Measuring the Benefits of Global Liberalization with a Consistent Tariff Aggregator

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Overview

• Why we need to aggregate and why it’s a problem

• Theory

• Implementation

• Results
The reality

- Tariffs (and tariff equivalents) are highly diverse
  - Illustration the EU dairy sector

- Trade negotiations aimed to reduce tariff dispersion
  - Harmonizing formulas
The constraint

• Typically aggregate from 10,000 tariff lines to 20-25
  • Even largest databases, will have fewer than 40 traded sectors
  • Enormous waste of information

• Can we do better?
  • Yes we can
  • Yes we must
  • Have the theory and the data to do better
Caveats

- Tariff revenue?
  - Theoretical tariff revenue
    - Tariffs x Trade
    - Collected custom duties (but not customs revenue!)
  - Discrepancies:
    - Difference in trade… even in the sectoral value is right
    - Official tariff suspension/waivers
    - Unofficial tariff exemption (= corruption)
- What to do:
  - Focus on official tariffs (including preferences): it matters for trade negotiations
  - Discrepancies can be handle in the model but requires different modeling assumptions (marginal vs average collect efficiency)
How to aggregate

• Appropriate aggregator depends on the objective of aggregation
  • Weighted average tariff is *ad hoc*

• What possible objective function?
  • Expenditure
  • Tariff revenue
  • Mercantilist aggregator
    • Value of exports at world prices
National model

- Can characterize an economy using a *Balance of Trade* function

\[
B = e(p,u) - r(p,v) - z_p(p-p^w)
\]

- \(e(p,u)\) = Expenditure need to achieve utility \(u\)
- \(r(p,v)\) = Max revenue at price \(p\), with resources \(v\)
- \(z_p(p,u,v) = (e_p - r_p)(p-p^w)\) = Tariff revenues
Potential aggregators

- Expenditure aggregators
- Revenue (production) aggregators
- Tariff revenue aggregators
Expenditure (& qty) aggregators

- Assume imperfect substitution between different goods at tariff line or HS 6 category
  - For 2-stage budgeting, utility functions must be weakly separable & the sub-utility functions homothetic
    - But we assume this every time we use an aggregate
  - Then can write the expenditure function in terms of aggregated prices and quantities
- Within the group, expenditure increases with the tariff, but at a decreasing rate
  - Slope = $e_p$
Revenue aggregator

- Assume linear production possibility frontiers between varieties
  - No need to track production & trade of varieties
- In reality, conversion of apples into oranges on the supply side is not costless
  - May use a lower elasticity of substitution on the demand side to allow for this
- Or explicit modeling at a detailed level:
  - See Laborde and Gohin (2006) or Grant, Hertel and Rutherford (2008)
Tariff revenue aggregator

- Want a measure that takes account of the fact that increases in high tariffs reduce revenues by more than the quantity loss.

- Slope of the tariff revenue function:
  - \( e_p + (p-p^w) e_{pp} \)
  - Becomes negative for large enough tariff.
    - The “Laffer curve”
Diagrammatically

Exp, Rev

Fixed weight

Expenditure

Tariff Revenue

(p-p^w)=0

Price, (p-p^w)
Marginal impacts of a tariff reduction on expenditure and tariff revenue
Why aggregation matters: libn

• Within the group, a tariff cut reduces expenditure (good)
  • at the slope of the expenditure function, $e_p$
  • which determine quantities demanded, & terms-of-trade effects in a global model
• Tariff decline reduces revenue (bad)
  • at a rate given by the slope of the revenue function:
    • $e_p + (p - p^w) e_{pp}$
• Miss these within-group gains if we use the same aggregator for expenditure & revenue
Insights

- We need to capture changes in the price dispersion
  - True price index

- We need to capture the right “average” tariff
  - “trade” Weights are endogenous

- We aggregate over several dimensions:
  - Products
  - Exporters
  - Importers
To solve a global model

- **Walras’ law a problem at the global level**
  - Couldn’t solve as income didn’t equal expenditure
- **Jim Anderson distinguishes quantities at domestic \((u_i)\) & world prices \((x_i^*)\)**
  - \(u_i = x_i^*(1+\tau_i^R)/(1+\tau_i^e)\)
  - Which allows global adding up
    - \(u_i(1+\tau_i^e)p^w = x_i^*(1+\tau_i^R)p^w\)
Computing aggregates

- Compute the expenditure tariff aggregator $y$ using a domestic price index

\[ P = PCIF \star \left( \sum_i \alpha_i (1 + t_i)^{1-\sigma} \right)^{1/(1-\sigma)} \]

- So $\tau^e = \frac{P}{PCIF} - 1$
Tariff revenue aggregator

- Initial tariff
  \[ \tau_0^R = \frac{\sum v_i^0 \times t_i^0}{\sum v_i^0} \]
  - Where \( v_i \) is the value of imports of \( i \)

- Final tariff
  \[ \tau_1^R = \frac{\sum v_i^0 \left\{ \frac{1+t_i^0}{1+t_i^1} \right\}^\sigma}{\sum v_i^0 \left\{ \frac{1+t_i^0}{1+t_i^1} \right\}^\sigma} \times t_i^1 \]
Implementation

- Modify model to distinguish quantities at domestic and at world prices
- Calculate the expenditure and tariff revenue aggregators
- Simulate impacts of changes
Nesting structure

\[ M(i, r, s) \]
\[ M^1(i, r, n) \]
\[ M^2(hs6, r, n) \]
\[ x(hs6, m, n) \]
Parameter estimates needed

- Great uncertainty about the elasticity of substitution at the six-digit level.
- Averages:
  - Kee, Nicita & Olarreaga $\eta = 3.12$
  - Hummels & Klenow $\sigma_2 = 7.5$
  - Broda and Weinstein $\sigma_2 = 13$
- Consider $\sigma_1 = 2$ or $5$ in this initial study
- We ignore effects of new varieties
## Results: Global Libn, $bn (σ=2)

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<th>Standard</th>
<th>Aggregators</th>
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<td>Japan</td>
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<tr>
<td>World total</td>
<td>496</td>
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### Sensitivity to elasticity: DDA

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<th>Sig=5</th>
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<tr>
<td>Japan</td>
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<tr>
<td>World total</td>
<td>94</td>
<td>121</td>
<td>161</td>
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Conclusions

• Feasible to solve global models with efficient aggregators
  • Eliminates the need to throw away information
• Depending upon the elasticities, the impacts can be very substantial
  • 50% increase in global welfare gains with $\sigma=2$
• Serious need for estimates of this key elasticity
• This problem goes beyond tariffs