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Abstract

Gender segmentation in labor markets shapes the local effects of international trade. This paper develops a theory that embeds trade in gender-segmented labor markets and shows that in this framework, foreign demand shocks may increase or decrease the female-to-male employment ratio. If a foreign demand shock from a relevant market happens in a female-intensive (male-intensive) sector, the model predicts that the female-to-male employment ratio should increase (decrease). The paper then uses plausibly exogenous variation in the exposure of Tunisian local labor markets to foreign demand shocks and shows that the empirical results are consistent with the theoretical prediction. In Tunisia, a country with a high degree of gender segmentation in the labor markets, foreign demand shocks have been relatively larger in male-intensive sectors. This induced a decrease in the female-to-male employment ratio, with households likely substituting female for male labor supply.

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Gender-Segmented Labor Markets and Trade Shocks

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1 Introduction

Gender inequality in labor markets is a widely discussed phenomenon, both among researchers and the general public. Even in countries that rank high in gender equality indicators, female workers tend to earn less than males with the same observable characteristics.[1]. This suggests that biases, social norms and/or individual preferences create frictions in the labor market that prevent workers from optimally moving across sectors. If large enough, such frictions can lead to substantial levels of market segmentation – a situation in which male and female workers perform different sets of pre-determined tasks, rather than sorting into tasks in which they are more productive.[2].

International trade can impact different groups of workers in differential ways. Trade shocks induced by changes in policy or in foreign demand alter domestic relative prices, both in product and factor markets, and will likely impact employment and wages. If the domestic market has a high degree of gender segmentation, it would not be surprising that trade shocks differentially impact males and females.

Through the lens of Becker's (1971) canonical model of "taste-based discrimination," bias creates inefficiencies in production since managers might be willing to pay male workers more relative to a female worker of the same productivity This equilibrium can only be sustained with some degree of protection from entry of new competitors. If trade liberalization increases competition in product markets, it should lead to a decrease in gender inequality in the labor market.

The empirical evidence does suggest that, in many instances, trade liberalization decreases gender inequality. But the mechanisms are more complex than what Becker had in mind. First, in many developing countries, trade liberalization induced sectoral shifts towards industries and tasks that are more female-intensive in a gender-segmented labor market. Second, increased foreign competition can temporarily displace male workers, reduce household incomes, and induce females to supply labor outside the household – an added worker effect.

These factors highlight that both the nature of the trade shocks and domestic labor market institutions matter in determining the impact of trade liberalization on gender inequality. This paper sheds light on the relationship between *exports* and gender-segmented labor markets by studying the effects of increased foreign demand shocks on local labor markets.

In this paper, we make two main contributions to the literature: one theoretical and another empirical. First, we present a general equilibrium model that combines international trade and gender-segmented labor markets. Production is divided between a female-intense sector and a male-intense sector and households optimize their combined consumption and leisure by supplying different quantities of female and male labor, given wages. In this framework, a foreign demand shock can either increase or decrease the equilibrium female-to-male employment ratio. The response depends crucially on (a) the sectoral composition of the demand shock; and (b) the relative market shares of each industry in the destination market.

We then present empirical evidence that is consistent with this theoretical mechanism. We construct a new dataset that combines labor market data and trade data from Tunisia, a developing country with a high degree of gender segmentation in the labor market and where foreign demand shocks were concentrated in male-intensive industries. We then use plausibly exogenous variation in export exposure of different regions in Tunisia to show that the direction of the effect of exports on labor markets is the same as the one predicted by the theoretical model.

Tunisia is a good case study because it has a high level of gender segmentation in labor markets but females are an important part of the labor force, participating at higher rates than other Middle East and Northern Africa (MENA) countries. During the sample period, the female-to-male employment ratio decreases in response to a foreign demand shock. This effect was concentrated par-

[1] For a review of gender imbalances in labor markets of developed countries, see the review in OECD (2012).

[2] In a policy review, Papageorgiou, Ostry, and Espinoza (2018) provide evidence of large gender sorting across different sectors for a large number of countries. In particular, they show the rise of services correlates with a narrowing of the male-to-female labor force participation gaps.

ticularly among married female workers, which suggests that households substitute male for female labor supply when male-intensive industries expand.

Related Literature This work is primarily related to the literature on trade and gender inequality. Black and Brainerd (2004), Gaddis and Pieters (2012), Juhn, Ujhelyi, and Villegas-Sanchez (2013), and Kis-Katos, Pieters, and Sparrow (2018) all show that female labor force participation and female employment increase with higher exposure to trade liberalization, which is typically seen as a negative labor market shock due to increased foreign competition.

The forces that contributed to an increase in female participation in the labor market were: (a) large reallocations both within and between sectors, particularly an increased shift of the total labor force from manufacturing to services, in line with the idea that structural transformation increases female participation; (b) capital upgrading making physically intensive tasks more accessible for women; and (c) income effects, for those households whose male worker transitioned into unemployment or the informal sector after trade liberalization. We add to this literature by focusing on the impact of foreign demand shocks, rather than tariff liberalization, on gender imbalances in local labor markets.

Additionally, since it presents a structural model of trade and gender inequality, it draws parallels to Do, Levchenko, and Raddatz (2016), Juhn, Ujhelyi, and Villegas-Sanchez (2014), Chauvin (2018), and Robertson, Kokas, et al. (2022), who present models of trade and gender-segmented labor markets. The focus of each of these papers are, however, different from ours.

The first analyzes trade liberalization and comparative advantage on female- vs. male-intensive sectors changes the patterns of fertility rates. The second focuses on the interactions between trade liberalization and gender inequality for high-skilled vs low-skilled female workers. The third highlights low local demand shocks on female vs male-intensive sectors can induce differential patterns of household migration. By contrast, we try to clarify the causal channels between foreign demand shocks and local demand for female vs. male workers. The last one underscores that positive shocks to female-intensive industries increase the the relative female wage —a prediction that our model also makes. In this paper, we endogenize and microfound labor supply decisions and derive analogous predictions for the female-to-male employment ratio.

2 Theory

Demand We consider a world economy with several countries $d \in \mathcal{K}$. In each country, there is a representative household that maximizes utility by choosing optimal consumption as well as female and male labor supply.

$$\begin{aligned} \max_{\{C_{d,m}, C_{d,m}, L_{d,m}, L_{d,f}\}} \quad & C_{d,m}^{\alpha_d} C_{d,f}^{1-\alpha_d} - \frac{L_{d,m}^{1+\eta_d}}{1+\eta_d} - \nu_d \frac{L_{d,f}^{1+\eta_d}}{1+\eta_d} \\ s.t. \quad & P_{d,m} C_{d,m} + P_{d,f} C_{d,f} \leq L_{d,m} w_{d,m} + L_{d,f} w_{d,f} + P_d e_d = Y_d \end{aligned}$$

where $C_{d,m}, C_{d,f}$ are quantities demanded for goods m and f, respectively, in country d; $P_{d,m}, P_{d,f}$ are the prices of those two goods; $L_{d,m}$ is female labor supply; $L_{d,f}$ is male labor supply; and e_d is some endowment, which can be interpreted as an income shifter. Given this structure, we can define the ideal price index $P_d = A \cdot P_{d,m}^{\alpha_d} P_{d,f}^{1-\alpha_d}$, where $A = (\alpha_d)^{-\alpha_d} (1-\alpha_d)^{-(1-\alpha_d)}$.

As it is clear from the formulation above, by assumption, males and females are *different kinds of workers*. One way to interpret that assumption is to understand that social norms and institutions might condition which kinds of tasks are acceptable for each gender, such that different industries have different gender-specific labor demand patterns. Here, we summarize this heterogeneity in a synthetic way, by proposing an economy with two sectors. A male-intensive one, which produces good

m; and a female-intensive one, which produces good f[3]. Social norms may also influence household preferences for supplying female versus male labor outside of the household, as summarized by the parameter ν_d.

Production In each of those sectors $i \in \{m, f\}$, there is a domestic competitive firm that aggregates country-specific differentiated varieties $c_{od,i}$ into a composite good:

$$C_{d,i} \equiv \left(\sum_{o \in \mathcal{K}} (c_{od,i})^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

where $\sigma > 0$ is the elasticity of substitution across varieties. This technology implies that the price $P_{d,i}$ of each composite good satisfies:

$$P_{d,i} \equiv \left(\sum_{o \in \mathcal{K}} (p_{od,i})^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$$

where $p_{od,i}$ is landed price of each variety. Demand for each differentiated variety satisfies:

$$c_{od,i} = \left(\frac{p_{od,i}}{P_{d,i}} \right)^{-\sigma} C_{d,i}$$

Firms in sector i use female labor or male labor to produce their variety according to a linear technology that uses either male or female labor[4]:

$$c_{od,i} = z_{o,i} \ell_{od}^{i}$$

where $z_{o,i}$ is total factor productivity in sector i of origin country o; ℓ_{od}^{i} is labor demand for worker of type $i \in \{m, f\}$.

International trade We further assume that there is free entry and perfect competition in both sectors, such that prices equal their marginal costs. However, in this world economy, trade is not costless. If households at d want to consume one unit of a given variety from country o, they must source and pay for $\tau_{od} \geq 1$ units – i.e., consumers face iceberg trade costs. We make the standard assumption that $\tau_{oo} = 1$ (self-trade is costless) and $\tau_{od} \leq \tau_{oz}\tau_{zd}$ (trade costs satisfy the triangle inequality). Therefore, landed prices in sector i satisfy:

$$p_{od,i} = \frac{\tau_{od} w_{o,i}}{z_{o,i}}$$

Note that we can rewrite the expenditure of consumers in d on goods coming country o in sectors m, f as:

$$\begin{aligned} X_{od,m} &\equiv p_{od,m} c_{od,m} = \left(\frac{p_{od,m}}{P_{d,m}} \right)^{1-\sigma} P_{d,m} C_{d,m} = \left(\frac{p_{od,m}}{P_{d,m}} \right)^{1-\sigma} \alpha_d Y_d \\ X_{od,f} &\equiv p_{od,f} c_{od,f} = \left(\frac{p_{od,f}}{P_{d,f}} \right)^{1-\sigma} P_{d,f} C_{d,f} = \left(\frac{p_{od,f}}{P_{d,f}} \right)^{1-\sigma} (1-\alpha_d) Y_d \end{aligned}$$

[3]One can endogenize the product shares α_d by assuming the existence of a continuum of industries i in which goods are produced with a linear technology (i.e., female and male workers are substitutes) and the relative productivity of genders is monotonic in i, such that genders specialize in a range of the industries space. We chose this simpler framework because the mechanism between foreign demand shocks and relative wages for different genders would be very similar. Furthermore, our focus is not to understand why labor markets are segmented, but rather to, given labor market segmentation, understand the impact of foreign demand shocks on domestic labor markets.

[4]In the Appendix, we present a generalization of the current model in which both sectors use both factors but do so with different intensities.

where the last equality comes from the Cobb-Douglas structure of preferences. We can also synthetically express expenditure in goods of sector $i \in \{m, f\}$ coming from o as a share of total expenditure of country d in that sector:

$$\begin{aligned}
\pi_{od,m} &\equiv \frac{X_{od,m}}{X_{d,m}} = \frac{(\tau_{od} w_{o,m})^{1-\sigma} (z_{o,m})^{\sigma-1}}{\sum_{k \in \mathcal{K}} (\tau_{kd} w_{k,m})^{1-\sigma} (z_{k,m})^{\sigma-1}} \\
\pi_{od,f} &\equiv \frac{X_{od,f}}{X_{d,f}} = \frac{(\tau_{od} w_{o,f})^{1-\sigma} (z_{o,f})^{\sigma-1}}{\sum_{k \in \mathcal{K}} (\tau_{kd} w_{k,f})^{1-\sigma} (z_{k,f})^{\sigma-1}}
\end{aligned}$$

where, by assumption, total expenditure in goods of either sector is $X_{d,m} = \alpha_d Y_d, X_{d,f} = (1-\alpha_d) Y_d$. Total labor income in each sector in origin country o satisfies:

$$\begin{aligned}
L_{o,f} w_{o,f} &= \sum_{d \in \mathcal{K}} \pi_{od,f} \cdot (1 - \alpha_d) Y_d \\
L_{o,m} w_{o,m} &= \sum_{d \in \mathcal{K}} \pi_{od,m} \cdot \alpha_d Y_d \\
Y_d &= L_{d,m} w_{d,m} + L_{d,f} w_{d,f} + P_d e_d
\end{aligned}$$

which, given labor allocations, represents a system of 3N nonlinear equations with 3N endogenous variables $(w_{1,f}, \cdots, w_{N,f}, w_{1,m}, \cdots, w_{N,m}, Y_1, \cdots, Y_N)$ and solves for the trade equilibrium of this world economy up to the choice of a numeraire.

Labor Market To complete the characterization of this world economy, one needs to specify 2N labor market clearing equations that, combined with the 3N equations from the trade equilibrium, solve for world equilibrium in this economy. From the optimal decisions of the household, we can show that the ratio of female-to-male labor supply is increasing in the wage-ratio with elasticity $1/\eta_o$:

$$L^s \equiv \frac{L_{o,f}}{L_{o,m}} = \left(\frac{1}{\nu_o} \frac{w_{o,f}}{w_{o,m}} \right)^{\frac{1}{\eta_o}}$$

Intuitively, since households are choosing optimally which bundle of female and male labor to supply, the ratio of female-to-male labor supply is an increasing function of relative wages. The taste parameter ν_o rotates the relative labor supply curve up or down around the origin. Conversely, labor demand is decreasing in the relative wage:

$$L^d \equiv \frac{L_{o,f}}{L_{o,m}} = \frac{\sum_{d \in \mathcal{K}} \pi_{od,f} \cdot (1 - \alpha_d) Y_d}{\sum_{k \in \mathcal{K}} \pi_{ok,m} \cdot \alpha_k Y_k} \cdot \left(\frac{w_{o,f}}{w_{o,m}} \right)^{-1}$$

which is decreasing in the relative wage. Here, a foreign demand shock can shift the labor supply curve either up or down. The direction of the shift depends on the sectoral composition of the shock and trade shares in a given market. We summarize the result in the proposition below.

Proposition 1 (Effects of foreign demand shocks on a gender-segmented labor market)**.** *Let the world economy be as described above. Then a foreign demand shock, defined as an increase e_d for some arbitrary country $d \neq o$, will decrease the female-to-male employment ratio $L_{o,f}/L_{o,m}$ if and only if (a) consumption in the destination market is sufficiently male-intensive (α_d is sufficiently large); and (b) the destination market in which the demand shock originates is a sufficiently important destination to the origin market ($\pi_{od,m}$ is sufficiently large). Otherwise, the female-to-male employment ratio $L_{o,f}/L_{o,m}$ will increase.*

Proof. Let $\Xi_o \equiv \sum_{k \in \mathcal{K}} \pi_{ok,m} \cdot \alpha_k Y_k$ and calculate $\frac{\partial L_{o,f}/L_{o,m}}{\partial e_d}$ for an arbitrary d. By the envelope theorem, since e_d is a parameter, it locally only impacts consumption through a direct effect and any indirect effect due to reoptimization is zero. Therefore:

$$\frac{\partial L_{o,f}/L_{o,m}}{\partial e_d} = \left[\Xi_o \left(1-\alpha_d\right) \pi_{od,f} - \ \alpha_d \pi_{od,m}\right] \cdot \frac{P_o}{\Xi_o^2} \cdot \left(\frac{w_{o,f}}{w_{o,m}}\right)^{-1}$$

For necessity, note that, for a large enough α_d and sufficiently large enough $\pi_{od,m}$, $\Xi_o \ \left(1-\alpha_d\right) \pi_{od,f} \ < \ \alpha_d \pi_{od,m}$ and $\frac{\partial L_{o,f}/L_{o,m}}{\partial e_d} < 0$, i.e., relative labor demand will decrease. For sufficiency, assume that $\frac{\partial L_{o,f}/L_{o,m}}{\partial e_d} < 0$. Then, since $\left(\frac{w_{o,f}}{w_{o,m}}\right)$, P_o, and Ξ_o^2 are positive numbers, this implies $\Xi_o \ \left(1-\alpha_d\right) \pi_{od,f} \ < \ \alpha_d \pi_{od,m}$, which requires a sufficiently large $\pi_{od,m}$ and a sufficiently large α_d. □

This result shows the way the female-to-male labor ratio responds to a foreign demand shock depends crucially on (a) the sectoral composition of the demand shock; and (b) the relative market shares of each industry of country o at the destination market. The former determines whether the demand shock from country d translates into higher demand for goods whose production is female- or male-intensive. The latter controls how intensely the demand increase in d transmits to origin labor markets o.

Intuitively, a sufficiently large increase in foreign demand for male-intensive goods will increase the labor demand for males relative to females. All else equal, this will decrease the relative wages of female workers. In equilibrium, households respond by increasing the male labor supply up to the point at which the labor market clears.

Some of the theoretical predictions of this model are exactly the opposite of those from a standard Heckscher-Ohlin model with male and female labor as two common factors. In that model, after a positive shock to the male-intensive sector, the aggregate female-to-male labor ratio is *unchanged*, since factor supply is assumed to be exogenous. However, both sectors would *increase* their female-to-male labor use ratios: male workers are in high demand, but in general equilibrium, both industries substitute away from male labor because their relative wages also increased. By contrast, in this model, after a positive foreign demand shock to the male-intensive sector, the aggregate female-to-male *decreases* and sector factor use ratios are *unchanged*, since by assumption each sector only uses one type of labor.

In the Appendix, we present a generalization of the current model in which both sectors use both male and female labor but do so with different intensities. Under mild restrictions, the intuition of the simplified model translates to the more general one, with the aggregate female-to-male ratio *decreasing* after a sufficiently relevant foreign demand shock to the male-intensive sector. Importantly, in that framework, both sectors would *increase* their female-to-male labor use ratios, like in the Heckscher-Ohlin model. However, the relative size of the male-intensive sector would increase in a way that would more than compensate for changes in factor use ratios.

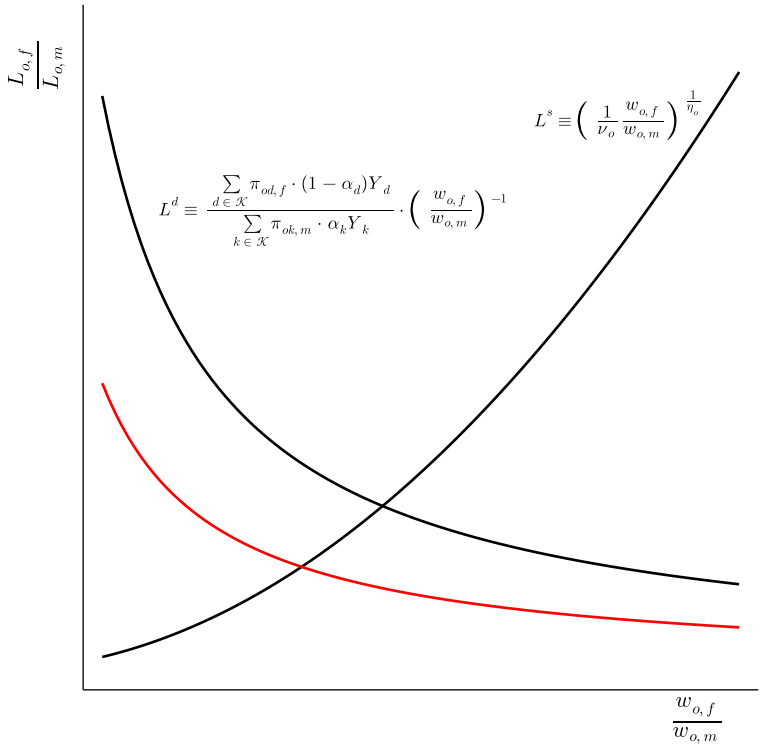

Figure 1: **Labor Market Equilibrium**. This chart illustrates the result of Proposition (1). A sufficiently large increase in foreign demand for male-intensive goods will increase the labor demand for males relative to females, shifting the relative labor demand curve down. The resulting equilibrium is a lower female-to-male employment ratio.

3 Data and Stylized Facts

Data We combine multiple data sources to be able to empirically test the predictions of the theory present in this paper. Labor market indicators come from the Tunisian Government's National Survey on Population and Employment (ENPE). Among other information, the ENPE reports individuals employment status by industry (if any), gender, and province for intermittent years between 2006 and 2016.

Trade data comes from two sources. Merchandise trade data comes from UNCOMTRADE while services trade numbers come from the WTO-OECD BaTiS database. We then used concordance tables to map HS and BOPS trade product codes onto ISIC industry codes, using concordance tables from WITS. Finally, we mapped ISIC industry codes onto Tunisian Economic Activity Nomenclature (NAT), which is a domestic economic activity classification based on NACE Revision 3. Additional details can be found in the Appendix.

We were then able to construct a provincial panel for labor market and trade indicators. Of primary concern, for each province, we can trace the evolution of employment by gender and sector as well as the provincial exposure to foreign demand shocks, which are defined later in this section.

Stylized facts Low female labor-force participation rates and high female unemployment rates characterize Tunisian labor markets. While Tunisia female labor force participation is higher than other Middle Eastern and Northern Africa (MENA) countries, it is about half of the rate of OECD countries and much lower than other developing regions such as Latin America. The gender gap in unemployment has increased substantially since the Arab spring, in 2011, and female unemployment rates have never converged back to pre-Arab spring levels.

Sectoral employment is very segmented across gender lines and exports grew less in more female-intensive sectors. In 2006, the female share of employment across different industries ranged anywhere from 1% to 75%. The most female-intensive industries are garments, social and cultural services, education, and banking and insurance. Importantly, industry contribution to export growth in the 2006-16 period is negatively correlated with initial female intensity. We plot these statistics in Figure 2.

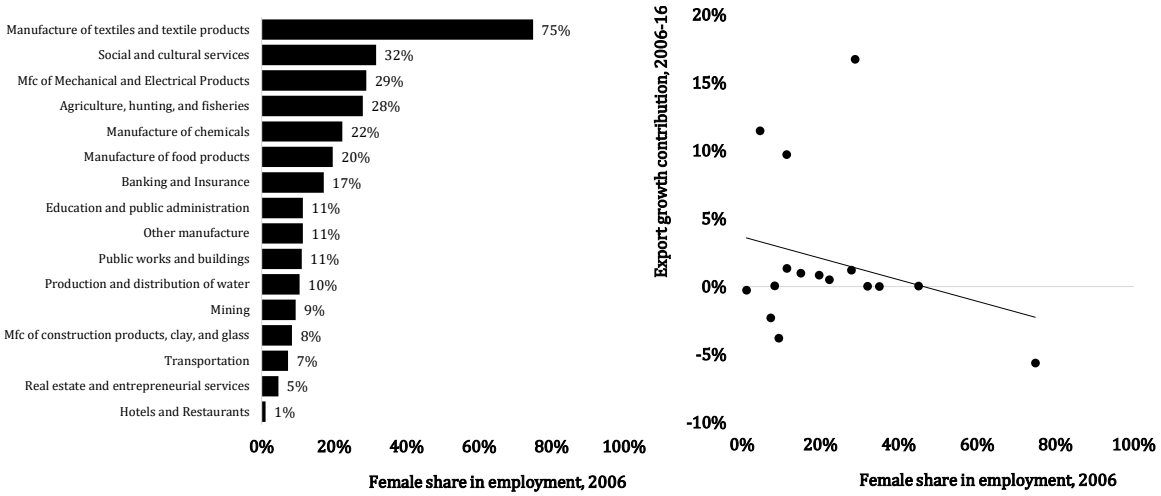

Figure 2: **Gender composition and contribution to export growth across industries**. The left-hand side panel shows the distribution of female intensity across industries at the beginning of the period (2006). The right-hand side panel shows that industries that contributed the most to aggregate export growth (2006-16) tended to be male-intensive in the base year (2006).

Large levels of labor market gender segmentation suggest that there could be frictions that prevent females from moving across industries. Formal or informal institutions – such as social norms – can make males and females be perceived as different kinds of workers that contribute in different proportions as factors of production in the labor market. One way to rationalize this framework is to assume that social norms dictate that some tasks are exclusively female tasks (e.g., sewing for garments) while other tasks are exclusively male tasks (e.g., operating an oil rig). If industries use tasks in different proportions, they will be either female- or male-intensive industries.

Gender segmentation in the labor market implies that households now face a decision regarding whether to substitute male for female labor supply after facing a shock. For instance, if a male worker is laid off in a household, the female worker might want to increase her labor supply outside of the household, in order to complement the household's budget. Conversely, if wages in male-intensive industries increase, females might be induced to reduce their work outside of the household, since the relative opportunity cost of housework becomes lower.

Tunisia is of particular interest because it has a large degree of gender segmentation in labor markets, but female workers are a non-negligible part of labor markets. In some MENA countries, female access to labor markets is very limited, such that there is limited variability in female response to labor market shocks. To test the hypothesis described above, one needs both relevant female participation in labor markets and a high degree of gender segmentation in labor markets.

Additionally, in Tunisia, industries with different female intensities have faced differential growth in exports. As illustrated by the theoretical model, this is a necessary condition to assess this causal mechanism. Finally, there is very limited literature on the impacts of economic shocks on local labor markets in Northern Africa and in particular the Maghreb region. This lower middle-income region's context is different from both Sub-saharan Africa and resource-rich Arab countries. Therefore, empirical work using this kind of data can be of independent interest for development economists.

Given the large degree of gender segmentation in the labor market and the differential exposure across industries to exports, Tunisia is a good stage to evaluate how gender-segmented labor markets respond to trade shocks. To test this hypothesis, we leverage variation in exposure to exports and labor force composition across Tunisian regions. For instance, the Northeast and Mid-East regions specialize in manufacturing, while the cities in the Grand Tunis region primarily specialize in services.

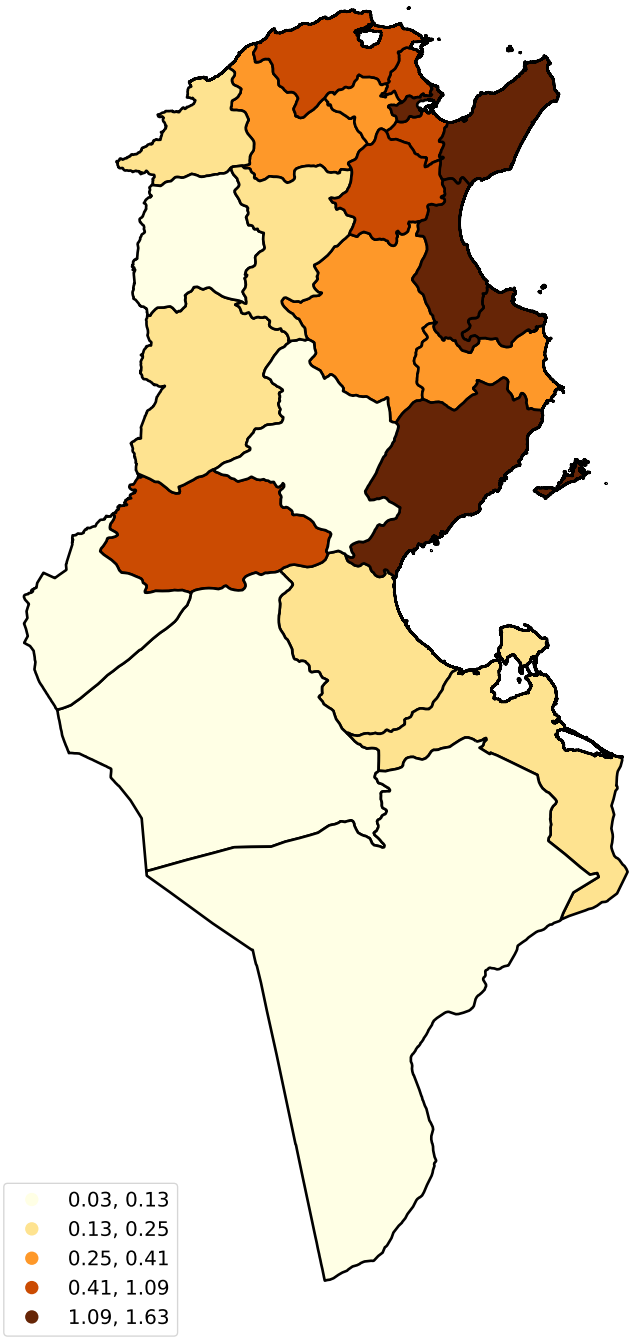

Figure 3: **District-Level Exposure to Exports, 2016** This Figure denotes a region-specific exposure to exports, defined as $\widetilde{X}_{r,t+h} \equiv \sum_{i \in \mathcal{I}} \frac{L_{r,i,t}}{L_{i,t}} \cdot \widetilde{X}_{i,t+h}$, where $\widetilde{X}_{i,t}$ denotes total exports of industry i at period t; $L_{r,i,t}$ denotes total employment in region r and industry i; and $L_{i,t} \equiv \sum_{r \in \mathcal{R}} L_{r,i,t}$ is total aggregate employment in industry i. Period t is taken as the base year.

4 Empirical Strategy and Results

Method In order to measure the impact of exports over local labor markets, we would ideally observe the share of exports produced in each region $r \in \mathcal{R}$. However, these data are typically not available for most countries. Even for countries that do report export by region, these data typically do not account for production location, but rather the location of the exporting firm – which could be an intermediary.

In order to circumvent such limitation, we use interact export growth in different industries $i \in \mathcal{I}$ interacted with differential exposure to industry-specific shocks across different local labor markets. Formally, we define local labor market exposure to exports growth as:

$$\Delta \widetilde{X}_{r,t+h} \equiv \sum_{i \in \mathcal{I}} \frac{L_{r,i,t}}{L_{i,t}} \cdot \Delta \widetilde{X}_{i,t+h} = \sum_{i \in \mathcal{I}} \frac{L_{r,i,t}}{L_{i,t}} \cdot \left(\widetilde{X}_{i,t+h} - \widetilde{X}_{i,t} \right)$$

where $\widetilde{X}_{i,t}$ denotes total exports of industry i at period t; $L_{r,i,t}$ denotes total employment in region r and industry i; and $L_{i,t} \equiv \sum_{r \in \mathcal{R}} L_{r,i,t}$ is total aggregate employment in industry i. This kind of shift-share approach mirrors the approach of many papers that study the impact of trade shocks on local labor markets, including Autor, Dorn, and Hanson (2013) and Dix-Carneiro and Kovak (2015), for imports exposure, and Robertson, Bahena, et al. (2021) for exports exposure.

Given the shares $\frac{L_{r,i,t}}{L_{i,t}}$, we can potentially estimate the effect of exports over local labor markets by regressing some variable of interest $\Delta O_{r,i,t+h}$ on the shift-share regressand above, provided that the shifters $\Delta \widetilde{X}_{i,t+h}$ are as good as random (for a formal treatment, see Borusyak, Hull, and Jaravel 2020). If that were the case, we would be able to run the regression:

$$\Delta O_{r,t+h} = \alpha + \beta \Delta \widetilde{X}_{r,t+h} + \boldsymbol{Z}'_{r,t+h} \boldsymbol{\delta} + \varepsilon_{r,t+h}$$

for which estimation of β is consistent if $E\left[\Delta \widetilde{X}_{i,t+h} \cdot \varepsilon_{r,t+h} \middle| \boldsymbol{Z}_{r,t+h},\ L_{r,i,t} \right] = 0$ for every i and r pair – i.e., if conditional on controls $\boldsymbol{Z}_{r,i,t+h}$ and on shares, changes in exports are uncorrelated with unobserved local labor markets shocks.

However, since exports depend partially on domestic human capital and technology use, which can be correlated with characteristics of local labor markets, the shifters $\Delta \widetilde{X}_{i,t+h}$ are likely not exogenous. For that reason, we instrument $\Delta \widetilde{X}_{r,i,t+h}$ with increases in foreign demand, proxied by changes in dollar GDP in foreign destinations.

For clarity, we need to introduce some notation. Recall that $\mathcal{S}$ is set of countries in the world and let $s \in \mathcal{S}$ denote the source country —in this case, Tunisia. Tunisia exports to countries other than itself —or to destinations $d \in \mathcal{S} \setminus s$. We denote the exports of each industry i as the sum of its sales to every foreign destinations: $\widetilde{X}_{i,t} = \sum_{d \in \mathcal{S} \setminus s} \widetilde{X}_{d,i,t}$. Our instrument leverages the correlation between changes in exports to destination d and changes in dollar GDP, which is expected given the gravity structure typical of international trade. It is:

$$\Delta \bar{X}_{r,t+h} \equiv \sum_{i \in \mathcal{I}} \frac{L_{r,i,t}}{L_{r,t}} \cdot \sum_{d \in \mathcal{S} \setminus s} \frac{\widetilde{X}_{d,i,t}}{\widetilde{X}_{i,t}} \cdot \Delta Y_{d,t+h}$$

where $\frac{\widetilde{X}_{d,i,t}}{\widetilde{X}_{i,t}}$ denotes country d's share of industry i's exports; and $\Delta Y_{d,t+h}$ is the change in U.S. dollar GDP in country d. Estimation now takes the form of two-stage least squares, with the first stage being:

$$\Delta \widetilde{X}_{r,t+h} = \omega + \gamma \Delta \bar{X}_{r,t+h} \ + \ \boldsymbol{Z}'_{r,t+h} \boldsymbol{\phi} + \bar{\varepsilon}_{r,t+h}$$

and the second stage is:

$$\Delta O_{r,t+h} = \alpha + \beta \Delta \hat{X}_{r,t+h} \; + \; \boldsymbol{Z}'_{r,t+h}\boldsymbol{\delta} + \varepsilon_{r,t+h}$$

where $\Delta \hat{X}_{r,t+h}$ are the predicted values of the first stage regression. Now estimation of β is consistent if $E\left[\Delta Y_{d,t+h} \cdot \varepsilon_{r,t+h} \middle| \boldsymbol{Z}_{r,t+h}, L_{r,i,t}, \widetilde{X}_{d,i,t}\right] = 0$ for every d and r pair – i.e. if changes in foreign demand are uncorrelated with unobserved factors that drive changes local labor markets in Tunisia.

Tunisia is a small open economy. Therefore, it is unlikely that changes in foreign demand are correlated with unobserved factors that differentially drive changes local labor markets – i.e., this instrument is likely valid. Furthermore, as changes in exposure to exports strongly correlated with changes in exposure to foreign demand shocks ($f-stat > 130$), the instrument is relevant. Satisfying the exclusion restriction and instrument relevance, we can appropriately interpret the results in this section as the causal effect of exports on local labor markets in Tunisia during this time-period.

Results Since the change in exports was higher in male intensive industries, the theoretical mechanism described above predicts that the female-to-male employment ratio should decline. The empirical estimates confirm the theoretical prediction. Panel A of Table 1 shows the results of the two-stage least squared regression of the change in female-to-male employment ratio on the change in exposure to exports instrumented by the change in exposure to foreign demand. Our preferred specification, which includes time- and province-fixed-effects as well socio-demographic controls is column (3).

A 1 billion USD increase in exposure to exports led to an average decrease of 6.8pp in the female-to-male employment ratio, which is statistically significant in at the 5% confidence level and in the same direction as predicted by the theoretical mechanism. To better understand the economic magnitude of these results, we can normalize this coefficient by using the standard deviations of both variables. An increase in exposure to exports of 1 standard deviation decreases the female-to-male employment ratio by 0.137 standard deviations.

We can decompose this result by running separate regressions of female and male employment, respectively, on exposure to exports. We present these results on Panels B and C of Table 1. This decomposition shows that, in fact, the effects of increased exports induced by foreign demand shocks have opposite signs on female and male employment.

While the point estimate for female employment is of 7,903 *fewer* female jobs in response to an increase of export exposure of 1 billion USD, the point estimate for male employment is of 2,418 *additional* jobs. Only the coefficient for females is statistically significant.

Normalizing in terms of standard deviations highlights that female employment is more responsive to trade at the extensive margin. An increase in exposure to exports of 1 standard deviation decreases the female employment ratio by 0.062 standard deviations while it increases male employment by 0.009 standard deviations.

No increase in male employment in response to the foreign demand shock is also consistent with the theoretical model. The model only makes a prediction regarding the female-to-male employment ratio, not the independent move about either of those equilibrium objects.

Mechanism Interpreted through the lens of the theoretical model, this suggests that households may be substituting male for female labor supply. ENPE has no information on wages, so one cannot confirm the substitution of lower wage female jobs for higher wage male jobs directly. Nonetheless, estimating the effect over some other margins can shed some light into the issue.

For instance, we first estimate the effect of the change in exposure to exports on the change of female and male unemployment, respectively. Neither estimate is statistically significant, but the results indicate that, on average, a 1 billion USD increase in export exposure displaced 272 women into unemployment and 1280 males out of unemployment. These results in Panels A and B of Table 2.

Table 1. Employment Regressions			
Panel A. Response Variable: Change in Female-to-Male Employment Ratio			
	(1)	(2)	(3)
Change in Exports Exposure (in billion USD)	0.002	-0.068*	-0.068**
	(0.018)	(0.035)	(0.031)
Panel B. Response Variable: Change in Female Employment			
	(1)	(2)	(3)
Change in Exports Exposure (billion USD)	-1,929.460	-8,173.887**	-7,903.951***
	(2,257.502)	(3,455.325)	(3,048.396)
Panel C. Response Variable: Change in Male Employment			
	(1)	(2)	(3)
Change in Exports Exposure (billion USD)	1,756.212	1,140.393	2,418.129
	(1,842.006)	(3,026.194)	(3,133.433)
Panel D. First-Stage. Response Variable: Change in Exports Exposure (billion USD)			
	(1)	(2)	(3)
Change in Foreign Demand Exposure (billion USD)	.0058***	.0046***	.0045***
	(.0006)	(.0008)	(.0004)
F-statistic	77.82	30.25	139.95
Time Fixed-Effects		✓	✓
District Fixed-Effects		✓	✓
Socio-Demographic Controls			✓
N	120	120	120

District cluster robust standard errors in parenthesis.
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Therefore, the induced change on female unemployment is either zero, negative or, if positive, more than one order of magnitude smaller than changes in employment. Combined with the results from the regressions on employment, this shows that the observed foreign demand shocks, known to be concentrated on male-intensive industries, primarily induced females to move out of the labor force rather than into unemployment.

This result is consistent with households optimizing quantities of female and male labor supply in a gender-segmented labor market. If there were large increases in the unemployment margin induced by foreign-demand shocks, then any analytical exercise could not abstract away from modeling involuntary unemployment.

Another important evidence comes from comparing the response of married versus single female workers. If households are indeed substituting male for female labor supply, then one would expect the effect to be stronger among married women. This is indeed the case. As shown in Panels C and D of Table 2, most of the variation in female employment following a foreign demand shock comes from married female workers.

On average, a 1 billion USD increase in export exposure led to 4,605 fewer jobs among married female workers and 2,501 fewer jobs among single female workers. Furthermore, the results are statistically significant at the 5% confidence level for married female workers and statistically insignificant for female workers, indicating that the relationship is much tighter for married women. This result is also suggestive evidence that the empirical response is consistent with the theoretical mechanism discussed before.

Both the primary result on the female-to-male employment ratio and the secondary results presented above are in line with the predictions of the theoretical model. The model thus is consistent with the empirical evidence in Tunisia – and its predictions can be tested for other countries.

Table 2. Unemployment Regressions and Married vs Single Regressions			
Panel A. Response Variable: Change in Unemployed Females			
	(1)	(2)	(3)
Change in Exports Exposure (billion USD)	-1,387.8	147.3	272.0
	(1,617.9)	(2,611.8)	(2,749.1)
Panel B. Response Variable: Change in Unemployed Males			
	(1)	(2)	(3)
Change in Exports Exposure (billion USD)	-1,750.4	-602.6	-1,279.6
	(1,680.8)	(2,243.9)	(2,156.9)
Panel C. Response Variable: Change in Female Employment, Married Women			
	(1)	(2)	(3)
Change in Exports Exposure (billion USD)	-343.177	-4,540.806**	-4,605.166**
	(1,348.004)	(1,993.872)	(1,897.571)
Panel D. Response Variable: Change in Female Employment, Single Women			
	(1)	(2)	(3)
Change in Exports Exposure (billion USD)	-1,446.643	-2,750.395*	-2,501.416
	(1,127.362)	(1,549.210)	(1,429.758)
Panel E. First-Stage. Response Variable: Change in Exports Exposure (billion USD)			
	(1)	(2)	(3)
Change in Foreign Demand Exposure (billion USD)	.0058***	.0046***	.0045***
	(.0006)	(.0008)	(.0004)
F-statistic	77.82	30.25	139.95
Time Fixed-Effects		✓	✓
District Fixed-Effects		✓	✓
Socio-Demographic Controls			✓
N	120	120	120

District cluster robust standard errors in parenthesis.
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Caveats The main limitation of this study is the lack of data on wages in the Tunisian labor force survey (ENPE). The joint prediction of the theoretical model described in this paper is that foreign demand shocks that concentrate on male-intensive industries should decrease both the female-to-male employment ratio and the female relative wage. There is quite extensive documentation in the literature that is indeed happened in other contexts[5]. Therefore, it would be surprising if male wages did not increase relative to female wages after a male-intensive positive foreign demand sock. Furthermore, the fact that we were able to identify that, in Tunisia, the changes in the female-to-male employment ratio work primarily through changes in the behavior of married women serves as an additional check on the theoretical mechanism, since it suggests that the mechanism operates through joint household decisions.

Another caveat relates to aggregation. The empirical strategy developed here relies on exploiting differential regional variation in exposure to exports. However, as documented by Chodorow-Reich (2020), strategies that rely on this kind of cross-sectional variation only capture the effect of additional exposure to exports relative to other regions[6]. One cannot extrapolate from the cross-sectional to the aggregate effect without imposing additional assumptions. In this case, one variable that could make aggregation harder is migration. If households move across provinces in response to negative (positive) shocks, they could make relative estimates larger (smaller) than aggregate estimates.

The empirical specification above only captures short-run effects, since it was limited to using the previous period as the base period. In that context, unless there are no mobility costs, the migration channel is likely more muted. If one thinks of labor as immobile, spillovers are a function of domestic trade patterns. Intuitively, if the provincial consumption basket of a province exposed to a foreign demand shock to its male-intensive sector is tilted towards the male-intensive sector, this will exacerbate the aggregate effect with respect to our estimates. Conversely, if their consumption basket is tilted towards the female-intensive sector, then the aggregate effect will be attenuated with respect to the relative effect.

Therefore, the relative effect could be either a lower bar or an upper bar to the aggregate effect. One cannot put bounds without knowing the consumption patterns at the regional level. Exploring these second-order effects that happen through the production network would be a fruitful avenue for future research.

5 Conclusion

This paper focuses on how gender segmentation in labor markets shapes the local effects of international trade. We first develop a theoretical framework that embeds trade and gender-segmented labor markets to show that foreign demand shocks may either increase or decrease the female-to-male employment ratio. The key theoretical result shows formally that the effects of trade on gender-segmented labor markets depend crucially on (a) the sectors that face the foreign demand shock; and (b) the domestic relevance of the foreign countries in which the demand shocks originate from. If the foreign demand shock from a relevant market happens in a female-intensive (male-intensive) sector, the model predicts that the female-to-male employment ratio should increase (decrease).

[5]This is true both in theory and empirics. Dhyne et al. (2022) shows that in a large class of models there is a positive pass-through of foreign demand shocks to labor (except when labor is fixed by assumption). Aguayo-Tellez, Airola, and Juhn (2010) shows that access to liberalized markets through NAFTA in Mexico led to an increase in relative female wages due to positive shocks to the clothing sector. Similarly, De Hoyos, Bussolo, and Núñez (2012) shows that the expansion of the maquilas in Honduras led to an increase of female relative earnings.

[6]In fact, Chodorow-Reich (2020) shows that this estimator is analogous to a differences-in-differences estimator with an additional term that captures spill-overs across regions (SUTVA violations). For instance, Caliendo, Dvorkin, and Parro (2019) show that the negative relative effect captured from the China Trade Shock estimated by Autor, Dorn, and Hanson (2013) may be positive in general equilibrium. Adão, Arkolakis, and Esposito (2019) develop a similar argument and show that spill-overs can have a non-negligible effect of attenuation or amplification of the relative effect.

We then use plausibly exogenous variation exposure of Tunisian local labor markets to foreign demand shocks and show that the empirical results are consistent with the theoretical prediction. In Tunisia, a country with a high degree of gender segmentation in labor markets, foreign-demand shocks have been relatively larger in male-intensive sectors. This induced a decrease in the female-to-male employment ratio. Since male-intensive sectors had relatively more favorable foreign demand shocks, the equilibrium response is that households likely substituted female for male labor supply. Estimates using data from 2006 to 2016 confirm the theoretical mechanism postulated in this paper.

One important policy implication of our study is that less gender segmentation in labor markets will dampen the effect of foreign demand shocks on gender inequality. Taking foreign demand shocks as exogenous, the policymaker can only induce changes in the institutions that generate domestic gender segmentation in labor markets. If every sector has no gender segmentation, however, any foreign shocks would be distributionally neutral across genders – that is, males and females would be equally affected.

Thus, as countries develop their trade policies, they might want to consider policies that reduce gender segmentation in labor markets. Policies that promote gender equity have the immediate benefit of more gender equity in the present – but they can also have the unintended benefit of inducing more equitable effects in the future, whenever economic shifters affect the local economy.

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ONLINE APPENDIX

A Summary Statistics

Variable	N	Mean	Std. dev.	Min	Max
Change in Exports Exposure (billion USD)	120	-.052	.374	-1.546	1.376
Change in Female-to-Male Employment Ratio	120	-.004	.072	-.386	.277
Change in Female Employment	120	592.7	6152.9	-20144.3	17400.2
Change in Male Employment	120	1592.5	5740.2	-12011.2	15507.2
Change in Education High School or Higher Share	120	-.008	.014	-.048	.023
Change in Urban Share	120	-.0002	.063	-.248	.267

B Details on data construction

Labor Market Survey Labor market indicators come from the Tunisian Government's National Survey on Population and Employment (*Enquête Nationale sur la Population et l'Emploi* —ENPE). The survey is a repeated cross-section of households that has as its main goal producing statistics regarding the social, educational, and economic characteristics of the population that is either working, unemployed or out of the labor force. Among other information, the ENPE reports individuals employment status by industry (if any), gender, and province for intermittent years between 2006 and 2016. ENPE provides individual level weights that aggregate to representative statistics of the Tunisian population. To construct the labor market indicators used in the empirical part of this paper, we excluded individuals under 15 years of age and aggregated the data at the district-year level using the provided weights.

Trade in Services Data for trade in services the WTO-OECD BaTiS database. The database uses the Extended Balance of Payments Services Classification (EBOPS) and inputting balance of payments data and harmonizes data to correct for divergences between import and exports of services. The data covers twelve sectors but for Tunisia only nine of them are relevant (represent $> 99\%$ of trade in services). We created a concordance between EBOPS codes and ENPE codes.

BaTiS Code	BaTiS id	Code ENPE
SC	205	76
SD	236	79
SE	249	69
SF	253	82
SG	260	82
SH	262	76
SJ	268	85
SK	287	89
SL	291	93

Trade in Merchandise Data for trade in merchandise comes from UNCOMTRADE. In particular, we bulk downloaded the dollar value of Tunisian U.S. dollar exports at the Harmonized System 6-digit level (HS6) and then mapped HS codes into International Standard of Industrial Classification (ISIC) industry codes using the HS-ISIC concordances publicized by the World Integrated Trade Solution (WITS). We then mapped ISIC codes into ENPE sectors. ENPE's sector classification is a national adaptation of the EU's Nomenclature of Economic Activities (NACE) codes. We mapped ISIC codes into NACE and ENPE codes using the following concordance matrix.

ISIC Division Code	Chapter NACE	Code ENPE
1-3	A	0
5-9	B	65
10-12	CA	10
13-15	CB	50
16-19	C	60
20	CE	40
21-22	C	60
23	CG	20
24-25	C	60
26	CI	30
27	CJ	30
28	CK	30
29-33	C	60
35	D	67
36-39	E	68
41-43	F	69
45-47	G	72
49-53	H	76
55-56	I	79
58-63	J	76
64-66	K	82
68	L	85
72-75	M	85
77-82	N	85
84	O	93
85	P	93
86-88	Q	89
90-93	R	89
94-96	S	89
97-98	T	99
99	U	98

C Model with factor substitution

Demand We consider a world economy with several countries $d \in \mathcal{K}$. In each country, there is a representative household that maximizes utility by choosing optimal consumption as well as female and male labor supply.

$$\begin{aligned}\max_{\{C_{d,m},C_{d,m},L_{d,m},L_{d,f}\}} \quad & C_{d,m}^{\alpha_d} C_{d,f}^{1-\alpha_d} - \frac{L_{d,m}^{1+\eta_d}}{1+\eta_d} - \nu_d \frac{L_{d,f}^{1+\eta_d}}{1+\eta_d} \\ s.t. \quad & P_{d,m}C_{d,m} + P_{d,f}C_{d,f} \leq L_{d,m}w_{d,m} + L_{d,f}w_{d,f} + P_d e_d = Y_d\end{aligned}$$

where $C_{d,m}, C_{d,f}$ are quantities demanded for goods m and f, respectively, in country d; $P_{d,m}, P_{d,f}$ are the prices of those two goods; $L_{d,m}$ is female labor supply; $L_{d,f}$ is male labor supply; and e_d is some endowment, which can be interpreted as an income shifter. Given this structure, we can define the ideal price index $P_d = A \cdot P_{d,m}^{\alpha_d} P_{d,f}^{1-\alpha_d}$, where $A = (\alpha_d)^{-\alpha_d} (1-\alpha_d)^{-(1-\alpha_d)}$.

Production In each of those sectors $i \in \{m, f\}$, there is a domestic competitive firm that aggregates country-specific differentiated varieties $c_{od,i}$ into a composite good:

$$C_{d,i} \equiv \left(\sum_{o \in \mathcal{K}} (c_{od,i})^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

where $\sigma > 0$ is the elasticity of substitution across varieties. This technology implies that the price $P_{d,i}$ of each composite good satisfies:

$$P_{d,i} \equiv \left(\sum_{o \in \mathcal{K}} (p_{od,i})^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$$

where $p_{od,i}$ is landed price of each variety. Demand for each differentiated variety satisfies:

$$c_{od,i} = \left(\frac{p_{od,i}}{P_{d,i}} \right)^{-\sigma} C_{d,i}$$

Firms in sector i use female labor or male labor to produce their variety according to a linear technology that uses either male or female labor:

$$c_{od,i} = z_{o,i} \left(\ell_{m,od}^i \right)^{\beta_{o,i}} \left(\ell_{f,od}^i \right)^{1-\beta_{o,i}}$$

where $z_{o,i}$ is total factor productivity in sector i of origin country o; $\ell_{m,od}^i, \ell_{f,od}^i$ is labor demand for male and female workers, respectively in the production of the good of type $i \in \{m, f\}$. Since m is the male-intensive sector, we assume $\beta_{o,m} > \beta_{o,f}$ for all $o \in \mathcal{K}$.

International trade We further assume that there is free entry and perfect competition in both sectors, such that prices equal their marginal costs. However, in this world economy, trade is not costless. If households at d want to consume one unit of a given variety from country o, they must source and pay for $\tau_{od} \geq 1$ units – i.e., consumers face iceberg trade costs. We make the standard assumption that $\tau_{oo} = 1$ (self-trade is costless) and $\tau_{od} \leq \tau_{oz}\tau_{zd}$ (trade costs satisfy the triangle inequality). Therefore, landed prices in sectors m, f satisfy:

$$p_{od,m} = \frac{\tau_{od}(w_{o,m})^{\beta_{o,m}}(w_{o,f})^{1-\beta_{o,m}}}{z_{o,m}}, \qquad p_{od,f} = \frac{\tau_{od}(w_{o,m})^{\beta_{o,f}}(w_{o,f})^{1-\beta_{o,f}}}{z_{o,f}}$$

Note that we can rewrite the expenditure of consumers in d on goods coming country o in sectors m, f as:

$$\begin{aligned} X_{od,m} &\equiv p_{od,m}c_{od,m} = \left(\frac{p_{od,m}}{P_{d,m}} \right)^{1-\sigma} P_{d,m}C_{d,m} = \left(\frac{p_{od,m}}{P_{d,m}} \right)^{1-\sigma} \alpha_d Y_d \\ X_{od,f} &\equiv p_{od,f}c_{od,f} = \left(\frac{p_{od,f}}{P_{d,f}} \right)^{1-\sigma} P_{d,f}C_{d,f} = \left(\frac{p_{od,f}}{P_{d,f}} \right)^{1-\sigma} (1-\alpha_d) Y_d \end{aligned}$$

where the last equality comes from the Cobb-Douglas structure of preferences. We can also synthetically express expenditure in goods of sector $i \in \{m, f\}$ coming from o as a share of total expenditure of country d in that sector:

$\mathrm{p}_{od,m} = \frac{\tau_{od}}{z_{o,m}}$

$$\begin{aligned}
\pi_{od,m} &\equiv \frac{X_{od,m}}{X_{d,m}} = \frac{\left(\tau_{od}(w_{o,m})^{\beta_{o,m}}(w_{o,f})^{1-\beta_{o,m}}\right)^{1-\sigma}(z_{o,m})^{\sigma-1}}{\sum_{k\in\mathcal{K}}\left(\tau_{kd}(w_{k,m})^{\beta_{k,m}}(w_{k,f})^{1-\beta_{k,m}}\right)^{1-\sigma}(z_{k,m})^{\sigma-1}} \\
\pi_{od,f} &\equiv \frac{X_{od,f}}{X_{d,f}} = \frac{\left(\tau_{od}(w_{o,m})^{\beta_{o,f}}(w_{o,f})^{1-\beta_{o,f}}\right)^{1-\sigma}(z_{o,f})^{\sigma-1}}{\sum_{k\in\mathcal{K}}\left(\tau_{kd}(w_{k,m})^{\beta_{k,f}}(w_{k,f})^{1-\beta_{k,f}}\right)^{1-\sigma}(z_{k,f})^{\sigma-1}}
\end{aligned}$$

where, by assumption, total expenditure in goods of either sector is $X_{d,m} = \alpha_d Y_d, X_{d,f} = (1-\alpha_d)Y_d$. Total labor income in each sector in origin country o satisfies:

$$\begin{aligned}
L_{o,f}w_{o,f} &= (1-\beta_{o,f})\sum_{d\in\mathcal{K}}\pi_{od,f}\cdot(1-\alpha_d)Y_d + (1-\beta_{o,m})\sum_{d\in\mathcal{K}}\pi_{od,m}\cdot\alpha_d Y_d \\
L_{o,m}w_{o,m} &= \beta_{o,f}\sum_{d\in\mathcal{K}}\pi_{od,f}\cdot(1-\alpha_d)Y_d + \beta_{o,m}\sum_{d\in\mathcal{K}}\pi_{od,m}\cdot\alpha_d Y_d \\
Y_d &= L_{d,m}w_{d,m} + L_{d,f}w_{d,f} + P_d e_d
\end{aligned}$$

which, given labor allocations, represents a system of 3N nonlinear equations with 3N endogenous variables $(w_{1,f}, \cdots, w_{N,f}, w_{1,m}, \cdots, w_{N,m}, Y_1, \cdots, Y_N)$ and solves for the trade equilibrium of this world economy up to the choice of a numeraire.

Labor Market To complete the characterization of this world economy, one needs to specify 2N labor market clearing equations that, combined with the 3N equations from the trade equilibrium, solve for world equilibrium in this economy. From the optimal decisions of the household, we can show that the ratio of female-to-male labor supply is increasing in the wage-ratio with elasticity $1/\eta_o$:

$$L^s \equiv \frac{L_{o,f}}{L_{o,m}} = \left(\frac{1}{\nu_o}\frac{w_{o,f}}{w_{o,m}}\right)^{\frac{1}{\eta_o}}$$

Intuitively, since households are choosing optimally which bundle of female and male labor to supply, the ratio of female-to-male labor supply is an increasing function of relative wages. The taste parameter ν_o rotates the relative labor supply curve up or down around the origin. Conversely, labor demand is decreasing in the relative wage:

$$L^d \equiv \frac{L_{o,f}}{L_{o,m}} = \frac{(1-\beta_{o,f})\sum_{d\in\mathcal{K}}\pi_{od,f}\cdot(1-\alpha_d)Y_d + (1-\beta_{o,m})\sum_{d\in\mathcal{K}}\pi_{od,m}\cdot\alpha_d Y_d}{\beta_{o,f}\sum_{d\in\mathcal{K}}\pi_{od,f}\cdot(1-\alpha_d)Y_d + \beta_{o,m}\sum_{d\in\mathcal{K}}\pi_{od,m}\cdot\alpha_d Y_d}\cdot\left(\frac{w_{o,f}}{w_{o,m}}\right)^{-1}$$

which is decreasing in the relative wage. Here, a foreign demand shock can shift the labor supply curve either up or down. The direction of the shift depends on the sectoral composition of the shock and trade shares in a given market. We summarize the result in the proposition below.

Proposition 2 (Effects of foreign demand shocks on a gender-segmented labor market)**.** *Let the world economy be as described above and define* $\Xi_o \equiv \beta_{o,f}\sum_{d\in\mathcal{K}}\pi_{od,f}\cdot(1-\alpha_d)Y_d + \beta_{o,m}\sum_{d\in\mathcal{K}}\pi_{od,m}\cdot\alpha_d Y_d$. *Suppose that factor intensities satisfy* $0 \leq \beta_{o,f} < \frac{\Xi_o}{1+\Xi_o} < \beta_{o,m} \leq 1$.

Then a foreign demand shock, defined as an increase e_d *for some arbitrary country* $d \neq o$*, will decrease the female-to-male employment ratio* $L_{o,f}/L_{o,m}$ *if and only if (a) consumption in the*

destination market is sufficiently male-intensive (α_d is sufficiently large); and (b) the destination market in which the demand shock originates is a sufficiently important destination to the origin market ($\pi_{od,m}$ is sufficiently large). Otherwise, the female-to-male employment ratio $L_{o,f}/L_{o,m}$ will increase.

Proof. Calculate $\frac{\partial L_{o,f}/L_{o,m}}{\partial e_d}$ for an arbitrary d. By the envelope theorem, since e_d is a parameter, it locally only impacts consumption through a direct effect and any indirect effect due to reoptimization is zero. Therefore:

$$\frac{\partial L_{o,f}/L_{o,m}}{\partial e_d} = \left\{ \pi_{od,f}(1-\alpha_d)\left[\frac{\Xi_o}{1+\Xi_o} - \beta_{o,f}\right] + \pi_{od,m}\alpha_d\left[\frac{\Xi_o}{1+\Xi_o} - \beta_{o,m}\right]\right\} \cdot \frac{P_o}{\Xi_o^2} \cdot \left(\frac{w_{o,f}}{w_{o,m}}\right)^{-1}$$

For necessity, first note that, for a large enough α_d and sufficiently large enough $\pi_{od,m}$:

$$\left|\pi_{od,m}\alpha_d\left[\frac{\Xi_o}{1+\Xi_o} - \beta_{o,m}\right]\right| > \left|\pi_{od,f}(1-\alpha_d)\left[\frac{\Xi_o}{1+\Xi_o} - \beta_{o,f}\right]\right|$$

which implies that $\frac{\partial L_{o,f}/L_{o,m}}{\partial e_d} < 0$, because $\beta_{o,f} < \frac{\Xi_o}{1+\Xi_o} < \beta_{o,m}$ and $\frac{P_o}{\Xi_o^2} \cdot \left(\frac{w_{o,f}}{w_{o,m}}\right)^{-1} > 0$. Therefore, relative labor demand will decrease.

For sufficiency, assume that $\frac{\partial L_{o,f}/L_{o,m}}{\partial e_d} < 0$. Then, since $\left(\frac{w_{o,f}}{w_{o,m}}\right)$, P_o, and Ξ_o^2 are positive numbers, this implies:

$$\underbrace{\pi_{od,f}(1-\alpha_d)\left[\frac{\Xi_o}{1+\Xi_o} - \beta_{o,f}\right]}_{>0} + \underbrace{\pi_{od,m}\alpha_d\left[\frac{\Xi_o}{1+\Xi_o} - \beta_{o,m}\right]}_{<0} < 0$$

which requires a sufficiently large $\pi_{od,m}$ and a sufficiently large α_d. □

This result extends the model of the main text of the paper and shows that, under mild restrictions, the intuition of the simplified model translates to a more general one. The way the female-to-male labor ratio responds to a foreign demand shock still depends crucially on (a) the sectoral composition of the demand shock; and (b) the relative market shares of each industry of country o at the destination market.

We can also show that, in equilibrium, if a shock induces a **decrease** in the female-to-male employment ratio and a decrease in the relative wages, then (a) both sectors **increase** their female-to-male labor ratio use; and (b) the male-intensive sector must expand in a way that more than compensates the increase in factor intensities.

To see that, first note that, within each sector, the factor use ratio is the same and equal to:

$$\frac{L^i_{o,f}}{L^i_{o,m}} = \frac{\beta_{o,i}}{1-\beta_{o,i}}\left(\frac{w_{o,f}}{w_{o,m}}\right)^{-1}, \qquad \text{for } i \in \{m, f\}$$

which shows that, in equilibrium, if $\frac{w_{o,f}}{w_{o,m}}$ decreases, $\frac{L^i_{o,f}}{L^i_{o,m}}$ must increase. Furthermore, the aggregate labor ratio can be written as:

$$\frac{L_{o,f}}{L_{o,m}} = \mu_{o,m}\frac{L^m_{o,f}}{L^m_{o,m}} + (1-\mu_{o,m})\frac{L^f_{o,f}}{L^f_{o,m}}, \qquad \mu_{o,m} \equiv \frac{L^m_{o,f}}{L_{o,m}}, \quad L_{o,m} = L^m_{o,f} + L^f_{o,f}$$

By Proposition (2) $\frac{L_{o,f}}{L_{o,m}}$ decreases after a sufficiently relevant foreign shock to the male-intensive sector. By the result previously stated, $\frac{L^i_{o,f}}{L^i_{o,m}}$ increases in both sectors after the same shock. To

reconcile these facts, since $\frac{L^m_{o,f}}{L^m_{o,m}} > \frac{L^f_{o,f}}{L^f_{o,m}}$, the male intensive sector must expand through an increase in its employment share $\mu_{o,m}$.

In this framework, both sectors would *increase* their female-to-male labor use ratios, like in the Heckscher-Ohlin model. However, the relative size of the male-intensive sector would increase in a way that would more than compensate for changes in factor use ratios.