Online Appendix: Unpacking the Long Run Effects of Tariff Shocks: New Structural Implications from Firm Heterogeneity Models

B Equivalent Variation for Continuum Quadratic Preferences

To quantify the welfare effects of tariffs within this model, suppose that the model generates an indirect utility function, $v(\mathbf{p}, I)$, where I is income and $\mathbf{p}_l$ is the vector of prices available to consumers in country l. At any solution to the consumers optimization problem, it must be the case that

$$U_l = v(\mathbf{p}_l, I_l)$$

Equivalent variation is defined as the change in income, holding prices constant, that is equivalent to some change in utility. Precisely:

$$dU_l = \frac{dv(\mathbf{p}_l, I_l)}{dI_l} dEV_l$$

Writing in log changes, we have

$$\widehat{U}_l = \frac{dv(\mathbf{p}_l, I_l)}{dI_l} \frac{I_l}{v(\mathbf{p}_l, I_l)} \widehat{EV}_l$$

where $\widehat{EV}_l$ is defined as the change in income required to generate the change in utility as a percentage of current income.

The Frisch setup of the model is convenient for simplifying this equation. First, the partial derivative of indirect utility with respect to income is simply the lagrange multiplier of the consumer's budget constraint: $\frac{dv(\mathbf{p}_l, I_l)}{dI_l} = \lambda_l$. Further, I_l is simply wage income plus re-distributed tariff revenue. Finally, $v(\mathbf{p}_l, I_l)$ is equal to consumer level utility in equilibrium, for which the model yields a simple formula. Substituting these relationships into the equation for equivalent variation, we have:

$$\frac{\widehat{U}_l}{\widehat{EV}_l} = \frac{\lambda_l\left(w_l + \frac{T_l}{L_l}\right)}{\prod_{i=1}^{I}\left(\frac{\lambda_{il}}{L_l}\sum_{j=1}^{M} V_{ijl}t_{ijl}\left(\frac{2k_{ij}+3}{2k_{ij}+2}\right)\right)^{\beta_{il}}}$$

Substituting $\lambda_{il} = \frac{\lambda_l U_l}{\beta_{il}U_{il}}$, multiplying the numerator and denominator by L_l, and canceling λ_l's, we have:

$$\frac{\widehat{U}_l}{\widehat{EV}_l} = \frac{(w_l L_l + T_l)}{\prod_{i=1}^{I}\left(\frac{U_l}{\beta_{il}U_{il}}\sum_{j=1}^{M} V_{ijl}t_{ijl}\left(\frac{2k_{ij}+3}{2k_{ij}+2}\right)\right)^{\beta_{il}}}$$

Factoring out utility, and noting that $\frac{U_l}{\prod_{i=1}^{I} U_{il}^{\beta_{il}}} = 1$, we have:

$$\frac{\widehat{U}_l}{\widehat{EV}_l} = \frac{(w_l L_l + T_l)}{\prod_{i=1}^{I}\left(\frac{1}{\beta_{il}}\sum_{j=1}^{M} V_{ijl}t_{ijl}\left(\frac{2k_{ij}+3}{2k_{ij}+2}\right)\right)^{\beta_{il}}}$$

Next, as $\beta_{il} = \frac{\sum_{j=1}^{M} V_{ijl}t_{ijl}\left(\frac{2k_{ij}+3}{2k_{ij}+2}\right)}{\sum_{i=1}^{I}\sum_{j=1}^{M} V_{ijl}t_{ijl}\left(\frac{2k_{ij}+3}{2k_{ij}+2}\right)}$, the denominator can be simplified as:

$$\frac{\widehat{U}_l}{\widehat{EV}_l} = \frac{(w_l L_l + T_l)}{\sum_{i=1}^{I}\sum_{j=1}^{M} V_{ijl}t_{ijl}\left(\frac{2k_{ij}+3}{2k_{ij}+2}\right)}$$

Finally, using the aggregate country l budget constraint, we can simplify the numerator to complete the link between utility changes and equivalent variation.

$$\frac{\widehat{U}_l}{\widehat{EV}_l} = \frac{\sum_{i=1}^{I}\sum_{j=1}^{M} V_{ijl}t_{ijl}}{\sum_{i=1}^{I}\sum_{j=1}^{M} V_{ijl}t_{ijl}\left(\frac{2k_{ij}+3}{2k_{ij}+2}\right)}$$

Thus, using the equation for $\widehat{U}_l$ in the manuscript, the relationship between tariff shocks and equivalent variation is summarized by the following:

$$\widehat{EV}_l = \sum_{i=1}^{I}\frac{\sum_{j=1}^{M} V_{ijl}t_{ijl}\left(\frac{2k_{ij}+3}{2k_{ij}+2}\right)}{\sum_{f=1}^{I}\sum_{j=1}^{M} V_{fjl}t_{fjl}}\left(\widehat{\lambda}_{il} - \widehat{\delta}_l\right)$$

C CES Comparison

In this appendix, I compare the model with quadratic sub-utility to one with CES sub-utility. The point of this section is that with appropriate variable definitions, the free entry, labor market clearing and trade balance conditions under CES are observationally equivalent to the adjusted linear demand model within the manuscript as long as the models are linked via observable data and the tariff elasticity. However, the sectoral optimization conditions, and the subsequent utility calculations, are not. This latter non-equivalence is directly related to the demand assumptions in the paper, and how producer shape heterogeneity maps into elasticity variation within each industry.

To begin, as in the manuscript, we assume that subutility is aggregated according to Cobb-Douglas, with weight β_{il} on each industry:

$$U_l^{ces} = \prod_{i=1}^{I} (U_{il}^{ces})^{\beta_{il}}$$

However, different from the manuscript, sub-utility is defined via:

$$U_{il}^{ces} = \left(\int_{\omega \in \Omega_{i,l}} \left(q_{\omega,l}^c\right)^{\frac{\sigma_i - 1}{\sigma_i}} d\omega \right)^{\frac{\sigma_i}{\sigma_i - 1}} \tag{28}$$

where σ_i is the elasticity of substitution within industry i, and $q_{\omega,l}^c$ is the consumption by the representative consumer of variety ω. As in the existing literature, I assume that σ_i is constant within industries.

Sectoral Optimization - CES

Given homothetic sub-utility, consumers in country l will spend a constant share of income β_{il} on industry i. Thus, it must be the case that:

$$\beta_{il} = \frac{\sum_{j=1}^{M} V_{ijl} t_{ijl}}{\sum_{i=1}^{I} \sum_{j=1}^{M} V_{ijl} t_{ijl}}$$

As in the linear demand model, V_{ijl} is aggregate producer revenues earned by selling from j to l in industry i, and t_{ijl} is the wedge between consumer expenditures and producer revenues for that same group. Using a similar definition of the denominator as in the linear demand model, sectoral optimization is defined by:

$$\beta_{il} = \delta_l^{ces} \sum_{j=1}^{M} V_{ijl} t_{ijl} \tag{29}$$

where δ_l^{ces} is an endogenous variable that may respond to equilibrium tariff shocks. Clearly, the sectoral optimization condition only differs in that for CES we care about expenditures and for linear demand we care about elasticity adjusted expenditures.

All other conditions - CES

To evaluate all other conditions, we need to fully specify the model and CES demand. Solving the consumer's problem and aggregating over L_l consumers, demand for variety ω is written as:

$$q(\omega) = \frac{\beta_{il} I_l}{\int_{z \in \Omega_{i,l}} p(z)^{1-\sigma_i} dz} p(\omega)^{-\sigma_i}$$

Using this demand function and constant mark-up pricing, producer profits, revenues, and variable labor costs in selling from j to l in industry i for a firm with unit-labor requirement a are written as:

$$\begin{aligned} \pi_{ijl}(a) &= B_{il} \left(w_j a\right)^{1-\sigma_i} t_{ijl}^{-\sigma_i} \\ v_{ijl}(a) &= B_{il} \left(w_j a\right)^{1-\sigma_i} t_{ijl}^{-\sigma_i} \sigma_i \\ w_j l_{ijl}(a) &= B_{il} \left(w_j a\right)^{1-\sigma_i} t_{ijl}^{-\sigma_i} \left(\sigma_i - 1\right) \end{aligned}$$

where $B_{il} = \frac{\beta_{il} I_l}{\int_{z \in \Omega_{i,l}} p(z)^{1-\sigma_i} dz} \left(\frac{1}{\sigma_i}\right)^{\sigma_i} \left(\frac{1}{\sigma_i - 1}\right)^{1-\sigma_i}$. Within the CES model, firms must pay a fixed cost F_{ijl} in domestic labor to export from j to l in industry i. Hence, firms profitably sell from j to l in industry i if $\pi_{ijl}(a) > w_j F_{ijl}$. This defines a cutoff, where firms can sell from j to l in industry i if $a < a_{ijl} \equiv \left(\frac{B_{il} t_{ijl}^{-\sigma_i}}{w_j^{\sigma_i} F_{ijl}}\right)^{\frac{1}{\sigma_i - 1}}$. Subject to this cutoff, and with N_{ij} entrants in industry i and country j, aggregate export value from j to l in industry i is written as:

$$V_{ijl} = N_{ij} B_{il}^{\frac{k_{ij}}{\sigma_i - 1}} t_{ijl}^{-\frac{k_{ij}\sigma_i}{\sigma_i - 1}} w_j^{-\frac{\sigma_i k_{ij}}{\sigma_i - 1} + 1} F_{ijl}^{-\frac{k_{ij}}{\sigma_i - 1} + 1} \left(\frac{\sigma_i k_{ij}}{\left(k_{ij} - (\sigma_i - 1)\right) (a_{ij}^m)^{k_{ij}}}\right)$$

In the linear model, shape parameters are identified empirically via partial tariff elasticities. Since demand elasticities are endogenous in the linear model, these shape differences determine the average productivity of surviving firms, and hence, the responsiveness of these firms. Subject to the parameters of the model, tariff elasticities (defined in absolute terms) are $(k_{ij}+1)$. In the CES model, intensive margin demand elasticities are exogenous, and all action related to shape parameters occurs on the extensive margin. So, the tariff elasticities, $\frac{k_{ij}\sigma_i}{\sigma_i-1}$ include both the exogenously specified elasticity of substitution, σ_i, and the exporter-industry shape parameter, k_{ij}. Moving forward, defining tariff elasticities in positive terms as ε_{ij}, and $\lambda_{il}^{ces}=B_{il}^{-1/\sigma_i}$, trade value is simplified as:,

$$V_{ijl}=N_{ij}\left(\lambda_{il}^{ces}\right)^{-\varepsilon_{ij}}t_{ijl}^{-\varepsilon_{ij}}w_j^{-\varepsilon_{ij}+1}Z_{ijl}^{ces}$$

where Z_{ijl}^{ces} is a constant representing exogenous factors in selling from j to l in industry i. In the linear case, the equivalent equation is $V_{ijl}=N_{ij}\left(\lambda_{il}\right)^{-\varepsilon_{ij}}t_{ijl}^{-\varepsilon_{ij}}w_j^{-\varepsilon_{ij}+1}Z_{ijl}$. Hence, trade values themselves say nothing about the underlying model other than through the revealed tariff elasticity.

Further, using the tariff elasticity within the CES model, aggregate profits Π_{ijl} and aggregate variable labor costs LC_{ijl} have a tight link to trade values through the elasticity.

$$V_{ijl}=\varepsilon_{ij}\Pi_{ijl} \quad , \quad V_{ijl}=\frac{\varepsilon_{ij}}{\varepsilon_{ij}-1}LC_{ijl}$$

We will now use these relationships to simplify the free entry, labor market clearing, and trade balance conditions to show equivalence to the linear model.

Free Entry

For industry i in country j, firms must make zero profits in expectation. Hence, it must be the case that:

$$\sum_{l=1}^{M}\frac{\Pi_{ijl}}{N_ij}=w_jF_{ij}^{E}$$

Linking this equation to trade value and the tariff elasticity, we have:

(30) $$\sum_{l=1}^{M}\frac{V_{ijl}}{\varepsilon_{ij}w_jN_ij}=F_{ij}^{E}$$

Since in the linear model $k_{ij} + 1$ is the tariff elasticity, equation (30) is equivalent to the linear model free entry condition in (9).

Labor Market Clearing + FE

Since firms earn zero profits and all costs are paid in terms of labor, it can be easily shown that the free entry condition substituted within the labor market clearing condition yields

$$\sum_{i=1}^{I}\sum_{j=1}^{M} V_{ijl} = w_j L_j \tag{31}$$

This equation is also equivalent to linear demand (and many other general equilibrium models),

Further, utilizing a different substitution of free entry into the labor market clearing condition, we get:

$$\sum_{i=1}^{I} N_{ij} F_{ij}^{E} \varepsilon_{ij} = L_j \tag{32}$$

This is once again equivalent to the linear model when defined via the tariff elasticity.

Labor Market Clearing + FE + Trade Balance

Finally, as in any trade model without imbalances, expenditures must equal income:

$$\sum_{i=1}^{I}\sum_{j=1}^{M} V_{ijl} t_{ijl} = w_l L_l + T_l$$

where T_l is aggregate tariff revenue. Since all tariff revenue is redistributed to consumers, this becomes:

$$\sum_{i=1}^{I}\sum_{j=1}^{M} V_{ijl} = w_l L_l$$

Using the relationship between labor payments and earned producer revenues in (31), we have:

$$\sum_{i=1}^{I}\sum_{j=1}^{M} V_{ijl} = \sum_{i=1}^{I}\sum_{h=1}^{M} V_{ilh}$$

This is, of course, identical to the same condition in the linear model.

Utility

As derived above, given an estimated tariff elasticity, the only difference between the linear model and the CES framework is the sectoral optimization condition, which is indicates that with CES expenditure shares are constant. For linear demand, *shape adjusted* expenditure shares are constant.

Within the CES model, recall that sub-utility is defined via,

$$U_{il}^{\frac{\sigma_i-1}{\sigma_i}} = \int_{\omega\in\Omega_{i,l}} \left(q_{i,l}^{c}(\omega)\right)^{\frac{\sigma_i-1}{\sigma_i}} d\omega,$$

For any variety being sold from j to l in industry i, quantity sold the representative consumer is:

$$q_{ijl}^{c}(a) = (\sigma_i - 1)\frac{B_{il}}{L_l}\left(w_j a\right)^{-\sigma} t_{ijl}^{-\sigma}$$

Substituting into sub-utility and aggregating over source markets, we have:

$$U_{il}^{\frac{\sigma_i-1}{\sigma_i}} = \sum_{j=1}^{M} N_{ij}\int_{0}^{\left(\frac{B_{il}t_{ijl}^{-\sigma_i}}{w_j^{\sigma_i}F_{ill}}\right)^{\frac{1}{\sigma_i-1}}} \left((\sigma_i - 1)\frac{B_{il}}{L_l}\left(w_j a\right)^{-\sigma_i} t_{ijl}^{-\sigma_i}\right)^{\frac{\sigma_i-1}{\sigma_i}} dG_{ij}(a),$$

Imposing Pareto, simplifying, and imposing the definition of trade value, we get:

$$U_{il}^{\frac{\sigma_i-1}{\sigma_i}} = \sum_{j=1}^{M} L_l^{-\frac{\sigma_i-1}{\sigma_i}}\frac{(\sigma_i-1)^{\frac{\sigma_i-1}{\sigma_i}}}{\sigma_i} B_{il}^{-\frac{1}{\sigma_i}} V_{ijl}t_{ijl}$$

Noting that $\lambda_{il}^{ces} = B_{il}^{-\frac{1}{\sigma_i}}$, we have that:

$$U_{il}^{\frac{\sigma_i - 1}{\sigma_i}} = \sum_{j=1}^{M} L_l^{-\frac{\sigma_i-1}{\sigma_i}} \frac{(\sigma_i - 1)^{\frac{\sigma_i-1}{\sigma_i}}}{\sigma_i} \lambda_{il}^{ces} V_{ijl} t_{ijl}$$

Pulling terms out of the summation where possible, and imposing the sectoral optimization, we have:

$$U_{il}^{\frac{\sigma_i - 1}{\sigma_i}} = L_l^{-\frac{\sigma_i-1}{\sigma_i}} \frac{(\sigma_i - 1)^{\frac{\sigma_i-1}{\sigma_i}}}{\sigma_i} \frac{\lambda_{il}^{ces}}{\delta_l^{ces}}$$

Hence, in response to an arbitrary tariff shock, changes in sub-utility can be written as:

$$\widehat{U}_{il} = \frac{\sigma_i}{\sigma_i - 1} \left(\widehat{\lambda}_{il}^{ces} - \widehat{\delta}_l^{ces} \right)$$

This is almost identical the linear demand case, where $\widehat{\lambda}_{il}^{ces}$ and $\widehat{\delta}_l^{ces}$ are scaled by $\frac{\sigma_i}{\sigma_i - 1}$. The underlying $\widehat{\lambda}_{il}^{ces}$ and $\widehat{\delta}_l^{ces}$ may differ from linear demand given the non-homothetic nature of sub-utility in the latter.

Equivalent Variation

For completeness, I now prove that utility changes in CES are equal to changes to equivalent variation. To begin, the Lagrangian for the consumers problem is written as:

$$L^{ces} = \prod_{i=1}^{I} \left(\left(\int_{\omega \in \Omega_{i,l}} \left(q_{\omega,l}^c \right)^{\frac{\sigma_i-1}{\sigma_i}} d\omega \right)^{\frac{\sigma_i}{\sigma_i-1}} \right)^{\beta_{il}} + \lambda_l \left(I_l - \sum_{i=1}^{I} \int_{\omega \in \Omega_{i,l}} q_{\omega,l}^c p_{\omega,l}^c d\omega \right)$$

The first order condition for maximization for variety v is written as

$$\beta_{il} U_l U_{il}^{\frac{1-\sigma_i}{\sigma_i}} q_v^{-\frac{1}{\sigma_i}} = \lambda_l p_v$$

where we have substituted for total utility and sub-utility where possible. Multiplying both sides by q_v

$$\beta_{il} U_l U_{il}^{\frac{1-\sigma_i}{\sigma_i}} q_v^{\frac{\sigma_i-1}{\sigma_i}} = \lambda_l p_v q_v$$

and then summing integrating over all varieties v within industry i in country l, we have:

$$\beta_{il} U_l U_{il}^{\frac{1-\sigma_i}{\sigma_i}} \int_{\omega \in \Omega_{i,l}} q_\omega^{\frac{\sigma_i - 1}{\sigma_i}} d\omega = \lambda_l \int_{\omega \in \Omega_{i,l}} p_\omega q_\omega d\omega$$

Noting that $\int_{\omega \in \Omega_{i,l}} p_\omega q_\omega d\omega = \beta_{il} I_l$ due to CES being homothetic, and $\int_{\omega \in \Omega_{i,l}} q_\omega^{\frac{\sigma_i - 1}{\sigma_i}} d\omega = U_{il}^{\frac{\sigma_i - 1}{\sigma_i}}$ from the definition of subutility, we have:

$$\beta_{il} U_l U_{il}^{\frac{1-\sigma_i}{\sigma_i}} U_{il}^{\frac{\sigma_i - 1}{\sigma_i}} = \lambda_l \beta_{il} I_l$$

Simplifying:

$$U_l = \lambda_l I_l$$

In Appendix B, we showed that:

$$\widehat{U}_l = \lambda_l \frac{I_l}{v(\mathbf{p}_l, I_l)} \widehat{EV}_l$$

Thus, substituting U_l for v, we have the following result for CES preferences.

$$\widehat{U}_l = \widehat{EV}_l$$

D Monte Carlo Experiment of Bi-Linear Estimator

In section three, I estimate the following equation for each industry:

$$\Delta \log V_{jl} \;\; = \;\; (k_j + 1)\alpha_l - (k_j + 1)\Delta \log(t_{jl}) + D_j^x + D_l^m + u_{jl}$$

Complicating estimation is the interaction between two parameters to estimate, $(k_j + 1)$ and α_l, which requires a variety of exclusion restrictions to estimate all k_j's. To estimate the model I adopt the following four step procedure using maximum likelihood:

1. For each industry, estimate (22) using maximum likelihood (ML) restricting that $\alpha_l = 0$ for all l. (thereby eliminating the non-linearity within the specification)

2. Collect values of k_j, D_j^x, and D_l^m from the linear ML and use as starting values for the full estimation of (22).

3. Set starting values of α_l's at zero, so that the procedure starts at the linear ML optimum.

4. Estimate the non-linear ML using the same exclusions on D_j^x, and D_l^m from the restricted model, and excluding one α_l for identification of relative α_l's.

To provide a numerical analysis of this estimation strategy I conduct two simple monte carlo experiments. To begin, I randomly assign values for the parameters, fixed effects, and residuals as follows:

$$\begin{aligned} u_{jl} &\sim Uniform(-0.2, 0.2) \\ k_j &\sim Uniform(0, 15) \\ \alpha_l &\sim Uniform(-1, 1) \cdot k_j/50 \\ D_j^x &\sim Uniform(-0.5, 0.5) \\ D_l^m &\sim Uniform(-0.5, 0.5) \end{aligned}$$

Importantly, I embed a potential correlation between α_l and k_j, since otherwise ignoring the interactive effect would not contaminate the estimation of k_{ij}'s, which is the primary parameter to estimate.

The difference in each experiment is the degree of tariff variation. In the first, I adopt the following for random tariff variation:

$$t_{jl} = t_l \sim Uniform(-0.2, 0.2)$$

The key for the first monte carlo is that there is no bilateral tariff variation within markets. In the second, I allow for bilateral tariff variation:

$$t_{jl} \sim Uniform(-0.2, 0.2)$$

I run each monte carlo experiment 100 times. For each random sample, I estimate the model first ignoring α_l and only estimating $\widehat{k}_j$'s, and then when estimating both α_l's and $\widehat{k}_j$'s. Summary statistics for the experiment are presented in the following table:

Table A1: Monte Carlo Results
Average correlation and mean differences from true parameters

	Ignore α_l		Estimate α_l	
	$cor\left(k_j, \widehat{k}_j\right)$	$E\left(k_j - \widehat{k}_j\right)$	$cor\left(k_j, \widehat{k}_j\right)$	$E\left(k_j - \widehat{k}_j\right)$
No bilateral tariff variation	0.010612	-8.5622	0.7669	-5.3430
With Bilateral Tariff Variation	0.012057	-0.001723	**0.9927**	**0.01370**

Clearly, we can only recover the true parameter vector for k_j's when (1) there is bilateral tariff variation and (2) when we account for the interactive effect of α_l. However, when we have bilateral tariff variation within markets and also account for the latter effect, we get very good estimates for k_j's.

E Identification of Bi-linear Estimator

In section three, I introduce a new "gravity" specification to the trade literature, which takes the following form:

$$y_{jl} = \alpha_l \beta_j + x_{jl} \beta_j + d_j + m_l + u_{jl} \tag{33}$$

In (33), y_{jl} is the dependent variable to be estimated, which may vary across groups j and l. In the paper, this dependent variable represents trade value from j to l, but in the literature outside of trade it could represent some pair of demographic groups (e.g.. survival rate of age j in a specific region l).

On the right-hand side of (33), we have four vectors of parameters to estimate: d_j and m_l are group fixed effects to be estimated by j and l, β_j are j-specific coefficients on an independent variable x_{jl}, and α_l is an l-specific parameter that interacts with the j specific parameter, β_j. In the draft, β_j is a linear transformation of the productivity shape parameter, and α_l is a transformation of industry-market-specific consumer budget multipliers. Finally, u_{jl} is a disturbance term that varies by j and l.

The common form (33) takes in the literature does not include the independently varying x_{jl}, and hence, one cannot identify the full vector of α_l's or β_j's. However, in the body of the paper, x_{jl} represents changes to tariffs, which can vary by j and l. As I derive below, this will be crucial for identification of β_j terms, but will not help identify the α_l terms.

A Identification

To address the issue of identification, we will first assume that that there are MxM total observations, which matches the theoretical framework in the manuscript. Then, we execute two de-meaning procedures to reduce the number of parameters to be estimated. To begin, average (33) across l for some group j,

$$\overline{y}_j = \overline{\alpha} \beta_j + \beta_j \overline{x}_j + d_j + m_l + \overline{u}_j$$

where $\overline{y}_j = \frac{1}{M} \sum_{l=1}^{M} y_{jl}$, $\overline{x}_j = \frac{1}{M} \sum_{l=1}^{M} x_{jl}$, and $\overline{\alpha} = \frac{1}{M} \sum_{l=1}^{M} \alpha_l$. Subtracting these means from (33) for each j, we get:

$$y_{jl} - \overline{y}_j = (\alpha_l - \overline{\alpha}) \beta_j + (x_{jl} - \overline{x}_j) \beta_j + (m_l - \overline{m}) + (u_{jl} - \overline{u}_j) \tag{34}$$

Next, we take means of (34) for each country l, which yields

$$\sum_{j=1}^{M}\left(y_{jl}-\overline{y}_{j}\right)=\left(\alpha_l-\overline{\alpha}\right)\overline{\beta}+\frac{1}{M}\sum_{j=1}^{M}\left(x_{jl}-\overline{x}_{j}\right)\beta_j+\left(m_l-\overline{m}\right)+\frac{1}{M}\sum_{j=1}^{M}\left(u_{jl}-\overline{u}_{j}\right)$$

Defining $\tilde{y}_{jl}=y_{jl}-\overline{y}_{j}-\sum_{j=1}^{M}\left(y_{jl}-\overline{y}_{j}\right)$, we can now write the twice de-meaned bilinear specification as:

$$\tilde{y}_{jl}=\left(\alpha_l-\overline{\alpha}\right)\left(\beta_j-\overline{\beta}\right)+\left(x_{jl}-\overline{x}_{j}\right)\beta_j-\frac{1}{M}\sum_{h=1}^{M}\left(x_{hl}-\overline{x}_{h}\right)\beta_h+\tilde{u}_{jl} \tag{35}$$

Clearly, in (35), we cannot identify α_l's other than their deviations from the mean. However, it appears to be possible to identify β_j's individually given the bilateral nature of x_{jl}. To expand on this point, suppose that x_{jl}'s only varied by l, where $x_{jl}=x_l$ for all l, and $\overline{x}_j=\overline{x}$. With these restrictions, (35) becomes:

$$\tilde{y}_{jl}=\left(\alpha_l-\overline{\alpha}\right)\left(\beta_j-\overline{\beta}\right)+\left(x_l-\overline{x}\right)\left(\beta_h-\overline{\beta}\right)+\tilde{u}_{jl} \tag{36}$$

Hence, when there is no bilateral variation in x_{jl} within l, we can only identify β_j relative to its mean.

To examine the identification of β_j under more general conditions, we define $a_l\equiv\alpha_l-\overline{\alpha}$ and minimize the sum of squared residuals of

$$SSR=\sum_{j=1}^{M}\sum_{l=1}^{M}\left(\tilde{y}_{jl}-a_l\left(\beta_j-\overline{\beta}\right)-\left(x_{jl}-\overline{x}_{j}\right)\beta_j+\frac{1}{M}\sum_{h=1}^{M}\left(x_{hl}-\overline{x}_{h}\right)\beta_h\right)^2 \tag{37}$$

with respect to α_l's and β_j's.

Differentiating SSR with respect to β_j and setting equal to zero, we get:

$$\frac{dSSR}{d\beta_j}=\sum_{l=1}^{M}\left(\tilde{y}_{jl}-a_l\left(\beta_j-\overline{\beta}\right)-\left(x_{jl}-\overline{x}_{j}\right)\beta_j+\frac{1}{M}\sum_{h=1}^{M}\left(x_{hl}-\overline{x}_{h}\right)\beta_h\right)\left(a_l+\left(x_{jl}-\overline{x}_{j}\right)\right)=0 \tag{38}$$

Rearranging and stacking first-order conditions for β_j, and defining $z_{jl}=a_l+\left(x_{jl}-\overline{x}_{j}\right)$ we can write the solution to β_j's as a function of data and a_l's as follows:

$$\begin{bmatrix} \sum_{l=1}^{M} \tilde{y}_{1l} z_{1l} \\ \sum_{l=1}^{M} \tilde{y}_{2l} z_{2l} \\ \vdots \\ \sum_{l=1}^{M} \tilde{y}_{Ml} z_{Ml} \end{bmatrix} = \underbrace{\begin{bmatrix} -\frac{M-1}{M}\sum_{l=1}^{M} z_{1l}^2 & \frac{1}{M}\sum_{l=1}^{M} z_{1l}z_{2l} & \cdots & \frac{1}{M}\sum_{l=1}^{M} z_{1l}z_{ml} \\ \frac{1}{M}\sum_{l=1}^{M} z_{2l}z_{1l} & -\frac{M-1}{M}\sum_{l=1}^{M} z_{2l}^2 & & \\ \vdots & & \ddots & \\ \frac{1}{M}\sum_{l=1}^{M} z_{Ml}z_{1l} & & & -\frac{M-1}{M}\sum_{l=1}^{M} z_{Ml}^2 \end{bmatrix}}_{\mathbf{X}} \cdot \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_M \end{bmatrix} \tag{39}$$

Cleary, for a given set of a_l's we can identify a full set of β_j's if the matrix $\mathbf{X}$ is invertible. The matrix $\mathbf{X}$ is symmetric, and not generally degenerate. Hence, the nature of tariff variation will determine whether $\mathbf{X}$ is invertible. We will return to this in a moment after discussion a similar solution for α_l's.

Taking a derivative of SSR with respect to α_l, we get the following:

$$\frac{dSSR}{d\alpha_l} = \sum_{j=1}^{M}\left(\tilde{y}_{jl} - a_l\left(\beta_j - \overline{\beta}\right) - \left(x_{jl} - \overline{x}_j\right)\beta_j + \frac{1}{M}\sum_{h=1}^{M}\left(x_{hl} - \overline{x}_h\right)\beta_h\right)\left(\beta_j - \overline{\beta}\right) = 0$$

Simplifying and solving for α_l, we find that there is a unique solution given that there is variation in β_j's.

$$\alpha_l = \frac{\sum_{j=1}^{M}\left(\tilde{y}_{jl} - \left(x_{jl} - \overline{x}_j\right)\beta_j\right)\left(\beta_j - \overline{\beta}\right)}{\sum_{j=1}^{M}\left(\beta_j - \overline{\beta}\right)^2} \tag{40}$$

Together, (39) and (40) form a 2M system of non-linear equations. Given a_l's, there is a unique solution for β_j's, and given β_j's, there is a unique solution for a_l's.

Ideally, we would now apply a Fixed Point Theorem to prove that a unique solution exists. However, the overall fixed point problem for β_j's is still of high dimension and non-linear, so we move forward by running a large number of simulation exercises.

To be specific, I generate observed dependent variables y_{jl} according to (33) using randomly selected data and parameters according to the following distributions.

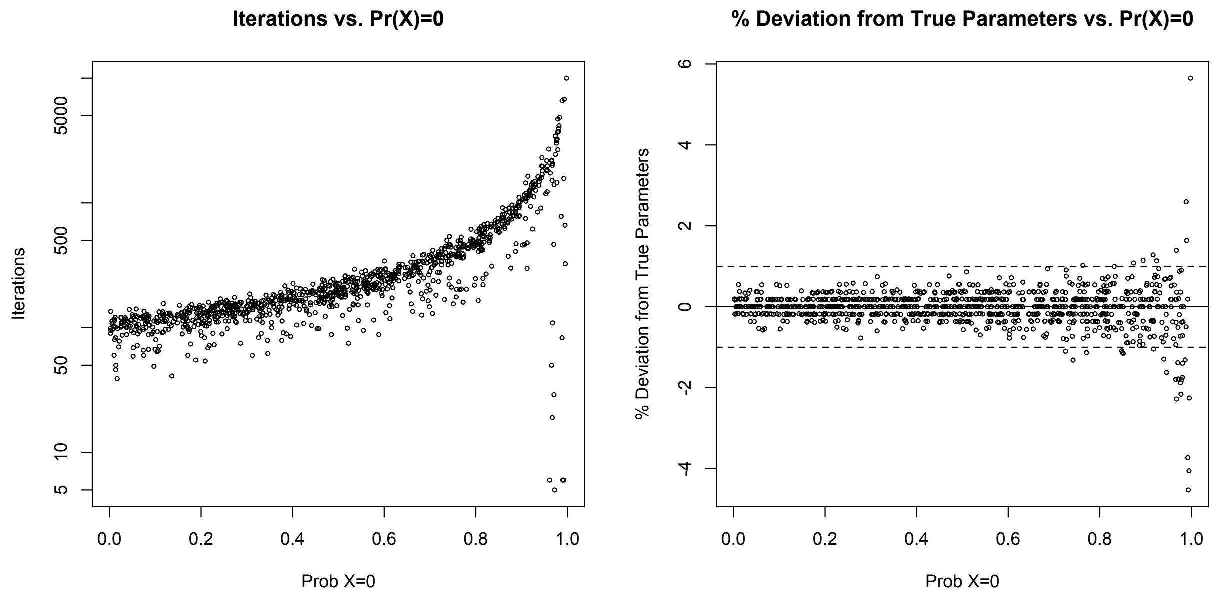
$$u_{jl} \sim Uniform(-0.1, 0.1)$$
$$x_{jl} \sim Uniform(-0.1, 0.1)$$
$$\beta_j \sim Uniform(-0.1, 0.1)$$
$$\alpha_l \sim Uniform(-0.3, 0.3)$$
$$d_j \sim Uniform(-0.1, 0.1)$$
$$m_l \sim Uniform(-0.1, 0.1)$$

Before calculating y_{jl}, I draw a random variable between 0 and 1 from a uniform distribution, and then randomly choose this share of values in x_{jl} to set equal to zero. Given that bilateral tariff variation is important for identification, $\Pr(x_{jl}) = 0$ is hypothesized to be inversely related to the strength of identification. How this probability relates to simulation diagnostics is the main goal of this section.

To execute each simulation with the generated dataset, I de-mean twice as indicated above (by row then by column), and then apply the iterative procedure defined by (39) and (40). Precisely, I impose that a_l's equal zero to start, first applying (39) at this starting value, and then using the solution within (40), and so on. The sequence ends when the mean square deviations of β_j's from the previous estimates changes less than the machine zero from one iteration to the next. At this stopping point, I evaluate the correlation between the β_j estimates and their true parameters, the average difference in means, and the number of iterations required for the stopping criteria to occur. In the left-panel of Figure 3, we find that the convergence iterations increase at an increasing rate as the degree of independent variation in x_{jl} falls. Once the degree of independent variation decreases to a very low level, the procedure may complete quickly, though as we'll see this occurs at a much higher level of error.

For every simulation, the correlation between estimates and actual values is equal to 1 (rounded to three significant digits), so the procedure has excellent performance in finding relative values of β_j's. Of course, this is possible even when there is no within-l variation in x_{jl} (as presented in equation 36), so we must also evaluate whether the β_j's are centered around their true parameters. These results are presented for all 1000 simulations in the right-panel of Figure 3. The results indicate that as long as there is minimal variation in x_{jl}, any deviance between the actual and true parameters is very small - less than 1% for

Figure 3: Summary Results from Iterative Fixed Point Solution



Notes: This figure reports results from the iterative procedure from this technical appendix. In the left panel, I present the relationship between the number of iterations until the stopping criteria is reached and the probability that each element of x_{jl} is equal to zero. In the right panel, I plot the average percent deviation from the true parameter value for each simulation against this same probability. All supporting R code is available upon request.

the great majority of observations. Further, any deviance around the true parameter is essentially zero when all simulations are averaged. Though only an example, the results in this simulation exercise shows that one can identify the true parameters of β_j's when there is sufficient variation in x_{jl}. Future work will examine more rigorously the theoretical properties of this type of estimator within a larger set of gravity models.

F Auxiliary Shape Regresions

In this Appendix, I present basic correlations between shape estimates and external measures to provide additional support that the shape estimates are sensible.

To begin, in Table D1, I show that shape estimates are negatively correlated with development (as measured by GDP per Capita), and Population. This implies that larger, more developed countries tend to have a better shape of firms. Adding country-industry factors such as capital-labor ratios and skill-unskilled labor ratios, I show that while there is a mild and negative relationship to capital intensity, the association is not significant at conventional levels. However, when controlling for both sets of fixed effects, we find that a higher share of skilled workers is positively associated with higher shape. This may be explained by countries and industries with more skilled workers being more responsive to shocks.

Table D1: Shape Parameters and Country-Industry Factors

Dep: k_{ij}	(1)	(2)	(3)	(4)
$\log(GDPPC_j)$	-0.319***	-0.318***	-0.317***	
	(0.028)	(0.028)	(0.039)	
$\log(Population_j)$	-0.327***	-0.330***	-0.309***	
	(0.028)	(0.029)	(0.028)	
$\log(Capital/Labor)_{ij}$		-0.043	-0.074	-0.089
		(0.054)	(0.054)	(0.058)
$\log(Skilled/Unskilled)_{ij}$			0.052	0.283***
			(0.084)	(0.096)
Observations	2,778	2,720	2,644	2,644
R^2	0.293	0.291	0.294	0.332
Fixed	Industry	Industry	Industry	Exp, Industry

Notes: Dependent variable is the estimated shape parameter k_{ij} for industry i in country j. Independent variables are obtained from the GTAP version 6 dataset. Population is defined as number of residents, and all other variables in terms of value.

In the final table, I regress the log of bilateral trade value from j to l in industry i on the estimated shape parameter for country j in industry i, industry fixed effects, and exporter fixed effects, for selected importers (to evaluate the stability of the relationships) In all cases, there is a significant, negative association between shape and bilateral trade values. This is intuitive, as a better shape of firms should correlate with larger trade flows.

Table D2: Bilateral Trade Values and Exporter Shape Parameters

Dep: $\log(V_{ijl})$	(1)	(2)	(3)	(4)	(5)	(6)
k_{ij}	-0.052^{**}	-0.081^{***}	-0.094^{***}	-0.075^{***}	-0.108^{***}	-0.077^{***}
	(0.023)	(0.022)	(0.030)	(0.023)	(0.022)	(0.028)
Observations	1,685	1,808	1,292	2,107	2,302	1,720
R^2	0.624	0.694	0.639	0.612	0.632	0.619
Importer	BRA	AUS	NZL	CHN	JPN	IND
Dep: $\log(V_{ijl})$	(7)	(8)	(9)	(10)	(11)	(12)
k_{ij}	-0.124^{***}	-0.095^{***}	-0.074^{***}	-0.100^{***}	-0.110^{***}	-0.122^{***}
	(0.022)	(0.020)	(0.023)	(0.019)	(0.018)	(0.021)
Observations	2,487	2,090	1,803	2,452	2,466	2,336
R^2	0.668	0.637	0.662	0.635	0.648	0.632
Importer	USA	CAN	MEX	GBR	DEU	FRA

Notes: Dependent variable is the log trade value from j to l in industry i. Independent variable is the estimated shape parameter for industry i in country j. All regressions include exporter fixed effects (to control for distance) and industry fixed effects. Robust standard errors.

G Full Tariff Counterfactual Tables

In this appendix, I present the the full set of results for all countries for all major multi-lateral counterfactuals. In each table to follow, in the first column, I report the percent change in welfare. In the second, I report the percent change in wages (relative to the numeraire restriction that world income equal unity). In the third column, I report the share of GTAP sectors that report an increase in product competition (λ_{il}). In the final column, I report the share of GTAP sectors that experience an increase in overall competition, as defined by the marginal domestic firm that operates in each market.

Table 7: Reversed Tariff Cuts from Uruguay Round

Country	$\%\Delta EV_l$	$\%\Delta w_l$	Share $\widehat{\lambda}_{il} > 0$	Share $\widehat{a}_{il} < 0$	Country	$\%\Delta EV_l$	$\%\Delta w_l$	Share $\widehat{\lambda}_{il} > 0$	Share $\widehat{a}_{il} < 0$
Albania	-1.00	-5.21	0.96	0.58	Philippines	-1.67	-1.60	0.89	0.46
Argentina	-0.38	-1.78	0.82	0.35	Poland	-0.32	1.62	0.00	0.05
Australia	0.04	0.65	0.02	0.09	Portugal	0.91	-3.36	0.95	0.39
Austria	0.01	-2.56	0.75	0.42	Romania	0.45	-1.81	0.93	0.37
Bangladesh	-3.66	2.45	0.00	0.12	Russia	-0.32	-0.71	0.75	0.16
Belgium	-0.01	-4.40	0.79	0.47	Singapore	-16.79	-5.20	0.79	0.46
Botswana	4.23	-5.15	0.91	0.75	Slovakia	-1.42	-1.27	0.81	0.35
Brazil	-0.16	7.10	0.02	0.07	Slovenia	-2.63	2.02	0.04	0.11
Bulgaria	-0.40	1.00	0.00	0.05	South Africa	-2.72	8.30	0.04	0.09
Canada	-0.18	0.41	0.09	0.18	Spain	-0.95	-1.76	0.79	0.30
Caribbean	-0.52	-1.93	0.82	0.39	Sri Lanka	2.56	-2.11	0.79	0.32
Chile	0.21	-1.69	0.89	0.46	Sweden	-0.88	-2.20	0.79	0.37
China	-0.38	8.29	0.00	0.04	Switzerland	-1.69	-1.83	0.81	0.42
Colombia	-0.17	-0.50	0.75	0.19	Taiwan	-3.45	1.14	0.02	0.12
Croatia	-0.23	-3.50	0.96	0.74	Tanzania	-0.67	-1.21	0.86	0.28
Cyprus	-1.46	-4.26	0.96	0.51	Thailand	-2.28	1.60	0.02	0.11
Czech Rep.	-1.36	-1.26	0.82	0.28	Tunisia	-1.06	-11.19	0.98	0.84
Denmark	-0.65	-1.98	0.61	0.30	Turkey	-1.37	-0.09	0.42	0.12
Estonia	3.98	-7.86	1.00	0.89	Uganda	-0.68	0.16	0.09	0.23
Finland	0.36	-3.11	0.93	0.42	United Kingdom	0.04	-2.62	0.95	0.40
France	-0.14	-2.22	0.86	0.30	United States	-0.17	0.70	0.00	0.04
Germany	0.08	-2.20	0.96	0.37	Uruguay	-0.58	-1.77	0.70	0.32
Greece	0.22	-1.39	0.81	0.28	Venezuela	-0.16	3.33	0.02	0.12
Hong Kong	-4.56	1.10	0.04	0.25	Vietnam	-18.13	0.11	0.09	0.18
Hungary	-0.29	-3.32	0.93	0.47	Zambia	1.30	-0.39	0.84	0.28
India	-4.02	14.16	0.00	0.02	Zimbabwe	-1.76	-5.57	0.96	0.56
Indonesia	2.94	1.28	0.07	0.16	Rest of Andean Pact	-0.53	0.23	0.04	0.16
Ireland	1.26	-3.34	0.77	0.49	Rest of Central America	-0.36	-3.00	0.93	0.49
Italy	-3.95	-1.22	0.79	0.21	Rest of East Asia	-4.39	10.68	0.00	0.02
Japan	0.26	-2.70	0.98	0.53	Rest of EFTA	-0.16	-4.87	0.93	0.53
Korea	2.47	0.61	0.02	0.18	Rest of Europe	-2.10	-5.13	0.86	0.49
Latvia	-2.07	1.86	0.02	0.09	Rest of Former Soviet Union	-0.27	-2.11	0.96	0.42
Lithuania	4.39	-10.45	1.00	0.93	Rest of FTA Americas	-0.76	1.87	0.00	0.04
Luxembourg	2.20	-4.36	0.88	0.44	Rest of Middle East	8.08	-1.21	0.68	0.32
Madagascar	2.41	-3.75	0.95	0.68	Rest of North Africa	0.39	-1.03	0.88	0.26
Malawi	-6.77	0.41	0.14	0.25	Rest of North America	-8.96	4.80	0.02	0.09
Malaysia	2.95	-4.72	0.89	0.70	Rest of Oceania	-3.51	-2.90	0.84	0.42
Malta	12.87	-5.66	0.91	0.56	Rest of South African CU	-2.53	-1.63	0.88	0.58
Mexico	0.38	-0.38	0.72	0.12	Rest of South African DC	-0.81	-0.90	0.86	0.28
Morocco	-0.33	3.59	0.00	0.04	Rest of South America	-0.46	0.01	0.07	0.11
Mozambique	-1.90	-2.31	0.88	0.53	Rest of South Asia	-0.57	-10.58	0.98	0.67
Netherlands	0.13	-3.50	0.81	0.40	Rest of Southeast Asia	-3.52	1.22	0.05	0.14
New Zealand	1.21	1.19	0.04	0.09	Rest of Sub-Saharan Africa	-17.92	7.25	0.00	0.00
Peru	-0.62	0.67	0.00	0.09					

Notes: In the first column, I report the percent change in welfare. In the second, I report the percent change in relative wages. In the third column, I report the share of GTAP sectors that report an increase in product competition (λ_{il}). In the final column, I report the share of GTAP sectors that experience an increase in overall competition, as defined by the marginal domestic firm that operates in each market.

Table 8: Simulated Impacts of the Complete Tariff Liberalization

Country	$\%\Delta EV_l$	$\%\Delta w_l$	Share $\widehat{\lambda}_{il} > 0$	Share $\widehat{a}_{il} < 0$	Country	$\%\Delta EV_l$	$\%\Delta w_l$	Share $\widehat{\lambda}_{il} > 0$	Share $\widehat{a}_{il} < 0$
Albania	1.23	-3.43	0.96	0.81	Philippines	0.65	0.91	0.11	0.51
Argentina	0.10	-0.99	1.00	0.89	Poland	0.55	-0.35	1.00	0.95
Australia	0.13	0.39	0.51	0.79	Portugal	-0.75	2.72	0.02	0.37
Austria	-0.08	1.20	0.23	0.56	Romania	0.64	1.52	0.04	0.44
Bangladesh	0.87	3.60	0.05	0.32	Russia	0.44	-2.26	1.00	0.98
Belgium	0.33	1.93	0.25	0.46	Singapore	7.19	2.38	0.33	0.61
Botswana	-7.10	4.34	0.14	0.23	Slovakia	0.55	0.06	0.65	0.91
Brazil	-0.02	-2.21	1.00	0.96	Slovenia	2.21	-0.31	0.95	0.89
Bulgaria	0.25	-1.97	1.00	0.93	South Africa	1.91	-4.20	0.98	0.93
Canada	0.12	-0.39	0.93	0.82	Spain	0.93	0.31	0.53	0.84
Caribbean	2.34	-5.99	1.00	0.98	Sri Lanka	-0.24	6.53	0.12	0.33
Chile	0.19	-0.81	1.00	0.79	Sweden	-0.11	1.88	0.14	0.56
China	0.42	-1.78	1.00	0.98	Switzerland	1.01	-0.23	0.98	0.93
Colombia	0.01	-0.80	1.00	0.86	Taiwan	1.51	0.25	0.37	0.74
Croatia	-0.19	0.33	0.19	0.56	Tanzania	0.26	-1.93	0.98	0.68
Cyprus	-0.83	3.83	0.09	0.26	Thailand	1.66	0.21	0.46	0.81
Czech Rep.	0.79	-0.83	0.98	0.93	Tunisia	7.00	0.50	0.18	0.58
Denmark	0.35	1.05	0.33	0.63	Turkey	1.63	-1.67	1.00	0.93
Estonia	-1.07	5.17	0.05	0.26	Uganda	1.62	-6.41	0.98	0.84
Finland	-0.21	2.07	0.04	0.53	United Kingdom	0.07	0.72	0.18	0.65
France	0.23	1.02	0.18	0.65	United States	0.12	-0.41	1.00	1.00
Germany	0.26	0.58	0.35	0.70	Uruguay	0.04	-2.21	1.00	0.86
Greece	-0.01	0.42	0.30	0.77	Venezuela	-0.50	-1.33	1.00	0.84
Hong Kong	1.73	1.18	0.18	0.58	Vietnam	8.49	-0.03	0.96	0.95
Hungary	-0.38	0.55	0.39	0.74	Zambia	-0.49	-0.61	0.95	0.65
India	2.12	-10.39	1.00	0.95	Zimbabwe	1.04	2.14	0.12	0.28
Indonesia	-0.01	-0.32	0.95	0.88	Rest of Andean Pact	-0.37	0.80	0.14	0.54
Ireland	1.38	1.13	0.37	0.61	Rest of Central America	-0.52	1.48	0.05	0.26
Italy	2.70	0.54	0.33	0.74	Rest of East Asia	2.06	-3.90	1.00	0.95
Japan	-0.03	2.34	0.00	0.54	Rest of EFTA	0.43	0.29	0.25	0.79
Korea	4.58	0.43	0.25	0.70	Rest of Europe	1.63	-2.72	1.00	0.95
Latvia	-0.45	2.53	0.12	0.58	Rest of Former Soviet Union	0.15	-0.56	0.98	0.93
Lithuania	-1.36	5.24	0.05	0.21	Rest of FTA Americas	0.22	-1.58	1.00	0.96
Luxembourg	0.32	1.22	0.25	0.61	Rest of Middle East	-6.44	1.88	0.00	0.16
Madagascar	-2.26	2.98	0.09	0.23	Rest of North Africa	0.15	-1.81	1.00	0.95
Malawi	1.56	0.33	0.21	0.53	Rest of North America	1.59	-4.52	1.00	0.74
Malaysia	-2.40	2.26	0.12	0.33	Rest of Oceania	-0.10	0.55	0.14	0.44
Malta	1.27	1.79	0.33	0.61	Rest of South African CU	-0.27	-1.92	0.89	0.68
Mexico	0.11	-1.51	1.00	0.93	Rest of South African DC	0.64	0.26	0.12	0.58
Morocco	0.88	-7.61	1.00	0.93	Rest of South America	-0.59	-0.75	0.91	0.77
Mozambique	-0.07	0.68	0.19	0.39	Rest of South Asia	0.09	-2.02	0.98	0.91
Netherlands	0.32	1.09	0.28	0.63	Rest of Southeast Asia	1.54	-1.83	0.96	0.88
New Zealand	0.22	1.18	0.21	0.53	Rest of Sub-Saharan Africa	13.68	-5.66	1.00	1.00
Peru	0.12	-1.63	1.00	0.89					

Notes: In the first column, I report the percent change in welfare. In the second, I report the percent change in relative wages. In the third column, I report the share of GTAP sectors that report an increase in product competition (λ_{il}). In the final column, I report the share of GTAP sectors that experience an increase in overall competition, as defined by the marginal domestic firm that operates in each market.

Table 9: Simulated Impacts of the Transpacific Partnership

Country	$\%\Delta EV_l$	$\%\Delta w_l$	Share $\widehat{\lambda}_{il} > 0$	Share $\widehat{a}_{il} < 0$	Country	$\%\Delta EV_l$	$\%\Delta w_l$	Share $\widehat{\lambda}_{il} > 0$	Share $\widehat{a}_{il} < 0$
Albania	0.02	-0.05	0.98	0.67	Philippines	0.00	-0.04	0.89	0.58
Argentina	0.00	-0.08	0.96	0.67	Poland	0.06	-0.15	1.00	0.95
Australia	-0.01	0.18	0.21	0.63	Portugal	0.03	-0.03	0.96	0.65
Austria	0.04	-0.08	0.96	0.91	Romania	0.08	-0.13	1.00	0.91
Bangladesh	0.00	0.33	0.02	0.18	Russia	0.00	-0.02	0.82	0.35
Belgium	0.11	-0.05	0.91	0.61	Singapore	0.13	0.43	0.23	0.40
Botswana	0.00	-0.05	0.89	0.58	Slovakia	0.01	-0.04	0.82	0.32
Brazil	0.00	-0.07	1.00	0.72	Slovenia	0.00	-0.04	0.91	0.47
Bulgaria	0.01	-0.15	1.00	0.93	South Africa	0.01	-0.07	0.96	0.75
Canada	0.03	-0.07	0.96	0.81	Spain	0.02	0.02	0.00	0.09
Caribbean	0.03	-0.03	0.88	0.46	Sri Lanka	-0.01	-0.03	0.84	0.53
Chile	-0.08	0.05	0.19	0.42	Sweden	0.04	-0.06	0.95	0.79
China	0.03	-0.14	1.00	0.93	Switzerland	-0.01	-0.06	0.96	0.61
Colombia	0.01	-0.08	1.00	0.65	Taiwan	-0.09	0.03	0.05	0.19
Croatia	0.05	-0.05	0.96	0.70	Tanzania	-0.02	0.07	0.12	0.23
Cyprus	0.00	-0.05	0.93	0.58	Thailand	-0.15	-0.05	0.89	0.72
Czech Rep.	0.03	-0.11	1.00	0.95	Tunisia	0.07	-0.02	0.86	0.35
Denmark	0.00	0.03	0.04	0.09	Turkey	0.02	-0.08	0.98	0.77
Estonia	-0.04	0.03	0.04	0.12	Uganda	-0.11	0.07	0.05	0.09
Finland	0.02	-0.04	0.91	0.53	United Kingdom	0.04	-0.02	0.86	0.40
France	0.05	-0.03	0.93	0.49	United States	0.00	-0.06	1.00	0.95
Germany	0.03	-0.08	0.98	0.88	Uruguay	-0.04	-0.21	0.98	0.84
Greece	0.03	0.00	0.54	0.16	Venezuela	0.06	-0.06	0.96	0.49
Hong Kong	-0.08	-0.02	0.81	0.25	Vietnam	0.63	0.39	0.12	0.32
Hungary	0.01	-0.07	0.96	0.63	Zambia	-0.01	-0.04	0.96	0.51
India	-0.02	0.33	0.00	0.05	Zimbabwe	-0.02	0.03	0.11	0.18
Indonesia	-0.16	-0.31	0.96	0.91	Rest of Andean Pact	0.00	-0.04	0.84	0.32
Ireland	0.01	-0.04	0.84	0.70	Rest of Central America	-0.03	0.00	0.58	0.09
Italy	0.03	0.00	0.54	0.19	Rest of East Asia	-0.11	0.14	0.00	0.09
Japan	0.09	0.34	0.02	0.47	Rest of EFTA	0.02	-0.03	0.88	0.40
Korea	0.02	-0.06	0.95	0.65	Rest of Europe	-0.01	-0.01	0.67	0.25
Latvia	0.09	-0.16	0.98	0.91	Rest of Former Soviet Union	0.00	-0.06	0.98	0.82
Lithuania	0.01	-0.08	0.95	0.70	Rest of FTA Americas	-0.03	-0.04	0.88	0.35
Luxembourg	0.06	-0.04	0.88	0.44	Rest of Middle East	-0.01	-0.05	0.98	0.72
Madagascar	0.04	-0.05	0.91	0.53	Rest of North Africa	0.04	-0.14	1.00	0.95
Malawi	-0.02	0.03	0.07	0.21	Rest of North America	-0.30	0.11	0.02	0.12
Malaysia	-0.63	0.16	0.25	0.58	Rest of Oceania	-0.20	0.24	0.00	0.09
Malta	0.55	-0.27	0.96	0.72	Rest of South African CU	0.03	-0.09	0.95	0.72
Mexico	0.01	-0.24	1.00	0.98	Rest of South African DC	0.09	-0.08	1.00	0.72
Morocco	0.08	-0.13	0.98	0.88	Rest of South America	0.01	-0.08	0.95	0.74
Mozambique	-0.02	-0.02	0.84	0.30	Rest of South Asia	-0.02	-0.03	0.95	0.65
Netherlands	0.06	-0.05	0.93	0.58	Rest of Southeast Asia	0.08	0.04	0.11	0.25
New Zealand	0.11	0.81	0.07	0.32	Rest of Sub-Saharan Africa	0.12	-0.05	0.93	0.79
Peru	0.07	-0.50	1.00	0.88					

Notes: In the first column, I report the percent change in welfare. In the second, I report the percent change in relative wages. In the third column, I report the share of GTAP sectors that report an increase in product competition (λ_{il}). In the final column, I report the share of GTAP sectors that experience an increase in overall competition, as defined by the marginal domestic firm that operates in each market.

Counterfactuals: Linear vs. CES

To run counterfactuals within the CES framework, along with using the tariff elasticities estimated in section three of the manuscript, I need to assign a value for σ_i's. To continue the focus on the role of shape variation as opposed to other factors, I assume that $\sigma_i = 4$ for all i. After making this assumption, the only adjustment that must be made to the multi-sector model in Appendix A is using expenditures in the sectoral optimization condition rather than shape adjusted expenditures. After doing this, in Table 10, I compare all large multi-lateral tariff shocks in the linear model vs. the CES model. The results indicate that there are some major differences in all tariff shocks between the models, and the qualitative welfare effects of tariff shocks differ for around 10% of countries for each counterfactual. In terms of quantitative differences, consider a 10% increase in tariffs by all nations. For Columbia, the welfare loss under CES (-0.09%) is roughly half of that from the linear model (-0.20%). In contrast, for Malaysia, the welfare loss under CES (-1.60%) is worse than in the linear model (-1.30%). Exploring the differences and potentially unifying the features of these models will be a fruitful area of future work.

Table 10: Welfare Effects ($\%\Delta EV_l$) - Linear Demand vs. CES

Country	10% ⇑		Reverse 94-00		Remove All		Country	10% ⇑		Reverse 94-00		Remove All	
	Linear	CES	Linear	CES	Linear	CES		Linear	CES	Linear	CES	Linear	CES
Albania	1.71	3.66	-1.00	-1.26	1.23	1.39	Philippines	-3.90	-2.32	-1.67	-0.97	0.65	0.43
Argentina	-0.17	-0.13	-0.38	-0.41	0.10	0.10	Poland	0.18	0.23	-0.32	-0.25	0.55	0.57
Australia	-1.08	-0.97	0.04	0.20	0.13	0.09	Portugal	0.54	0.46	0.91	1.30	-0.75	-1.07
Austria	1.82	2.06	0.01	0.07	-0.08	-0.23	Romania	0.74	1.86	0.45	0.80	0.64	0.46
Bangladesh	0.38	0.78	-3.66	-5.11	0.87	0.34	Russia	-0.95	-0.94	-0.32	-0.30	0.44	0.38
Belgium	-0.18	-0.25	-0.01	0.23	0.33	-0.05	Singapore	-27.66	-16.18	-16.79	-10.73	7.19	4.68
Botswana	-2.83	-2.82	4.23	5.72	-7.10	-8.52	Slovakia	-1.28	-1.32	-1.42	-1.58	0.55	0.39
Brazil	-0.46	-0.19	-0.16	-0.11	-0.02	-0.09	Slovenia	-3.96	-4.90	-2.63	-3.03	2.21	2.27
Bulgaria	-0.11	0.05	-0.40	-0.45	0.25	0.27	South Africa	-1.35	-1.50	-2.72	-4.41	1.91	3.36
Canada	-0.52	-0.46	-0.18	-0.22	0.12	0.14	Spain	-1.03	-1.09	-0.95	-0.79	0.93	0.86
Caribbean	0.37	0.04	-0.52	-0.21	2.34	2.44	Sri Lanka	0.67	0.04	2.56	2.45	-0.24	-1.55
Chile	-2.02	-1.70	0.21	0.66	0.19	0.00	Sweden	-0.75	-1.06	-0.88	-0.87	-0.11	-0.21
China	-0.95	-0.83	-0.38	-0.33	0.42	0.42	Switzerland	-2.03	-1.67	-1.69	-1.88	1.01	1.03
Colombia	-0.27	-0.09	-0.17	-0.34	0.01	-0.24	Taiwan	-5.98	-6.67	-3.45	-3.70	1.51	1.69
Croatia	1.92	2.39	-0.23	-0.01	-0.19	-0.38	Tanzania	0.28	0.36	-0.67	-0.72	0.26	0.31
Cyprus	0.62	1.78	-1.46	0.21	-0.83	-1.73	Thailand	-11.79	-9.53	-2.28	-0.84	1.66	1.05
Czech Rep.	-1.27	-1.43	-1.36	-1.51	0.79	0.77	Tunisia	-5.00	-5.75	-1.06	-1.09	7.00	9.52
Denmark	-1.35	-1.61	-0.65	-0.69	0.35	0.26	Turkey	-3.00	-2.68	-1.37	-1.29	1.63	1.71
Estonia	1.89	0.76	3.98	2.94	-1.07	-1.20	Uganda	-0.20	0.37	-0.68	-0.33	1.62	1.47
Finland	-0.57	-0.52	0.36	0.30	-0.21	-0.36	United Kingdom	0.04	-0.11	0.04	-0.02	0.07	-0.01
France	0.40	0.30	-0.14	0.11	0.23	0.01	United States	-0.15	-0.09	-0.17	-0.19	0.12	0.14
Germany	0.16	-0.04	0.08	0.02	0.26	0.29	Uruguay	-0.37	-0.24	-0.58	-0.68	0.04	-0.04
Greece	1.66	1.85	0.22	0.38	-0.01	-0.08	Venezuela	0.19	0.40	-0.16	-0.26	-0.50	-0.82
Hong Kong	-6.17	-3.53	-4.56	-3.35	1.73	1.16	Vietnam	-31.62	-27.15	-18.13	-15.03	8.49	7.07
Hungary	-1.02	-0.26	-0.29	-0.09	-0.38	-0.63	Zambia	0.81	1.65	1.30	1.71	-0.49	-0.82
India	-2.63	-2.29	-4.02	-5.99	2.12	2.56	Zimbabwe	-0.47	0.06	-1.76	-1.27	1.04	0.38
Indonesia	-2.92	-2.64	2.94	4.15	-0.01	-0.20	Rest of Andean Pact	1.07	0.22	-0.53	-0.34	-0.37	-0.36
Ireland	-1.41	-1.79	1.26	1.33	1.38	1.42	Rest of Central America	-1.11	-0.65	-0.36	-0.38	-0.52	-0.73
Italy	-2.44	-2.55	-3.95	-3.97	2.70	2.97	Rest of East Asia	-8.01	-4.25	-4.39	-2.68	2.06	1.11
Japan	1.00	1.16	0.26	0.20	-0.03	-0.01	Rest of EFTA	0.34	0.54	-0.16	-0.18	0.43	0.43
Korea	-1.61	-0.99	2.47	3.39	4.58	5.34	Rest of Europe	-1.86	-0.43	-2.10	-1.17	1.63	1.51
Latvia	-4.99	-1.12	-2.07	0.88	-0.45	-0.97	Rest of Former Soviet Union	-0.10	-0.08	-0.27	-0.34	0.15	0.17
Lithuania	-1.06	-0.43	4.39	4.28	-1.36	-1.46	Rest of FTA Americas	-2.02	-1.46	-0.76	-0.38	0.22	0.04
Luxembourg	0.40	-1.47	2.20	1.29	0.32	-0.36	Rest of Middle East	-2.14	1.93	8.08	8.62	-6.44	-6.98
Madagascar	-0.39	-2.05	2.41	2.26	-2.26	-2.69	Rest of North Africa	0.63	0.27	0.39	-0.08	0.15	0.46
Malawi	-15.74	-5.01	-6.77	1.13	1.56	-1.31	Rest of North America	-16.25	-20.26	-8.96	-12.25	1.59	2.55
Malaysia	-1.35	-1.61	2.95	3.31	-2.40	-2.57	Rest of Oceania	-6.91	-4.19	-3.51	-1.59	-0.10	-0.94
Malta	24.36	24.61	12.87	11.60	1.27	2.90	Rest of South African CU	0.53	1.06	-2.53	-2.93	-0.27	0.22
Mexico	-0.05	-0.04	0.38	0.50	0.11	0.13	Rest of South African DC	0.52	2.21	-0.81	-0.26	0.64	0.02
Morocco	-1.22	-0.59	-0.33	0.01	0.88	0.56	Rest of South America	0.37	0.73	-0.46	-0.25	-0.59	-0.82
Mozambique	0.33	0.86	-1.90	-1.76	-0.07	-0.99	Rest of South Asia	-1.74	-1.93	-0.57	-0.11	0.09	-0.08
Netherlands	0.04	-0.25	0.13	0.32	0.32	0.07	Rest of Southeast Asia	-5.10	-1.92	-3.52	-2.57	1.54	1.06
New Zealand	-1.03	-0.88	1.21	1.83	0.22	0.20	Rest of Sub-Saharan Africa	-4.92	-8.17	-17.92	-20.30	13.68	14.93
Peru	0.15	0.24	-0.62	-0.64	0.12	-0.03							