Partial Equilibrium Model: An Example

ARTNet Capacity Building Workshop for Trade Research
Phnom Penh, Cambodia
2-6 June 2008

Outline

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

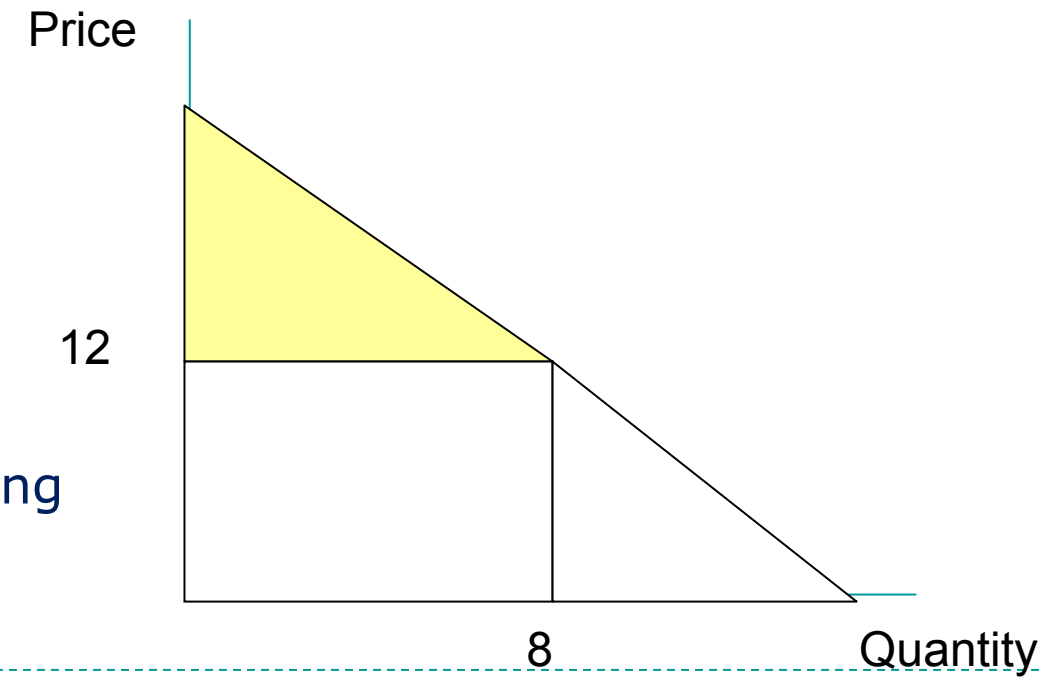
Reference

- François, Joseph and Reinert, Kenneth (eds.) 1997. *Applied Methods for Trade Policy Analysis.* Cambridge: Cambridge University Press.
- 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 effects of a tariff

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

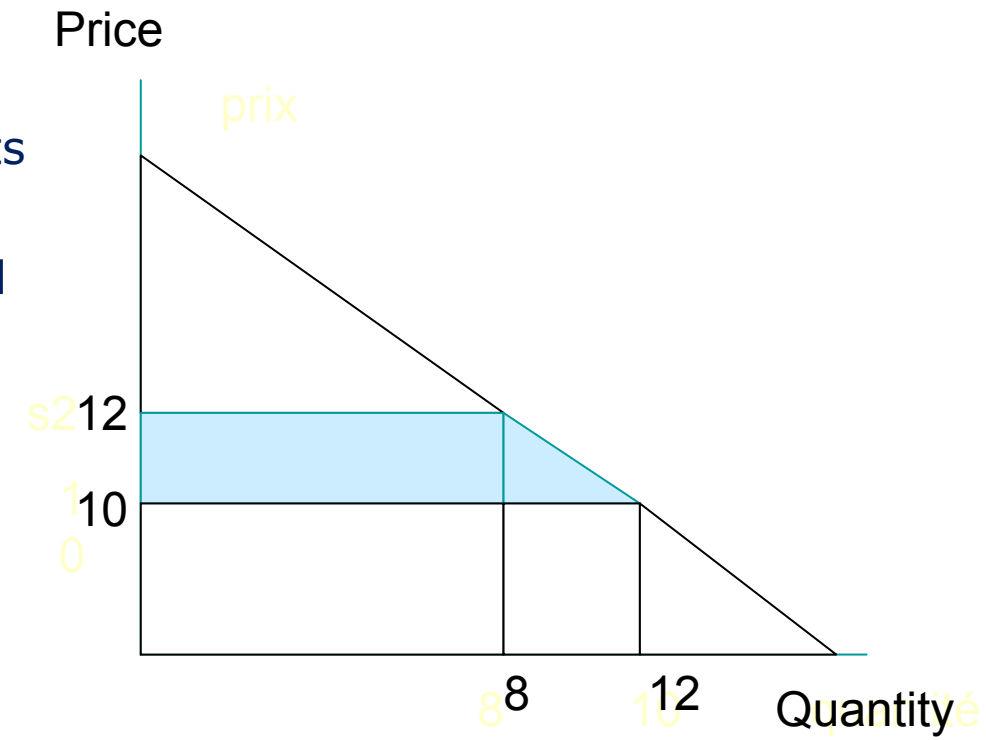


The effects of a tariff

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

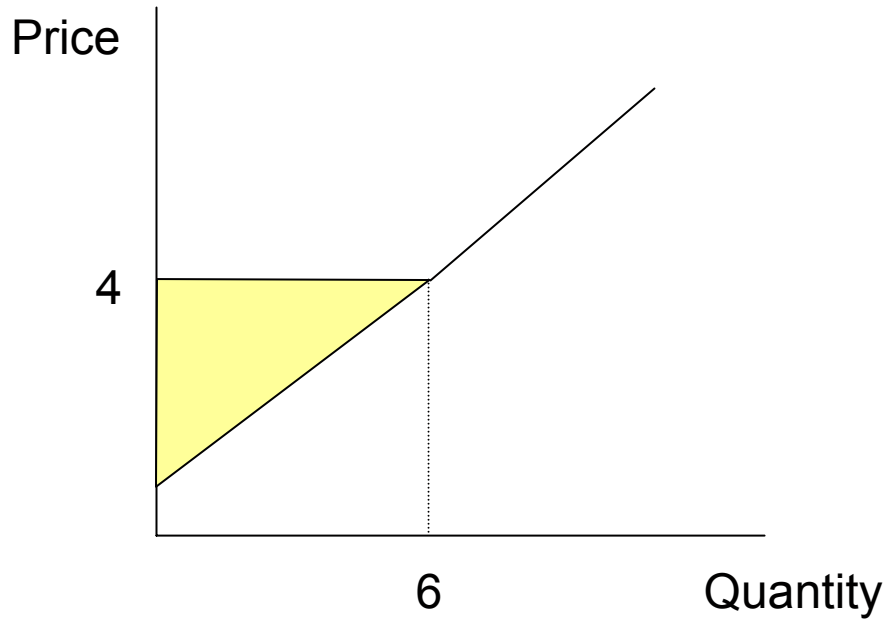
The gain in consumer surplus due to the price reduction is indicated by the blue surface



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.

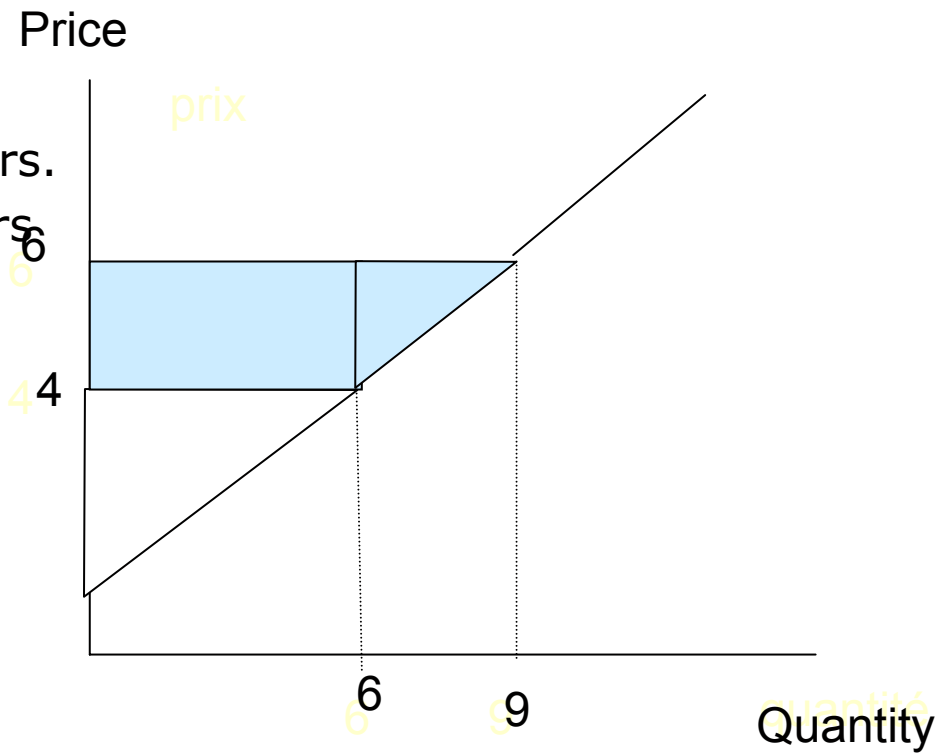
The producer surplus corresponds to the surface above the supply curve and below the line indicating the equilibrium price.



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

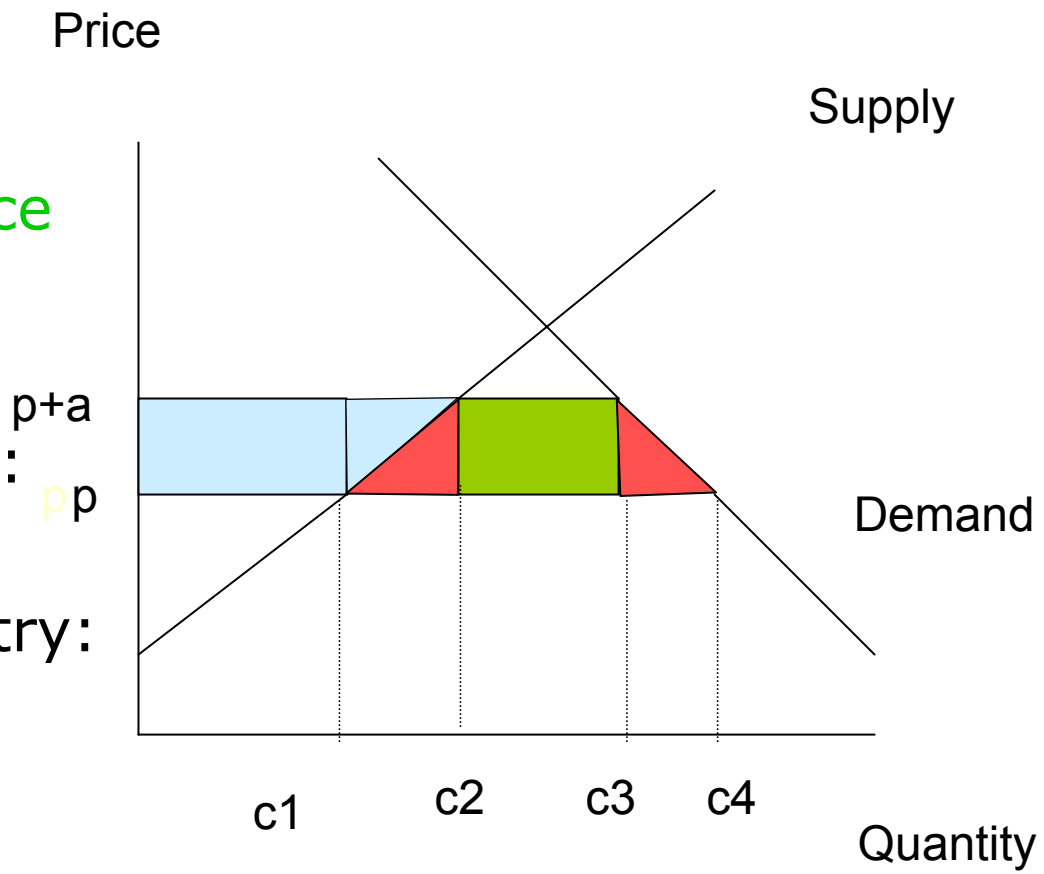
Net loss induced by a tariff of size *a*

Consumer loss: the entire coloured surface

Producer gain: the blue surface

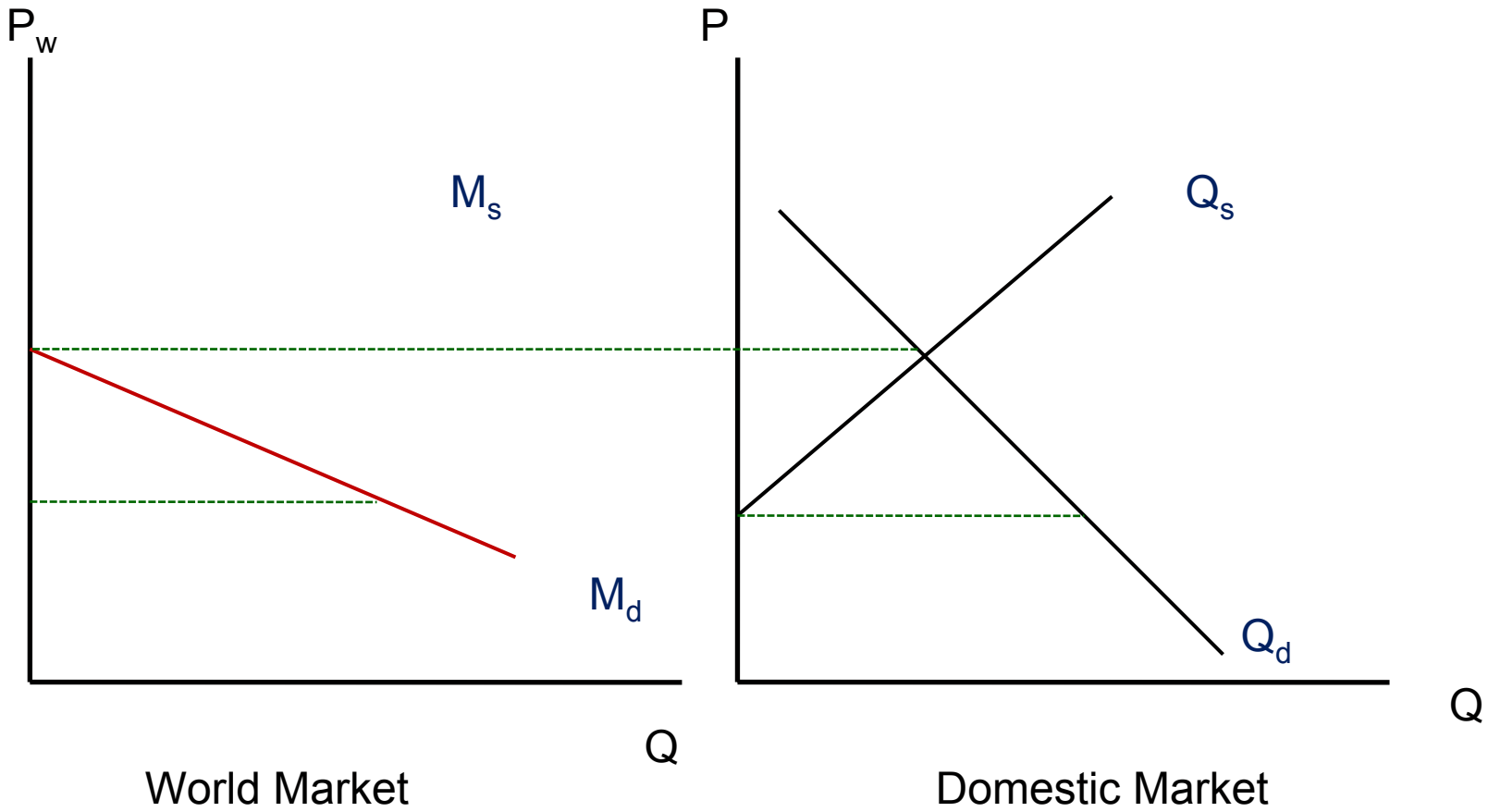
Government revenue: the green surface

Net loss for the country: the two red triangles



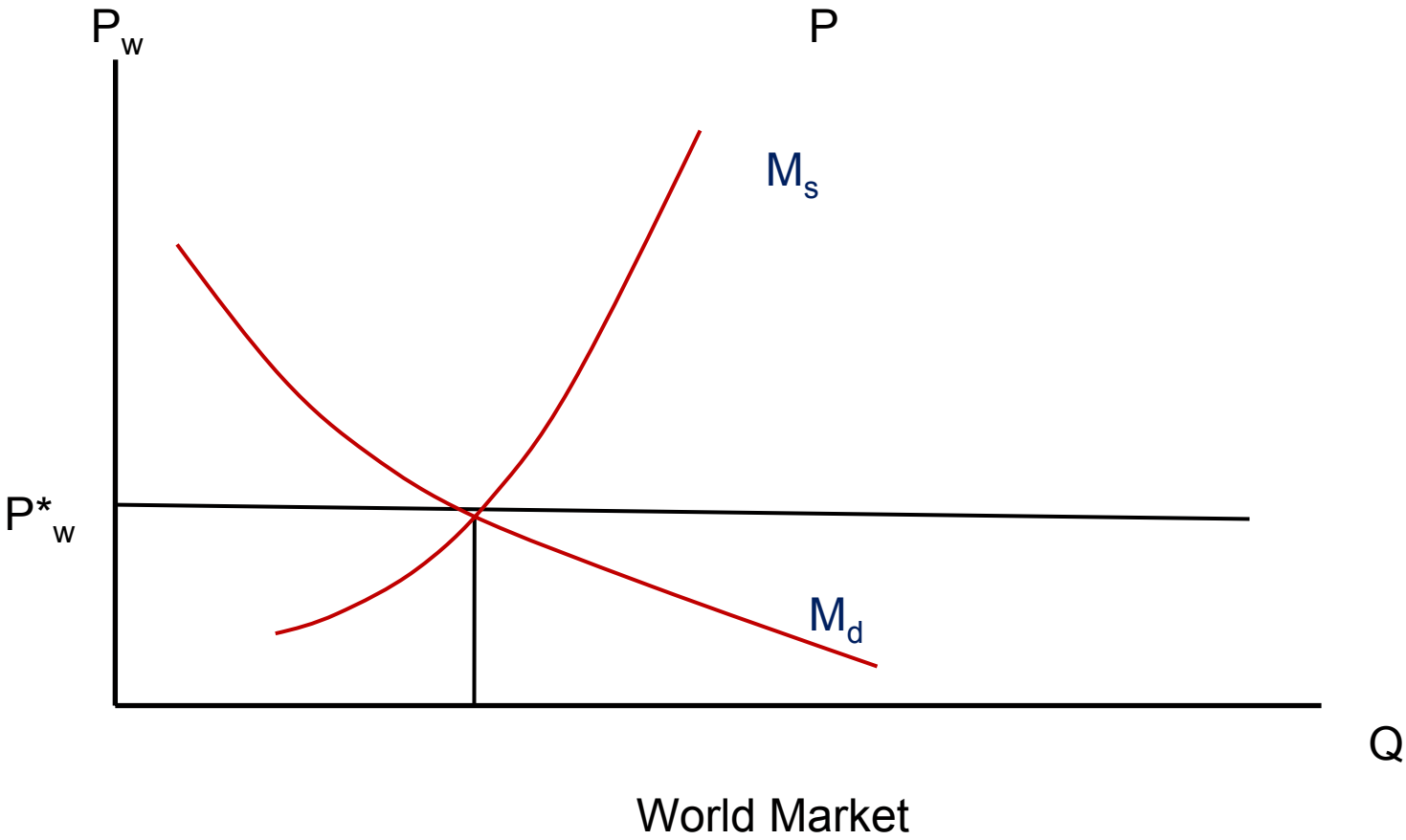
General Case

Deriving Import Demand Curve



General Case

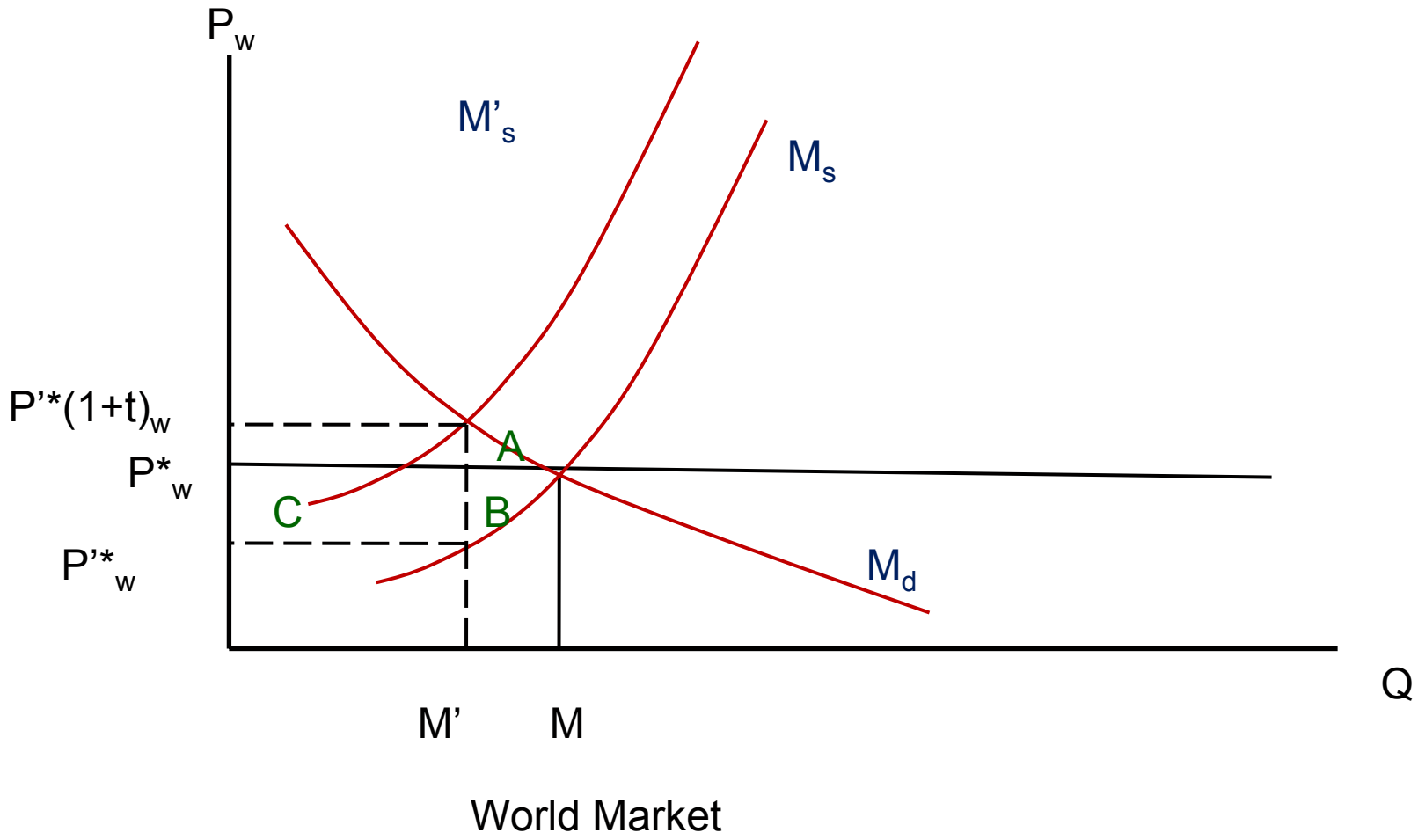
Determining world price and imports



World Market

General Case

Determining world price and imports



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: $P = (1+t)*P_w$

Algebraic Representation

- Equilibrium Condition: Import Demand = Import Supply
- $\alpha(P)^{\eta} - \beta(P)^{\varepsilon} = \gamma\,(P_w)^{\theta}$ ... OR ...
- $A(P_w(1+t))^{\eta} - \beta(P_w(1+t))^{\varepsilon} - \gamma\,(P_w)^{\theta} = 0$

Welfare Analysis

- 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	Harberger triangles
Areas C + B	Areas A+B

Areas A-C

Parameters

PARAMETERS:

α= Constant in demand function
β = Constant in supply function
γ = Constant in import supply function
ε = Elasticity of supply
η = Elasticity of demand
θ = Elasticity of import supply
t= Ad valorem tariff rate

Benchmark Data

Parameters / Variables	Values
Qs	1,182.38
M	7,480.06
t	0%
η	-1.0
ε	3.0
θ	10.0
P	1.0
P_w	1.0

Calibration

Parameters:
η,ε and θ

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

Constants:

α = 1,182.38

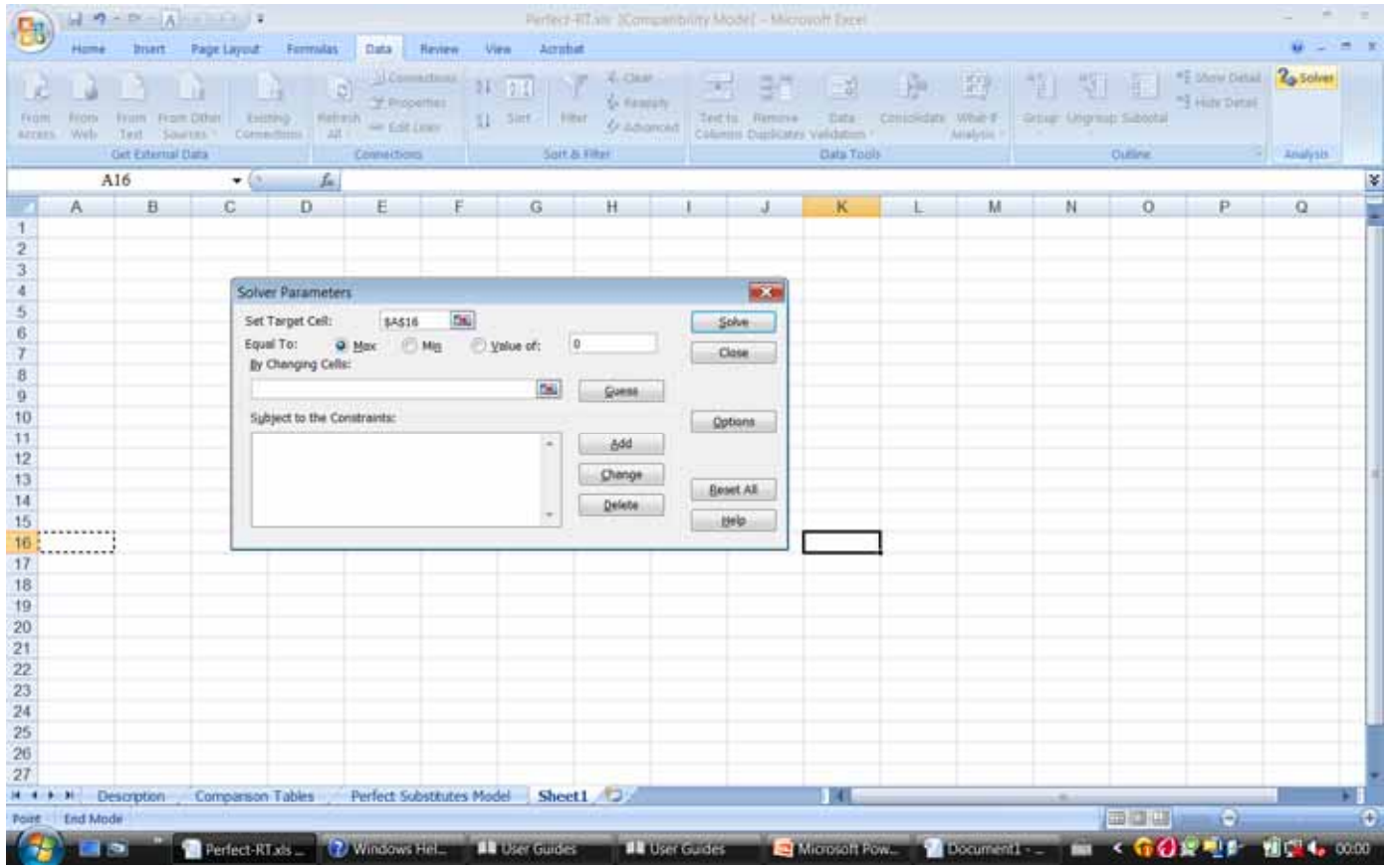
β = 7,480.06

γ = 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

1182.38	Benchmark sales of the domestic industry
7480.06	Benchmark total sales (domestic origin and imported)
3	ε: Elasticity of domestic supply
-1	η: Elasticity of demand
10	θ: Elasticity of import supply
0.00%	Initial tariff
20.00%	New tariff
1.00	Benchmark domestic price

Calibrated values

1,182.38 β : domestic supply constant

7,480.06 α: total demand constant term

6,297.68 γ: import supply constant term

Solution

1.162	Domestic price solution	
	non-linear optimization constraint (excess	
-2.0E-07	demand)	
0.969	World price solution	

Welfare and Output Comparisons

VARIABLES	BEFORE	AFTER	CHANGE	PERCENT CHANGE
Pw	1.000	0.969	-0.031	-3.14%
P	1.000	1.162	0.162	16.23%
M	6,297.68	4,578.51	-1,719.17	-27.30%
Q	1,182.38	1,856.80	674.42	57.04%
Demand	7,480.06	6,435.31	-1,044.75	-13.97%
Tariffs	0	886.97	886.97	

Terms of trade effect	170.64
Harberger triangle effect	- 166.52
Welfare effect	4.11