A Second-Best Argument for Low Optimal Tariffs

Lorenzo Caliendo
Yale University, NBER

Robert C. Feenstra
UC Davis, NBER

John Romalis
University of Sydney, ABFER

Alan M. Taylor
UC Davis, NBER & CEPR

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Introduction

- President Trump pushed for protectionist tariffs
  - Chinese products first subject to higher tariffs were selected to minimize the direct impact on consumer prices
  - Producers faced the brunt of the tariffs on their imported inputs (Fajgelbaum, Goldberg, Kennedy and Khandelwal, 2020)
- In earlier work (NBER WP 21768: 2015, 2017, 2020) on the Uruguay Round tariff cuts, we calculated countries' individually-optimal tariffs in 1990 and found that they were surprisingly low (even negative). Why?
  - Quantitative model had input-output linkages with a nontraded sector
  - Second-best tariffs were applied on traded intermediate inputs (only)
  - We used the EORA global database with many small countries
- To understand our earlier results, we investigate the second-best role for uniform tariffs on intermediate inputs with a traded & nontraded sector, heterogeneous firms and roundabout production in both sectors; we also re-compute the optimal tariffs for each country using EORA for 2010

Brief Literature Review

- Gros (1987): tariffs are needed to offset domestic markups even in a "small country" monopolistic competition model with homogeneous firms
- With heterogeneous firms: Demidova and Rodríguez-Clare (2009) find a lower optimal tariff we call t^{opt}; Felbermayr, Jung and Larch (FJL, 2015); Costinot, Rodríguez-Clare and Werning (2020) generalize the tastes, technologies and allow for *nonuniform* tariffs
  - They find several instances of negative optimal tariffs on final goods
  - Haaland and Venables (2016) demonstrate a second-best role for reduced trade taxes to offset a monopoly distortion; Flam and Helpman (1987)
  - But this work has no IO linkages or nontraded sector
- Lashkaripour and Lugovsky (2020) generalize to many sectors and IO-linkages, but only provide *first-best* (with restricted entry) in the presence of IO-linkages; second-best without IO-linkages
- **Critical gap in the literature**: Second-best tariffs in the presence of IO-linkages (roundabout production) and endogenous entry

Road map

- Introduction
- Brief description of two-sector model
- First-best
  - Closed economy (uniform tax/subsidies)
  - Small open economy (uniform tax/subsidies + tariff)
- Second-best
  - Closed economy (restricted tax/subsidies)
  - Small open economy (uniform tariff only)
- Application to EORA in 2010: Quantitative results
- Conclusions and directions for further research

The Model

- Small open economy indexed by home i, foreign j (rest of the world)
  - 2 sectors, $s = 1$ tradable sector and $s = 2$ nontradable
- There is a mass L_i of identical consumers
  - Consume final goods with tradable share $\alpha_i \in (0, 1]$, utility

$$U_i = C_{i1}^{\alpha_i} C_{i2}^{1-\alpha_i}$$

- Sectoral outputs are Q_{i1} produced with intermediate varieties $q_{ki1}(\varphi)$ from the same sector, differentiated inputs are traded in sector 1

$$Q_{i1} \equiv \left(\sum_{k=i,j} N_{k1} \int_{\varphi^*_{ki1}}^{\infty} q_{ki1}(\varphi)^{\frac{\sigma_1 - 1}{\sigma_1}} g_1(\varphi) d\varphi \right)^{\frac{\sigma_1}{\sigma_1 - 1}}$$

  CES aggregator with elasticity $\sigma_1 > 1$
- Sectoral outputs – **"finished goods"** – are nontraded and used as inputs for the production of differentiated inputs in same sector

Differentiated Inputs

- **Intermediates** produced in each sector under monopolistic competition with heterogeneous productivities φ
  - In home country i, producers demand labor with share γ_{is} and the finished good from the same sector with share $1-\gamma_{is}$,

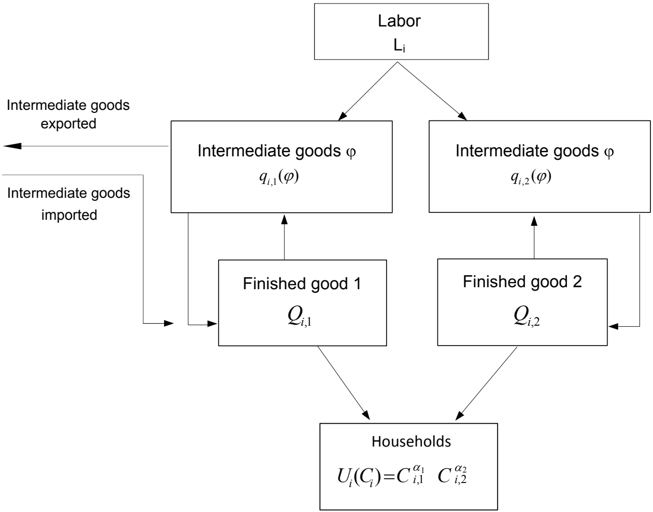
$$x_{is} \equiv (w_i)^{\gamma_{is}} (P_{is})^{1-\gamma_{is}} \tag{1}$$

  - Prices of home differentiated inputs are a markup over marginal costs

$$p_{iks} = \frac{\sigma_s}{\sigma_s - 1} \frac{x_{is}}{\varphi} \tau_{iks}$$

- **Free entry**: sunk and fixed costs f_{is}^E, f_{iis} and f_{ij1} paid in domestic labor
  - Upon entry, φ drawn from Pareto $G_s(\varphi) = 1 - \varphi^{-\theta_s}$ with $\theta_s > \sigma_s - 1$
  - Denote by φ^*_{iks} the cutoff or threshold productivity
  - Denote by N_{is} the mass of entering firms in i and sector s
  - The number of firms/products actually sold in sector s, from country i to country k is given by $N_{iks} = N_{is}{\varphi^*_{iks}}^{-\theta_s}$

Production structure



Tariffs

- One plus the *ad valorem* tariff $= t_{ji1}$ applied to i imports from j in sector 1
- Expenditure shares on imported differentiated inputs are given by

$$\lambda_{ji1} = {\varphi^*_{ji1}}^{-\theta_1} N_{j1} \left(\frac{\sigma_1}{\sigma_1 - 1} \frac{\tau_{ji1}\, w_j\, t_{ji1}}{\bar{\varphi}_{ji1}\, P_{i1}} \right)^{1-\sigma_1} \text{ and } \lambda_{ji2} \equiv 0$$

- The finished output in each sector has quantity Q_{is}, price index P_{is}, and value $Y_{is} \equiv P_{is} Q_{is}$, and expenditure on the finished good is

$$Y_{is} = \alpha_{is}(w_i L_i + B_i) + \tilde{\gamma}_{is} \left(\lambda_{iis} Y_{is} + \lambda_{ijs} Y_{js} \right), \tag{2}$$

with $\tilde{\gamma}_{is} \equiv (1 - \gamma_{is}) \left(\frac{\sigma_s - 1}{\sigma_s} \right) < 1$, and $B_i =$ tariff revenue

- Choose the foreign wage w_j as the numeraire, and then (Demidova and Rodríguez-Clare, 2013) the home wage is determined by trade balance

$$\text{Duty-free imports} = \frac{\lambda_{ji1} Y_{i1}}{t_{ji1}} = \lambda_{ij1} Y_{j1} = \text{Exports.}$$

Entry and tariffs

- The mass of entrants in sector 1 depends on country i domestic sales $\lambda_{ii1} Y_{i1}$ plus exports $\lambda_{ij1} Y_{j1} = (\lambda_{ji1} Y_{i1}) / t_{ji1}$, so we obtain

$$N_{i1} = \frac{\alpha_i(\sigma_1 - 1)}{f_{i1}^e \theta_1 \sigma_1} \left[\frac{L_i}{\frac{1-\alpha_i}{\Lambda_{ii1}} + (\alpha_i - \tilde{\gamma}_{i1})} \right], \Lambda_{i1} \equiv \left(\lambda_{ii1} + \frac{\lambda_{ji1}}{t_{ji1}} \right). \quad (3)$$

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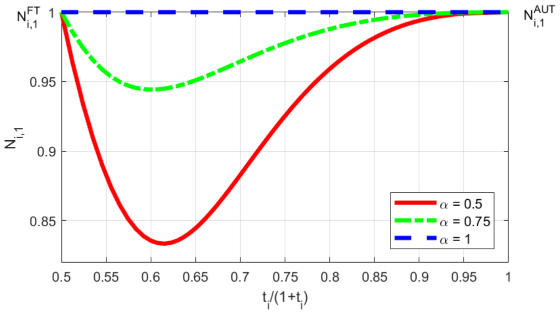
- The mass of entering firms in sector 2, N_{i2}, is a $\cap$-shaped function of the tariff, and is highest where B_i / w_i is maximized .

Sector 1 Entry and Tariffs



- Exit from the traded sector occurs due to **Lerner Symmetry** (Costinot and Werning, 2019): import tariff $\equiv$ export tax (in general equilibrium)
- Expect the same entry result in a Krugman model with a *nontraded* sector; but other research on the Krugman or Melitz-Ottaviano models has analyzed the *home-market or firm-delocation* effect, which occurs with a *traded* outside sector that pins down wages so the tariff *attracts* firms (Ossa, 2011; Bagwell and Staiger, 2015; Bagwell and Lee, 2020) (partial equilibrium)

First-best policy in closed economy

- Introduce a tax/subsidy to producers and consumers buying the finished good at rates t_s^p, t_s^c = one plus the *ad valorem* rates
- Maximize utility with the *cutoff productivities fixed in autarky*
- Use expressions for price index and income to solve for optimal taxes:

$$t_{is}^p = \left(\frac{\sigma_s - 1}{\sigma_s}\right) < 1, \tag{4}$$

$$\frac{t_{i1}^c}{t_{i2}^c} = \frac{t_{i1}^p}{t_{i2}^p}. \tag{5}$$

- Optimal producer subsidies counteract the mark-up on inputs
- Optimal consumption taxes/subsidies offset the markups on inputs but in *in relative terms*

First-best policy in small open economy

- One sector, no roundabout:
- Gros (1987): With monopolistic competition and homogeneous firms, tariffs are needed to offset domestic markups: $t_1 = \sigma_1 / (\sigma_1 - 1)$
- Demidova and Rodríguez-Clare (2009): t_1 has too few imported varieties due to an externality, so *equivalent* first-best policies are
  - $$t^*_{ii1} = \rho_1 \equiv \frac{\sigma_1 - 1}{\sigma_1} < 1 \quad \text{and} \quad t^*_{ji1} = \frac{\theta_1 \rho_1}{(\theta_1 - \rho_1)} < 1. \tag{6}$$
  - $$t^{opt} \equiv t_1 \times t^*_{ji1} = \frac{\theta_1}{(\theta_1 - \rho_1)} > 1. \tag{7}$$
  - OR divide both instruments in (6) by ρ_1:

$$\frac{t^*_{ii1}}{\rho_1} = 1, \quad \frac{t^*_{ji1}}{\rho_1} = t^{opt} = \frac{\theta_1}{(\theta_1 - \rho_1)} \quad \textit{and} \quad t^p_{i1} = \rho_1 < 1. \tag{8}$$

- **Question:** Is the policy in (8) first-best with roundabout production?

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- **Question:** Is the policy in (8) first-best with roundabout production?
- **Answer:** Not quite, because t^p_{i1} must also offset the optimal tariff!

First-best policy in closed economy

- To obtain first-best with roundabout, modify our assumptions so that *fixed and sunk costs in sector 1 are proportional to* x_{i1}

$$x_{is} = (w_i)^{\gamma_{is}} \left(t^p_{i1} P_{is}\right)^{1-\gamma_{is}} \tag{9}$$

- Then we find the first-best producer subsidy is

$$t^{p*}_{i1} = \rho_1 \left(\lambda_{ii1} + \frac{\lambda_{ji1}}{t^*_{ji1}} \right) < \rho_1 \text{ and } t^*_{ji1} = t^{opt} \text{ still holds!} \tag{10}$$

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  - They assume restricted entry, whereas (10) still holds with nontraded sector and endogenous entry, provided $t^{p*}_{i2} = \rho_2, \;\; t^{c*}_{i1} / t^{c*}_{i2} = t^{p*}_{i1} / t^{p*}_{i2}$

Second-best policy in closed economy

- Suppose only consumer taxes/subsidies can be used $(t_{is}^p \equiv 1)$
- Because of double-marginalization of the markups charged on differentiated outputs, the sector s elasticity σ_s effectively becomes $\tilde{\sigma}_{is} \equiv 1 + \gamma_{is}(\sigma_s - 1) \leq \sigma_{is}$ and the markup is $\frac{\tilde{\sigma}_{is}}{(\tilde{\sigma}_{is}-1)}$.
- The optimal consumption tax/subsidies are

$$\frac{t_{i1}^c}{t_{i2}^c} = \frac{\left(\frac{\tilde{\sigma}_1 - 1}{\tilde{\sigma}_1}\right)}{\left(\frac{\tilde{\sigma}_2 - 1}{\tilde{\sigma}_2}\right)} \quad \text{for} \quad \tilde{\sigma}_{is} \equiv 1 + \gamma_{is}(\sigma_s - 1). \tag{11}$$

- Optimal consumption taxes are inversely proportional to the *effective* monopoly distortions, amplified by roundabout.
- Second-best policy promotes the final output in sector with high roundabout production (low γ_s) or low substitution elasticity.

Second-best trade taxes: Two sectors and roundabout

- Only country i imposes tariffs and there are no other instruments, so we replace t_{ji1} with t_i, and denote the optimal tariff by t_i^*
- The absence of the producer subsidy is one reason to reduce $t_i^* < t^{opt}$. Second reason is *exit* from sector 1 as the tariff is raised from free trade.
- Totally differentiating utility w.r.t. the tariff, we find

$$\hat{U}_i = \alpha_i \left[\mathcal{E}_\phi \hat{\varphi}_{ij1}^* + D(t_i) \hat{N}_{i1} \right], \tag{12}$$

where $\mathcal{E}_\phi$ includes all the *selection effects* and $D(t_i)$ reflects entry into the traded sector *holding selection constant*:

$$D(t_i) = \left[\frac{\tilde{\sigma}_{i1}}{(\tilde{\sigma}_{i1} - 1)} - \frac{\tilde{\sigma}_{i2}}{(\tilde{\sigma}_{i2} - 1)} \frac{\Lambda_{ii1}(1 - \tilde{\gamma}_{i1})}{1 - \tilde{\gamma}_{i1} \Lambda_{ii1}} - \mathcal{E}_d \right] \tag{13}$$

  - The term $\frac{\Lambda_{ii1}(1-\tilde{\gamma}_{i1})}{1-\tilde{\gamma}_{i1}\Lambda_{ii1}} \leq 1$ reflects tariff revenue
  - $\mathcal{E}_d > 0$ because the tariff is an inefficient instrument to affect entry
  - So $D(t_i) > 0$ and exit from manufacturing harms welfare iff $\tilde{\sigma}_{i1} << \tilde{\sigma}_{i2}$, and then a reduced import tariff is needed to encourage entry.

Optimal second-best tariff

- The optimal second best tariff is a fixed point of the equation:

$$t_i^* = t^{opt} F(t_i^*), \text{ with } F(t_i) \equiv \left[\frac{1 - (1 - \gamma_{i1}) R(t_i)}{1 + (1 - \alpha_i) M(t_i)} \right], \tag{14}$$

- where $R(t_i)$ reflects roundabout in the traded sector

$$R(t_i) = \mathcal{R} \times \left[\frac{\theta_1 - \rho_1 (1 - \lambda_{ii1})}{\Lambda_{i1}} - \theta_1 \rho_1 \right] \quad \text{with} \quad \mathcal{R} > 0. \tag{15}$$

$M(t_i)$ reflects the monopoly distortion in the traded versus nontraded sector

$$M(t_i) \equiv \mathcal{M} \times \left(\mathcal{E}_m - \frac{(t_i - 1)}{t_i} \theta_1 \right) \frac{D(t_i)}{A(t_i)} \quad \text{with} \quad \mathcal{M} > 0, \ \mathcal{E}_m > 0, \tag{16}$$

and $A(t_i)$ is an "adjusted size" of the traded sector defined by

$$A(t_i) \equiv \alpha_i - \tilde{\gamma}_{i1} + (1 - \alpha_i) \mathcal{E}_a \quad \text{with} \quad \mathcal{E}_a > 0. \tag{17}$$

With no roundabout ($\gamma_{i1} = 1, \tilde{\gamma}_{i1} = 0$) then $A(t_i) = \alpha_i + (1 - \alpha_i) \mathcal{E}_a > 0$.

Theorem 1(a) and (b)

- The optimal second best tariff is a fixed point of the equation:

$$t_i^* = t^{opt}\, F(t_i^*), \text{ with } F(t_i) \equiv \left[\frac{1-(1-\gamma_{i1})R(t_i)}{1+(1-\alpha_i)M(t_i)}\right], \tag{18}$$

Theorem

(a) Pure roundabout: If $\alpha_i = 1$ and $\gamma_{i1} < 1$, then the optimal tariff is $t_i^* < t^{opt}$ with $R(t_i^*) > 0$.

(b) No roundabout: If $\gamma_{i1} = \gamma_{i2} = 1$ then (i) $D(t_i^*) > 0$ and the optimal tariff is $t_i^* < t^{opt}$ when

$$\sigma_1 < \sigma_2 \left[\frac{\sigma_1(\theta_1 - \rho_1)}{\sigma_1\theta_1 - \rho_1}\right] < \sigma_2, \tag{19}$$

(ii) if $\sigma_1 \geq \sigma_2$ then $D(t_i^*) < 0$ and the optimal tariff is $t_i^* > t^{opt}$.

Theorem 1(c)

Theorem

(c) Two sectors with roundabout: Assume that $\alpha_i < 1$ and the following two conditions hold:

$$\gamma_{i1} \geq \frac{1}{1 + \frac{\sigma_1}{\rho_1}(\theta_1 - \rho_1)(1 - \rho_1)}, \tag{20}$$

$$\alpha_i \geq \min\left\{ \tilde{\gamma}_{i1}, \frac{-\gamma_{i1}\theta_1 + \rho_1\left(1 + \frac{1-\gamma_{i1}}{\sigma_1\gamma_{i1}}\right)}{\frac{\theta_1(1-\rho_1)}{\rho_1} + \rho_1\left(1 + \frac{1-\gamma_{i1}}{\sigma_1\gamma_{i1}}\right)} \right\}. \tag{21}$$

Then $A(t_i) > 0$ for $t_i > t_i'$, where $t_i' < 1$ is an import subsidy. Furthermore, if there is enough roundabout production so that

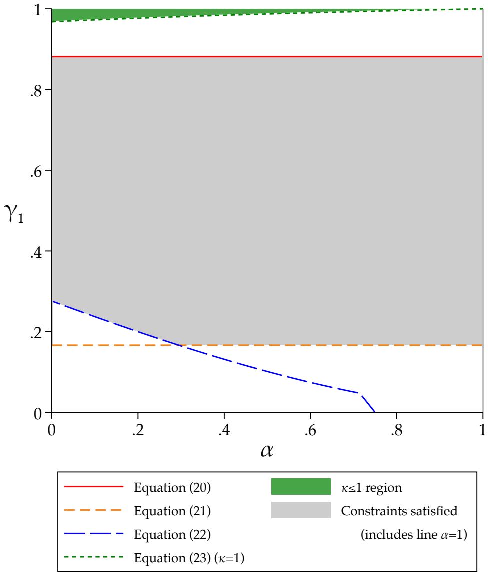
$$\gamma_{i1} \leq 1 - \frac{\rho_1}{[\theta_1(1-\rho_1) + \rho_1^2](\theta_1 - \rho_1)} < 1, \tag{22}$$

and the following bounds hold (where we specify and can compute κ_i):

$$\frac{(\tilde{\sigma}_{i1} - 1)}{\tilde{\sigma}_{i1}} < \kappa_i \frac{(\tilde{\sigma}_{i2} - 1)}{\tilde{\sigma}_{i2}}, \tag{23}$$

then the optimal tariff is $t_i^* < t^{opt}$ with $R(t_i^*) > 0$.

Parameter restrictions



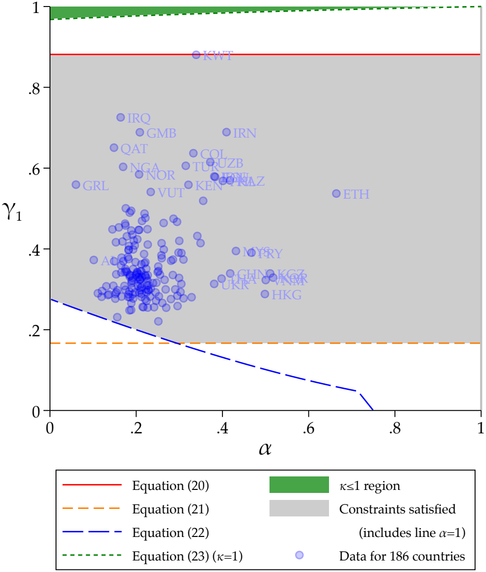
Quantitative Model - taking the model to the data

- Use 2010 EORA dataset (http://worldmrio.com)
  - 186 (usable) countries, 15 sectors, with national input-output tables
- **Goals:**
  - 1) Show that admissible region with two-sectors is empirically relevant
  - 2) Compute numerically optimal uniform tariffs from 15-sector model
- Need estimates of θ_s and σ_s
  - Caliendo and Parro (2015) sectoral elasticities: $\frac{\sigma_s \theta_s}{\sigma_s - 1} - 1$
  - Eaton, Kortum, and Kramarz (2008): $\frac{\theta_s}{\sigma_s - 1} \approx 1.5$
  - Back out θ_s and σ_s, but lower in services (Gervais and Jensen, 2019).

Table: Parameters by Broad Sector

Statistic	Agriculture (1 industry)	Mining (1 industry)	Manufacturing (8 industries)	Services (5 nontraded)
θ_s	8.61	13.03	5.05	2.70
σ_s	6.74	**9.69**	**4.36**	**2.80**
α_{is} (*median*)	0.01	0.00	0.20	0.79
γ_{is} (*median*)	0.51	0.46	0.28	0.56
$\tilde{\sigma}_{is} = 1 + \gamma_{is}(\sigma_s - 1)$ (*median*)	3.93	4.98	**1.96**	**2.01**

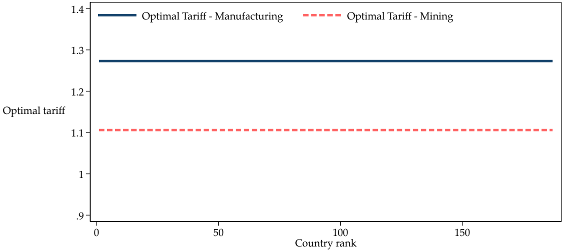
Goal 1: Parameter restrictions



Goal 2: Optimal tariffs

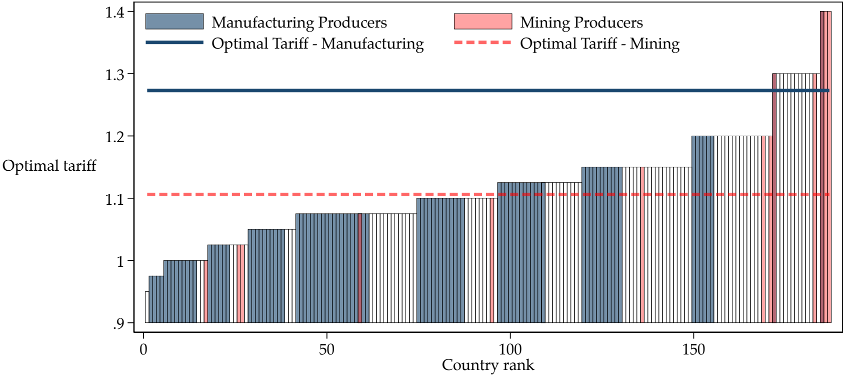
- Our earlier work (NBER WP) allowed for *nested CES*, with elasticity ω_s between the aggregate of domestic varieties and aggregate of imported varieties in the traded sectors, with $\omega_s = \sigma_s/1.25$
- When applied to a single traded sector, this gives a new formula for t^{opt} from Costinot, Rodríguez-Clare and Werning (2020):

$$t^{opt} = \frac{\omega_1}{\left[\omega_1 - \frac{(\sigma_1 - 1)}{\theta_1}\right]} = \begin{cases} 1.27 & \text{in Manufacturing} \\ 1.11 & \text{in Mining} \end{cases}$$



Goal 2: Optimal tariffs

- We compare the *one-sector* formula to the *numerically computed* optimal uniform tariffs in the 186-country, 15-sector EORA model



Conclusions

- We develop a new formula for the *second-best* optimal tariff t^* that includes two new terms:
  - M reflects the relative monopoly distortion in the traded sector relative to the nontraded sector, $M > 0$ reduces t^* but we could have $M < 0$ instead
  - R reflects roundabout production in traded sector, $R > 0$ reduces t^*
  - $t^* < t^{opt}$ for a wide range of (but not all) parameter values because even if $M < 0$ a small amount of roundabout, $R > 0$, overwhelms M
- In 186-country, 15-sector EORA model, we numerically compute t^* which has a median value of only 10% (or 7.5% for countries with above-median shares of manufacturing production), and is negative for five countries: *Bhutan, Myanmar, New Caledonia, Hong Kong, and Spain*
  - This compares with $t^{opt} = 27\%$ for the manufacturing sector, so $t^* < t^{opt}$ for nearly all countries specializing in manufactured exports
  - But for the OPEC countries, $t^* > t^{opt}$
  - *Resource exports* that are not used in final consumption were not covered by our model; those optimal tariffs may be influenced by *large-country* effects (or other second-best results across sectors)

Directions for further research

- **Theory:**
- Need to reconcile the differences between models with a nontraded second sector versus a traded second sector that pins down wages
- The former model means that starting from free trade, a tariff leads to **exit** from the traded sector due to Lerner symmetry (general equilibrium); while the latter model implies that a tariff leads to **entry** into the traded sector (partial equilibrium)
- What is the appropriate range of applications for each model?

- **Empirical:**
- In our quantitative results for 1990, we find that the optimal uniform tariff is negative for 10 countries: including China, Hong Kong, India, Israel, Vietnam, and five more remote countries
- The gains for these (and other) countries due to Uruguay Round tariff cuts + PTA's + WTO membership remain to be examined.