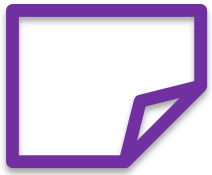
PubPol/Econ 541

Classes 3, 4

Tariffs and Quotas

by
Alan V. Deardorff
University of Michigan
2022



Announcements

- Quiz 1
  - Available today after class
  - Due Friday midnight
  - Accepted until Saturday midnight with penalty
  - Covers material on State of Play, 1 and 2
- Suggestion for in-class responses:
  - If you've already responded once, give time for others to respond
- How to handle skipped slides

Pause for News

Announcements

- Quiz 1
  - Question 4 about the Northern Ireland Protocol should have been “All of these”
    - I somehow had the system saying “inside EU customs union” was correct. It is, but so are the others.
    - I’ve given credit for those who said “All of these”
- Quizzes in general
  - Clarify my expectations:
    - Feel free to look up anything you like from course or other sources.
    - But write your answers yourself and do not work with other students.

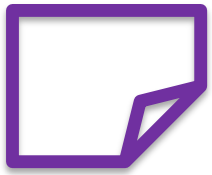
Announcements

- Quiz 1 Scores

	Q1
Mean	8.64
Median	9
Max	10
Min	5.5
S.D.	1.23

Announcements

- Page assignments for KOM 12th edition are now in the posted syllabus
- I need to reschedule my next Monday office hour, Sep 19, to 2:00 PM.



Pause for Discussion

Questions from KOM

- How do “specific” and “ad valorem” tariffs differ?
- An import demand curve is sometimes called a “derived demand curve.” Why?
- What is an “effective rate of protection”?

Outline for Today and Next Tuesday

- Tariff by Small country
- Tariff by large country
- Quotas

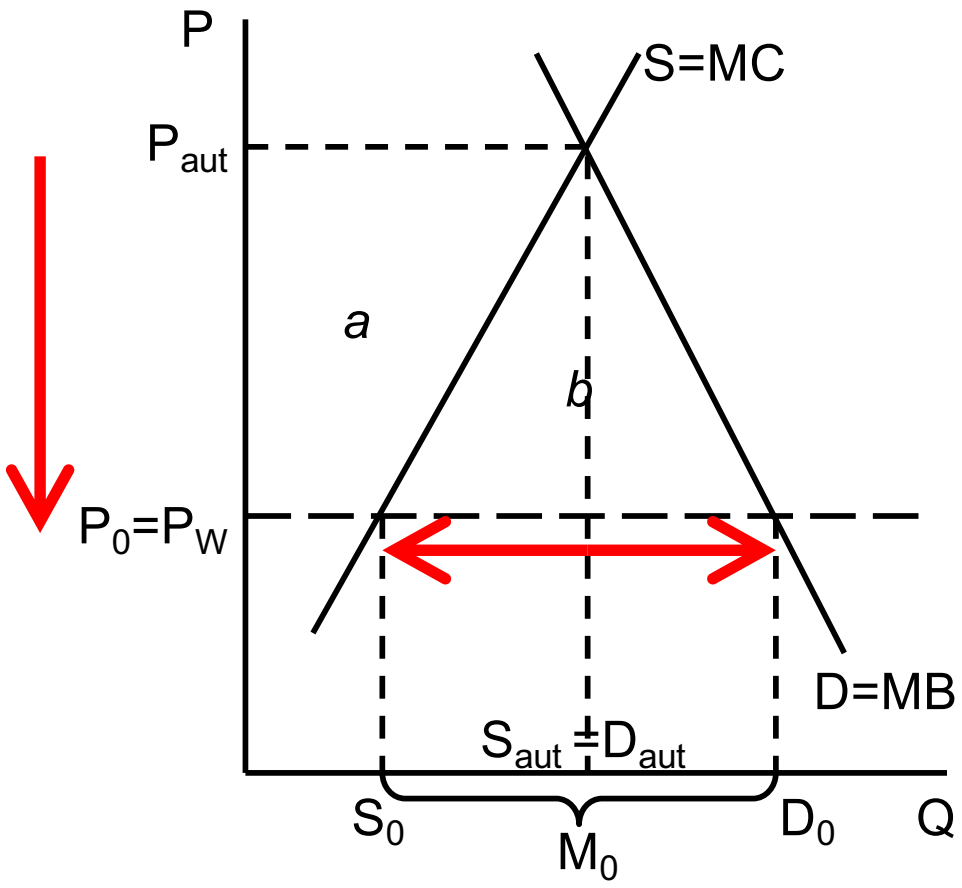
Small country

- Assumptions throughout
  - Markets perfectly competitive
  - Product homogeneous
  - Markets in equilibrium
  - There are no “distortions” (externalities, etc.)
  - Supply and demand curves are linear
    - Just for simplicity
  - Model is partial equilibrium
  - Model is static
  - Trade is free and frictionless
    - No tariffs or quotas other than those we introduce
    - No transport costs (for simplicity)

Small country

- Special assumption for small country case
  - World price is given (country too small to influence it)
  - More correctly: country's supply and demand in that industry too small to influence the world price

Small country, Import Industry

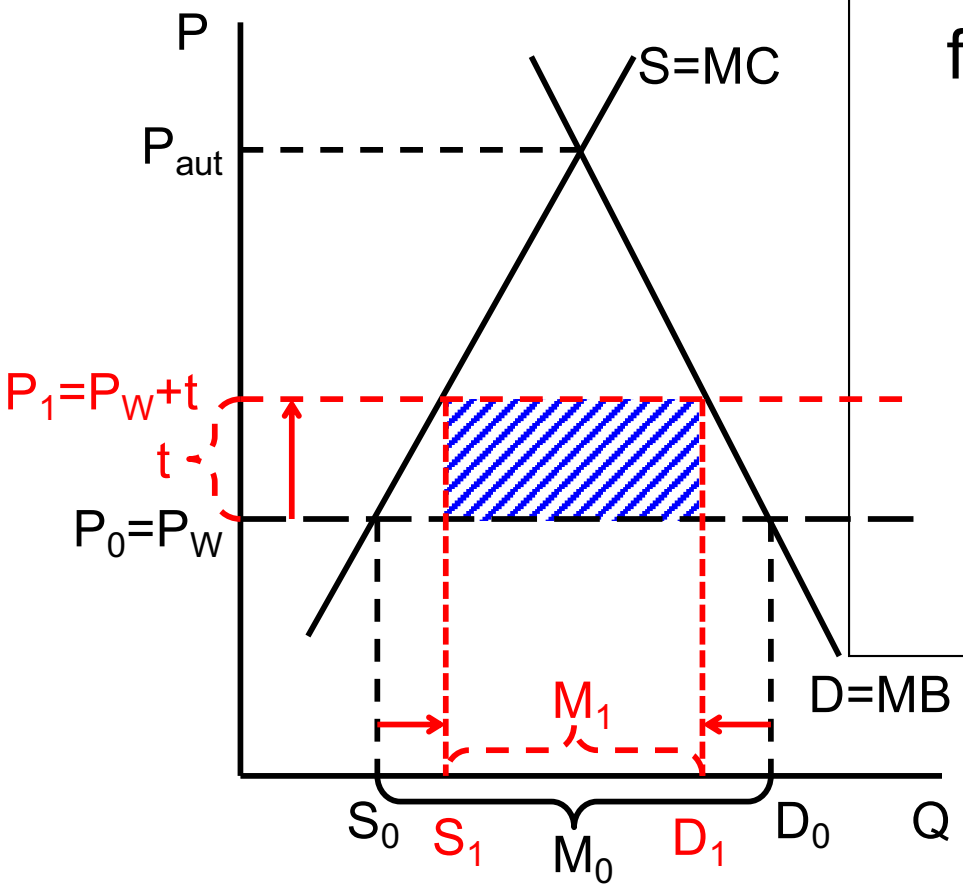


- Effects of move from autarky to free trade
  - Price falls
  - Quantity supplied falls
  - Quantity demanded rises
  - Imports rise
- Welfare effects:
  - Suppliers lose $-a$
  - Demanders gain $+(a+b)$
  - Country gains $+b$

The Gain from Trade

Free trade

Small country tariff

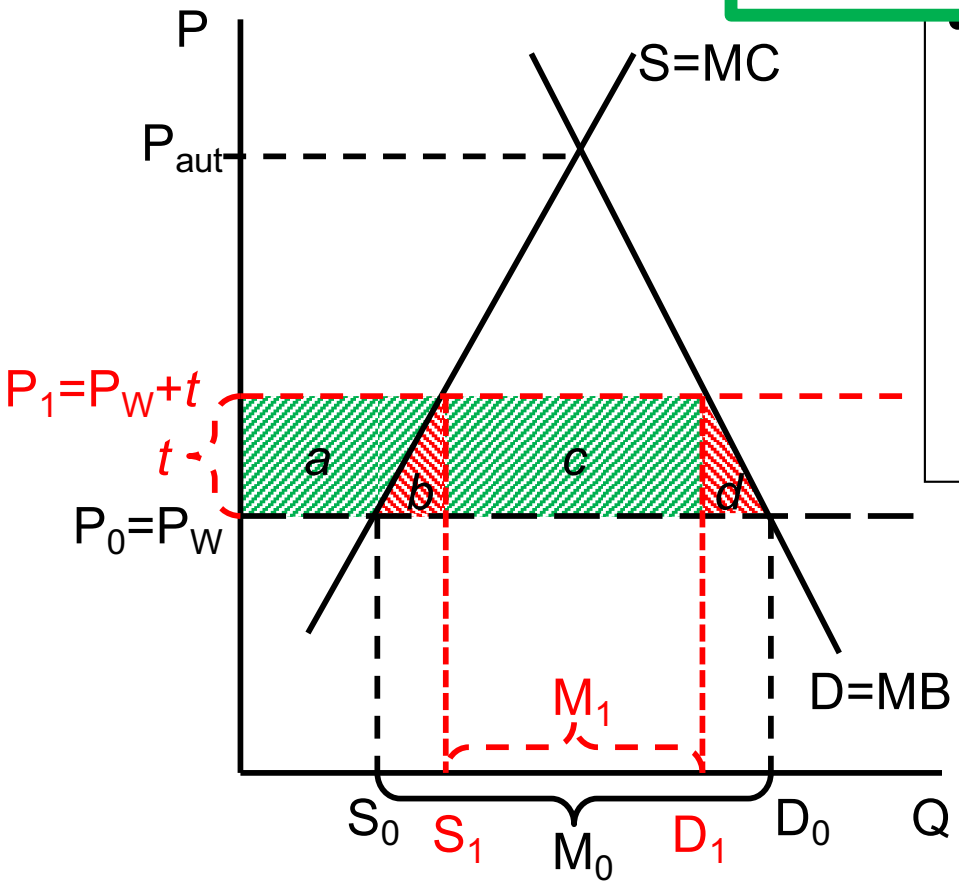


- Effects of a tariff, starting from free trade
  - Price rises for both the
    - Imported good
    - Domestically produced good
  - Quantity supplied rises
  - Quantity demanded falls
  - Quantity of imports falls
  - Tariff revenue rises from zero

Specific Tariff t

Small country tariff

WHY?



- Welfare effects of a tariff, starting from free

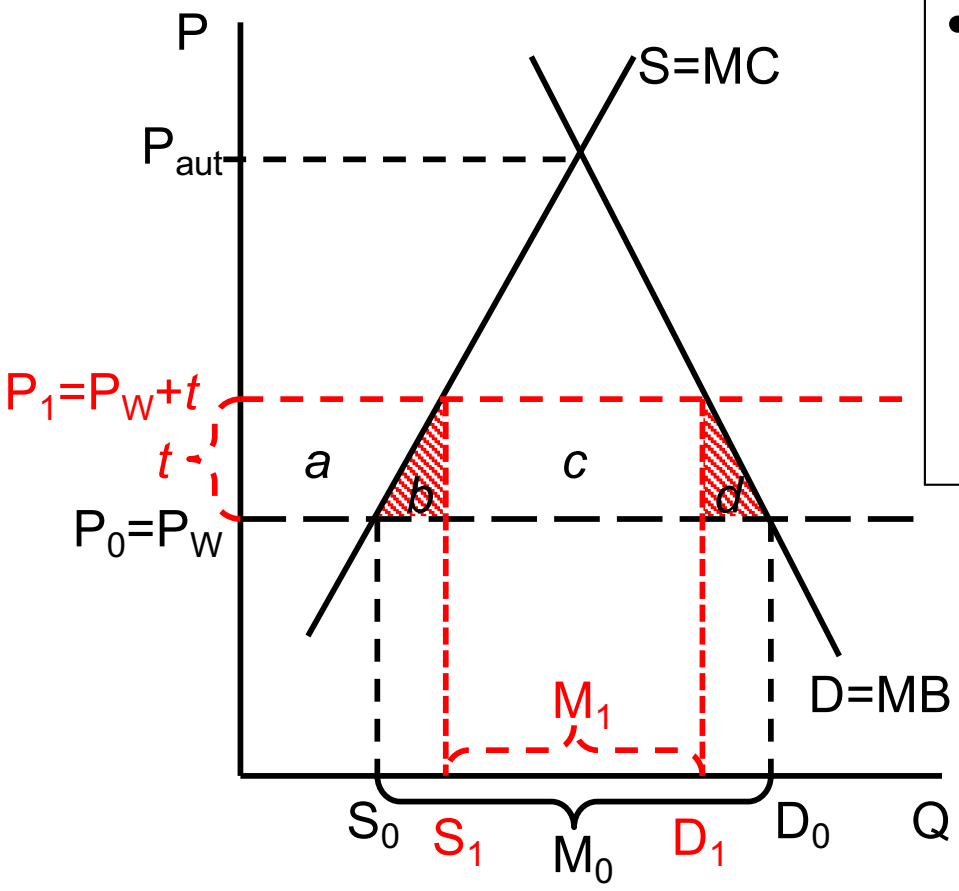
WHY?

  - Suppliers gain
  - Demanders Lose $-(a+b+c+d)$
  - Government gains $+c$
  - Country loses $-(b+d)$

"Dead Weight Loss"

Specific Tariff t

Small country tariff



- Welfare effects of a tariff, starting from free trade
  - Suppliers gain $+a$
  - Demanders Lose $-(a+b+c+d)$
  - Government gains $+c$
  - Country loses $-(b+d)$

"Dead Weight Loss"

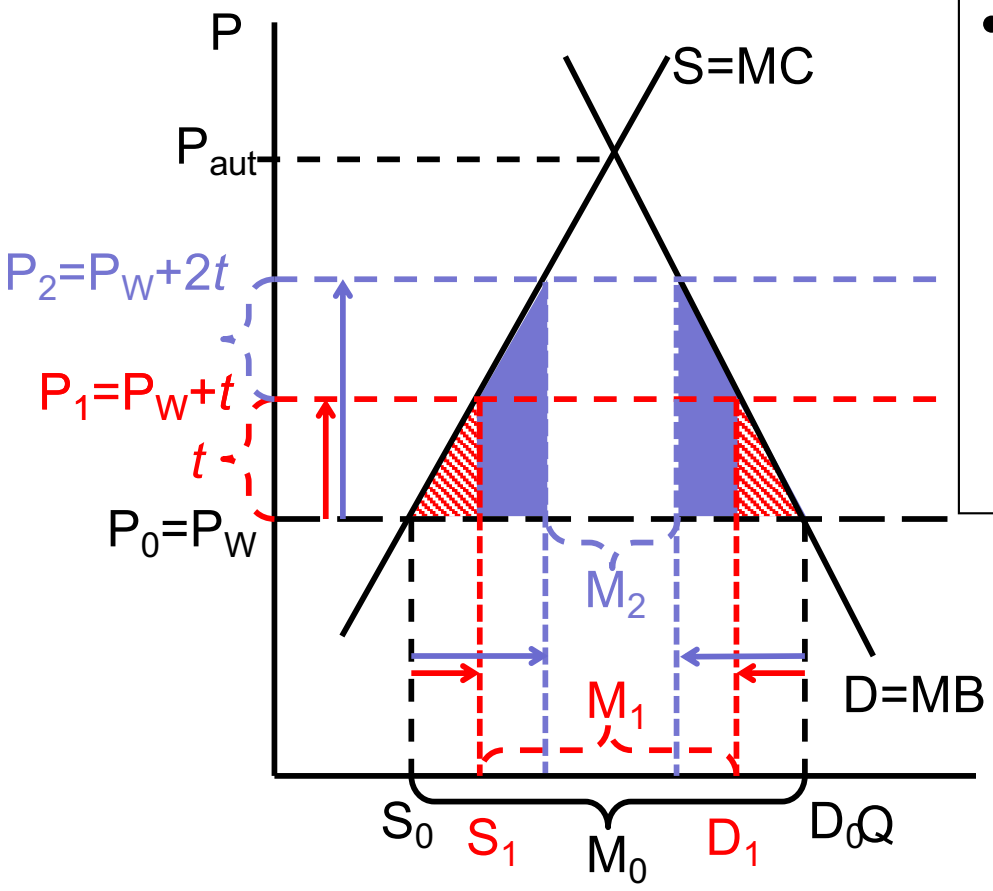
Specific Tariff *t*

Pause for Discussion

Questions on Graph

- If a price falls, why does the gain to demanders not equal the fall in what they pay? Is it larger than this or smaller?
- If a price rises, why is the gain to suppliers not their rise in revenue? Is it larger or smaller?
- In what sense does a small country gain by eliminating a tariff? Does anybody in the country lose?

Small country, larger tariff



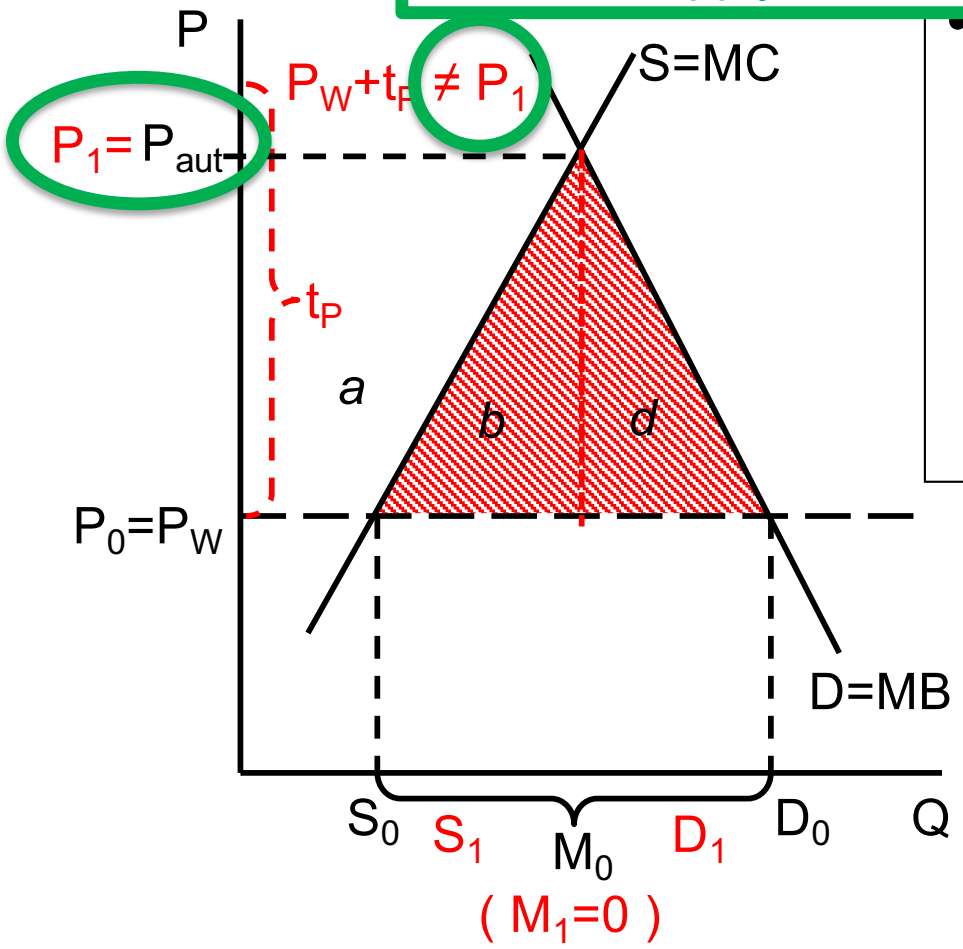
- Effects of doubling the tariff
  - Price rises by twice as much
  - Imports fall by twice as much
  - Deadweight loss is 4-times as large!
    - (Efficiency loss rises with the square of the tariff)

(These are exact only if S and D are straight lines. Approximate otherwise.)

Specific Tariffs, t, then 2t

Small country, prohibitive tariff

NOTE: You'll have to calculate this from supply and demand

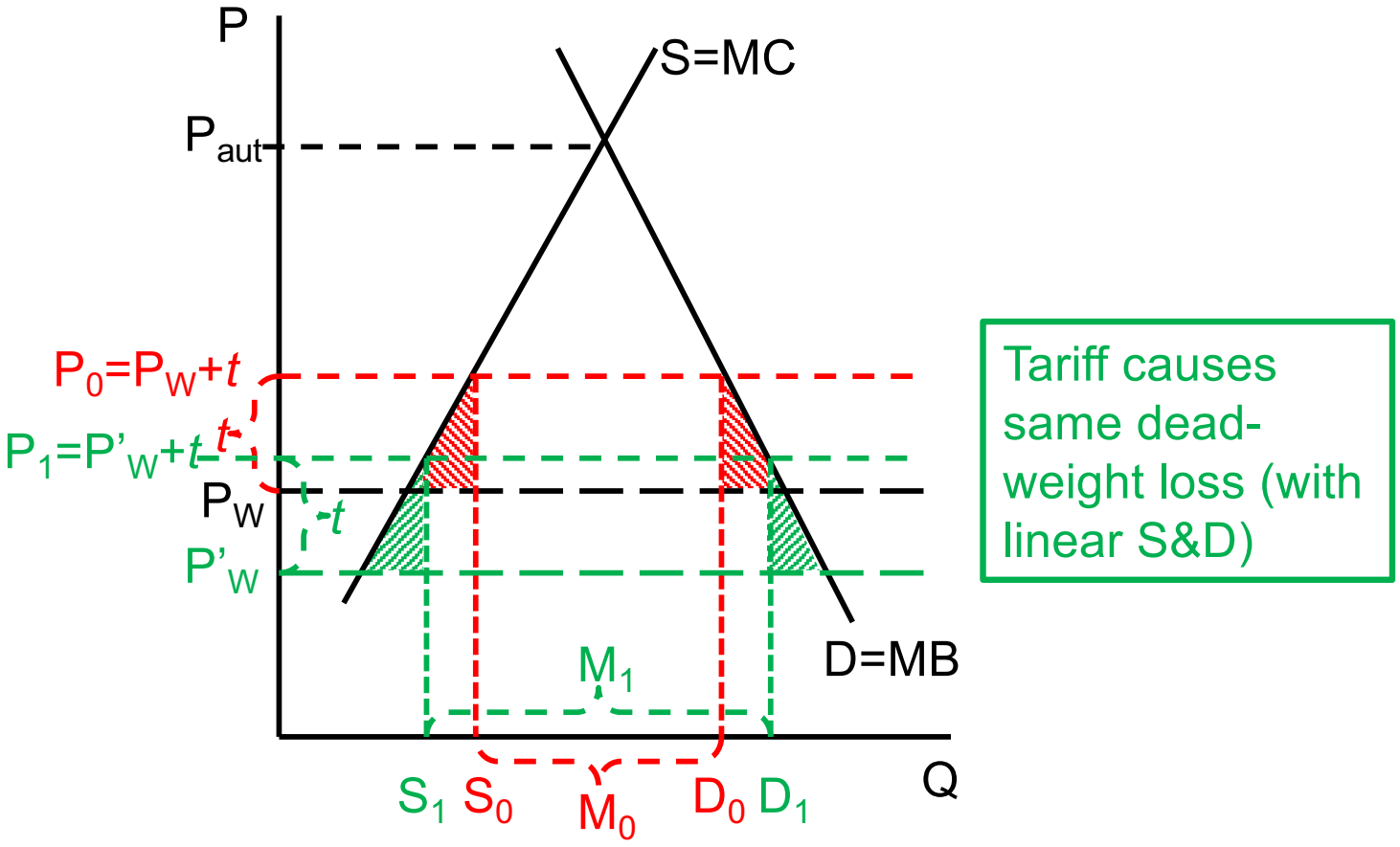


- Welfare effects of a prohibitive tariff, starting from free trade
  - Suppliers gain $+a$
  - Demanders Lose $-(a+b+d)$
  - Government gains 0
  - Country loses $-(b+d)$

"Dead Weight Loss"

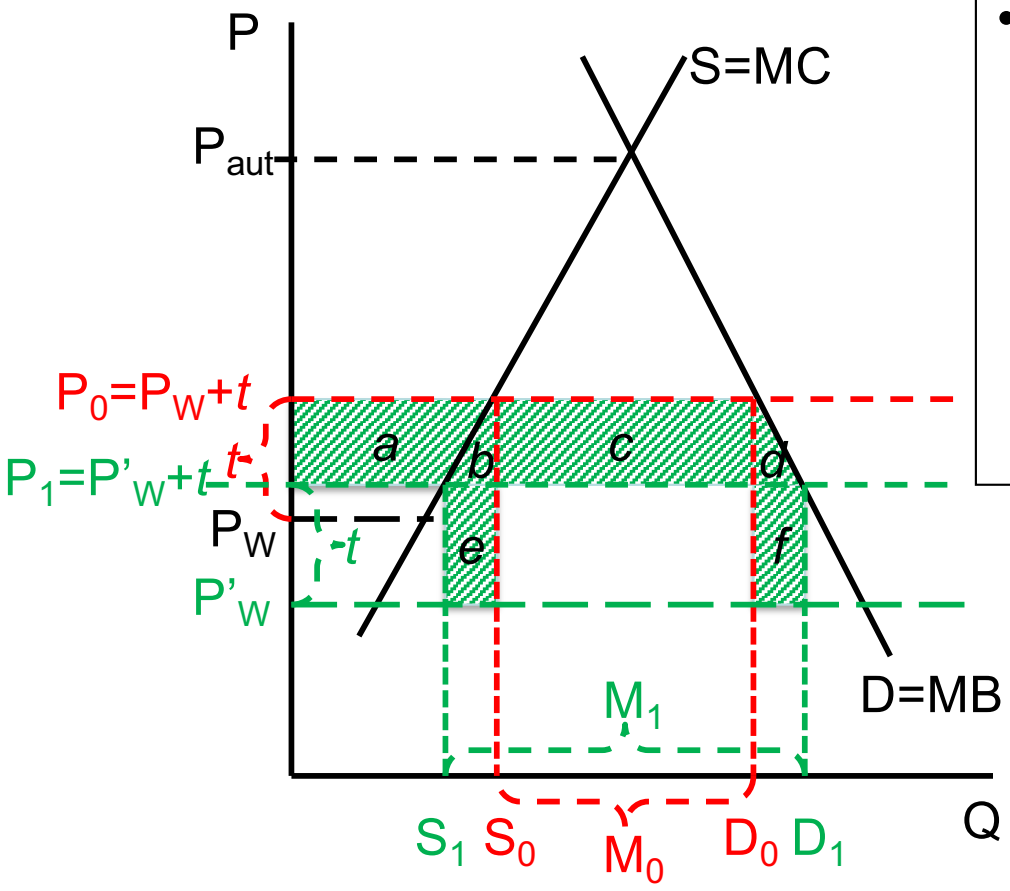
Specific Tariff $t_P > P_{aut} - P_W$

Comparative Statics with Tariff Fall in World Price



Tariff causes same dead-weight loss (with linear S&D)

Comparative Statics with Tariff Fall in World Price



- Welfare effects of a fall in world price in presence of specific tariff
  - Suppliers lose –*a*
  - Demanders gain +(a+b+c+d)
  - Government gains +(e+f)
  - Country gains +(b+c+d+e+f)

Pause for Your Questions

Pause for Discussion

Questions on Lahart, "The Imperfect Science …"

- Why does Lahart say the measurement of harm from tariffs is an "imperfect science"?
- Lahart cited an estimate of loss from Trump's tariffs and retaliation of 1.3% of GDP. Is this big?
- What effects of tariffs are missing from the welfare effects of tariffs?

Small Country in Equations

- Let p^w be world price and p^h be price in home market. With *ad valorem* tariff, t, *assumed not large enough to stop trade:*

$$p^h = (1+t)p^w$$

- Demand: $Q^d = D(p^h)$
- Supply: $Q^s = S(p^h)$
- Imports: $Q^m = Q^d - Q^s$

NOTE: Used specific tariff in graphs, ad valorem in eqns. Both are for simplicity.

Small Country in Equations

- Without tariff (free trade; $t = 0$):

$$p^{h0} = p^{w}$$
$$Q^{m0} = D(p^{w}) - S(p^{w})$$

- With tariff, $t > 0$:

$$p^{h1} = (1 + t)p^{w}$$
$$Q^{m1} = D\big((1 + t)p^{w}\big) - S\big((1 + t)p^{w}\big)$$

Small Country in Equations

- Notation: Let

$$\Delta x = x^1 - x^0$$

for $x = p, Q,$ etc.

Then

$$\Delta p^h = p^{h1} - p^{h0} = (1 + t)p^w - p^w = tp^w$$

and

$$t = \frac{\Delta p^h}{p^w} = \frac{\Delta p^h}{p^{h0}}$$

Small Country in Equations

- It is most convenient to work with <u>percentage changes</u> and <u>elasticities</u>:

- Percentage change in any variable, x, is

$$Percent\ change\ in\ x = \frac{\Delta x}{x}$$

- Elasticity of x with respect to y is

$$\frac{\Delta x}{x} \Big/ \frac{\Delta y}{y}$$

Small Country in Equations

- Elasticity of (home) demand (η):

$$\eta = \frac{\Delta Q^d}{Q^{d0}} \Big/ \frac{\Delta p^h}{p^{h0}} \quad \text{or} \quad \frac{\Delta Q^d}{Q^{d0}} = \eta \frac{\Delta p^h}{p^{h0}}$$

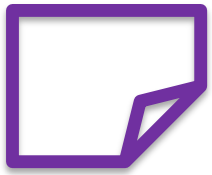
- Note that $\eta < 0$ (downward sloping)
- Elasticity of (home) supply (ε):

$$\varepsilon = \frac{\Delta Q^s}{Q^{s0}} \Big/ \frac{\Delta p^h}{p^{h0}} \quad \text{or} \quad \frac{\Delta Q^s}{Q^{s0}} = \varepsilon \frac{\Delta p^h}{p^{h0}}$$

When you know the price change, use these to find the quantity change

Small Country in Equations

- Notes regarding elasticities:
  - *They'll be defined here as changes relative to the free-trade quantities and prices.*
  - *Different, but just as valid, would be changes relative to quantities and prices in the presence of the tariff.*
  - *Answers will differ, but by much less than our uncertainty about the values of elasticities.*
  - *In your calculations, use whichever is most convenient, but be consistent.*



Small Country in Equations

- Data are usually values, not quantities.

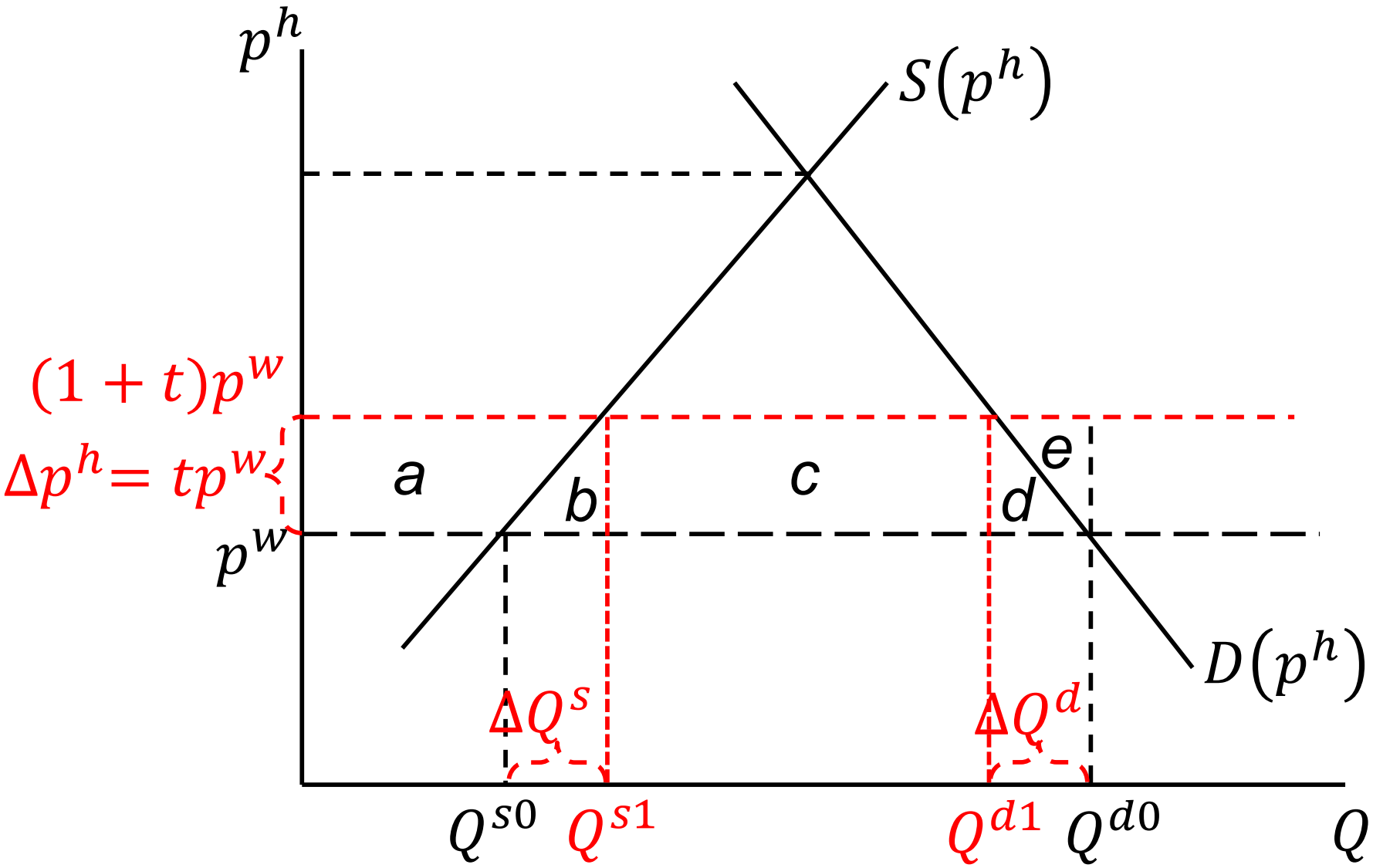
- Values of initial quantities:
- Demand: $V^{d0} = p^{h0}Q^{d0} = p^{w}Q^{d0}$
- Supply: $V^{s0} = p^{h0}Q^{s0} = p^{w}Q^{s0}$
- Imports: $V^{m0} = p^{w0}\left(Q^{d0} - Q^{s0}\right)$

Small Country in Equations

- Effects of tariff on quantities:

Demand: $\Delta Q^d = \eta t Q^{d0}$

Supply: $\Delta Q^s = \varepsilon t Q^{s0}$



I'll use $\langle a \rangle$, $\langle abcd \rangle$, $etc.$ to represent these areas.

Small Country in Equations

- Welfare gain of suppliers (producers & upstream):

$$WGS = \langle a \rangle$$

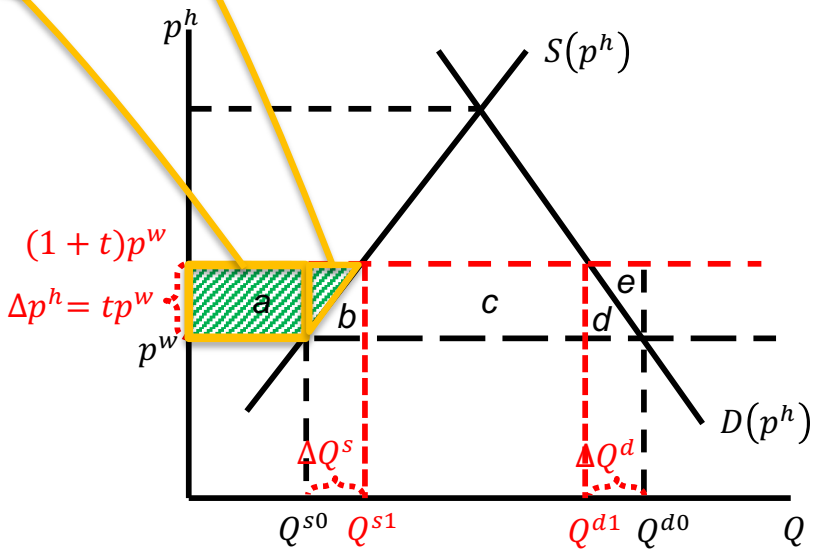
$$= (Q^{s0})(\Delta p^h) + \frac{1}{2}(\Delta Q^s)(\Delta p^h)$$

$$= Q^{s0}\Delta p^h + \frac{1}{2}\frac{\Delta Q^s}{Q^{s0}}Q^{s0}\Delta p^h$$

$$= \left(1 + \frac{1}{2}\varepsilon\frac{\Delta p^h}{p^{h0}}\right)p^{h0}Q^{s0}\frac{\Delta p^h}{p^{h0}}$$

$$= \left(1 + \frac{1}{2}\varepsilon\frac{\Delta p^h}{p^{h0}}\right)V^{s0}\frac{\Delta p^h}{p^{h0}}$$

$$= \boxed{\left(1 + \frac{1}{2}\varepsilon t\right)tV^{s0}}$$



Small Country in Equations

- Welfare gain of suppliers (producers & upstream):

$$WGS = \langle a \rangle$$

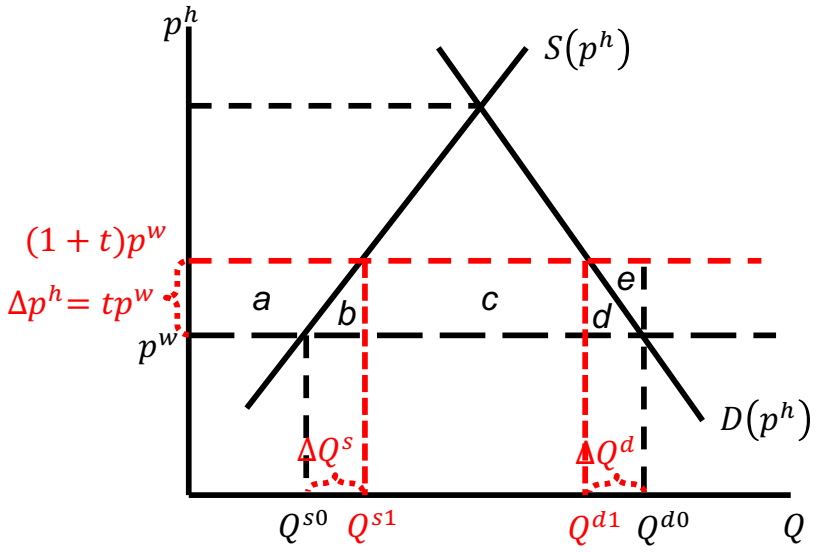
$$= (Q^{s0})(\Delta p^h) + \frac{1}{2}(\Delta Q^s)(\Delta p^h)$$

$$= Q^{s0}\Delta p^h + \frac{1}{2}\frac{\Delta Q^s}{Q^{s0}} Q^{s0}\Delta p^h$$

$$= \left(1 + \frac{1}{2}\varepsilon\frac{\Delta p^h}{p^{h0}}\right) p^{h0} Q^{s0}\frac{\Delta p^h}{p^{h0}}$$

$$= \left(1 + \frac{1}{2}\varepsilon\frac{\Delta p^h}{p^{h0}}\right) V^{s0}\frac{\Delta p^h}{p^{h0}}$$

$$= \left(1 + \frac{1}{2}\varepsilon t\right) t V^{s0}$$



Small Country in Equations

- Welfare loss of demanders (consumers and downstream):

$$WLD = \langle abcd \rangle = \langle abcde \rangle - \langle e \rangle$$

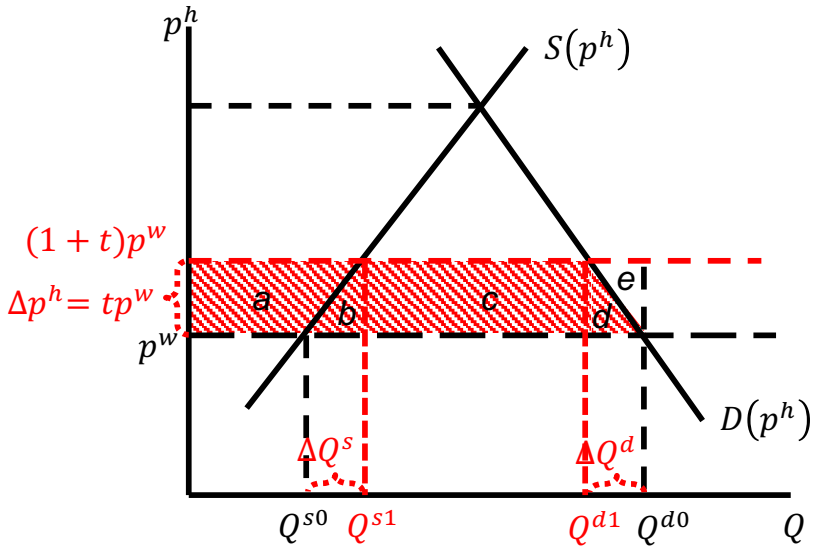
$$= \left(Q^{d0}\right)\left(\Delta p^h\right) - \frac{1}{2}\left(\left|\Delta Q^d\right|\right)\left(\Delta p^h\right)$$

$$= \left(1 - \frac{1}{2}\frac{\left|\Delta Q^d\right|}{Q^{d0}}\right) Q^{d0}\Delta p^h$$

$$= \left(1 + \frac{1}{2}\frac{\Delta Q^d}{Q^{d0}}\right) p^{h0} Q^{d0}\frac{\Delta p^h}{p^{h0}}$$

$$= \left(1 + \frac{1}{2}\eta\frac{\Delta p^h}{p^{h0}}\right) V^{d0}\frac{\Delta p^h}{p^{h0}}$$

$$= \boxed{\left(1 + \frac{1}{2}\eta t\right) t V^{d0}}$$



Small Country in Equations

- Revenue gain of (home) government:

$$R = \langle c \rangle$$

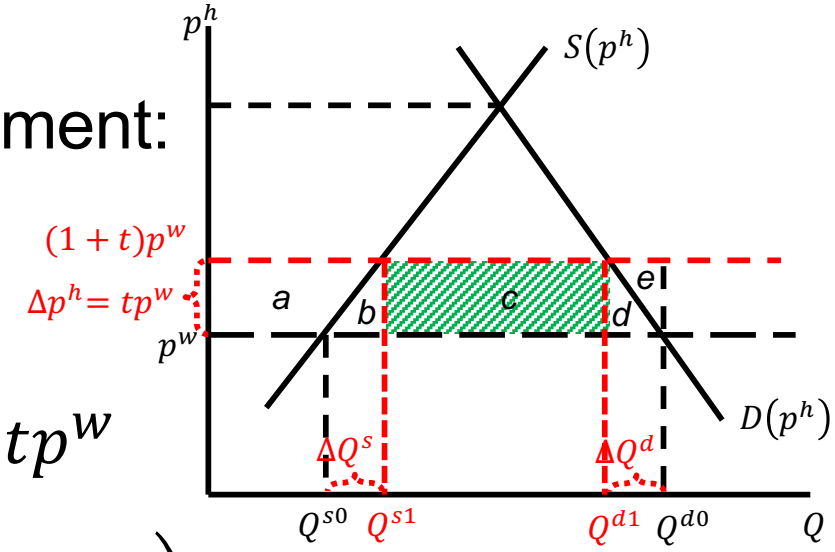
$$= \left(Q^{d1} - Q^{s1}\right)\Delta p^h$$

$$= \left(Q^{d0} + \Delta Q^d - Q^{s0} - \Delta Q^s\right)tp^w$$

$$= \left(Q^{d0}\left(1 + \frac{\Delta Q^d}{Q^{d0}}\right) - Q^{s0}\left(1 + \frac{\Delta Q^s}{Q^{s0}}\right)\right)tp^w$$

$$= \left(Q^{d0}\left(1 + \eta\frac{\Delta p^h}{p^{h0}}\right) - Q^{s0}\left(1 + \varepsilon\frac{\Delta p^h}{p^{h0}}\right)\right)tp^w$$

$$= \boxed{\left(V^{d0}(1 + \eta t) - V^{s0}(1 + \varepsilon t)\right)t}$$



Small Country in Equations

- Welfare change for country:

$$WCC = -\langle abcd \rangle + \langle a \rangle + \langle c \rangle$$

$$= WLD - WGS - R$$

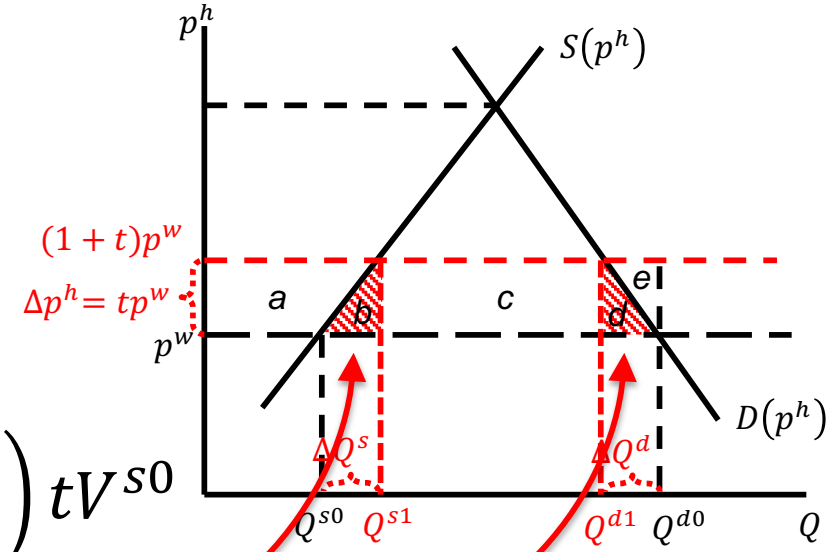
$$= -\left(1 + \frac{1}{2}\eta t\right) t V^{d0} + \left(1 + \frac{1}{2}\varepsilon t\right) t V^{s0}$$

$$+ \left(V^{d0}(1 + \eta t) - V^{s0}(1 + \varepsilon t)\right) t$$

$$= -tV^{d0} + tV^{s0} - \frac{1}{2}\eta t^2 V^{d0} + \frac{1}{2}\varepsilon t^2 V^{s0} + tV^{d0} - tV^{s0}$$

$$+\eta t^2 V^{d0} - \varepsilon t^2 V^{s0}$$

$$= \boxed{-\left[\frac{1}{2}\varepsilon t^2 V^{s0} - \frac{1}{2}\eta t^2 V^{d0}\right]}$$



Small Country in Equations

WGS = Welfare Gain of Suppliers
WLD = Welfare Loss of Demanders
R = Government Revenue
WCC = Welfare Change of Country

- Summary:
- $\text{WGS} = \left(1 + \frac{1}{2}\varepsilon t\right) t V^{s0}$
- $\text{WLD} = \left(1 + \frac{1}{2}\eta t\right) t V^{d0}$
- $\text{R} = \left(V^{d0}(1 + \eta t) - V^{s0}(1 + \varepsilon t)\right) t$
- $\text{WCC} = -\left[\frac{1}{2}\varepsilon t^2 V^{s0} - \frac{1}{2}\eta t^2 V^{d0}\right]$

Pause for Discussion

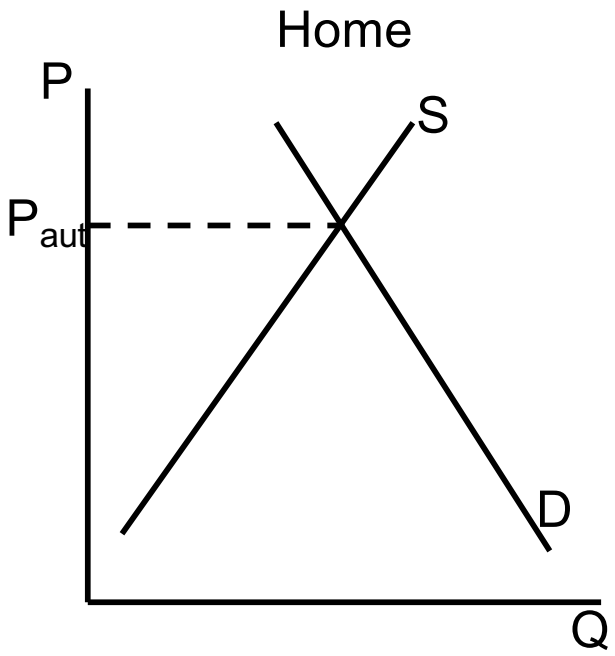
Questions on Equations

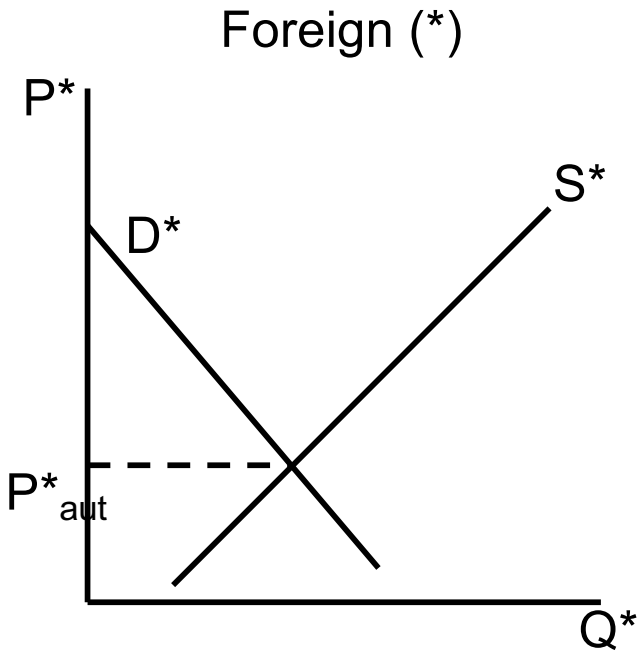
- What information do you need to calculate these welfare effects?
- How do the equations change with larger tariffs?
- Explain the sources of the “production distortion loss” and the “consumption distortion loss.”
  - Why does each occur, and who is it that loses in each case?
  - Where do these appear in the equations?

Outline

- Tariff by Small country
- Tariff by large country
- Quotas

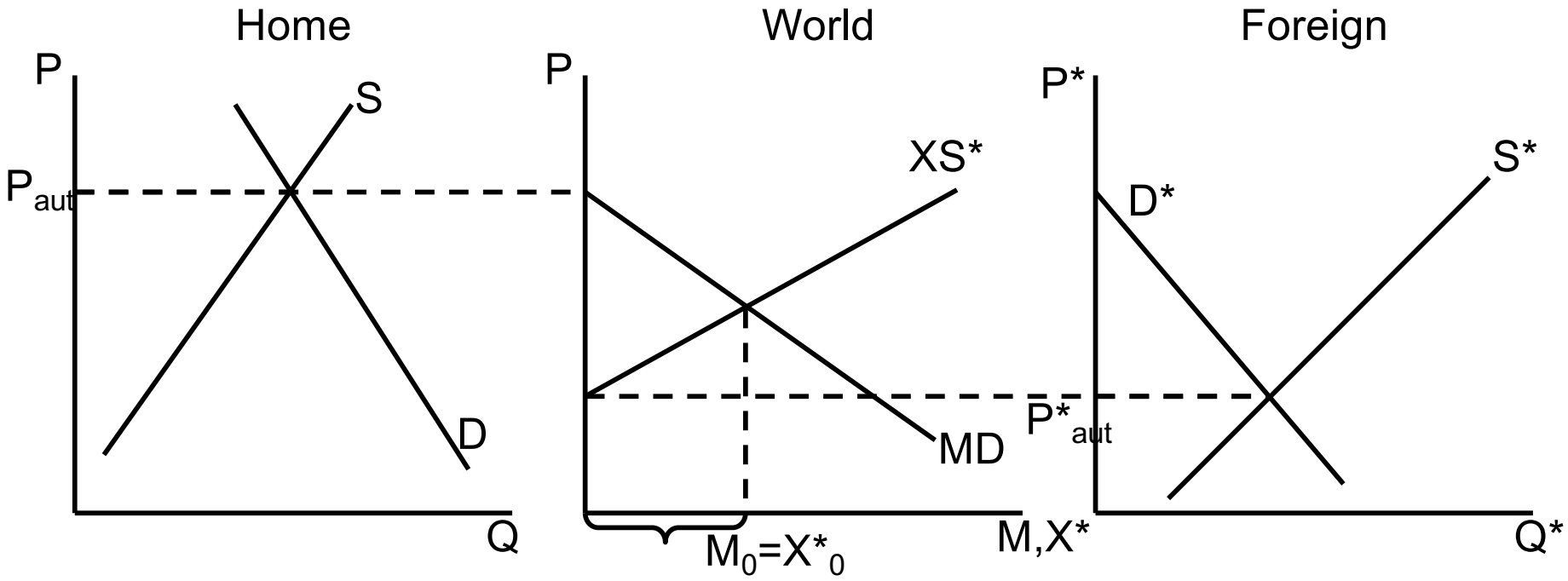
Large country
(i.e., Two Countries)





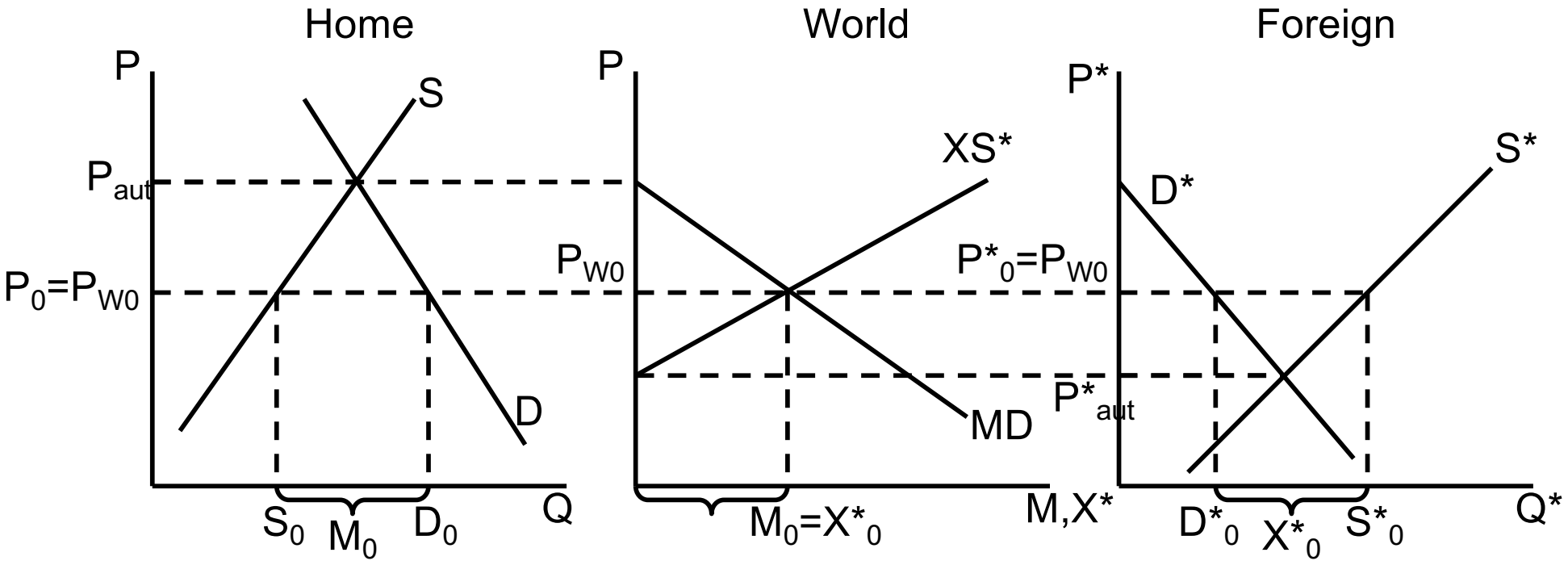
Autarky

Large country
(i.e., Two Countries)



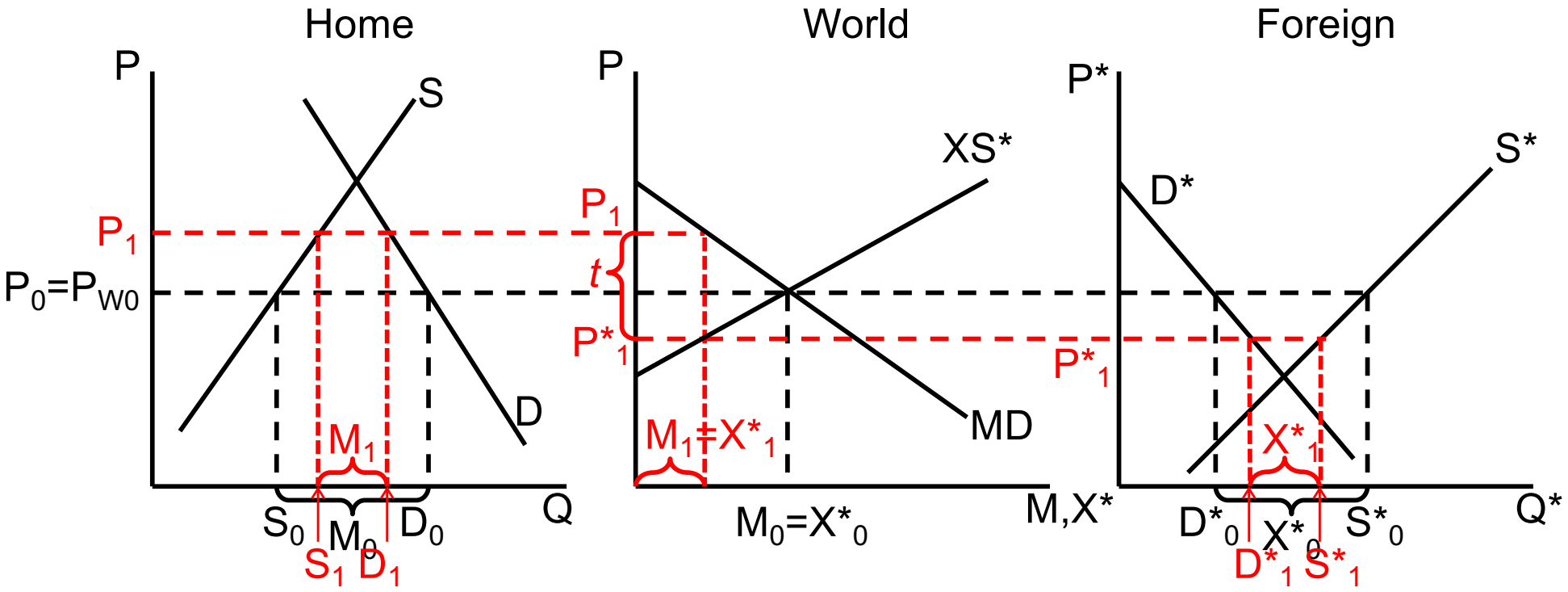
Free trade

Large country
(i.e., Two Countries)



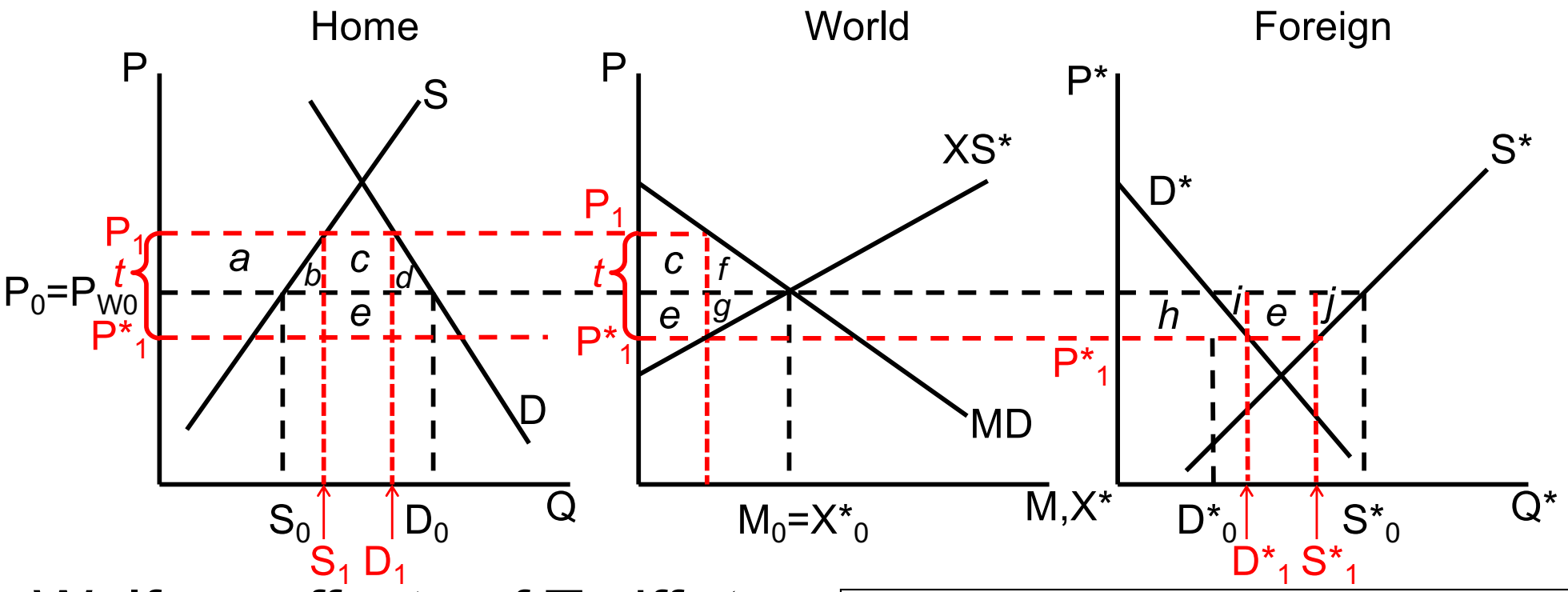
Free trade

Large country
(i.e., Two Countries)



Specific Tariff, *t,* by Home
Requires: P=P*+*t*, MD=XS*

Large country (i.e., Two Countries)



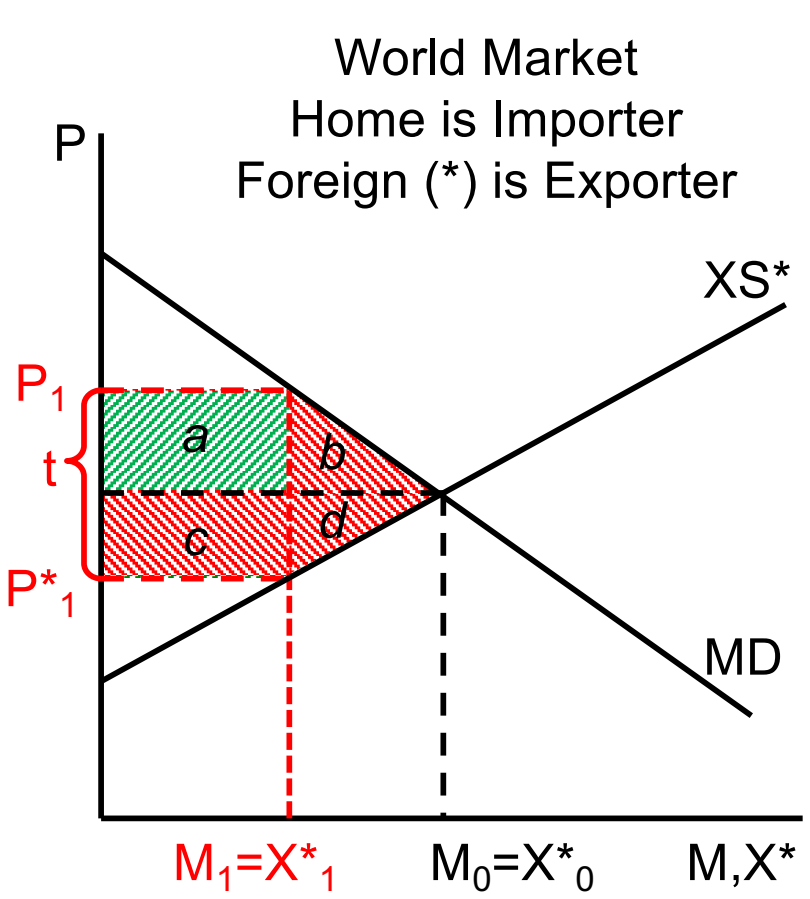
Welfare effects of Tariff, *t*:

- Home
  - Suppliers $+a$
  - Demanders $-(a+b+c+d)$
  - Government $+(c+e)$
  - Country $+e-(b+d) = e-f$

- Foreign
  - Suppliers $-(h+i+e+j)$
  - Demanders $+h$
  - Country $-(i+e+j) = -(e+g)$

- World: $-(f+g) = -(b+d+i+j)$

Large country, World Market

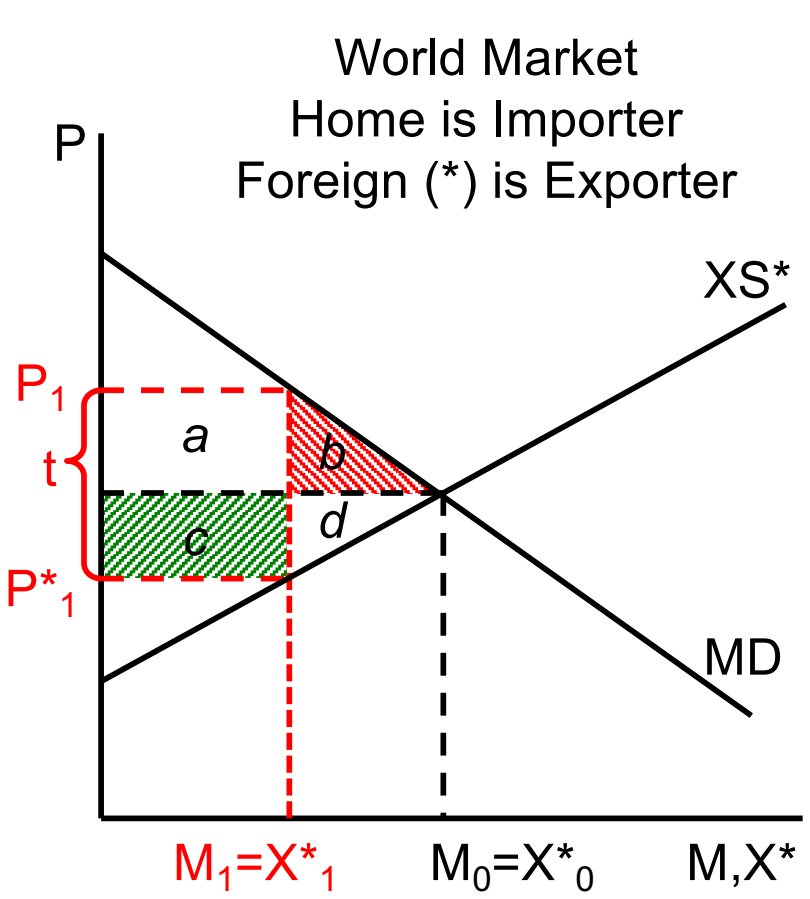


Welfare effects of a large-country tariff, starting from free trade

- Home:
  - Private sector (S&D) loses $-(a+b)$
  - Government gains $+(a+c)$
  - Country may gain or lose: $+c-b$
- Foreign
  - Private sector (S&D) loses $-(c+d)$
- World loses $-(b+d)$

"Dead Weight Loss" =

Large country, World Market



Thus large country will gain from tariff if *c>b*

- What is area c?
  - The portion of the tariff paid by foreign exporters, who get a lower price
  - A transfer from foreign producers to the home government
  - The result of improving the home country's "terms of trade"

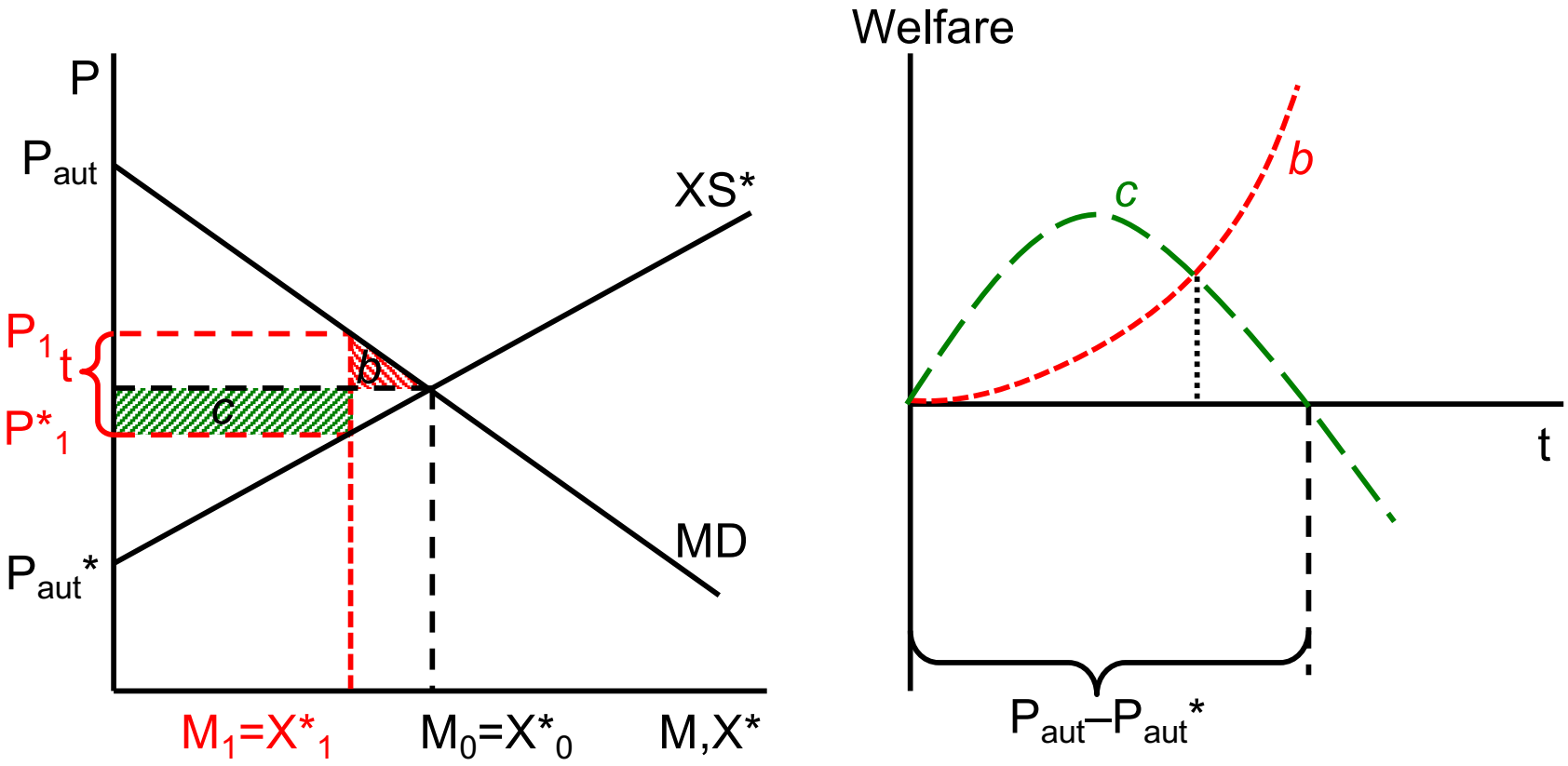
"Terms of Trade" ≡ Relative price of exports = P^X/P^M

Pause for Discussion

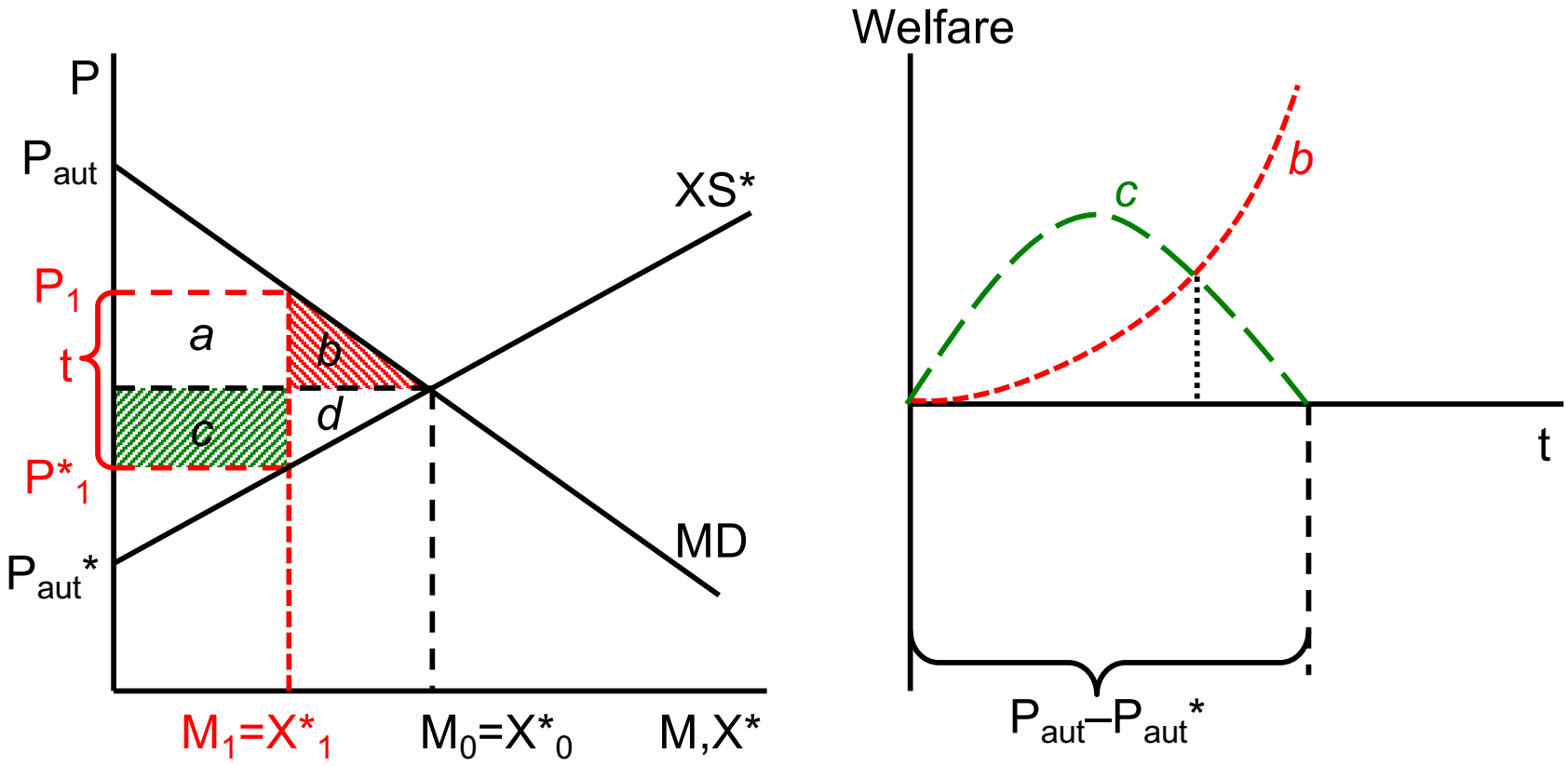
Questions on Large Country

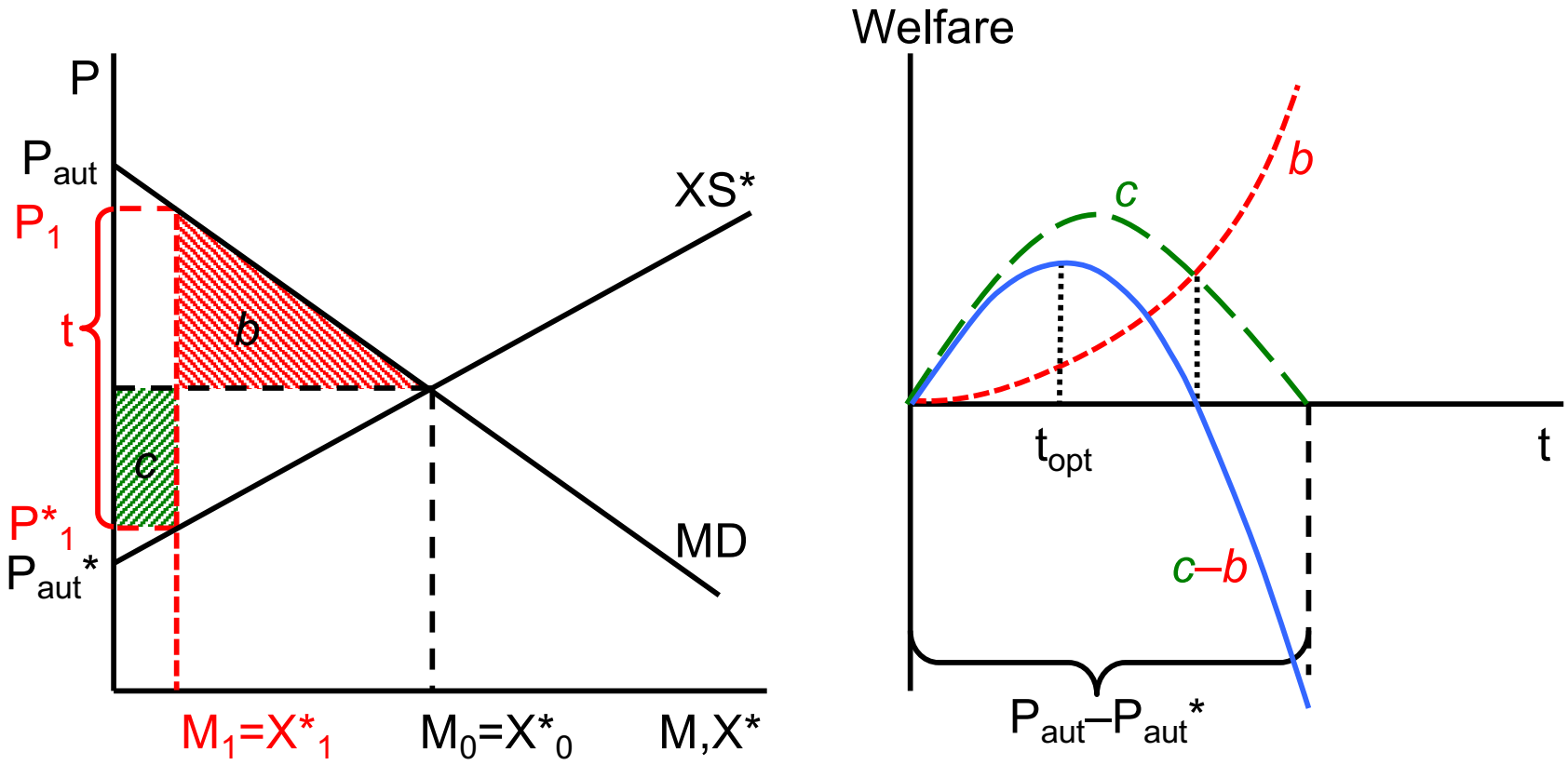
- The figure for the world market shows the tariff causing the world price to fall. What in the figure tells you that the Home country is large?
- In what sense might a large country gain by using a tariff? Who in the country benefits from that gain?
- What reasons are there, if any, for a large country not to levy a tariff?

Large country, "Optimal" tariff
Watch as *t* rises

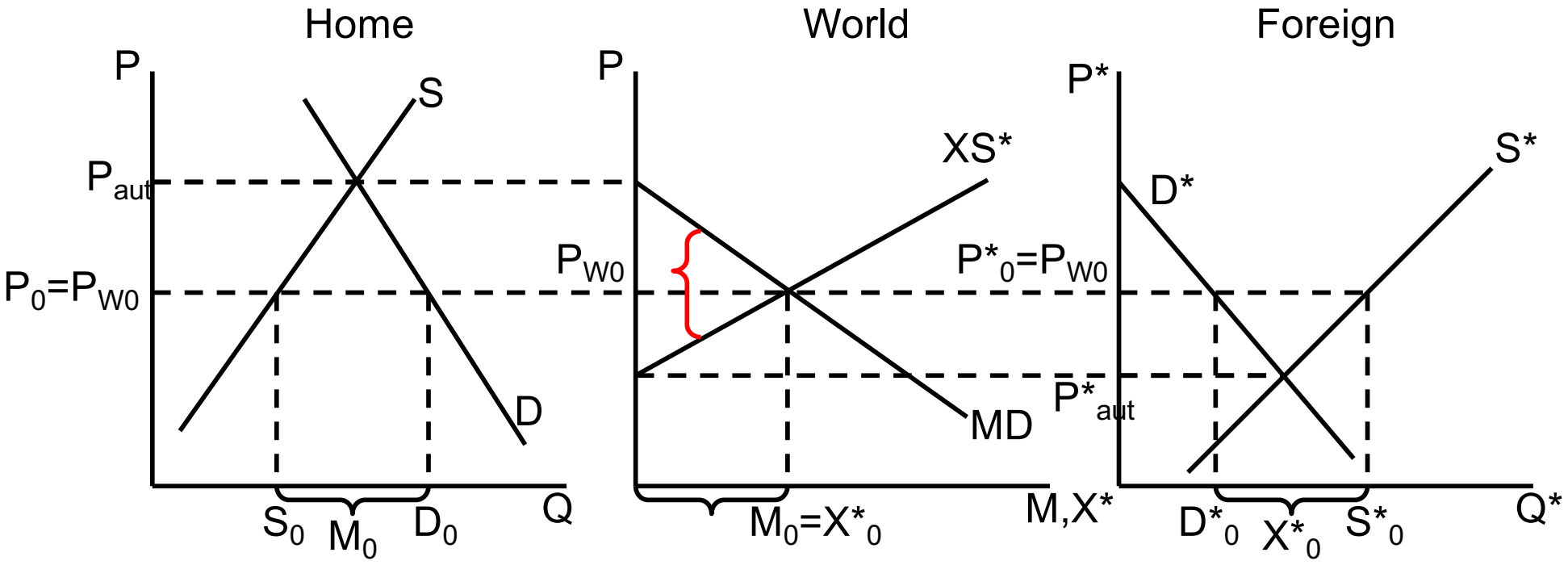


Large country, “Optimal” tariff
Watch as *t* rises




P
P_aut
P_1
t
b
c
P*_1
P_aut*
XS*
MD
M_1=X*_1
M_0=X*_0
M,X*
Welfare
b
c
t_opt
t
c–b
P_aut–P_aut*

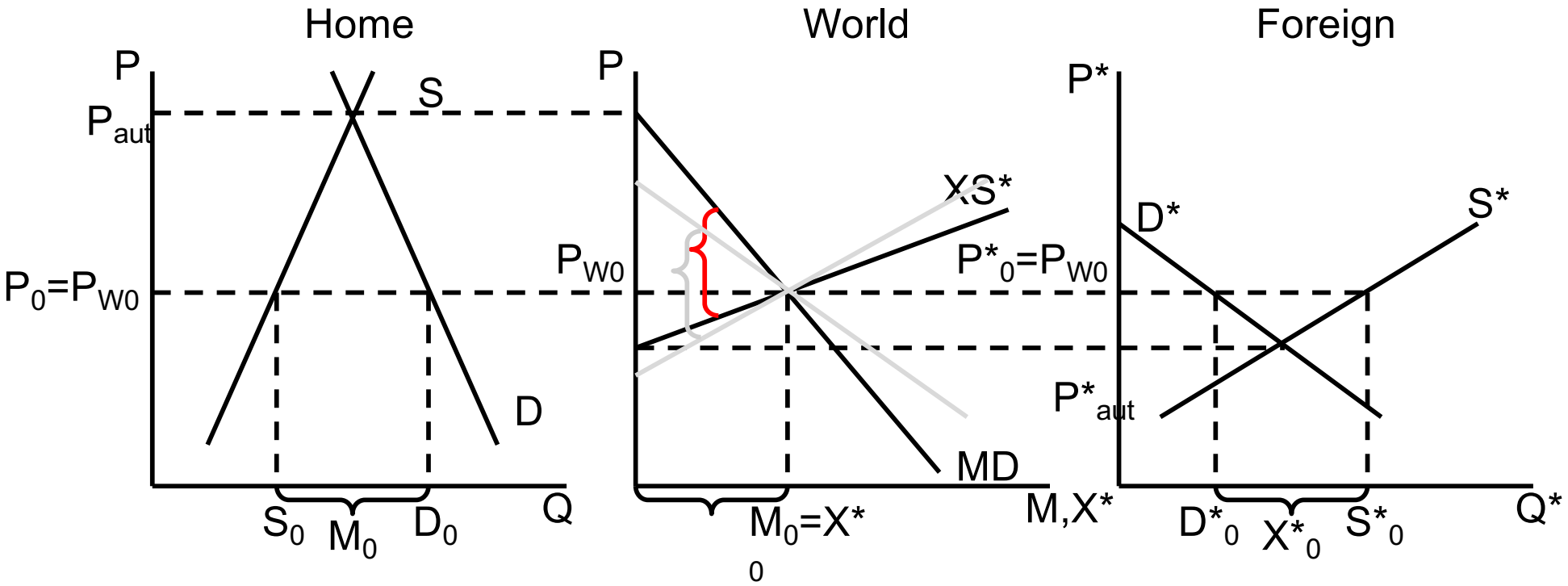
How Sizes and Slopes Matter



Free trade

Tariff

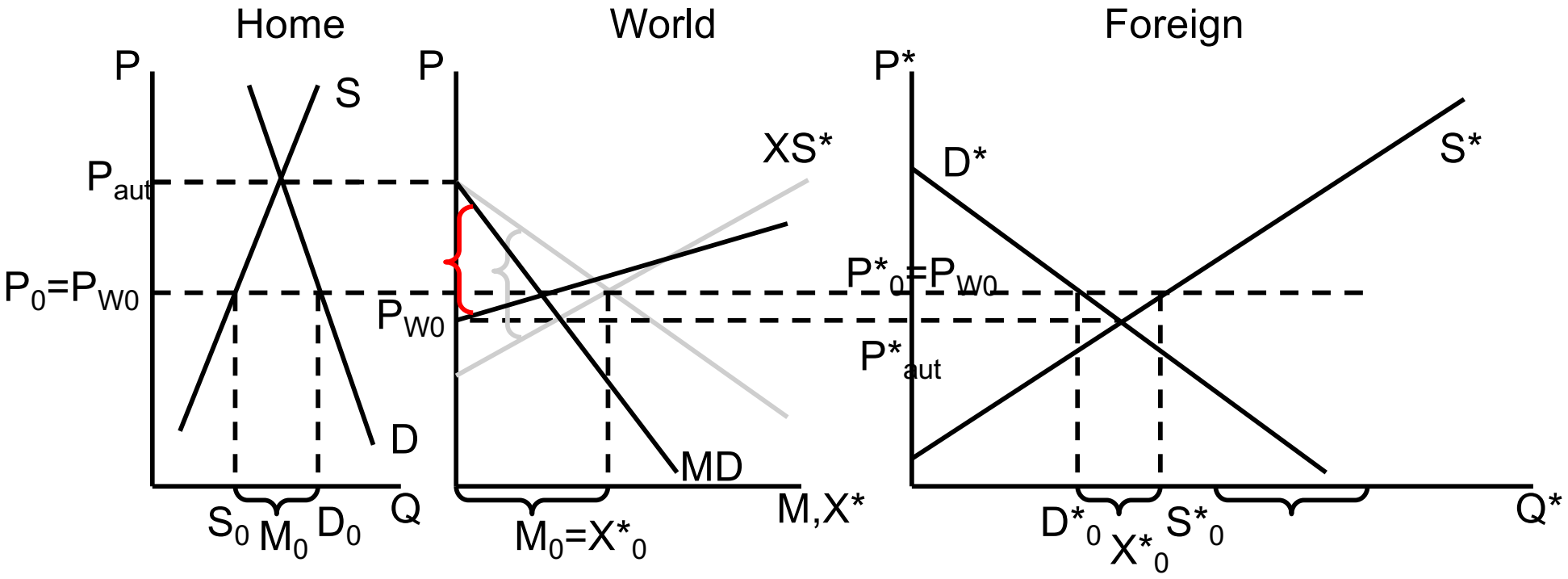
How Slopes (Elasticities) Matter



Free trade

Tariff

How Sizes Matter



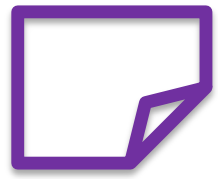
Free trade

Tariff

Pause for Your Questions

Two-Country in Equations

- Countries $i = h, f = home, foreign$
- Prices $p^i, i = h, f$
  - With free trade, equilibrium #0:
$$p^{h0} = p^{f0} (= p^{w0})$$
  - With specific tariff, t, levied by country h on export of f, equilibrium #1:
$$p^{h1} = p^{f1} + t$$
  - *Ad valorem* equivalent of the specific tariff at the initial price:
$$\tau = \frac{t}{p^{h0}}$$



Two-Country in Equations

- Domestic supply and demand in each country, $i = h, f$, are represented by their elasticities:

$$\varepsilon^i = \frac{\Delta Q^{is}}{Q^{is0}} \Big/ \frac{\Delta p^i}{p^{i0}} > 0 \quad \text{or} \quad \Delta Q^{is} = \varepsilon^i \frac{\Delta p^i}{p^{i0}} Q^{is0}$$

$$\eta^i = \frac{\Delta Q^{id}}{Q^{id0}} \Big/ \frac{\Delta p^i}{p^{i0}} < 0 \quad \text{or} \quad \Delta Q^{id} = \eta^i \frac{\Delta p^i}{p^{i0}} Q^{id0}$$

Two-Country in Equations

- Notation
  - Values of initial supply and demand, $i = h, f$:

$$V^{is0} = p^{i0}Q^{is0}$$
$$V^{id0} = p^{i0}Q^{id0}$$

  - Value of initial (home-country) imports:

$$M^0 = \left(V^{hd0} - V^{hs0}\right)$$

  - Convenient values, capturing both size and price responsiveness, $i = h, f$:

$$A^i \equiv \varepsilon^i V^{is0} - \eta^i V^{id0} > 0$$
$$\bar{A} = A^h + A^f > 0$$

Two-Country in Equations

- Price changes must add up to tariff:

$$\Delta p^h - \Delta p^f = t$$

- Divide by $p^{h0} = p^{f0}$:

$$\frac{\Delta p^h}{p^{h0}} - \frac{\Delta p^f}{p^{f0}} = \frac{t}{p^{h0}} = \tau$$

or:

$$\frac{\Delta p^h}{p^{h0}} = \frac{\Delta p^f}{p^{f0}} + \tau$$

Two-Country in Equations

- Equilibrium quantities:

$$\Delta Q^{hd} - \Delta Q^{hs} = \Delta Q^{fs} - \Delta Q^{fd}$$

- Use elasticities:

$$\eta^h \frac{\Delta p^h}{p^{h0}} Q^{hd0} - \varepsilon^h \frac{\Delta p^h}{p^{h0}} Q^{hs0} = \varepsilon^f \frac{\Delta p^f}{p^{f0}} Q^{fs0} - \eta^f \frac{\Delta p^f}{p^{f0}} Q^{fd0}$$

- Multiply through by $p^{h0} = p^{f0}$ to get values:

$$A^h \left(\eta^h V^{hd0} - \varepsilon^h V^{hs0}\right) \frac{\Delta p^h}{p^{h0}} = \left(\varepsilon^h f V^{fs0} - \eta^f V^{fd0}\right) \frac{\Delta p^f}{p^{f0}}$$

- or:

$$A^h \frac{\Delta p^h}{p^{h0}} = -A^f \frac{\Delta p^f}{p^{f0}}$$

Two-Country in Equations

- This gives us two equations in two unknowns, $\frac{\Delta p^h}{p^{h0}}$ & $\frac{\Delta p^f}{p^{f0}}$:

$$\frac{\Delta p^h}{p^{h0}} = \frac{\Delta p^f}{p^{f0}} + \tau$$

$$A^h \frac{\Delta p^h}{p^{h0}} = -A^f \frac{\Delta p^f}{p^{f0}}$$

Two-Country in Equations

- Solution:

$$A^h \frac{\Delta p^h}{p^{h0}} = A^h \left(\frac{\Delta p^f}{p^{f0}} + \tau \right) = -A^f \frac{\Delta p^f}{p^{f0}}$$

$$= \left(A^h + A^f \right) \frac{\Delta p^f}{p^{f0}} = -A^h$$

$$\frac{\Delta p^f}{p^{f0}} = -\frac{A^h}{\bar{A}} \tau$$

Where
$A^h \approx$ Home size
$A^f \approx$ Foreign size
$\bar{A} = A^h + A^f$

$$\frac{\Delta p^h}{p^{h0}} = -\frac{A^h}{\bar{A}} \tau + \frac{A^h + A^f}{\bar{A}} \tau = \frac{A^f}{\bar{A}} \tau$$

$$\frac{\Delta p^h}{p^{h0}} = \frac{A^f}{\bar{A}} \tau$$

Two-Country in Equations

- Interpretation:
  - Ratio of two price changes:

$$R \equiv \frac{\Delta p^h}{-\Delta p^f} = \frac{\Delta p^h / p^{h0}}{-\Delta p^f / p^{f0}} = \frac{A^f}{A^h}$$

  - Home country share of tariff incidence:

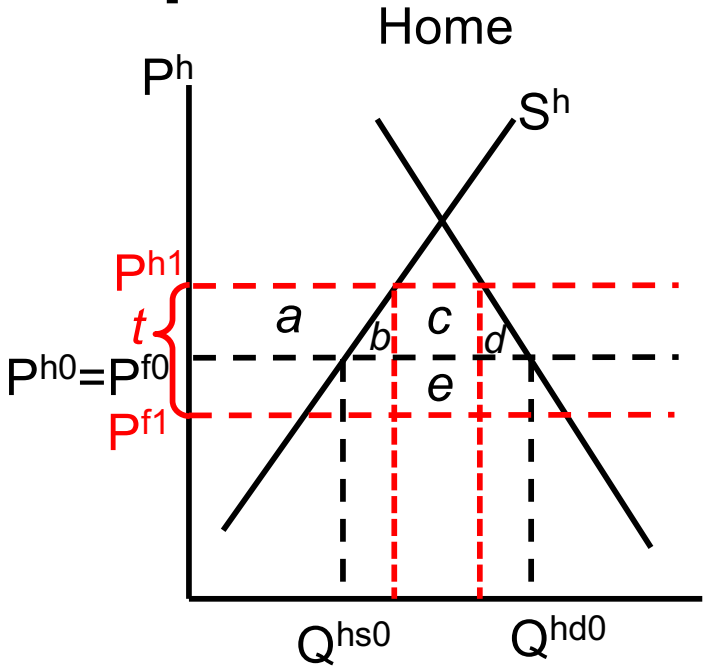
$$S \equiv \frac{\Delta p^h}{\Delta p^h - \Delta p^f} = \frac{A^f}{A^h + A^f}$$

- Recall that $A^i = \varepsilon^i V^{is0} - \eta^i V^{id0}$ measures country <u>size</u> in this industry:
  - Small home country: if $A^h \to 0; R \to \infty;\ S \to 1$
  - Large home country: if $A^h \approx A^f; R \approx 1;\ S \approx 1/2$

Two-Country in Equations

- Welfare of home country:

$$WHC = \langle e \rangle - \langle b \rangle - \langle d \rangle$$



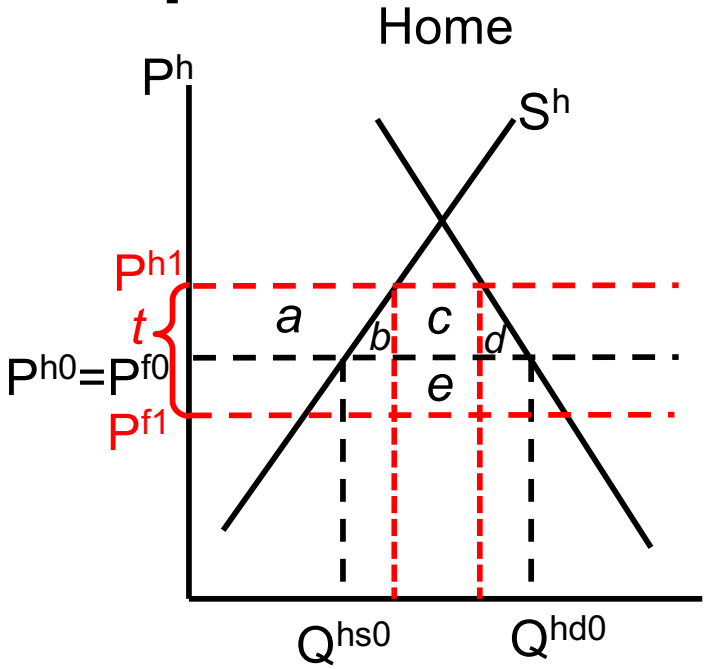
$$\langle e \rangle = -\Delta p^f \left(Q^{hd0} + \Delta Q^{hd} - Q^{hs0} - \Delta Q^{hs} \right)$$
$$= -\Delta p^f \left(Q^{hd0} - Q^{hs0} \right) - \Delta p^f \left(\Delta Q^{hd} - \Delta Q^{hs} \right)$$
$$= -\frac{\Delta p^f}{p^{f0}} M^0 + \Delta p^f \left(\varepsilon^h \frac{\Delta p^h}{p^{h0}} Q^{hs0} - \eta^h \frac{\Delta p^h}{p^{h0}} Q^{hd0} \right)$$
$$= -\frac{\Delta p^f}{p^{f0}} M^0 + \frac{\Delta p^f}{p^{f0}} \left(\varepsilon^h V^{hs0} - \eta^h V^{hd0} \right) \frac{\Delta p^h}{p^{h0}}$$
$$= \frac{A^h}{\bar{A}} \tau M^0 - \frac{A^h}{\bar{A}} \tau A^h \frac{A^f}{\bar{A}} \tau$$

$$\langle e \rangle = \frac{A^h}{\bar{A}} M^0 \tau - \frac{{A^h}^2 A^f}{\bar{A}^2} \tau^2$$

Two-Country in Equations

- Welfare of home country:

$$WHC = \langle e \rangle - \langle b \rangle - \langle d \rangle$$



$$\langle b \rangle + \langle d \rangle = \Delta p^h \left(\Delta Q^{hs} - \Delta Q^{hd} \right)/2$$

$$= \frac{\Delta p^h}{2p^{h0}} \left(\varepsilon^h \frac{\Delta p^h}{p^{h0}} p^{h0} Q^{hs0} - \eta^h \frac{\Delta p^h}{p^{h0}} p^{h0} Q^{hd0} \right)$$

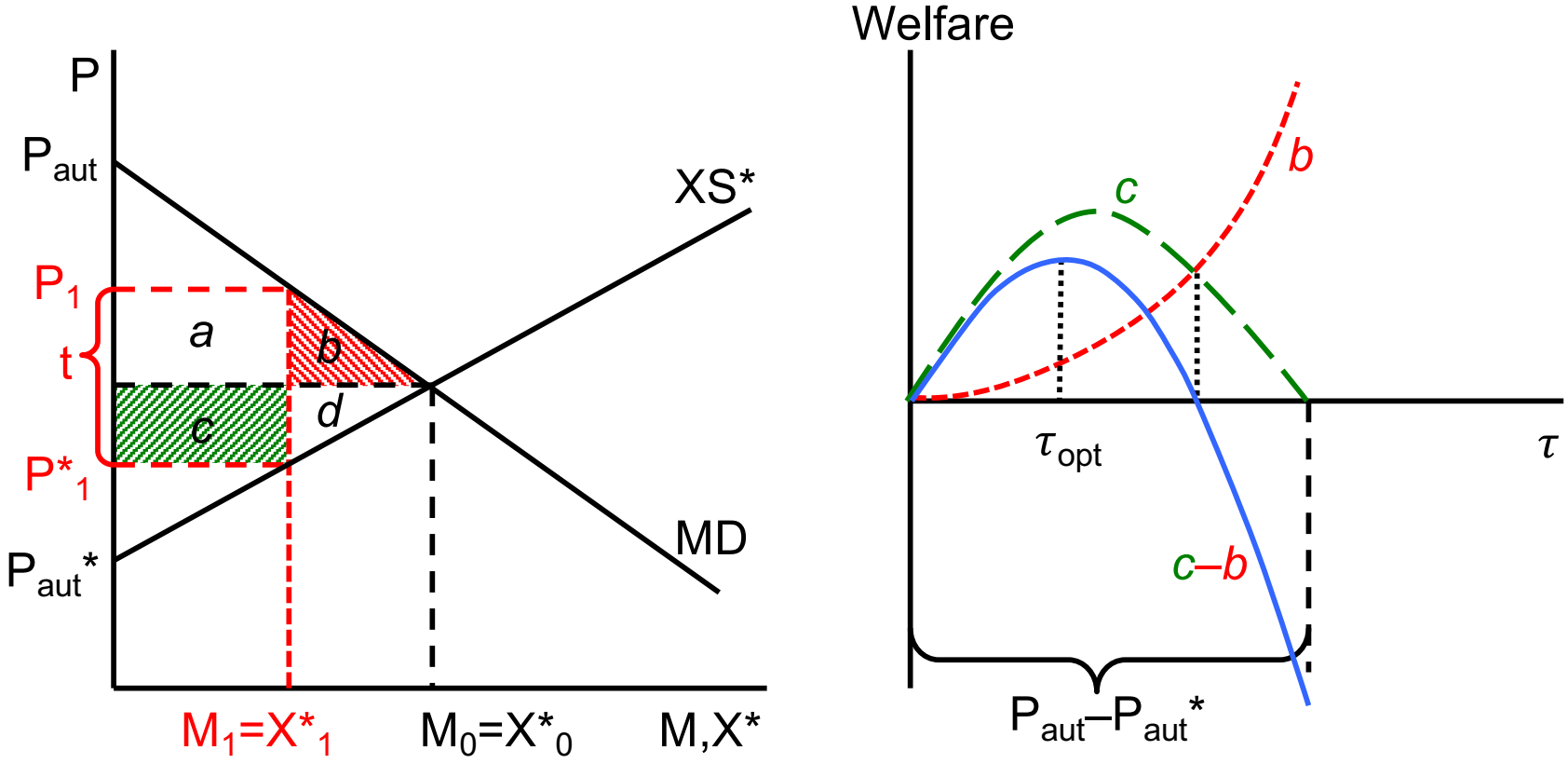
$$= \frac{\Delta p^h}{2p^{h0}} \left(\varepsilon^h V^{hs0} - \eta^h V^{hd0} \right) \frac{\Delta p^h}{p^{h0}}$$

$$= \frac{1}{2} A^h \left(\frac{\Delta p^h}{p^{h0}} \right)^2 = \frac{1}{2} A^h \left(\frac{A^f}{\bar{A}} \tau \right)^2$$

$$\langle b \rangle + \langle d \rangle = \frac{A^h {A^f}^2}{2\bar{A}^2} \tau^2$$

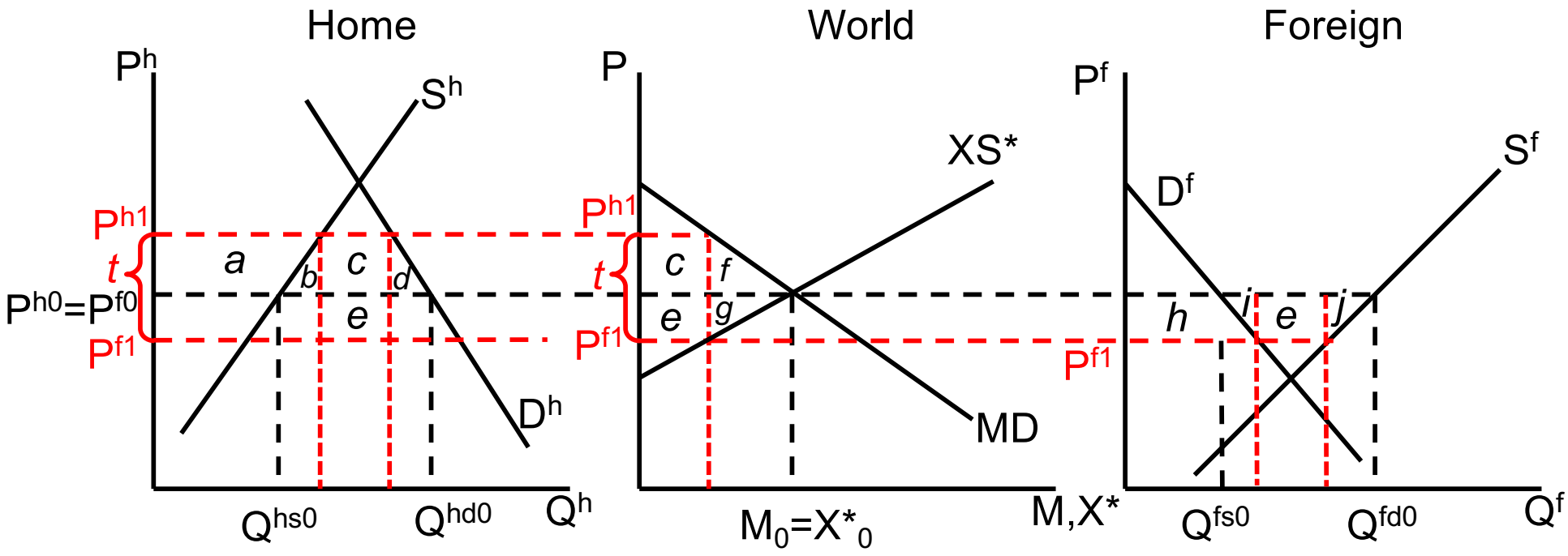
Welfare of Home Country

$$WHC = \langle e \rangle - (\langle b \rangle + \langle d \rangle) = \left[\frac{A^h}{\bar{A}} M^0 \tau - \frac{{A^h}^2 A^f}{\bar{A}^2} \tau^2\right] - \frac{A^h {A^f}^2}{2\bar{A}^2} \tau^2$$



Two-Country in Equations

- Other effects can be calculated similarly from the areas in the figure:



Two-Country in Equations

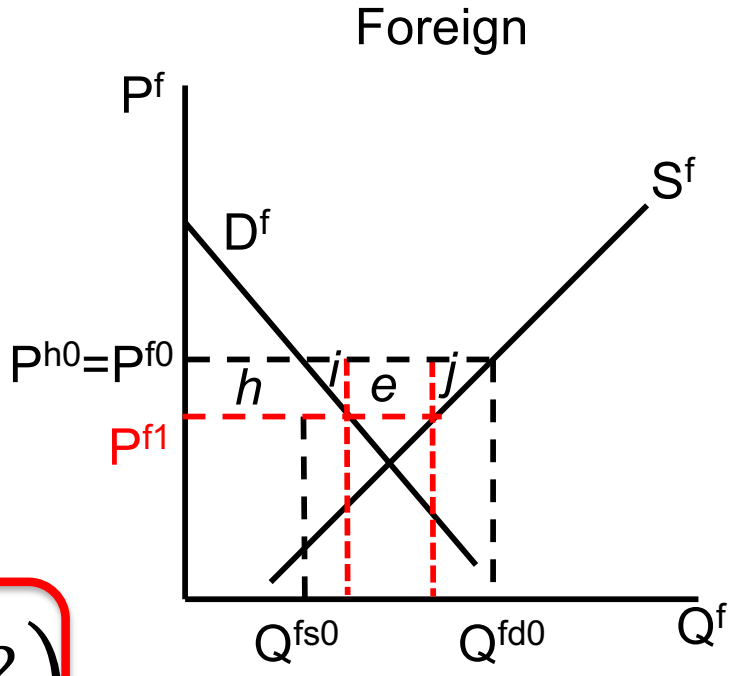
- Welfare of foreign country:

$$WFC = -\langle e \rangle - \langle i \rangle - \langle j \rangle$$

$$\langle e \rangle = \frac{A^h}{\bar{A}} M^0 \tau - \frac{{A^h}^2 A^f}{\bar{A}^2} \tau^2$$

$$\langle i \rangle + \langle j \rangle = \frac{1}{2}\left(\frac{A^h}{A^f}\right) A^h \left(\frac{A^f}{\bar{A}} \tau\right)^2$$

$$WFC = -\frac{A^h}{\bar{A}}\left(M^0 \tau - \frac{1}{2}\frac{A^h A^f}{\bar{A}} \tau^2\right)$$



Note that as A^h goes to zero, so does $\frac{A^h}{\bar{A}}$ and WFC.

However, area $\langle h \rangle$ may not, so the welfare effects on foreign demanders and suppliers separately are not negligible.

Is the US a Large Country?

- Consider Trump's 25% tariff on steel

$$\frac{\Delta p^f}{p^{f0}} = -\frac{A^{US}}{\bar{A}} 25\%$$

$$A^{US} \equiv \varepsilon^{US} V^{USs0} - \eta^{US} V^{USd0}$$

$$\bar{A} = A^{US} + A^f$$

- So
  - Foreign price of steel should fall by 25% times the US share of the world market
  - US price of steel should rise by 25% of the foreign share of the world market

Is the US a Large Country?

- What matters is, approximately, the US share of the world market for steel.
- In 2018 (from Wikipedia)
  - US/World production ≈ 5%
  - US/World demand ≈ 7%
- So US share was, at most, 7%
  - World price change 7% of 25%: negative < 2%
  - US price change 93% of 25%: positive > 23%
- Several studies of the 2018 tariffs showed
  - No perceptible fall in world prices
  - US prices rose by amount of tariffs

Pause for Your Questions

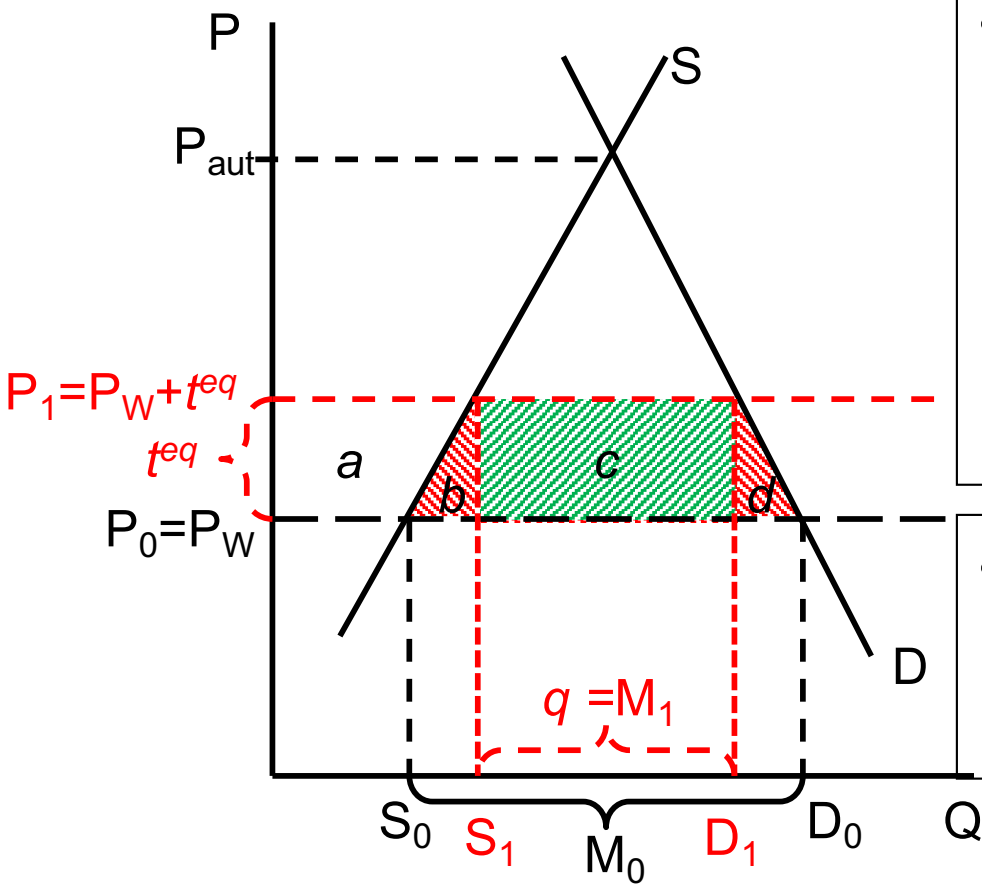
Outline

- Tariff by Small country
- Tariff by large country
- Quotas

Quotas

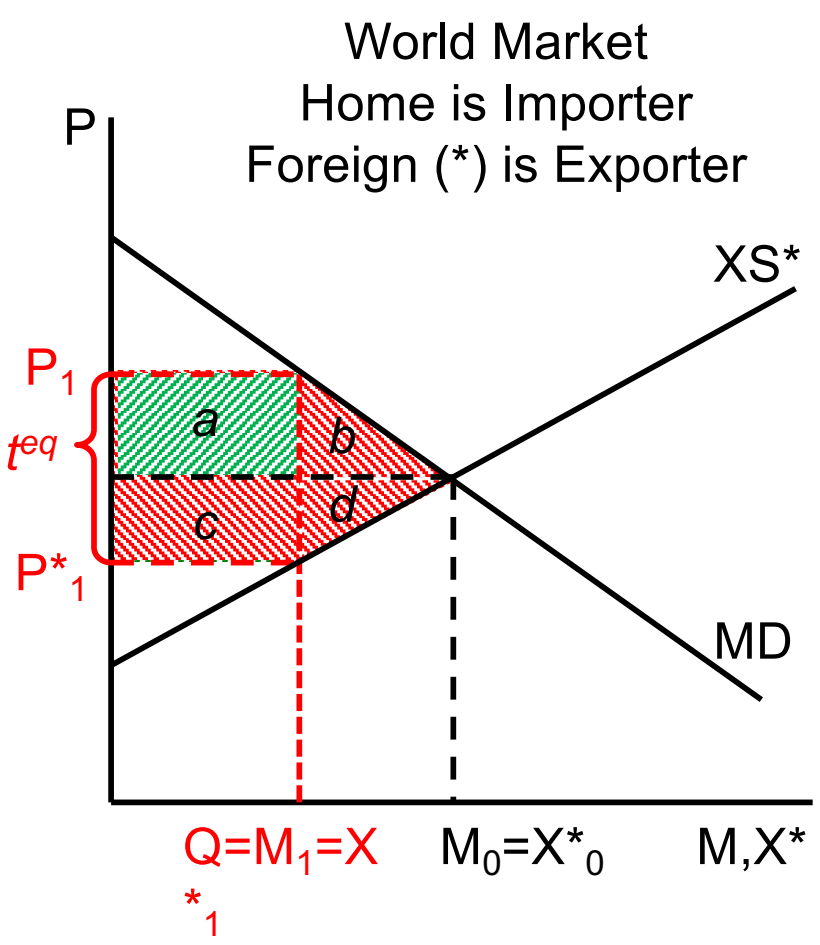
- Quota puts upper limit on quantity of imports
- Analysis is exactly the same as a tariff, except
  - Policy sets quantity of imports
  - Price difference is determined by the market (supply & demand)
  - Price difference is called “tariff equivalent” of the quota
- Welfare analysis of quota is the same as tariff, except
  - “Quota rent” instead of tariff revenue
- Who gets the quota rent?
  - Depends on how quota is administered
  - Most commonly, goes to foreigners

Small country quota (with rents to foreigners)



- Welfare effects of a quota, *q*, starting from free trade
  - Suppliers gain $+a$
  - Demanders Lose $-(a+b+c+d)$
  - Government gains nothing
  - Country loses $-(b+c+d)$
- Foreign gains quota rent $+c$
  - But this is negligible for world, since country is small
- World dead-weight loss is still $b+d$

Large country quota
(with rents to foreigners)



Welfare effects of a large-country quota, starting from free trade

- Home:

Private sector (S&D) loses	$-(a+b)$
Government gains	0
Country must lose:	$-(a+b)$

- Foreign:

Private sector (S&D) loses	$-(c+d)$
Foreigners gain rents	$+(a+c)$
Country may gain or lose	$+a-d$

- World loses $-(b+d)$

"Dead Weight Loss" =

Pause for Discussion

Questions on Quotas from Deardorff "Nontariff …"

- How might quotas be administered; what happens to the quota rents in each case?
- How is an import quota equivalent to a tariff? How is it not?
- With a fixed and binding import quota, how will the domestic price and the tariff-equivalent of the quota change if curves shift?