Partial Equilibrium Model: An Example

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Outline

- Graphical Analysis
- Mathematical formulation
  - Equations
  - Parameters
  - Endogenous variables
- Use of benchmark data
- Calibration (of parameters)
- Simulation
Reference

- [http://www.intereconomics.com/handbook/Models/Index.htm](http://www.intereconomics.com/handbook/Models/Index.htm)
- Domestic and foreign goods are perfect substitutes (Chapter 5)
- Domestic and foreign goods are differentiated (Chapter 5)
- Multi-market, multi-region models (Chapter 8)
The **consumer surplus** measures what consumers gain by buying a good at a certain price while they would have been willing to buy it at a higher price.

The **consumer surplus** corresponds to the surface below the demand curve and above the line indicating the equilibrium price.
The effects of a tariff

The effect of a price reduction:

Consumers were willing to pay 12 dollars for 8 units of the product, but at the price of 10 dollars they will buy 10 units. The gain in consumer surplus due to the price reduction is indicated by the blue surface.
The effects of a tariff

The **producer surplus** corresponds to what producers gain by selling products at a certain price while they would have been willing to sell them at lower prices.

The **producer surplus** corresponds to the surface above the supply curve and below the line indicating the equilibrium price.
The effects of a tariff

The effect of a price increase on producers:

Producers are willing to sell 6 units at the price of 4 dollars. At the higher price of 6 dollars, they sell 9 units. The gain in producer surplus due to the price increase corresponds to the blue surface.
The effects of a tariff

An import tariff increases the domestic price of the relevant good:

- Domestic producers of the relevant good gain
- Domestic consumers of the good lose;
- The collected tariffs represent revenue for the government.

For the country the net effect of a tariff is negative
(see chart)
The effects of a tariff

Net loss induced by a tariff of size $a$

Consumer loss: the entire coloured surface
Producer gain: the blue surface
Government revenue: the green surface
Net loss for the country: the two red triangles
General Case

Deriving Import Demand Curve

World Market

P

M_s

M_d

Q

P

Q

Q_s

Q_d

Domestic Market
General Case

Determining world price and imports

World Market
General Case

Determining world price and imports

World Market

\[ \text{P}^*(1+t)w \]

\[ \text{P}^* \]

\[ \text{P}^*_w \]
Algebraic Representation

- Domestic Demand: $Q_d = \alpha(P)^\eta$
- Domestic Supply: $Q_s = \beta(P)^\varepsilon$
- Import Demand: $M_d = Q_d - Q_s = \alpha(P)^\eta - \beta(P)^\varepsilon$
- Import Supply: $M_s = \gamma(P_w)^\theta$
- Price Equation: $P = (1+t)*P_w$
Equilibrium Condition: Import Demand = Import Supply

\[ \alpha(P)\eta - \beta(P)\varepsilon = \gamma(P_w)^\theta \quad \text{... OR ...} \]

\[ A(P_w(1+t))^\eta - \beta(P_w(1+t))^{\varepsilon} - \gamma(P_w)^\theta = 0 \]
To a first approximation, the welfare change from trade policy changes is equal to:

\[
dW = - M(dP_w) + (P-P_w)(dM)
\]

- **Terms of trade effect**
  - Areas C + B
- **Harberger triangles**
  - Areas A+B
- **Areas A-C**
PARAMETERS:

\( \alpha = \) Constant in demand function
\( \beta = \) Constant in supply function
\( \gamma = \) Constant in import supply function
\( \varepsilon = \) Elasticity of supply
\( \eta = \) Elasticity of demand
\( \theta = \) Elasticity of import supply
\( t = \) Ad valorem tariff rate
<table>
<thead>
<tr>
<th>Parameters/Variables</th>
<th>Values</th>
</tr>
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<tbody>
<tr>
<td>Qs</td>
<td>1,182.38</td>
</tr>
<tr>
<td>M</td>
<td>7,480.06</td>
</tr>
<tr>
<td>t</td>
<td>0%</td>
</tr>
<tr>
<td>η</td>
<td>-1.0</td>
</tr>
<tr>
<td>ε</td>
<td>3.0</td>
</tr>
<tr>
<td>θ</td>
<td>10.0</td>
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<tr>
<td>P</td>
<td>1.0</td>
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<tr>
<td>P_w</td>
<td>1.0</td>
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</table>
Calibration

Parameters:
\( \eta, \varepsilon \) and \( \theta \)

Benchmark Data:
\( Q_s, M_d \)
\( t = 0 \)
\( P = 1 \)
\( P_w = 1 \)

Constants:
\( \alpha = 1,182.38 \)
\( \beta = 7,480.06 \)
\( \gamma = 6,297.68 \)
Simulation

- The model is now ready for simulating tariff policy changes
- Suppose tariff is increased from 0% to 20%
  - What happens to imports?
  - Production?
  - Tariff revenues?
  - Harberger triangles
  - Terms of trade effect
Excel Solver
Calibration

- Benchmark sales of the domestic industry: $1,182.38$
- Benchmark total sales (domestic origin and imported): $7,480.06$
- $\varepsilon$: Elasticity of domestic supply
  - $3$
- $\eta$: Elasticity of demand
  - $-1$
- $\theta$: Elasticity of import supply
  - $10$
- Initial tariff: $0.00\%$
- New tariff: $20.00\%$
- Benchmark domestic price: $1.00$

Calibrated values:

- $1,182.38 \beta$: domestic supply constant
- $7,480.06 \alpha$: total demand constant term
- $6,297.68 \gamma$: import supply constant term
### Domestic price solution

- non-linear optimization constraint (excess demand)

### World price solution

#### Welfare and Output Comparisons

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>BEFORE</th>
<th>AFTER</th>
<th>CHANGE</th>
<th>PERCENT CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pw</td>
<td>1.000</td>
<td>0.969</td>
<td>-0.031</td>
<td>-3.14%</td>
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<tr>
<td>P</td>
<td>1.000</td>
<td>1.162</td>
<td>0.162</td>
<td>16.23%</td>
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<tr>
<td>M</td>
<td>6,297.68</td>
<td>4,578.51</td>
<td>-1,719.17</td>
<td>-27.30%</td>
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<tr>
<td>Q</td>
<td>1,182.38</td>
<td>1,856.80</td>
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<td>Demand</td>
<td>7,480.06</td>
<td>6,435.31</td>
<td>-1,044.75</td>
<td>-13.97%</td>
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<td>Tariffs</td>
<td>0</td>
<td>886.97</td>
<td>886.97</td>
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#### Terms of trade effect

- 170.64

#### Harberger triangle effect

- 166.52

#### Welfare effect

- 4.11