Ninth ARTNeT Capacity Building Workshop for Trade Research
"Trade Flows and Trade Policy Analysis"

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Cosimo Beverelli and Rainer Lanz
(World Trade Organization)
Partial-equilibrium (PE) trade policy analysis and simulation
Content

a. Market access analysis with PE modelling
b. Basic PE model for analyzing welfare changes
c. Empirical tool for trade policy simulations: SMART
a. Market access analysis with PE modelling

- **Rationale** for market access analysis
- **Rationale** for PE modelling
  - Advantages
  - Disadvantages
b. Basic PE model for analyzing welfare changes

- Derivation of social welfare function
- Perfect competition
  - Small open economy (SOE)
  - Large country
Social welfare

- Each consumer \( h \) has quasi-linear utility function \( c^h_0 + U^h(c^h) \)
- Budget constraint: \( c^h_0 + p'c^h \leq I^h \)
- FOC: \( 1 = \lambda \) and \( U' = \lambda p = p \) (demand for non-numeraire goods is independent of income)
- Demand functions are \( c^h = d^h(p) \) and \( c^h_0 = I^h - p'd^h(p) \)
- Welfare is defined as the sum of individual indirect utilities \( V^h \):

\[
W(p, I) \equiv \sum_{h=1}^{H} V^h = \sum_{h=1}^{H} \{I^h - p'd^h(p) + U^h[d^h(p)]\}
\]

- Notice that:
  - \( \sum_{h=1}^{H} I^h = I \) (total income)
  - \( \frac{\partial W}{\partial I} = 1 \) and (by envelope theorem) \( \frac{\partial W}{\partial p} = \sum_{h=1}^{H} -d^h(p) \equiv -d(p) \)
  - \( \sum_{h=1}^{H} \{-p'd^h(p) + U^h[d^h(p)]\} = CS \) (consumer surplus)
Social welfare (ct’d)

• To simplify, let there be only one good subject to specific tariff $t$
• World price is $p^*$ and $p = p^* + t$
• Numeraire good is freely traded at fixed world price of unity
• Labor is the only factor of production. Each unit of numeraire requires one unit of labor
  – Therefore, $w = 1$ and $WL = L$
• Output of the good subject to the tariff is $y$. Produced by firms with cost function $C(y)$ and marginal costs $C'(y)$
• Imports $m = d(p) - y$, with $d'(p) < 0$
• Tariff revenue $tm$ is redistributed to consumers
• Consumers are also entitled to profits from import-competing industry
  – Under perfect competition, $py - C(y) = PS$ (producer surplus)
  – Under imperfect competition, $py - C(y) = \pi$ (industry profits)
• Social welfare is then:

$$W(p, I) = W[p, L + tm + py - C(y)] \equiv W(t)$$
Social welfare (ct’d)

• How does social welfare vary with the tariff?

\[ dW = \frac{\partial W}{\partial p} dp + \frac{\partial W}{\partial I} dI \]

\[ dW = -d(p)dp + d[L + tm + py - C(y)] \]

\[ dW = -d(p)dp + mdt + tdm + pdy + ydp - C'(y)dy \]

\[ \frac{dW}{dt} = -d(p) \frac{dp}{dt} + m + t \frac{dm}{dp} \frac{dp}{dt} + y \frac{dp}{dt} + [p - C'(y)] \frac{dy}{dt} \]

\[ \frac{dW}{dt} = t \frac{dm}{dp} \frac{dp}{dt} - m \frac{dp^*}{dt} + [p - C'(y)] \frac{dy}{dt} \]  

(1)
Perfect competition, SOE

• Perfect competition implies that $p = C'(y)$
• SOE assumption implies that $dp^*/dt = 0$, therefore $dp = dt$ (there is full pass-through of the tariff to domestic price)
• Equation (1) simplifies to:

$$
\frac{dW}{dt} = t \frac{dm}{dp}
$$

• Since $\left.\frac{dw}{dt}\right|_{t=0} = 0$, the optimal tariff for a SOE is zero
Welfare loss from a tariff (SOE)

• Taking a second-order Taylor series approximation of welfare:

\[ W(t) \approx W(0) + t \frac{dw}{dt} \bigg|_{t=0} + \frac{1}{2} t^2 \frac{d^2W}{dt^2} \bigg|_{t=0} \]

\[ W(t) - W(0) \approx 0 + \frac{1}{2} t^2 \frac{dm}{dp} < 0 \]

• This is the deadweight loss (DWL). It can also be expressed as fraction of import expenditure \( pm \):

\[ \frac{W(t) - W(0)}{pm} \approx \frac{1}{2} \left( \frac{t}{p} \right)^2 \left( \frac{dm}{dp} \frac{p}{m} \right) \]

• E.g. with a 10% tariff and import demand elasticity (IDE) of 2, DWL (relative to import expenditure) is 1%
Perfect competition, SOE: graphical representation

- **CS loss** = -(a+b+c+d)
- **PS gain** = +a
- **Tariff revenues** = c
- **DWL** = b+d (also shown as triangle under import demand curve)

Home price rises by the amount of the tariff. Home supply increases and Home demand decreases → Imports fall from $M_1$ to $M_2$.
Perfect competition, large country

• Large country assumption implies that $dp^*/dt \neq 0$, therefore $dp/dt \neq 1$
  – $dp^*/dt < 0$ (intuitively, if a large country imposes a tariff it reduces its imports sufficiently to drive down the world price
  – $dp/dt < 1$ (intuitively, the pass-through of the tariff is not full, and foreign exporters absorb part of the tariff in the form of lower world price $(dp^*/dt < 0)$

• Equation (1) becomes:

$$\frac{dW}{dt} = t \frac{dm}{dp} \frac{dp}{dt} = -m \frac{dp^*}{dt}$$  \hspace{1cm} (2)

• Therefore:

$$\left. \frac{dw}{dt} \right|_{t=0} = -m \frac{dp^*}{dt} > 0$$

• A small enough tariff will necessarily raise welfare for a large country
• What does “large” mean?
Optimal tariff for large country

- “Large" means that the export supply is upward sloping (i.e. elasticity of export supply is finite – vs. SOE case in which export supply is horizontal, i.e. infinitely elastic)

- Optimal tariff $t^{opt}$ for such large country is computed where (2) equals 0:

$$\frac{dW}{dt} = 0 \Rightarrow \frac{t^{opt}}{p^*} = \left( m \frac{dp^*}{dt} \right) \left( \frac{dm}{dp} \right)^{-1}$$  \hspace{1cm} (3)

- Since domestic imports $m = \text{foreign exports} \; x$, $\frac{dm}{dp} \frac{dp}{dt} = \frac{dx}{dt}$. Therefore:

$$\frac{t^{opt}}{p^*} = \left( \frac{dx}{dp^*} \frac{p^*}{x} \right)^{-1}$$  \hspace{1cm} (4)

- Optimal % tariff is equal to the inverse of the export supply elasticity (XSE)
Optimal tariff for large country (ct’d)

- Alternatively, equation (4) can be re-arranged to yield:

\[
\frac{t^{opt}}{p} = \left( \frac{dm}{dp} \frac{p}{m} \frac{1}{IDE} \right)^{-1} \left( \frac{dp^*/dt}{dp/dt} \right)
\]

- Optimal % tariff is larger:
  - the smaller the pass-through \( dp/dt \)
  - (\( \Leftrightarrow \)) the larger the terms-of-trade (TOT) gain \( dp^*/dt \)
Optimal tariff for large country: graphical representation

- The increase in the domestic price is less than the tariff \( \frac{dp}{dt} < 1 \)
- Foreign exporters absorb part of the tariff \( \frac{dp^*}{dt} < 0 \): area “e” = TOT gain
- If the gain of e is greater than the DWL loss (b+d), Home gains
Empirical evidence

• **Broda et al. (2008)** find that prior to WTO membership, countries set import tariffs 9 percentage points higher on inelastically supplied imports relative to those supplied elastically

• See **bonus exercise** for a replication of their results

• See also the R. Feenstra, “Advanced International Trade” (Princeton, 2004), Chapter 7, Section “Tariffs on Japanese Trucks and Motorcycles” (pp. 233-240).
c. Empirical tool for trade policy simulations: SMART

- Chapter 4 of the *Practical Guide to TPA* discusses various empirical tools
- Here we use SMART (built-in in WITS)

SMART

- **Overview**
- **Theoretical underpinnings**
  - Export supply side
  - Demand side
- **Effects of policy changes**
  - Trade effects
  - Effects on Tariff Revenue, Consumer Surplus and Welfare

- More details and formulas in *Jammes and Olarreaga (2005)*
SMART example: Albania’s unilateral trade liberalization with the EU

- In 2007, Albania sourced buses (HS 870210) from 19 trading partners, of which 11 were European Union countries
- Albania levied tariffs from all sources, including the EU
- Using SMART, the user can simulate the effect of a full trade liberalization towards the EU, but not to the rest of the world
- SMART yields the results that all 11 EU countries would be able to increase their exports to Albania, for example Germany, the biggest exporter, by almost 1 million USD
- Non-EU countries, by contrast, would see their shares shrink, in particular the US, by about 0.3 million USD
- SMART results indicate that the tariff liberalization would:
  - Increase imports
  - Lower tariff revenues
  - Raise consumer surplus (Albania is a SOE)
- Results in this folder