

**Partial Equilibrium:**

International trade equilibrium:

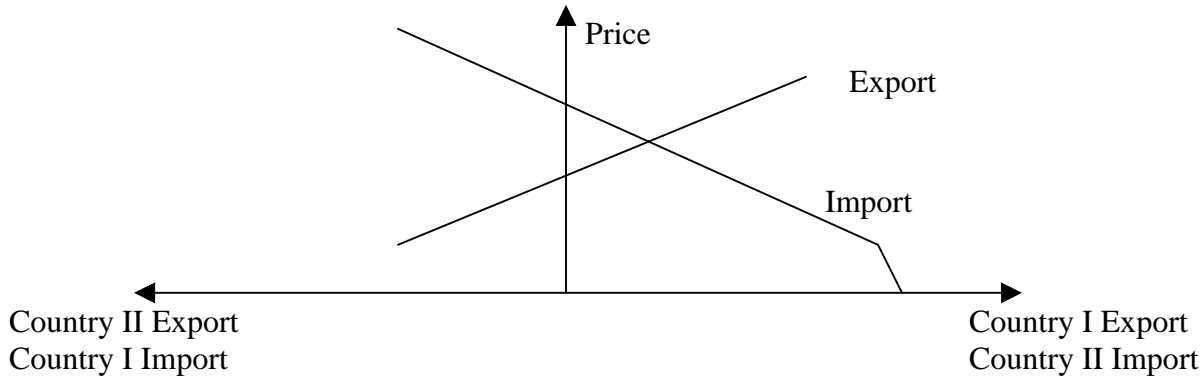
$$E(p) = S(p) - D(p)$$

$$M(p) = D(p) - S(p)$$

$$S^I(p) + S^{II}(p) = D^I(p) + D^{II}(p)$$

Export supply schedule: T shape, upside down. Export on positive X-axis and import on the negative part. Y-axis is Price. Co-relate to supply and demand curve.

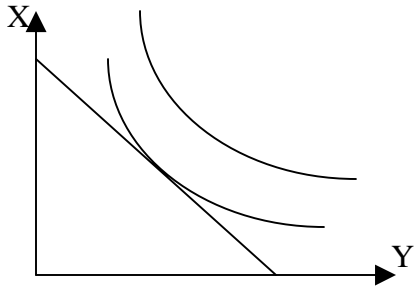
**Import and Export are treated as supply and demand.**



**Indifference curve:**

Convex to the origin b/c the principle of “diminish marginal rate of substitution” (the marginal utility gain decreases towards the end)

Marginal Rate of Substitution (MRS): the slope of the indifference curve. In order to keep at the same level, an increase of X means giving up Y.



**Isoquant:** links **factor** inputs to output. Shows various combinations of the 2 inputs that produce the same level of output. (Note: NOT factor price but input)

X-axis: factor 1, Y-axis: factor 2

*Cardinal: how many, countable: 3 shirts, 2 friends*

*Ordinal: order of things in a set: 3<sup>rd</sup> fastest, 2<sup>nd</sup> in line*

*Nominal number: number 4, zip code 39873*

Production isoquant is **cardinal** (e.g. total units of output, etc.)

**Diminishing marginal productivity:** it is impossible to produce an infinite level of output when some factors of production (machines or land) fixed in quantity.

**Constant return to scale:** only when *all* input changes in the same direction by the same percentage, will the output change in the same direction of the same percentage.

**Isocost line:** shows the various combinations of the factors of production that can be purchased by the firm for a given total cost at given input prices.

The negative value of the slope of the isocost line:  $\frac{K}{L} = \frac{B/r}{B/w} = \frac{w}{r}$

Also called “factor price line”.

**Producer equilibrium:** the maximum output given a budget (when isoquant is tangent to isocost)

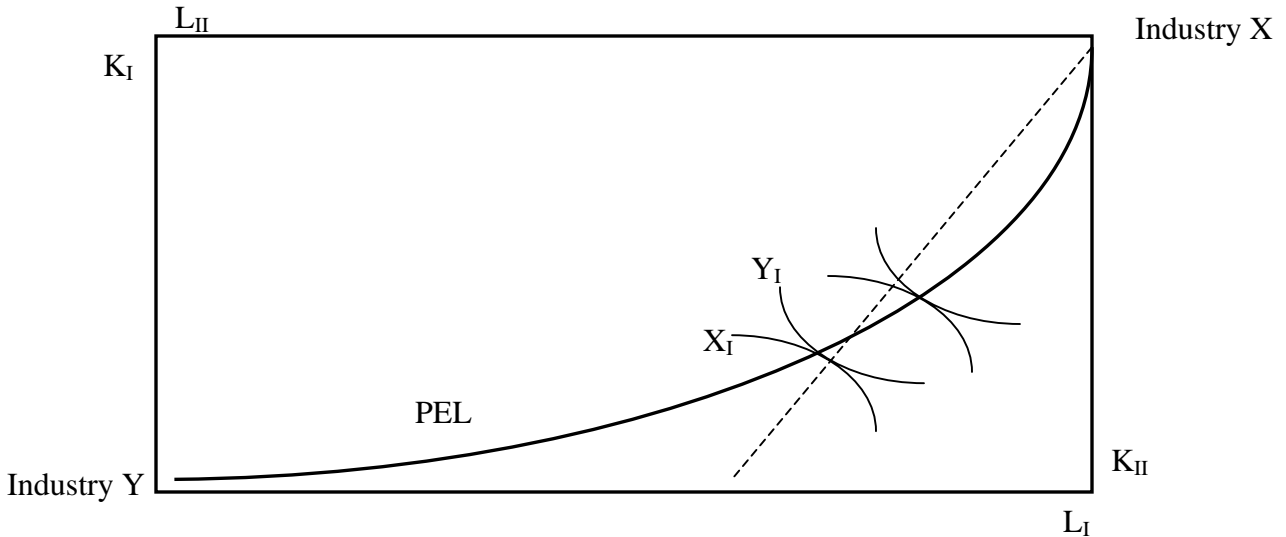
**The Edgeworth box diagram and the production efficiency locus (PEL):**

Two factors, 2 commodities. X-axis are L, Y-axis are K. Original points are 2 commodities.

In a competitive economy with **perfect factor mobility** b/w industries, the relative factor price ration ( $w/r$ ) will be identical.

- ⇒ The isoquants of the two industries must have the same isocost lines (or the same  $w/r$  ratios)
- ⇒ The two isoquants must be tangent to each other.
- ⇒ All the tangent points links up the production efficiency locus.
- ⇒ At any point on the PEL, the ratio  $\frac{MPP_L}{MPP_K}$  is identical in two industries.

PEL does NOT show overall output or welfare in general. Only all the combinations of most likely outputs of two industries.



**PPF:**

Downward slope, concave to origin.

Each point on PPF can be found on PEL: the tangent isoquants (representing production of goods) X and Y are the values on the (goods) X, Y-axis for PPF.

PPF demonstrates **increasing opportunity cost** (increasing amount of Y to give up in order to secure more X).

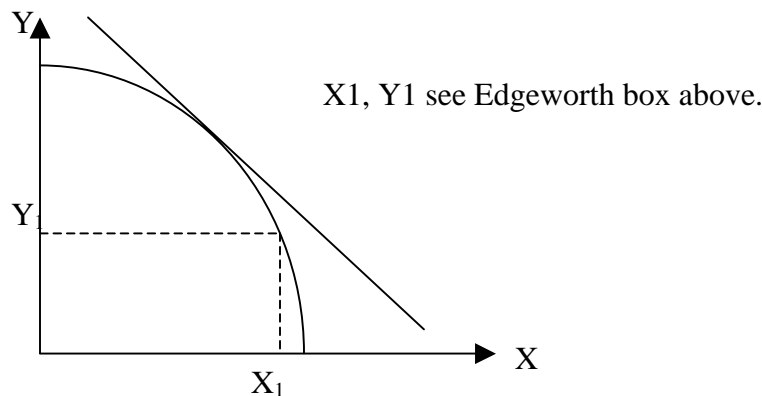
Note, this is still under the **two products equilibrium condition** (not the same as to give up factor X or Y or to change w/r!)

The slope of PPF is **marginal rate of transformation (MRT)**.

Curve does not change unless production factors are changed.

Producer's reaction to price change is reflected at the PPF and price line tangent point (increase of export will move the tangent point to the right of X-axis if X-axis represents the export good)

*Why increasing opportunity cost? Per Samuelson: if constant return to scale holds, 1/2 factors in both industries will yield 1/2 X and 1/2 Y goods. But the two industries have different w/r ratio, resource will also move toward generating uneven but higher total of outputs in X and Y. Per Edgeworth box: the straight diagonal line vs. curving PEL.*



**Neoclassical theory assumptions:**

1. Two industries
2. Two factors (labor and capital)
3. Two countries
4. Fixed initial factor endowments
5. Insignificant transportation cost
6. Similar production function/technologies
7. Flexible prices
8. Constant return to scale
9. Factors perfectly mobile domestically but NOT internationally

**Autarky equilibrium:**

Domestic price line tangent to PPF or

$$\frac{P_x}{P_y} = \frac{MC_x}{MC_y} \text{ (ratio of marginal cost, or MRT)}$$

When consumers are included, autarky point is: MRT=MRS result in 3 curves (PPF, Consumer Indifference Line, Domestic Price Line) tangent.

International trade will introduce a **trading line** with a different price ratio.

*The new trading line is also the new Consumer Possibility Frontline (CPF), which tangent to a new consumer indifference curve.*

**Why Trade:** different autarky prices. Differences in either demand (community difference curve) or production (PPF) are sufficient to provide a basis for trade.

*Neoclassical model vs. classical: added more factors (capital), consumer demands (indifference curve) and concaving PPF (increasing opportunity cost)*

**Offer curve:** shows a country's willingness to trade at various possible terms of trade.

X-axis: home country exports X

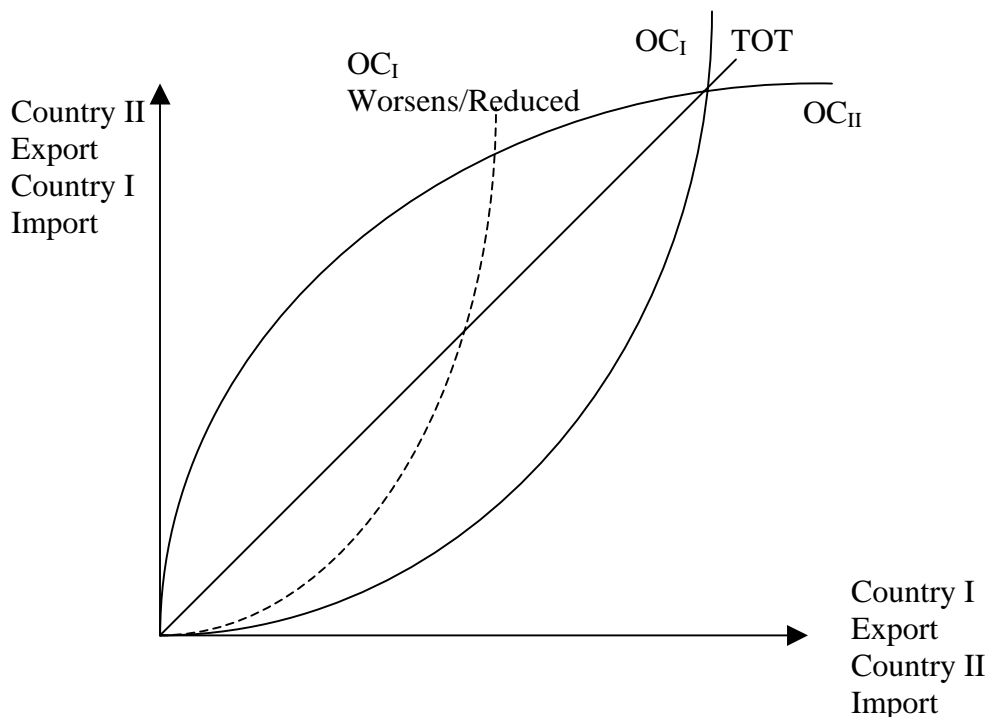
Y-axis: foreign country imports Y

TOT:  $P_x/P_y$

*The trade triangle approach to derive willingness to trade (what is import, what is export?)*

**Equilibrium terms of trade:** the intersection of two offer curves

*Why equilibrium: price! If there is imbalance b/w export/import supply and demand, goods price will change and the ratio will shift toward equilibrium.*



**Willingness to trade (shifts in demand/taste, etc.):** at each price point, more likely to trade (total export, import). Offer curve shifts: each point on the old curve shifts out along the original price line. The overall line **expands**.

*In the case of small country/big country:*

*Small country cannot influence price, or terms of trade. A price taker.*

*Big country offers curve is the terms of trade. A price setter.*

**Heckscher-Ohlin Theorem:**

Concern factor endowment and trade.

Related to comparative advantage.

Assumptions: neoclassical plus:

- Different initial factor endowments for 2 countries,

- Different factor intensities for 2 commodities,
- Same preference and taste (similar demand),
- Same production functions (technologies),
- Free trade (no barrier, no transportation cost, etc.)

A country will export the commodity that uses relatively intensively its relatively abundant factor of production, and it will import the one that uses relatively scarce factor of production.

*Concerns the impact factor endowment, instead of productive function, has on trade.*

*Conclusion: the factor price ratio is negatively linked to the commodity price ratio.*

*E.g. Labor intensive->low w/r ratio->low cloth/steel price ratio*

### **Relative factor abundance:**

Country 1 is capital abundant if:

**Physical:**  $\frac{K_1}{L_1} > \frac{K_2}{L_2}$  **Price:**  $\frac{r_1}{w_1} < \frac{r_2}{w_2}$  (Pay attention to the signs, reverse relations)

*The link between the two: price definition is the result of physical definition plus **demand**.*

*Demand is defined as consumer demand and production consumption rate. To keep the two in sync, hence the assumptions of same technologies and taste/preference.*

*Proof by isoquant and isocost: Figure 4 on page 124, Fourth Ed. Appleyard & Field book*

### **Factor Price Equalization:**

An extension of H-O theorem: all assumptions stand.

Given no transportation cost, free trade leads to equalization of factor price ratios, which can only happen when factor prices are equalized too.

Key: perfect competition, free trade. H-O: equalized price line.

*Assumption: perfect competition means no profit. Goods price is the same as average cost in sector.*

### **Stolper-Samuelson Theorem:**

Concerns commodity price and factor price.

Given full employment, the falling price of the scarce factor and the increasing price of the abundant one because of the trade, imply that the owners of the abundant factor will find their real incomes rising and the owners of the scarce factor will find their real incomes falling.

Or:

A rise in the price of a commodity (as a result of trade) will increase the real reward of the factor used intensively (abundant) in the sector and decrease that of the other factor.

### **Rybczynski Theorem:**

Concerns increase in factor endowment and production output.

Assumption/condition: constant commodity price (thus factor price).

An increase in one factor causes a greater proportion of increase in the output of the product that uses the factor most intensively. It also decreases the output of the other sector.

### **Specific factor model (SF model):**

Factor immobility, short term, uneven reward/reaction among owners of the same factor in the same country.

Because of factor immobility, and commodity price and production change caused by free trade, the factor price will change **unevenly**.

Thus contradicts with H-O theorem, in which the factor price moves in sync.

Helps to explain why some capital owners are for free trade but those in another sector may be opposed to it.

### **Leontief Paradox:**

Test against H-O theorem: whether abundant factor will determine what to export.

$$\text{Result: } \left[ \frac{K}{L} \right]_{\text{import}} > \left[ \frac{K}{L} \right]_{\text{export}}$$

*Possible explanations: demand reversal, factor intensity reversal, human capital, natural resources, etc.*

### **Product Cycle Theory:**

Keys concerns: standardized, economic of scale, number of producers, demand from different parts of the world (US, other developed countries, less developed countries)

*Dynamic comparative advantage.*

### **Linder Theory:**

No factor endowment, no production concern.

Demand. Local demand.

Overlapping products.

Consumption pattern as a result of per capita income, not locale-specific.

Explains intensive trade between developed countries.

Cannot explain patterns of trade, not for policy decisions.

### **Economy of scale:**

Increasing return.

Same average cost, lowered wage

External vs. internal causes: external can exist perfect competition. Internal monopoly or oligopoly: maximum return/profits.

Assuming constant factor price.

Uncertain trade pattern: multiple equilibria.

Volumes predictable, not pattern.

Trade may exist between identical countries.

Trade may affect number of varieties.

### **Inter-industry vs. Intra-industry trade:**

Different industries: some with comparative advantages, some not.

Production specialization in the former and intra-industry trade in the latter.

### **Imperfect competition**

Domestic Monopoly:

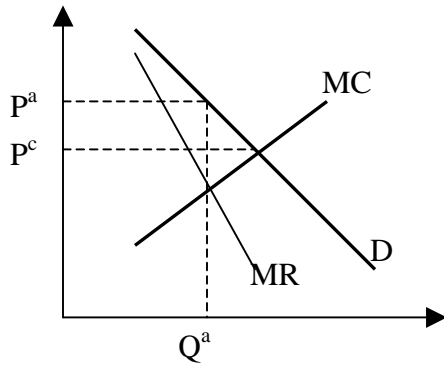
Monopoly in small open economy under free trade (allow import)

A home price setter but world price **taker**.

Competitive price:  $MC=D$

Autarky price: when  $MC=MR$  (maximum profits),  $Q$  decides autarky price.

World price: given



It can be proved:

When  $p^w = p^c$ ,  $q^f$  is  $MC = p^w$ ,  $q^d$  is  $q^a$  at  $D = p^w$  Result: export  $q^f - q^d$

When  $p^a > p^w > p^c$ ,  $q^f$  is  $MC = p^w$ ,  $q^d$  at  $D = p^w$  Result: export  $q^f - q^d$

When  $p^a > p^c > p^w$ ,  $q^f$  is  $MC = p^w$ ,  $q^d$  at  $D = p^w$  Result: import  $q^d - q^f$

➔ For a small open economy, free trade is the best way to eliminate domestic monopoly.

### Cost and Profit

Variable Cost vs. Fixed Cost

Variable Profit

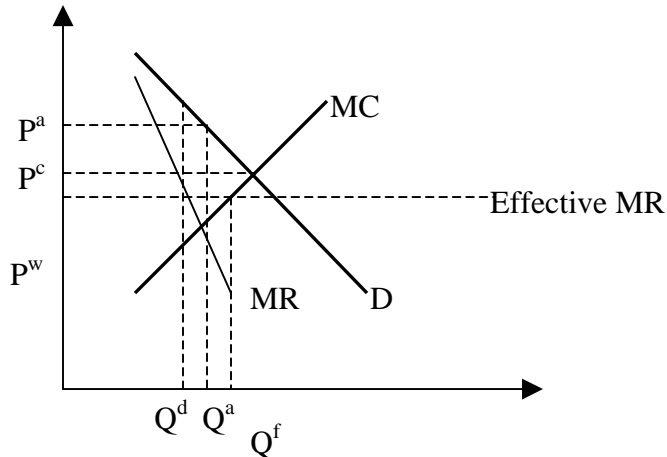
$\pi = R - C$  (Pi: profit, R: revenue, C: cost)

$C = vC + fC \rightarrow \pi = R - (vC + fC) = (R - vC) - fC$  (where  $R - vC$  is Variable Profit)

### Price Discrimination and Dumping

Dumping is a form of Price Discrimination:

1. Price difference
2. Market segmentation, NO import
3. Domestic producer decides how much to sell to where
4. Effective  $MR = \text{World Price}$



**Gains from trade – Classical and partial equilibrium framework**

Classical: Richardian diagram. CPF fan out from PPF (two are the same under autarky).  
 Partial equilibrium: Supply and demand curve with different price line cut through. The added area represents the gains.

**Gains from trade – Neoclassical framework**

Autarky equilibrium:

$$MRT = \frac{MC_x}{MC_y} = \frac{P_x}{P_y} = \frac{MU_x}{MU_y} = MRS$$

Where MRT: Marginal rate of transformation (produce A instead of B)

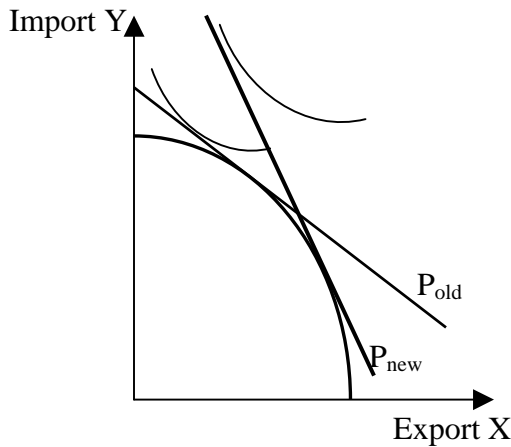
MU: Marginal utility

MRS: Marginal rate of substitution (buy A instead of B)

Gain after trade:

Gain from international trade is from the difference in price ratio compared to that of autarky.

**Utility curve is always closer to the import good axis.**

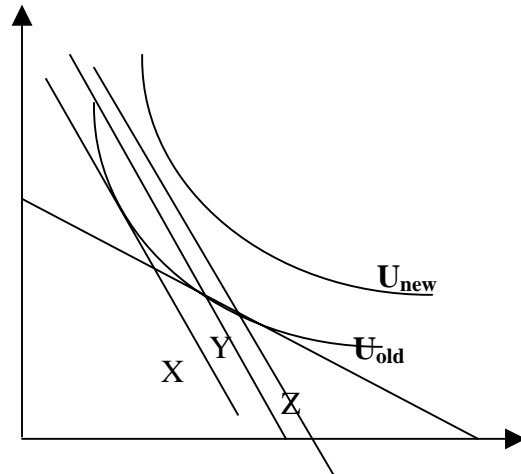


*New price line is steeper than under autarky. Therefore, the utility curve moves up/out. PPF does not change. But producers move the production of X further out after trade is allowed.*

**Consumption Gains:** gains from exchange, lowered price.

**Production Gains:** gains from specialization, increased production.

Consumption gains: assume NO production change only price line difference. In PPF graph, a line parallel to NEW price line but through OLD (autarky) production point.  
Production gains: assume NO consumption changes (same utility curve). In PPF graph, find a NEW parallel line tangent to the OLD utility curve.



X: Price line tangent to old utility curve.  
Y: Price line through old (autarky) production point.  
Z: New price line under free trade in equilibrium.  
**Z-X: Grain from trade**  
**Y-X: Consumption gains**  
**Z-Y: Production gains**

### **Other considerations: Conditions for trade**

Supply conditions and demand conditions.

Supply conditions: what if two countries have the same PPF? This case cannot be handled by Ricardian model. But OK in neoclassical model (separation of production and consumption, e.g. PPF no longer the same as CPF)

Graphically, merge the two PPF into one, two autarky points should be on both sides of the PPF. A new, single price line will “lift” the UCs (tangent to original autarky points) outward.

Demand conditions: what if two countries have the same CPF/utility curves? Again, this case cannot be handled in Ricardian model. In neoclassical model, different production functions create efficiency gap in producing different goods, thus induce different price ratios.

### **Other considerations: Distribution of gains with heterogeneous endowments**

Stolper-Samuelson theorem: more intensively used factor in exported good benefits more.

For example, export good X uses capital intensively. The increase in export after free trade increases capital rent,  $r$ , per Stolper-Samuelson.

If budget line of capital  $= \frac{r}{p}$ , new budget line is steeper  $\rightarrow$  The utility curve tangent to the budget line moves outward.

### **Other considerations: Distribution of gains with heterogeneous tastes**

How to present this case: two utility curves tangent to price line at different sides of the autarky point. A new price line with inevitably shifts one out one in.

So some benefit from the trade others are hurt.

### Free trade as the optimal policy for small open economy

$$TOT = \frac{P_{exp}}{P_{imp}} \text{ (Price of exportable/Price of Importable)}$$

TOT is the world price line, is the CPF

Any improvement of TOT increases welfare.

Tariff or restrictions will cause production move away from free trade equilibrium point but with the same slope. Therefore, the new line is bound to be under the original world price line. As a result, utility curve shifts inward.

### Free trade as the optimal policy of the world

The world as a whole is a closed economy

A competitive equilibrium without restriction reaches **Pareto efficiency**: one cannot improve one's fortune without sacrificing that of any other.

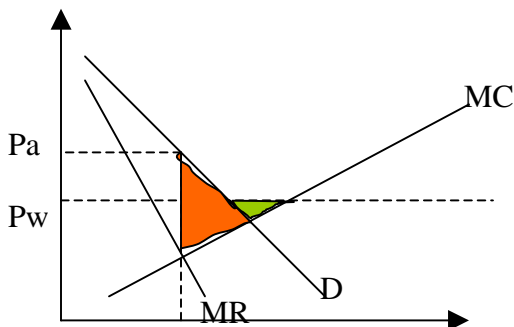
### Monopoly in small open economy

**Without trade restrictions:**

Consumer surplus gain > 0

Producer surplus gain: expanded production for export-competition from abroad

Welfare gain: consumption gain, production gain (together green zone), gain from eliminating the monopolist (red zone).



**With import restrictions:**

Consumer surplus gains < 0

Producer surplus gains > 0

Total welfare gain < 0: transfer from CS to PS plus dead weight loss: area between  $Q^d$ ,  $P^w$  and D

### International Factor Movements

In 1999, total FDI of the world was about \$4.1 trillion. It grew faster every year and has outpaced that of trade in goods.

European economies, the U.K., the Netherlands, Switzerland, are U.S.'s largest FDI destinations (51% vs. 16.4% in Asia-Pacific). 38.5% of U.S. FDI is in the finance, insurance and real estate.

European economies are the largest FDI sources to the U.S. 69.5%. Asia is 17%. 39.6% of FDI inflow is in manufacturing.

Factors influences capital inflow:

- Market access
- Per capita income
- Natural resources (raw material deposits)
- Tariffs and other barriers
- Wage rate differences
- Need to diversification

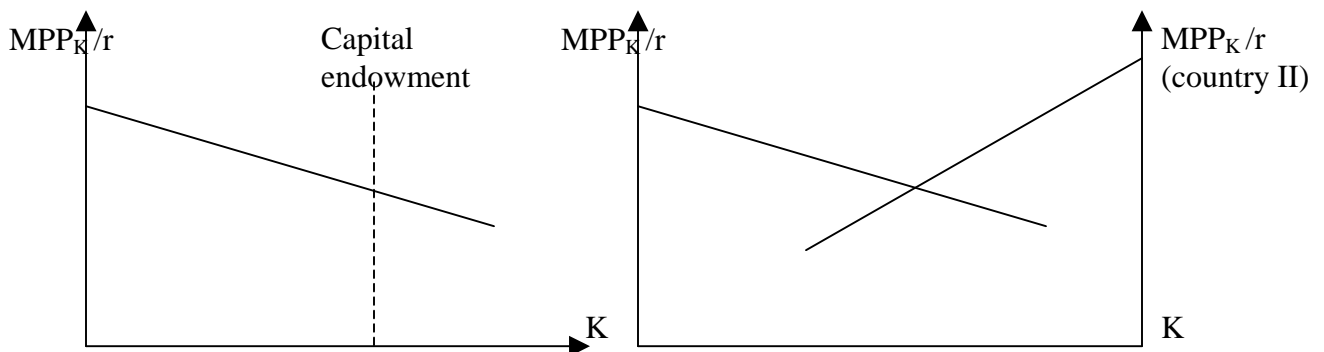
Effects of capital movements:

Assumptions:

1. 2 countries
2. 2 factors
3. Single, homogeneous good (represents the aggregate of all goods produced)

Marginal physical product of capital schedule ( $MPP_K$ ):

The additions to output that result from adding 1 more unit of capital to production when other inputs are held constant.



**If perfect competition is assumed,  $MPP_K=r$  (rental rate)**

In two-country model, the X-axis is the total capital endowment.

GDP is the area

Total GDP: the area enclosed by  $MPP_K$  curve and the capital endowment line.

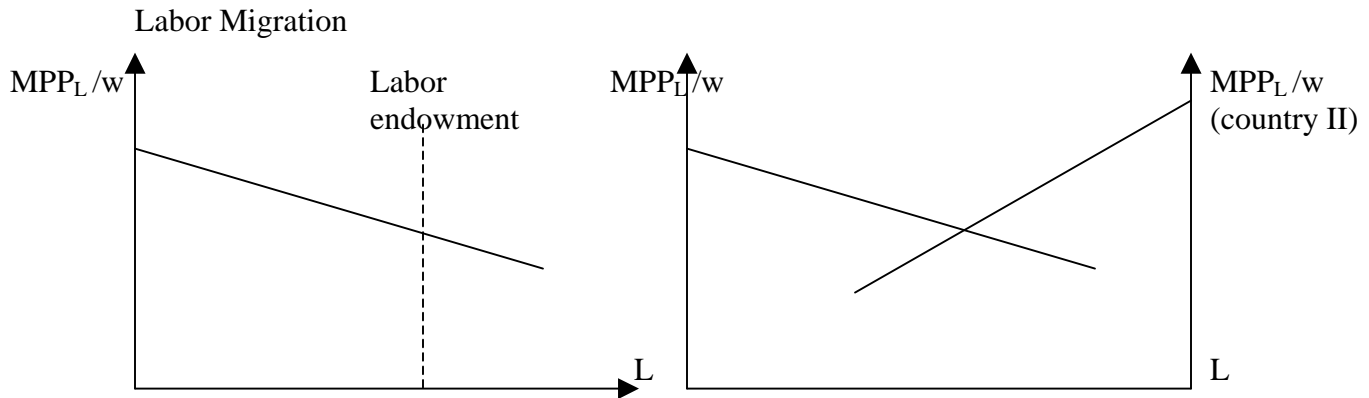
*Free factor flow will equalize return on factors, just like free trade will equalize factor prices according to Heckscher-Ohlin.*

Hence the argument that free trade and free factor mobility are substitutes for each other.

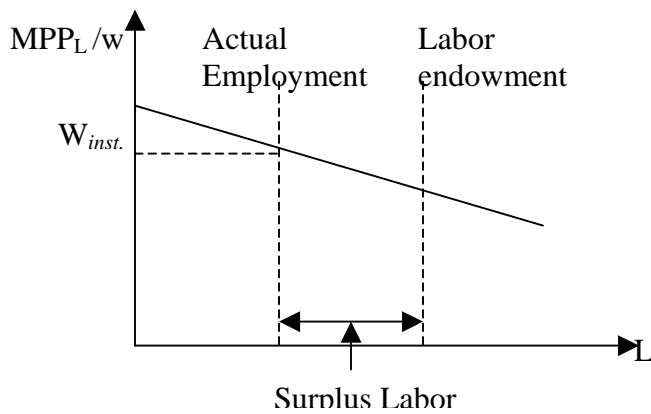
FDI:

1. **Benefits:** Increased output, wage rates, employment, tax revenue. Realization of scale economics. Technology transfer. Weakening of local monopoly.
2. **Costs:** worsen the host country's commodity terms of trade, decrease domestic savings (reduction of tax), local investment being crowded out by increased interest rate if capital inflow borrows from local bank, worsen trade balance, social effects.

Performance requirements: requirements made by host country to foreign companies to protect domestic economy: e.g. hiring locals, exporting to balance reserve, etc. Considered part of the no-tariff barriers.



**Surplus Labor**: caused due to institutional (or traditional) wage being higher than equilibrium wage: e.g. minimum wage causing reduction of employment.



If put in a two-country model, it is shown that if the country has surplus labor allows migration to the labor-shortage country, total output of both will increase. However, the surplus country enjoys higher per capital income while the shortage country sees a lower wage rate as a result.

**Factor endowment theory of factor mobility**

Given two countries with identical technology (same production functions), capital flows from the country that is abundant in capital to the country that is scarce in capital until both countries have the same capital-labor-ratio.

**Factor movement has no effect on small open economy:** as price takers, factor prices in SOE do not change when a small amount of capital moves in (Stolper-Samuelson). If  $GNP = w\bar{L} + r\bar{K}$ , there is no change in GNP either.

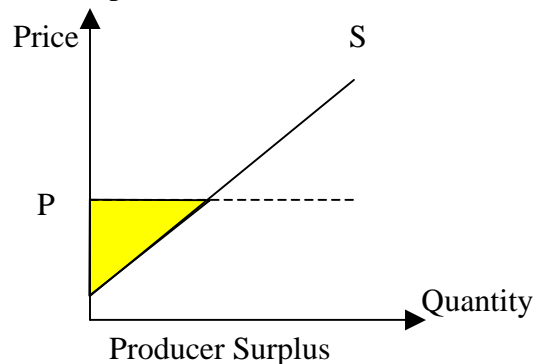
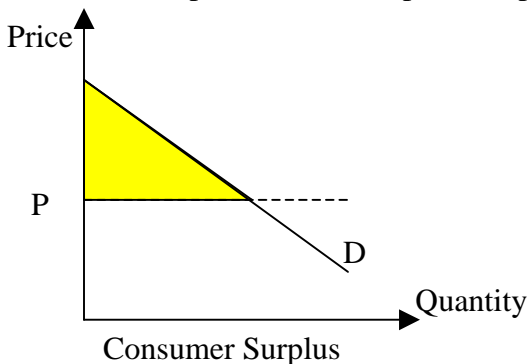
**The ultra-antitrade effect:** if labor-intensive country exports labor, the result is export output declines but import output increases. The trade volume decreases too.

Types of immigration:

1. Permanent: no GNP contribution to source country.
2. Guest worker or temporary migration: income included in GNP
3. Brain drain: skilled worker. Cost to source countries but benefit to the recipient.
4. Illegal immigrants: Cost to recipient.

### The Impact of Trade Policies

Basic concept: consumer surplus and producer surplus.



**Consumer surplus:** The free-rider effect: those who are willing to pay more now enjoy a lower price.

**Producer surplus:** those who are willing to produce for less now enjoys a higher price.

### Partial equilibrium: Small country

Assume given world price, policy changes only domestic price.

#### **Impact of Tariff:**

Artificially increased price line. Consumer surplus is transferred to producer surplus and government tariff revenue. Plus deadweight losses.

**Deadweight losses:** efficiency loss because artificially increased demand or supply decreases return on the margin.

#### **Impact of Import Quota:**

Quota causes the same **market effects** (SD curves) as tariff does.

However, it does not have the same **revenue effects**: same type of transfer but loses tariff tax—quota rent.

Quota rent: many people can claim it: government (through quota auction), foreign government (export control), local retailers or foreign exporters.

#### **Impact of Import Competing Subsidy:**

Changes market effects: shifts the supply curve outward. Government give-away to producers (moral hazard?). Loss of efficiency: instead of use a lower-cost of foreign supply.

Welfare effect: no cost to consumer surplus. If consumers have to pay for the subsidy, the cost is still lower than tariff.

A more attractive policy option.

Tariff equivalent subsidy: the supply curve moves out enough to generate the same demand as a higher price would because of tariff.

*Can use equivalent tariff level to calculate welfare change.*

*Impact of Export Tax and Quota:*

***Similar to analysis of import tariff and quota: deadweight loss, negative welfare change, quota rent concern, transfer between consumer and producer surplus.***

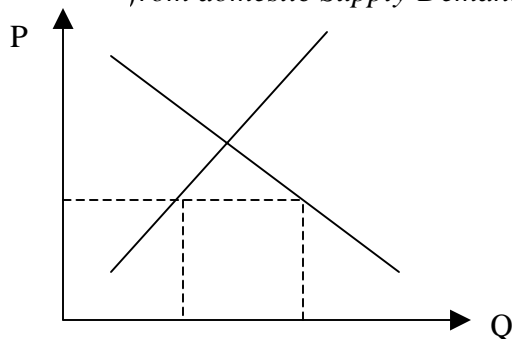
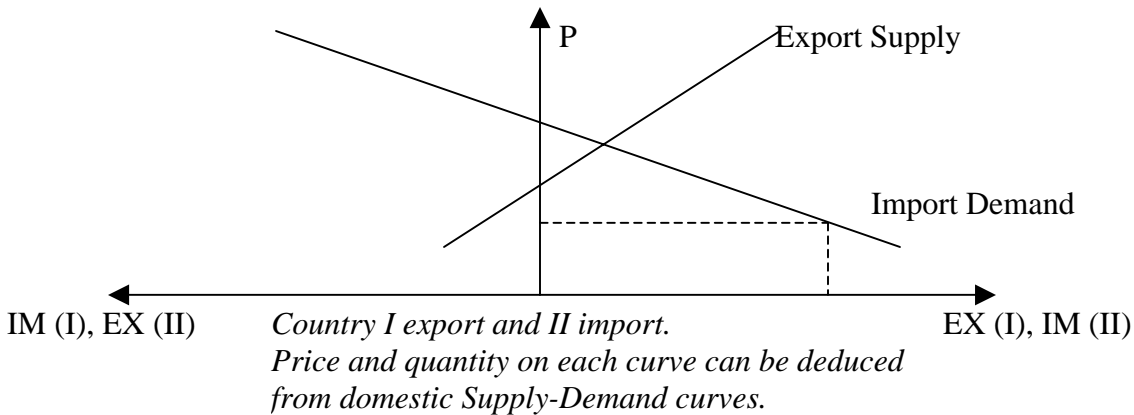
*Impact of Export Subsidy:*

***No “equivalent tax” effect as in import competing subsidy.***

***Instead, consumers pay twice: for the subsidy and the reduced domestic consumption.***

*Partial equilibrium: Large country*

***Use import-demand, export-supply schedule:***

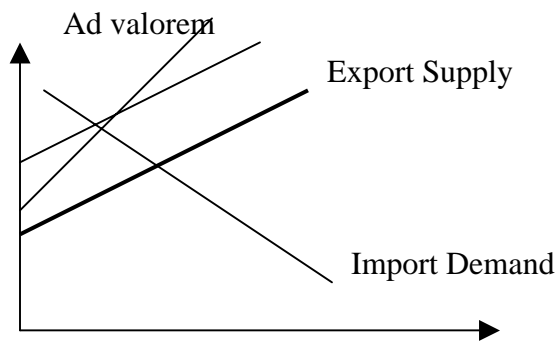


*Country II domestic S-D curve.  
Same price line as in above chart.  
Quantity difference between S-D is the Q reading in the above chart.*

Tariff types:

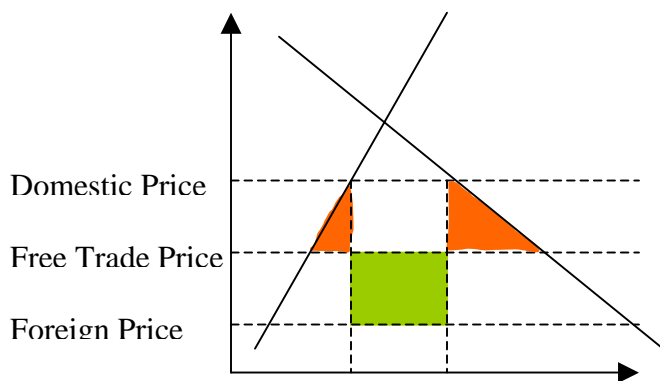
A fixed (specific) tariff moves the export curve parallel up.

An ad valorem tax (proportional) makes the export curve “pulls away” from the original one.



Because these are large economies, a tariff will cause domestic and foreign prices to diverge. Foreign price will keep lowering until the foreign producer reduces its production to meet reduced demand. The new world price is therefore lower than before. The difference between them is the tariff.

Consumer surplus is transferred to supplier surplus.  
Welfare change is part of the tariff gain (beyond original price line) minus deadweight losses (green minus oranges).



**Other observations: optimal tariff vs. prohibitive tariff**

A small tariff will ensure a net increase in benefit, e.g. green is larger than the sum of oranges.

A prohibitive tariff will bring price line back to autarky point—green is zero. Therefore, any trade is good.

A tariff always transfers domestic consumer surplus (CS) to producer surplus (PS) and foreign PS to CS.

The loss of the loser is always bigger than the gain of the winner → free trade is always the best policy.

**Difference between large and small countries in partial equilibrium:**

In small country, the world price is given.

In large country's case, tariff will reduce the world price therefore, the price change is never the original price plus tariff. Therefore, the deadweight losses are smaller in large country's case.

**General equilibrium: Small country**

Small country is a world price taker. After tariff, domestic price ratio differs (worsens) from world price ratio.

The domestic ratio:  $\frac{P_{ex}}{P_{im}}$  changes to  $\frac{P_{ex}}{P_{im}(1+t)}$  → new CPF

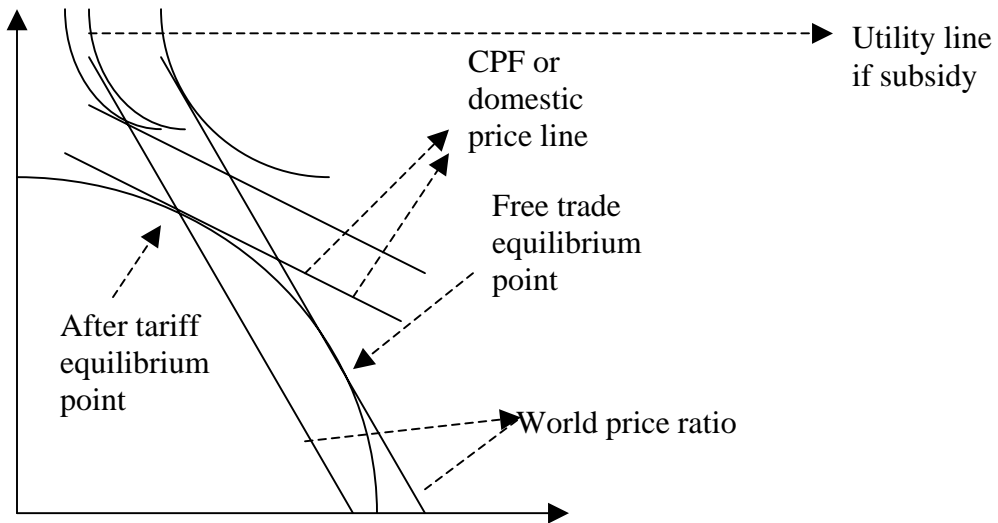
This induces producer to expand import competing product, the equilibrium point A moves to B as a result.

Because world price ratio is given, a line parallel to world price ratio goes through B, the new equilibrium point.

The difference between the two lines is welfare loss.

Utility curve shift down to tangent with outline of CPF (not sure why outer line? Domestic ratio plus tariff?)

If it is import competing subsidy, no consumer loss, the utility curve tangent to inner world price line, NOT the upper CPF.



**General equilibrium: Large country**

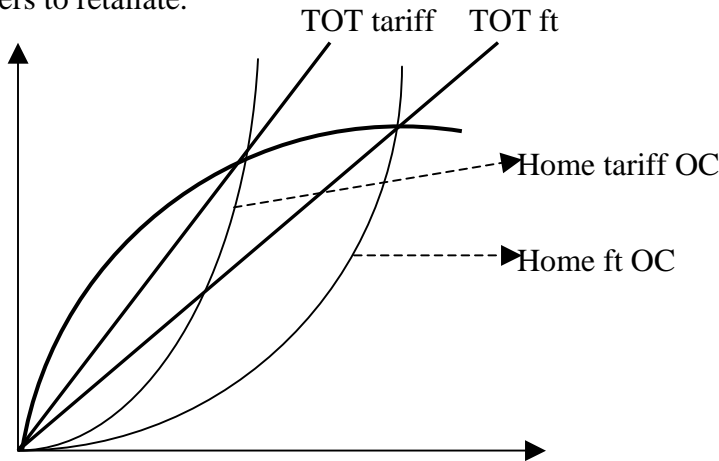
Use offer curve to demonstrate:

Tariff will reduce import good's world price. Hence an improvement on TOT.

Reduced willingness to trade causes consumption loss.

However, if tariff is small enough, TOT improvement may result in total welfare gain.

Cause for others to retaliate.



**New Protectionist arguments:**

Infant industry:

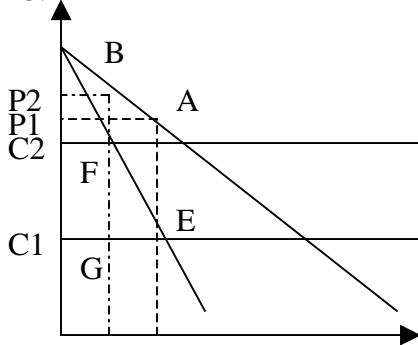
Protection now, increased productivity ( $AC < MC$ ) in the future and removal of protections.

Problem: protection has high cost, no imperial support.

**Imperfect competition:**

Tariff to extract foreign monopoly profit

Assumption: foreign monopoly = world monopoly → no domestic alternative. Constant MC.



Original foreign monopoly profit:  $P_1AEC_1$

After tariff foreign profit reduced by  $C_2FGC_1$

Consumer loss  $P_2BAP_1$

Counting on tariff revenue is greater than consumer loss.

**Common differences between Tariff, Quota and Subsidy**

1. Tariff is through **price distortion** and let quantity to adjust
2. Quota is through **fixed quantity** and let price to adjust.
3. Producer prefers quota to tariff because they may gain more if demand increases.
4. Subsidy is still better because government intervention is limited to producer only. The principle social cost of the subsidy is the loss in real income resulting from decreased specialization.

## Nash Equilibrium

Game, Coordination, Payoff Matrix

### **Prisoners' Dilemma:**

No coordination, thus the globally optimal strategy is unstable—it is not an equilibrium.

NE: Stable

How to find out:

1. Construct payoff matrix
2. Find cells that has the max in residing column and row:

|                 | <b>Option A</b> | <b>Option B</b> | <b>Option C</b> |
|-----------------|-----------------|-----------------|-----------------|
| <b>Option A</b> | 0, 0            | <b>25, 40</b>   | 5, 10           |
| <b>Option B</b> | <b>40, 25</b>   | 0, 0            | 5, 15           |
| <b>Option C</b> | 10, 5           | 15, 5           | <b>10, 10</b>   |

*For cell (B,A) 40 is the maximum of the first column and 25 is the maximum of the second row. For (A,B) 25 is the maximum of the second column and 40 is the maximum of the first row. For other cells, either one or both of the duplet members are not the maximum of the corresponding rows and columns.*