International Economics — Exercises

Designed for undergraduate students.
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International Economics — Exercises

Week 1 — Comparative advantage and the production frontier

DRAFT — working version. University of Miskolc · GEMI · Course plan v2, Week 1 of 11.

How these exercises work

C-1 is worked together in class. P-1 has the same structure but a different setting, so you practise the method rather than memorising one story. Both use the unit labour requirement (hours per unit) throughout. Brief solutions are at the end — attempt P-1 before reading them. The general rules these exercises apply are in the explanation expansion, §1.3–§1.5.

C-1 — Wine and oranges (worked in class)

Hungary and Ecuador can each produce wine and oranges. Labour is the only factor of production, and the two countries use different technology. The table gives the unit labour requirement for each good in each country — the number of working hours needed to produce one unit — together with the total labour available.

	a_{LW}	a_{LO}	L
Hungary	5	4	2,000
Ecuador	4	2	1,600

W = wine, O = oranges. Unit labour requirements in hours per unit; L in hours available.

(a) Does either country have an absolute advantage in wine? In oranges? State the rule you used.

(b) On this evidence, can Adam Smith's absolute-advantage rule tell the two countries what to specialise in? Explain in one sentence.

(c) Compute the opportunity cost of wine in terms of oranges in each country. Then compute the opportunity cost of oranges in terms of wine.

(d) Which country has the comparative advantage in wine, and which in oranges?

(e) Draw both production possibility frontiers. Mark the two intercepts and state the slope of each.

(f) Hungary is less efficient at producing both goods. Explain in two sentences why it can still gain from trade.

(g) Suppose, before specialising, each country had devoted exactly half its labour to each good. Compute total world wine and orange output in that case. Then compare with total world output under full specialisation, using your answers to part (e). What changed?

P-1 — Machines and honey (practice)

Germany and Hungary can each produce machines and honey. Again labour is the only factor, and the two countries differ in technology.

	a_{LM}	a_{LH}	L
Germany	10	4	4,000
Hungary	25	5	2,500

M = machines, H = honey. Unit labour requirements in hours per unit; L in hours available.

(a) Which country has the absolute advantage in machines? In honey?

(b) Compute all four opportunity costs.

(c) Which country has the comparative advantage in each good?

(d) Draw both frontiers, marking intercepts and slopes.

(e) Germany is 2.5 times better at making machines than Hungary, but only slightly better at producing honey. Explain how that pattern — rather than Germany's overall superiority — determines the direction of trade.

(f) Suppose Hungarian labour productivity in honey improves so that the unit labour requirement falls from 5 to 4 hours. Recompute Hungary's opportunity costs. Does the direction of comparative advantage change?

(g) Suppose, before specialising, each country had devoted exactly half its labour to each good. Compute total world machine and honey output in that case, then compare with full specialisation using your answers to part (d). Then, using a world price of 3 units of honey per machine, show that total world value, measured in honey, still rises — even though one good's total output falls.

> **Before you turn the page**
>
> Attempt every part of P-1 first, including the two written parts. The numerical answers are the easy half — the parts that ask you to explain WHY the direction of trade comes out as it does are the ones the exam essay will test. If your explanation appeals to one country being better overall, reread §1.4: that is the answer the model rejects.

Solutions

Results and the main steps only. Full reasoning belongs in your own working.

C-1

(a) Ecuador has the absolute advantage in both goods: it needs fewer hours per unit of wine (4 < 5) and fewer per unit of oranges (2 < 4). The rule compares unit labour requirements directly — a lower a_L means an absolute advantage.

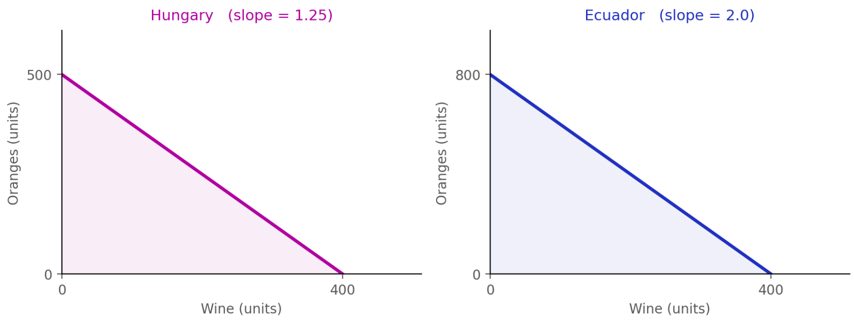
(b) No. Smith's rule assumes each country is better at something. Here one country is better at everything, so the rule gives no guidance on what to specialise in.

(c) Opportunity cost of wine in oranges = a_{LW} / a_{LO}: Hungary 5/4 = 1.25; Ecuador 4/2 = 2.0. Opportunity cost of oranges in wine = a_{LO} / a_{LW}: Hungary 4/5 = 0.8; Ecuador 2/4 = 0.5.

(d) Hungary has the comparative advantage in wine (1.25 < 2.0). Ecuador has it in oranges (0.5 < 0.8). Note that each country has one, and they are on opposite goods — this is always true.

(e) Hungary: wine intercept 2,000/5 = 400; orange intercept 2,000/4 = 500; slope 1.25. Ecuador: wine intercept 1,600/4 = 400; orange intercept 1,600/2 = 800; slope 2.0. Ecuador's frontier is steeper, which is the same statement as its higher opportunity cost of wine.

C-1 solution: production possibility frontiers



(f) What matters for trade is not how many hours a country needs, but what it gives up at home to get one more unit. Hungary sacrifices only 1.25 oranges per unit of wine while Ecuador sacrifices 2, so Hungary is the cheaper source of wine even though it is the slower producer.

(g) Half-labour benchmark: Hungary wine 1,000/5 = 200, oranges 1,000/4 = 250. Ecuador wine 800/4 = 200, oranges 800/2 = 400. World: 400 wine, 650 oranges. Full specialisation (from (e)): 400 wine, 800 oranges. World wine output is unchanged; oranges rise by 150. No price is even needed here to see the world is better off — one good is unchanged and the other strictly rises. (Contrast P-1(g), where a price is required.)

P-1

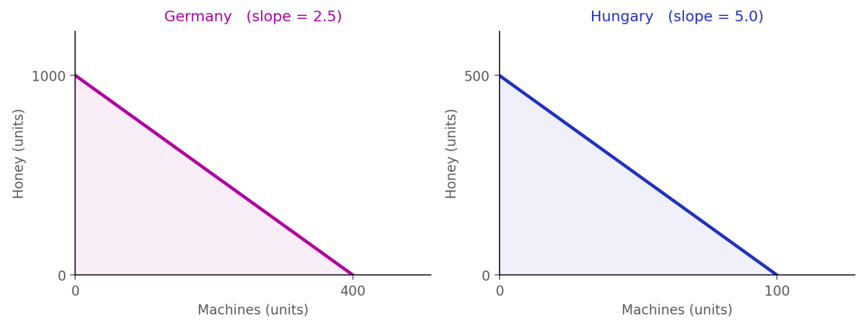
(a) Germany, in both: machines 10 < 25 hours, honey 4 < 5 hours.

(b) Opportunity cost of machines in honey = a_{LM} / a_{LH}: Germany 10/4 = 2.5; Hungary 25/5 = 5.0. Opportunity cost of honey in machines = a_{LH} / a_{LM}: Germany 4/10 = 0.4; Hungary 5/25 = 0.2.

(c) Germany has the comparative advantage in machines (2.5 < 5.0); Hungary in honey (0.2 < 0.4).

(d) Germany: machines intercept 4,000/10 = 400; honey intercept 4,000/4 = 1,000; slope 2.5. Hungary: machines intercept 2,500/25 = 100; honey intercept 2,500/5 = 500; slope 5.0.

P-1 solution: production possibility frontiers



(e) Germany’s advantage is large in machines (2.5×) and small in honey (1.25×). Trade follows the comparison of these ratios, not their levels: Germany’s edge is concentrated in machines, so that is where its resources are worth most, and honey is left to Hungary.

(f) With a_{LH} = 4: Hungary’s opportunity cost of machines becomes 25/4 = 6.25 and of honey 4/25 = 0.16. Hungary’s comparative advantage in honey is unchanged — in fact it strengthens (0.16 < 0.2). Becoming better at the good you already export deepens the existing pattern of specialisation rather than reversing it.

(g) Half-labour benchmark: Germany machines 2,000/10 = 200, honey 2,000/4 = 500. Hungary machines 1,250/25 = 50, honey 1,250/5 = 250. World: 250 machines, 750 honey. Full specialisation (from (d)): 400 machines, 500 honey. Machines rise by 150 but honey falls by 250 — unlike C-1, inspection alone does not show a gain. At a world price of 3 (honey per machine, inside the 2.5–5.0 mutually beneficial range): value before = 250×3 + 750 = 1,500; value after = 400×3 + 500 = 1,700. World value rises by 200 — the gain is real, but here it only shows up once a price inside the range is applied.

International Economics — Exercises

Week 2 — Splitting the gains, and country size

DRAFT — working version. University of Miskolc · GEMI · Course plan v2, Week 2 of 11.

How these exercises work

C-2 continues the Hungary/Ecuador case from C-1. P-2 has the same structure but a different setting (Germany/Hungary, machines and honey, from P-1), so you practise the method rather than memorising one story. Both use the notation from §2.1–§2.4: $(P_W/P_O)_d$ for the domestic relative price, $(P_W/P_O)_i$ for the terms of trade. Brief solutions are at the end — attempt P-2 before reading them.

C-2 — Wine and oranges: splitting the surplus (worked in class)

Hungary and Ecuador are the two countries from C-1. As a reminder:

	a_{LW}	a_{LO}	$(P_W/P_O)_d$
Hungary	5	4	1.25
Ecuador	4	2	2.00

(a) State the mutually beneficial range for $(P_W/P_O)_i$. Which country is indifferent at each end of it?

(b) Suppose Hungary exports 300 units of wine to Ecuador at $(P_W/P_O)_i = 1.5$. How many oranges does Hungary receive in return?

(c) Compute Hungary's production surplus from this trade: how many oranges could the labour behind those 300 units of wine have produced directly, and how does that compare with what Hungary actually received in part (b)?

(d) Compute Ecuador's production surplus from the same trade, in units of wine: how many oranges did Ecuador give up, what could the labour behind those oranges have produced in wine directly, and how does that compare with the 300 units of wine Ecuador actually received?

(e) Repeat parts (b)–(d) at $(P_W/P_O)_i = 1.8$, keeping the wine volume at 300 units.

(f) Hungary's surplus is measured in oranges; Ecuador's is measured in wine — they cannot be compared as raw numbers. Convert Ecuador's surplus into oranges (at the price actually traded) before comparing. Which country gained more at $(P_W/P_O)_i = 1.5$? Which gained more at 1.8? Explain the pattern using the two countries' domestic relative prices — not just the numbers.

(g) Connect your answer to §2.3: if you were negotiating on Hungary's behalf, which of these two prices would you push for in a single transaction — and what risk would that create for the trading relationship?

P-2 — Machines and honey: splitting the surplus (practice)

Germany and Hungary are the two countries from P-1.

	a_{LM}	a_{LH}	$(P_M/P_H)_d$
Germany	10	4	2.50
Hungary	25	5	5.00

(a) State the mutually beneficial range for the terms of trade of machines (in honey). Which country is indifferent at each end?

(b) Suppose Germany exports 200 machines to Hungary at $(P_M/P_H)_i = 3.5$. How much honey does Germany receive?

(c) Compute Germany's production surplus from this trade, in honey.

(d) Compute Hungary's production surplus from the same trade, in machines.

(e) Repeat parts (b)–(d) at a price of 4.5, keeping the machine volume at 200 units.

(f) Germany's surplus is measured in honey; Hungary's is measured in machines — they cannot be compared as raw numbers. Convert Hungary's surplus into honey (at the price actually traded) before comparing. Which country gained more at each price? Explain the pattern using the two countries' domestic relative prices.

> **Before you turn the page**
>
> Attempt every part of P-2 first, including (f). The numbers are the easy half — explaining WHY the split moves the way it does, in terms of the two domestic relative prices, is what the exam essay will test.

Solutions

Results and the main steps only. Full reasoning belongs in your own working.

C-2

(a) $(P_W/P_O)_i$ between 1.25 and 2.00. At 1.25 Hungary is indifferent; at 2.00 Ecuador is indifferent.

(b) 300 × 1.5 = 450 oranges.

(c) 300 units of wine cost Hungary 300×5 = 1,500 hours. Those hours in oranges directly: 1,500/4 = 375 oranges. Hungary actually received 450 — a surplus of 75 oranges.

(d) Ecuador gave up 450 oranges, costing 450×2 = 900 hours. Those hours in wine directly: 900/4 = 225 wine. Ecuador actually received 300 — a surplus of 75 wine.

(e) At 1.8: Hungary receives 300×1.8 = 540 oranges. Direct alternative unchanged at 375 (same labour) — surplus 165 oranges. Ecuador gives up 540 oranges (1,080 hours), direct alternative 1,080/4 = 270 wine — surplus 30 wine.

(f) AT 1.5: Ecuador's surplus of 75 wine × 1.5 = 112.5 oranges. Compared with Hungary's 75 oranges, ECUADOR gains more. AT 1.8: Ecuador's surplus of 30 wine × 1.8 = 54 oranges, against Hungary's 165 oranges — HUNGARY gains far more. The pattern: a price near your OWN domestic price is bad for you, a price near your partner's is good for you. 1.5 sits only 0.25 from Hungary's own price (1.25) but 0.50 from Ecuador's (2.00) — closer to Hungary's own cost, which is why Ecuador comes out ahead. 1.8 reverses this: only 0.20 from Ecuador's own price but 0.55 from Hungary's — now it is Hungary's turn to gain the most.

(g) 1.8 gives Hungary far more of the surplus in this one transaction. But it leaves Ecuador with very little, and §2.3 warns that a partner left close to indifferent is the partner most likely to stop trading when circumstances change — the short-term gain risks the long-term relationship.

P-2

(a) Between 2.50 and 5.00. At 2.50 Germany is indifferent; at 5.00 Hungary is indifferent.

(b) 200 × 3.5 = 700 units of honey.

(c) 200 machines cost Germany 200×10 = 2,000 hours. Direct alternative in honey: 2,000/4 = 500. Germany received 700 — surplus 200 honey.

(d) Hungary gave up 700 honey, costing 700×5 = 3,500 hours. Direct alternative in machines: 3,500/25 = 140. Hungary received 200 — surplus 60 machines.

(e) At 4.5: Germany receives 200×4.5 = 900 honey — surplus 400 honey (unchanged direct alternative, 500). Hungary gives up 900 honey (4,500 hours), direct alternative 4,500/25 = 180 machines — surplus 20 machines.

(f) AT 3.5: Hungary's surplus of 60 machines × 3.5 = 210 honey. Compared with Germany's 200 honey, HUNGARY gains slightly more — the reverse of what the raw numbers (200 vs 60) would suggest before converting. AT 4.5: Hungary's surplus of 20 machines × 4.5 = 90 honey, against Germany's 400 — GERMANY gains far more. The same rule as C-2: a price near your own domestic price is bad for you, near your partner's is good for you. 3.5 sits 1.00 from Germany's own price (2.50) but 1.50 from Hungary's (5.00) — closer to Germany's own cost, which is why Hungary edges ahead, if only slightly. 4.5 reverses this decisively: only 0.50 from Hungary's own price but 2.00 from Germany's — now Germany gains by far the most.

International Economics — Exercises

Week 3 — The concave frontier, and choosing a point on it

DRAFT — working version. University of Miskolc · GEMI · Course plan v2, Week 3 of 11.

How these exercises work

C-3 is worked together in class. P-3 has the same structure but a different setting (land plots making cheese and wool, instead of parcels making wine and oranges), so you practise the method rather than memorising one story. Both use the notation from §3.3–§3.4: $(P_W/P_O)_i$ for the world price. Brief solutions are at the end — attempt P-3 before reading them.

C-3 — Four parcels: wine and oranges (worked in class)

An economy has four parcels of land. Each can produce 100 units of wine if devoted entirely to wine, or the stated quantity of oranges if devoted entirely to oranges.

Parcel	Wine, if all wine	Oranges, if all oranges	Opportunity cost of wine
A	100	50	?
B	100	100	?
C	100	200	?
D	100	300	?

(a) Compute the opportunity cost of wine for each parcel, and rank the parcels from cheapest to dearest source of wine.

(b) Build the frontier: starting from all parcels in oranges, add parcels to wine one at a time, cheapest first. State the (wine, oranges) coordinate after each switch, and the slope of each new segment.

(c) Draw the frontier. Mark each kink with its coordinates.

(d) At $(P_W/P_O)_i = 1.2$, which parcels go to wine and which stay in oranges? State the resulting production point.

(e) Repeat part (d) at $(P_W/P_O)_i = 2.5$.

(f) At what price would the economy first produce only wine? At what price would it first produce only oranges? Explain both in one sentence using the parcel table.

(g) At $(P_W/P_O)_i = 1.2$, compute the value of production, measured in oranges. Then state one other combination of wine and oranges that has the same value, and check it.

(h) Suppose all four parcels could instead produce 100 wine or 100 oranges each. Redraw the frontier in this case, and explain in one sentence why it no longer bends.

P-3 — Four land plots: cheese and wool (practice)

A different economy has four land plots. Each can produce 100 units of cheese if devoted entirely to cheese, or the stated quantity of wool if devoted entirely to wool.

Plot	Cheese, if all cheese	Wool, if all wool	Opportunity cost of cheese
P	100	40	?
Q	100	80	?

Plot	Cheese, if all cheese	Wool, if all wool	Opportunity cost of cheese
R	100	160	?
S	100	280	?

(a) Compute the opportunity cost of cheese for each plot, and rank the plots from cheapest to dearest source of cheese.

(b) Build the frontier, plot by plot, cheapest first. State each kink's coordinates and each new segment's slope.

(c) Draw the frontier.

(d) At a world price of 0.6 (wool per unit of cheese), which plots produce cheese? State the production point.

(e) Repeat part (d) at a price of 2.2.

(f) At the price in part (e), compute the value of production measured in wool. State one other output combination with the same value.

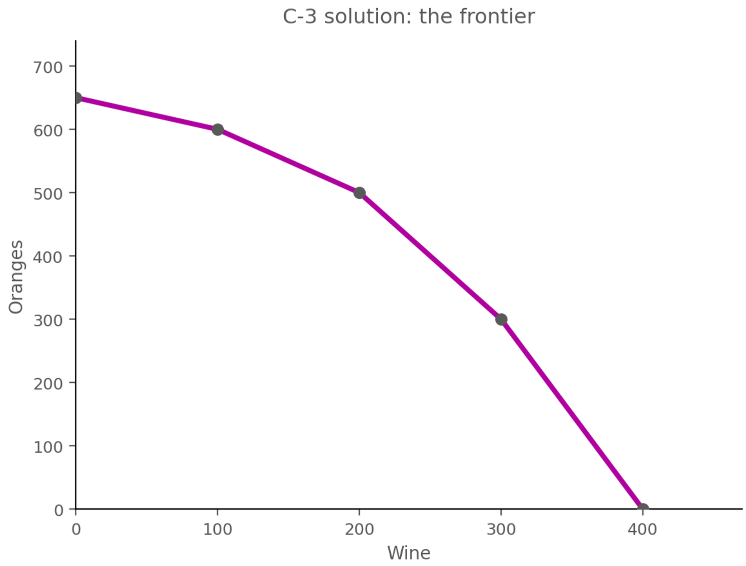
Solutions

Results and the main steps only. Full reasoning belongs in your own working.

C-3

(a) Opportunity costs: A = 50/100 = 0.5; B = 100/100 = 1.0; C = 200/100 = 2.0; D = 300/100 = 3.0. Order: A, B, C, D.

(b) Start (0, 650). +A → (100, 600), slope 0.5. +B → (200, 500), slope 1.0. +C → (300, 300), slope 2.0. +D → (400, 0), slope 3.0.



(d) At 1.2: parcels with opportunity cost below 1.2 go to wine — A (0.5) and B (1.0). Production = (200, 500), the kink between the B and C segments.

(e) At 2.5: A, B and C (2.0) all go to wine — D (3.0) stays in oranges. Production = (300, 300).

(f) Only wine when the price exceeds parcel D's opportunity cost, 3.0 — even the most expensive source is worth switching. Only oranges when the price falls below parcel A's, 0.5 — not even the cheapest source is worth switching.

(g) Value = 500 + 1.2×200 = 740, in oranges. Any (wine, oranges) pair on the same line works, e.g. (100, 620): 620 + 1.2×100 = 740. ✓

(h) With every parcel identical (100 wine or 100 oranges each), every opportunity cost is 1.0. All four segments share the same slope, so they form one straight line from (0, 400) to (400, 0) — the linear frontier of Weeks 1–2 is the special case where the parcels do not differ.

Before you turn the page

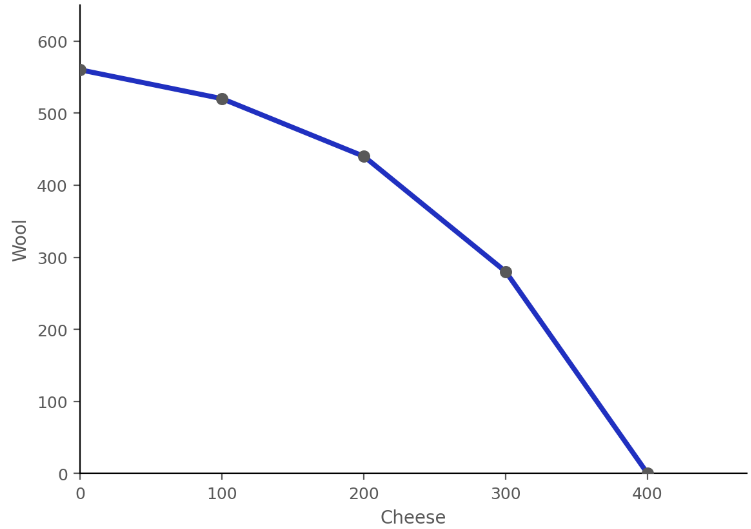
Attempt every part of P-3 first. Part (f) is the one that matters most for the exam — computing a value and checking a second point on the same line is exactly what the essay question will ask.

P-3

(a) Opportunity costs: P = 40/100 = 0.4; Q = 80/100 = 0.8; R = 160/100 = 1.6; S = 280/100 = 2.8. Order: P, Q, R, S.

(b) Start (0, 560). +P → (100, 520), slope 0.4. +Q → (200, 440), slope 0.8. +R → (300, 280), slope 1.6. +S → (400, 0), slope 2.8.

P-3 solution: the frontier



(d) At 0.6: plot P (0.4) is below the price and goes to cheese; Q (0.8), R and S stay in wool. Production = (100, 520).

(e) At 2.2: P, Q and R (1.6) go to cheese; S (2.8) stays in wool. Production = (300, 280).

(f) Value = 280 + 2.2×300 = 940, in wool. Any pair on the same line works, e.g. (200, 500): 500 + 2.2×200 = 940. ✓

GEMI MISKOLC

International Economics — Exercises

Week 4 — Two ways of growing, and when growth hurts

DRAFT — working version. University of Miskolc · GEMI · Course plan v2, Week 4 of 11.

How these exercises work

C-4 continues the four-parcel wine/oranges economy of C-3, now with the export-biased growth described in the expansion §4.2. P-4 has the same structure but a different setting (the cheese/wool land plots of P-3), so you practise the method rather than memorising one story. Both use the notation from §4.3–§4.4: (PW/PO)i for the terms of trade. Brief solutions are at the end — attempt P-4 before reading them.

C-4 — Wine and oranges: does growth help? (worked in class)

Recall the four parcels from C-3: each can produce 100 units of wine, or the stated oranges.

Parcel	Wine cap.	Oranges cap.	Opp. cost of wine (before)
A	100	50	0.5
B	100	100	1.0
C	100	200	2.0
D	100	300	3.0

A new grape variety raises every parcel's wine capacity by half, to 150 units. Orange capacity is unchanged.

(a) Compute each parcel's new opportunity cost of wine after the growth.

(b) State the new frontier's two intercepts (maximum wine, maximum oranges).

(c) Suppose the country is small, so $(P_W/P_O)_i$ stays at 1.5. Find the new production point and its value, measured in oranges.

(d) Before growth, the country produced 200 wine and 500 oranges (worth 800) and consumed 50 wine and 725 oranges. Confirm this bundle was exactly affordable at the old price.

(e) Using your answer to (c): can the country (from part c, the small-country case) still afford the bundle in (d)? State the verdict.

(f) Now suppose the country is large, and its own growth pushes the world price down to $(P_W/P_O)_i = 0.86$. Find the new production point and its value.

(g) Can the country still afford the bundle in (d) at this new price? Show the numbers and state the verdict.

(h) Find the exact price threshold below which this bundle becomes unaffordable.

(i) A different country consumes wine and oranges in a 1-to-6.5 ratio instead — a bundle of 100 wine and 650 oranges. Facing the identical growth and the identical price fall to 0.86, is growth immiserising for this country? Show your work.

P-4 — Cheese and wool: does growth help? (practice)

Recall the four land plots from P-3: each can produce 100 units of cheese, or the stated wool.

Plot	Cheese cap.	Wool cap.	Opp. cost of cheese (before)
P	100	40	0.4

Plot	Cheese cap.	Wool cap.	Opp. cost of cheese (before)
Q	100	80	0.8
R	100	160	1.6
S	100	280	2.8

A new irrigation scheme raises every plot's cheese capacity by half, to 150 units. Wool capacity is unchanged. Before growth, at a world price of 1.2, the country produced 200 cheese and 440 wool (worth 680) and consumed 30 cheese and 644 wool.

(a) Compute each plot's new opportunity cost of cheese after the growth.

(b) Confirm the consumption bundle (30, 644) was exactly affordable before growth.

(c) Suppose the country is small, so the price stays at 1.2. Find the new production point and its value. Is the old bundle still affordable?

(d) Suppose instead the country is large, and its own growth pushes the price down to 0.65. Find the new production point and its value.

(e) Is the old bundle still affordable at 0.65? Show the numbers and state the verdict.

(f) Find the exact price threshold below which the old bundle becomes unaffordable.

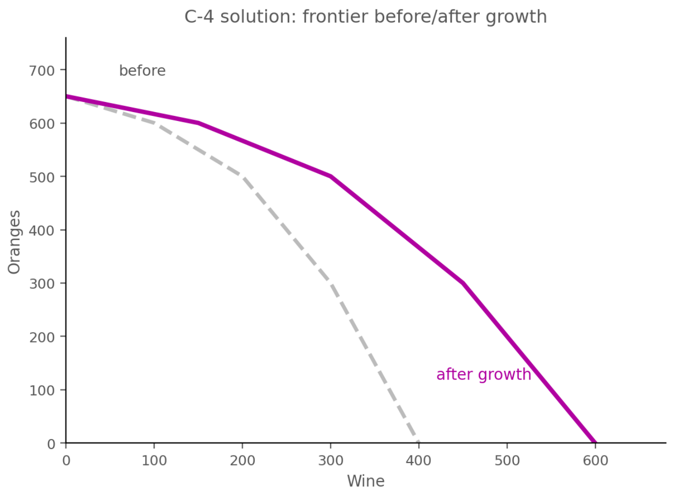
Solutions

Results and the main steps only. Full reasoning belongs in your own working.

C-4

(a) New opportunity costs: A = 50/150 = 0.33; B = 100/150 = 0.67; C = 200/150 = 1.33; D = 300/150 = 2.0.

(b) Max wine = 4×150 = 600. Max oranges unchanged = 650.



(c) At 1.5, parcels A, B and C (0.33, 0.67, 1.33, all below 1.5) go to wine; D (2.0) stays in oranges. Production = 450 wine, 300 oranges. Value = 300 + 1.5×450 = 975.

(d) Cost = 725 + 1.5×50 = 800, which equals the production value before growth (500 + 1.5×200 = 800). Exactly affordable.

(e) 975 > 800 — yes, easily affordable, with plenty to spare. Growth helps.

(f) At 0.86, only A and B (0.33, 0.67) are below the price; C (1.33) stays in oranges. Production = 300 wine, 500 oranges. Value = 500 + 0.86×300 = 758.

(g) Old bundle now costs 725 + 0.86×50 = 768. Income is 758. The country is about 10 oranges short — it cannot afford what it used to consume. Worse off.

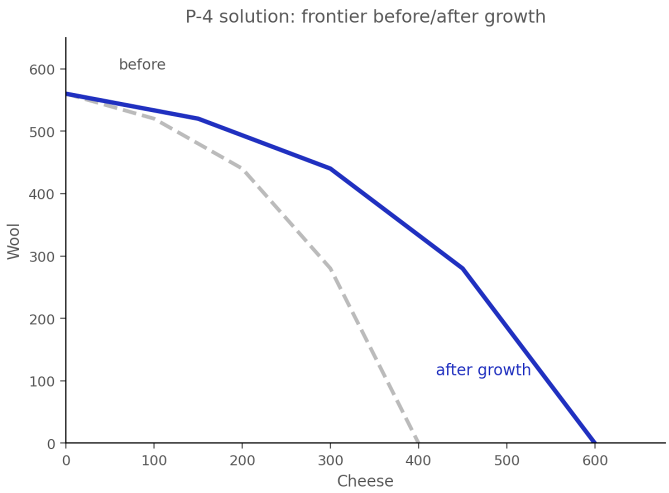
(h) Worse off whenever 500 + 300P < 725 + 50P, i.e. 250P < 225, i.e. P < 0.9.

(i) At 0.86: production is still 300 wine, 500 oranges, value 758 (same as (f) — production does not depend on who consumes what). The 1-to-6.5 bundle costs 650 + 0.86×100 = 736. Income 758 > cost 736 — affordable, with room to spare. Growth is NOT immiserising for this country: it is less trade-dependent, so the cheaper wine it now buys for itself partly offsets the lower price it sells at.

> **Before you turn the page**
>
> Attempt every part of P-4 first. Part (f), the threshold, is the calculation the exam essay is most likely to ask for directly.

P-4

(a) New opportunity costs: P = 40/150 = 0.27; Q = 80/150 = 0.53; R = 160/150 = 1.07; S = 280/150 = 1.87.



(b) Cost = 644 + 1.2×30 = 680, which equals the pre-growth production value (440 + 1.2×200 = 680). Exactly affordable.

(c) At 1.2, P, Q and R (0.27, 0.53, 1.07, all below 1.2) go to cheese; S (1.87) stays in wool. Production = 450 cheese, 280 wool. Value = 280 + 1.2×450 = 820. Old bundle still costs 680 — easily affordable. Growth helps.

(d) At 0.65, only P and Q (0.27, 0.53) are below the price; R (1.07) stays in wool. Production = 300 cheese, 440 wool. Value = 440 + 0.65×300 = 635.

(e) Old bundle now costs 644 + 0.65×30 = 663.5. Income is 635. The country is about 28.5 wool short. Worse off.

(f) Worse off whenever 440 + 300P < 644 + 30P, i.e. 270P < 204, i.e. P < 0.756.

International Economics — Exercises

Week 5 — Factor endowments: Heckscher-Ohlin and Stolper-Samuelson

DRAFT — working version. University of Miskolc · GEMI · Course plan v2, Week 5 of 11.

How these exercises work

C-5 is the exact Hungary/Italy, wine/cloth case from the expansion — the numbers should already look familiar. P-5 uses the same structure and the same underlying technology, but a different country pair (Hungary and the USA) and a different factor pair (capital and labour instead of land and labour), so you practise the method rather than repeating the story. Both use (P_W/P_O) or $(P_T/P_M) = \sqrt{(w/r)}$ as the given Stolper-Samuelson relationship for this technology — you do not need to derive it. Brief solutions are at the end.

C-5 — Wine and cloth: Hungary and Italy (worked in class)

Good	Land per unit	Labour per unit	Land per labour
Wine	3	1	3
Cloth	1	3	0.33
Country	**Land**	**Labour**	**Land per worker**
Hungary	600	1,200	0.5
Italy	4,000	2,000	2.0

The equations you need

$P_C/P_W = \sqrt{(w/r)}$ pins down the RATIO w/r, but not r and w individually — solving parts (e) and (h) needs one more piece of information. For this technology (wine: land-share 0.75; cloth: labour-share 0.75), the unit-cost equations are $P_W = 4r^{0.75}w^{0.25}$ and $P_C = 4r^{0.25}w^{0.75}$. Combined with a known price and the w/r ratio, these pin down r and w separately.

(a) Which country is land-abundant and which is labour-abundant? Which factor is each country's scarce factor?

(b) Solve for full-employment production in each country (two equations, two unknowns, per country). Which country produces relatively more wine, and which more cloth?

(c) State the Heckscher–Ohlin prediction for who exports what, and confirm your answer to (b) matches it.

(d) At w/r = 1, wine's cost-minimising input ratio is 3 and cloth's is 0.33 — matching the table. Using $(PC/PW) = \sqrt{(w/r)}$, confirm this is consistent with both goods priced at 100 in Hungary's autarky.

(e) Trade opens and the price of cloth (Hungary's export) rises to 140, while wine stays at 100. Compute the new w/r, then the new r and w.

(f) State the magnification-effect ordering of all four percentage changes (rent, wine price, cloth price, wage). Which theorem does this confirm?

(g) Who gains and who loses in Hungary? Explain using the Stolper–Samuelson theorem in one sentence.

(h) Italy's autarky price of cloth is 200 (i.e. $P_C/P_W = 2$). Compute Italy's autarky r and w, then compare to the post-trade r and w from part (e). Who gains and who loses in Italy?

(i) What does it mean that Hungary and Italy reach the SAME r and w after trade, despite having very different endowments? Name the result.

P-5 — Machinery and textiles: Hungary and the USA (practice)

A different pair of countries trades a different pair of goods, using capital and labour instead of land and labour. The technology has the same structure as C-5 — machinery is capital-intensive, textiles are labour-intensive — so the same relationship, (PT/PM) = √(w/r), applies here too.

Good	Capital per unit	Labour per unit	Capital per labour
Machinery	3	1	3
Textiles	1	3	0.33
Country	**Capital**	**Labour**	**Capital per worker**
Hungary	600	1,200	0.5
USA	8,000	4,000	2.0

The equations you need

As in C-5, the price ratio alone pins down w/r but not r and w individually. For this technology (machinery: capital-share 0.75; textiles: labour-share 0.75), the unit-cost equations are $P_M = 4r^{0.75}w^{0.25}$ and $P_T = 4r^{0.25}w^{0.75}$, where r is now the rental rate on capital.

(a) Which country is capital-abundant and which is labour-abundant?

(b) Solve for full-employment production in each country. Which country produces relatively more machinery, and which more textiles?

(c) State the Heckscher–Ohlin prediction for who exports what.

(d) Trade opens and the price of textiles (Hungary's export) rises from 100 to 130, while machinery stays at 100. Compute the new w/r, then r and w.

(e) State the magnification-effect ordering. Does it confirm the Stolper–Samuelson theorem?

(f) Who gains and who loses in Hungary?

(g) The USA's autarky price of textiles is 180 (P_T/P_M = 1.8). Compute the USA's autarky r and w, then compare to the post-trade values from part (d). Who gains and who loses in the USA?

Before you turn the page

Attempt every part of P-5 first. It uses the identical technology and identical arithmetic method as C-5 — only the country names, endowment numbers, and factor labels change.

Solutions

Results and the main steps only. Full reasoning belongs in your own working.

C-5

(a) Hungary: land/worker = 0.5. Italy: land/worker = 2.0. Hungary is labour-abundant (its scarce factor is land); Italy is land-abundant (its scarce factor is labour).

(b) Hungary: $3Q_W + Q_C = 600$, $Q_W + 3Q_C = 1{,}200$ → $Q_W = 75$, $Q_C = 375$. Italy: $3QW + Q_C = 4{,}000$, $Q_W + 3Q_C = 2{,}000$ → $Q_W = 1{,}250$, $Q_C = 250$. Hungary produces relatively more cloth; Italy relatively more wine.

(c) HO predicts the labour-abundant country exports the labour-intensive good (Hungary → cloth) and the land-abundant country exports the land-intensive good (Italy → wine). Matches (b).

(d) At $w/r = 1$: $P_C/P_W = \sqrt{1} = 1$, so $P_C = P_W = 100$ when both are priced equally — consistent.

(e) $P_C/P_W = 1.4$, so $w/r = 1.4^2 = 1.96$. Using $P_W = 100 = 4 \times r^{0.75} \times w^{0.25}$ with $w = 1.96r$: $r = 21.13$, $w = 41.41$.

(f) Rent −15.5% < wine price 0% < cloth price +40% < wage +65.6%. Both factor prices move further than either goods price — the magnification effect, confirming Stolper–Samuelson.

(g) Hungary's workers (its abundant factor) gain; its landowners (its scarce factor) lose — Stolper–Samuelson: a rise in the relative price of the labour-intensive good raises the real return to labour and lowers the real return to land.

(h) Italy autarky ($PC/PW = 2$, so $w/r = 4$): using $P_W = 100 = 4 \times r^{0.75} \times w^{0.25}$ with $w = 4r$: $r = 17.68$, $w = 70.71$. Post-trade: $r = 21.13$ (+19.5%), $w = 41.41$ (−41.4%). Italy's landowners (its abundant factor) gain; its workers (its scarce factor) lose — the exact mirror of Hungary.

(i) Factor price equalisation: free trade in goods, with identical technology in both countries, equalises the wage and the rent across countries even though no factor ever crosses a border.

P-5

(a) Hungary: capital/worker = 0.5, labour-abundant. USA: capital/worker = 2.0, capital-abundant.

(b) Hungary: $3Q_M + Q_T = 600$, $Q_M + 3Q_T = 1{,}200$ → $Q_M = 75$, $Q_T = 375$. USA: $3Q_M + Q_T = 8{,}000$, $Q_M + 3Q_T = 4{,}000$ → $Q_M = 2{,}500$, $Q_T = 500$. Hungary produces relatively more textiles; the USA relatively more machinery.

(c) HO predicts Hungary (labour-abundant) exports textiles (labour-intensive); the USA (capital-abundant) exports machinery (capital-intensive). Matches (b).

(d) $P_T/P_M = 1.3$, so $w/r = 1.3^2 = 1.69$. Using $P_M = 100 = 4 \times r^{0.75} \times w^{0.25}$ with $w = 1.69r$: $r = 21.93$, $w = 37.06$.

(e) Rent −12.3% < machinery price 0% < textile price +30% < wage +48.2%. Confirms Stolper–Samuelson.

(f) Hungary's workers gain; its capital owners lose.

(g) USA autarky ($P_T/P_M = 1.8$, so $w/r = 3.24$): using $P_M = 100 = 4 \times r^{0.75} \times w^{0.25}$ with $w = 3.24r$: $r = 18.63$, $w = 60.37$. Post-trade: $r = 21.93$ (+17.7%), $w = 37.06$ (−38.6%). The USA's capital owners gain; its workers lose — the mirror of Hungary.

GEMI
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International Economics — Exercises

Week 6 — Increasing returns and intra-industry trade

DRAFT — working version. University of Miskolc · GEMI · Course plan v2, Week 6 of 11. Last week before Midterm 1.

How these exercises work

C-6 is the exact car-market case from the expansion (Hungary alone vs the EU integrated market). P-6 uses the same CC/PP method and the same Grubel–Lloyd formula, but a different industry (pharmaceuticals) and different countries (Sweden and the Nordic market), with different parameters — so the price fall from integration comes out a different size. That difference is itself part of the exercise. Brief solutions are at the end.

C-6 — Cars: Hungary and the EU market (worked in class)

An industry has fixed cost $F = 500$ per firm, marginal cost $c = 5$, and demand parameter $b = 0.05$. CC: $AC = nF/S + c$. PP: $P = c + 1/(bn)$.

(a) Show that the equilibrium number of firms is $n = \sqrt{S/(bF)}$. (Hint: set CC equal to PP and solve for n.)

(b) Hungary alone: S = 900. Compute the equilibrium number of firms, the price, and output per firm.

(c) The EU integrated market: S = 3,600. Compute the same three values.

(d) State the percentage change in price, and the factor by which output per firm changes, moving from (b) to (c).

(e) Explain in one sentence why the PP curve does not shift when the market grows, while the CC curve does.

(f) Name the three distinct gains from this market integration. Which comparative advantage is responsible for any of them?

Hungary's trade authority reports the following exports and imports, by industry (millions of euros):

Industry	Exports	Imports	GL
Machinery	250	250	?
Cars	300	500	?
Wine	400	20	?
Crude oil	0	600	?

(g) Compute the Grubel–Lloyd index for each industry, and the aggregate index across all four.

(h) Which industries look like intra-industry trade, and which look like inter-industry trade? Which chapter of the course — Ricardo/HO, or this week's model — better explains each?

P-6 — Pharmaceuticals: Sweden and the Nordic market (practice)

A different industry has fixed cost $F = 800$ per firm, marginal cost $c = 8$, and demand parameter $b = 0.04$.

(a) Sweden alone: S = 800. Compute the equilibrium number of firms, the price, and output per firm.

(b) The Nordic integrated market: S = 3,200. Compute the same three values.

(c) State the percentage change in price. Is it exactly −20%, as in C-6? If not, why not — given that the market again quadrupled and the number of firms again doubled?

Sweden's trade, by industry (millions of euros):

Industry	Exports	Imports	GL
Pharmaceuticals	400	400	?
Furniture	350	150	?
Timber	450	50	?
Iron ore	0	300	?

(d) Compute the Grubel–Lloyd index for each industry, and the aggregate.

(e) Which of Sweden's industries would you expect to show up as both an exporter and importer in the same year? Which would not?

> **Before you turn the page**
>
> Attempt every part of P-6 first, especially (c) — it is the one part where the numbers deliberately do NOT match C-6, and explaining why is the point.

Solutions

Results and the main steps only. Full reasoning belongs in your own working.

C-6

(a) CC = PP: $nF/S + c = c + 1/(bn) \rightarrow nF/S = 1/(bn) \rightarrow n^2 = S/(bF) \rightarrow n = \sqrt{S/(bF)}$.

(b) $n = \sqrt{900/(0.05\times500)} = \sqrt{36} = 6$. $P = 5 + 1/(0.05\times6) = 8.33$. Output per firm = 900/6 = 150.

(c) $n = \sqrt{3{,}600/(0.05\times500)} = \sqrt{144} = 12$. $P = 5 + 1/(0.05\times12) = 6.67$. Output per firm = 3,600/12 = 300.

(d) Price falls by (6.67−8.33)/8.33 = −20.0%. Output per firm doubles, ×2.

(e) PP depends only on c and b (how competition intensifies as firms multiply) — neither depends on the size of the market. CC depends on F/S, which falls as S grows for any given n, so only CC shifts.

(f) More varieties (6 → 12 firms/models), a lower price for every variety, and larger, more efficient firms (150 → 300 units each). None of this needs Hungary and its EU partners to differ in technology or endowments — no comparative advantage is doing any work here.

(g) Machinery: 1−|0|/500 = 1.00. Cars: 1−200/800 = 0.75. Wine: 1−380/420 = 0.10. Crude oil: 1−600/600 = 0.00. Aggregate: 1−(0+200+380+600)/(500+800+420+600) = 1−1,180/2,320 = 0.49.

(h) Machinery and cars (GL near or above 0.75) look like intra-industry trade — this week's monopolistic-competition model. Wine and crude oil (GL near 0) look like inter-industry trade — Ricardo or Heckscher–Ohlin, depending on whether the difference is technology or endowments.

P-6

(a) $n = \sqrt{800/(0.04\times800)} = \sqrt{25} = 5$. $P = 8 + 1/(0.04\times5) = 13.00$. Output per firm = 800/5 = 160.

(b) $n = \sqrt{3{,}200/(0.04\times800)} = \sqrt{100} = 10$. $P = 8 + 1/(0.04\times10) = 10.50$. Output per firm = 3,200/10 = 320.

(c) Price falls by (10.50−13.00)/13.00 = −19.2%, not exactly −20%. The number of firms still doubles because S still quadruples — that part of the structure is general. But the SIZE of the price fall depends on how large marginal cost c is relative to the competition term 1/(bn); with a higher c here (8, vs 5 in C-6), a smaller share of the price is the part that responds to more firms, so the same doubling of n produces a slightly smaller percentage fall in price.

(d) Pharmaceuticals: 1−0/800 = 1.00. Furniture: 1−200/500 = 0.60. Timber: 1−400/500 = 0.20. Iron ore: 1−300/300 = 0.00. Aggregate: 1−(0+200+400+300)/(800+500+500+300) = 1−900/2,100 = 0.57.

(e) Pharmaceuticals and furniture (high GL) — both exported and imported. Timber and iron ore (GL near 0) — Sweden is a net exporter of timber and a pure importer of iron ore; neither shows meaningful two-way trade.

M I S K O L C

International Economics — Exercises

Week 7 — Trade policy instruments

DRAFT — working version. University of Miskolc · GEMI · Course plan v2, Week 7 of 11.

> **How these exercises work**
>
> C-7 uses the exact tariff/quota numbers from the expansion (world price 100, tariff 40%). P-7 uses the same method on a different product and different numbers (solar panels, tariff 25%), so you practise the method rather than repeating the story. Both assume, for simplicity, that each unit of unmet demand under a quota raises the domestic price by exactly 1 — stated so you do not need to derive it from a full demand curve. Brief solutions are at the end.

C-7 — Tariff vs quota under demand growth (worked in class)

(a) The world price of a good is 100. A tariff of 40% is applied. Compute the domestic price.

(b) At that price, 60 units are imported. Domestic demand then grows by 30 units (at any given price). Under the TARIFF, what happens to the quantity of imports? What happens to the domestic price?

(c) Now suppose a QUOTA of 60 units had been used instead of the tariff. Domestic demand grows by the same 30 units. What happens to the domestic price? (Use the rule: each unit of unmet demand raises price by 1.)

(d) In one sentence, state the general lesson: which instrument's protection increases automatically as the economy grows, and why?

(e) In (a), who receives the tariff revenue? If the 60-unit quota in (c) is instead administered by handing licences to domestic importers for free, who captures the value of the wedge?

(f) In 2026 the EU let Volkswagen's China-made Cupra Tavascan swap the EV tariff for a minimum price plus an import quota. Using the who-gets-the-money logic from §7.6, explain why a foreign exporter might prefer this arrangement to paying the tariff.

(g) Match each event to what it did: Cobden–Chevalier Treaty (1860), Smoot–Hawley Tariff Act (1930), GATT (1947), WTO (1995).

P-7 — Solar panels: a different tariff, the same method (practice)

(a) The world price of solar panels is 200. A tariff of 25% is applied. Compute the domestic price.

(b) At that price, 80 units are imported. Domestic demand grows by 20 units. Under the TARIFF, what happens to imports? What happens to the domestic price?

(c) Now suppose a QUOTA of 80 units had been used instead. Demand grows by the same 20 units. Compute the new domestic price under the quota.

(d) Compute the percentage rise in the domestic price under the quota in (c). Compare it to the percentage rise under the tariff in (b). What does this confirm about the two instruments?

(e) If the 80-unit quota's licences are auctioned by the government, who captures the wedge? If they are instead handed out free to importers, who captures it?

(f) A 'voluntary' export restraint on solar panels would not be legal today. Why not? Name its modern legal equivalent, and state who would capture the wedge under that alternative.

> **Before you turn the page**
>
> Attempt every part of P-7 first. Part (d) is the one that matters most — confirming numerically that the tariff's protection stays fixed while the quota's protection grows.

Solutions

Results and the main steps only. Full reasoning belongs in your own working.

C-7

(a) Domestic price = 100 × 1.40 = 140.

(b) Tariff: the wedge (40%) stays fixed, so the domestic price stays at 140. The extra demand is met entirely by more imports: 60 + 30 = 90 units.

(c) Quota: the quantity is capped at 60 regardless of price. The 30 units of demand that cannot be met as imports push the domestic price up instead: 140 + 30 = 170.

(d) The quota's protection tightens automatically as demand grows, because quantity cannot adjust and price must instead. The tariff's protection (the 40% wedge) stays constant, because quantity is free to adjust.

(e) The home government receives the tariff revenue. If quota licences are given away free, the domestic importers holding those licences capture the value of the wedge.

(f) Under the tariff, the EU government would collect the revenue. Under the minimum-price-and-quota arrangement, Volkswagen's Chinese manufacturing arm effectively sets the price itself within the quota — it captures the wedge instead of the EU government. A firm facing this choice would generally prefer keeping that value for itself over handing it to the importer's treasury.

(g) Cobden–Chevalier (1860): Britain–France treaty that cut tariffs sharply and spread most-favoured-nation treatment across Europe. Smoot–Hawley (1930): US Act that raised tariffs sharply and deepened the Great Depression through retaliation. GATT (1947): 23-country agreement setting rules for tariff reduction and non-discrimination. WTO (1995): absorbed GATT and now administers the rules-based trading system.

P-7

(a) Domestic price = 200 × 1.25 = 250.

(b) Tariff: domestic price stays at 250; imports rise from 80 to 80 + 20 = 100.

(c) Quota: price rises from 250 to 250 + 20 = 270.

(d) Quota price rise: 20/250 = 8.0%. Tariff price rise: 0%. This confirms the quota becomes more restrictive as demand grows, while the tariff's protection is unchanged.

(e) Auctioned: the government captures the wedge (auction proceeds). Free allocation: the importers holding the licences capture it.

(f) The WTO's 1995 Agreement on Safeguards prohibits new voluntary export restraints. The modern legal equivalent is a price undertaking, where an individual exporting firm agrees to a minimum price and quantity limit in exchange for exemption from a tariff. The foreign exporting firm captures the wedge under this arrangement, just as it would under a VER.

M I S K O L C

International Economics — Exercises

Week 8 — Modelling the tariff

DRAFT — working version. University of Miskolc · GEMI · Course plan v2, Week 8 of 11.

How these exercises work

C-8 is the exact steel market from the expansion ($D = 100-10P$, $S = 10P-20$, $XS = 20P$). P-8 uses the same method on a different market — wheat — with different numbers, so you practise the method rather than repeating the story. Both ask you to find the a–e areas, compare small-country and large-country outcomes, and test how the split changes with the slope of XS. Brief solutions are at the end.

C-8 — Steel: small country vs large country (worked in class)

Home demand for steel is $D = 100 - 10P$; home supply is $S = 10P - 20$. Foreign export supply is $XS = 20P$. A tariff of $t = 1$ is imposed.

(a) Compute MD. At what price is $MD = 0$ (home's own autarky price)? Find the no-tariff world price and quantity traded.

(b) SMALL COUNTRY: the tariff adds fully to the world price. Compute the new home price, consumption, production, and imports.

(c) Find areas a, b, c, d for the small-country case. Confirm a + b + c + d equals the total consumer loss.

(d) Compute the small country's net welfare change. Is there an area e? Why or why not?

(e) LARGE COUNTRY: solve $MD(PW + t) = XS(PW)$ for the new world price and home price. Compute the new imports.

(f) Find areas a, b, c, d, e for the large-country case. Compute net welfare. Compare the sign of the answer to (d).

(g) Suppose XS were flatter: $XS = 80P$ instead of $20P$. Find the NEW no-tariff world price for this flatter XS, then find the world and home prices after the same $t = 1$ tariff. What fraction of the tariff does the foreign side now bear? State the MD : XS slope ratio.

(h) Using the optimum-tariff logic from §8.6, would you expect the optimum tariff on steel to be higher or lower than 2 if XS were flatter (as in part g)? Explain in one sentence, without recomputing the full table.

P-8 — Wheat: the same method, a different market (practice)

Home demand for wheat is $D = 80 - 8P$; home supply is $S = 8P - 16$. Foreign export supply is $XS = 16P$. A tariff of $t = 1$ is imposed.

(a) Compute MD. Find home's own autarky price, and the no-tariff world price and quantity traded.

(b) SMALL COUNTRY: compute the new home price, consumption, production, and imports after the tariff.

(c) Find areas a, b, c, d for the small-country case, and the net welfare change.

(d) LARGE COUNTRY: find the new world price, home price, and imports after the same tariff.

(e) Find areas a, b, c, d, e for the large-country case, and the net welfare change.

(f) Suppose XS were steeper: $XS = 4P$ instead of $16P$. What fraction of the tariff would the foreign side bear? State the MD : XS slope ratio.

Before you turn the page

Attempt every part of P-8 first. It uses the identical method as C-8, just with different demand, supply, and export-supply numbers.

Solutions

Results and the main steps only. Full reasoning belongs in your own working.

C-8

(a) MD = 120 − 20P. MD = 0 at P = 6 (home's autarky price). No-tariff: MD = XS → P = 3, quantity = 60.

(b) Home price = 3 + 1 = 4. D(4) = 60, S(4) = 20, imports = 40.

(c) a = (10+20)/2×1 = 15. b = 0.5×1×(20−10) = 5. c = 1×40 = 40. d = 0.5×1×(70−60) = 5. Sum = 65, matching consumer loss (70+60)/2×1 = 65.

(d) Net = −(b+d) = −10. No area e — a small country's purchases are too small a share of the world market to move the world price, so there is nothing below PW = 3 to draw.

(e) MD(PW+1) = XS(PW) → 120−20(PW+1) = 20PW → PW = 2.5. Home price = 3.5. Imports = 20×2.5 = 50.

(f) a = (10+15)/2×0.5 = 6.25. b = 0.5×0.5×(15−10) = 1.25. d = 0.5×0.5×(70−65) = 1.25. e = (3−2.5)×50 = 25. c = 1×50−25 = 25. Net = 25−(1.25+1.25) = +22.5 — positive, the opposite sign from (d).

(g) With XS = 80P, the no-tariff world price is different too: MD = XS → 120−20P = 80P → P = 1.2 (not 3 — a flatter XS changes the whole equilibrium, not just the tariff's effect). After the tariff: 120−20(PW+1) = 80PW → PW = 1.0, home price = 2.0. World price fell by 1.2−1.0 = 0.2, so foreign bears 0.2/1 = 20% of the tariff — matching the ratio exactly. MD : XS slope ratio = 20:80 = 1:4, and foreign share = 20/(20+80) = 20%. The lesson: changing XS's slope changes the WHOLE equilibrium, not just how a given tariff splits — always recompute the no-tariff baseline first.

(h) Flatter XS (smaller MD:XS ratio in MD's favour) means e grows more slowly with the tariff, so the balance between the marginal gain on e and the marginal loss on b+d is reached at a SMALLER t. Expect the optimum tariff to be LOWER than 2, not higher.

P-8

(a) MD = 96 − 16P. MD = 0 at P = 6. No-tariff: MD = XS → 96−16P = 16P → P = 3, quantity = 48.

(b) Home price = 4. D(4) = 48, S(4) = 16, imports = 32.

(c) a = (8+16)/2×1 = 12. b = 0.5×1×(16−8) = 4. c = 1×32 = 32. d = 0.5×1×(56−48) = 4. Net = −(4+4) = −8.

(d) 96−16(PW+1) = 16PW → PW = 2.5. Home price = 3.5. Imports = 16×2.5 = 40.

(e) a = (8+12)/2×0.5 = 5. b = 0.5×0.5×(12−8) = 1. D(3.5)=52: d = 0.5×0.5×(56−52) = 1. e = (3−2.5)×40 = 20. c = 1×40−20 = 20. Net = 20−(1+1) = +18.

(f) MD : XS slope ratio = 16:4 = 4:1. Foreign share = 16/(16+4) = 80%.

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International Economics — Exercises

Week 9 — Security, chokepoints, and sanctions

DRAFT — working version. University of Miskolc · GEMI · Course plan v2, Week 9 of 11.

How these exercises work

Both C-9 and P-9 have two parts: a retaliation game, and a concentration calculation. C-9 reuses the exact steel numbers from Week 8's expansion. P-9 reuses Week 8's wheat market (P-8) — same method, same underlying model, a different market. Brief solutions are at the end.

C-9 — Steel: retaliation and concentration (worked in class)

Part 1: the retaliation game

Recall Week 8's steel market: Home's optimum tariff is t = 2, giving Home a net welfare gain of +30 while extracting e = 40 from Foreign through the terms-of-trade channel. Suppose Foreign faces an identical market in reverse, so its own optimum tariff would do exactly the same thing to Home.

(a) Fill in the 2×2 payoff matrix (Home, Foreign) for: both free trade; Home tariffs and Foreign doesn't; Foreign tariffs and Home doesn't; both tariff. (Use −40 for the passive side's loss, and −10 for each side's loss when both tariff — the pure efficiency loss with no terms-of-trade gain to either side.)

(b) Is there a dominant strategy for Home? Check both cases (Foreign free trade; Foreign tariff) explicitly.

(c) What is the Nash equilibrium of this game? Compare its payoff to the (free trade, free trade) outcome.

(d) In one or two sentences, explain why this result is called a Prisoner's Dilemma, and what real-world institution exists partly to help both sides escape it.

Part 2: measuring concentration

Global steel production is illustratively distributed: China 54%, India 8%, Japan 5%, United States 4%, Russia 4%, all other countries combined 25%. (Note: use the "other" category as a single supplier, which is a simplification and it gives the upper bound of HHI).

(e) Compute the HHI for this market.

(f) Using the convention below 1,500 = unconcentrated, 1,500–2,500 = moderate, above 2,500 = highly concentrated, classify this market.

(g) The expansion found rare earth MINING at HHI ≈ 5,100 and rare earth PROCESSING at HHI ≈ 8,200. Where does steel production sit relative to these two? What does that suggest about how much of a chokepoint steel is, compared to rare earths?

P-9 — Wheat: the same method, different numbers (practice)

Part 1: the retaliation game

Recall Week 8's wheat market (P-8): Home's optimum tariff is t = 2, giving a net welfare gain of +24 while extracting e = 32 from Foreign. As with C-9, assume Foreign's own optimum tariff would do the same in reverse, and that mutual tariffs leave each side with only its own efficiency loss (b + d = 8 each).

(a) Build the 2×2 payoff matrix (Home, Foreign) for wheat, following the same structure as C-9.

(b) Find the dominant strategy for each side, and the Nash equilibrium.

(c) Compare the Nash equilibrium payoff to (free trade, free trade). Is the qualitative conclusion the same as C-9's, even though the numbers are different?

Part 2: measuring concentration

A hypothetical lithium mining market (illustrative numbers, for practice) is distributed: Country A 45%, Country B 25%, Country C 15%, all others combined 15%.

(d) Compute the HHI for this market. For this exercise, treat the 15% “all others” category as a single supplier. This simplification gives an upper bound for the HHI.

(e) Classify it using the same convention as C-9(f).

(f) Suppose Country A’s share rose to 60%, with the fall coming entirely from “all others.” Recompute the HHI. Does concentration rise or fall, and by how much?

> **Before you turn the page**
>
> Attempt every part of P-9 first. Part (f) is the one that matters most — recomputing HHI after a share shifts is exactly the kind of calculation a real concentration report asks for.

Solutions

Results and the main steps only. Full reasoning belongs in your own working.

C-9

	Foreign: free trade	Foreign: tariff
Home: free trade	(0, 0)	(−40, +30)
Home: tariff	(+30, −40)	(−10, −10)

(a) Matrix as above. (b) Yes — if Foreign is free trade, Home's tariff (+30) beats free trade (0); if Foreign tariffs, Home's tariff (−10) beats free trade (−40). Tariff dominates in both cases. (c) Nash equilibrium is (tariff, tariff) = (−10, −10), worse for both than (free trade, free trade) = (0, 0). (d) Each side acting in its own rational self-interest leads to a jointly worse outcome than cooperation would — the defining feature of a Prisoner's Dilemma. The WTO exists partly to let countries commit to mutual free trade rather than being driven to (tariff, tariff) by this logic.

(e) HHI = $54^2+8^2+5^2+4^2+4^2+25^2$ = 2,916+64+25+16+16+625 = 3,662.

(f) 3,662 is above 2,500 — highly concentrated.

(g) Steel (3,662) sits well below both rare earth mining (5,100) and rare earth processing (8,200). Steel production is concentrated, but nowhere near as concentrated as either stage of the rare earth supply chain — it is a much weaker chokepoint.

P-9

	Foreign: free trade	Foreign: tariff
Home: free trade	(0, 0)	(−32, +24)
Home: tariff	(+24, −32)	(−8, −8)

(a) Matrix as above. (b) Tariff dominates for both sides (24 beats 0; −8 beats −32). Nash equilibrium = (tariff, tariff) = (−8, −8).

(c) (−8, −8) is worse for both than (0, 0), exactly as in C-9 — same qualitative conclusion (mutual tariffs are a Prisoner's Dilemma), even though the specific numbers (24, 32, 8) differ from steel's (30, 40, 10).

(d) HHI = $45^2+25^2+15^2+15^2$ = 2,025+625+225+225 = 3,100.

(e) 3,100 is above 2,500 — highly concentrated.

(f) New shares: A = 60%, others fall to 0% (15% removed entirely from A's gain, taken from the 15% "all others" bucket, which is now 0). New HHI = $60^2+25^2+15^2+0^2$ = 3,600+625+225+0 = 4,450. Concentration rises from 3,100 to 4,450, an increase of 1,350 — a single supplier absorbing a rival's share raises HHI a lot, since HHI weights big shares disproportionately (squaring).

International Economics — Exercises

Week 10 — Countermeasures and the politics of protection

DRAFT — working version. University of Miskolc · GEMI · Course plan v2, Week 10 of 11.

How these exercises work

This week has TWO separate exercise pairs — (10a) export subsidies, (10b) effective protection — and each is complete on its own. C-10a/C-10b use the exact numbers from the expansion. P-10a/P-10b use different markets, same method. Attempt any one you like independently of the others.

C-10a — Wine: a large country's export subsidy (worked in class)

Home wine market: D = 60 − 10P, S = 10P + 20. Foreign import demand: M = 80 − 20P. A subsidy of 1 per unit is introduced.

(a) Home's export supply is X(P) = S(P) − D(P). Find X(P), and confirm the no-subsidy equilibrium price is 3 by solving X(P) = M(P).

(b) With the subsidy, the domestic price is Pd = world price + 1. Solve X(Pd) = M(world price) for the new world price and Pd.

(c) Compute D, S at both the old price (3) and the new domestic price, and the export quantity before and after.

(d) Using the a–e labelling from the expansion (a = rectangle, b = triangle beside it, c = trapezoid, d = triangle, e = rectangle below), find all five areas.

(e) Confirm a + b equals the consumer surplus loss, a + b + c equals the producer surplus gain, and b + c + d + e equals the government's subsidy bill.

(f) State the net welfare change. In one sentence, explain why area e works AGAINST this country, unlike a large country's tariff in Week 8.

C-10b — EVs: China's subsidy and Europe's response (worked in class)

An EV is priced at 30,000 with 20,000 of imported inputs, so VA = 10,000. China gives its EV producers a 25% subsidy on the finished car (inputs untaxed).

(a) Compute China's VA′ and g. How does this compare to the 25% nominal subsidy rate?

(b) The EU considers a 25% tariff on EVs. Compute g for three cases: 0% on inputs, 25% on inputs, 50% on inputs.

(c) Which of the three EU schedules exactly offsets China's advantage? Which falls short? Which makes protection negative?

(d) In one or two sentences, explain why "match the nominal rate" is not, by itself, enough information to design a countermeasure.

P-10a — Furniture: a large country's export subsidy (practice)

Home furniture market: D = 40 − 8P, S = 8P + 8. Foreign import demand: M = 64 − 16P. A subsidy of 1 per unit is introduced.

(a) Find home's export supply X(P), and confirm the no-subsidy price is 3.

(b) Solve for the new world price and the new domestic price after the subsidy.

(c) Compute D, S, and exports before and after.

(d) Find all five areas (a–e).

(e) State the net welfare change.

P-10b — Smartphones: a foreign subsidy and the home response (practice)

A smartphone is priced at 800 with 500 of imported inputs, so VA = 300. A foreign country gives its producers a 30% subsidy on the finished phone (inputs untaxed). Home considers a 30% tariff of its own.

(a) Compute the foreign country's VA′ and g.

(b) Compute Home's g for three tariff schedules: 0% on inputs, 30% on inputs, 60% on inputs.

(c) Which schedule matches the foreign advantage? Which falls short? Which goes negative?

> **Before you turn the page**
>
> Attempt P-10a and P-10b before reading on. Both use the identical method as C-10a and C-10b — only the numbers change.

Solutions — C-10a and C-10b

Results and the main steps only. Full reasoning belongs in your own working.

C-10a

(a) $X(P) = (10P+20) - (60-10P) = 20P - 40$. Setting $20P-40 = 80-20P$ gives $40P = 120$, $P = 3$.

(b) $20(P_w'+1)-40 = 80-20P_w' \rightarrow 40P_w' = 100 \rightarrow P_w' = 2.5$, $P_d = 3.5$.

(c) $D(3)=30$, $S(3)=50$, $D(3.5)=25$, $S(3.5)=55$. Exports: $X0 = 50-30 = 20$, $X1 = 55-25 = 30$.

(d) $a = 25\times0.5 = 12.5$. $b = 0.5\times5\times0.5 = 1.25$. PS gain $= (50+55)/2\times0.5 = 26.25$, so $c = 26.25-12.5-1.25 = 12.5$. $d = 0.5\times5\times0.5 = 1.25$. $e = (3-2.5)\times30 = 15$.

(e) $a+b = 13.75$ = CS loss ($(30+25)/2\times0.5$). $a+b+c = 26.25$ = PS gain. $b+c+d+e = 1.25+12.5+1.25+15 = 30$ = subsidy bill (1×30).

(f) Net $= -(b+d+e) = -17.5$. Area e is a LOSS here because subsidising exports pushes MORE supply onto the world market, driving the world price DOWN — the opposite of a tariff, which restricts imports and can push the world price down in the exporter's favour instead.

C-10b

(a) $VA' = 30{,}000\times1.25 - 20{,}000 = 17{,}500$. $g = (17{,}500-10{,}000)/10{,}000 = +75\%$ — three times the nominal 25% subsidy.

(b) 0% on inputs: $VA' = 37{,}500-20{,}000 = 17{,}500$, $g = +75\%$. 25% on inputs: $VA' = 37{,}500-25{,}000 = 12{,}500$, $g = +25\%$. 50% on inputs: $VA' = 37{,}500-30{,}000 = 7{,}500$, $g = -25\%$.

(c) 0% on inputs exactly matches (+75% = +75%). 25% on inputs undershoots (+25% ≪ +75%). 50% on inputs is negative and worse than doing nothing.

(d) The nominal rate says nothing about the input side of the schedule, and the input side alone can swing effective protection from matching the foreign advantage to reversing it — the schedule has to be evaluated as a whole, not read off its headline number.

Solutions — P-10a and P-10b

P-10a

(a) $X(P) = 16P-32$. Check: $16(3)-32 = 16 = M(3) = 64-48 = 16$ ✓.

(b) $16(P_w'+1)-32 = 64-16P_w' \rightarrow 32P_w' = 80 \rightarrow P_w' = 2.5$, $P_d = 3.5$.

(c) $D(3)=16$, $S(3)=32$, $D(3.5)=12$, $S(3.5)=36$. $X0 = 16$, $X1 = 24$.

(d) $a = 12\times0.5 = 6$. $b = 0.5\times4\times0.5 = 1$. PS gain $= (32+36)/2\times0.5 = 17$, $c = 17-6-1 = 10$. $d = 0.5\times4\times0.5 = 1$. $e = (3-2.5)\times24 = 12$.

(e) Net $= -(1+1+12) = -14$.

P-10b

(a) $VA' = 800\times1.30 - 500 = 540$. $g = (540-300)/300 = +80\%$.

(b) 0% on inputs: $VA' = 1040-500 = 540$, $g = +80\%$. 30% on inputs: $VA' = 1040-650 = 390$, $g = +30\%$. 60% on inputs: $VA' = 1040-800 = 240$, $g = -20\%$.

(c) 0% on inputs matches exactly. 30% on inputs undershoots. 60% on inputs is negative.

International Economics — Exercises

Week 11 — The balance of payments and exchange rates

How these exercises work

C-11 uses Hungary's actual 2024 data from the expansion. P-11 uses a fresh, clearly fictional country ("Ruritania") with illustrative numbers, same method. Both cover the whole week: the accounting identity, the two sign conventions, the GDP→GNI→GNDI bridge, and the exchange rate's price effect.

C-11 — Hungary, 2024 (worked in class)

Hungary's 2024 current account components (billion HUF): goods and services +3,642.1, primary income −1,723.6, secondary income −507.7. Capital account +286.1. Financial account (MNB convention, net claims) +504.6.

(a) Verify that the three current account components sum to the reported current account balance of +1,410.7 (allow for small rounding).

(b) Using MNB's convention (current account + capital account + net errors and omissions = financial account), compute net errors and omissions.

(c) Convert to the textbook convention, where all four items sum to zero. State the financial account's new sign, and confirm net errors and omissions comes out (almost) the same as in (b).

Hungary's 2024 national accounts (revised, billion HUF): GDP 81,493.5, net primary income received from abroad −1,584.4, net secondary income received from abroad −507.7.

(d) Compute GNI and GNDI.

(e) Is GNI above or below GDP? Net primary income here nets together two very different flows — foreign-owned firms' repatriated profits, and Hungary's net position with EU institutions on subsidies and taxes. Name which direction each one pulls, and which one wins out overall.

In 2024, E (the HUF price of one euro) rose from 380 to 400.

(f) A machine is imported from Germany at €15,000. Compute its HUF cost before and after, and the percentage change. How does that percentage compare to the size of the depreciation?

(g) A Hungarian software licence is exported at a fixed price of 950,000 HUF. Compute its EUR price before and after. Did it get more or less attractive to a foreign buyer?

(h) Hungary operates a floating exchange rate regime. In one or two sentences, explain what this implies for how a persistent current account deficit would be resolved, without any deliberate policy action.

P-11 — Ruritania (practice, illustrative figures)

Ruritania's current account (billion Talent, T): current account +800, capital account +100, financial account (net claims) +500.

(a) Compute net errors and omissions using MNB's convention.

(b) Convert to the textbook (sum-to-zero) convention. State the financial account's new sign and confirm net errors and omissions is unchanged.

Ruritania's national accounts (billion T): GDP 50,000, net primary income −1,500, net secondary income +300.

(c) Compute GNI and GNDI.

Ruritania's currency is the Talent (T). E (Talent price of one US dollar) rises from 20 to 25.

(d) A laptop is imported from the US at $500. Compute its Talent cost before and after.

(e) Ruritanian cheese is exported at a fixed price of 2,000 Talent. Compute its USD price before and after.

(f) Is the Talent appreciating or depreciating? Explain your answer using the definition of E.

Before you turn the page

Attempt every part of P-11 first — it is the last practice sheet of the course, and it uses every method from this week in one pass.

Solutions

C-11

(a) 3,642.1 − 1,723.6 − 507.7 = 1,410.8 ≈ 1,410.7 (rounding).

(b) EO = FA − (CA+KA) = 504.6 − (1,410.7+286.1) = 504.6 − 1,696.8 = −1,192.2 (matches the reported −1,192.3 to rounding).

(c) Textbook convention: FA′ = −504.6. CA+KA+FA′+EO = 0 → EO = −(1,410.7+286.1−504.6) = −1,192.2 — same figure, only the financial account's sign changed.

(d) GNI = 81,493.5 − 1,584.4 = 79,909.1. GNDI = 79,909.1 − 507.7 = 79,401.4.

(e) GNI is BELOW GDP. Two flows net together inside that −1,584.4: repatriated profits of foreign-owned firms operating in Hungary are a large OUTFLOW (they belong, as income, to their foreign owners, even though produced within Hungary's GDP), partly offset by an INFLOW from EU institutions — Hungary receives more in agricultural and structural subsidies than it pays in EU own-resource contributions. The outflow is larger, so the net effect still pulls GNI below GDP, just by less than the profit-repatriation figure alone would suggest.

(f) Before: 380×15,000 = 5,700,000 HUF. After: 400×15,000 = 6,000,000 HUF. Change: +5.26%, matching the size of the depreciation almost exactly (a foreign-currency price that doesn't change translates one-for-one into the domestic-currency cost).

(g) Before: 950,000/380 = €2,500. After: 950,000/400 = €2,375. It became MORE attractive to a foreign buyer — cheaper in euro terms, without the Hungarian exporter changing its forint price at all.

(h) Under a floating regime, a persistent deficit creates excess demand for foreign currency, which pushes E up (the forint depreciates) until imports become dear enough and exports cheap enough to narrow the deficit — no central bank action is required.

P-11

(a) EO = 500 − (800+100) = 500 − 900 = −400.

(b) FA′ = −500. CA+KA+FA′+EO = 0 → EO = −(800+100−500) = −400 — unchanged.

(c) GNI = 50,000 − 1,500 = 48,500. GNDI = 48,500 + 300 = 48,800.

(d) Before: 20×500 = 10,000 T. After: 25×500 = 12,500 T.

(e) Before: 2,000/20 = $100. After: 2,000/25 = $80.

(f) E rose (20→25), so MORE Talent is needed to buy one dollar — the Talent is DEPRECIATING.