Tariff Reductions, Entry, and Welfare

Theory and Evidence for the Last Two Decades

Lorenzo Caliendo
Yale University, NBER

Robert C. Feenstra
UC. Davis, NBER

John Romalis
University of Sydney, NBER

Alan M. Taylor
UC. Davis, NBER

January 2018

Introduction

- There has been an unprecedented reduction in bilateral and multilateral trade tariffs over the last quarter century
  - *Uruguay Round* (Most-Favoured-Nation -MFN tariffs) and *PTA*'s (Preferential Trade Agreements) led to reductions in the level and dispersion of tariffs
- Yet, very little it is known about the quantitative effects of these actual tariff changes
  - Requires comprehensive commercial policy dataset
- In particular, the role that firm entry and production linkages play in shaping the effects from tariff changes
  - Requires extending quantitative trade policy frameworks

What is this paper about?

- Theory: We build on recent advances in trade and present a quantitative heterogeneous firms model for tariff policy evaluation
  - Multiple-country, multiple-sectors, intermediate goods and I-O linkages
  - Importantly, commercial policy influences **entry of firms** within sectors

- Quantitative evaluation *of Uruguay Round and PTA tariffs cuts*:
  - Many different tariff sources (e.g. TRAINS), including hand collection from the International Customs Tariffs Bureau (BITD)
  - Annual 1984-2011 ($T = 28$); World ($M = 189$ countries); SITC 4-digit
  - Major tariff reductions in advanced & emerging/developing
  - Bigger in the latter countries, and the real action starts circa 1990
  - Merge with global IO tables (EORA) with 15 industries

Our results

- We show and quantify how tariff policy affects the **entry margin**
  - Obtain analytical solutions in a two-sector, two-country model, and show conditions under which the **optimal unilateral import tariff is negative**
    - ★ Result crucially depends on the level of openness and production linkages
- We find that *Uruguay Round* generated larger trade and welfare effects than *PTA's*
  - Moving to Free-trade, Emerging/Developing countries gain more
  - Investigate the potential for *negative optimal tariffs* in the general quantitative model, which hold for about one-quarter of the countries

Road map

- Model
  - Quantitative multi-country model
  - Illustrative Two-Sector, Two-Country Model
- Tariff data
- Quantification of the trade and welfare effects of the Uruguay round and PTA's
- Conclusion

The Model

- M countries, indexed by i and j, and S sectors indexed by s and s'
- There is a mass L_i of identical agents in each country
  - Supply labor, consume final goods with share α^s, $\sum_{s=1}^{S} \alpha^s = 1$
- Sectoral outputs are nontraded and produced with intermediate varieties from the same sector

$$Q_{i,s} = \left[\left(Q_{i,s}^{H} \right)^{\frac{\omega_s - 1}{\omega_s}} + \left(Q_{i,s}^{F} \right)^{\frac{\omega_s - 1}{\omega_s}} \right]^{\frac{\omega_s}{\omega_s - 1}}$$

  - $Q_{i,s}^{H}$ is a CES aggregator over domestic varieties, elasticity $\sigma_s > 1$
  - $Q_{i,s}^{F}$ is a CES aggregator over foreign varieties, elasticity $\sigma_s > 1$ ▸ CES
- Sectoral outputs – **"finished goods"** – are used as materials, i.e. inputs, for the production of intermediate goods

The Model

- Intermediates produced in each sector under monopolistic competition with heterogeneous productivities φ
  - Producers demand labor $(\gamma_{i,s})$ and "materials" from all sectors $(\gamma_{i,s's})$
    - ★ "Materials" means domestic **finished goods** *from own sector and other sectors* (I-O) Caliendo and Parro (2015)

$$q_{i,s}(\varphi) = \varphi l_{i,s}(\varphi)^{\gamma_{i,s}} \prod_{s'=1}^{S} m_{i,s's}(\varphi)^{\gamma_{i,s's}},$$

- Free entry, fix entry cost $f_{i,s}^{E}$
  - Upon entry, φ is drawn from distribution $G_s(\varphi)$
  - We assume that $G_s(\varphi) = 1 - \varphi^{-\theta_s}$ with $\theta_s > \sigma_s - 1$

Production of Intermediates

- *Ad valorem* tariff $t_{ij,s}$ applied to the *revenue* of imports from i to j
  - Iceberg trade costs $\tau_{ij,s} \geq 1$ with $\tau_{ii,s} = 1$
- Firms face fixed fixed costs of exporting, $f_{ii,s} \leq f_{ij,s}$ for all $j \neq i$,paid in domestic labor
- Profits

$$\pi_{ij,s}(\varphi) = \max_{p_{ij,s}(\varphi) \geq 0} \left\{ \frac{p_{ij,s}(\varphi)}{1 + t_{ij,s}} q_{ij,s}(\varphi) - \frac{x_{i,s}}{\varphi} \tau_{ij,s} q_{ij,s}(\varphi) - w_i f_{ij,s} \right\}$$

where $x_{i,s} \equiv (w_i)^{\gamma_{i,s}} \prod_{s'=1}^{S} (P_{i,s'})^{\gamma_{i,s's}}$

Selection and Free Entry

- Selection (ZCP)
  - Denote by $\varphi^*_{ij,s}$ to the cutoff or threshold productivity
    - if $\varphi < \varphi^*_{ij,s}$ then firm is not active in country j
- Free Entry (FE)
  - Denote by $N_{j,s}$ the mass of entering firms to j in sector s
    - The number of firms/products actually sold in sector s, from country j, into market i is given by $N_{j,s}[1 - G_s(\varphi^*_{ji,s})] = N_{j,s}{\varphi^*_{ji,s}}^{-\theta_s}$
  - Free Entry (FE),with $w_i \equiv 1$,

$$L_i = \sum_{s=1}^{S} N_{i,s} f^E_{i,s} \left(\frac{\theta_s \sigma_s}{\sigma_s - 1} \right).$$

Illustrative Two-Sector, Two-Country Model

Adopt the simplest model that illustrates outcomes as trade costs vary

- Consider a two-country, two-sector model
  - Each country has a mass L agents, wlog $w_H = 1$
    - ★ Sector 1: monop. comp., traded inputs + labor
    - ★ Sector 2: perf. comp., no inputs, labor (no traded inputs)
  - **Consumption share of tradable** given by α
- *Ad valorem* **home** tariff $t_{FH} = t > 0$, iceberg costs $\tau_{ij} = \tau$
- Fixed costs $f_X \geq f_D$, f^E in sector 1 (zero in sector 2)
- Share of materials in production, $\gamma \equiv \gamma_{i,ss}$ with $0 < \gamma < 1$
  - Define $\tilde{\gamma} \equiv \frac{\sigma-1}{\sigma}\gamma$, $\Delta \equiv \frac{\alpha-\tilde{\gamma}}{1-\tilde{\gamma}} \leq 1$, $\kappa \equiv \frac{\theta}{\sigma-1} > 1$, $\kappa\Delta >< 1$.

Change in Welfare in the 2x2 Model

$$\left.\frac{dU_H}{U_H}\right|_{t=0} = \underbrace{-\frac{\alpha}{(1-\gamma)\theta}\frac{d\lambda_{HH}}{\lambda_{HH}}}_{\text{trade volume}} + \underbrace{\frac{\alpha(1-\lambda)}{(1-\gamma)\theta}(\kappa\Delta - 1)\,dt}_{\text{entry+selection}} + \underbrace{\frac{\alpha(1-\lambda)}{(1-\widetilde{\gamma})}dt}_{\text{tariff rebate}}.$$

Theorem

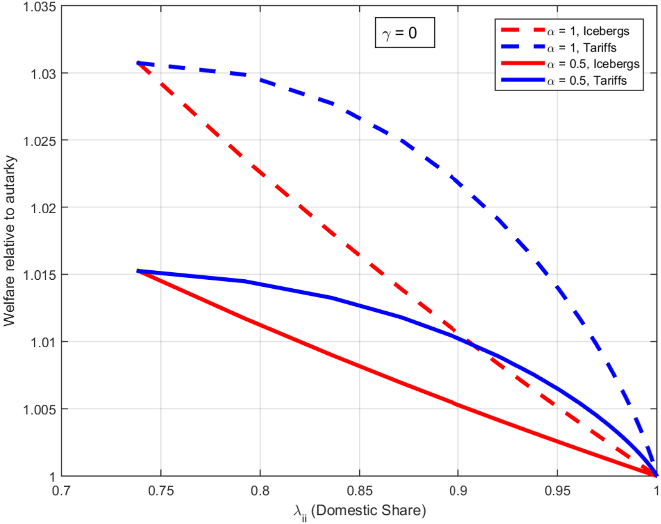
Iff

$$\tilde{\gamma} \equiv \gamma\left(\frac{\sigma-1}{\sigma}\right) > 1 - \left(\frac{2-\alpha}{\sigma+1-[(\sigma-1)/\theta]}\right),$$

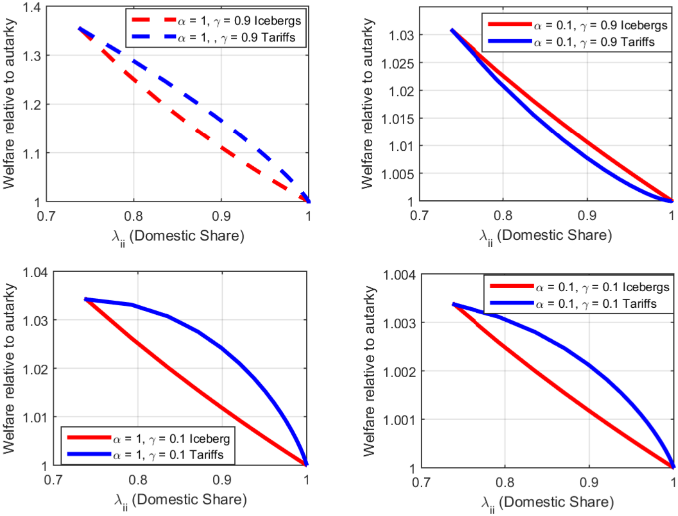
a small increase in the tariff t is worse than an increase in iceberg transport costs, namely $d\ln U_H < -\frac{\alpha}{(1-\gamma)\theta} d\ln\lambda_{HH}$.

This condition holds only if $\gamma > 0$ (production linkages are present) and $\alpha < 1$ (the service sector is present).

Welfare Iceberg versus Tariffs



Welfare Iceberg versus Tariffs (Role of Production linkages)



Small change in the Home tariff only around FTE

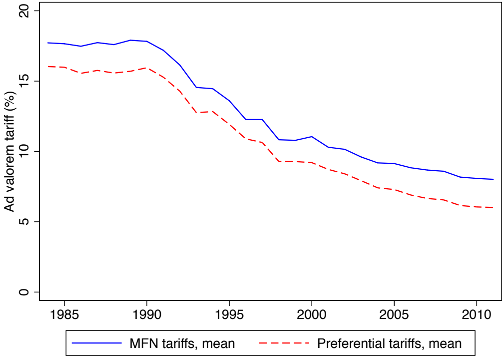
Theorem

(a) $\gamma = 0$ *(no linkages):* $\left.\frac{d \ln U_H}{dt}\right|_{\gamma=t=0} < 0$ *if* $\alpha < 1$ *and* λ *is sufficiently close to unity (remoteness);*
(b) $\gamma \to 1$ *(strong linkages):* $\left.\frac{d \ln U_H}{dt}\right|_{t=0,\lim_{\gamma\to 1}} < 0$ *for all* $0.5 < \lambda < 1$ *and* $\alpha \leq 1$.
It follows in either case that the ***optimal home tariff is negative****.*

Bottom line: Countries with more production linkages benefit more from lower tariffs

Bring New Tariff Data to Table

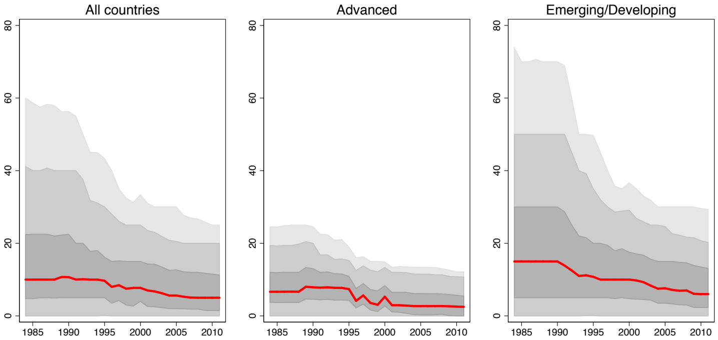
- Look at the raw MFN tariffs
  - About 1m obs per year in 1980s, rising to 2m by 2000s!
- Can see that both MFN and preferential tariffs fell, by about the same amount (7 pct.pt.: note that)



Tariff policy variation

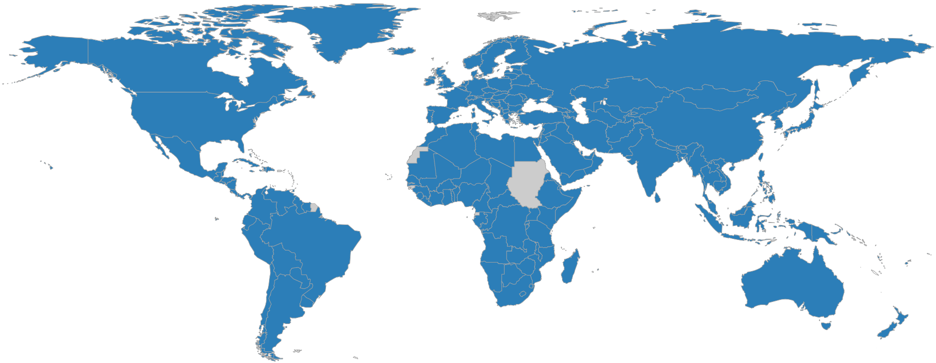
By region and year

- Remark: big declines in levels and dispersion in Em./Dev.
- Percentiles marked are 5/10/25/50(red)/75/90/95



Quantitative Model - taking the model to the data

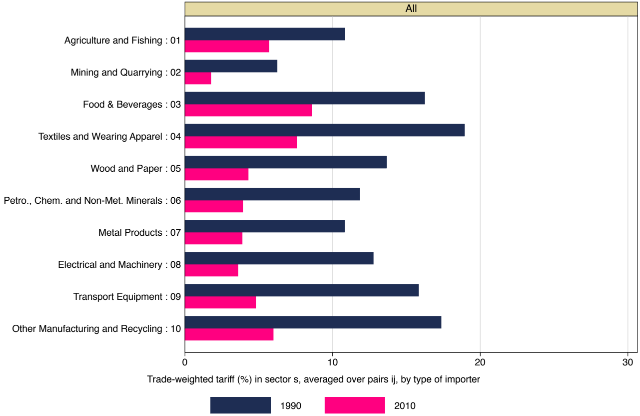
- Use 1990 EORA dataset (http://worldmrio.com)
  - Input-Output Matrix Data put to use for many countries
  - 189 countries, 15 sectors, with national input-output tables



Tariff policy variation - sectors

By sector and year

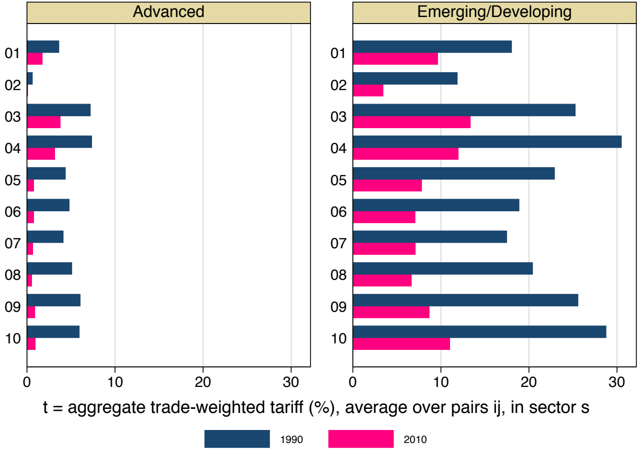
- Remark: big declines in most sectors



Tariff policy variation - sectors

By Region, Sector, and Year

- Remark: big declines in Em./Dev. all sectors



Quantitative Model - taking the model to the data

- Calibrate the model to assess the gains from tariff changes
  - In principle we need information on fixed costs: $f_{ij,s}$ and $f^E_{i,s}$ for all i, j, s
  - But compute the model in changes (hat notation $\hat{y} = y'/y$) ▸ hat
  - $M + 4SM + SM^2 = 547344$ equations and unknowns
- Need estimates of θ_s, σ_s, and ω_s
  - Eaton, Kortum, and Kramarz (2008): $\frac{\theta_s}{\sigma_s - 1} \approx 1.5$
  - Caliendo and Parro (2015) sectoral elasticities: $\frac{\sigma_s \theta_s}{\sigma_s - 1} - 1$
  - Back out θ_s and σ_s, but lower in services (Gervais and Jensen, 2013).

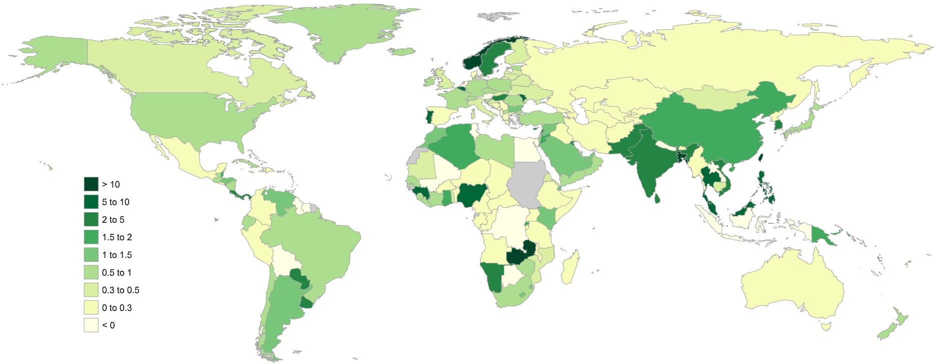
Sectors	$\frac{\sigma_s \theta_s}{\sigma_s - 1} - 1$	θ_s	σ_s
Agriculture and Fishing (1 sector)	9.1	8.6	6.7
Mining and Quarrying (1 sector)	13.5	13.0	9.7
Manufacturing Sectors (all 8 sectors)	5.5	5.0	4.4
Nontraded services (all 5 sectors)	—	2.7	2.8

Four Policy Experiments

- **Baseline** levels
  - 1990 actual = min(preference 1990, MFN 1990)
- **Uruguay Round** only
  - min(preference 1990, MFN 2010)
- **Uruguay Round + Preference**
  - 2010 actual = min(preference 2010, MFN 2010)
- **Free Trade** = set all tariffs to zero
- **Negative (optimal) Tariffs** = check country-by-country

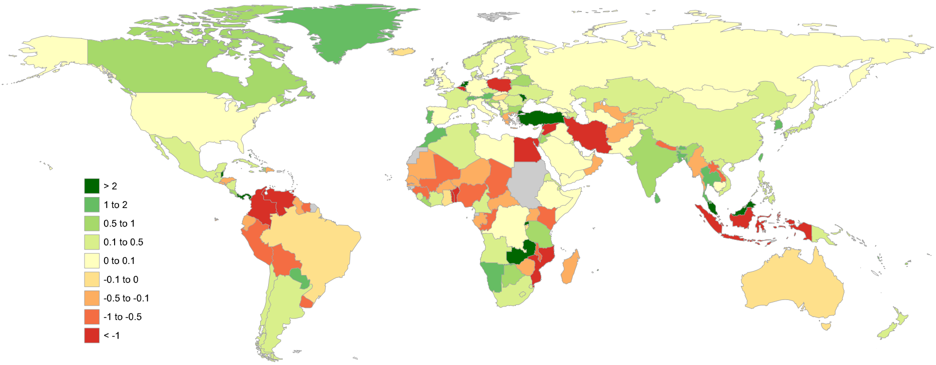
Welfare gains from actual tariff changes

Years 1990 - 2010, percentage change



Welfare gains from 2010 tariffs to Free trade

Percentage change



Negative Optimal Tariffs

- **Due to Strong Linkages (Theorem part (b)):**

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  - Belgium, France, Italy, Luxembourg, Portugal, Sweden, and also Malaysia and the Philippines (with Hungary on the borderline with a zero optimal tariff).

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- **Due to Strong Linkages (Theorem part (b)):**
  - Belgium, France, Italy, Luxembourg, Portugal, Sweden, and also Malaysia and the Philippines (with Hungary on the borderline with a zero optimal tariff).
- **Due to Remoteness (Theorem part (a)):**
  - Andorra, Angola, Aruba, Bahamas, Bahrain, Belarus, Belize, Brazil, British Virgin Islands, Brunei, Cameroon, Cayman Islands, Croatia, Cyprus, Czechia, Congo, Greenland, Haiti, Jamaica, Latvia, Liberia, Libya, Macao, Maldives, Mauritius, Moldova, Morocco, Namibia, Netherlands Antilles, New Caledonia, Palestine, Rwanda, San Marino, Sao Tome and Principe, Saudi Arabia, Slovenia, Syria and Yemen.

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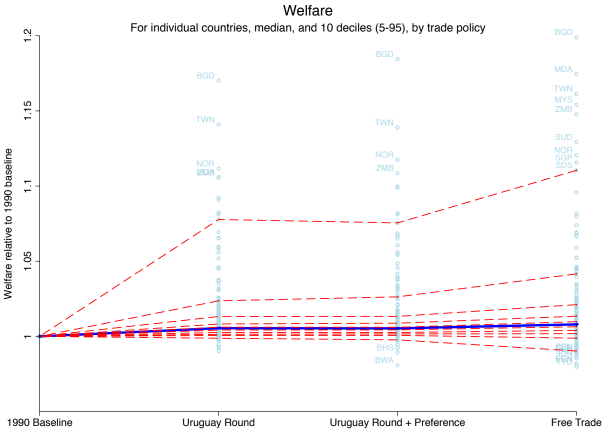
  - Andorra, Angola, Aruba, Bahamas, Bahrain, Belarus, Belize, Brazil, British Virgin Islands, Brunei, Cameroon, Cayman Islands, Croatia, Cyprus, Czechia, Congo, Greenland, Haiti, Jamaica, Latvia, Liberia, Libya, Macao, Maldives, Mauritius, Moldova, Morocco, Namibia, Netherlands Antilles, New Caledonia, Palestine, Rwanda, San Marino, Sao Tome and Principe, Saudi Arabia, Slovenia, Syria and Yemen.
- It appears that (some of) the countries with largest welfare gains are benefitting from their own tariff cuts rather than RoW tariff cuts

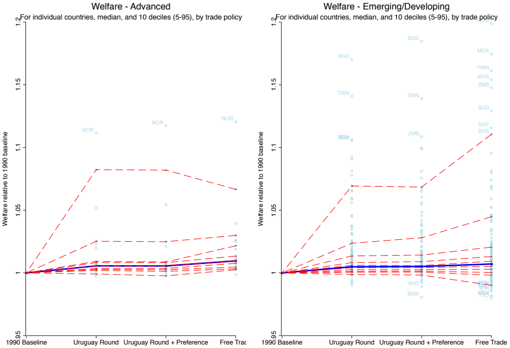
Welfare Effects

- Most of the gains are due to MFN tariff reductions (Uruguay round) compared to PTA's
  - The Uruguay round generated an average increase in world welfare of 1.43%, while the additional effect from PTAs was only 0.13%



Welfare: Advanced vs. Emerging/Developing

- Remark: Very heterogeneous welfare effects
- Advanced economies have less incentives to continue reducing tariffs compared to Emerging/Developing economies



Conclusion

- Tariff changes have major quantitative implications
  - Affect entry decisions of firms across markets, sectors
- Almost all the gains from tariff elimination in the last two decades result from the MFN tariff cuts in the Uruguay Round
  - Welfare gains are large, esp. for some EM/Dev countries
  - Yet, very heterogeneous
- Production linkages play a very important role for commercial policy design
  - Negative optimal tariffs

Finished good producer

- The cost minimization problem of the finished good producers in each sector s and country i is then

$$\min_{\{q_{ji,s}(\varphi)\}\geq 0} \sum_{j=1}^{M} N_{j,s} \int_{\varphi^*_{ji,s}}^{\infty} p_{ji,s}(\varphi)\, q_{ji,s}(\varphi)\, g_s(\varphi)\, d\varphi,$$

subject to

$$Q_{i,s} = \left[\left(N_{i,s} \int_{\varphi^*_{ii,s}}^{\infty} q_{ii,s}(\varphi)^{\frac{\sigma_s-1}{\sigma_s}}\, dG_s(\varphi) \right)^{\frac{\sigma_s(\omega_s-1)}{\omega_s(\sigma_s-1)}} + \left(\sum_{j\neq i}^{M} N_{j,s} \int_{\varphi^*_{ji,s}}^{\infty} q_{ji,s}(\varphi)^{\frac{\sigma_s-1}{\sigma_s}}\, dG_s(\varphi) \right)^{\frac{\sigma_s(\omega_s-1)}{\omega_s(\sigma_s-1)}} \right]^{\frac{\omega_s}{\omega_s-1}}$$

Back

Quantitative Model - relative changes

- Cost of the input bundle

$$\widehat{x}_{i,s} \equiv (\widehat{w}_i)^{\gamma_{i,s}} \prod_{s'=1}^{S} \left(\widehat{\tilde{P}}_{i,s'}\right)^{\gamma_{i,s's}}$$

- Price index

$$\widehat{\tilde{P}}_{i,s} = \left(\sum_{j=1}^{M} \lambda_{ji,s} \left[\widehat{\tau}_{ji,s}\widehat{x}_{j,s}(\widehat{1+t_{ji,s}})\right]^{-\theta_s} \hat{A}_{ji,s}\right)^{\frac{1}{-\theta_s}}$$

- Trade shares

$$\hat{\lambda}_{ji,s} = \frac{\left[\widehat{\tau}_{ji,s}\widehat{x}_{j,s}(\widehat{1+t_{ji,s}})\right]^{-\theta_s} \hat{A}_{ji,s}}{\sum_{j=1}^{M} \lambda_{ji,s} \left[\widehat{\tau}_{ji,s}\widehat{x}_{j,s}(\widehat{1+t_{ji,s}})\right]^{-\theta_s} \hat{A}_{ji,s}}$$

- Goods market

$$Y'_{i,s} = \sum_{s'=1}^{S} \gamma_{i,ss'} \frac{\sigma_s - 1}{\sigma_s} \sum_{j=1}^{M} \frac{\lambda'_{ij,s'}}{1+t'_{ij,s'}} Y'_{j,s'} + \alpha_{i,s}\left(w'_i L'_i + T'_i\right)$$

- Trade balance

$$\sum_{s=1}^{S} \sum_{j=1}^{M} \frac{\lambda'_{ji,s}}{1+t'_{ji,s}} Y'_{i,s} = \sum_{s=1}^{S} \sum_{j=1}^{M} \frac{\lambda'_{ij,s}}{1+t'_{ij,s}} Y'_{j,s},$$

where $\hat{A}_{ji,s} \equiv \hat{N}_{j,s}\left(\frac{\hat{w}_j(\widehat{1+t_{ji,s}})}{\hat{Y}_{i,s}}\right)^{\frac{\sigma_s - 1 - \theta_s}{\sigma_s - 1}}$, and entry given by $\hat{N}_{i,s} = \frac{\sum_{j=1}^{M} \widehat{\frac{\lambda_{ij,s}}{1+t_{ij,s}}} Y_{j,s}}{\hat{w}_i}$

Back