

Exercise set 1. Assignment 1

Objective: This exercise set is designed to illustrate the economic and welfare implications of trade liberalization and trade policy intervention, both in a partial and general equilibrium context. In solving for the equilibrium solutions, students are expected to apply various trade concepts and economic principles introduced in class and in the readings.

Problem: Given the market information below, use a partial equilibrium, 2-country model to show how price differences motivate international trade and affect economic change. Assume that the good in question (say meat) is identical in both countries, there are no transportation or other marketing costs, there is no government policy or domestic regulations that serve as a barrier to trade, and that the good is denominated in one currency (no exchange rate issues).

Suppose that the internal markets for agricultural products in North and South, respectively, are expressed mathematically in the table below.

North's Agricultural Market	South's Agricultural Market
$D_A: Q_A = 6500 - 500 P_A$	$D_A: Q_A = 11615.39 - 523.08 P_A$
$S_A: Q_A = -166.67 + 333.33 P_A$	$S_A: Q_A = 10269.23 + 246.15 P_A$

- 1.1. *Step 1.* Solve for the closed market (autarky) equilibrium in the agricultural sector of North and South to determine the internal price, $[P_A]^*$, and quantities supplied, $[Q_S]^*$, and demanded, $[Q_D]^*$. Note: the solution will be of use in the subsequent assignments.

Pre-trade partial equilibrium

North's agricultural market					South's agricultural market				
$[P_A]^*$	$[Q_S]^*$	$[Q_D]^*$	$[Q_T]$	V_T	$[P_A]^*$	$[Q_S]^*$	$[Q_D]^*$	$[Q_T]$	V_T
			0	0				0	0

- 1.2. *Step 2.* Identify the net agricultural importer and exporter from the pre-trade equilibrium prices. Derive excess demand (ED) of the importer and excess supply (ES) of the exporter.

Excess demand function	Excess supply function
$ED_A =$	$ES_A =$

- 1.3. *Step 3.* Solve for the free trade equilibrium (equate ED_A and ES_A). Determine the world price, $[P_A]_W$, quantity traded, Q_T , the value of trade, V_T , and the new domestic market situations in each country, i.e., $[Q_S]_1$ and $[Q_D]_1$.

Free trade partial equilibrium

North's agricultural market					South's agricultural market				
$[P_A]_W$	$[Q_S]_1$	$[Q_D]_1$	$[Q_T]$	V_T	$[P_A]_W$	$[Q_S]_1$	$[Q_D]_1$	$[Q_T]$	V_T

- 1.4. *Step 4.* Construct the 3-panel diagram showing the market changes from pre-trade to free trade.

- 1.5. Concepts for class discussion:
- 1.5.1. How do the results under 1.3 and 1.4 relate to the law of one price? What is arbitrage and how does this concept apply in this case?
 - 1.5.2. Suppose the good is frozen meat and that to trade meat there is fixed transportation cost per unit (€/kg). At what cost per kg would transport costs prohibit trade?
 - 1.5.3. How does a transportation cost of €1.50/kg affect prices and the volume of trade?
 - 1.5.4. What determines how much of the transportation costs are borne by the exporter and importer? Why does this make sense?
 - 1.5.5. Do the transportation costs affect the general lesson of international trade? Explain in terms of the law of one price?

Exercise set 1. Assignment 2

Problem: The economies of North and South have both an agricultural and a manufacturing sector. Solve the partial equilibrium economic effects of trade liberalization in both sectors. The results of the partial equilibrium analysis are to be put into a general equilibrium context by using the H-O-S framework. Maintain the standard H-O-S assumptions discussed in class.

The internal agricultural markets in North and South are expressed exactly as in assignment 1.

North's Agricultural Market	South's Agricultural Market
$D_A: Q_A = 6500 - 500 P_A$	$D_A: Q_A = 11615.39 - 523.08 P_A$
$S_A: Q_A = -166.67 + 333.33 P_A$	$S_A: Q_A = 10269.23 + 246.15 P_A$

Suppose that the internal markets for manufactured products in North and South, respectively, are expressed mathematically as:

North's Manufacturing Market	South's Manufacturing Market
$D_M: Q_M = 8571.43 - 571.43 P_M$	$D_M: Q_M = 6000 - 400 P_M$
$S_M: Q_M = 3428.57 + 571.43 P_M$	$S_M: Q_M = 666.67 + 133.33 P_M$

Suppose that the endpoints of the production possibilities curves are observable: for PPC^N they are (0A,7500M) and (4000A,0M); and for PPC^S they are (0A,2500M) and (13000A,0M).

- 2.1. The partial equilibrium analysis for the agricultural good was done in assignment 1. Repeat the steps taken to solve for the pre-trade equilibrium in the manufacturing sector: the quantity of manufactured goods produced (Q_M) and consumed (C_M) in North and South.

Pre-trade equilibrium in the agricultural and manufacturing sectors

North's agricultural market					South's agricultural market				
$[P_A]^*$	$[Q_A]^*$	$[C_A]^*$	$[Q_A]_T$	$[V_A]_T$	$[P_A]^*$	$[Q_A]^*$	$[C_A]^*$	$[Q_T]$	V_T
			0	0				0	0
North's manufacturing market					South's manufacturing market				
$[P_M]^*$	$[Q_M]^*$	$[C_M]^*$	$[Q_M]_T$	$[V_M]_T$	$[P_M]^*$	$[Q_M]^*$	$[C_M]^*$	$[Q_T]$	V_T
			0	0				0	0

- 2.2. Complete the partial equilibrium analysis by deriving the excess supply (ES) and demand curves (ED) for the world manufacturing market.

Excess demand and supply functions

World agricultural market	
$ED_A =$	$ES_A =$
World manufacturing market	
$ED_M =$	$ES_M =$

- 2.3. Determine the world price, $[P_M]_w$, quantity traded, $[Q_M]_T$, the value of trade, $[V_M]_T$, and the new domestic market situations in the manufacturing sectors in each country, i.e., $[Q_M]_1$ and $[C_M]_1$.

Free-trade equilibrium in the agricultural and manufacturing sectors

North's agricultural sector					South's agricultural sector				
$[P_A]_w$	$[Q_A]_1$	$[C_A]_1$	$[Q_A]_T$	$[V_A]_T$	$[P_A]_w$	$[Q_A]_1$	$[C_A]_1$	$[Q_A]_T$	$[V_A]_T$
North's manufacturing sector					South's manufacturing sector				
$[P_M]_w$	$[Q_M]_1$	$[C_M]_1$	$[Q_M]_T$	$[V_M]_T$	$[P_M]_w$	$[Q_M]_1$	$[C_M]_1$	$[Q_M]_T$	$[V_M]_T$

- 2.4. Construct the 3-panel diagram showing the market changes from pre-trade to free trade.
- 2.5. Using the price and the quantity traded information from parts 2.1 through 2.3, compute the pre-trade price ratios in both countries, $[P_A]_N / [P_M]_N$ and $[P_A]_S / [P_M]_S$, the free trade price, ratio, $[P_A]_w / [P_M]_w$, and compare the ratio of volume traded ratio, $[Q_M]_T / [Q_A]_T$.

General equilibrium analysis

Market:	Pre-trade prices				Trade prices		Quantity traded	
	North		South		World prices	TOT P-ratio	Volumes	$[Q_M]_T / [Q_A]_T$ ratio
	Prices	P-ratio	Prices	P-ratio				
Agriculture								
Manufacturing								

- 2.6. Use the H-O-S $2 \times 2 \times 2$ modeling framework to construct the general equilibrium outcome that corresponds with the results of the partial equilibrium solutions. Separately graph the general equilibrium situations of North and South to show the economic and welfare effects of trade liberalization, i.e., moving from a pre-trade to a free trade situation. Identify the pre-trade prices, P_A / P_M , the TOT, the trade triangles, and plot the pre-trade and with-trade production and consumption points and the endpoints of the production possibilities curves. Be sure to include social welfare curves, SW, to show that the consumption points are welfare maximizing given preferences, income, and prices.

Exercise set 1. Assignment 3

Problem: This assignment is designed to illustrate the economic and welfare implications of a market access restriction (i.e., an import tariff) both in terms of the partial equilibrium effects and some expected general equilibrium effects. Suppose the government in the net importing agricultural country applies a tariff. Model the changes in equilibrium and analyze the economic effects of a policy change from free trade to restricted trade.

North's Agricultural Market	South's Agricultural Market
$D_A: Q_A = 6500 - 500 P_A$	$D_A: Q_A = 11615.39 - 523.08 P_A$
$S_A: Q_A = -166.67 + 333.33 P_A$	$S_A: Q_A = 10269.23 + 246.15 P_A$

3.1. The initial situation is the free trade partial equilibrium solution from assignment 2.

Free trade partial equilibrium

North's agricultural market					South's agricultural market				
$[P_A]_W$	$[Q_S]_1$	$[Q_D]_1$	$[Q_A]_T$	$[V_A]_T$	$[P_M]_W$	$[Q_S]_1$	$[Q_D]_1$	$[Q_A]_T$	$[V_A]_T$

3.2. Now, the government in the importing country applies a specific tariff of €3.125 per unit. Ignore the possibility for retaliation. Derive the new excess demand function with the tariff.

New excess demand function	Excess supply function
$[ED_A]^T =$	$ES_A =$

3.3. Determine the new world price, $[P_A]_W'$, the domestic price, $[P_A]_D$ in the importing country, the new quantity traded, $[Q_A]_T'$, the value of trade, $[V_A]_T'$, and the new domestic market situations in the agricultural sectors in each country, i.e., $[Q_S]'$ and $[Q_D]'$.

Equilibrium under a €3.125 per unit tariff on the agricultural good

North's agricultural sector						South's agricultural sector				
$[P_A]_W'$	$[P_A]_D$	$[Q_S]_1'$	$[Q_D]_1'$	$[Q_A]_T'$	$[V_A]_T'$	$[P_A]_W'$	$[Q_S]_1'$	$[Q_D]_1'$	$[Q_A]_T'$	$[V_A]_T'$

3.4. Construct a 3-panel diagram showing the market changes from free trade to restricted trade.

3.5. Analyze the welfare effects of the import tariff using free trade as the benchmark. Identify the areas in your model that represent the welfare changes in consumer surplus, ΔCS , producer surplus, ΔPS , change in government revenue, ΔG , and the change in net social welfare, ΔNSW . What is the ΔNSW in the world? Explain.

Welfare analysis of a tariff

Welfare analysis			
	Importer	Exporter	Change in NSW in the world
ΔCS			
ΔPS			
ΔG			
ΔNSW			

3.6. Concepts related to tariffs for class discussion:

- 3.6.1. What is the ad valorem tariff equivalent of the specific tariff? That is, what percent tax results in the same economic and welfare effects? What is the quota equivalent of the tariff?
- 3.6.2. Is this the maximum revenue-generating tariff? That is, is there a different tariff rate that generates more revenue for the government?
- 3.6.3. Is this an example of an optimal tariff? Explain. What would it mean for the tariff to be considered a “strategic import policy” on the part of the importing government?
- 3.6.4. Would you expect retaliation from the part of the exporting country? Explain. What action could the exporting country take? Would or could it result in a welfare improvement in the exporting country?

- 3.7. Recall that each country has a manufacturing sector that competes with the agricultural sector. So, the change in the nominal price of the agricultural good, $[P_A]_W'$, will affect the relative price of the goods, $[P_A]_W'/[P_M]_W$. You have only solved a partial equilibrium problem and do not have specific information on how the tariff on the agricultural good affects the manufacturing sector. However, you can deduce how the trade effect on the international agricultural market affects the relative prices of the goods (i.e., P_A relative to P_M) in the markets of both economies. To do this, use the offer curve analysis to show: (1) the initial equilibrium of quantity traded, $[Q_A]_T$ for $[Q_M]_T$, (2) the initial terms of trade (TOT), (3) the new equilibrium quantity traded, $[Q_A]_T'$ for $[Q_M]_T'$, and (4) the new terms of trade, TOT_1 .

Optional: A more advanced general equilibrium solution would be the use of the H-O-S framework. Relying on the use of the H-O-S model, show the direction of the changes in a general equilibrium context as a result of the tariff's effect on relative prices, production, consumption, trade and welfare. Do this for each country separately.

Exercise set 1. Assignment 4

Problem: This assignment is designed to illustrate the economic and welfare implications of a policy affecting export competition (i.e., an export subsidy) both in terms of the partial equilibrium effects and some expected general equilibrium effects. Suppose the government in the net exporting manufacturing country applies an export subsidy. Model the changes in equilibrium and analyze the economic effects of a policy change from free trade to subsidized trade.

The internal manufacturing markets in North and South are expressed exactly as in assignment 1.

North's Manufacturing Market	South's Manufacturing Market
$D_M: Q_M = 8571.43 - 571.43 P_M$	$D_M: Q_M = 6000 - 400 P_M$
$S_M: Q_M = 3428.57 + 571.43 P_M$	$S_M: Q_M = 666.67 + 133.33 P_M$

4.1. The initial situation is the free trade partial equilibrium solution from assignment 2.

Free trade partial equilibrium

North's manufacturing market					South's manufacturing market				
$[P_M]_W$	$[Q_S]_1$	$[Q_D]_1$	$[Q_T]$	V_T	$[P_M]_W$	$[Q_S]_1$	$[Q_D]_1$	$[Q_T]$	V_T

4.2. Now, the government in the exporting country applies a specific subsidy of 1.10 per unit. Ignore the possibility for retaliation. Derive the new excess supply function with a subsidy.

Excess demand function	Excess supply function
$[ED_M] =$	$[ES_M]^1 =$

4.3. Determine the new world price, $[P_M]_W'$, the domestic price, $[P_M]_D$ in the exporting country, the new quantity traded, $[Q_M]_T'$, the value of trade, $[V_M]_T'$, and the new domestic market situations in the manufacturing sectors in each country, i.e., $[Q_S]'$ and $[Q_D]'$.

Equilibrium under a specific export subsidy of 1.10 on the manufactured good

North's manufacturing sector						South's manufacturing sector				
$[P_M]_W'$	$[P_M]_D$	$[Q_S]_1'$	$[Q_D]_1'$	$[Q_M]_T'$	$[V_M]_T'$	$[P_M]_W'$	$[Q_S]_1'$	$[Q_D]_1'$	$[Q_M]_T'$	$[V_M]_T'$

4.4. Construct a 3-panel diagram to show market changes from free trade to subsidized trade.

4.5. Analyze the welfare effects of the export subsidy using free trade as the benchmark. Identify the areas in your model that represent the welfare changes in consumer surplus, ΔCS , producer surplus, ΔPS , change in government revenue, ΔG , and the change in net social welfare, ΔNSW . What is the ΔNSW in the world? Explain.

Welfare analysis of an export subsidy

Welfare analysis			
	Importer	Exporter	Change in NSW in the world
ΔCS			
ΔPS			
ΔG			
ΔNSW			

- 4.6. Concepts related to export subsidies for class discussion:
- 4.6.1. What is the ad valorem export subsidy equivalent to the specific export subsidy? That is, what percent rate of an export subsidy results in the same economic and welfare effects? What is the export quota equivalent of the export subsidy?
- 4.6.2. Is this an example of an optimal policy? Explain. What would it mean for an export subsidy to be considered a “strategic export policy” on the part of the exporting government?
- 4.6.3. Would you expect a retaliatory policy response by the importing country? Explain. What action could the importing country take? Would or could it result in a welfare improvement in the importing country?
- 4.7. Recall that each country has an agricultural sector that competes with the manufacturing sector. So, the change in the nominal price of the manufactured good, $[P_M]_W'$, will affect the relative price of the goods, $[P_A]_W/[P_M]_W'$. You have only solved a partial equilibrium problem and do not have specific information on how the export subsidy on manufacturing exports affects the agricultural sector. However, you can deduce how the trade effect on the international manufacturing market affects the relative prices of the goods (i.e., P_A relative to P_M) in the markets of both economies. To do this, use the offer curve analysis to show: (1) the initial equilibrium of quantity traded, $[Q_A]_T$ for $[Q_M]_T$, (2) the initial terms of trade (TOT), (3) the new equilibrium quantity traded, $[Q_A]_{T'}$ for $[Q_M]_{T'}$, and (4) the new terms of trade, TOT_1 .

Optional: A more advanced general equilibrium solution would be the use of the H-O-S framework. Relying on the use of the H-O-S model, show the direction of the changes in a general equilibrium context as a result of the export subsidy's effect on relative prices, production, consumption, trade and welfare. Do this for each country separately.