,ag}$, can also be easily determined according to the following equation with $q_{rc}^{so,ag}$ defined in (27):

$$tar_{rc}^{so,ag} = (ta_{rc}^{so,ag} - 1)\,p_{rc}^{so,ag} q_{rc}^{so,ag} \tag{A.10}$$

Import tariff revenues and export tax revenues can also be expressed in a straightforward way as follows:

$$tar_{src} = \frac{(ta_{src} - 1)\,p_{src} q_{src}}{ta_{src}} \tag{A.11}$$

$$ter_{src} = (te_{src} - 1)\,p_{rc}^{ib} q_{src} \tag{A.12}$$

Because the bilateral price p_{src} is defined as tariff inclusive, in equation (A.11) we divide by the power of the tariff to calculate tariff revenues. This is not the case for source-specific import and domestic tax revenues and export taxes instead, as for these taxes the tax base is defined based on prices, exclusive of the power of the tax.

The different indirect tax revenues can be added up to generate total tax revenues on indirect taxes:

$$tr_r^{ind} = \sum_{e=1}^{E} \sum_{c=1}^{C} tnr_{rce} + \sum_{c=1}^{C} \left[tpr_{rc} + \sum_{ag} \sum_{so} tar_{rc}^{so,ag} + \sum_{s=1}^{R} (tar_{src} + ter_{rsc}) \right] \tag{A.13}$$

Finally, the price of savings in a specific economy is a weighted average of the price of investment goods across the world acquired by the global bank and the price of domestic investment goods. With this specification more weight is given to the domestic price of investment flows. The price of savings is determined by the domestic price of investment and a weighted average of the global price of investment goods:

$$p_r^{sa} = p_r^{in} \sum_{s=1}^{R} \left(p_s^{in}\right)^{\chi_s} \tag{A.14}$$

χ_s is the value of net investment minus the value of savings in economy s divided by the value of global net investment:

$$\chi_s = \frac{p_s^{sa}\left(q_s^{sa} - \delta_s q_{scap}^{end}\right) - p_s^{sa} q_s^{sa}}{\sum_{u=1}^{K} p_u^{sa}\left(q_u^{sa} - \delta q_{ucap}^{end}\right)} \tag{A.15}$$

Appendix A.3 Derivations Demand

Log differentiating the expenditure function in equation (6) with respect to utility q_r^{pr}, prices p_{rc}^{pr}, and expenditure x_r^{pr} and solving for $\widehat{x_r^{pr}}$ leads to:

$$\widehat{x_r^{pr}} = \sum_{c=1}^{C} \frac{\alpha_c \left(q_r^{pr}\right)^{\gamma_c \eta_c} \left(\frac{p_{rc}^{pr}}{x_r^{pr}}\right)^{\gamma_c} \gamma_c}{\sum_{u=1}^{C} \alpha_u \left(q_r^{pr}\right)^{\gamma_u \eta_u} \left(\frac{p_{ru}^{pr}}{x_r^{pr}}\right)^{\gamma_u} \gamma_u} \left(\widehat{p_{rc}^{pr}} + \eta_c \widehat{q_r^{pr}}\right) = \sum_{c=1}^{C} s_{rc}^{pr} \widehat{p_{rc}^{pr}} + \sum_{c=1}^{C} s_{rc}^{pr} \eta_c \widehat{q_r^{pr}} \tag{A.16}$$

Variables with a hat indicate relative changes, i.e. $\widehat{x} = \frac{dx}{x}$. Equation (A.16) can be used to derive two equations in the main text, the expression for sectoral private demand, q_{rc}^{pr}, in equation (7) and the expression for the elasticity of quantity, q_r^{pr}, with respect to expenditure, x_r^{pr}, in equation (4).

s_{rc}^{pr}, the coefficient on $\widehat{p_{rc}^{pr}}$, is the expenditure share on good c by Shepherd's lemma, i.e. $s_{rc}^{pr} = \frac{dx_r^{pr}}{dp_{rc}^{pr}} \frac{p_{rc}^{pr}}{x_r^{pr}} = \frac{q_{rc}^{pr} p_{rc}^{pr}}{x_r^{pr}}$. Recall that Shepherd's lemma shows that the partial derivative of the expenditure function, x_r^{pr}, with respect to the price of the good from sector c, p_{rc}^{pr}, gives Hicksian demand, which can be converted into Marshallian demand by writing utility as a function of expenditure. From equation (A.16) we can thus find the expression for demand q_{rc}^{pr} in equation (7) using the expression for s_{rc}^{pr} and the fact that $q_{rc}^{pr} = s_{rc}^{pr} \frac{x_{rc}^{pr}}{p_{rc}^{pr}}$:

$$q_{rc}^{pr} = s_{rc}^{pr} \frac{x_{rc}^{pr}}{p_{rc}^{pr}} = \frac{\alpha_c \left(q_r^{pr}\right)^{\gamma_c \eta_c} \left(\frac{p_{rc}^{pr}}{x_r^{pr}}\right)^{\gamma_c - 1} \gamma_c}{\sum_{u=1}^{C} \alpha_u \left(q_r^{pr}\right)^{\gamma_u \eta_u} \left(\frac{p_{ru}^{pr}}{x_r^{pr}}\right)^{\gamma_u} \gamma_u} \tag{A.17}$$

The coefficient on $\widehat{q_r^{pr}}$, $\sum_{c=1}^{C} s_{rc}^{pr} \eta_c$, is the inverse of the elasticity of utility with respect to expenditure, Ψ_r^{pr} in equation (4).

To derive equations (3) and (5) we maximise utility in equation (1) subject to the implicit budget constraint in equation (2). The first order conditions (FOCs) are given by:

$$\kappa_r^{ca} \frac{u_r}{q_r^{ca}} = \lambda \frac{\partial e_r^{ca}}{\partial q_r^{ca}} \tag{A.18}$$

λ is the Lagrange multiplier of the maximisation problem. Combining the FOCs, defining Ψ_r^{ca} as the elasticity of quantity with respect to expenditure, $\Psi_j^{ca} = \frac{\partial q_j^{ca}}{\partial e_j^{ca}} \frac{x_j^{ca}}{q_j^{ca}}$, and substituting the result into the budget constraint leads to the following expression for x_r^{ca}:

$$x_r^{ca} = \frac{\kappa_r^{ca}\Psi_r^{ca}}{\sum\limits_{d\in\{pr,go,sa\}} \kappa_r^d \Psi_r^d} x_r \tag{A.19}$$

We get then to equation (3) using the expression for Ψ_r in equation (5). To derive equation (5) we log differentiate the utility function in (1). Applying the definition of Ψ_r^{ca} gives:

$$\widehat{u_r} = \sum_{ca\in\{p,g,s\}} \kappa_r^{ca}\widehat{q_r^{ca}} = \sum \kappa_r^{ca}\Psi_r^{ca}\widehat{x_r^{ca}} \tag{A.20}$$

Log differentiating the budget constraint and substituting equation (3) generates:

$$\sum_{ca\in\{pr,go,sa\}} \kappa^{ca} \frac{\Psi_r^{ca}}{\sum\limits_{d\in\{pr,go,sa\}} \kappa_r^d \Psi_r^d} \widehat{x_r^c} = \widehat{x_r} \tag{A.21}$$

Substituting equation (A.20) into equation (A.21) we get:

$$\frac{1}{\sum\limits_{d\in\{pr,go,sa\}} \kappa_r^d \Psi_r^d} \widehat{u_r} = \widehat{x_r} \tag{A.22}$$

Hence, equation (A.22) shows that the elasticity of utility u_r with respect to expenditure x_r is given by the expression in equation (5).

Appendix B Sectoral and regional aggregations

Table B.1: Regional aggregation

Region	Region description
anz	Australia & New Zealand
asl	Asia LDC
bra	Brazil
can	Canada
chn	China
e27	European Union 27
eft	European Free Trade Association
gbr	United Kingdom
hnt	Hong Kong & Chinese Taipei
idn	Indonesia
ind	India
jpn	Japan
kor	Korea, Republic of
lac	Latin America
mex	Mexico
min	Middle East and North Africa
oas	Other Asian countries
row	Rest of World
rus	Russian Federation
sau	Saudi Arabia, Kingdom of
sea	Southeast Asia
ssl	Sub-Saharan Africa LDC
sso	Sub-Saharan Africa other
tur	Türkiye
usa	United States of America
zaf	South Africa

Table B.2: Sectoral aggregation - 28 sectors

Sector	Sector description
b_t	Beverages and Tobacco products
bph	Manufacture of pharmaceuticals, medicinal chemical and botanical products
chm	Manufacture of chemicals and chemical products
coa	Coal
cro	Crops
eeq	Electrical Equipment
ele	Manufacture of electrical equipment
fmp	Manufacture of fabricated metal products, except machinery and equipment
gas	Gas
i_s	Iron & Steel: basic production and casting
lea	Manufacture of leather and related products
lum	Lumber: manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
lvs	Livestock
mvh	Manufacture of motor vehicles, trailers and semi-trailers
nfm	Non-Ferrous Metals: production and casting of copper, aluminium, zinc, lead, gold, and silver
nmm	Manufacture of other non-metallic mineral products
oil	Oil
ome	Manufacture of machinery and equipment n.e.c.
omf	Other Manufacturing: includes furniture
otn	Manufacture of other transport equipment
oxt	Other Mining Extraction (formerly omn): mining of metal ores; other mining and quarrying
p_c	Petroleum & Coke: manufacture of coke and refined petroleum products
pcf	Processed food
ppp	Paper & Paper Products: includes printing and reproduction of recorded media
rpp	Manufacture of rubber and plastics products
ser	Services
tex	Manufacture of textiles
wap	Manufacture of wearing apparel

Table B.3: Sectoral aggregation - 23 sectors

Sector	Sector description
agr	Agriculture
ffl	Fossil Fuel dependent sectors
pcf	Processed Food and Beverages
otg	Other goods like Textile, Apparel, Leather, Wood products, paper products
p_c	Petroleum and coal products
che	Chemical, Pharmaceutical, Rubber and Plastic products
met	Ferrous and other metal products
teq	Manufacture of transport equipment such as motor vehicles, trailers and semi-trailers
ome	Manufacture of machinery and equipment n.e.c.
eeq	Electrical Equipment
ele	Manufacture of computer, electronic and optic equipment
utl	Provision of utility serivces such as electricity, water and gas
cns	Construction services
trd	Trade related services
ars	Accommodation, Food and recreational services
trp	All transport services
whs	Warehousing and related services
cmn	Communication and related services
ofi	Other financial services
ins	Insurance and related services
rsa	Real Estate services
bus	Other business related services
osg	Other services including education, health, dwellings, public adminisitration and defence

Table B.4: Sectoral aggregation - TiVa categorization

Sector	Sector description
Primary	Crop and Livestock
Mining	Extraction related sectors
Food	Processed food, beverages and tobacco products
Textile & Leather	Textiles, wearing apparel and leather
Wood	Wood products
Paper	Paper products, publishing
Chemicals	Chemical products
Plastics	Rubber and plastic products
Mineral	Mineral products nec
Metal	Ferrous metals
Electronics	Computer, electronic and optic and electrical products
Other machinery	Machinery and equipment nec
Transport	Motor vehicles and parts and transport equipment nec
Other manuf	Manufactures nec
Construction	Construction
Wholesale	Retail
Trade	
Inland	Transport nec
Maritime	Water transport
Air	Air transport
Logistics	Warehousing and support activities
Post & Telecom	Communication
Finance	Financial services nec
Business & Professional	Real estate activities
Other Services	Other Services

Appendix C Further details scenario design and shocks

We present a detailed description of each scenario and how we calculate its shock for the remainder of this section.

Appendix C.1 Shock design for sophisticated tariff reform in the goods sector

Based on the analysis of the tariff equalization scenario, we develop in this section a more targeted tariff liberalisation scenario to improve the labour market position of women. The starting point is that variation in sectoral tariffs affects the demand for different types of workers along three channels: through the impact on export opportunities, through the costs of intermediate inputs, and through import competition. We construct three metrics to measure them separately and then create a shock taking into account the cumulative of all three metrics. We impose tariff revenue neutrality by ensuring that the ratio of total tariff revenues to regional income is held constant.

In all three metrics the change in the tariff rate in region j in sector s, Δt_{js}, are reduced in proportion to their initial tariffs, t_{js}, with the factor of proportion a function of a coefficient varying by sector, $coef_{js}$:

$$\Delta t_{js} = -coef_{js} * t_{js} \tag{C.1}$$

For the first channel the coefficient determining the size of the tariff reduction is designed to generate more export opportunities in exporting sectors with a high female labour share. Hence, the metric governing the tariff reduction in importing region j in sector s is determined by the share of imports from exporting region i and the female labour intensity in exporter i in sector s:

$$v1 = \sum_{i} imp\_share_{ijs} * flf_{is} \tag{C.2}$$

imp_share_{ijs} is the import share of exporting region i into the importing region j in sector s and flf_{is} is the female labour share in the exporting region i for sector s.

For the second channel, the tariffs are reduced not only to promote export opportunities in female labour intensive sectors but also to reduce the costs of intermediate inputs used in female labour intensive sectors. A reduced cost of intermediate inputs is expected to raise production and thus demand for labour inputs because of the complementarity in production between intermediate inputs and factor inputs such as labour and capital. The metric is

$$v2 = \sum_{i} \sum_{t} int\_input\_import.share_{ijst} * flf_{jt}$$

Where $int\_input\_import.share_{ijst}$ is the intermediate input import share of importer j from exporter i of intermediate inputs s used by sector t and flf_{jt} the female labour share in importing region j and sector t.

In the third channel import competition is added. The analysis of the results of the tariffs equalization experiment, showed that in many regions output was not promoted in the female labour intensive sectors, because of fiercer import competition. Therefore, we added a third channel for our final shock, to prevent output from falling in female labour intensive sectors where import competition is strong.

$$v3 = imp.share_{js} * flf_{js}$$

Where $imp.share_{js}$ is the share of imports in total absorption in sector s in importing region j. It is calculated as the share of imports in total absorption consisting of investment, private household demand, government demand and intermediate inputs demand. Finally, the overall coefficient for tariffs reduction is calculated as a follows,

$$coef_{js} = [\frac{(v1) * (v2)}{v3}]^{1/3} \tag{C.3}$$

Since the import competition term is in the denominator it reduces the tariffs shock for female labour intensive sectors facing more import competition, while the other two channels increase the reduction.

Table C.1 and C.2 below, show the final shock values by sector and region. We see that the overall shock is not very high in magnitude.

Table C.1: Initial female wage share and variation in tariffs by sector

Sector	Initial female wage share (in %)	Change in tariffs (in percentage point) Scenario 3
b_t	0.22	-1.47
bph	0.24	0.27
chm	0.21	0.43
coa	0.17	-0.21
cro	0.17	-1.75
eeq	0.17	0.43
ele	0.24	0.81
fmp	0.18	-0.07
gas	0.20	0.11
i_s	0.21	0.46
lea	0.27	-0.66
lum	0.19	-0.51
lvs	0.18	-3.33
mvh	0.18	-0.57
nfm	0.17	1.26
nmm	0.17	-0.11
oil	0.21	0.32
ome	0.17	0.48
omf	0.17	0.09
otn	0.18	0.56
oxt	0.15	0.95
p_c	0.21	1.49
pcf	0.24	-2.24
ppp	0.26	-0.43
rpp	0.21	-0.82
ser	0.31	0
tex	0.33	-2.06
wap	0.35	-0.44

Appendix C.2 Shock designs for trade reform in Services sector

As discussed in Section 2.3, there are multiple ways to measure the trade costs related to non-tariffs measures in the services sector. While conducting our experiments, we restrict our focus to the ad valorem equivalents (AVEs) calculated using the World Bank - WTO database called Services Trade Policy Database (STPD). We use the 5 sectors for which data is available

Table C.2: Initial female wage share and variation in tariffs by region

Region Change in tariffs (in percentage point)	Initial female wage share (in %)	
		Scenario 3
anz	0.42	0.06
asl	0.18	-0.23
bra	0.37	-0.13
can	0.27	0.07
chn	0.30	-0.14
e27	0.29	0.06
eft	0.30	0.03
gbr	0.26	0.06
hnt	0.26	0.03
idn	0.20	0.02
ind	0.23	0.17
jpn	0.25	0.37
kor	0.24	1.25
lac	0.35	0.05
mex	0.28	0.03
min	0.22	0.04
oas	0.22	0.16
row	0.25	0.21
rus	0.46	0.26
sau	0.22	-0.13
sea	0.32	0.18
ssl	0.29	-0.02
sso	0.25	0.26
tur	0.28	-0.05
usa	0.42	0.20
zaf	0.39	0.03

and draw the positive relation between the estimated AVEs and female intensity. However, due to possible errors in measurement, we avoid using the sector "ofi" or other financial services in our analysis[34]. Hence, we finally analyse and implement the shocks on four services sectors : Business services (bus), transport services (trp), communication services (cmn) and Insurance services (ins).

To estimate AVEs, we convert STPD values using the following formula,

$$AVE = (e^{\frac{coeff * \Delta STPD}{\sigma - 1}} - 1) * 100$$

Where σ is the elasticity of substitution equal to 3.8, taken from the baseline data. The coefficient is estimated using a Poisson pseudo maximum likelihood (ppml) regression for gravity estimation. Our calculations are based on Bekkers and So (forthcoming). Table 2 discusses the two different kinds of shocks designed for these sectors. The first scenario (S5.1) refers to shocks where we first identify the lowest AVEs value for each of these sectors in the world and then reduce the AVEs in other regions to this value. The term $\Delta STPD$ in this scenario is the gap between actual AVEs and the global minimum AVEs for that sector. In the second scenario (S4.1) we cut the AVEs in these sectors, in all the regions by 50%. The term $STPD$ in this case is half of the actual STPD value.

[34] The estimated AVEs trade cost for this sector is negative

Appendix C.3 Comparison of trade cost changes in Sc1.2 of tariff reform and Sc 2.1 of services trade reform

Before we discuss further the other scenarios, we want to present here the average regional changes in AVEs implied by the policy reforms implemented in simulations for Scenario 1.2 and 2.1. The purpose of this table is to give the reader a rough idea of how the magnitude of the change in trade costs varies in the goods and services experiments.

Table C.3: Weighted average changes in regional AVEs for scenario 1.2 and 2.1

reg	Sc1.2	Sc2.1
anz	-3.100	-0.049
asl	-0.692	-0.770
bra	-3.524	-0.4258
can	-2.008	-0.0794
chn	-1.1781	-0.090
e27	-3.078	-0.065
eft	-4.747	-0.037
gbr	-4.008	-0.070
hnt	-3.127	-0.032
idn	-2.143	-0.065
ind	-1.474	-0.098
jpn	-2.229	-0.134
kor	-1.456	-0.073
lac	-2.621	-0.243
mex	-1.073	-0.077
min	-1.514	-0.274
oas	-1.375	-0.293
row	-2.368	-0.176
rus	-2.559	-0.347
sau	-2.213	-0.179
sea	-2.235	-0.106
ssl	-1.105	-0.493
sso	-2.253	-0.672
tur	-1.050	-0.154
usa	-2.561	-0.258
zaf	-2.574	-0.311

Appendix C.4 Shock designs for digitalisation scenario

For the face-to-face index we use a measure of face-to-face requirements developed by Blinder (2009) using data from the American O*NET database. The index uses data on the importance scores assigned to four kinds of tasks in various occupations and condenses it into a measurement of face-to-face requirement using the Oldenski (2012) scoring method and data from United

States bureau of labour statistics for industry shares of each occupation as per the following formula[35] .

$$M_{sz} = \sum_{c} \alpha_{zc} l_{sc}$$

Where s indicates tasks, c occupation and z industries, such that M_{sz} indicates the importance of task s in industry z. α refers to the share of occupation c in industry z and l refers to the average importance value for task s in occupation c, taken from the ONET survey. To calculate the final face-to-face index we normalize each score and take an average value of importance score across the four selected tasks.

We design shocks for experiments related to this field by converting the face-to-face requirement index into iceberg trade costs using a simple gravity estimation equation with the HRM index as a measure for trade costs. The HRM index refers to trade costs calculated as a ratio of international to intranational trade, based on Head and Ries (2001) and Chen and Novy (2011). To calculate the shocks we first run a gravity estimation using HRM index as a measure of trade costs and including face-to-face index in the vector of independent variables. We use the standard gravity variables complemented by economy specific variables such as the credit and contract environments, a dummy for a common language, logistics efficiency, customs procedures as well as broadband subscriptions. Using the coefficient from these regressions, we convert changes in face-to-face requirement to changes in iceberg trade costs with the same formula as described below.

$$shock = (e^{(-coeff * \Delta FacetoFaceIndex)} - 1) * 100$$

Where the coeff is the coefficient obtained from the gravity regression and the change in face-to-face index is the expected reduction as per the scenario design. For scenario 6.1, it is reduced to half its original value and for scenario 6.2 it is reduced to the lowest current value across the sectors.

An important point to keep in mind regarding face-to-face index is that its one-dimensional and based on United States data. For further research, this index can be reconstructed at a world level with industry shares for occupations collated separately for each region.

Appendix C.5 Shock designs for counterfactual scenarios - NTMs in goods sector

As a robustness check, we look at non-tariffs measures in goods sector. Although the regression results in Section 2.2 revealed that the apparent positive correlation between the female share and non-tariffs measures in goods is not significant, we still conduct a policy experiment to see if reducing them has any impact on gender wage gap. Since the measures cannot be related to female share, the shock is constructed as simple 50% reduction in barriers across sectors. To measure this value we use AVEs of NTMs taken from Kee and Nicita (2022) as explained in 2.2. The shock is equivalent to a reduction in iceberg trade costs at importer, exporter and product level. Given that for exporter i, importer j and good t, iceberg trade costs are defined as :

[35]Refer to Blinder(2009) for more details regarding the calculation of importance score for each task and selection of tasks for this index

$$itc_{ijt} = 1 + AVE_{ijt} \tag{C.4}$$

The 50% iceberg trade cost reduction across all sectors is calculated as:

$$\Delta itc_{ijt} = -0.50 \times \frac{(1 + AVE_{1,ijt}/100) - (1 + AVE_{0,ijt}/100)}{1 + AVE_{0,ijt}/100} \times 100 = -0.50 \times \frac{AVE_{1,ijt} - AVE_{0,ijt}}{1 + AVE_{0,ijt}/100} \tag{C.5}$$

where $AVE0_{ijt}$ is the current estimated ad valorem equivalent trade cost of NTMs in % terms, estimated by Kee and Nicita (2022). For example, a value of 20 would imply that the ad valorem equivalent of NTMs imposed on good t, by importer j to the exporter i is 20%.

Appendix D Calculation of regional and global wage premia values

This appendix describes how regional and global values of male wage premia are calculated.

We start by defining 2 variables defined over the set of regions (listed in Appendix A) and the set of genders male and female (g). The variable $pe_{r,g}$ denotes the percentage change in the wage of gender g, in region r, by 2026 relative to the baseline. For example, if $pe_{asl,male} = 2$, this implies that male wages in region ASL have increased by 2 %. [36]. The variable $evfb_{r,g}$ denotes the total wage bill (in nominal terms) in the base year 2017.

The regional wage premium value (wp_r) is computed as:

$$wp_r = 100(\times \frac{1 + \frac{pe_{r,m}}{100}}{1 + \frac{pe_{r,f}}{100}} - 1)$$

The global wage premium value is a weighted average of the wp_r, using the total wage bill in the region as weights. Thus, the weight assigned to each region is computed as:

$$evfb_r = \sum_s evfb_{r,s}$$

Thus, the global wage premium (gwp) value is computed as:

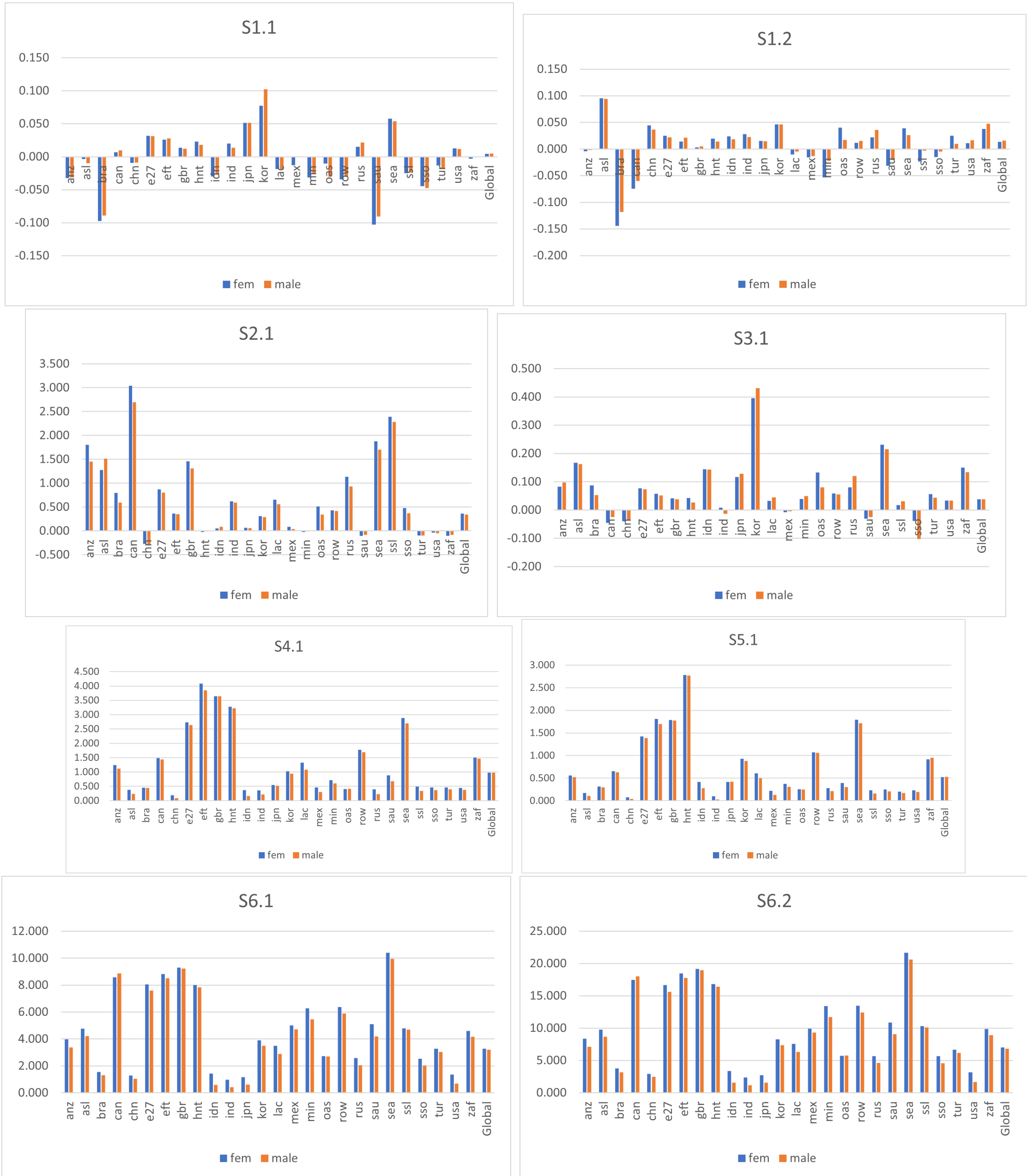
$$gwp = \frac{\sum_r wp_r \times evfb_r}{\sum_r evfb_r}$$

[36] Given that we have full factor mobility in our model, male and female workers allocate their labour across sectors depending on labour demand, such that wages are equalized across sectors.

Appendix E Additional Simulation Results

Appendix E.1 Changes in Real Income across experiments:

Figure D.1: Real income changes by region



Source: Authors'calculations based on simulation results
Note: Global weighted average across sectors taken using factor value shares as weights