1 Appendix

The general equilibrium model described below extends the discussion in the text. There are three countries, two of which, the US (U) and the EU (E), are of the same size and with the same technology, Bangladesh (B) is smaller in that it has fewer units of effective labor. To achieve factor price equalization in the presence of asymmetries, we introduce a homogenous good, which can be freely traded and is made using one unit of effective labor. Note that as labor is measured in effective units, factor price equalization says nothing about wages per worker which can be lower in Bangladesh if their labor is less productive. There are L consumers in the US and EU, and L^B consumers in Bangladesh. A consumer in country i, $i = E, U, B$, supplies one unit of labor.

1.1 Production and Firm Behavior

We assume that there is no specialization in equilibrium. Hence, we can normalize the wage rate and the price of the homogenous good to unity.[1] The expenditure and revenue earned from the differentiated good are denoted by E^i and R^i, respectively, for $i = E, U, B$. The trade policy environment is summarized in Figure 1. The per unit trade costs of the US and EU of exporting to Bangladesh are assumed to be the same and equal to τ^B reflecting similar transport costs and the MFN tariffs set by Bangladesh. The per unit trade costs of exporting to the US and EU are, respectively, τ^U and τ^E reflecting the MFN tariffs set by two countries. The US has quotas, which impose an additional cost both as US $ROOs$ have to be met and because of the non zero license price, while the EU has preferences, which reduce these costs if EU $ROOs$ are met.

Given our assumptions, the export price set by the US and EU firms exporting to Bangladesh with productivity level ϕ is $\tau^B p(\phi)$, while the export prices set by US firms exporting to the EU and

[1] Even if unit labor requirements differ, factor price equalization in efficiency units is achieved.

EU firms exporting to the US are, respectively, $\tau^{E}p(\phi)$ and $\tau^{U}p(\phi)$. Exporters from Bangladesh with productivity level ϕ set the following prices[2]:

$$p_x(\phi) = \begin{cases} \tau^{E}p(\phi), \text{ if the firm exports to the EU without meeting } ROOs; \\ \lambda^{E}\theta^{E}\tau^{E}p(\phi), \text{ if the firm meets } ROOs \text{ while exporting into the EU;} \\ \left(\theta^{U}+t\right)\tau^{U}p(\phi), \text{ if the firm exports into the US.} \end{cases} \tag{1}$$

Since $r(\phi) = E(\rho\phi P)^{\sigma-1}$, where E is the expenditure on the aggregate differentiated good, we can write the revenues earned by a firm from country k from serving its own market, $r_d^k(\phi)$, and from exporting to country j, $r_x^{kj}(\phi)$ as

$$r_d^k(\phi) = E^k\left(P^k\rho\phi\right)^{\sigma-1}, \ k = E, U, B \tag{2}$$

$$r_x^{EU}(\phi) = E^U\left(P^U\rho\left(\tau^U\right)^{-1}\phi\right)^{\sigma-1}, \tag{3}$$

$$r_x^{UE}(\phi) = E^E\left(P^E\rho\left(\tau^E\right)^{-1}\phi\right)^{\sigma-1}, \tag{4}$$

$$r_x^{kB}(\phi) = E^B\left(P^B\rho\left(\tau^B\right)^{-1}\phi\right)^{\sigma-1}, \ k = E, U. \tag{5}$$

A firm from Bangladesh gets:

$$r_x^{BE}(\phi) = E^E\left(P^E\rho\left(\tau^E\right)^{-1}\phi\right)^{\sigma-1}, \tag{6}$$

$$r_{xr}^{BE}(\phi) = E^E\left(P^E\rho\left(\lambda^E\theta^E\tau^E\right)^{-1}\phi\right)^{\sigma-1}, \tag{7}$$

$$r_{xr}^{BU}(\phi) = E^U\left(P^U\rho\left(\left(\theta^U+t\right)\tau^U\right)^{-1}\phi\right)^{\sigma-1}, \tag{8}$$

where $r_{xr}^{Bk}(\phi)$ and $r_x^{Bk}(\phi)$ are the revenues earned by this firm from exporting to country k while

[2] Note that $\lambda^U = 1$, since the US does not give tariff preferences to Bangladeshi garments. (See Section 2.3.)

meeting $ROOs$ and not meeting $ROOs$ there, respectively. To simplify our analysis, we rewrite $r_{xr}^{BE}(\phi)$ as $r_{x}^{BE}(\phi) + r_{R}^{BE}(\phi)$, where

$$r_R^{BE}(\phi) = E^E \left(P^E \rho\phi\right)^{\sigma-1} \left(\tau^E\right)^{1-\sigma} \left(\left(\lambda^E\theta^E\right)^{1-\sigma} - 1\right).$$

In other words, $r_R^{BE}(\phi)$, which is positive as $\sigma > 1$ (needed for bounded profits) and $\lambda\theta < 1$ (needed for preferences to ever be worth invoking), reflects the additional revenue gains of firms in Bangladesh from meeting $ROOs$ in the EU. Firms in Bangladesh use $ROOs$ only if the additional variable profit, $\frac{r_R^{BE}(\phi)}{\sigma}$, exceeds the fixed cost of meeting $ROOs$, d^E.

Note that in each country under trade, the aggregate revenue earned by domestic firms in the differentiated good sector, R^k, can differ from the aggregate expenditure on the differentiated goods, E^k. (Since the value of final goods and services equals the value of factor payments, in an open economy, $R^k = \gamma^k L^k$, where γ^k is the fraction of labor employed in the differentiated good sector in country k[3], and $E^k = \beta I^k$, where I^k is income in country k. $I^k = L^k + NTR^k$, where NTR^k is the net tariff revenues received by country k.). However, world expenditure on the differentiated goods equals the revenues earned in this sector, $\gamma^E L^E + \gamma^U L^U + \gamma^B L^B = \beta(L^B + L^U + L^E)$.

Let us define by ϕ^{*i} and ϕ_x^{*ij} the productivity cutoffs for the firms in country i, which decide, respectively, to produce for the domestic market ($\frac{r_d(\phi^{*i})}{\sigma} = f$) or to export into country j without meeting $ROOs$ ($\frac{r_x^{ij}(\phi_x^{*ij})}{\sigma} = f_x$). In addition, ϕ_{xr}^{*BE} and ϕ_{xr}^{*BU} denote the productivity cutoffs for firms from Bangladesh, which decide to export, respectively, into the EU and US meeting ROOs there, i.e., $\frac{r_R^{BE}(\phi_{xr}^{*BE})}{\sigma} = d^E$ and $\frac{r_{xr}^{BU}(\phi_{xr}^{*BU})}{\sigma} = f_x + d^U$. Now, there are a number of relations between

[3] The value of output or revenue earned in the differentiated good sector equals the total factor payment or the earnings of labor employed in the sector. The value of output in country k includes revenue earned in the differentiated good sector and in the homogenous good sector and equals factor payments or L. National income in addition includes net government revenue, in this case, tariff revenue.

these cutoffs. For example, the export cutoff for a Bangladeshi firm exporting to the EU without meeting *ROOs* must be related to the entry cutoff for a EU firm. Since

$$r\left(\phi^{*E}, P^E, E^E\right) = \sigma f, \quad r\left(\frac{\phi_x^{*BE}}{\tau^E}, P^E, E^E\right) = \sigma f_x,$$

using the explicit functional form for revenue, yields

$$\phi_x^{*BE} = \tau^E \left(\frac{f_x}{f}\right)^{\frac{1}{\sigma-1}} \phi^{*E} = A^{EU} \phi^{*E}.$$

In a similar manner, the following relationships among the productivity cutoffs in all three countries can be obtained:

$$\phi_x^{*EU} = A^{US} \phi^{*U}, \quad \phi_x^{*UE} = \phi_x^{*BE} = A^{EU} \phi^{*E}, \tag{9}$$

$$\phi_x^{*EB} = \phi_x^{*UB} = A^B \phi^{*B}, \tag{10}$$

$$\phi_{xr}^{*BE} = A_{ROO}^{BE} \phi_x^{*BE} = A_{ROO}^{BE} A^{EU} \phi^{*E} \tag{11}$$

$$\phi_{xr}^{*BU} = A_{ROO}^{BU} \phi^{*U}, \tag{12}$$

where

$$A^{US} = \tau^U \left(\frac{f_x}{f}\right)^{\frac{1}{\sigma-1}} > 1, \; A^{EU} = \tau^E \left(\frac{f_x}{f}\right)^{\frac{1}{\sigma-1}} > 1, \; A^B = \tau^B \left(\frac{f_x}{f}\right)^{\frac{1}{\sigma-1}} > 1, \tag{13}$$

$$A_{ROO}^{BE} = \left(\frac{d^E}{f_x} \frac{1}{\left(\lambda^E \theta^E\right)^{1-\sigma} - 1}\right)^{\frac{1}{\sigma-1}} > 1, \tag{14}$$

$$A_{ROO}^{BU} = \tau^U \left(\theta^U + t\right) \left(\frac{f_x + d^U}{f}\right)^{\frac{1}{\sigma-1}} > 1. \tag{15}$$

We assume that d^E, λ^E, and θ^E are such that $A_{ROO}^{BE} > 1$, i.e., not all Bangladeshi firms exporting to the EU invoke $ROOs$. In addition, as $\tau^U > \tau^E$ and tariffs are MFN, we have $A^{US} > A^{EU}$. Moreover, we will assume that $A^B > A^{BU}_{ROO}$. This is motivated by Bangladeshi tariffs on imports being quite high. We assume that they are higher than the implicit effect of US $ROOs$ and quotas, i.e., $\tau^B > \tau^U(\theta^U + t)$. As a result, the relationship between the parameters is:

$$A^B > A^{BU}_{ROO} > A^{US} > A^{EU}. \tag{16}$$

The free entry (FE) condition in country i leads to the following equation[4]:

$$\frac{\bar{\pi}_i}{\delta}\left(1 - G\left(\phi^{*i}\right)\right) = f_e,\ i = E, U, B, \tag{17}$$

where $\bar{\pi}_i$ represents the average level of profits earned by firms in country i. In other words, in each country the present discounted value of the expected profits upon entering should be equal to the costs of entering. Let's define $\tilde{\phi}\left(\phi^*\right)$ as

$$\begin{aligned} \tilde{\phi}\left(\phi^*\right) &\equiv \left[\int_0^\infty \phi^{\sigma-1}\mu\left(\phi\right)d\phi\right]^{\frac{1}{\sigma-1}} && (18) \\ &= \left[\frac{1}{1-G\left(\phi^*\right)}\int_{\phi^*}^\infty \phi^{\sigma-1}g\left(\phi\right)d\phi\right]^{\frac{1}{\sigma-1}}. && (19) \end{aligned}$$

Denote $\tilde{\phi}\left(\phi^{*i}\right)$ by $\tilde{\phi}^i$, $\tilde{\phi}\left(\phi_x^{*ij}\right)$ by $\tilde{\phi}_x^{ij}$, and $\tilde{\phi}\left(\phi_{xr}^{*ij}\right)$ by $\tilde{\phi}_{xr}^{ij}$. Then the average profits earned in the EU, the US, and Bangladesh are, respectively:

$$\bar{\pi}^E = \pi_d^E\left(\tilde{\phi}^E\right) + p_x^{EU}\pi_x^{EU}\left(\tilde{\phi}_x^{EU}\right) + p_x^{EB}\pi_x^{EB}\left(\tilde{\phi}_x^{EB}\right), \tag{20}$$

[4] δ is the usual exogenous probability of death for a firm which allows the static model to be interpreted as a dynamic one in its steady state.

$$\bar{\pi}^U = \pi_d^U\left(\tilde{\phi}^U\right) + p_x^{UE}\pi_x^{UE}\left(\tilde{\phi}_x^{UE}\right) + p_x^{UB}\pi_x^{UB}\left(\tilde{\phi}_x^{UB}\right), \tag{21}$$

$$\begin{aligned}\bar{\pi}^B &= \pi_d^B\left(\tilde{\phi}^B\right) + p_x^{BE}\pi_x^{BE}\left(\tilde{\phi}_x^{BE}\right) \\ &\quad + p_{xr}^{BE}\pi_R^{BE}\left(\tilde{\phi}_{xr}^{BE}\right) + p_{xr}^{BU}\pi_{xr}^{BU}\left(\tilde{\phi}_{xr}^{BU}\right),\end{aligned} \tag{22}$$

where p_x^{ij} is the probability of becoming an exporter from country i to country j conditional on successful entry,

$$p_x^{ij} = \left(1 - G\left(\phi_x^{*ij}\right)\right) / \left(1 - G\left(\phi^{*i}\right)\right).$$

Similarly, p_{xr}^{BE} is the probability of becoming an exporter from Bangladesh to the EU who meets $ROOs$, conditional on successful entry,

$$p_{xr}^{BE} = \left(1 - G\left(\phi_{xr}^{*BE}\right)\right) / \left(1 - G\left(\phi^{*B}\right)\right),$$

and p_{xr}^{BU} is the probability of becoming an exporter from Bangladesh to the US, conditional on successful entry,

$$p_{xr}^{BU} = \left(1 - G\left(\phi_{xr}^{*BU}\right)\right) / \left(1 - G\left(\phi^{*B}\right)\right).$$

Note that

$$\pi_d^i\left(\tilde{\phi}^i\right) = \frac{r_d^i\left(\tilde{\phi}^i\right)}{\sigma} - f \quad \text{and } r_d^i\left(\tilde{\phi}^i\right) = r_d^i\left(\phi^{*i}\right)\left(\frac{\tilde{\phi}^i}{\phi^{*i}}\right)^{\sigma-1} = \sigma f\left(\frac{\tilde{\phi}^i}{\phi^{*i}}\right)^{\sigma-1}. \tag{23}$$

Thus,

$$\pi_d^i\left(\tilde{\phi}^i\right) = fk\left(\phi^{*i}\right), \quad \text{where } k\left(\phi\right) = \left(\frac{\tilde{\phi}\left(\phi\right)}{\phi}\right)^{\sigma-1} - 1. \tag{24}$$

Similarly,

$$\pi_x^{ij}\left(\tilde{\phi}_x^{ij}\right) = f_x k\left(\phi_x^{*ij}\right), \tag{25}$$

$$\pi_R^{BE}\left(\tilde{\phi}_x^{BE}\right) = d^E k\left(\phi_{xr}^{*BE}\right), \tag{26}$$

$$\pi_{xr}^{BU}\left(\tilde{\phi}_{xr}^{BU}\right) = \left(f_x + d^U\right) k\left(\phi_{xr}^{*BU}\right). \tag{27}$$

Let us denote $(1 - G(\phi))\, k(\phi)$ by $J(\phi)$. By substituting the expressions above into (17) and using relationships (9)-(12), we receive three equations for the productivity cutoffs corresponding to, respectively, the EU, the US, and Bangladesh**:**

$$fJ(\phi^{*E}) + f_x J(A^{US}\phi^{*U}) + f_x J\left(A^B\phi^{*B}\right) = \delta f_e, \tag{28}$$

$$fJ(\phi^{*U}) + f_x J(A^{EU}\phi^{*E}) + f_x J\left(A^B\phi^{*B}\right) = \delta f_e, \tag{29}$$

$$\begin{aligned} &fJ(\phi^{*B}) + f_x J(A^{EU}\phi^{*E}) + d^E J\left(A_{ROO}^{BE}A^{EU}\phi^{*E}\right) \\ &\quad + \left(f_x + d^U\right) J\left(A_{ROO}^{BU}\phi^{*U}\right) = \delta f_e. \end{aligned} \tag{30}$$

Solving the above system gives ϕ^{*E}, ϕ^{*U}, and ϕ^{*B}, which, in turn, allows to solve for all the other variables in the economy.[5]

[5] All variables in the economy can be expressed through the productivity cutoffs, ϕ^{*E}, ϕ^{*U}, and ϕ^{*B}, and the masses of variety in each country, M^E, M^U, and M^B. To derive M^i, $i = E, U, B$, trade balance equations can be used.

1.2 Ranking Domestic Cutoffs

To compare ϕ^{*U}, ϕ^{*E}, and ϕ^{*B}, we will first discuss the solution of the following system of equations:

$$fJ(\phi^{*E}) + f_x J(A^{US}\phi^{*U}) + f_x J\left(A^{B}\phi^{*B}\right) = \delta f_e, \tag{31}$$

$$fJ(\phi^{*U}) + f_x J(A^{EU}\phi^{*E}) + f_x J\left(A^{B}\phi^{*B}\right) = \delta f_e, \tag{32}$$

$$fJ(\phi^{*B}) + f_x J(A^{EU}\phi^{*E}) + f_x J\left(A^{BU}_{ROO}\phi^{*U}\right) = \delta f_e, \tag{33}$$

where equation (31) corresponds to the EU, equation (32) corresponds to the US, and equation (33) corresponds to Bangladesh. Using the same technique as in Demidova (2005), we will show that the solution of (31)-(33) must satisfy $\phi^{*B} > \phi^{*U} > \phi^{*E}$ and adding $d^{E}J\left(A^{BE}_{ROO}A^{EU}\phi^{*E}\right) + d^{U}J\left(A^{BU}_{ROO}\phi^{*U}\right)$ to equation (33) does not change this result.

Lemma 1 *In the equilibrium defined by (31)-(33),* $\phi^{*B} > \phi^{*U} > \phi^{*E}$.

Proof. First, let us prove that for any ϕ^{*B}, from (31) and (32) $\phi^{*U} > \phi^{*E}$. Then we will show that for any ϕ^{*E}, from (32) and (33) $\phi^{*B} > \phi^{*U}$, and the lemma will be proved.

Consider equations (31) and (32). Move $f_x J\left(A^{B}\phi^{*B}\right)$ to the RHS of these equations. This gives two equations in ϕ^{*E} and ϕ^{*U} which are equal to the same value on the RHS, namely $\delta f_e - f_x J\left(A^{B}\phi^{*B}\right)$. Clearly, if $A^{US} = A^{EU}$, then then the intersection of two curves is on the 45^0 line as shown in Figure $2(a)$. What if $A^{US} > A^{EU}$?

Well, ϕ^{*U} can be written as a function of ϕ^{*E} (ϕ^{*B} is fixed):

$$(31) \quad \Rightarrow \quad \phi^{*U} = \frac{1}{A^{US}} J^{-1}\left(\frac{\delta f_e}{f_x} - \frac{f}{f_x} J\left(\phi^{*E}\right) - J(A^{B}\phi^{*B})\right), \tag{34}$$

$$(32) \quad \Rightarrow \quad \phi^{*U} = J^{-1}\left(\frac{\delta f_e}{f} - \frac{f_x}{f} J(A^{EU}\phi^{*E}) - \frac{f_x}{f} J\left(A^{B}\phi^{*B}\right)\right). \tag{35}$$

Recall that $J(\phi^*) = (1 - G(\phi^*))\, k(\phi^*) = (\phi^*)^{1-\sigma} \int\limits_{\phi^*}^{\infty} \phi^{\sigma-1} g(\phi)\, d\phi - [1 - G(\phi^*)]$. Thus,

$$J'(\phi^*) = -(\sigma - 1)(\phi^*)^{-\sigma} \int\limits_{\phi^*}^{\infty} \phi^{\sigma-1} g(\phi)\, d\phi < 0. \tag{36}$$

Since $J(\phi)$ is a decreasing function of ϕ, ϕ^{*U} is decreasing function of ϕ^{*E} in both equations (34) and (35). Moreover, at any intersection point, the curve for the US corresponding to equation (35) is flatter than the curve for the EU corresponding to equation (34)[6] as depicted in Figure 2(a). Suppose A^{EU} falls to $\tau^{EU}\left(\frac{f_x}{f}\right)^{\frac{1}{\sigma-1}}$. Then, it is obvious that the curve for the US corresponding to equation (35) shifts up as shown in Figure 2(b). Hence, we know that for any ϕ^{*B}, $\phi^{*U} > \phi^{*E}$.

The proof that for any ϕ^{*E}, $\phi^{*B} > \phi^{*U}$ in the equilibrium defined by (31)-(33), is analogous to the previous one, but now we use equations (32) and (33) and the fact that $A^B > A^{BU}_{ROO}$. ■

Next, we add $d^E J\left(A^{BE}_{ROO} A^{EU} \phi^{*E}\right) + d^U J\left(A^{BU}_{ROO} \phi^{*U}\right)$ to equation (33).[7] Thus, instead of equation (33), we have

$$fJ(\phi^{*B}) + f_x J(A^{EU}\phi^{*E}) + f_x J\left(A^{BU}_{ROO}\phi^{*U}\right) + d^E J\left(A^{BE}_{ROO} A^{EU}\phi^{*E}\right) + d^U J\left(A^{BU}_{ROO}\phi^{*U}\right) = \delta f_e, \tag{37}$$

which is equivalent to equation (30). Note that this change does not affect equations (31) and (32). Thus, ϕ^{*U} remains above ϕ^{*E}, whatever be the value of ϕ^{*B}.

We can think of what happens when we add these two terms in three steps. First, as shown in Lemma 2, raising ϕ^{*B} raises $\delta f_e - f_x J(A^B \phi^{*B})$, and shifts out both the curves determining the values of ϕ^{*U} and ϕ^{*E}. If one curve shifts out more than the other, it is possible that ϕ^{*U} and

[6] The expressions for the slopes can be derived from (31) and (32) using the implicit function theorem.

[7] In the detailed appendix (available upon request) we consider an additional possible variation: that Bangladesh draws from a better productivity in terms of hazard rate stochastic dominance. This leads to the same result: ϕ^{*B} rises, while ϕ^{*U} and ϕ^{*E} fall with $\phi^{*B} > \phi^{*U} > \phi^{*E}$.

ϕ^{*E} do not move in the same direction. However, we show below that this is not so. Both their equilibrium values rise. Second, using this relation between ϕ^{*U} and ϕ^{*E}, denoted by $\phi^{*E}(\phi^{*U})$, we can make the equations corresponding to (33) and (32) a function only of ϕ^{*B} and ϕ^{*U}. We show, in Lemma 3, that these two curves have similar properties as they do when ϕ^{*E} is fixed: in other words, that indirect effects do not swamp direct ones. In Lemma 4, we show that adding these terms thus shifts up only the augmented curve corresponding to (33) and so raises ϕ^{*B} from its value in the more symmetric system.

Lemma 2 *Any change in ϕ^{*B} moves ϕ^{*U} and ϕ^{*E} in the same direction.*

Proof. A change in ϕ^{*B} will raise the RHS of (31) and (32) equally so that it will remain true that

$$fJ(\phi^{*E}) + f_x J(A^{US}\phi^{*U}) = fJ(\phi^{*U}) + f_x J(A^{EU}\phi^{*E}). \tag{38}$$

Thus, equation (38) gives the relationship between ϕ^{*E} and ϕ^{*U} in the equilibrium. Using the implicit function theorem and differentiating (38) gives

$$\begin{aligned}\frac{d\phi^{*E}}{d\phi^{*U}} &= -\frac{-fJ'\left(\phi^{*U}\right) + f_x A^{US} J'\left(A^{US}\phi^{*U}\right)}{fJ'\left(\phi^{*E}\right) - f_x A^{EU} J'\left(A^{EU}\phi^{*E}\right)} \\ &= \frac{f\left|J'\left(\phi^{*U}\right)\right| - f_x A^{US}\left|J'\left(A^{US}\phi^{*U}\right)\right|}{f\left|J'\left(\phi^{*E}\right)\right| - f_x A^{EU}\left|J'\left(A^{EU}\phi^{*E}\right)\right|} > 0,\end{aligned}$$

since $J'\left(\phi^{*}\right) < 0$ and $f\left|J'\left(\phi^{*}\right)\right| > f_x A^j \left|J'\left(A^j\phi^{*}\right)\right|$.

From (36),

$$\frac{f\left|J'\left(\phi^{*}\right)\right|}{f_x A^j \left|J'\left(A^j\phi^{*}\right)\right|} = \frac{f\displaystyle\int_{\phi^*}^{\infty} \phi^{\sigma-1} g\left(\phi\right) d\phi}{f_x \left(A^j\right)^{1-\sigma} \displaystyle\int_{A^j\phi^*}^{\infty} \phi^{\sigma-1} g\left(\phi\right)\phi} = \left(\tau^j\right)^{\sigma-1} \frac{\displaystyle\int_{\phi^*}^{\infty} \phi^{\sigma-1} g\left(\phi\right) d\phi}{\displaystyle\int_{A^j\phi^*}^{\infty} \phi^{\sigma-1} g\left(\phi\right)\phi} > 1, \tag{39}$$

since $\tau^j > 1$, $A^j > 1$, $j = EU, US, B$. Thus, in the equilibrium, $\phi^{*E}\left(\phi^{*U}\right)$ is an increasing function of ϕ^{*U}. ■

Lemma 3 *The addition of* $d^E J\left(A_{ROO}^{BE} A^{EU} \phi^{*E}\right) + d^U J\left(A_{ROO}^{BU} \phi^{*U}\right)$ *to equation (33) must move* ϕ^{*B} *in the opposite direction to* ϕ^{*E} *and* ϕ^{*U}**.**

Proof. Note that

$$f_x J\left(A^B \phi^{*B}\right) = \delta f_e - f J(\phi^{*E}) - f_x J(A^{US} \phi^{*U}).$$

As ϕ^{*E} and ϕ^{*U} move in the same direction, the RHS either rises (if ϕ^{*E} rises) or falls (if ϕ^{*E} falls). As $J(\cdot)$ is a decreasing function**,** for the above equation to hold, ϕ^{*B} has to move in the opposite direction from ϕ^{*E} and ϕ^{*U}**.** ■

Now we move to the third step.

Lemma 4 *The addition of* $d^E J\left(A_{ROO}^{BE} A^{EU} \phi^{*E}\right) + d^U J\left(A_{ROO}^{BU} \phi^{*U}\right)$ *to equation (33) must raise* ϕ^{*B}**.**

Proof. Using Lemma 2, we can rewrite equations (32) and (33) as

$$f J(\phi^{*U}) + f_x J(A^{EU} \phi^{*E}\left(\phi^{*U}\right)) + f_x J\left(A^B \phi^{*B}\right) = \delta f_e, \tag{40}$$

$$f J(\phi^{*B}) + f_x J(A^{EU} \phi^{*E}\left(\phi^{*U}\right)) + f_x J\left(A_{ROO}^{BU} \phi^{*U}\right) = \delta f_e, \tag{41}$$

where $\phi^{*E}\left(\phi^{*U}\right)$ is defined by (38). We can rewrite (40) and (41) as

$$\phi^{*B} = \frac{1}{A^B} J^{-1}\left(\frac{\delta f_e}{f_x} - \frac{f}{f_x} J(\phi^{*U}) - J(A^{EU} \phi^{*E}\left(\phi^{*U}\right))\right), \tag{42}$$

$$\phi^{*B} = J^{-1}\left(\frac{\delta f_e}{f} - \frac{f_x}{f} J(A^{EU} \phi^{*E}\left(\phi^{*U}\right)) - \frac{f_x}{f} J\left(A_{ROO}^{BU} \phi^{*U}\right)\right). \tag{43}$$

Note that the curve corresponding to equation (42) is steeper than the curve corresponding to equation (43) as shown in Figure 3(a). Moreover, the intersection of these curves is above the 45^0 line since from Lemma 1, $\phi^{*U} < \phi^{*B}$.

Adding $d^E J\left(A^{BE}_{ROO} A^{EU} \phi^{*E}\left(\phi^{*U}\right)\right) + d^U J\left(A^{BU}_{ROO} \phi^{*U}\right)$ to equation (33) shifts the curve corresponding to equation (43) up as shown in Figure 3(b). Moreover, the property of the slopes of two curves at the intersection point remains the same, if d^E and d^U are small enough. Hence, this change leads to an increase in ϕ^{*B} and a fall in ϕ^{*U}, which, in turn, leads to the fall in ϕ^{*E}. (The latter follows from Lemma 2.) ■

Thus, we have proved our main result.

Proposition 5 *In the equilibrium defined by (28)-(30),* $\phi^{*B} > \phi^{*U} > \phi^{*E}$.

It is easy to see that various cutoffs can now be ranked. For example, the productivity cutoff levels for firms exporting from Bangladesh to the EU and US can be ranked as in Result 2. Since $A^{BU}_{ROO} > A^{EU}$, using the relations in equations (9) and (12), namely that $\phi^{*BE}_x = A^{EU}\phi^{*E}$ and $\phi^{*BU}_{xr} = A^{BU}_{ROO}\phi^{*U}$, we see that $\phi^{*BE}_x < \phi^{*BU}_{xr}$. This shows that a more restrictive trade policy in the US results in only more productive Bangladeshi firms being able to compete there. Other cutoff comparisons follow from using these relations along with the assumptions and results so far.

That the number of firms that export to the US is smaller than the number of firms who export to the EU in both woven and non-woven industries (3(a)) needs a little explanation. The definition of mass of firms exporting to the US and EU:

$$M^{BE}_x = p^{BE}_x M^B = \frac{1 - G\left(\phi^{*BE}_x\right)}{1 - G\left(\phi^{*B}\right)} M^B, \tag{44}$$

$$M^{BE}_{xr} = p^{BE}_{xr} M^B = \frac{1 - G\left(\phi^{*BE}_{xr}\right)}{1 - G\left(\phi^{*B}\right)} M_B, \tag{45}$$

$$M_{xr}^{BU} = p_{xr}^{BU} M^B = \frac{1 - G\left(\phi_{xr}^{*BU}\right)}{1 - G\left(\phi^{*B}\right)} M^B. \tag{46}$$

From Result 1, it follows that $M_{xr}^{BU} < M_x^{BE}$.

1.3 Ranking Price Indices

By definition, the price index in country i can be written as

$$P_t^i = \left(M_t^i\right)^{\frac{1}{1-\sigma}} p\left(\tilde{\phi}_t^i\right), \tag{47}$$

where M_t^i is the total mass of variety available to consumers in country i, and $\tilde{\phi}_t^i$ is the average productivity level of firms, who sell in country i. For example, in country E (that represents the EU in our model)[8]

$$\begin{aligned} M_t^E &= M^E + M_x^{UE} + M_x^{BE} + M_{xr}^{BE}, \text{ and} \qquad (48) \\ \tilde{\phi}_t^E &\equiv \left\{ \frac{1}{M_t^E} \left[M^E \left(\tilde{\phi}^E\right)^{\sigma-1} + M_x^{UE} \left(\tau^{-1} \tilde{\phi}_x^{UE}\right)^{\sigma-1} + M_x^{BE} \left(\left(\tau^E\right)^{-1} \tilde{\phi}_x^{BE}\right)^{\sigma-1} \right.\right. \\ &\quad \left.\left. + M_{xr}^{BE} \left((\lambda^E \theta^E \tau^E)^{-1} \tilde{\phi}_{xr}^{BE}\right)^{\sigma-1} \right] \right\}^{1/(\sigma-1)}. \qquad (49) \end{aligned}$$

M_t^i and $\tilde{\phi}_t^i$ can be defined similarly for $i = U,\, B$.

By definition, $M_t^i = \frac{E^i}{r^i\left(\tilde{\phi}_t^i\right)}$, where E^i is the expenditure on the differentiated goods in country i,

$$E^i = \beta I^i = \beta\left(L^i + TR^i\right),$$

[8] Note that in the formulas below $M_x^{BE} = \frac{G\left(\phi_{xr}^{*BE}\right) - G\left(\phi_x^{*BE}\right)}{1 - G\left(\phi^{*B}\right)}$ and $\tilde{\phi}_x^{BE} = \left[\frac{1}{G\left(\phi_{xr}^{*BE}\right) - G\left(\phi_x^{*BE}\right)} \int_{\phi_x^{*BE}}^{\phi_{xr}^{*BE}} \phi^{\sigma-1} g\left(\phi\right) d\phi\right]^{\frac{1}{\sigma-1}}$. These formulas differ from the original definitions used before, and we choose to redefine them to simplify the interpretation. For instance, now M_x^{BE} is the mass of Bangladeshi exporters to the EU, who do not invoke *ROOs*, while previously M_x^{BE} included both exporters who invoked *ROOs* and those who did not.

and $r_i\left(\tilde{\phi}_{ti}\right)$ is the average revenues earned by firms, who sell in country i. Note that

$$r^i\left(\tilde{\phi}_t^i\right) = r^i\left(\phi^{*i}\right)\left(\frac{\tilde{\phi}_t^i}{\phi^{*i}}\right)^{\sigma-1} = \sigma f\left(\frac{\tilde{\phi}_t^i}{\phi^{*i}}\right)^{\sigma-1}.$$

Since $p\left(\tilde{\phi}_t^i\right) = \frac{1}{\rho\tilde{\phi}_t^i}$, equation (47) can be written as

$$P^i = \left(\frac{E^i}{\sigma f}\right)^{\frac{1}{1-\sigma}} \frac{1}{\rho\phi^{*i}}. \tag{50}$$

Note that if countries have the same income (for instance, if tariff revenues are not included into the country's income, so that $E^i = \beta L$ for any i), then the country with the highest cutoff level for domestic firms has the lowest price index and, as a result, the highest level of welfare. Also, to the extent that tariff revenues are a small share of national income, their effect can be outweighed by the price index effect. We use these results on cutoff and price index rankings to derive our results in the body of the paper. We can also derive some further results.

1.4 Some Further Implications

There is an interesting implication of our results so far, namely, that preferences given by developed countries might not be in their own interests.

Proposition Relaxing *ROOs* on Bangladeshi exports can reduce welfare in the US and EU if tariff revenues effects are small.

Proof: The proof of the last result is the following: trade policy, which makes *ROOs* for Bangladeshi firms less restrictive, is equivalent to a fall in A_{ROO}^{BE} and A_{ROO}^{BU}. This leaves unaffected the argument that $\phi^{*U} > \phi^{*E}$. However, the fall in A^{BE}_{ROO} and A^{BU}_{ROO} will at any ϕ^{*U} raise

$$\phi^{*B} = J^{-1}\left(\frac{\delta f_e}{f} - \frac{f_x}{f} J(A^{EU}\phi^{*E}\left(\phi^{*U}\right)) - \frac{d^E}{f} J\left(A^{BE}_{ROO}A^{EU}\phi^{*E}\left(\phi^{*U}\right)\right) - \frac{\left(f_x + d^U\right)}{f} J\left(A^{BU}_{ROO}\phi^{*U}\right)\right) \tag{51}$$

and shift the flatter curve in Figure 3 upwards. This will increase ϕ^{*B} and reduce ϕ^{*U} and ϕ^{*E}. But, as shown below, this will tend to raise the aggregate price index in the US and EU and reduce US and EU welfare for a given level of tariff revenues! Relaxing *ROOs* makes the average Bangladeshi exporter less productive, and the average firms selling in Bangladesh more productive, thus, raising the price index in export markets and lowering it in Bangladesh. This is consistent with the harmful unilateral liberalization results of Melitz and Ottaviano (2005).

Figure 1: The Structure of Economy

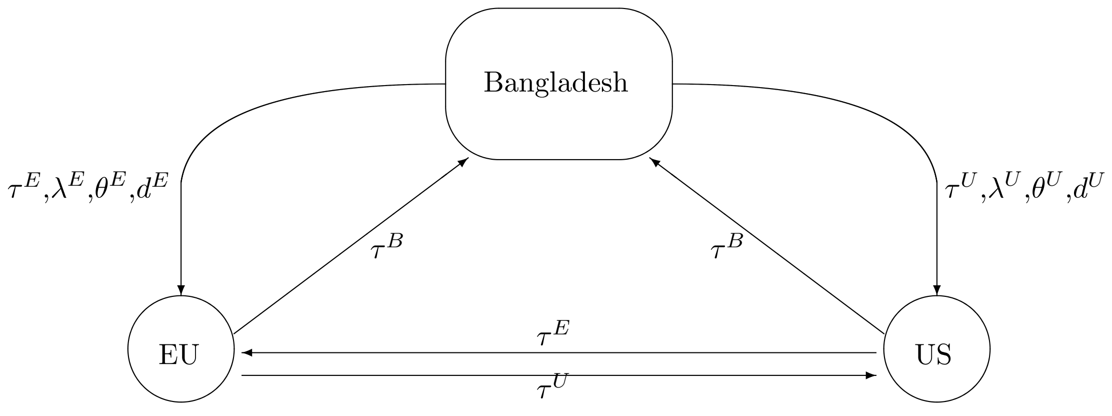

Figure 2: Proof of Lemma 1

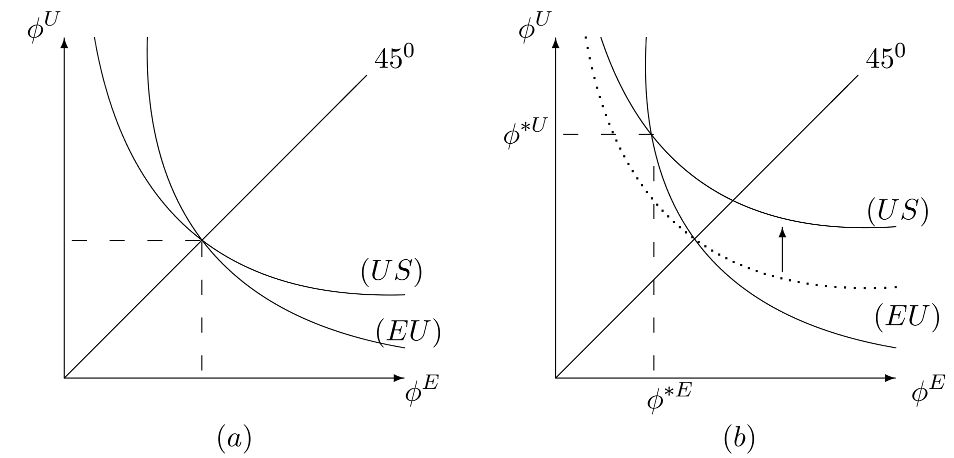

Figure 3: The Domestic Cutoffs in the US and Bangladesh