PubPol/Econ 541

Classes 3, 4

Tariffs and Quotas

by
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2023

Announcements

- New optional reading for last week
  - Article by Indira Rajaraman, grad-school classmate of mine, now in India, on India's new laptop policy.
    - She says "I think it is important for students in the West to know that good stuff is available in non-Western sources, written in English they can understand, just to alert them to the advantages of not confining themselves to sources like the WSJ which has a few correspondents piping in news about the rest of the world."

Pause for News

Announcements

- I will stay only very briefly in my office hour this morning, as I have a meeting to attend. If you want to see me, either stay after class or come right at 10:00.
- 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.
    - In “short answer” questions, no need to write paragraphs or even sentences if you can convey what I ask for.

Announcements

- Quiz 1 Scores

	Q1
Mean	7.80
Median	8
Max	10
Min	1
S.D.	2.19

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 Wednesday

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

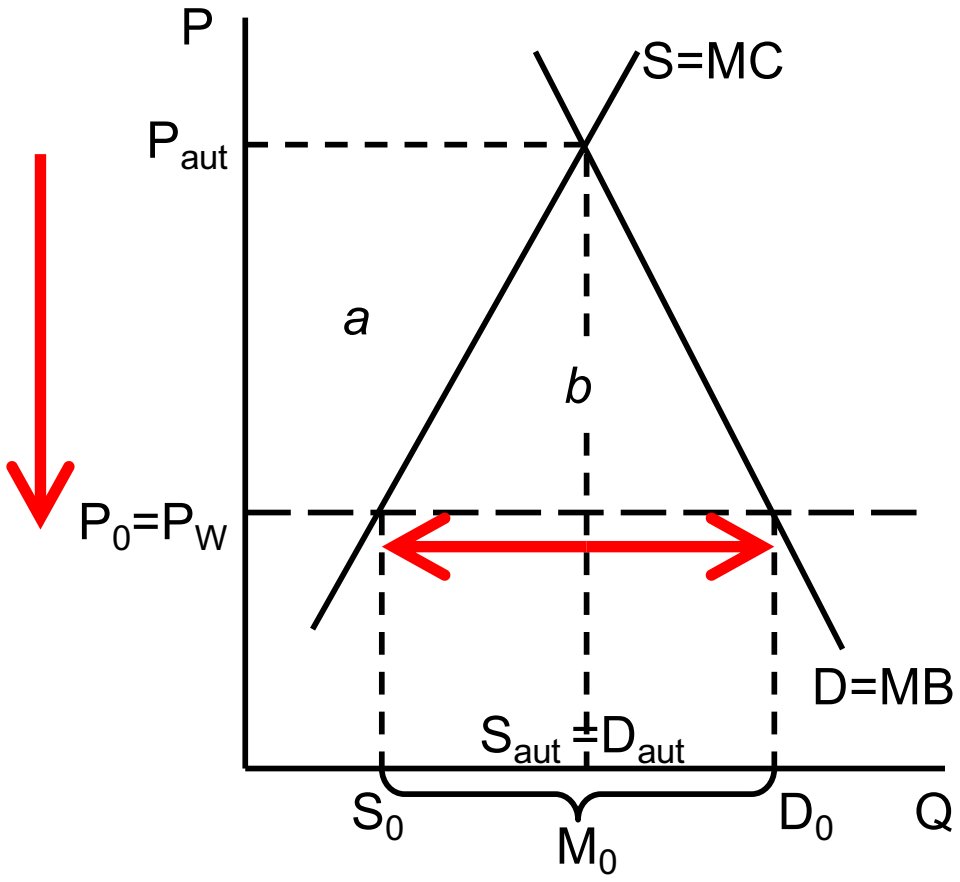
Small country

- Assumptions throughout
  - Markets perfectly competitive (many small buyers and sellers)
  - Product homogeneous (all units from all suppliers the same)
  - Markets in equilibrium (quantities supplied and demanded equal)
  - There are no “distortions” (externalities, etc.)
    - This includes no taxes other than tariffs
  - Supply and demand curves are straight lines
    - Just for simplicity
  - Model is partial equilibrium (takes all other prices as given)
  - Model is static (time does not play any role)
  - 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



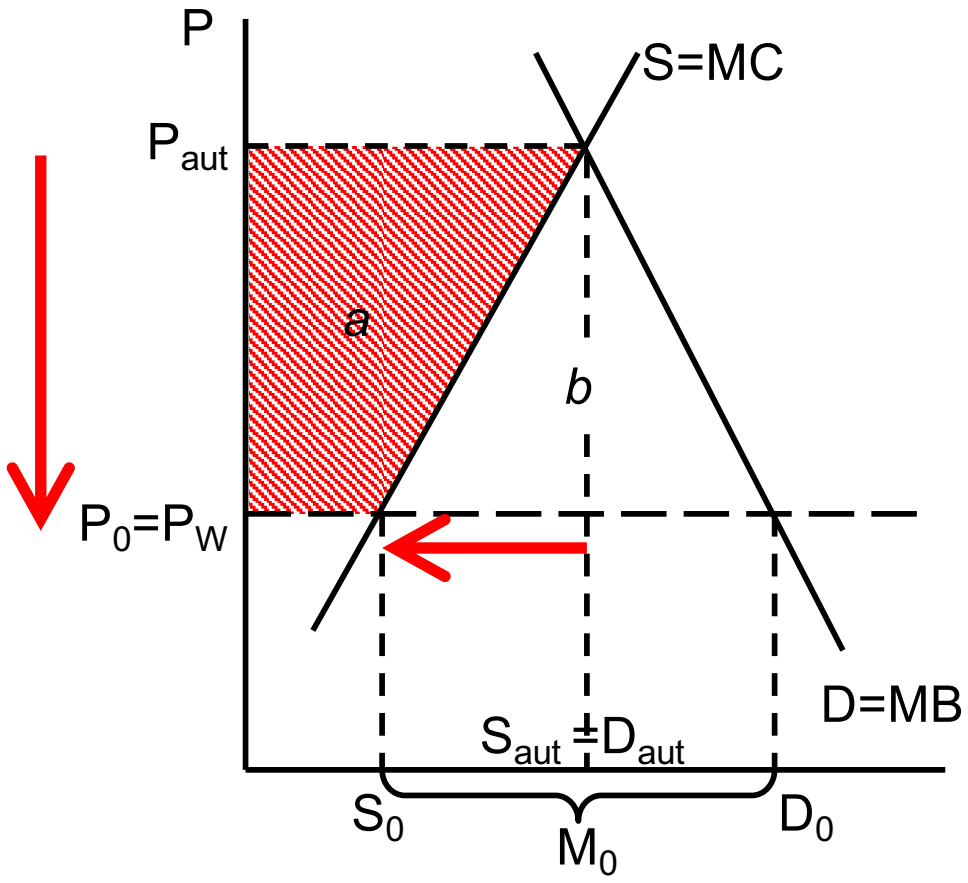
- Effects of move from autarky to free trade
  - Price falls
  - Quantity supplied falls
  - Quantity demanded rises
  - Imports rise
- Welfare effects:
  - Suppliers lose $-a$
  - Demanders gain $+(a+b)$
  - Country gains $+b$

The Gain from Trade

Free trade

Welfare Effects

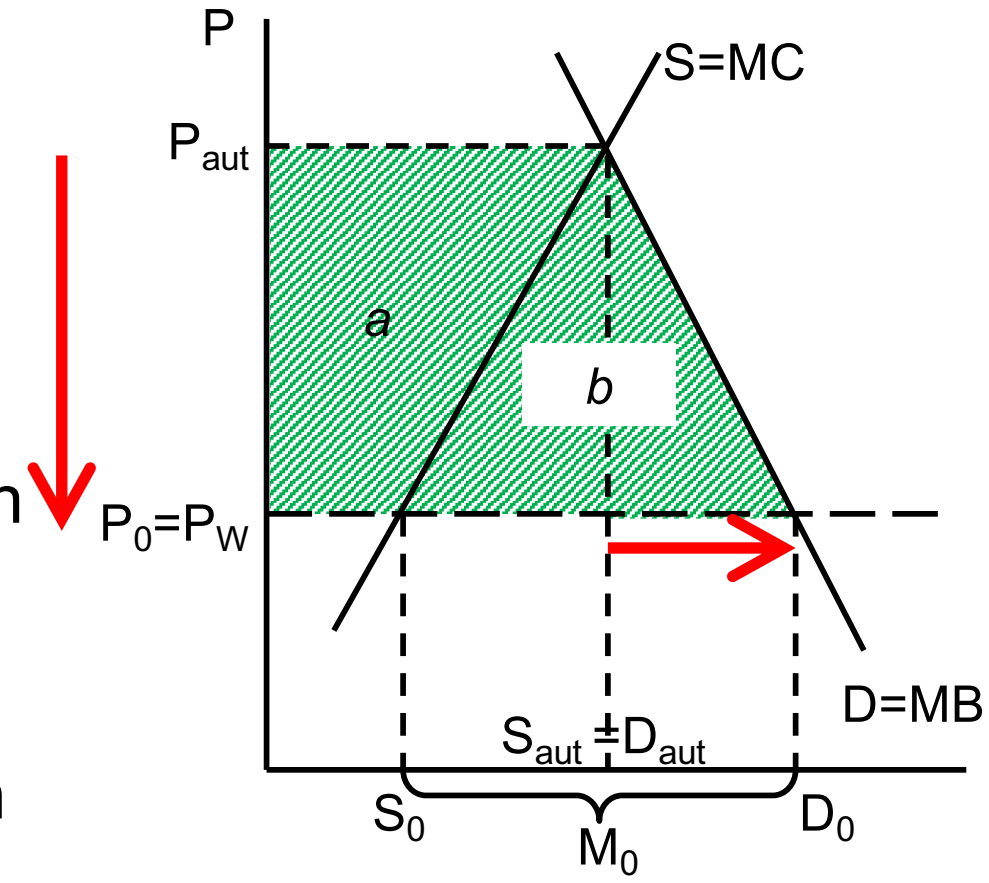
- Why *a* and (*a*+*b*)?
- Area *a*
  - Loss of "producer surplus"
  - Zero to S_0
    - Lost revenue
  - S_0 to S_{aut}
    - Lost profit from P_{aut} above MC



Welfare Effects

- Area (*a*+*b*)
  - Gain of "consumer surplus"
  - Zero to D_{aut}
    - Less expenditure on previous purchase
  - D_{aut} to D_0

    Additional units worth more (MB) than price



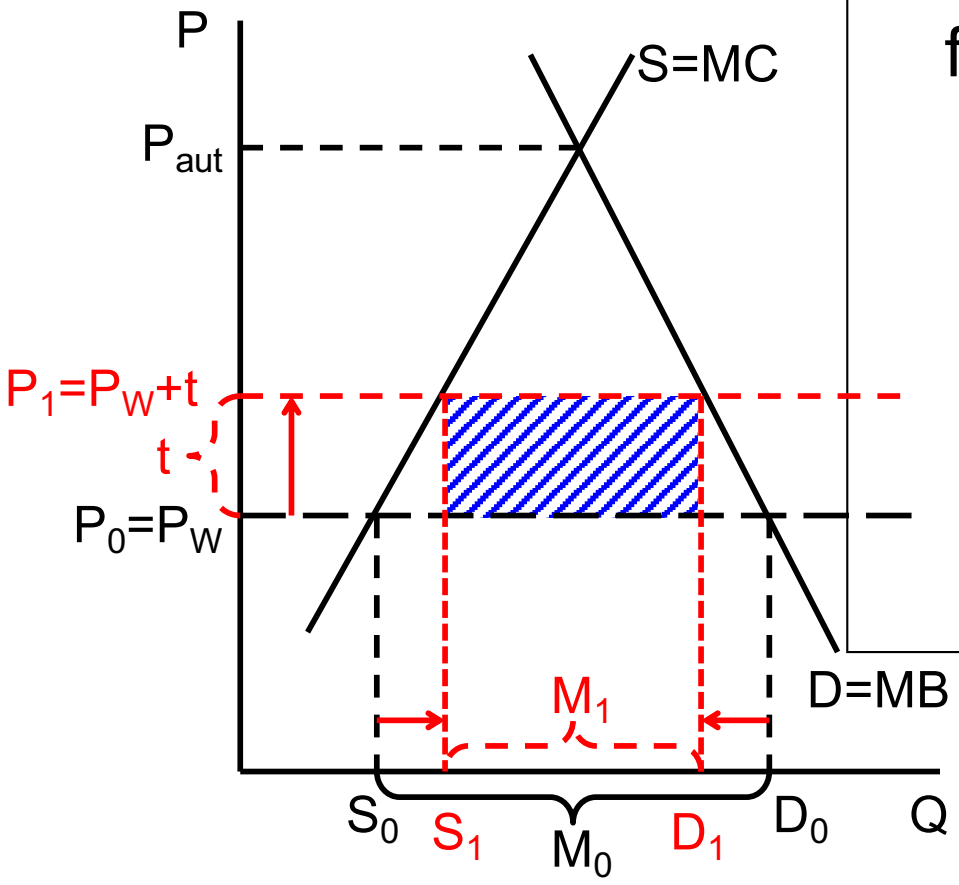
Welfare Effects

- Note that these welfare effects are
  - Measured in currency, price times quantity
  - Loss of producer surplus is what suppliers would be “willing to pay” to avoid the loss
  - Gain in consumer surplus is what buyers would be “willing to pay” to get this benefit
- This does not tell us about individual buyers and sellers, only them as a group

Small country tariff

- Tariff makes importing buyers pay more than the foreign exporters receive
  - By size of tariff, % or $
  - Difference goes to importing government
- Small country means that world price does not change
- So domestic price rises above world price by amount of the tariff

Small country tariff

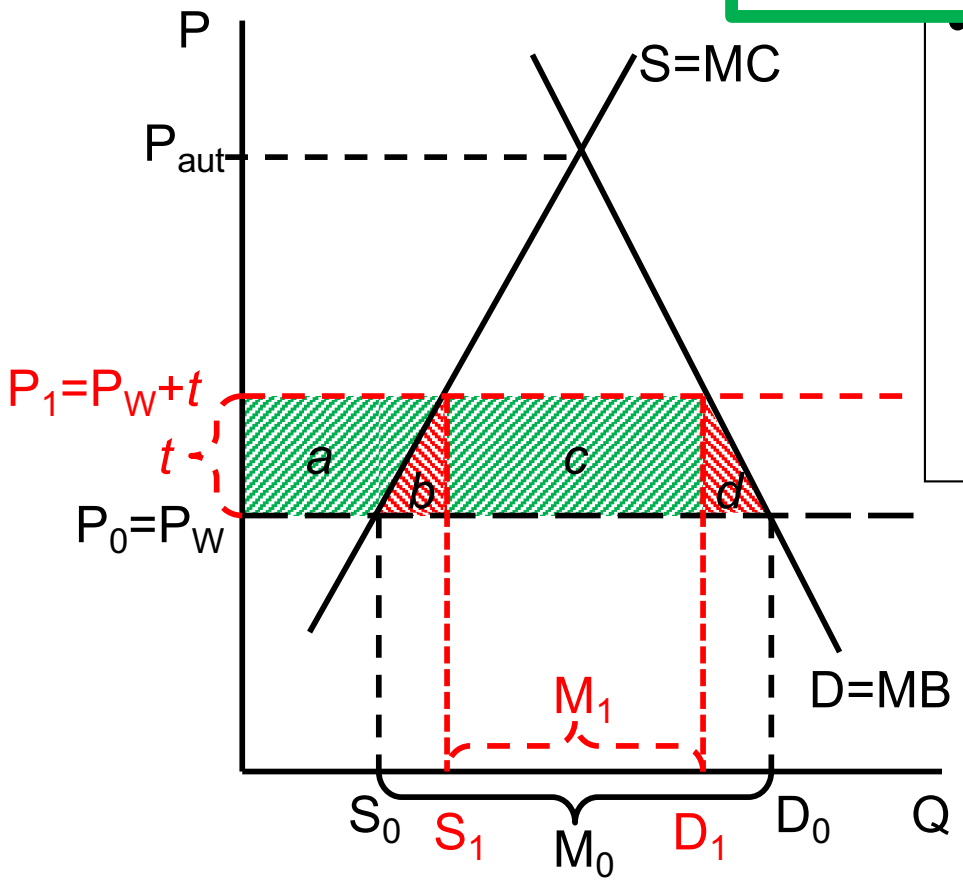


- Effects of a tariff, starting from free trade
  - Price rises for both the
    - Imported good
    - Domestically produced good
  - Quantity supplied rises
  - Quantity demanded falls
  - Quantity of imports falls
  - Tariff revenue rises from zero

Specific Tariff t

Small country tariff

WHY?



- Welfare effects of a tariff, starting from free

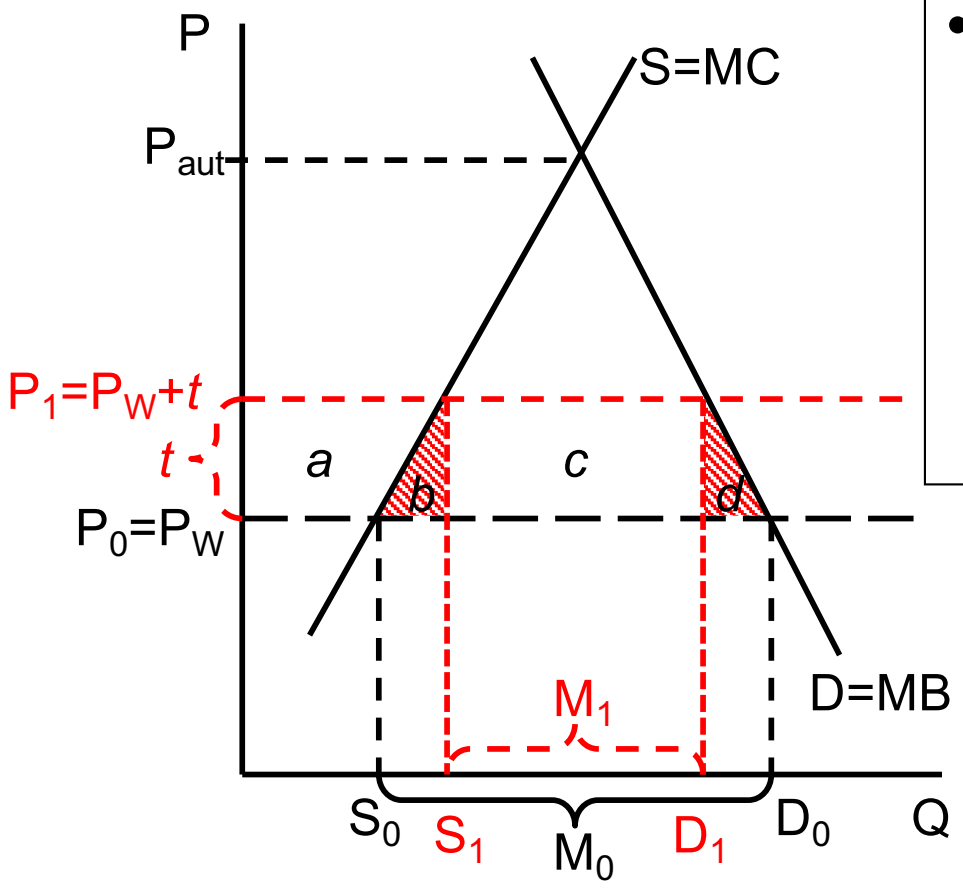
WHY?

  - 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" =

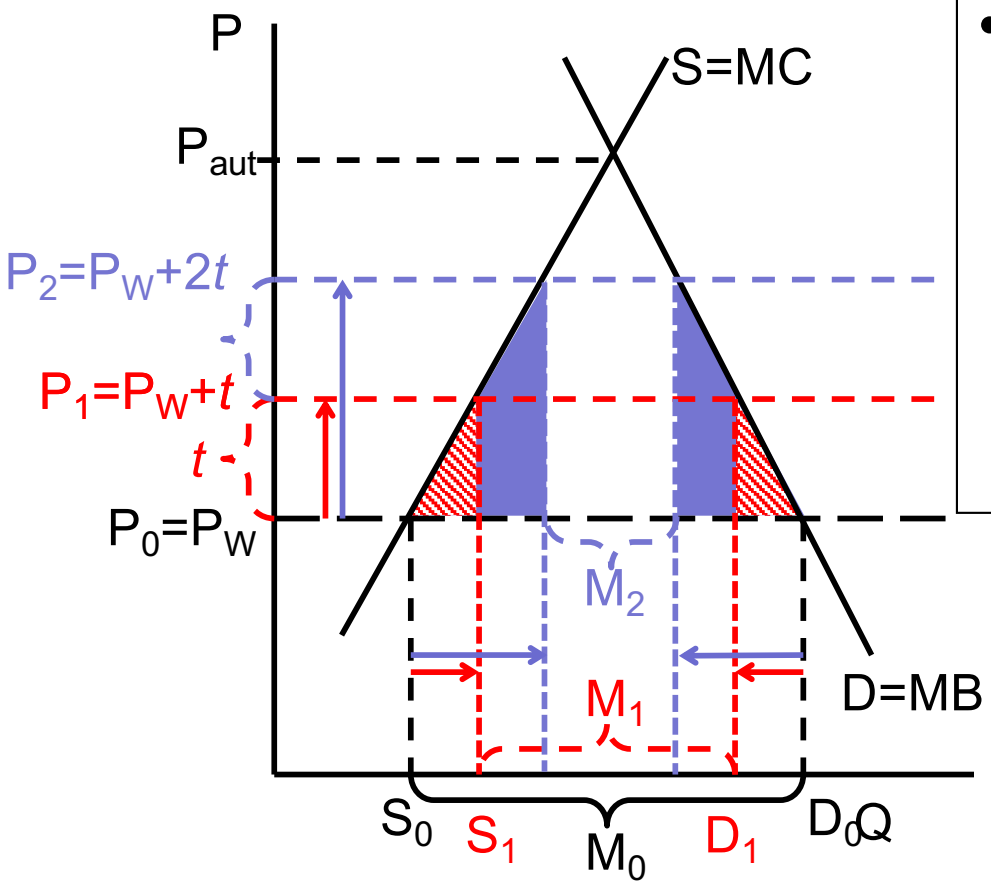
Specific Tariff t

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



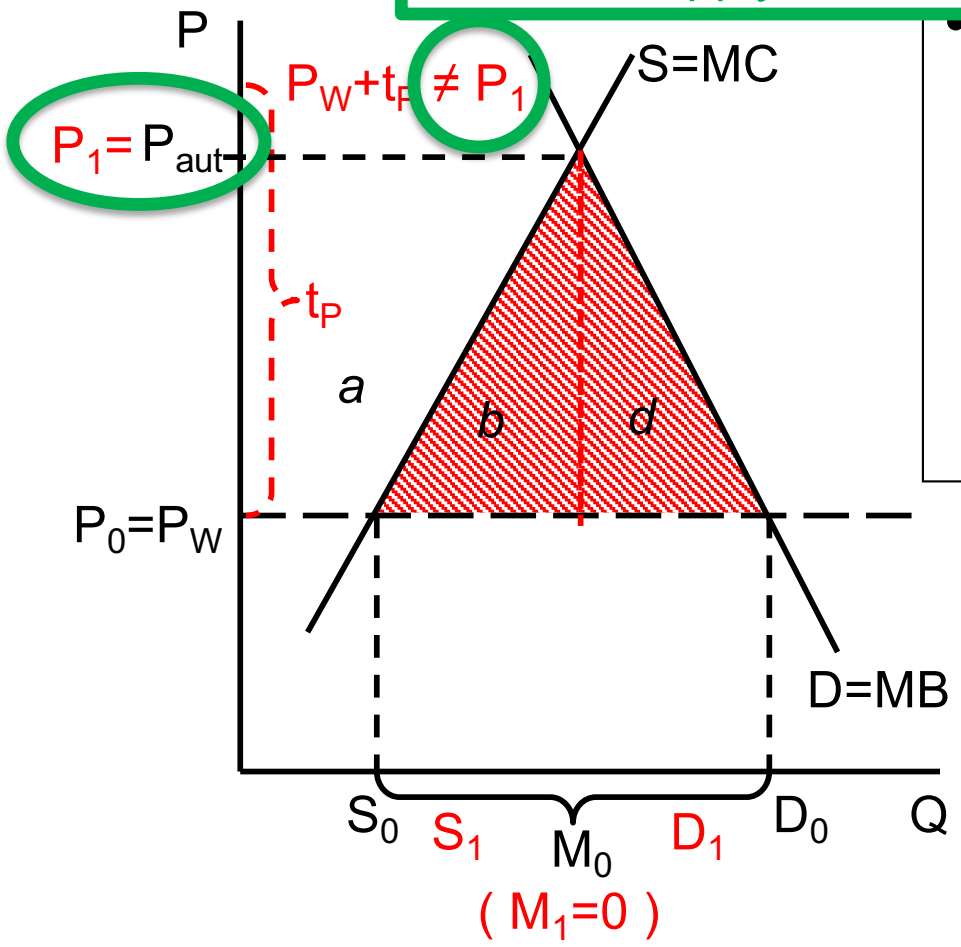
- Effects of doubling the tariff
  - Price rises by twice as much
  - Imports fall by twice as much
  - Deadweight loss is 4-times as large!
    - (Efficiency loss rises with the square of the tariff)

(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

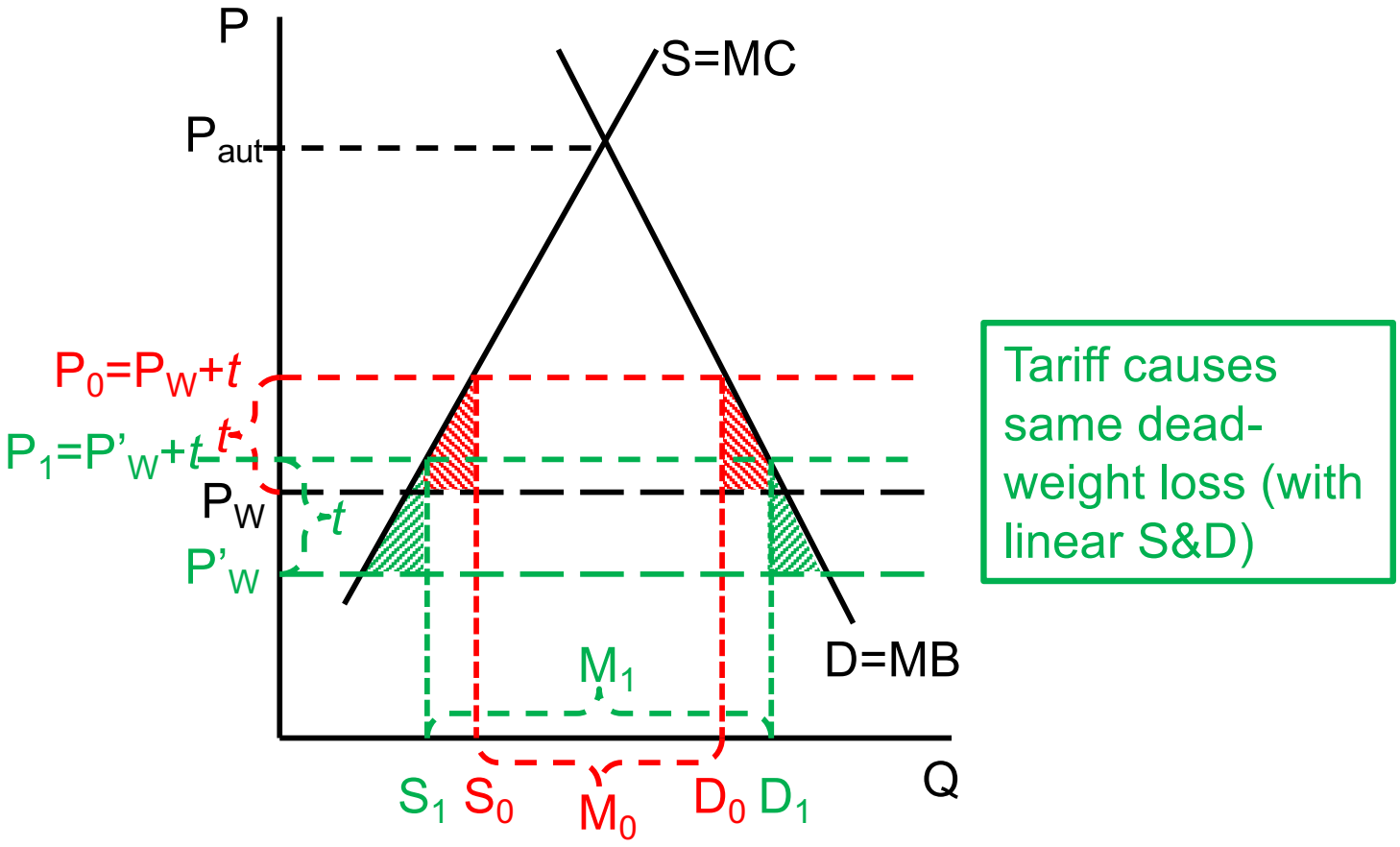


- Welfare effects of a prohibitive tariff, starting from free trade
  - Suppliers gain $+a$
  - Demanders Lose $-(a+b+d)$
  - Government gains 0
  - Country loses $-(b+d)$

"Dead Weight Loss" =

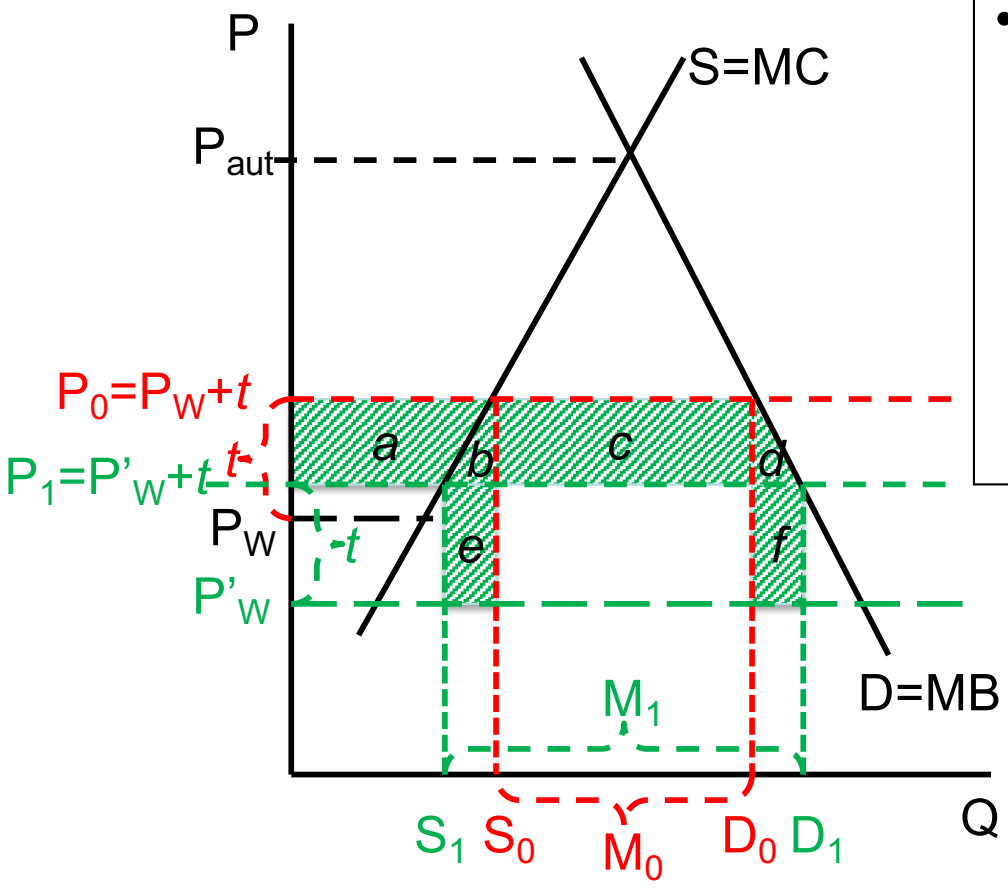
Specific Tariff $t_P > P_{aut} - P_W$

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 percentage changes and elasticities:

- 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.

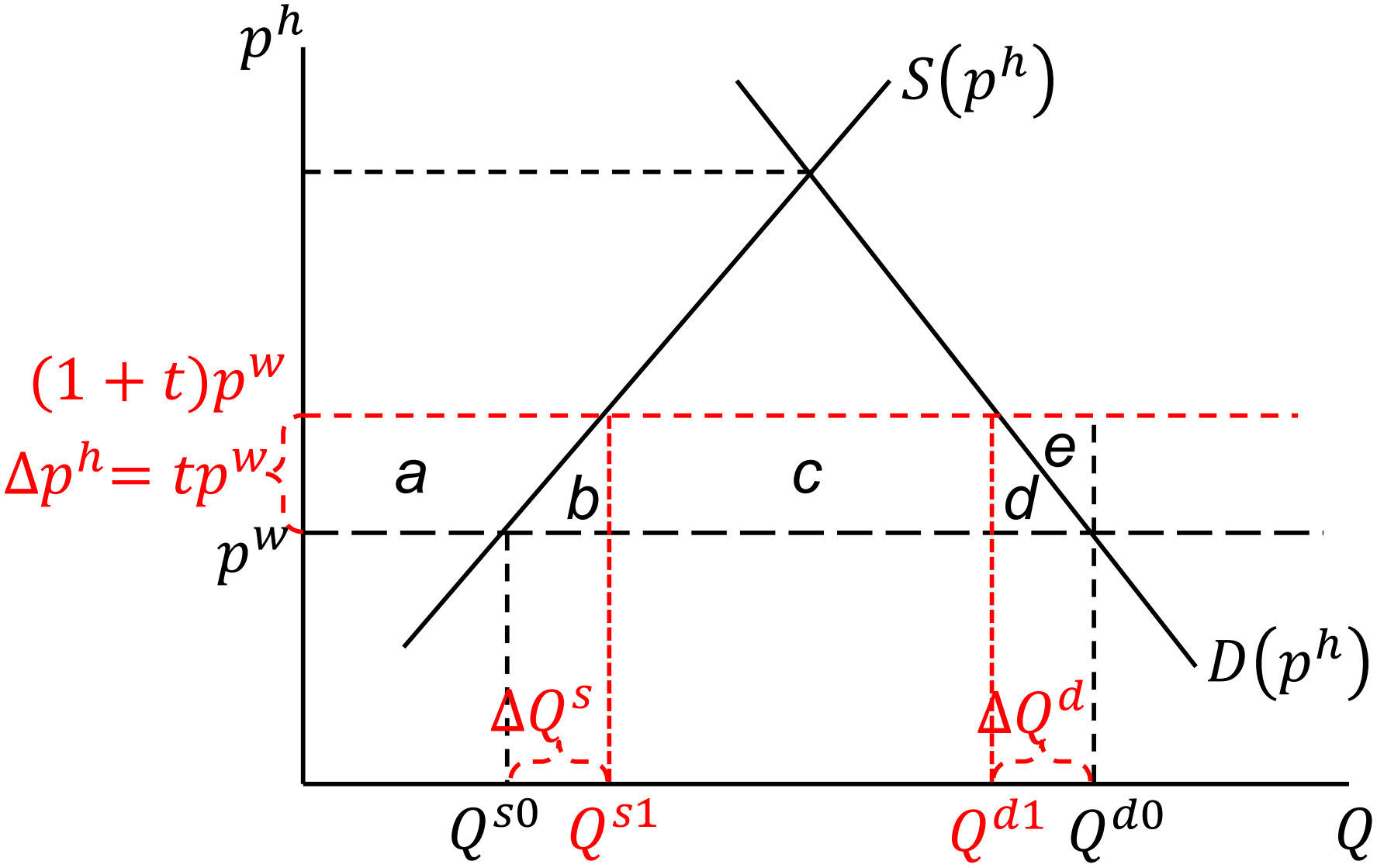
- Values of initial quantities:
- Demand: $V^{d0} = p^{h0}Q^{d0} = p^{w}Q^{d0}$
- Supply: $V^{s0} = p^{h0}Q^{s0} = p^{w}Q^{s0}$
- Imports: $V^{m0} = p^{w0}\left(Q^{d0} - Q^{s0}\right)$

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):

$$WGS = \langle a \rangle$$

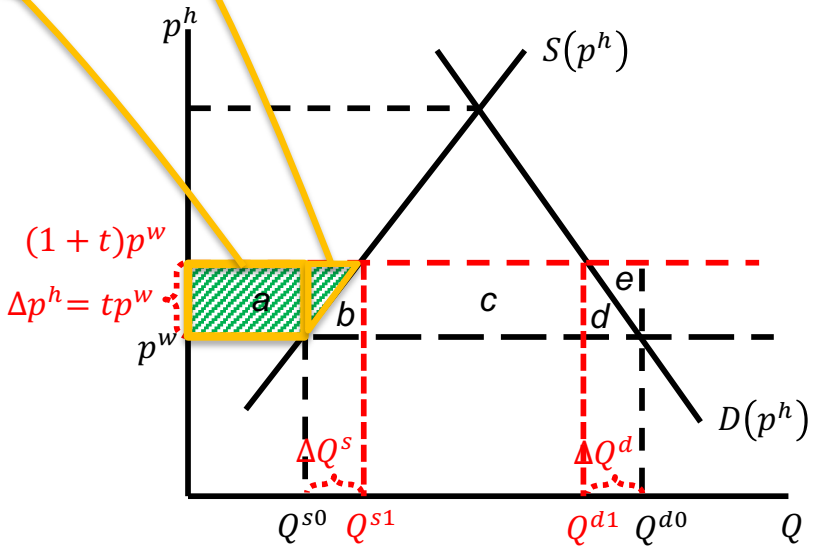
$$= (Q^{s0})(\Delta p^h) + \frac{1}{2}(\Delta Q^s)(\Delta p^h)$$

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

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

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

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



Small Country in Equations

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

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

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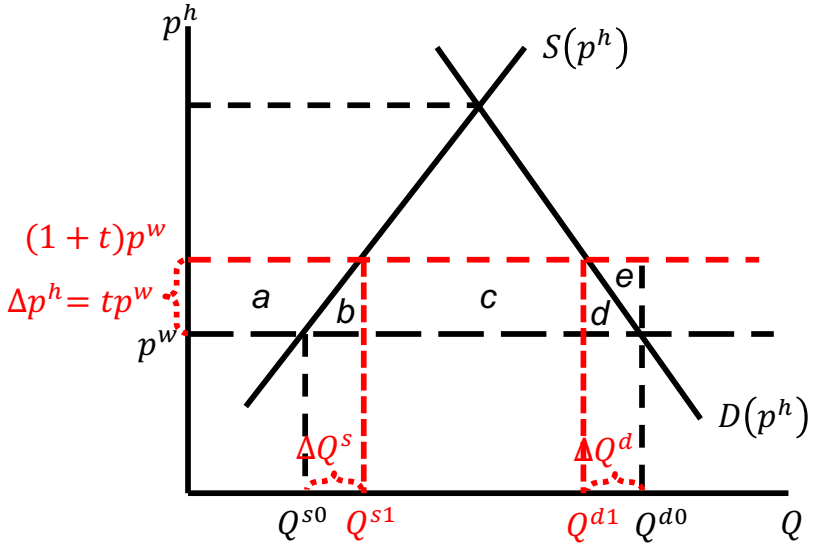
$$= \boxed{\left(1 + \frac{1}{2}\varepsilon t\right) t V^{s0}}$$



Small Country in Equations

- Welfare loss of demanders (consumers and downstream):

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

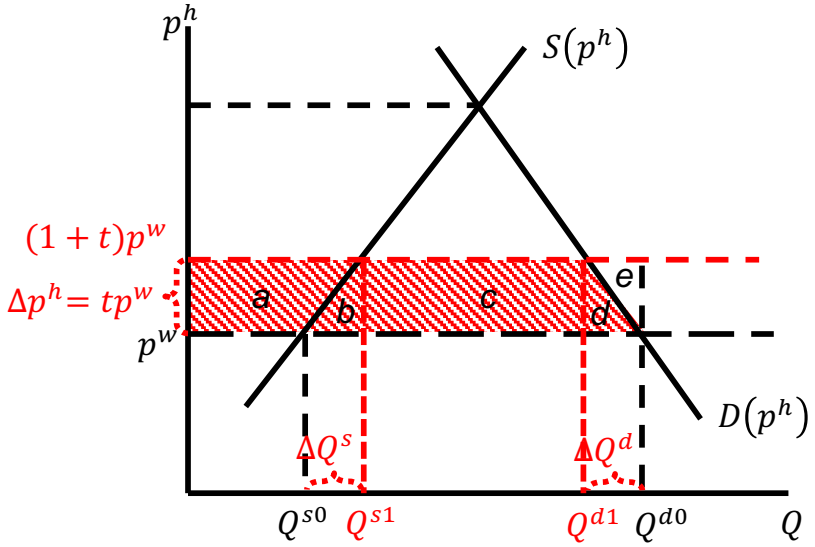
$$= \left(Q^{d0}\right)\left(\Delta p^h\right) - \frac{1}{2}\left(\left|\Delta Q^d\right|\right)\left(\Delta p^h\right)$$

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

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

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

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



Small Country in Equations

- Revenue gain of (home) government:

$$R = \langle c \rangle$$

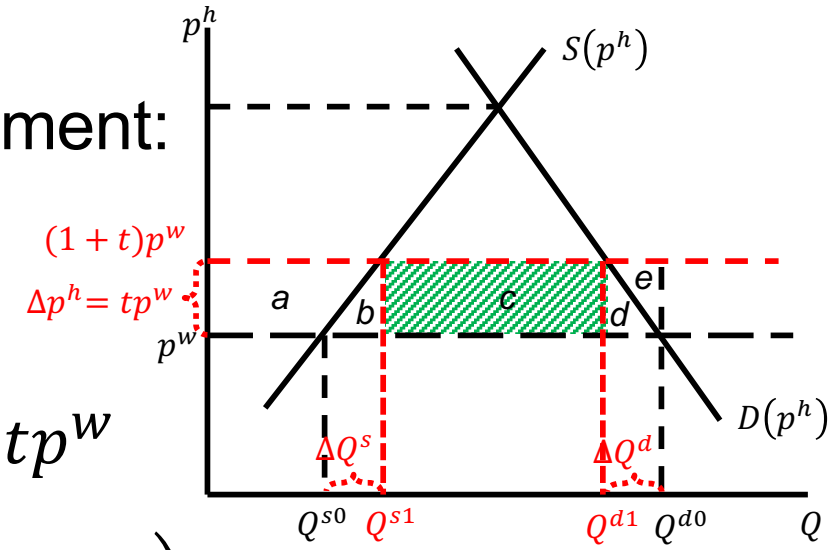
$$= \left(Q^{d1} - Q^{s1}\right)\Delta p^h$$

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

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

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

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



Small Country in Equations

- Welfare change for country:

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

$$= WLD - WGS - R$$

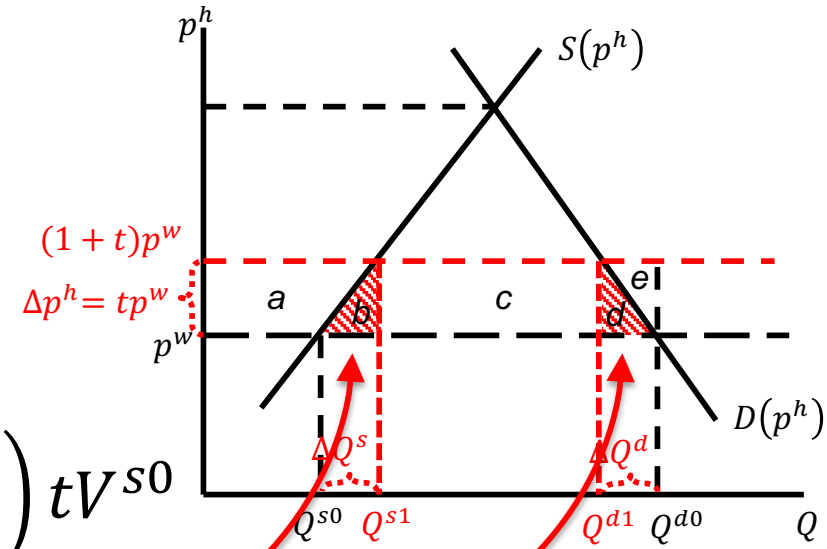
$$= -\left(1 + \frac{1}{2}\eta t\right) t V^{d0} + \left(1 + \frac{1}{2}\varepsilon t\right) t V^{s0}$$

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

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

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

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



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

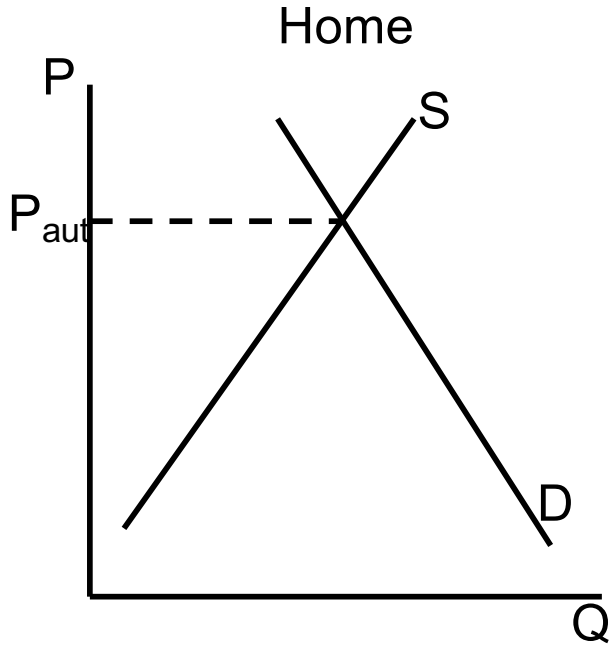
Questions on Equations

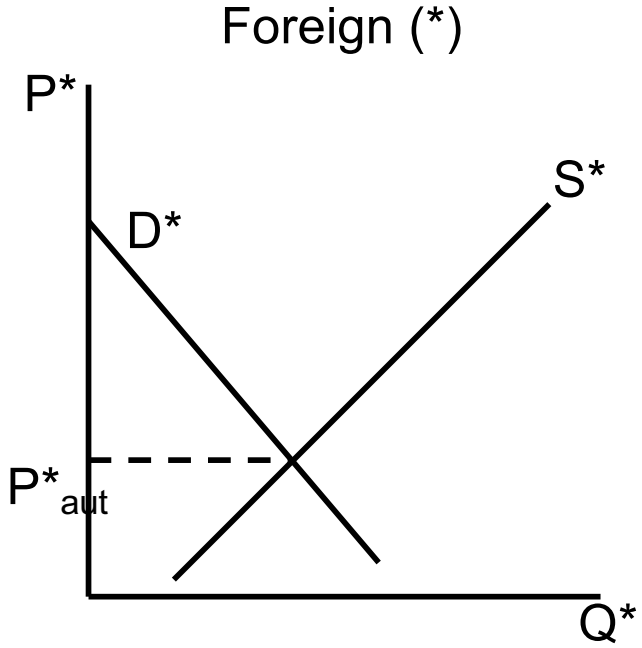
- What information do you need to calculate these welfare effects?
- How do the equations change with larger tariffs?
- Explain the sources of the “production distortion loss” and the “consumption distortion loss.”
  - Why does each occur, and who is it that loses in each case?
  - Where do these appear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

Outline

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

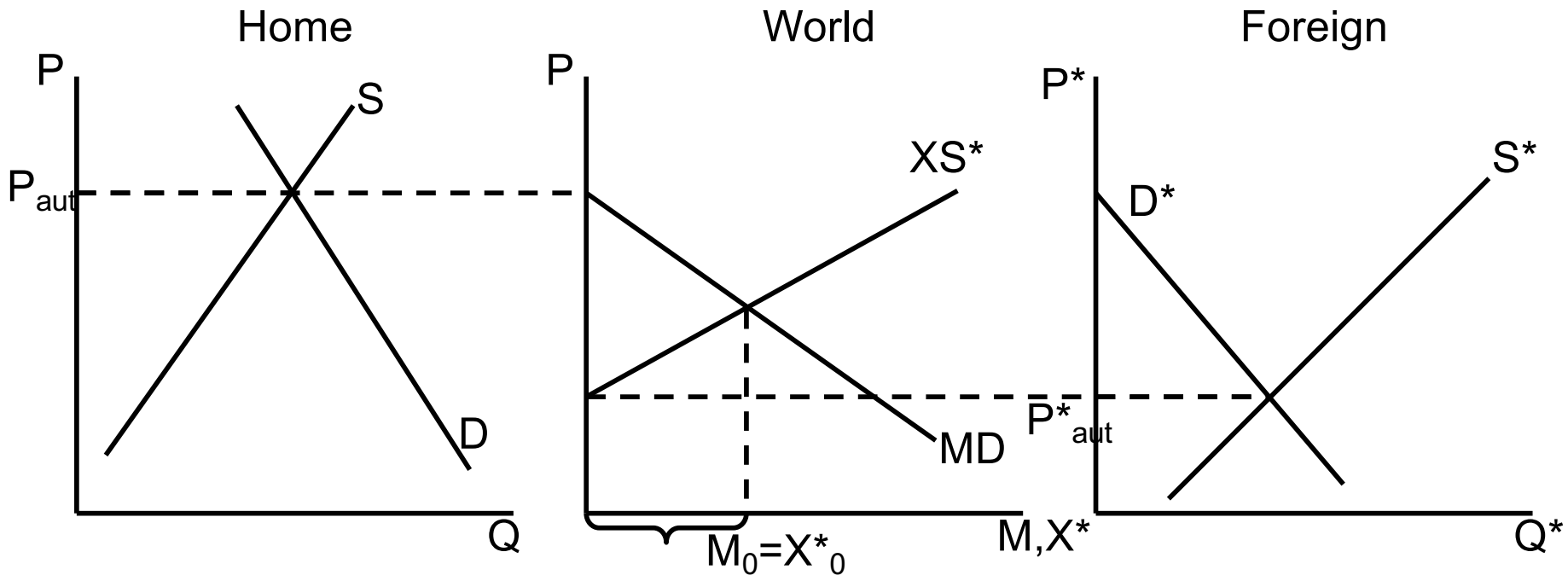
Large country
(i.e., Two Countries)





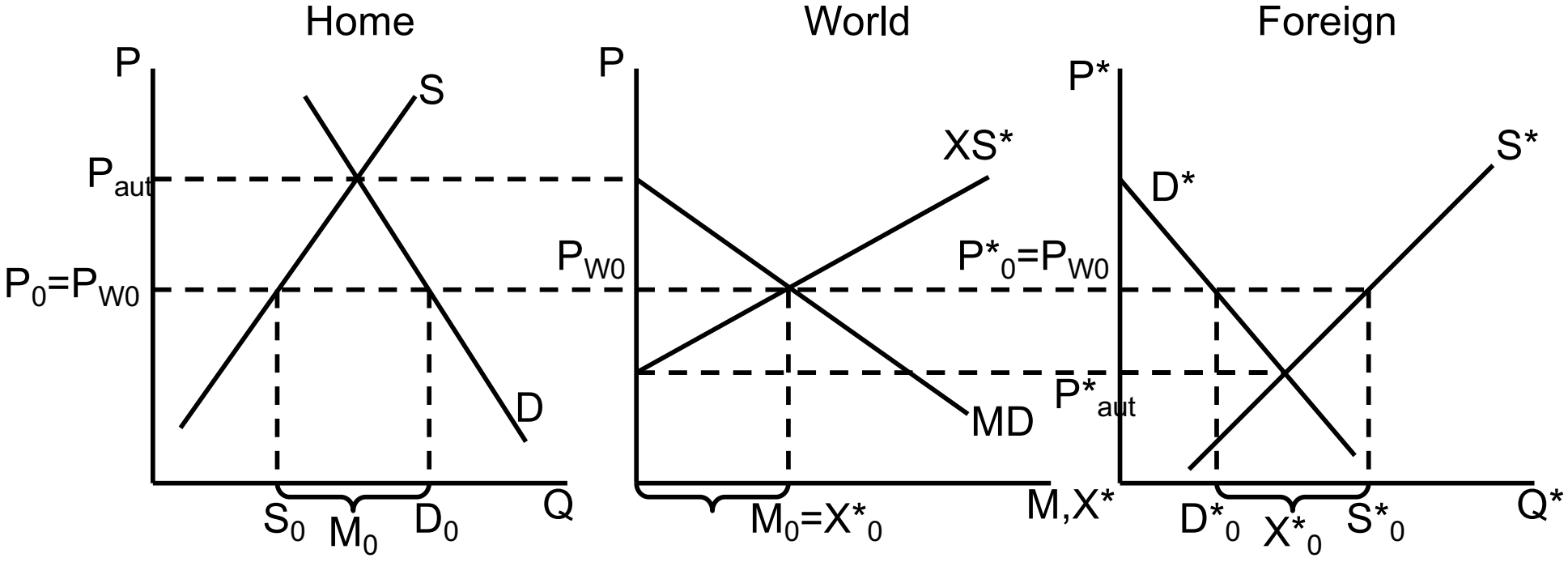
Autarky

Large country
(i.e., Two Countries)



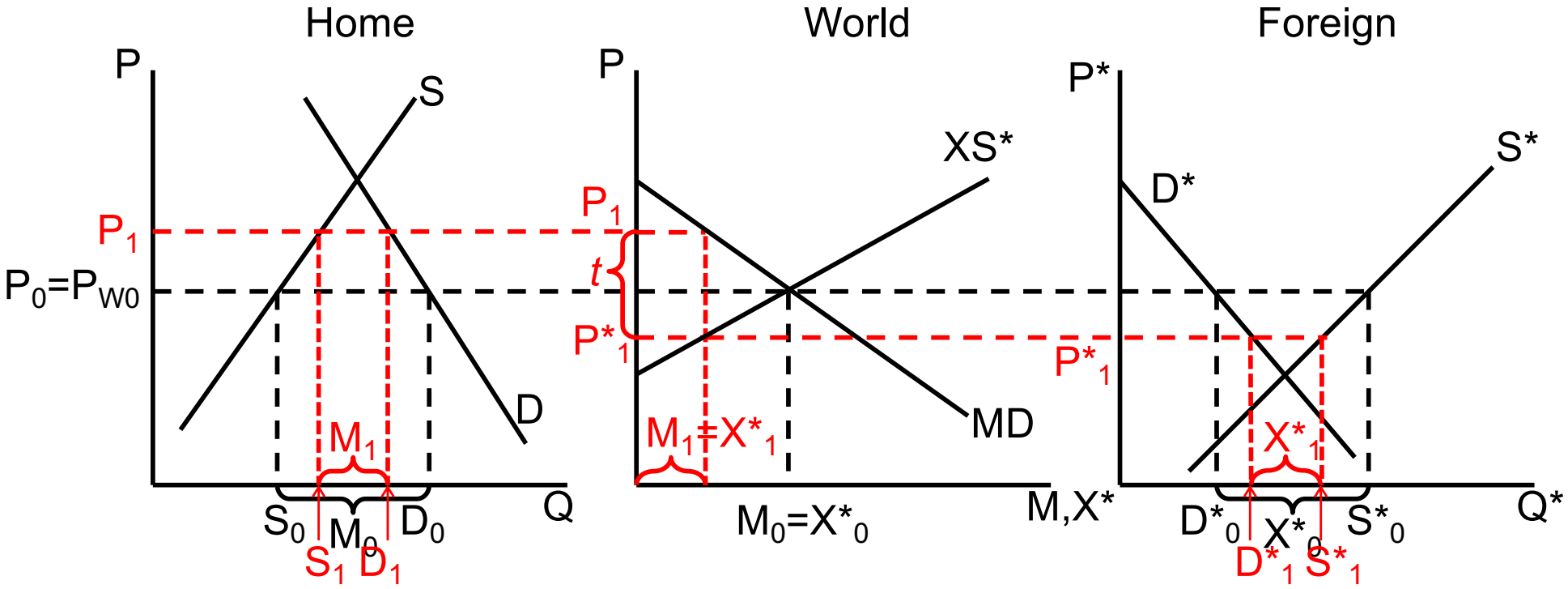
Free trade

Large country
(i.e., Two Countries)



Free trade

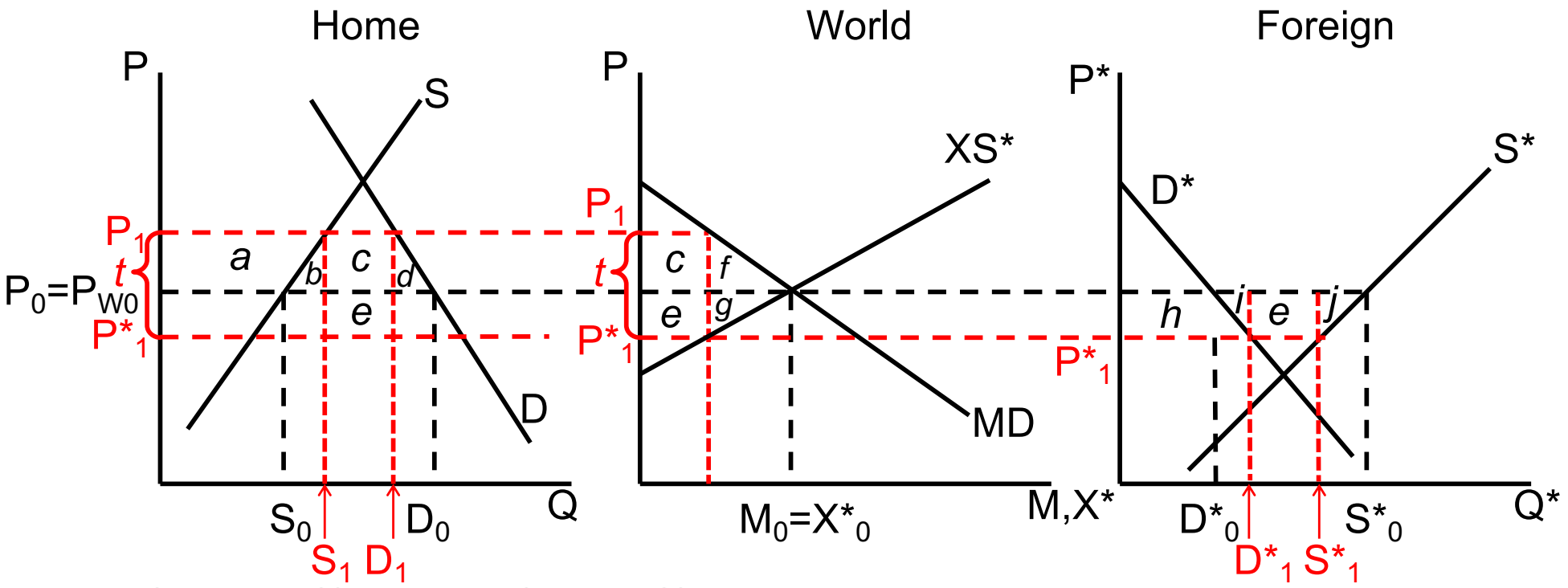
Large country
(i.e., Two Countries)



Specific Tariff, *t,* by Home

Requires: P=P*+*t*, MD=XS*

Large country (i.e., Two Countries)



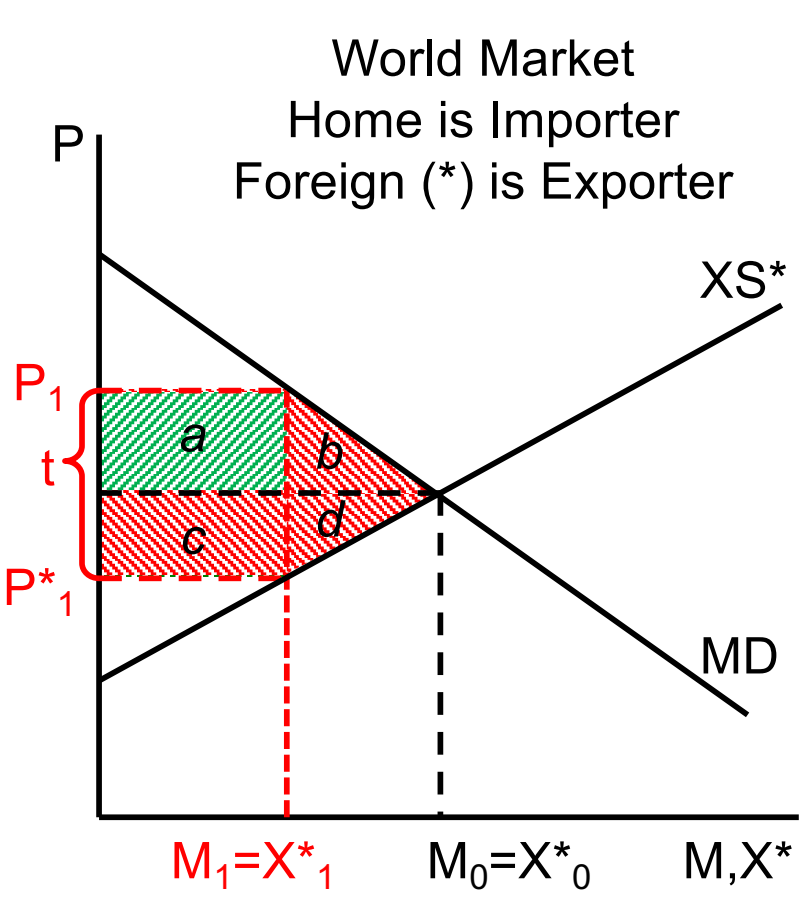
Welfare effects of Tariff, *t*:

- 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

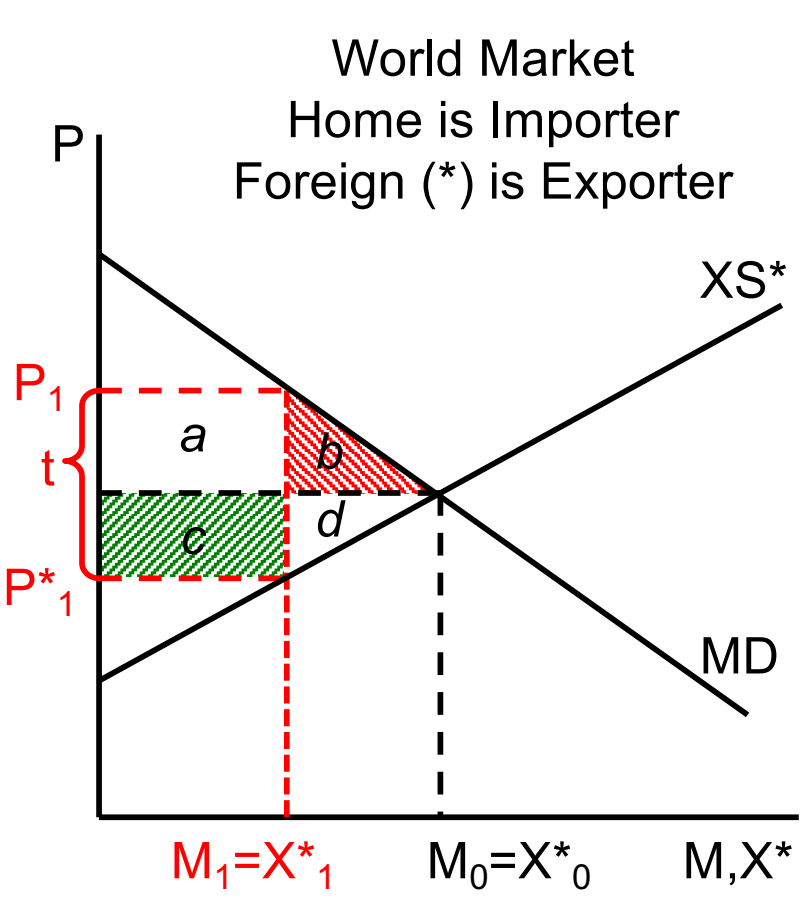


Welfare effects of a large-country tariff, starting from free trade

- 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"

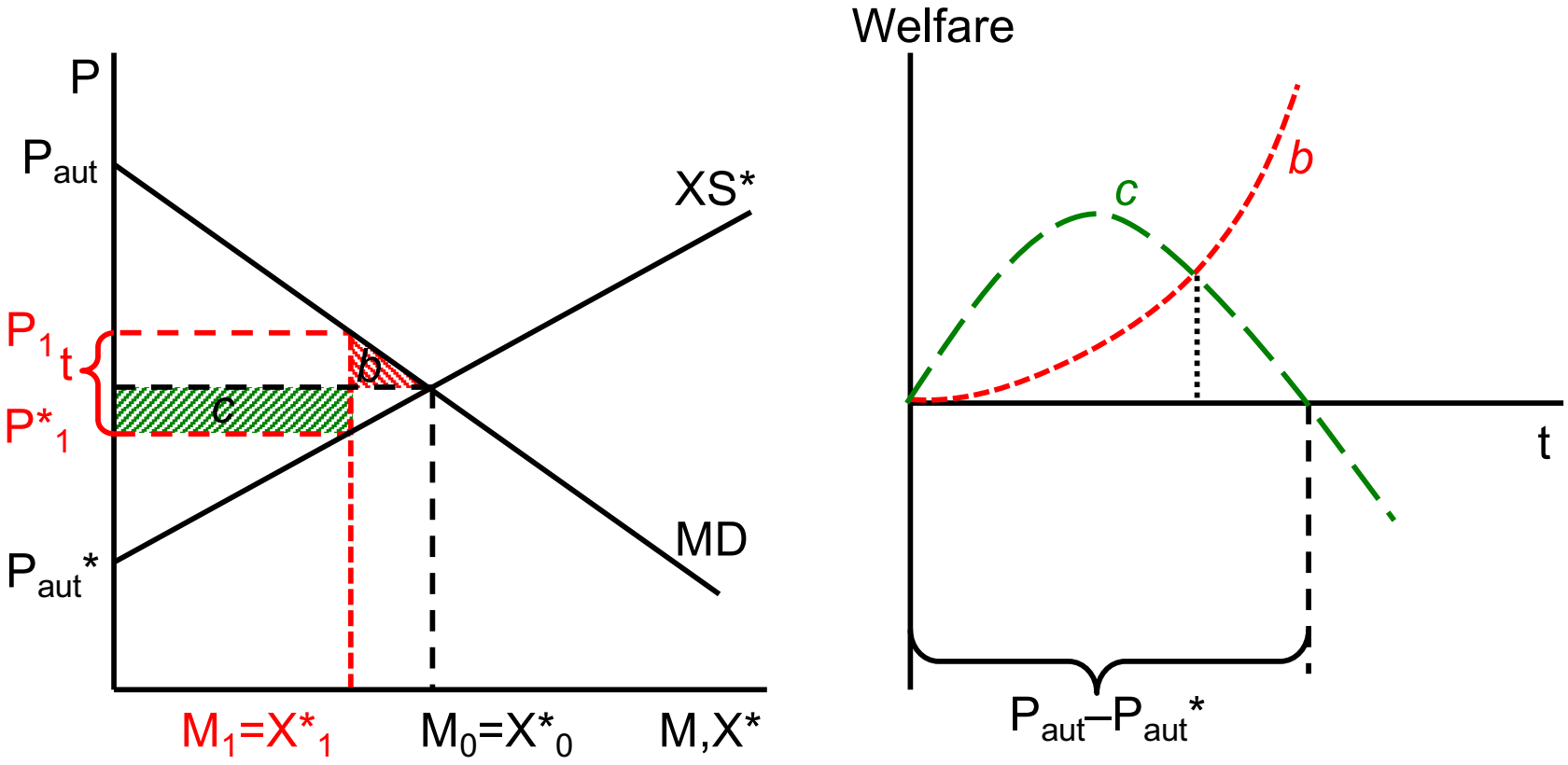
"Terms of Trade" ≡ Relative price of exports = P^X/P^M

Pause for Discussion

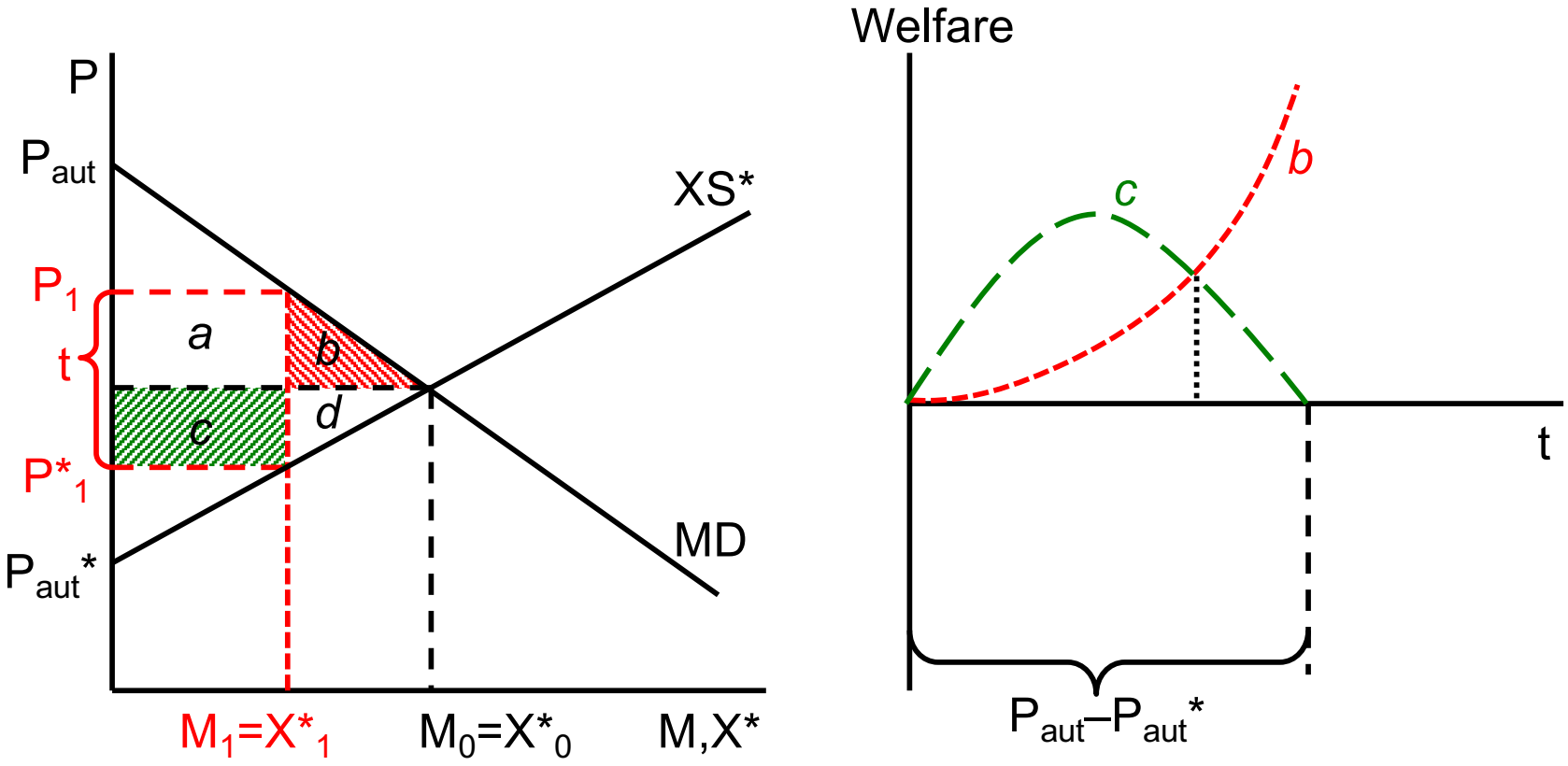
Questions on Large Country

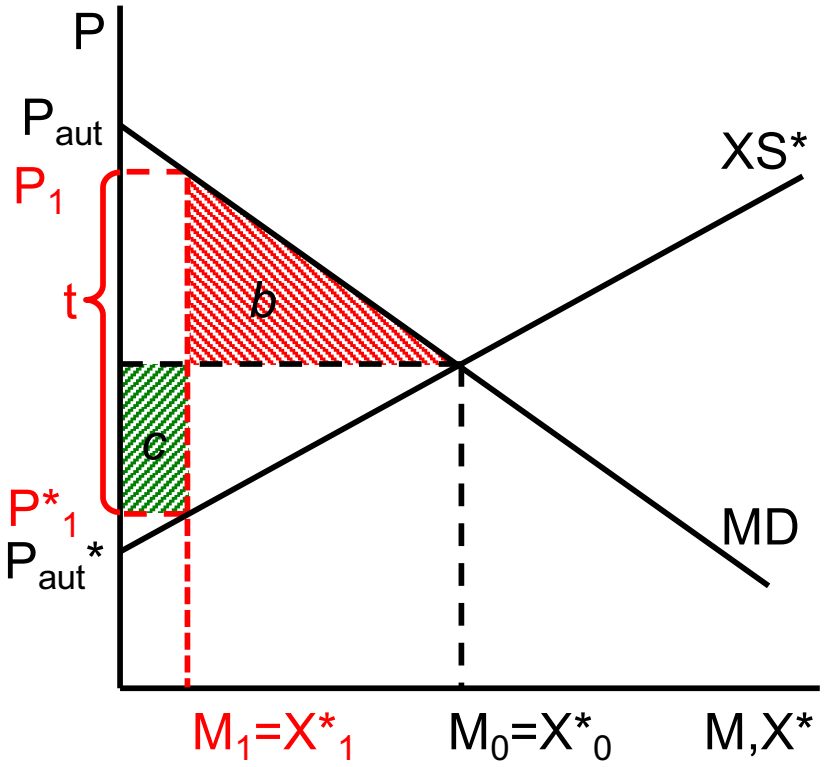
- The figure for the world market shows the tariff causing the world price to fall. What in the figure tells you that the Home country is large?
- In what sense might a large country gain by using a tariff? Who in the country benefits from that gain?
- What reasons are there, if any, for a large country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

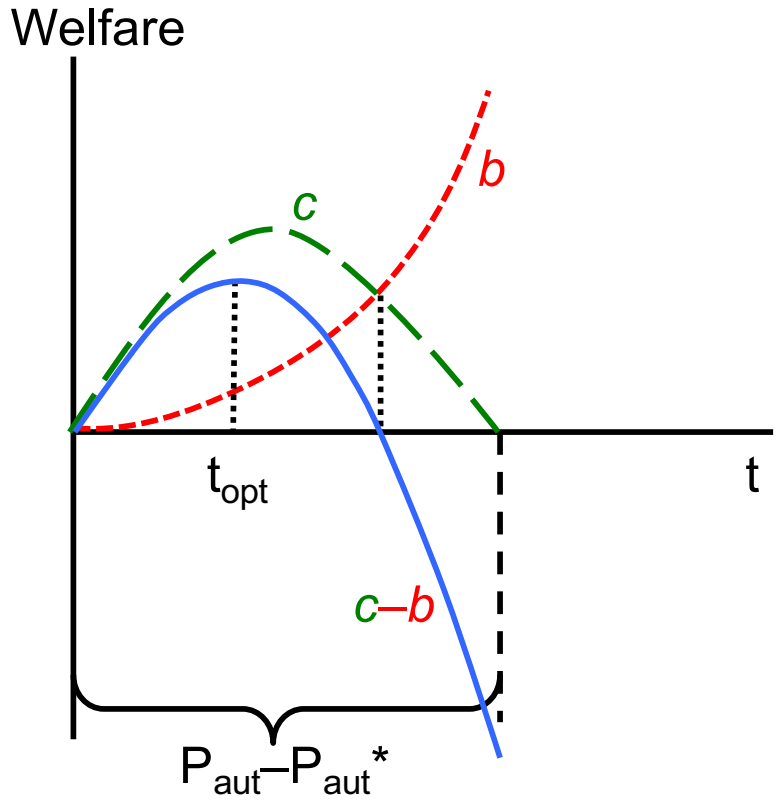
Large country, "Optimal" tariff
Watch as *t* rises



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

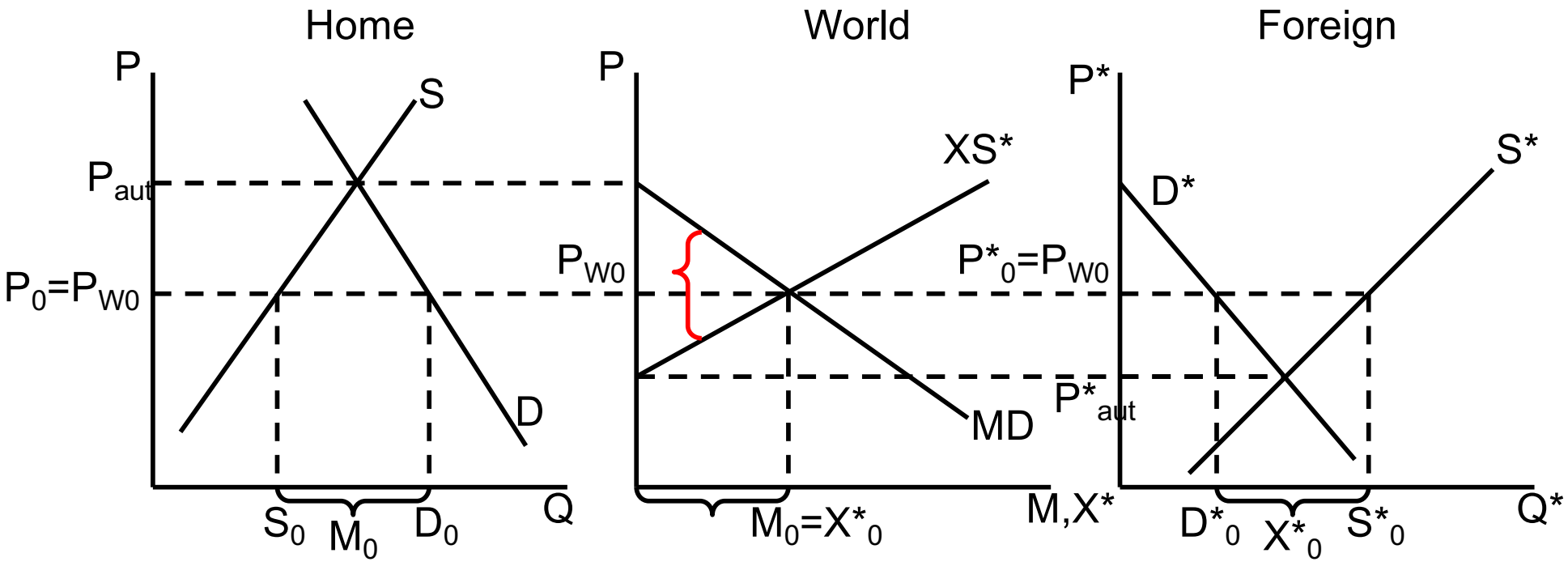






Skipping slides 58-60
How Sizes and
Slopes Matter

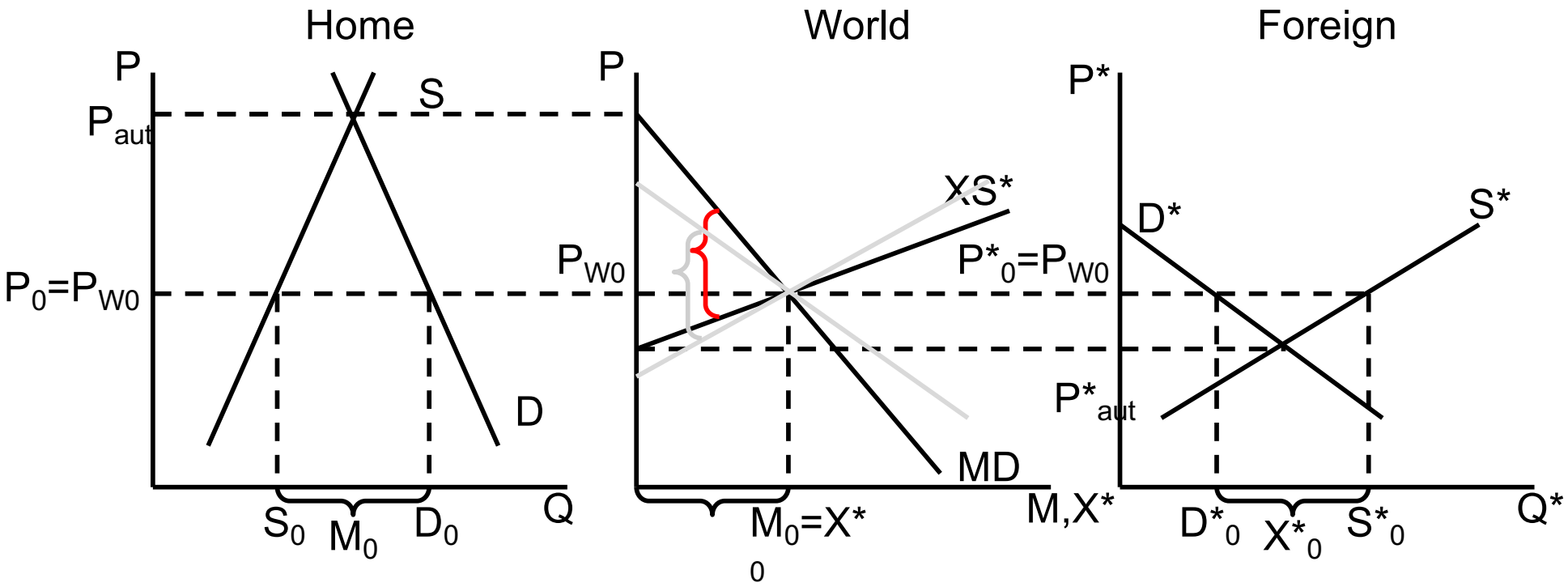
How Sizes and Slopes Matter



Free trade

Tariff

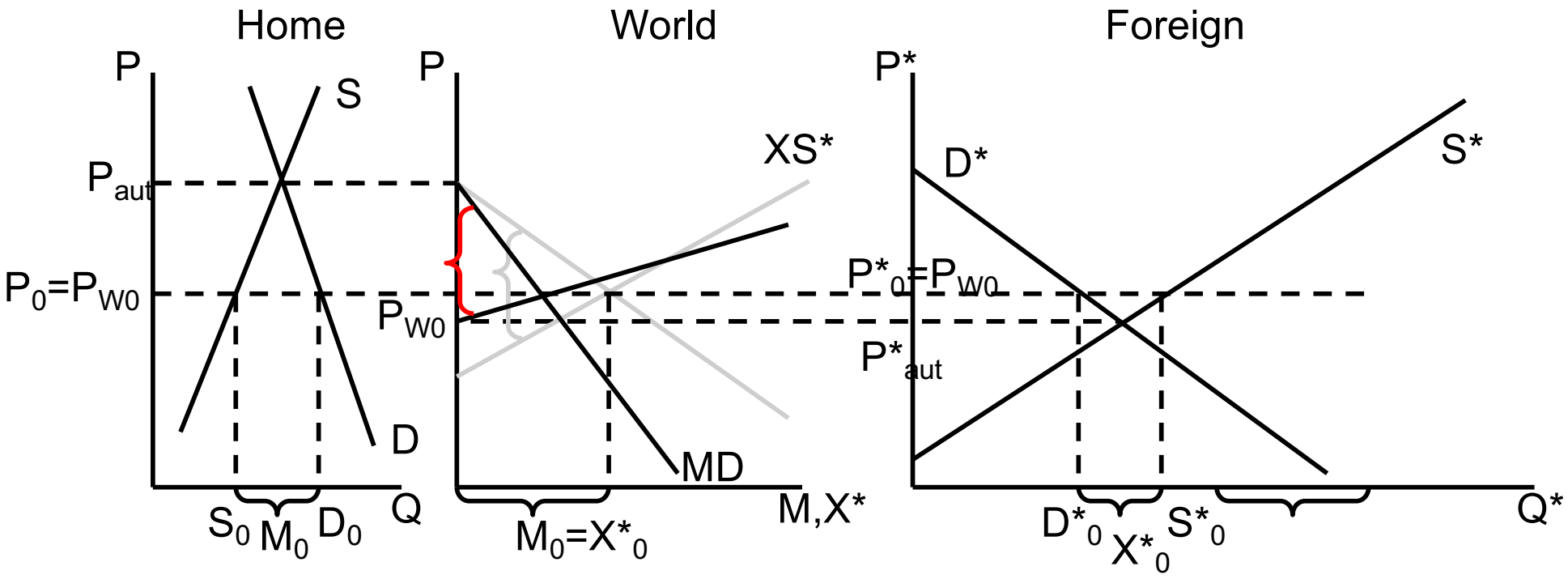
How Slopes (Elasticities) Matter



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:
$$\tau = \frac{t}{p^{h0}}$$

Go to Solution
Skipping slides 63-74

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:

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

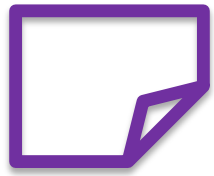
$$= \left(A^h + A^f \right) \frac{\Delta p^f}{p^{f0}} = -A^h$$

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

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:

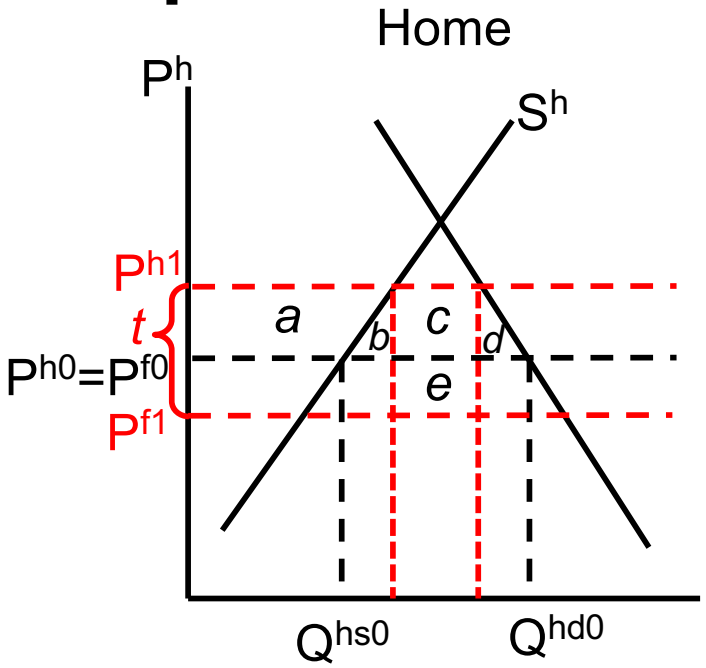
$$S \equiv \frac{\Delta p^h}{\Delta p^h - \Delta p^f} = \frac{A^f}{A^h + A^f}$$

- Recall that $A^i = \varepsilon^i V^{is0} - \eta^i V^{id0}$ measures country size 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:

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



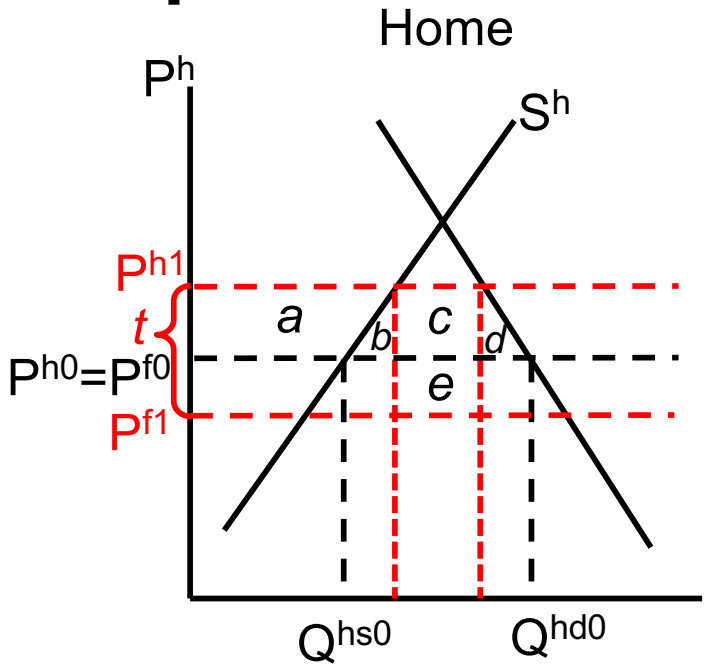
$$\langle e \rangle = -\Delta p^f \left(Q^{hd0} + \Delta Q^{hd} - Q^{hs0} - \Delta Q^{hs} \right)$$
$$= -\Delta p^f \left(Q^{hd0} - Q^{hs0} \right) - \Delta p^f \left(\Delta Q^{hd} - \Delta Q^{hs} \right)$$
$$= -\frac{\Delta p^f}{p^{f0}} M^0 + \Delta p^f \left(\varepsilon^h \frac{\Delta p^h}{p^{h0}}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

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

Two-Country in Equations

- Welfare of home country:

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



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

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

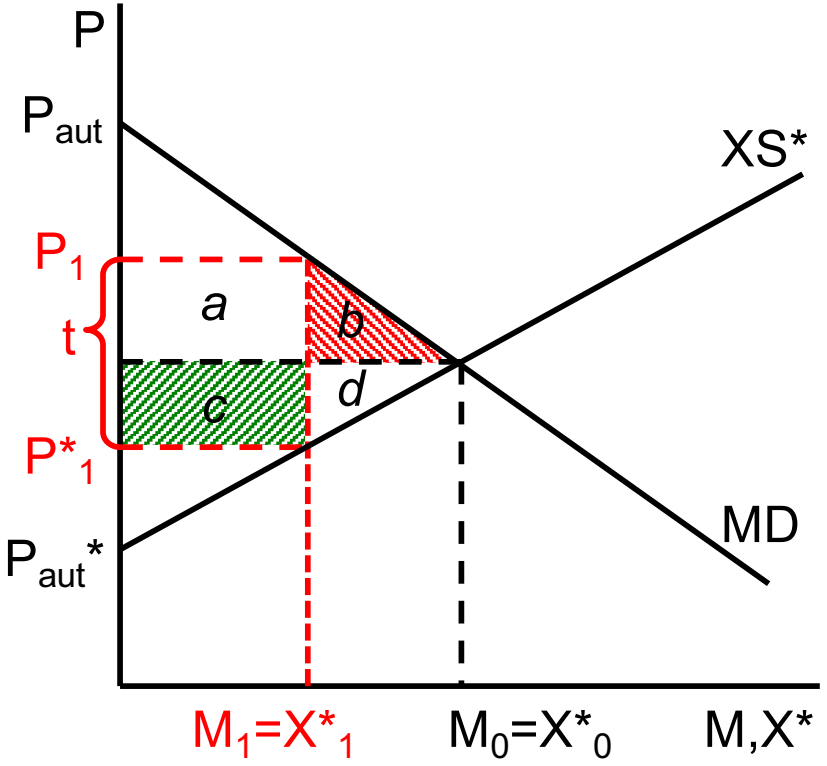
$$= \frac{\Delta p^h}{2p^{h0}} \left(\varepsilon^h V^{hs0} - \eta^h V^{hd0} \right) \frac{\Delta p^h}{p^{h0}}$$

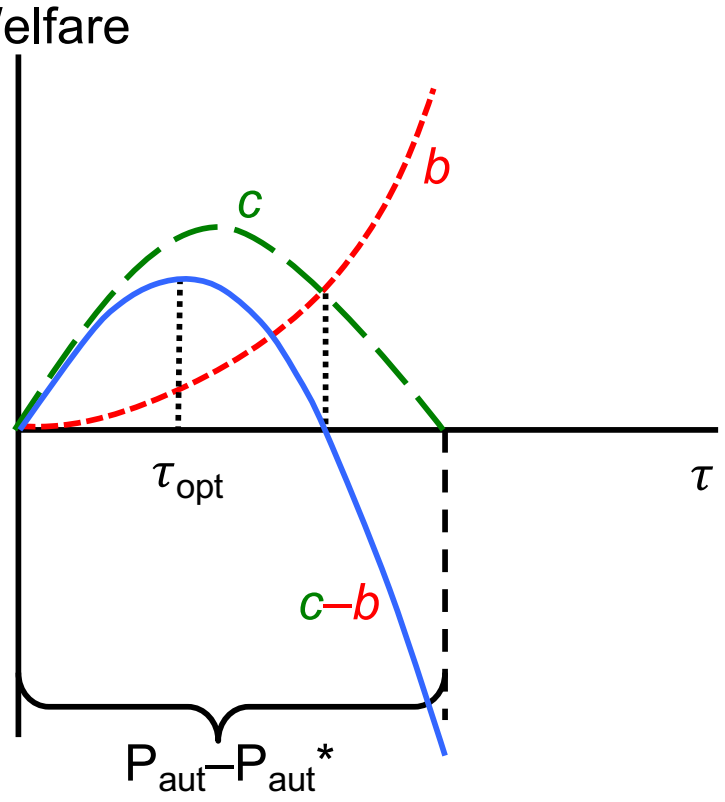
$$= \frac{1}{2} A^h \left(\frac{\Delta p^h}{p^{h0}} \right)^2 = \frac{1}{2} A^h \left(\frac{A^f}{\bar{A}} \tau \right)^2$$

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

Welfare of Home Country

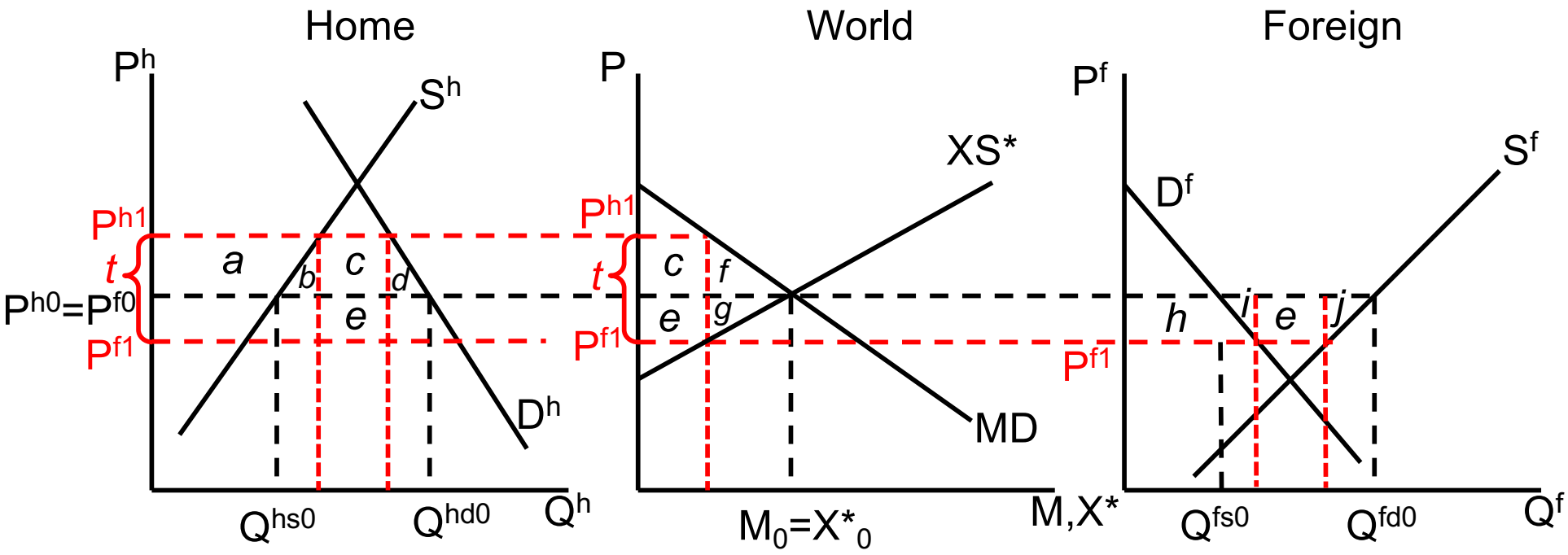
$$WHC = \langle e \rangle - (\langle b \rangle + \langle d \rangle) = \left[\frac{A^h}{\bar{A}} M^0 \tau - \frac{{A^h}^2 A^f}{\bar{A}^2} \tau^2\right] - \frac{A^h {A^f}^2}{2\bar{A}^2} \tau^2$$





Two-Country in Equations

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



Two-Country in Equations

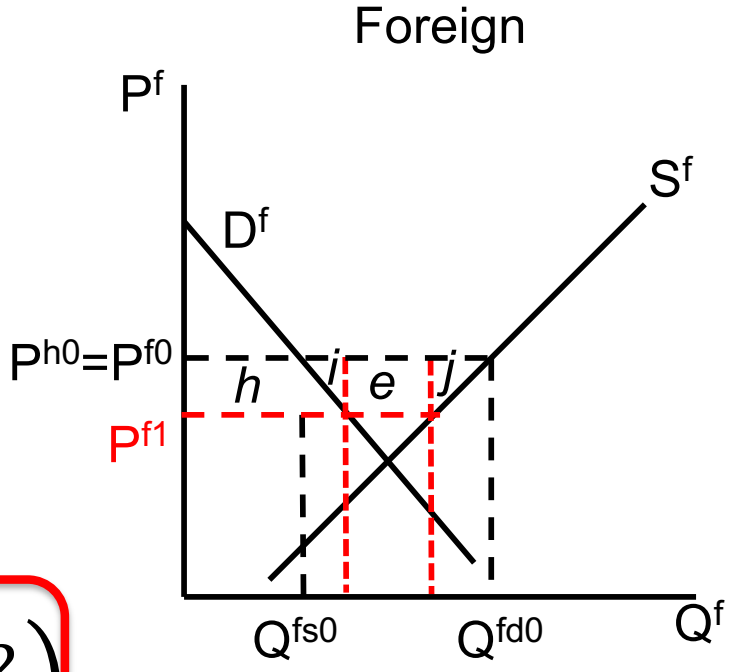
- Welfare of foreign country:

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

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

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

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



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.

Two-Country in Equations

- Solution:

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

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

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

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 Discussion

Questions Martin, "US Importers Bore Cost…"

- By how much did prices of items subject to tariffs rise?
- How much did this mean for individual items?
- How much did imports decline from China?
- Has USTR under Biden responded?

Pause for Your Questions

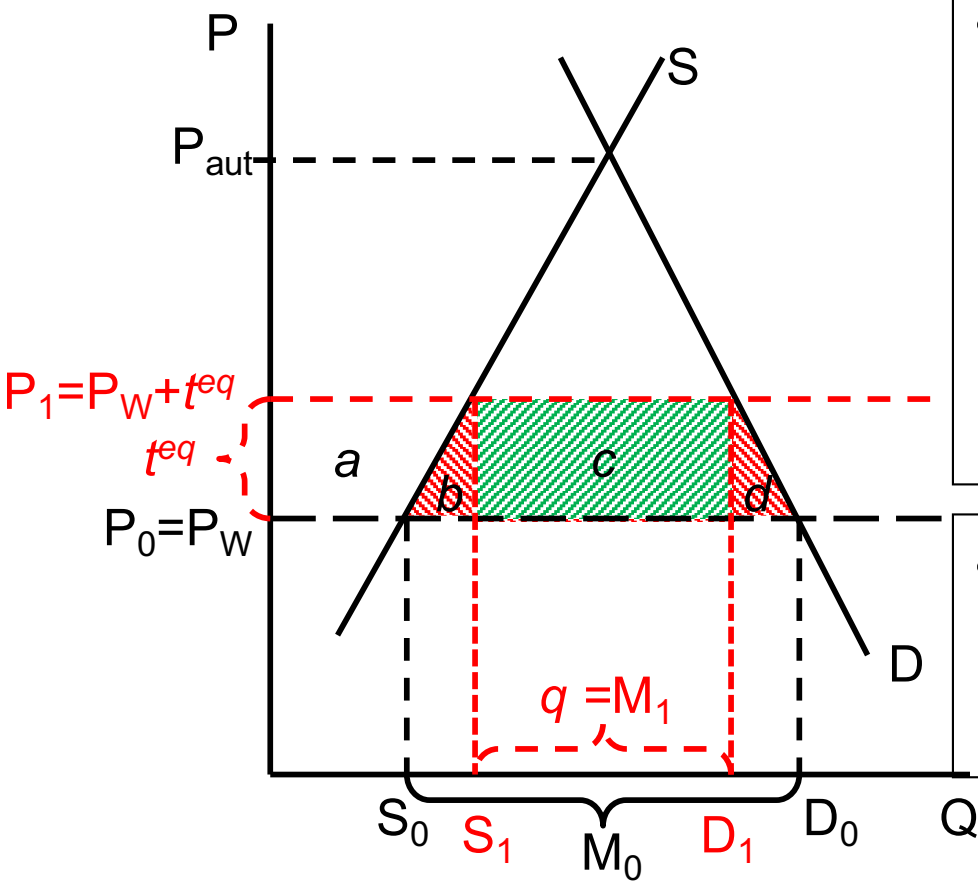
Outline

- 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)

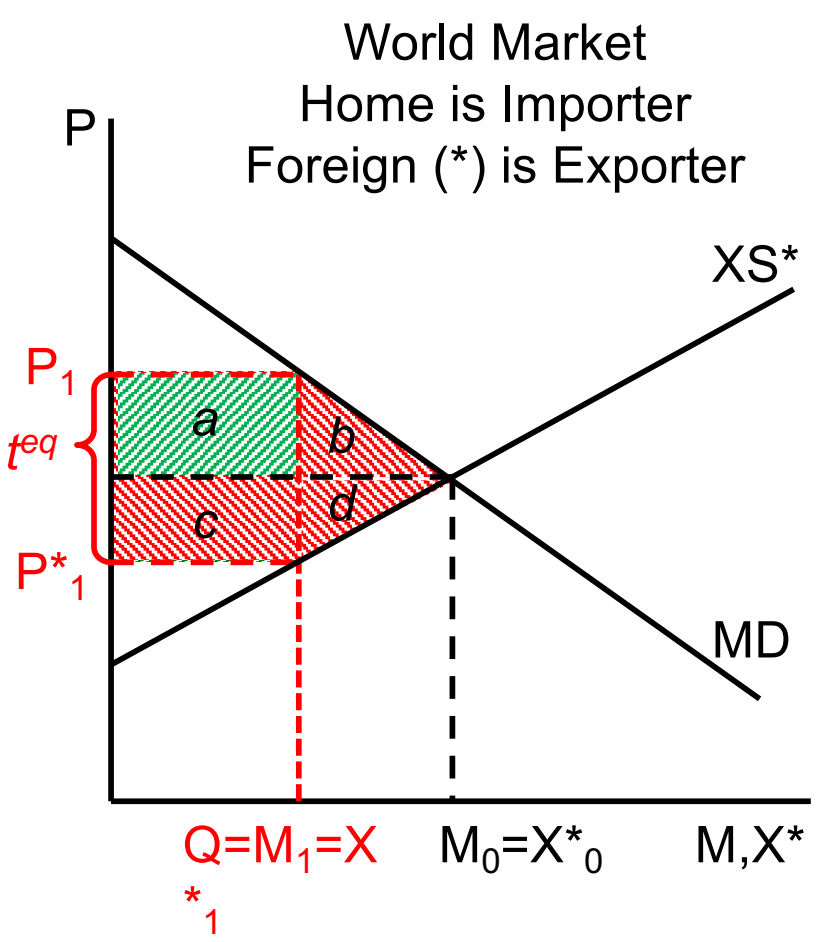


- Welfare effects of a quota, *q*, starting from free trade
  - Suppliers gain $+a$
  - Demanders Lose $-(a+b+c+d)$
  - Government gains nothing
  - Country loses $-(b+c+d)$

- 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?