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Open economy microeconomics
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Solution Problem Set 2

1. As a result of the productivity increase, the world production possibility frontier shifts to the dashed line in Figure 1. (Compare to figure 4 of Notes1.) Remember that the "real wage" has two definitions: it is either an index number that tells me how many "consumption bundles" that a worker can exchange for one unit of labor, or it is the number of "utils" (units of utility) that a worker can exchange for one unit of labor. To use either of these definitions, I need to specify what constitutes a "consumption bundle", or to specify the utility function. However, I know that the real wage unambiguously increases if and only if the worker can buy more of everything with one unit of labor. That possibility requires that both w/p_1 and w/p_2 increase. (What are the units of these ratios?)

A. If the initial equilibrium is in region A, where the US is completely specialized and Canada is unspecialized, the US welfare increases and Canadian welfare is unchanged. The world relative commodity price ($\frac{p_2}{p_1}$) is given by the Canadian autarkic price, which is unchanged by technological change in US umbrella manufacturing. Canada receives no benefits from trade - before or after the technological improvement. We can normalize by setting $p_1 = 1$ (any other normalization is OK). The free trade equilibrium relative price $\frac{p_2}{p_1}$(and therefore p_2) is unchanged by the change in U.S. technolgoy. Therefore the nominal wage in Canada, w^c, is unchanged, as is the Canadian real wage. The nominal wage in US is given by the 0 profit condition $p_2 = w^u a_2^u$. Since a_2^u has decreased, the nominal US wage must have increased. Since nominal commodity prices are unchanged, real US wage has increased. (Both $w^u/p_1$and w^u/p_2 increase.)

C. If the initial equilibrium is in region C, where only Canada is specialized, the world price under trade equals the autarkic US price. The world relative price of corn increases (i.e., the relative price of umbrellas falls) as a result of technological improvement in umbrella sector). If I normalize by setting p_2, the nominal price of umbrellas, equal to 1, this means that p_1, the nominal price of corn, must have increased. Zero profits in the Canadian

corn sector requires $p_1 = w^c a_1^c$, so the nominal Canadian wage increases. Since w^c/p_1 is unchanged, but w^c/p_2 increases, the real Canadian wage (and therefore Canadian welfare) increases. Given my normalization $p_2 = 1$, the 0 profit condition in US umbrella sector implies that the nominal US wage, w^u, has increased, as has w^u/p_2. The 0 profit condition in US corn sector requires $p_1 = w^u a_c^u$, or $1/a_c^u = w^u/p_1$, which is unchanged. Therefore US real wage (and US welfare) has increased. Note that US does not gain from trade. The welfare increase it obtains is due to the improvement in technology. The US would obtain that welfare increase under autarky or free trade. Canada does benefit from trade. Canada benefits from the improvement in technology only because it trades. Under autarky Canada would obviously not be affected by a change in US technology.

B. If the initial equilibrium is at point B, both countries are specialized and both gain from trade. However, it is not necessarily the case that both benefit from the technological improvement in US umbrella manufacturing. The increased supply of umbrellas means that p_2/p_1 must have decreased. (This claim requires the assumption that the original equilibrium is stable. See the hint to the problem.)Therefore the terms of trade turn against the US. Canada is certainly better off. Normalize by setting $p_1 = 1$, so the 0 profit condition in Canadian corn sector implies that nominal Canadian wage is unchanged. Therefore w^c/p_1 is unchanged, but w^c/p_2 increases (remember, the relative price of umbrellas falls); conclude that the real Canadian wage increases. The 0 profit condition in US umbrella sector requires $w^u/p_2 = 1/a_2^u$, which has increased. However, we do not know what has happened to w^u/p_1, so we do not know whether US real wage has increased or decreased.

You should find it easy to construct an example under which the US gains from the improvement in technology when the initial equilibrium is at point B. The situation where it loses is a bit more subtle. The following remarks provide an example where the US loses.

Figure 2 shows the situation where the US loses as a consequence of an improvement in technology in umbrellas, its export good. Initially, if the US is specialized, it can produce A units of umbrellas. The solid line through this point, with slope p^w is the US's BOP constraint in the initial equilibrium. (This line is NOT the US production possibility frontier; to avoid clutter, I have not shown that line.)

After the improvement in umbrella technology, the US can produce A' umbrellas. If world relative price was unchanged, the US BOP constraint would shift out in a parallel fashion, and its welfare would certainly increase.

However, the improvement in the US umbrella technology causes the US export supply (of umbrellas) to shift out. See section 2.2.1 of the notes to make sure that you understand how to draw the US export supply function in the Ricardian model; make sure you understand why the improvement in US technology causes the function to shift out. This shift causes a decrease in the relative price of umbrellas (equivalently, an increase in the relative price of corn, from p^w to $p^{w'}$. The US BOP constraint under the higher relative corn price is the steep line through point A'. The IEP shifts to the dashed line. The new consumption point, B', is below the initial level of utility. The improvement in US technology leads to such a large deterioration in its terms of trade, that welfare falls.

Notice that in order for this result to occur, it must be the case that the US consumption of corn is lower at the new equilibrium (after the change in technology) compared to at the original equilibrium. (Point B' lies to the left of point B in figure 2.) Since world corn production is unchanged, it must be the case that, after the increase in the relative price of corn, Canada exports less corn. Therefore, the equilibrium must occur on the negatively sloped portion of Canada's export supply function.

Figure 3 shows the US import demand for corn, the curve labelled M_1^{US}, and the Canadian export supply for corn, labelled X^{CAN}. The initial equilibrium is at point C. The improvement in the US technology causes the US import demand function to shift out, as shown by the dashed line This change occurs because, at every price, the level of income in the US is higher after the improvement in technology. Since corn is a normal good, at every price the US wants to consume more corn. Since the US produces no corn, it must be the case that at every price the US wants to import more corn. Therefore, the US import demand function shifts out, as a consequence of the improvement in technology. The new equilibrium is at point C'. At the higher price associated with this equilibrium, Canada exports less corn.

At this point, you should review the discussion of the Marshall-Lerner condition in Chapter 2.3.3 of the notes. There you see that if the export supply elasticity is negative (that is, if the supply curve has a negative slope), then the import demand is inelastic. Figure 3 shows the situation where the Canadian export supply of corn has a negative slope at the equilibrium; therefore, the Canadian export supply elastictity is negative. This means that the Canadian import demand (for umbrellas) is inelastic.

What does all this mean? It means that (at the initial equilibrium) the US is facing an inelastic demand for the good that it exports. When

the improvement in umbrella technology causes its export supply function to shift out, the relative price of its exports falls. Since the Canadian demand for this good is inelastic, Canada now spends less on umbrellas. The US therefore has less revenue to buy corn. Here it may be helpful to think of corn as the numeraire good; with this convention, the decreased US export earnings means that the US can afford to buy less corn.

2a) (i) Bolivia has a comparative advantage in milk production iff A < 15.

(ii) A necessary condition for post-trade wages to be equal is that neither county has an absolute advantage in both commodities. This condition requires requires $A < 6$.

If both (i) and (ii) hold, it must be the case that $A < 6$.

2b) See figure 1.4, a production possibility frontier with two kinks and flat segments B, P and C. The slopes of these segments are 2/3, 1, and 5/4, the autarkic prices of Bolivia, Peru and Chile, respectively. Bolivia always produces milk and Chile always produces saltenas. A country can be nonspecialized only if the world equilibrium price equals its autarkic price. On the two kinks all countries are specialized. On segment B, Peru and Chile are specialized. On segment P, Bolivia and Chile are specialized. On segment C, Bolivia and Peru are specialized.

2c) The improvement in Bolivia's technology in the commodity for which Bolivia has a comparative advantage causes Bolivia's export supply function to shift out. If this curve intersects the flat portion of Chile's import demand function (before and after the technology change), then world price does not change, but the volume of imports and exports increase. (In this scenario, Chile is incompletely specialized before and after the technology change.)

In any other scenario, the shift out of Bolivia's export supply function must cause the world price of milk to fall, increasing Chile's import of milk – so the *volume* of milk trade increases. The *volume* of saltena trade might either increase or decrease. This question is essentially the same as the last part of question 1. (I'm just seeing if you are awake.)

3) a) Venezuela's autarky (relative) price of beer is $\frac{1}{6}/\frac{1}{3} = \frac{1}{2}$. This autarkic relative price is greater than the world relative price of beer =

1/4. Therefore when Venezuela trades it specializes in pizza. Consequently, Venezuela produces $(3)\,500 = 1500$ units of pizza. It total revenue (national income) is $4(15000) = 60,000$.

By assumption, when it consumes x pizzas, it consumes $2x$ beers. The budget constraint is

$$4x + 2x = 6x = 60,000$$

so it consumes 10,000 pizzas and 20,000 beers. It imports 20,000 beers and exports 5,000 pizzas.

b) The zero profit condition in the pizza sector requires

$$4 = \frac{w}{3}$$

so the wage is 12.

c) Denote y as pizza production (and consumption) under autarky, so $2y$ equals beer production (because of the assumption on preferences). The total supply of labor is 5000 units. The requirement of full employment implies

$$\frac{y}{3} + \frac{2y}{6} = 5000$$

which implies $y = 7500$

d) In this case Venezuela's autarky price equals world price. Now Venezuela has no gains from trade. Starting from free trade, the technological improvement does not alter Venezuela's wage or its consumption. However, the change in technology means that Venezualan production is indeterminate.

Question 4

a) (Fill in the blank with the commodity name) Vietnam has a comparative advantage in milkshake ,compared to Paraguay. Vietnam has a comparative advantage in milkshake compared to Chad.

Paraguay has a comparative advantage in ipod compared to Vietnam. Paraguay has a comparative advantage in neither good compared to Chad.

b) For what (if any) pattern(s) of production are the wages in Vietnam and Paraguay possibly equal?

Answer: [Vietnam specialized in milkshake, Paraguay and Chad both specialized in ipods.

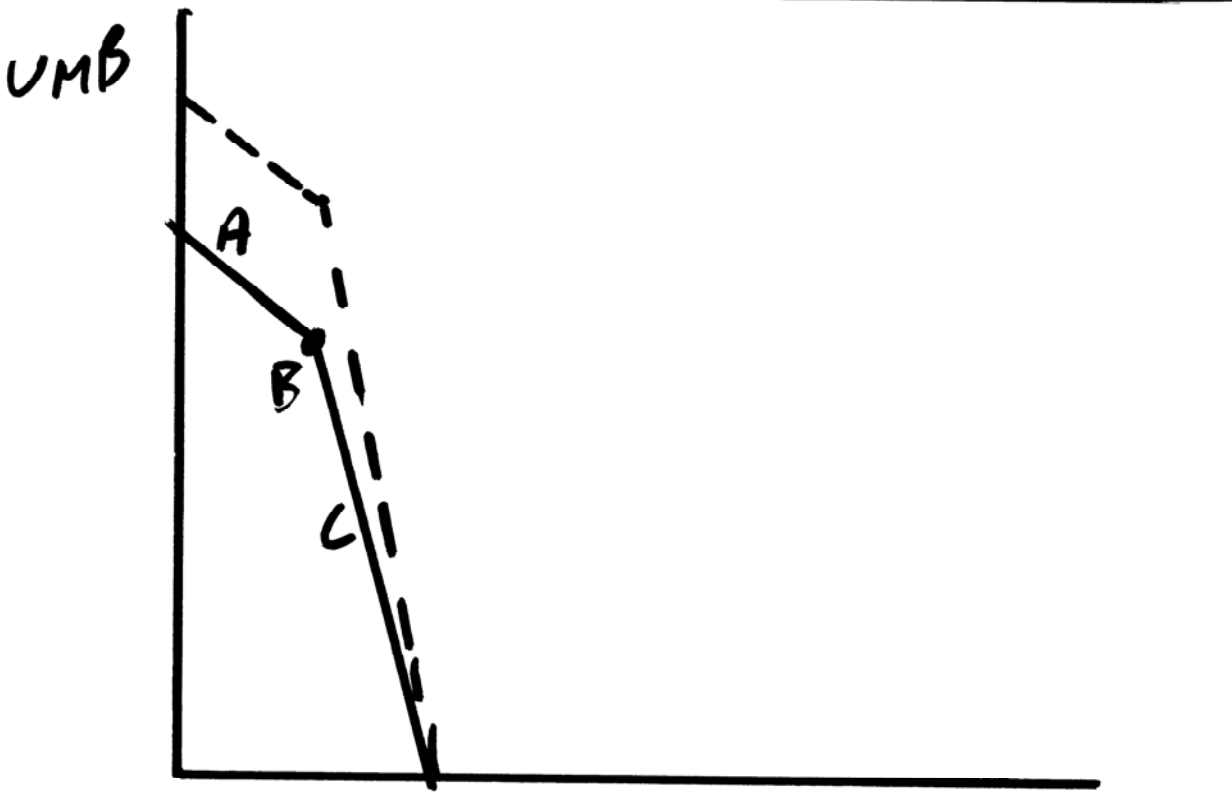
c) For the pattern(s) of production in part (b), are the wages necessarily equal? Answer:NO

d) For what (if any) pattern(s) of production are the wages in Vietnam and Chad possibly equal?

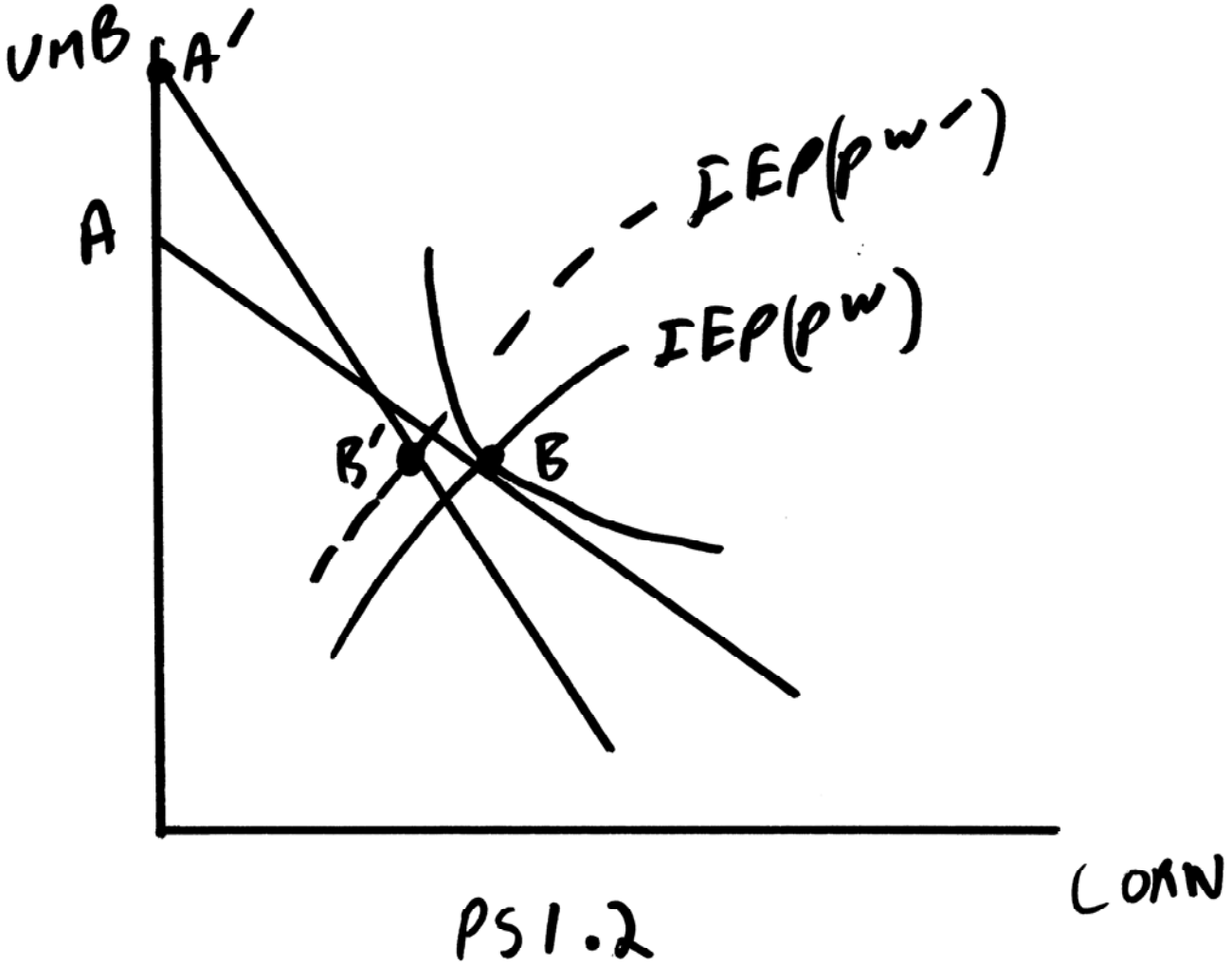
Answer: [Wages in the two countries can be equal iff the equilibrium relative price of milkshakes, $\frac{p_M}{p_I} = 1$. In this case, Chad is specialized in ipods and Vietnam is either incompletely specialized, or in the "knife-edge case" completely specialized in milkshakes. The answer "both countries completely specialized in the good for which they have comparative advantage" is not correct, because this comple specialization is neither necessary nor sufficient for equality of wages.

e) For what (if any) pattern(s) of production are the wages in Paraguay and Chad possibly equal?

Answer: No pattern of production.



PS1.1



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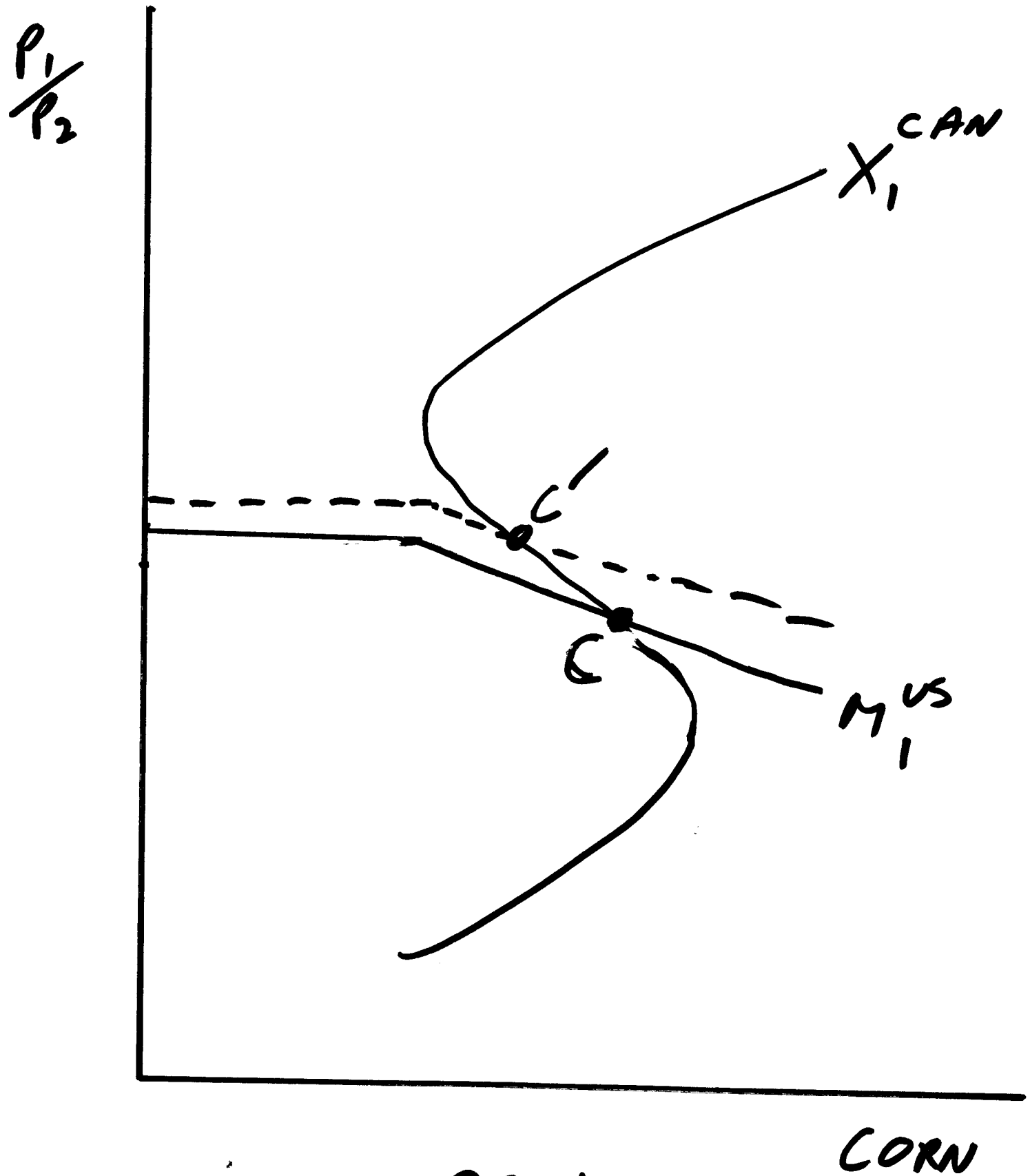
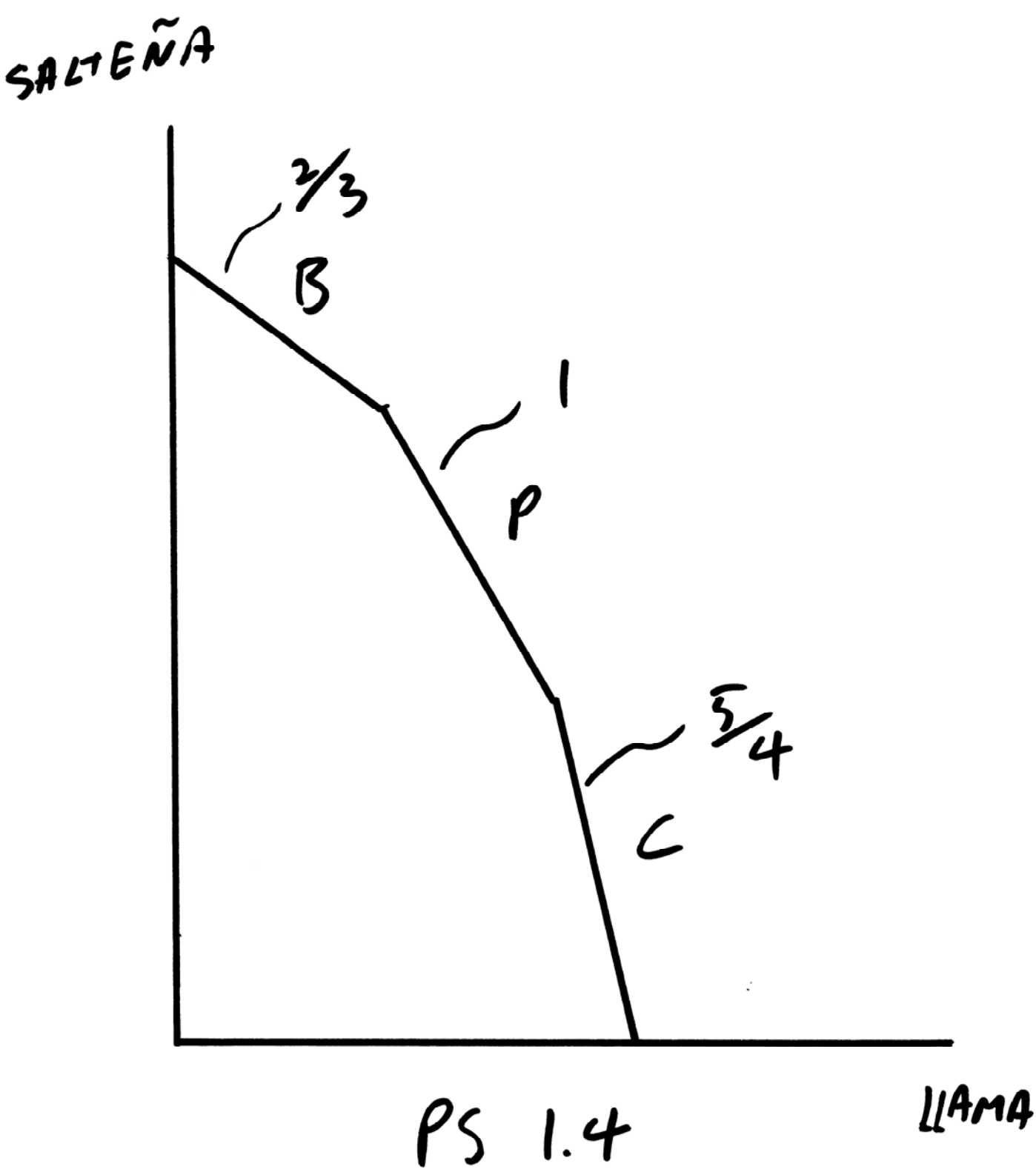


PS 1.3



PS 1.4