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Abstract

The authors analyze the interaction between a country's world market integration and its attitude towards gender roles. They discuss both theoretically and empirically how female empowerment is a source of comparative advantage that shapes a country's response to trade opening. Reciprocally, the authors show that as countries integrate into the world economy, the costs and benefits of gender discrimination shift. Their theory goes beyond a potential aggregate wealth effect associated with trade opening, and emphasizes the heterogeneity of impacts. On the one hand, countries in which women are empowered—measured by fertility rates, female labor force participation or female schooling—experience an expansion of industries that use female labor relatively more intensively. On the other hand, the gender gap is smaller in countries that export more in relatively female-labor intensive sectors. In an increasingly globalized economy, the road to gender equality is paradoxically very specific to each country's productive structure and exposure to world markets.

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Engendering Trade*

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Introduction

The third Millennium Development Goal is to "Promote gender equality and empower women." In this paper, we look at this objective in the context of an increasingly integrated world. Two related questions come to mind when faced with the issue of globalization and the gender gap. First, how does discrimination against women influence the way countries integrate into world markets? And second, how does globalization in turn change countries' incentives to "promote gender equality and empower women"?

To address these questions, we take the view of globalization as the expansion of trade in goods and services, with changes in relative factor prices as a primary consequence. We therefore abstract from other important socio-economic phenomena associated with globalization, such as cross-border movements of capital and labor, or the worldwide spread of information, technology, culture, and social norms, among other things. Our analysis of the interplay between globalization and gender inequality instead emphasizes the distortionary effects of discrimination on trade patterns, and reciprocally, the role that trade has in affecting the extent to which women are being discriminated against.

To guide our discussion, we consider a two-sector specific factors model of international trade (Jones, 1971; Mussa, 1974), combined with a simplified occupational choice decision along the lines of Roy (1951). The first sector combines capital with female labor (henceforth the *brain* sector), and the second combines capital with male labor (henceforth the *brawn* sector). Capital flows freely across sectors, so the marginal products of capital equalize, and this determines the equilibrium of the economy in autarky. To investigate the effect of world market integration, we consider two otherwise similar countries that differ along two dimensions: (i) the relative productivity of the brain versus brawn sectors, and (ii) the severity of gender discrimination, which is modeled as the extent to which women are restricted from participating in the labor market. The former source of heterogeneity reflects Ricardian technology differences, while the latter leads to Heckscher-Ohlin-type differences in female labor endowments. Under trade, capital flows to the sector in which the country has a comparative advantage. Moreover, gender discrimination, by affecting relative factor endowments, distorts trade patterns by either exacerbating or mitigating inherent Ricardian comparative advantage.

The second stage of our theoretical discussion endogenizes the gender gap, and analyzes several mechanisms through which trade opening will affect discrimination outcomes. When women's empowerment is expressed through higher female labor force participation or lower fertility, we examine how world market integration changes the trade-off between formal labor wages and the marginal product of home production.[1] Similarly, when looking at education, we analyze how trade opening might affect the returns to girls' schooling. Finally, we propose a political economy model of gender discrimination in which relative incomes within a household determine bargaining power and men choose female labor force participation; men thus face the trade-off between increasing total

[1] In this paper, we view fertility solely as an indication of women's opportunity cost of formal labor.

household income and a higher bargaining power of female household members as female earnings increase. In all these cases, by affecting relative factor prices, trade alters the costs and benefits of restricting female participation in the labor force; countries that exhibit a larger comparative advantage in the brain sector will tend to discriminate less against women, since such practice comes at a larger cost.

We take the two main theoretical predictions of the model to the data. First, all else equal, countries where gender discrimination is less severe have a comparative advantage in exporting goods that are more intensive in the use of female labor. Second, under trade, countries with comparative advantage in female intensive sectors will reduce the severity of gender discrimination. To test these predictions, we use industry-level export data for 61 manufacturing sectors in 146 developed and developing countries over 45 years. We measure a sector's female-labor intensity by its average ratio of female to total employment among countries with full data coverage, and test whether, consistent with the first prediction, countries where women are more empowered tend to export relatively more of the female-labor intensive goods. Next we follow the methodology of Almeida and Wolfenzon (2005), and use a country's export shares in different sectors to aggregate the industry-level measures of female labor intensity into a country-level measure of *female-labor needs of exports* that captures a country's comparative advantage in female-labor intensive sectors. We use this measure to test the second prediction: that gender discrimination is less severe in countries with a comparative advantage in female-labor intensive sectors. In testing both predictions, we recognize the possibility of endogeneity of our explanatory variable that comes from the model itself and address it using instrumentation strategies. In the first case, since the share of a country's exports in a sector that is female-labor intensive may affect its attitude towards gender, we instrument the attitude towards gender by a measure of the distribution of religions in the population. In the second case, since the comparative advantage of a country in female-labor intensive sectors depend on its attitude towards gender, we follow the methodology of Do and Levchenko (2007), and instrument for the female-labor needs of exports by a measure of a country's exogenously determined comparative advantage in these sectors using export weights predicted by sector-level gravity equations. These instrumentation strategies are described and justified in more detail in section 2 below.

The results support the main empirical predictions of the model. Countries with higher degrees of women's empowerment, whether it is measured by higher female labor force participation, lower fertility, or higher female educational attainment, have a significantly larger export shares in sectors that are intensive in the use of female labor, controlling for industry and country fixed effects. This finding is specially strong in two-stage least squares (2SLS) regressions that instrument for the possible endogeneity of gender attitudes with respect to export composition. Moving from the 25th to the 75 percentile in a gender gap variable increases the export share in a sector at the 75th percentile of female intensity by between 0.7 and 1.89 percentage points more compared to a sector at the 25th percentile of female intensity, depending on the gender gap measure. Similarly, countries that have a comparative advantage in the production of female-labor intensive goods tend to exhibit relatively greater female empowerment, especially in terms of a lower fertility rate, and to a lesser extent in terms of educational attainment and labor force participation. For instance, moving from the 25th to the 75th percentile in the distribution of the female-labor needs of exports lowers fertility by as much as 0.21 births per woman, or about 0.37 standard deviations of average fertility across countries.

Our paper builds on the assumption that male and female labor are not perfect substitutes. This assumption has also been the cornerstone of recent empirical analyzes by Galor and Weil (1996), Black and Juhn (2000), Qian (2008), Alesina et al. (2011), and Pitt et al. (2010), among others. By examining the effect of trade on various measures of the gender gap, the analysis conducted in this paper relates to an emerging literature on the effect of trade liberalization on female outcomes (Rendall, 2010; Oostendorp, 2009; Aguayo-Tellez et al., 2010). Finally, our paper belongs to the broader "Institutions and Trade" literature, which examines both how institutions become a source of comparative advantage (e.g. Beck, 2003; Levchenko, 2007), as well as how trade in turn influences institutions (Acemoglu et al., 2005; Braun and Raddatz, 2008; Do and Levchenko, 2007, 2009; Segura-Cayuela, 2006).

The rest of the paper is organized as follows. Section 1 presents a simple two-country two-sector model of trade with gender discrimination. It then proposes and analyzes mechanisms to endogenize the gender gap. Section 2 lays out our empirical strategy to test the predictions of the model. Section 3 describes the data, while section 4 presents estimation results. Section 5 concludes.

1 A Model of Trade with Gender Discrimination

1.1 The Environment

We consider a two-country, two-sector model. Countries are indexed by $i \in \{X, Y\}$ and sectors are labeled F and M. Consumers have Cobb-Douglas preferences over the two goods:

$$u\left(C_F^i, C_M^i\right) = \left(C_F^i\right)^{\eta}\left(C_M^i\right)^{1-\eta}.$$

Instead of considering sectors of relative brain versus brawn intensities, we restrict attention to a specific-factors model of production:

$$\begin{aligned} Y_F^i\left(K_F, L_F\right) &= F^i K_F^{\alpha} L_F^{1-\alpha} \\ Y_M^i\left(K_M, L_M\right) &= M^i K_M^{\alpha} L_M^{1-\alpha}, \end{aligned}$$

where L_F and L_M are, respectively, the amount of female labor and male labor employed in production, and K_F and K_M are the amounts of capital employed in each sector. Thus, men and women are assumed not to be substitutes of each other; we take the arguably simplistic view that men supply brawn-only labor, while women supply brain-only labor.[2]

Countries are characterized by endowments of female labor $\bar{L}_F^i$, male labor $\bar{L}_M^i$ and capital $\bar{K}^i$. Capital can move freely between sectors, and the market clearing condition for capital implied that $K_F^i + K_M^i = \bar{K}^i$. To capture the notion of gender discrimination, we set $\bar{L}_M^i = 1$ for $i \in \{X, Y\}$, while female labor supply is given by $\bar{L}_F^i = 1 - \delta^i$ in country i. The parameters δ^i capture the extent to which female labor supply is being restricted in country i. We can either think of δ^i as actual restrictions on women's participation in the labor force (discrimination, social norms, etc.), or female schooling restrictions so that $\left(1 - \delta^i\right)$ measures "effective" female labor supply. In this model, trade will be driven by both Ricardian (relative productivity of sectors A and B will differ across countries) and Heckscher-Ohlin (countries will differ by their effective endowment of female labor) motives.

In country i, capital is rented out at rate r^i and female and male workers are paid wages w_F^i and w_M^i, respectively. The price of the M-good is set to be numeraire, and the price of F goods is denoted p^i. Given the prevailing extent of discrimination against women (δ^i), all the goods and factor markets are perfectly competitive. An equilibrium in this economy is a set of prices $\left\{p^i, r^i, w_F^i, w_M^i\right\}_{i\in\{X,Y\}}$, and factor allocations $\left\{K_M^i\right\}_{i\in\{X,Y\}}$, such that (i) consumers maximize utility; (ii) firms maximize profits; (iii) all goods and factor markets clear. In the rest of the section, we will first solve the equilibrium of the economy when countries are in autarky, and compare these outcomes to the case in which goods can be traded freely across countries so that the law of one price holds. We will then propose several mechanisms to endogenize δ^i, the extent of gender imbalance in country i.

1.2 Autarky

To characterize the autarky equilibrium, we look at (i) the first order conditions for optimizing firms and consumers, and (ii) market clearing conditions. For convenience, we will express all the unknown parameters of the economy (prices and quantities) as functions of $f = \frac{\bar{K}}{K_M}$, which is a measure of the size of the female-labor intensive sector. To simplify notation, this section drops the country superscripts.

Firms' optimization

In each of the two sectors, firms rent capital and hire labor to maximize profits. In other words, sector M firms solve the following program:

$$\max_{K,L} MK^{\alpha}L^{1-\alpha} - rK - w_M L$$

[2] In the rest of the paper, we will use female-labor (resp. male-labor) or brain (resp. brawn) intensive sectors interchangeably.

The necessary and sufficient first-order conditions with respect to K_M and L_M yield, respectively:

$$r = \alpha M \left(\frac{1}{K_M}\right)^{1-\alpha} = \frac{\alpha M}{\bar{K}} \bar{K}^{\alpha} f^{1-\alpha} \tag{1}$$

$$w_M = (1-\alpha) M K_M^{\alpha} = (1-\alpha) M \left(\frac{\bar{K}}{f}\right)^{\alpha}. \tag{2}$$

Similarly, sector F firms choose capital and demand labor to maximize

$$\max_{K,L} pFK^{\alpha}L^{1-\alpha} - rK - w_F L.$$

The necessary and sufficient first-order conditions with respect to K yield $r = \alpha pF \left(\frac{1-\delta}{K_F}\right)^{1-\alpha}$ and since returns to capital equalize across sectors, the expression for r given by equation (1) pins down relative goods prices:

$$p = \frac{F}{M}\left(\frac{f-1}{1-\delta}\right)^{1-\alpha}. \tag{3}$$

Finally, the first-order conditions with respect to L determine female wages:

$$w_F = (1-\alpha) pF \left(\frac{K_F}{1-\delta}\right)^{\alpha} = \frac{1}{1-\delta}(1-\alpha) M \left(\frac{\bar{K}}{f}\right)^{\alpha} (f-1). \tag{4}$$

Consumers' optimization and market clearing conditions

Cobb-Douglas utility implies constant expenditure shares on the two goods:

$$\begin{aligned} pC_F &= \eta E \\ C_M &= (1-\eta) E, \end{aligned}$$

where expenditure is equal to aggregate income, which is derived from wages paid to labor and rental of capital:

$$E = r\bar{K} + w_F(1-\delta) + w_M.$$

Therefore, aggregate consumption of good F is

$$C_F = \eta \frac{r\bar{K} + w_F(1-\delta) + w_M}{p}. \tag{5}$$

The market clearing condition for good F (equivalently for good M, since Walras' law holds) equalizes consumption and production:

$$\eta \frac{r\bar{K} + w_F(1-\delta) + w_M}{p} = FK_F^{\alpha}(1-\delta)^{1-\alpha}.$$

Substituting for goods and factor prices from (4), (2), and (3) and rearranging gives us the following expression for equilibrium capital allocation:

$$(1-\eta) f = 1. \tag{6}$$

Equilibrium characterization

The autarky equilibrium is thus characterized by the following allocation of resources:

$$\begin{cases} L_M & = 1 \\ L_F & = 1-\delta \end{cases} \text{and} \begin{cases} K_M & = (1-\eta)\bar{K} \\ K_F & = \eta\bar{K} \end{cases}.$$

The allocation of capital across sectors does not depend on δ, the extent of gender discrimination. Any restriction in labor supply is compensated by an increase in female wages, with unit elasticity of substitution (Cobb-Douglas), so that the factor rewards are independent of δ. To see this, let's look at equilibrium wages:

$$\begin{cases} w_F & = \frac{1}{1-\delta}\frac{\eta}{1-\eta}(1-\alpha)(1-\eta)^{\alpha} M\bar{K}^{\alpha} \\ w_M & = (1-\alpha)(1-\eta)^{\alpha} M\bar{K}^{\alpha} \end{cases}, \tag{7}$$

so that total labor incomes for women and men are given by

$$\begin{cases} w_F L_F & = \frac{\eta}{1-\eta}(1-\alpha)(1-\eta)^{\alpha} M\bar{K}^{\alpha} \\ w_M L_M & = (1-\alpha)(1-\eta)^{\alpha} M\bar{K}^{\alpha} \end{cases},$$

which means that relative total labor income of women to men is entirely determined by the relative weight of female to male goods in the utility function:

$$\frac{w_F L_F}{w_M L_M} = \frac{\eta}{1-\eta}. \tag{8}$$

Since capital allocation is independent of the extent of gender discrimination, neither are interest rates:

$$r = \frac{\alpha(1-\eta)^{\alpha} M\left(\bar{K}\right)^{\alpha}}{(1-\eta)\bar{K}}.$$

Finally, prices of female-produced goods are (negatively) responsive to female labor supply:

$$p = \frac{1}{(1-\delta)^{1-\alpha}}\frac{M}{F}\left(\frac{\eta}{1-\eta}\right)^{1-\alpha} \tag{9}$$

and consumption levels are thus

$$\begin{cases} C_F & = (1-\delta)^{1-\alpha} \eta^\alpha F \bar{K}^\alpha \\ C_M & = (1-\eta)^\alpha M \bar{K}^\alpha \end{cases}, \tag{10}$$

which implies that autarky equilibrium welfare is equal to

$$U = F^\eta M^{1-\eta} \left[\eta^\eta (1-\eta)^{1-\eta} \bar{K}\right]^\alpha (1-\delta)^{(1-\alpha)\eta}. \tag{11}$$

The main lesson from the autarky case is that general equilibrium forces put a natural limit on the "effectiveness" of gender discrimination: restricting the female labor supply bids up the price of the goods produced by women, and therefore women's wage. Though under the Cobb-Douglas assumption, the general equilibrium force perfectly offsets discrimination – in the sense that the total female labor income in the economy is independent of δ – this force is of course much more general, and will still operate under non-unitary elasticities of substitution.

1.3 Trade

Now suppose countries can freely trade goods with each other. A superscript $i \in \{X, Y\}$ indexes the countries. We follow the same approach as in the autarky case to solve for the equilibrium allocation of resources. The only differences lie in the goods market clearing condition that now aggregates consumption and production from both countries, and prices of good F that equalize across countries.

Firms' and consumers' optimization

Following the same steps as in autarky, we can obtain expressions for equilibrium prices in each country $i \in \{X, Y\}$ that we express as functions of $f^i = \frac{\bar{K}^i}{K_M^i}$.

$$\begin{cases} r^i & = \frac{\alpha M^i}{\bar{K}^i} \left(\bar{K}^i\right)^\alpha \left(f^i\right)^{1-\alpha} \\ p^i & = \frac{M^i}{F^i} \left(\frac{f^i-1}{1-\delta^i}\right)^{1-\alpha} \\ w_M^i & = (1-\alpha) M^i \left(\bar{K}^i\right)^\alpha \left(\frac{1}{f^i}\right)^\alpha \\ w_F^i & = \frac{1}{1-\delta^i} (1-\alpha) M^i \left(\bar{K}^i\right)^\alpha \left(f^i - 1\right) \left(\frac{1}{f^i}\right)^\alpha \end{cases}. \tag{12}$$

On the consumption side, we similarly have

$$\begin{cases} p^i C_F^i & = \eta \left[r^i \bar{K}^i + w_F^i \left(1-\delta^i\right) + w_M^i\right] \\ C_M^i & = (1-\eta) \left[r^i \bar{K}^i + w_F^i \left(1-\delta^i\right) + w_M^i\right] \end{cases}.$$

Market clearing conditions and law of one price

In sector F, world consumption and production equalize, so that

$$\sum_i p^i F^i \left(\bar{K}^i - K_M^i\right)^\alpha \left(1-\delta^i\right)^{1-\alpha} \quad = \quad \eta \left[\sum_i r^i \bar{K}^i + \left(1-\delta^i\right) w_F^i + w_M^i\right],$$

which simplifies to

$$\sum_i M^i \left(\bar{K}^i\right)^\alpha \left(\frac{1}{f^i}\right)^\alpha \left[1-(1-\eta) f^i\right] = 0. \tag{13}$$

With frictionless trade across countries, $p^i = p^{-i}$ or

$$\frac{M^i}{F^i}\left(\frac{f^i-1}{1-\delta^i}\right)^{1-\alpha} = \frac{M^{-i}}{F^{-i}}\left(\frac{f^{-i}-1}{1-\delta^{-i}}\right)^{1-\alpha}, \tag{14}$$

where the notation "$-i$" denotes "not country i".

Equilibrium characterization

We define:

$$\rho^i = \left(\frac{F^i}{M^i}\frac{M^{-i}}{F^{-i}}\right)^{\frac{1}{1-\alpha}} \frac{1-\delta^i}{1-\delta^{-i}}.$$

A value $\rho > 1$ indicates that country i has a comparative advantage in good F, i.e. the female-labor intensive good. The comparative advantage can be decomposed into a *technological* or Ricardian component $\left(\frac{F^i}{M^i}\frac{M^{-i}}{F^{-i}}\right)^{\frac{1}{1-\alpha}}$ and an *institutional* or Heckscher-Ohlin component $\frac{1-\delta^i}{1-\delta^{-i}}$, which can exacerbate or attenuate technological differences. We also define the constant

$$\theta^i = \frac{M^{-i}}{M^i}\left(\frac{\bar{K}^{-i}}{\bar{K}^i}\right)^\alpha$$

and rewrite the two equations (13) and (14) as a system of two equations with two unknowns $\left(f^i, f^{-i}\right)$:

$$\begin{cases} \left(f^i\right)^{-\alpha}\left[1-(1-\eta) f^i\right] + \theta^i \left(f^{-i}\right)^{-\alpha}\left[1-(1-\eta) f^{-i}\right] & = 0 \\ \rho^i \frac{f^{-i}-1}{f^i-1} & = 1 \end{cases}. \tag{15}$$

The first equation of (15) is the world market clearing condition for good F. It consists of two terms that add up to zero. Thus, we have the first implication: for $i \in \{X, Y\}$

$$\left[(1-\eta) f^i \geq 1\right] \Leftrightarrow \left[(1-\eta) f^{-i} \leq 1\right].$$

In words, and since $(1-\eta) f = 1$ in autarky, it means that the female sector shrinks in country i as a consequence of trade if and only if it expands in $i's$ trade partner. Intuitively, this first result means that countries will specialize when they open to trade. If we now examine the law of one price condition (second equation in (15)), we have $\left[f^i \geq f^{-i}\right] \Leftrightarrow \left[\rho^i \geq 1\right]$: the country with comparative advantage in the female-labor intensive good ends up having a larger brain sector. These two results together imply the following equivalence:

$$\left[(1-\eta) f^i > 1\right] \Leftrightarrow \left[\rho^i > 1\right]. \tag{16}$$

In summary, we have the following result:

Proposition 1: Autarky vs. trade outcomes As a result of trade opening, capital flows into the sector for which the country has a comparative advantage in production.■

Proof: Follows immediately as an interpretation of equivalence (16).■

Take i, the country with comparative advantage in the female sector. Since capital will flow into the female sector, interest rates will increase accordingly as capital is now put to more productive use ($\frac{\partial r^i}{\partial f^i} > 0$). At the same time, the price of the brain-intensive good will increase, driven by demand from country $-i$: $\frac{\partial p}{\partial f^i} > 0$. Consequently, nominal wages will increase for women, and decrease for men ($\frac{\partial w_F^i}{\partial f^i} > 0$ and $\frac{\partial w_M^i}{\partial f^i} < 0$), so that the wage gap (defined as male to female wage bill ratio) decreases and takes the form:

$$\frac{w_M^i}{\left(1-\delta^i\right) w_F^i} = \frac{1}{f^i - 1}.$$

Furthermore, since the price of the A good is higher in i under trade than it was in autarky, consumption of good A will decrease by a factor $\left[\frac{(1-\eta) f^i}{1+\frac{(1-\eta) f^i - 1}{\eta}}\right]^{1-\alpha} < 1$, while consumption of good B will increase by a factor $\left[(1-\eta) f^i\right]^{1-\alpha} > 1$. Overall, welfare increases by a factor $\frac{\left[(1-\eta) f^i\right]^{1-\alpha}}{\left[1+\frac{(1-\eta) f^i - 1}{\eta}\right]^{\eta(1-\alpha)}} > 1$.

Proposition 2: Comparative statics If comparative advantage in the female-intensive sector is accentuated (ρ^i increases), then in the trade equilibrium more capital will flow into that sector:

$$\frac{df^i}{d\rho^i}\left(\rho^i\right) > 0.$$

■

Proof: See Mathematical Appendix.■

This section formalizes the intuition that trade opening induces countries to specialize in their comparative advantage industry, with the associated implications for capital allocation and female wages (Proposition 1). Comparative advantage in our model is a combination of both technological and institutional differences. An exacerbation of these differences induces an even larger inflow of capital in the female-labor intensive sector, with the corresponding female wage increase (Proposition 2). We thus have the first prediction of the model:

Prediction 1: Gender discrimination is a source of Heckscher-Ohlin comparative disadvantage: countries that discriminate more against women are less likely to export female-labor intensive goods.

1.4 Endogenizing the Gender Gap

The previous subsection laid out the basic model of trade in which countries differ in both technology and supply of female labor. In this subsection, we introduce several mechanisms that endogenize the gender discrimination parameter of the model, namely δ^i. Since comparative advantage in female-intensive industries implies higher wages for women, the "returns to gender discrimination" decrease with the extent of female intensity in production.

1.4.1 Fertility and the gender gap in labor force participation

The first extension of this model is to endogenize $1-\delta$, viewed as the measure of female labor force participation or fertility. We therefore consider a continuum of couples (husband, wife) of measure one, and investigate their time allocation decisions. To that end, we assume that men always supply one unit of labor, while women choose δ, the amount of time they spend at home in home production; child rearing would be a natural way to think of home activities. Households also own $\bar{K}^i$ units of capital invested in production. Finally, we assume that home production is increasing and concave in female labor and brings benefits $v(\delta) = \gamma\left(\delta - \frac{1}{2}\delta^2\right)$ that are measured in utility terms.[3] Households take the vector of prices as given and make their investment decisions accordingly; in other words, they maximize their indirect utility

$$max_\delta \frac{(\eta)^\eta (1-\eta)^{1-\eta}}{p^\eta}\left[r\bar{K}^i + w_F^i\left(1-\delta^i\right) + w_M^i\right] - \frac{1}{2}\gamma(1-\delta)^2,$$

in which goods consumption decisions have been maximized out. Consequently, the optimal choice of labor force participation is given by

$$\delta^i \in argmax_\delta \left(\frac{\eta}{p}\right)^\eta (1-\eta)^{1-\eta} w_F^i (1-\delta) - \frac{1}{2}\gamma(1-\delta)^2$$

which gives

$$1-\delta^i = \frac{1}{\gamma}\eta^\eta (1-\eta)^{1-\eta}\frac{w_F^i}{p^\eta}.$$

[3] Note that $v(\delta) = -\frac{1}{2}\gamma(1-\delta)^2$ up to a constant.

In natural logs this becomes:

$$\ln\left(1-\delta^{i}\right)=\Lambda_{supply}+\ln\left(\frac{w_{F}^{i}}{p^{\eta}}\right), \tag{17}$$

with $\Lambda_{supply} = \ln\left[\frac{1}{\gamma}\eta^{\eta}\left(1-\eta\right)^{1-\eta}\right]$. Equation (17) defines the labor supply curve. As expected, labor force participation (resp. fertility) is an increasing (resp. decreasing) function of the prevailing female wage, as picture in Figure 1, panel A. We now close the model in autarky and trade, respectively.

Labor force participation in autarky Plugging in the autarky expressions for w_F and p from equations (7) and (3) and taking natural logs, we get the expression for the equilibrium real female wage:

$$\ln\frac{w_{F}^{i}}{p^{\eta}} = \Lambda_{autarky}^{i}-\left[1-\eta\left(1-\alpha\right)\right]\ln\left(1-\delta^{i}\right), \tag{18}$$

with $\Lambda_{autarky}^{i} = \ln\left[\left(\frac{\eta}{1-\eta}\right)^{1-\eta(1-\alpha)}\left(1-\eta\right)^{\alpha}\left(1-\alpha\right)\left(F^{i}\right)^{\beta}\left(M^{i}\right)^{1-\beta}\left(\bar{K}^{i}\right)^{\alpha}\right]$. Equation (18) defines the labor demand curve as pictured in Figure 1 panel A, and reflects the fact that female labor force participation exerts a downward pressure on female wages.

The equilibrium female labor force participation in autarky is therefore the unique intersection between supply and demand curves and is equal to

$$\ln\left(1-\delta_{autarky}^{i}\right)=\frac{\Lambda_{supply}^{i}+\Lambda_{autarky}^{i}}{2-\eta\left(1-\alpha\right)}.$$

Labor force participation under trade Using the expression for w_F and p under trade from equations (12), the labor demand curve can be written in logs as:

$$\ln\frac{w_{F}^{i}}{p^{\eta}} = \Lambda_{autarky}^{i}+\ln g\left[\frac{\left(1-\eta\right)f^{i}-1}{\eta}\right]-\left[1-\eta\left(1-\alpha\right)\right]\ln\left(1-\delta^{i}\right),$$

where $g\left(y\right)=\left(1+y\right)^{1-\eta(1-\alpha)}\left(\frac{1}{1+\eta y}\right)^{\alpha}$. We can write

$$\begin{aligned}\ln\left(1-\delta_{trade}^{i}\right) &= \frac{\Lambda_{supply}^{i}+\Lambda_{autarky}^{i}}{2-\eta\left(1-\alpha\right)}+\frac{1}{2-\eta\left(1-\alpha\right)}\ln\left\{g\left[\frac{\left(1-\eta\right)f^{i}-1}{\eta}\right]\right\}\\ &= \ln\left(1-\delta_{autarky}^{i}\right)+\frac{1}{2-\eta\left(1-\alpha\right)}\ln\left\{g\left[\frac{\left(1-\eta\right)f^{i}-1}{\eta}\right]\right\}.\end{aligned}$$

Consequently,

$$\delta_{autarky}^{i}>\delta_{trade}^{i}$$

if and only if

$$g\left[\frac{(1-\eta)\,f^{i}-1}{\eta}\right]>1$$

It is easy to verify that $g(y)$ is positive increasing for every y and $g(0)=1$. Thus, $g\left[\frac{(1-\eta)f^{i}-1}{\eta}\right]>1$ if and only if $(1-\eta)\,f^{i}>1$, and given (16), we conclude that

$$\delta^{i}_{autarky}>\delta^{i}_{trade}$$

if and only if

$$\rho^{i}>1.$$

The labor demand curve therefore shifts up (resp. down) when the country has a comparative advantage in the female-labor (resp. male-labor) intensive good. Thus, the country that has a comparative advantage in the female-intensive sector will increase female labor force participation as a consequence of trade opening.

Prediction 2a: Countries that have a comparative advantage in the female intensive good have higher female labor force participation and lower fertility once they open to trade. The reverse holds for countries with a comparative *dis*-advantage in brain intensive goods.

1.4.2 Trade and the gender gap in education

Another pathway through which trade opening can impact countries differentially is through investments in education. By affecting the relative returns to male versus female labor, trade might alter the nature of gender-biased parental investments in education. To capture the notion of education in our model, we assume that $(1-\delta)$ is the supply of "effective labor," given that education increases the productivity of labor. We also consider a dynastic model whereby parents are born at the beginning of a period t with endowment $\bar{K}^{i}$ of capital; the mother has education $(1-\delta_t)$ that allows her to supply $(1-\delta_t)$ units of effective labor. Parents produce and make their consumption decisions. They have two children, one boy and one girl and choose to invest e_t in educating their girl at cost $\frac{1}{2}\lambda e_t^{2}$, which is measured in utility terms. Once again, for the sake of simplicity, we abstract from boys' education. The investment sets the next generation's education following the law of motion $1-\delta_{t+1}=f(1-\delta_t,e_t)$. $f(.)$ is assumed to have the standard regularity properties. Parents' optimization program takes future wages as given and maximizes:

$$V_t(1-\delta_t)=\max_{e}\left[\left(\frac{\eta}{p_t}\right)^{\eta}(1-\eta)^{1-\eta}\,w^{i}_{Ft}(1-\delta_t)-\frac{1}{2}\lambda e^{2}+\beta V_{t+1}(1-\delta_{t+1})\right]$$

subject to

$$1-\delta_{t+1}=f(1-\delta_t,e)\,.$$

The first-order condition gives

$$\lambda e_t = \beta f_e \left(1 - \delta_t, e_t\right) V'_{t+1} \left(1 - \delta_{t+1}\right),$$

while the envelope theorem yields:

$$V'_t \left(1 - \delta_t\right) = \left(\frac{\eta}{p_t}\right)^{\eta} \left(1 - \eta\right)^{1-\eta} w^i_{Ft}.$$

We consequently have the following Euler equation, which defines the demand for education:

$$e_t = \frac{\beta \eta^{\eta} \left(1 - \eta\right)^{1-\eta}}{\lambda} f_e \left(1 - \delta_t, e_t\right) \frac{w^i_{Ft+1}}{p^{\eta}_{t+1}}. \tag{19}$$

To simplify, we assume that $f\left(1 - \delta, e\right) = e$ so that Euler equation (19) fully defines the labor supply curve:

$$1 - \delta_t = \frac{\beta \eta^{\eta} \left(1 - \eta\right)^{1-\eta}}{\lambda} \frac{w^i_{Ft}}{p^{\eta}_t}.$$

Taking logs,

$$\ln\left(1 - \delta_t\right) = \ln \frac{\beta \eta^{\eta} \left(1 - \eta\right)^{1-\eta}}{\lambda} + \ln \frac{w^i_{Ft}}{p^{\eta}_t},$$

This equation is identical to (17) up to a constant, and thus all of the derivations regarding the impact of trade opening on δ carry over from the previous case. Note that, given the simplification assumption made for the law of motion of education, the economy converges to its steady state immediately and the analysis of the properties of the steady state is identical to the labor-force-participation/fertility case.

Prediction 2b: Countries that have a comparative advantage in the brain-intensive good reduce the gender gap in education when they open to trade. The reverse holds for countries with a comparative *dis*-advantage in brain intensive goods.

1.4.3 The political economy of gender discrimination

Finally, to model the endogenous choice of δ^i in a political economy setting, we depart from the unitary household, and assume that husbands and wives bargain over aggregate income so that their individual utilities end up being

$$\begin{cases} u^i_F\left(\delta^i\right) & = \left[1 - \omega^i\left(\delta^i\right)\right] U^i\left(\delta^i\right) \\ u^i_M\left(\delta^i\right) & = \omega^i\left(\delta^i\right) U^i\left(\delta^i\right) \end{cases},$$

where $U^i\left(\delta^i\right)$ is the total indirect utility of the household, $U^i\left(\delta^i\right) = \frac{\eta^\eta(1-\eta)^{1-\eta}}{p^\eta}\left[r^i\bar{K}^i + w_F^i\left(1-\delta^i\right) + w_M^i\right]$ and

$$\omega^i\left(\delta^i|w_M^i, w_F^i, p\right) = \omega\left[\frac{w_M^i}{p^\eta}; \frac{w_F^i\left(1-\delta^i\right)}{p^\eta}\right]$$

is the husband's bargaining weight. The bargaining weight is increasing in the husband's real income ($\omega_1(.) > 0$) while decreasing in the wife's ($\omega_2(.) < 0$). Furthermore, if we assume that bargaining power is unchanged if both incomes are equally inflated, we can express $\omega^i\left(\delta^i|w_M^i, w_F^i, p\right)$ as a function of income ratios only:

$$\omega^i\left(\delta^i|w_M^i, w_F^i, p\right) = \Omega\left(\frac{w_F^i\left(1-\delta^i\right)}{w_M^i}\right).$$

Finally, in this political economy model, men choose the level of gender discrimination δ^i to maximize their own indirect utility $\omega^i\left(\delta^i\right)U^i\left(\delta^i\right)$. In doing so, we assume that they internalize the general equilibrium effects of their policy decision δ.

Gender discrimination in autarky Plugging in autarky equilibrium wages from (7) and dropping country superscripts, bargaining power in autarky is given by

$$\omega(\delta) = \Omega\left(\frac{\eta}{1-\eta}\right),$$

which is independent of δ. The bargaining power of husbands is unaffected when they restrict female labor force participation since any restriction will induce an increase in wages that will keep payments to female labor constant. In our model, any partial equilibrium effect associated with a restriction on female labor supply (higher δ) is fully offset by general equilibrium effects. Although the extreme result is driven by the unit elasticity of substitution specific to Cobb-Douglas specifications for both preferences and technology, the mechanism is still robust to alternative functional forms and works as follows: a reduction in female effective labor supply decreases output in the A sector that induces prices of A goods to go up. This is captured in the expression (9) for prices. In the Cobb-Douglas case, the price response is exactly equal to output shortage, so that the allocation of capital across sectors is invariant to changes in δ. As a consequence of the price hike, female labor becomes relatively more productive and this translates into higher wages for women. Unit elasticity of substitution implies that total labor income is unaffected by δ (cf. equation 8).

Therefore, any restriction in female supply only affects consumption levels through lower production (cf. equation 10); ultimately, welfare is adversely affected without any change in men's bargaining power (cf. equation 11). The autarky gender discrimination level is therefore minimal: $\delta = 0$.

Gender discrimination under trade Under the trade regime, bargaining power becomes

$$\omega^i\left(\delta^i\right) = \Omega\left(f^i - 1\right)$$

so that

$$\omega^i\left(\delta^i\right)U^i\left(\delta^i\right) \quad \propto \quad \Omega\left(f^i-1\right)\times\left[\frac{f^i\left(1-\delta^i\right)^{\eta}}{\left(f^i-1\right)^{\eta}}\right]^{1-\alpha}.$$

The optimal choice for men in country i is then determined by the first-order condition with respect to δ :

$$\begin{aligned}\frac{d\ln\left[\omega^i\left(\delta^i\right)U^i\left(\delta^i\right)\right]}{d\ln\left(1-\delta^i\right)} &= \frac{d\ln f}{d\ln\rho}\frac{d\ln\Omega\left(f^i-1\right)}{d\ln f}+(1-\alpha)\frac{d\ln f^i}{d\ln\rho}\left[1-\eta\frac{f^i}{f^i-1}\right]+\eta(1-\alpha) \quad (20)\\ &= 0\end{aligned}$$

The right-hand side of (20) consists of three terms. The first term is the change in husbands' bargaining power. An increase in female labor force participation results in an increase in the country's comparative advantage in female good production, inducing an increase of the relative income of women. This in turn reduces husbands' bargaining power, since $\Omega(.)$ is decreasing in f. The second term is the allocative effect: an increase in female labor supply will induce the male sector to shrink, pushing female wages up but also price of the female good up. The net effect on real income is therefore ambiguous and is positive if and only if $1-\eta\frac{f}{f-1}>0$, i.e. if and only if country i has a comparative advantage in the female-labor intensive good; when a reallocation of capital across sectors decreases the gains from trade (i.e. when capital flows into the female-labor [resp. male-labor] intensive sector in the country with comparative advantage in the male-labor [resp. female-labor] intensive good), the effect on real income is negative. On the contrary, when capital movements make countries more different, the gains from trade increase. Finally, the third term is the real income effect of an increased aggregate supply of the female-labor intensive good, which pushes prices down.

Prediction 2c: Both countries increase discrimination against women when they open to trade. However the increase in discrimination is more pronounced when the country has a comparative dis-advantage in the female-labor intensive sector.

2 Empirical Strategy

The model of international trade and gender inequality developed above has two main predictions. When female participation in labor markets $\left(1-\delta^i\right)$ is taken as given, countries with lower participation will have a comparative disadvantage in the production of female-labor intensive goods, and will export relatively less of these goods. This first prediction comes from the Hecksher-Ohlin aspects of the model. A lower female participation, resulting either from cultural or economic forces, effectively makes the country relatively less abundant in female labor and reduces the force to export these goods that arises purely from differences in factor endowments.

The model also recognizes that in the longer run, a country's comparative advantage has an impact on women's wages and thus their incentives to participate in the formal labor markets. If a country has a comparative advantage in the goods that are produced by women, female wages will rise and women will have a greater incentive to participate in the formal labor markets and invest in the types of human capital that will be valued by the formal economy. By contrast, when a country has a comparative advantage in the goods produced primarily by males, women's incentives to invest in human capital and participate in the formal labor markets will decrease with trade openness. This is the second empirical prediction that we test below. Both of these predictions suggest that what matters most for how globalization affects the relative status of women in the society is not simply the level of overall trade openness, but the country's comparative advantage. Conversely, the status of women should affect not just overall trade volumes, but also trade patterns in the shorter-run.

To test these predictions empirically, we measure an industry's female-labor intensity FL_i as the share of female workers in the total employment in sector i. We take this measure as a technologically determined industry characteristic that does not vary across countries. Using this measure, we first estimate the following regression in a cross-section of industries across countries:

$$SHARE_{ic} = \nu FL_i \times GENDER_c + \gamma_c + \gamma_i + \epsilon_{ic}, \tag{21}$$

where $SHARE_{ic}$ is the average share of good i in country c total exports, $GENDER_c$ is a measure of women's participation in the labor force or human capital investment in country c, and γ_c and γ_i are country and industry fixed effects, respectively. This specification allows us to test the first prediction about the relation between female participation and comparative advantage. If women's labor force participation is a source of comparative advantage in sectors that are brain intensive, the coefficient ν would be significantly positive for measures of female participation and negative for measures of exclusion. To address the endogeneity of $GENDER_c$ predicted by our model, we instrument it by the composition of religions in a country. Specifically, for each country, we construct two variables that are the proportions of the population that is Muslim and Christian, respectively. The interactions $FL_i \times MUSLIM_c$ and $FL_i \times CHRISTIAN_c$ are then used to instrument for the interaction $FL_i \times GENDER_c$.[4] It is important to note that we do not claim that religion variables are valid instruments for the variable $GENDER_c$, since country fixed effects are not excluded from the first stage. Rather, the identification assumption is valid if, conditional on country and industry fixed effects, the *interaction* between religious composition of country c and the female-labor intensive character of industry i affects the share of good i in country c total exports only through its effect on the *interaction* between gender discrimination in country c and the female-labor intensive character of industry i.

Starting from the same measure of an industry's female-labor intensity FL_i, we can also test the second prediction that comparative advantage shapes female labor participation and exclusion. To

[4] Our results are similar if we use $FL_i \times MUSLIM_c$ as the only instrument for $FL_i \times GENDER_c$.

this end, we first measure the "gender content" of each country's comparative advantage. In order to do this, we follow Almeida and Wolfenzon (2005) and construct for each country and time period, a measure of the "female-labor needs of exports":

$$FLNX_{ct} = \sum_{i=1}^{I} \omega_{ict}^{X} FL_i, \tag{22}$$

where i indexes sectors, c countries, and t time periods. In this expression, ω_{ict} is the share of sector i exports in country c's total exports to the rest of the world in time period t. Thus, $FLNX_{ct}$ in effect measures the gender composition of exports in country c. This measure will be high if a country exports mostly in sectors with a large female share of employment, and vice versa.

Using this variable, we would like to estimate the following equation in the cross-section of countries:

$$GENDER_c = \alpha + \beta FLNX_c + \gamma \mathbf{Z}_c + \varepsilon_c. \tag{23}$$

The left-hand side variable, $GENDER_c$, is a measure of women's participation in the labor force or human capital investment, and $\mathbf{Z}_c$ is a vector of controls. The main hypothesis is that the effect of comparative advantage in brain-intensive sectors, $FLNX$, on women's labor market outcomes is positive ($\beta > 0$). To deal with reverse causality, we implement an instrumentation strategy that follows Do and Levchenko (2007), and exploits exogenous geographical characteristics of countries, along with how those exogenous characteristics affect international trade in different sectors differentially. The construction of the instrument is described in Appendix B.

We also exploit the time variation in the variables to estimate a panel specification of the type

$$GENDER_{ct} = \alpha + \beta FLNX_{ct} + \gamma \mathbf{Z}_{ct} + \gamma_c + \gamma_t + \varepsilon_{ct}, \tag{24}$$

where country and time fixed effects are denoted by γ_c and γ_t respectively. The advantage of the panel specification is that the use of fixed effects allows us to control for a wide range of omitted variables, and identify the coefficient purely from the time variation in comparative advantage and women's outcomes *within a country over time*. The panel estimation is carried out on non-overlapping 5-year averages, to sweep out any variation at the business cycle frequencies.

Our main $GENDER_c$ measure is fertility, measured by the total number of births per woman. Since women typically bear the primary responsibility for caring for their children, a greater number of children will effectively reduce a woman's capacity to supply labor to the formal labor market. The key advantage of a variable like fertility is that unlike other indicators of female labor supply, the number of births per woman is likely to be measured quite precisely in all countries and at all levels of development. We also check whether results are robust to two additional measures: female labor force participation and female educational attainment. Female labor force participation is perhaps the most direct indicator of the outcome of interest for this study, but it is also likely to be measured with greater error, especially in poorer countries with large informal sectors. Female educational attainment is measured by the average years of schooling of females over 15 years of age. This variable measures women's investment in human capital, which can be interpreted as making women more suitable for formal sector employment. Note, however, that this variable's relationship to female labor supply is probably less straightforward, since staying in school longer actually *reduces* one's labor supply in the short to medium run. To summarize, these three outcome variables are intended to test the prediction of the model that when trade expands women's employment opportunities, they will respond by raising their labor supply and investing in human capital (predictions 2a, 2b and 2c).

The controls include PPP-adjusted per capita income, overall trade openness, and, in the case of cross-sectional regressions, regional dummies. Our cross-sectional specifications are estimates on long-run averages for the period 1962-2007, while in the panel specifications the unit of time is a 5-year period, so all the variables are 5-year averages. The data span 1962 to 2007 in the best of cases, though not all variables are available for all time periods.

3 Data Sources and Summary Statistics

The key indicator required for the analysis is the share of female workers in the total employment in each sector. We obtain this information from the UNIDO Industrial Statistics Database (INDSTAT4 2009). This database contains information on the total employment and female employment in each manufacturing sector for a large number of countries, starting in the late 1990s. The data are available at the 3-digit ISIC Revision 3 classification (61 distinct sectors). In order to construct the share of female workers in total employment in sector i, FL_i, we take the mean of this value across the countries for which these data are available and relatively complete. The resulting sample includes eleven countries in each of the developed and developing sub-samples: Austria, Malta, Slovak Republic, Cyprus, Lithuania, Japan, United Kingdom, New Zealand, Korea, Italy, Ireland; and Indonesia, Turkey, Azerbaijan, Jordan, India, Philippines, Malaysia, Chile, Morocco, Egypt, Thailand. Table 1 reports the values of FL_i in our sample of sectors. It is clear that there is wide variation in the share of women in sectoral employment. While the mean is 27 percent, these values range from the high of 71 percent in Wearing Apparel and 62 percent in Knitted and Crocheted Fabrics to the low of 8 or 9 percent in Motor Vehicles, Bodies of Motor Vehicles, Building and Repairing of Ships, and Railway Locomotives.[5]

The export shares ω_{ict}^X are calculated based on the COMTRADE database, which contains bilateral trade data starting in 1962 in the SITC revision 1 and 2 classification. The trade data are then aggregated up to the ISIC Revision 3 classification using a concordance developed by the authors.

[5]One may be concerned that these values are very different across countries in general, and across developed and developing countries in particular. However, it turns out that the rankings of sectors are remarkably similar across countries. The values of FL_i computed on the OECD and non-OECD samples have a correlation of 0.89. Pooling all the countries together, the first principal component explains 77 percent of the cross-sectoral variation across countries, suggesting that rankings are very similar. We also experimented with taking alternative averages: medians instead of means across countries; and dropping outlier values of female shares in individual sectors. The results were very similar.

Data on female labor force participation and fertility are sourced from the World Bank's World Development indicators, while information on female educational attainment comes from the Barro-Lee database. Controls – PPP-adjusted per capita income and overall trade openness – come from the Penn World Tables 6.3 (Heston et al., 2002).

Table 2 reports some summary statistics for the female content of exports for the OECD and non-OECD country groups. We can see that for the OECD, these averages are slightly lower, at about 0.25, and stable across decades. For the non-OECD countries, the female content of exports is higher, between 0.27 and 0.30, and, if anything, rising over time. Notably, the dispersion among the non-OECD countries is both much larger than among the OECD, and increasing over time. While the OECD sample, the standard deviation is stable at 0.03-0.04, for the non-OECD is rises monotonically from 0.08 to 0.12 between the 1960s and the 2000s.

Tables 3a to 3c report, for the different time periods, the countries with highest and lowest $FLNX$ values. Typically, countries with the highest values of female content of exports are those that export mostly textiles and wearing apparel, while countries with the lowest $FLNX$ are natural resource exporters. Equally important for our empirical strategy are changes over time. Tables 4a and 4b report the countries with the largest positive and negative changes in $FLNX$ between the 1960s and today. We can see that relative to the cross-sectional variation, the time variation is also considerable. Table 5 presents the summary statistics of the country-level variables of interest and controls. Our final dataset contains country-level variables on up to 146 countries.

4 Regression Results

Table 6 reports the results of estimating the impact of the gender gap on comparative advantage in trade, i.e. eq. (21). The top panel presents the OLS results, the bottom panel the two-stage least squares results in which the interaction of FL_i with $GENDER_c$ is instrumented with the interactions of FL_i with shares of Muslims and Christians in the population. All columns control include country and sector dummies. Columns 2, 4, and 6 in addition include the interaction terms means to capture Heckscher-Ohlin specialization forces, following the empirical model of Romalis (2004): capital intensity of sector i is interacted with capital abundance of country c, and skill intensity of sector i is interacted with skill abundance of country c.[6] We can see that the gender gap has a clear impact on trade flows, especially when the gender gap measures are instrumented with religious composition. The bottom of Panel B reports the first-stage results. The first-stage coefficients are highly statistically significant, and the instruments are comfortably strong in the econometric sense. The estimates are economically significant: moving from the 25th to the 75 percentile in a gender gap variable increases the export share in a sector at the 75th percentile

[6] Capital intensity is computed as the share of value added not going to labor compensation, and is built using the UNIDO database. Skill intensity is computed as the fraction of the total wage bill corresponding to workers with at least some college education in the US (originally obtained from Autor et al., 1998; and translated from the US Census Industrial Classification (CIC) into ISIC Rev. 3 industries using a correspondence built by the authors). Country-level skill and capital abundance are sourced from Hall and Jones (1999).

of female intensity by between 0.7 and 1.89 percentage points more than in a sector at the 25th percentile of female intensity, depending on the $GENDER_c$ measure.

We next present the results of testing for the opposite effect: the role of comparative advantage in determining attitudes towards gender. Table 7 reports the results of estimating the cross-sectional specification in equation (23), focusing on fertility as the outcome variable. All of the specifications control for income per capita and overall openness, and columns 2-4 and 6-7 also include population as an additional control. Both left-hand side and the right-hand side variables are in natural logs. Columns 1 and 2 report the simple OLS results for fertility. There is a highly significant negative relationship: greater female content of exports is associated with lower fertility, exactly as theory would predict. Columns 3 and 4 explore the impact of comparative advantage on the other gender gap measures: female labor force participation and female educational attainment. We can see that the OLS coefficients are marginally significant, and with the expected sign. Columns 5 through 8 report the 2SLS results, in which the instrument is the female content of exports as predicted based purely on geographical characteristics, described in Appendix B. For the main outcome variable of interest, fertility, the 2SLS coefficient is significant at the one-percent level. For the other outcome variables, the coefficient retains the correct sign but is not robustly significant.[7] The bottom panel of columns 4 through 6 report the first-stage results. The first stage is quite strong: the instrument is highly significant as a predictor of actual female content of exports. The partial F-statistics indicate that the instrument is strong in the econometric sense. The estimates are economically significant. Moving from the 25th to the 75th percentile in the distribution of the female content of exports lowers fertility by as much as 0.21 births per woman, or about 0.37 standard deviations of average fertility across countries.

Table 8 presents the panel results. All of the specifications control for per capita income, openness, and population. The first column presents the pooled estimates on fertility without any fixed effects. The second column adds country effects, while column 3, both country and time effects. The impact of $FNLX$ on fertility is of the expected sign and significant at 1% level throughout. This is a powerful result: country effects control for all the unobservable features of countries that do not vary over time, such as geography and climate, ethnic and religious composition, and so on. Thus, the coefficients in column 2 and 3 are identified from changes in the variables within a country over time. Columns 4 and 5 present the pooled estimates and the estimates with both country and time effects for female labor force participation, while columns 6 and 7 do the same for female educational attainment. As was the case in the cross-section, the results for these two outcome variables are not robust. For both outcome variables, the inclusion of time effects renders the coefficient estimate not significant, and of the "wrong" sign. It appears that over the past 40 years, there has been a common time trend in both $FLNX$ and these outcome variables, and thus

[7] When the adopted measure of attitude toward gender is either female labor force participation or education attainment, the results are not robust to the inclusion of region fixed effects. The finding is not surprising given the high spatial correlation of our variables of interest. We indeed expect differences in attitude towards gender to be higher between rather than within geographical regions. The fertility results are fully robust to the inclusion of region dummies.

controlling for this trend leaves no variation that can be exploited to identify these coefficients.[8]

Our main industry-level female intensity variable (FL) is computed as the average share of female workers in each sector in a sample of some 20 developed and developing countries. We favor this measure because it is most representative of the female intensity of sectors in an average country. However, a drawback of our main measure is that it does not include non-manufacturing sectors. To check robustness of our results, we implement an alternative strategy, of constructing a measure of FL based on data for a single country – the U.S.. We thus use the Labor Force Statistics database of the U.S. Bureau of Labor Statistics (BLS). Using data from the Current Population Survey, the BLS publishes "Women in the Labor Force: A Databook" on an annual basis since 2005. It contains information on total employment and the female share of employment in each industry covered by the Census. The data are available at the 4-digit U.S. Census 2007 classification (262 distinct sectors, including both manufacturing and non-manufacturing). In order to construct the share of female workers in total employment in sector i, FL_i, we take the mean of this value across the years for which the data on the female share of employment are available (2004-2009). The resulting sample includes 78 manufacturing and 15 non-manufacturing sectors. Appendix Table A1 reports the values of FL_i for the top and bottom 5 sectors according to U.S. data. These sectors are similar to what we find in our baseline measure: the least female-intensive sectors tend to be in heavy machinery, while the most female-intensive sectors in textiles and apparel. Appendix Table A1 presents the basic summary statistics of the U.S.-based FL measure, breaking up the manufacturing and the non-manufacturing sectors.

While the U.S.-based alternative FL measure has the advantage of extending the set of sectors to agriculture and mining, it has two important drawbacks. First, the data are compiled based on individual-level surveys rather than firm- or plant-level data, and thus relies on workers self-reporting their industry of occupation. Thus, if the number of individuals in the survey who report working in a particular sector is small, or if workers make mistakes in reporting their industry of employment, the data will be measured with error. And second, the U.S. is only one, very special country, and thus its values of of FL may not be representative of the average country's experience.[9] Both of these considerations will raise the amount of measurement error on the right-hand side, leading to attenuation bias in the coefficients.

With these caveats in mind, Appendix Tables A3 through A5 replicate all of the regression estimates in the paper using the U.S.-based FL indicator instead. We can see that by and large, the results using our main measure of gender gap – fertility – are robust. However, the other two outcome variables, that are marginally significant in our main results, are less so here.

[8] For these two outcome variables, adding country effects but no time effects produces marginally significant coefficients with the right sign, implying that the time effects are responsible for changing the sign of the coefficient.

[9] For our UNIDO-based measure, averaging of the share of female workers across a couple of dozen countries helps alleviate both of these problems.

5 Conclusion

We have analyzed both theoretically and empirically the interplay between trade and discrimination against women. The main findings suggest that gender equality is a source of comparative advantage when a country integrates into world markets. Reciprocally, trade is found to affect societies' attitudes towards gender.

Our results go beyond positing an unequivocal relationship between overall trade openness and gender inequality. Instead, we emphasize the heterogeneity of the effects of trade on countries' industrial structures and attitudes towards women. On the one hand, industries that rely relatively more on female labor will expand more in countries where women are empowered. On the other hand, we find a lower gender gap in countries that export more goods that require female labor to be produced.

From a policy perspective, these results indicate that countries with technologically-based comparative advantage in male-labor intensive goods will have to undertake a larger effort to counterbalance the economic forces, leading to a slower pace of women's empowerment compared to countries with a comparative advantage in female-labor intensive goods. Nonetheless, these same efforts will reduce the impact of comparative advantage on the incentives for female labor force participation, and further feed the conditions to empower women. In an increasingly integrated world market, the road to female empowerment is paradoxically very specific to each country's productive structure and exposure to world markets.

A Mathematical Appendix

From equation (**??**), let's try to characterize the behavior of f when the patterns of comparative advantage ρ are changing.

Dropping the country reference and substituting for f^S, $f(\rho)$ is implicitly defined by:

$$\left[\frac{1}{\rho}(f-1)+1\right]^{\alpha}\left[1-(1-\eta)f\right]+\theta f^{\alpha}\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]=0$$

that is denoted $x(f,\rho)=0$.

$$\begin{aligned}\frac{\partial x(f,\rho)}{\partial\rho} &= -\frac{1}{\rho^2}\frac{\alpha(f-1)}{\frac{1}{\rho}(f-1)+1}\left[\frac{1}{\rho}(f-1)+1\right]^{\alpha}\left[1-(1-\eta)f\right]\\ &+\frac{1}{\rho^2}(1-\eta)(f-1)\theta f^{\alpha}\end{aligned}$$

and since $x(f,\rho)=0$ implies

$$\left[\frac{1}{\rho}(f-1)+1\right]^{\alpha}\left[1-(1-\eta)f\right]=-\theta f^{\alpha}\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right],$$

we have

$$\begin{aligned}\frac{\partial x(f,\rho)}{\partial \rho} &= \frac{1}{\rho^2}\frac{\alpha(f-1)}{\frac{1}{\rho}(f-1)+1}\theta f^{\alpha}\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]\\
&+ \frac{1}{\rho^2}(1-\eta)(f-1)\,\theta f^{\alpha}\\
&= \frac{1}{\rho^2}\frac{\theta f^{\alpha}(f-1)}{\frac{1}{\rho}(f-1)+1}\left\{\alpha\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]+(1-\eta)\left[\frac{1}{\rho}(f-1)+1\right]\right\}\\
&= \frac{1}{\rho^2}\frac{\theta x^{\alpha}(f-1)}{\frac{1}{\rho}(f-1)+1}\left\{\alpha\eta+(1-\eta)+(1-\alpha)\frac{1}{\rho}(1-\eta)(f-1)\right\}\end{aligned}$$

On the other hand,

$$\begin{aligned}\frac{\partial x(f,\rho)}{\partial f} &= \frac{1}{\rho}\frac{\alpha}{\frac{1}{\rho}(f-1)+1}\left[\frac{1}{\rho}(f-1)+1\right]^{\alpha}[1-(1-\eta)f]\\
&- (1-\eta)\left[\frac{1}{\rho}(f-1)+1\right]^{\alpha}\\
&+ \frac{\alpha\theta}{f}f^{\alpha}\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]\\
&- \frac{1}{\rho}(1-\eta)\,\theta f^{\alpha}\end{aligned}$$

After substitution

$$\begin{aligned}\frac{\partial x(f,\rho)}{\partial f} &= -\quad \theta f^{\alpha}\frac{1}{\rho}\frac{\alpha}{\frac{1}{\rho}(f-1)+1}\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]\\
&+ \quad \theta f^{\alpha}(1-\eta)\frac{\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]}{[1-(1-\eta)f]}\\
&+ \quad \theta f^{\alpha}\frac{\alpha}{f}\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]\\
&- \quad \theta f^{\alpha}\frac{1}{\rho}(1-\eta)\end{aligned}$$

taking terms 1 and 3, and 2 and 4 together, we simplify to:

$$\begin{aligned}\frac{\partial x(f,\rho)}{\partial f} &= \theta f^{\alpha}\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]\frac{\rho-1}{\rho}\left\{\frac{\alpha}{f\left[\frac{1}{\rho}(f-1)+1\right]}\right\}\\
&+ \theta f^{\alpha}\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]\frac{\rho-1}{\rho}\left\{\frac{\eta(1-\eta)}{[1-(1-\eta)f]\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]}\right\}\end{aligned}$$

We can now compute the local derivative of f with respect to ρ :

$$
\begin{aligned}
f'(\rho) = -\frac{\frac{\partial x(f,\rho)}{\partial \rho}}{\frac{\partial x(f,\rho)}{\partial f}} &= -\frac{1}{\rho^2}\frac{\frac{\theta f^{\alpha}(f-1)}{\frac{1}{\rho}(f-1)+1}\left\{\alpha\eta+(1-\eta)+(1-\alpha)\frac{1}{\rho}(1-\eta)(f-1)\right\}}{\theta f^{\alpha}\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]\frac{\rho-1}{\rho}\left\{\frac{\alpha[1-(1-\eta)f]\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]+\eta(1-\eta)f\left[\frac{1}{\rho}(f-1)+1\right]}{f\left[\frac{1}{\rho}(f-1)+1\right][1-(1-\eta)f]\left[\eta-\frac{1}{\rho}(1-\eta)(f-1)\right]}\right\}} \\
&= -\frac{1}{\rho^2}\frac{1-(1-\eta)f}{\rho-1}\frac{\rho(f-1)f[\alpha\eta\rho+(1-\eta)\rho+(1-\alpha)(1-\eta)(f-1)]}{\alpha[1-(1-\eta)f][\rho\eta-(1-\eta)(f-1)]+\eta(1-\eta)f[(f-1)+\rho]} \\
&= \frac{(1-\eta)f-1}{\rho-1}\frac{(f-1)f}{\rho}\frac{\alpha\eta\rho+(1-\eta)\rho+(1-\alpha)(1-\eta)(f-1)}{\eta\rho[\alpha+(1-\alpha)(1-\eta)f]+(1-\eta)(f-1)[\alpha(f-1)+(1-\alpha)\eta f]}
\end{aligned}
$$

The second and third terms of the equation are always positive, since $f > 1$. And by virtue of (16), the first term $\frac{(1-\eta)f-1}{\rho-1} > 0$. We thus have

$$f'(\rho) > 0$$

Q.E.D.■

B Instrumentation Strategy

This Appendix describes the steps necessary to build the instrument for the female content of exports. The construction of the instrument follows Do and Levchenko (2007), and exploits exogenous geographic characteristics of countries together with the empirically observed regularity that trade responds differentially to the standard gravity forces across sectors. For each industry i, we estimate the Frankel and Romer (1999) gravity specification, which relates observed trade flows to exogenous geographic variables:

$$
\begin{aligned}
LogX_{icd} &= \alpha_i + \eta_i^1 ldist_{cd} + \eta_i^2 lpop_c + \eta_i^3 larea_c + \eta_i^4 lpop_d + \eta_i^5 larea_d + \\
&\quad \eta_i^6 landlocked_{cd} + \eta_i^7 border_{cd} + \eta_i^8 border_{cd} \times ldist_{cd} + \\
&\quad \eta_i^9 border_{cd} \times pop_c + \eta_i^{10} border_{cd} \times area_c + \eta_i^{11} border_{cd} \times pop_d + \\
&\quad \eta_i^{12} border_{cd} \times area_d + \eta_i^{13} border_{cd} \times landlocked_{cd} + \epsilon_{icd},
\end{aligned}
\tag{25}
$$

where $LogX_{icd}$ is the log of exports as a share of GDP in industry i, from country c to country d. The right-hand side consists of the geographical variables. In particular, $ldist_{cd}$ is the log of distance between the two countries, defined as distance between the major cities in the two countries, $lpop_c$ is the log of population of country c, $larea_c$ log of land area, $landlocked_{cd}$ takes the value of 0, 1, or 2 depending on whether none, one, or both of the trading countries are landlocked, and $border_{cd}$ is the dummy variable for common border. The right-hand side of the specification is identical to the one Frankel and Romer (1999) use. We use bilateral trade flows from the COMTRADE database, converted to the 3-digit ISIC Revision 3 classification. To estimate the gravity equation, the bilateral trade flows X_{icd} are averaged over the period 1980-2007. This allows to smooth out any short-run variation in trade shares across sectors, and reduce the impact of zero observations.

Having estimated equation (25) for each industry, we then obtain the predicted logarithm of industry i exports to GDP from country c to each of its trading partners indexed by d, $\widehat{LogX}_{icd}$. In order to construct the predicted overall industry i exports as a share of GDP from country c, we then take the exponential of the predicted bilateral log of trade, and sum over the trading partner countries $d = 1, ..., C$, exactly as in Frankel and Romer (1999):

$$\hat{X}_{ic} = \sum_{\substack{d=1 \\ d \neq c}}^{C} e^{\widehat{LogX}_{icd}}.$$

That is, predicted total trade as a share of GDP for each industry and country is the sum of the predicted bilateral trade to GDP over all trading partners. This exercise extends and modifies the Frankel and Romer (1999) methodology in two respects. First, and most importantly, it constructs the Frankel and Romer (1999) predicted trade measures by industry. And second, rather than looking at total trade, it looks solely at exports.

Do and Levchenko (2007) discuss and justify this strategy at length. As mentioned above, the objective is to predict trade patterns, not trade volumes. How can this procedure yield different predictions for $\hat{X}_{ic}$ across sectors if all of the geographical characteristics on the right-hand side of equation (25) do not vary by sector? Note that the procedure estimates an individual gravity equation for each sector. Thus, crucially for this strategy, if the vector of estimated gravity coefficients η_i differs across sectors, so will the predicted total exports $\hat{X}_{ic}$ across sectors i within the same country. Indeed, Do and Levchenko (2007) show that the variation in these coefficients across sectors is substantial, generating variation in predicted trade patterns across countries.

There is another potentially important issue, namely the zero trade observations. In our gravity sample, only about two-thirds of the possible exporter-importer pairs record positive exports, in any sector. At the level of individual industry, on average only a third of possible country-pairs have strictly positive exports, in spite of the coarse level of aggregation.[10] We follow the Do and Levchenko (2007) procedure, and deal with zero observations in two ways. First, following the large majority of gravity studies, we take logs of trade values, and thus their baseline gravity estimation procedure ignores zeros. However, instead of predicting in-sample, we use the estimated gravity model to predict out-of-sample. Thus, for those observations that are zero or missing and are not used in the actual estimation, we still predict trade.[11] In the second approach, we instead estimate the gravity regression in levels using the Poisson pseudo-maximum likelihood estimator suggested by (Santos Silva and Tenreyro, 2006). The advantage of this procedure is that it actually includes zero observations in the estimation, and can predict both zero and non- zero trade values in-sample

[10] These two calculations make the common assumption that missing trade observations represent zeros (see Helpman et al., 2008).

[11] More precisely, for a given exporter-importer pair, we predict bilateral exports out-of-sample for all 61 sectors as long as there is any bilateral exports for that country pair in at least one of the 61 sectors.

from the same estimated equation. Its disadvantage is that it assumes a particular likelihood function, and is not (yet) a standard way of estimating gravity equations found in the literature. It turns out that the two are quite close to each other, an indication that the zeros problem is not an important one for this empirical strategy. This paper only reports the results of implementing the first approach. The results of using the second one are available upon request.

Armed with a working model for predicting exports to GDP in each industry i, it is straightforward to construct the instrument for the female content of exports, based on predicted export patterns rather than actual ones. That is, our instrument will be, in a manner identical to equation (22):

$$\widehat{FLNX}_c = \sum_{i=1}^{I} \widehat{\omega}_{ic}^X FL_i.$$

Here, the predicted share of total exports in industry i in country c, $\widehat{\omega}_{ic}^X$, is constructed from the predicted export ratios $\hat{X}_{ic}$ in a straightforward manner:

$$\widehat{\omega}_{ic}^X = \frac{\hat{X}_{ic}}{\sum_{i=1}^{I} \hat{X}_{ic}}.$$

Note that even though $\hat{X}_{ic}$ is exports in industry i normalized by a country's GDP, every sector is normalized by the same GDP, and thus they cancel out when we take the predicted export share.

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Table 1: Female Labor Dependence of Sectors

ISIC Code	Sector Name	Dependence
151	Meat, fish, fruit, vegetables, oils and fats	0.36
152	Dairy products	0.25
153	Grain mill, starch products, and prepared animal feeds	0.20
154	Other food products	0.39
155	Beverages	0.23
160	Tobacco products	0.33
171	Spinning, weaving and finishing of textiles	0.37
172	Other textiles	0.47
173	Knitted and crocheted fabrics and articles	0.62
181	Wearing apparel, except fur apparel	0.71
182	Fur and articles of fur	0.41
191	Leather and leather products	0.43
192	Footwear	0.49
201	Sawmilling and planing of wood	0.16
202	Products of wood, cork, straw and plaiting materials	0.18
210	Paper and paper products	0.23
221	Publishing	0.33
222	Printing and service activities related to printing	0.29
223	Reproduction of recorded media	0.35
231	Coke oven products	0.14
232	Refined petroleum products	0.13
233	Nuclear fuel	0.11
241	Basic chemicals	0.15
242	Other chemical products	0.36
243	Man-made fibres	0.22
251	Rubber products	0.23
252	Plastics products	0.27
261	Glass and glass products	0.19
269	Non-metallic mineral products n.e.c.	0.16
271	Basic iron and steel	0.10
272	Basic precious and non-ferrous metals	0.13
273	Casting of metals	0.12
281	Structural metal products, tanks, reservoirs, steam generators	0.12
289	Other fabricated metal products	0.19
291	General purpose machinery	0.16
292	Special purpose machinery	0.14
293	Domestic appliances n.e.c.	0.28

Table 1 (continued): Female Labor Dependence of Sectors

ISIC Code	Sector Name	Dependence
300	Office, accounting and computing machinery	0.34
311	Electric motors, generators and transformers	0.32
312	Electricity distribution and control apparatus	0.30
313	Insulated wire and cable	0.32
314	Accumulators, primary cells and primary batteries	0.26
315	Electric lamps and lighting equipment	0.34
319	Other electrical equipment n.e.c.	0.42
321	Electronic valves and tubes and other electronic components	0.46
322	TV and radio transmitters; telephony and telegraphy apparatus	0.38
323	TV and radio receivers, sound or video apparatus	0.43
331	Medical appliances and instruments	0.38
332	Optical instruments and photographic equipment	0.45
333	Watches and clocks	0.42
341	Motor vehicles	0.09
342	Bodies for motor vehicles; trailers and semi-trailers	0.08
343	Parts and accessories for motor vehicles and their engines	0.21
351	Building and repairing of ships and boats	0.09
352	Railway and tramway locomotives and rolling stock	0.08
353	Aircraft and spacecraft	0.15
359	Transport equipment n.e.c.	0.21
361	Furniture	0.20
369	Manufacturing n.e.c.	0.38
371	Recycling of metal waste and scrap	0.17
372	Recycling of non-metal waste and scrap	0.25
	Mean	0.274
	Min	0.08
	Max	0.71

Table 2: Summary Statistics for Female Labor Need of Exports

	OECD			*Non-OECD*		
	Mean	St. Dev.	Countries	Mean	St. Dev.	Countries
1960s	.251	.043	20	.271	.077	100
1970s	.239	.034	20	.260	.078	103
1980s	.244	.043	20	.269	.094	103
1990s	.262	.043	20	.302	.111	123
2000s	.256	.033	21	.293	.124	127

Table 3a: Female Labor Need of Exports: Top 10 and Bottom 10 Countries, 1962-2007.

Highest Female Labor Need of Exports		*Lowest Female Labor Need of Exports*	
Lesotho	0.657	Nigeria	0.149
Bangladesh	0.531	Iran	0.148
Haiti	0.510	Algeria	0.148
Mauritius	0.479	Kazakhstan	0.141
Mongolia	0.446	Venezuela, RB	0.138
Cambodia	0.441	Gabon	0.138
Sri Lanka	0.433	Kuwait	0.137
Nepal	0.432	Saudi Arabia	0.137
Dominican Republic	0.425	Iraq	0.134
Pakistan	0.421	Libya	0.133

Table 3b: Female Labor Need of Exports: Top 10 and Bottom 10 Countries, 1960s.

Highest Female Labor Need of Exports		*Lowest Female Labor Need of Exports*	
Afghanistan	0.391	Iran	0.154
Mauritius	0.385	Gabon	0.149
Haiti	0.382	Chile	0.144
Pakistan	0.382	Zambia	0.136
Timor-Leste	0.379	Oman	0.135
Dominican Rep.	0.379	Venezuela	0.134
Cuba	0.378	Iraq	0.134
Sierra Leone	0.378	Libya	0.134
Mongolia	0.374	Kuwait	0.133
Hong Kong	0.369	Saudi Arabia	0.133

Table 3c: Female Labor Need of Exports: Top 10 and Bottom 10 Countries, 2000s.

Highest Female Labor Need of Exports		*Lowest Female Labor Need of Exports*	
Cambodia	0.660	Saudi Arabia	0.140
Haiti	0.658	Algeria	0.139
Lesotho	0.649	Gabon	0.139
Bangladesh	0.640	Venezuela	0.138
Honduras	0.576	Kuwait	0.138
Sri Lanka	0.550	Nigeria	0.138
Madagascar	0.535	Kazakhstan	0.136
Mongolia	0.533	Iraq	0.135
Mauritius	0.525	Libya	0.134
El Salvador	0.522	Liberia	0.125

Table 4a: Female Labor Need of Exports: Top 10 and Bottom 10 Changers since 1960s.

Largest Increase in Female Labor Need of Exports		*Largest Decrease in Female Labor Need of Exports*	
Cambodia	0.423	Mozambique	-0.094
Honduras	0.326	Liberia	-0.095
Haiti	0.276	Sudan	-0.114
Albania	0.233	Rwanda	-0.115
Sri Lanka	0.226	Ecuador	-0.131
Tunisia	0.223	Congo	-0.136
Morocco	0.205	Chad	-0.154
El Salvador	0.199	Niger	-0.161
Madagascar	0.178	Yemen	-0.168
Nicaragua	0.166	Angola	-0.179

Note: Change is calculated as the difference between the average Female Labor Need of Exports in 2000 and that in 1960.

Table 4b: Female Labor Need of Exports: Top 10 and Bottom 10 Changers since 1980s.

Largest Increase in Female Labor Need of Exports		*Largest Decrease in Female Labor Need of Exports*	
Cambodia	0.352	Uruguay	-0.056
Honduras	0.238	Yemen	-0.057
Albania	0.210	Burundi	-0.059
Bangladesh	0.209	Liberia	-0.062
Haiti	0.205	Papua New Guinea	-0.068
Madagascar	0.194	Guinea-Bissau	-0.081
Nicaragua	0.189	Rwanda	-0.096
Sri Lanka	0.183	Afghanistan	-0.129
El Salvador	0.164	Sudan	-0.138
Tunisia	0.158	Chad	-0.139

Note: Change is calculated as the difference between the average Female Labor Need of Exports in 2000 and that in 1980.

Table 5: Summary Statistics

	Observations	Mean	Std. Dev.
(Log) Female Labor Need of Exports	146	3.29	0.35
(Log) Real GDP per capita	146	8.57	1.14
(Log) Openness	146	4.19	0.56
(Log) Female Years of Schooling	146	1.63	0.69
(Log) Fertility	146	1.15	0.55
(Log) Female Labor Force Participation	146	3.87	0.39
(Log) Population	146	16.05	1.38
(Log) Predicted Female Labor Need of Exports	146	-1.43	0.06

Table 6: Sectoral Export Shares and Female Attainment Measures

	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A: OLS			
Dep. Var.: Sectoral Share of Exports						
Female Labor Intensity * Fertility	0.08	-0.39				
	(0.259)	(0.322)				
Female Labor Intensity * Female Labor Force Participation			0.09**	0.08*		
			(0.036)	(0.043)		
Female Labor Intensity * Ratio of Female to Total Education					0.29	3.97
					(4.122)	(5.487)
Capital Intensity * Capital Abundance		1.72**		1.67**		1.53**
		(0.791)		(0.784)		(0.751)
Skill Intensity * Skill Abundance		-1.53		-1.42		-0.44
		(1.583)		(1.546)		(1.532)
Country and Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.245	0.253	0.246	0.254	0.227	0.239
Observations	8,533	6,190	8,533	6,190	7,361	5,732
			Panel B: 2SLS			
Dep. Var.: Sectoral Share of Exports						
Female Labor Intensity * Fertility	-2.27***	-1.59*				
	(0.761)	(0.941)				
Female Labor Intensity * Female Labor Force Participation			0.23***	0.19**		
			(0.072)	(0.096)		
Female Labor Intensity * Ratio of Female to Total Education					11.07*	4.51
					(6.450)	(7.125)
Capital Intensity * Capital Abundance		1.96***		1.80**		1.90**
		(0.815)		(0.784)		(0.789)
Skill Intensity * Skill Abundance		-1.69		-1.283		-0.57
		(1.619)		(1.536)		(1.588)
Country and Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,416	6,075	8,416	6,075	7,244	5,501
			First Stage			
Dep. Var.:	FL_i* Fertility	FL_i* Fertility	FL_i*FLFP	FL_i*FLFP	FL_i*Ratio of Female to Total Education	FL_i*Ratio of Female to Total Education
Female Labor Intensity * Muslim Share of Population	2.71***	2.54***	-30.53***	-29.67***	-0.23***	-0.20***
	(0.111)	(0.156)	(1.151)	(1.775)	(0.012)	(0.014)
Female Labor Intensity * Christian Share of Population	0.68***	0.37***	-12.61***	-11.30***	0.08***	0.12***
	(0.098)	(0.138)	(0.883)	(1.499)	(0.010)	(0.013)
F-test	367.44	252.18	359.32	180.25	604.16	740.47
Partial R^2	0.911	0.920	0.947	0.942	0.977	0.981

Notes: Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. *Female Labor Intensity* (FL_i) is the average fraction of female employees in a sector at the ISIC Rev. 3 three-digit level; *Fertility Rate* is total births per woman; *Female Labor Force Participation (FLFP)* is female labor participation rate (% of female population ages 15+); *Ratio of Female to Total Education* is the ratio of the Barro-Lee measures of female to total educational attainment. All of the variables are averages over the period 1962-2007, except for *Female Labor Force Participation,* which is averaged over the period 1980-2007. Variable definitions and sources are described in detail in the text.

Table 7: Cross-Country Regression Results, 1962-2007

	OLS				2SLS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable:	Fertility Rate	Fertility Rate	Female Labor Force Participation	Female Educational Attainment	Fertility Rate	Fertility Rate	Female Labor Force Participation	Female Educational Attainment
(Log) Female Labor Need of Exports (FLNX)	-0.30***	-0.31***	0.19*	0.24*	-0.49***	-0.51***	0.30*	0.25
	(0.082)	(0.080)	(0.112)	(0.138)	(0.136)	(0.126)	(0.160)	(0.190)
(Log) Openness	-0.00	-0.07	-0.06	0.10	-0.01	-0.08	-0.06	0.10
	(0.04)	(0.051)	(0.059)	(0.098)	(0.038)	(0.052)	(0.057)	(0.096)
(Log) GDP per capita	-0.40***	-0.39***	-0.07***	0.48***	-0.41***	-0.40***	-0.06**	0.48***
	(0.020)	(0.021)	(0.028)	(0.045)	(0.020)	(0.020)	(0.028)	(0.046)
(Log) Population		-0.05**	-0.04	-0.00		-0.06**	-0.04	-0.00
		(0.023)	(0.027)	(0.032)		(0.022)	(0.026)	(0.031)
R^2	0.636	0.649	0.116	0.592				
					First Stage			
Dep. Var.: (Log) FLNX								
(Log) Predicted FLNX					3.14***	3.14***	3.14***	3.08***
					(0.326)	(0.320)	(0.320)	(0.330)
F-test					45.38	34.70	34.70	29.73
R^2					0.385	0.387	0.387	0.397
Observations	146	146	146	126	146	146	146	126

Notes: Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. *Fertility Rate* is (log) total births per woman; *Female Labor Force Participation* is (log) female labor participation rate (% of female population ages 15+); *Female Educational Attainment* is the (log of) Barro-Lee measure of female educational attainment (average years of schooling among female population ages 15+ at five-year intervals). All of the variables are averages over the period 1962-2007, except for *Female Labor Force Participation,* which is averaged over the period 1980-2007. Variable definitions and sources are described in detail in the text.

Table 8: Panel Regression Results, 1962-2007

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable:	Fertility Rate	Fertility Rate	Fertility Rate	Female Labor Force Participation	Female Labor Force Participation	Female Educational Attainment	Female Educational Attainment
(Log) Female Labor Need of Exports (FLNX)	-0.39***	-0.27***	-0.23***	0.20***	-0.02	0.39***	-0.05
	(0.031)	(0.030)	(0.028)	(0.045)	(0.026)	(0.067)	(0.060)
(Log) Openness	-0.08***	-0.10***	-0.02	-0.04**	-0.04**	0.16***	-0.07**
	(0.017)	(0.017)	(0.017)	(0.021)	(0.015)	(0.037)	(0.032)
(Log) GDP per capita	-0.37***	-0.26***	-0.19***	-0.07***	0.01	0.62***	-0.06
	(0.009)	(0.020)	(0.022)	(0.011)	(0.018)	(0.021)	(0.035)
(Log) Population	-0.08***	-0.43***	-0.08**	-0.04***	0.20***	0.09***	0.99***
	(0.008)	(0.021)	(0.036)	(0.011)	(0.049)	(0.016)	(0.087)
Country Fixed Effects	No	Yes	Yes	No	Yes	No	Yes
Year Fixed Effects	No	No	Yes	No	Yes	No	Yes
R^2	0.609	0.929	0.938	0.113	0.968	0.508	0.949
Observations	1,247	1,247	1,247	819	819	1,102	1,102

Notes: Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. *Fertility Rate* is (log) total births per woman; *Female Labor Force Participation* is (log) female labor participation rate (% of female population ages 15+); *Female Educational Attainment* is the (log of) Barro-Lee measure of female educational attainment (average years of schooling among female population ages 15+ at five-year intervals). All of the variables are five-year averages over the period 1962-2007, except for *Female Labor Force Participation,* which is averaged over the period 1980-2007. Variable definitions and sources are described in detail in the text.

Table A1: Least and Most Female-Intensive Sectors, U.S. Data

Least Female-Intensive	FL_i	Most Female-Intensive	FL_i
Logging	5.4	Other apparel and accessories	56.3
Coal Mining	5.7	Leather tanning and finishing	56.3
Cement, concrete, lime, and gypsum	10.3	Retail bakeries	58
Sawmills and wood preservation	11.3	Specialized design services	58
Nonmetallic mineral mining and quarrying	11.5	Cut and sew apparel	66.1

Appendix Table A2: Summary Statistics, U.S.-based measure of FL

	Mean	Min	Max	SD	N
Manufacturing	29.7	10.3	66.1	13.6	78
Non-manufacturing	25.8	5.4	58	15.6	15

Appendix Table A3: Sectoral Export Shares and Female Attainment Measures

	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A: OLS			
Dep. Var.: Sectoral Share of Exports						
Female Labor Intensity * Fertility	-0.01***	-0.00				
	(0.001)	(0.001)				
Female Labor Intensity * Female Labor Force Participation			-0.00	-0.00		
			(0.000)	(0.000)		
Female Labor Intensity * Ratio of Female to Total Education					0.03*	-0.00
					(0.020)	(0.027)
Capital Intensity * Capital Abundance		0.38***		0.38***		0.45***
		(0.166)		(0.168)		(0.200)
Skill Intensity * Skill Abundance		9.63***		9.60***		10.42***
		(2.112)		(2.091)		(2.251)
Country and Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.229	0.131	0.229	0.131	0.212	0.134
Observations	13,269	8,055	13,269	8,055	11,468	7,309
			Panel B: 2SLS			
Dep. Var.: Sectoral Share of Exports						
Female Labor Intensity * Fertility	-0.01***	0.00				
	(0.004)	(0.003)				
Female Labor Intensity * Female Labor Force Participation			0.01***	-0.00		
			(0.000)	(0.000)		
Female Labor Intensity * Ratio of Female to Total Education					0.08***	-0.03
					(0.031)	(0.028)
Capital Intensity * Capital Abundance		0.36**		0.38**		0.43**
		(0.165)		(0.167)		(0.196)
Skill Intensity * Skill Abundance		9.23***		9.64***		10.01***
		(2.149)		(2.074)		(2.180)
Country and Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,269	8,055	13,269	8,055	11,468	7,309
			First Stage			
Dep. Var.:	FL_i* Fertility	FL_i* Fertility	FL_i*FLFP	FL_i*FLFP	FL_i*Ratio of Female to Total Education	FL_i*Ratio of Female to Total Education
Female Labor Intensity * Muslim Share of Population	0.02***	0.03***	-0.27***	-0.28***	-0.01***	-0.01***
	(0.001)	(0.001)	(0.007)	(0.010)	(0.000)	(0.000)
Female Labor Intensity * Christian Share of Population	0.01***	0.01***	-0.15***	-0.15***	0.01***	0.01***
	(0.001)	(0.001)	(0.005)	(0.007)	(0.000)	(0.000)
F-test	599.40	442.34	852.97	444.94	898.03	1053.12
Partial R^2	0.913	0.927	0.950	0.949	0.976	0.981

Notes: Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. *Female Labor Intensity* (FL_i) is the average fraction of female employees in a sector at the four-digit level of the US Census classification; *Fertility Rate* is total births per woman; *Female Labor Force Participation (FLFP)* is female labor participation rate (% of female population ages 15+); *Ratio of Female to Total Education* is the ratio of the Barro-Lee measures of female to total educational attainment. All of the variables are averages over the period 1962-2007, except for *Female Labor Force Participation,* which is averaged over the period 1980-2007. Variable definitions and sources are described in detail in the text.

Appendix Table A4: Cross-Country Regression Results, 1962-2007

	OLS				2SLS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable:	Fertility Rate	Fertility Rate	Female Labor Force Participation	Female Educational Attainment	Fertility Rate	Fertility Rate	Female Labor Force Participation	Female Educational Attainment
(Log) Female Labor Need of Exports (FLNX)	-0.57***	-0.56***	0.10	0.36**	-1.03***	-0.94***	0.21	0.19
	(0.132)	(0.127)	(0.159)	(0.181)	(0.233)	(0.222)	(0.266)	(0.294)
(Log) Openness	-0.00	-0.06	-0.07	0.10	-0.01	-0.06	-0.07	0.10
	(0.038)	(0.050)	(0.063)	(0.096)	(0.042)	(0.051)	(0.061)	(0.093)
(Log) GDP per capita	-0.37***	-0.36***	-0.08***	0.47***	-0.37***	-0.36***	-0.08***	0.47***
	(0.021)	(0.022)	(0.028)	(0.042)	(0.021)	(0.021)	(0.028)	(0.042)
(Log) Population		-0.04*	-0.05*	-0.01		-0.04*	-0.05*	-0.01
		(0.023)	(0.028)	(0.032)		(0.023)	(0.027)	(0.032)
R^2	0.651	0.659	0.091	0.591				
					First Stage			
Dep. Var.: (Log) FLNX								
(Log) Predicted FLNX					1.548***	1.62***	1.62***	1.64***
					(0.212)	(0.219)	(0.219)	(0.237)
F-test					20.19	15.95	15.95	14.01
R^2					0.328	0.340	0.340	0.359
Observations	146	146	146	126	146	146	146	126

Notes: Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. *Fertility Rate* is (log) total births per woman; *Female Labor Force Participation* is (log) female labor participation rate (% of female population ages 15+); *Female Educational Attainment* is the (log of) Barro-Lee measure of female educational attainment (average years of schooling among female population ages 15+ at five-year intervals). All of the variables are averages over the period 1962-2007, except for *Female Labor Force Participation,* which is averaged over the period 1980-2007. Variable definitions and sources are described in detail in the text.

Appendix Table A5: Panel Regression Results, 1962-2007

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable:	Fertility Rate	Fertility Rate	Fertility Rate	Female Labor Force Participation	Female Labor Force Participation	Female Educational Attainment	Female Educational Attainment
(Log) Female Labor Need of Exports (FLNX)	-0.56***	-0.28***	-0.24***	0.03	-0.05	0.62***	0.30***
	(0.043)	(0.047)	(0.042)	(0.059)	(0.030)	(0.080)	(0.079)
(Log) Openness	-0.06***	-0.09***	-0.02	-0.05**	-0.03**	0.14***	-0.09***
	(0.016)	(0.018)	(0.017)	(0.022)	(0.015)	(0.037)	(0.033)
(Log) GDP per capita	-0.35***	-0.27***	-0.19***	-0.09***	0.01	0.59***	-0.06*
	(0.009)	(0.020)	(0.022)	(0.012)	(0.018)	(0.021)	(0.036)
(Log) Population	-0.06***	-0.42***	-0.07*	-0.04***	0.20***	0.08***	0.97***
	(0.008)	(0.021)	(0.038)	(0.011)	(0.049)	(0.016)	(0.087)
Country Fixed Effects	No	Yes	Yes	No	Yes	No	Yes
Year Fixed Effects	No	No	Yes	No	Yes	No	Yes
R^2	0.610	0.927	0.936	0.083	0.968	0.512	0.950
Observations	1,247	1,247	1,247	819	819	1,102	1,102

Notes: Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. *Fertility Rate* is (log) total births per woman; *Female Labor Force Participation* is (log) female labor participation rate (% of female population ages 15+); *Female Educational Attainment* is the (log of) Barro-Lee measure of female educational attainment (average years of schooling among female population ages 15+ at five-year intervals). All of the variables are five-year averages over the period 1962-2007, except for *Female Labor Force Participation,* which is averaged over the period 1980-2007. Variable definitions and sources are described in detail in the text.