

Homework Solutions – Lectures 5 and 6

1. Fair Trade coffee sells at a minimum price of \$1.26 per pound to wholesalers, although some producers would be willing to sell their coffee as low as \$0.90 per pound, which is the free market price. Assume producers can produce any amount of coffee at either price at a cost of \$0.80 a pound.

- a. Assume the elasticity of demand for coffee is 1.5 and the amount sold is 100,000 bags of coffee. What are total revenues to the sellers when they sell to Fair Trade? When they sell in the free market?

$$\Delta R = x(1 - \varepsilon)\Delta p$$

$$\Delta R = 100,000(-0.5)(-0.36) = 18,000$$

$$TR_{\text{FairTrade}} = 100,000 \cdot 1.26 = 126,000$$

$$TR_{\text{FreeMarket}} = 126,000 + \Delta R = 144,000$$

- b. What are total profits for the growers?

In order to have made more sense, I should have assumed that the cost of producing coffee is fixed, rather than assume a cost per pound. If costs are fixed, profits are higher with higher revenues. But the question stated that costs were variable (i.e., per pound). So profits are $TR - TC$. In the case of Fair Trade, sell 100,000 bags at a cost of 0.80, profits are \$46,000. We can use TR to calculate the amount sold on the free market: $Q = TR/p = 144,000/0.90 = 160,000$. Therefore, profits in the free market are \$16,000.

- c. Assume elasticity is 0.8 and repeat a. and b.

$$\Delta R = x(1 - \varepsilon)\Delta p$$

$$\Delta R = 100,000(0.2)(-0.36) = -7,200$$

$$TR_{\text{FairTrade}} = 100,000 \cdot 1.26 = 126,000$$

$$TR_{\text{FreeMarket}} = 126,000 + \Delta R = 118,800$$

In the case of Fair Trade, sell 100,000 bags at a cost of 0.80, profits are still \$46,000. Again we can use TR to calculate the amount sold on the free market: $Q = TR/p = 118,800/0.90 = 132,000$. Therefore, profits in the free market are \$13,200. As expected, free market profit decreased with elasticity.

- d. Is selling coffee to Fair Trade advantageous to growers? Find the actual elasticity of demand for coffee on the Internet (or the library) and use part b to give an informed answer.

Given our assumptions on costs and elasticity, yes, in both cases. Chris found the elasticity of coffee at <http://www.mackinac.org/1247> to be 0.25. Therefore, even if I had made the assumption that coffee production costs are fixed (which may be a reasonable assumption), it still pays to sell to Fair Trade since revenues are higher.

2. (optional) KR 3.10, page 87.

- a. *The elasticity of demand for opium would be greater in the long run because in the long run addicts may be able to get off the drug, and higher prices would discourage some people from ever trying, and getting addicted, to opium.*
- b. *In the short run, since the price elasticity of demand is less than 1, total expenditure on opium increases if the price goes up. We would expect crime to go up as addicts need to come up with more cash. In the long run, total expenditure stays the same since the price elasticity of demand is 1. Opium-related crime should remain about the same as before the price increase, since individual expenditure is up, but some individuals quit. This, of course, assumes that crime is proportional to opium consumption.*

3. (optional – exercises to train the algebra of calculating elasticities).

a. Calculate the price elasticity of Denise’s demand for oil given that a \$0.15 increase from \$1.32 in price led her lower her consumption from 10 gallons a week to 9.

$$\epsilon = |(\Delta x/x)/(\Delta p/p)|$$

$$\Delta x = -1, x(\text{mid-point}) = 9.5, \Delta p = 0.15, p(\text{mid-point}) = 0.78$$

$$\epsilon = |(-1/9.5)/(0.15/1.40)| = 0.98$$

b. What is Denise’s total expenditures on oil?

$$\Delta R = x(1 - \epsilon)\Delta p$$

$$\Delta R = 9.5(0.02)(0.15) = 0.03$$

$$TR = 10 \cdot 1.32 + 0.03 = \$13.23$$

$$\text{or } TR = 9 \cdot 1.47 = \$13.23$$

c. Calculate the income elasticity of Denise’s demand for oil given that she lost \$10,000 of her \$40,000 income in Atlantic City, which forced her to reduce oil consumption from 10 gallons a week to 9.

$$\epsilon = |(\Delta x/x)/(\Delta I/I)|$$

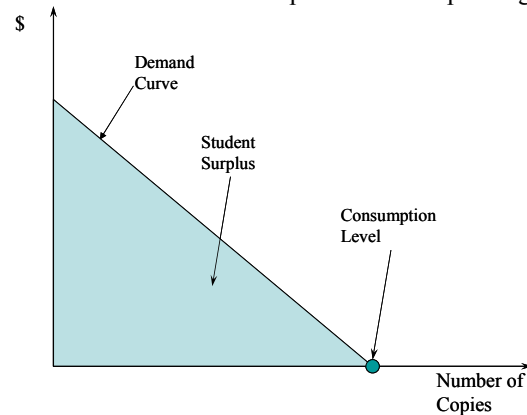
$$\Delta x = -1, x(\text{mid-point}) = 9.5, \Delta I = -10,000, I(\text{mid-point}) = 35,000$$

$$\epsilon = (-1/9.5)/(-10/35) = 0.37$$

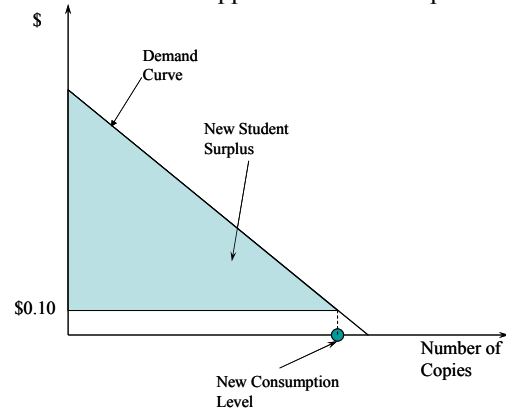
So oil is income inelastic.

4. As mentioned in class, laser printing in Princeton is free.

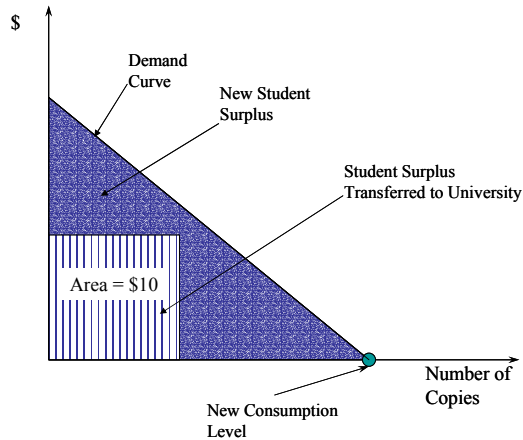
a. Sketch the student surplus from free printing.



b. Sketch what happens to student surplus when the university decides to charge \$0.10 per copy.

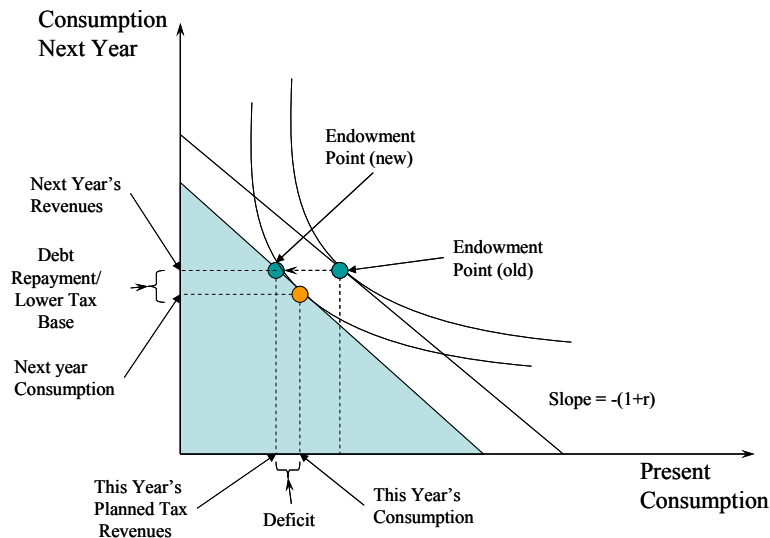


c. Sketch what happens to student surplus when the university decides to charge a \$10 flat fee for printing.



We assume that once the student pays the \$10 fee he or she can make copies for free afterwards. If the student pays the fee, he or she consumes at the old level.

5. The government in our example from the previous lecture needs to run a deficit because a war broke and both new tanks and new hospital beds were necessary.
 - a. Sketch the government's choice problem between present and future consumption.



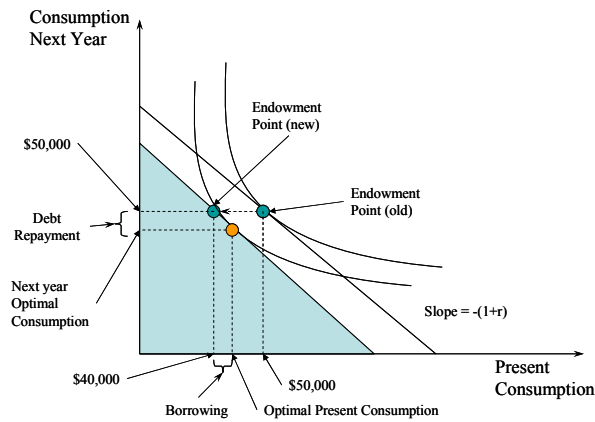
The endowment point shifts to the left because we assume part of today's tax revenues were effectively seized by the compulsory additional expenses with the war. The shift is parallel because there was no change in the interest rate (therefore, we have a pure income effect). We assume that the war is over by next year, and so next year's tax revenues are not changed in principle. However, we will argue that if the government taxes individuals today, they will borrow to smooth consumption. Next period individuals will have to pay their debts and we assume that debt payments are not taxable. Hence the "lower tax base" possibility. This should be more clear after you see the answer below.

- b. The government is considering financing its deficit in two ways: raising taxes or borrowing money. If it borrows money, it must pay back next period.
 - i. Sketch the intertemporal budget constraint of a taxpayer who earns \$50,000 in each of two periods. Suppose taxes were zero before the deficit, and suppose that the government must either borrow or tax the equivalent of \$10,000 per citizen. Also assume for simplicity that interest rates are zero.

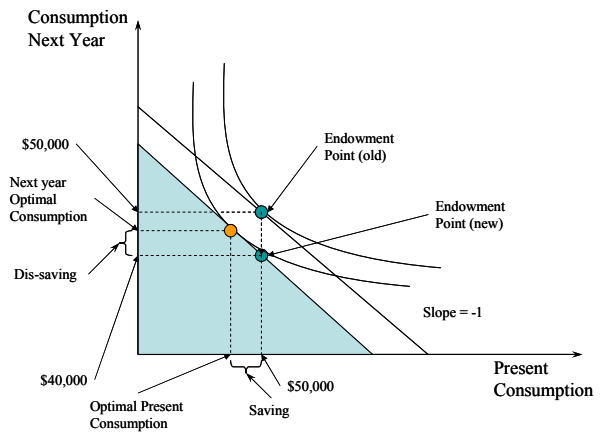
Since the government must pay back the debt next period, it must tax citizens tomorrow for that purpose. See the graphs below.

ii. What are the endowment points in both cases?

In the case of taxes today, the endowment is (40,000, 50,000). In the case of taxes tomorrow, the endowment is (50,000, 40,000). Recall that this is symmetric because we assumed $r=0$. Also see the graphs below.



Tax



Borrow

iii. Show that the consumer's consumption behavior is unchanged regardless of whether the deficit is financed with debt or taxation. This is a simple version of *Ricardian Equivalence*.

The basic idea of Ricardian equivalence is that if a government runs a budget deficit, taxpayers have to pay for it sooner (through present taxation) or later (through future taxation to pay for present borrowing). Since taxpayers anticipate being taxed in the future when the government borrows to finance the deficit, they change their present behavior accordingly to smooth consumption. In this simple model, we can show that the consumer behavior (i.e., the optimal consumption bundle) doesn't change regardless of the strategy adopted by the government to finance its deficit. Since preferences don't change, we must show that the intertemporal budget constraint faced by the individual is the same regardless of the government's financing choice.

The equation for the budget constraint when interest rates are 0 is $C(\text{next year}) = (\text{income this year} + \text{income next year}) - C(\text{this year})$. So if I consume nothing this year, next year I can consume all of this year's income plus all of tomorrow's income. On the other hand, the minimum I can consume next year is zero, so this year's consumption must be at most this year's income plus next year's income. Since this equation depends only on the sum of this and next year's income, the budget constraint is the same whether I'm taxed today or tomorrow, and therefore my consumption choices are invariant to government deficit financing strategy.

(optional) Is this an artifact of zero interest rates? The budget constraint with non-zero interest rates is $C(\text{next year}) = (\text{income this year} \times (1+r) + \text{income next year}) - (1+r)C(\text{this year})$. This equation says that for every dollar that I save (i.e., not consume) this year, I'll have an extra $1+r$ dollars next year. Endowments are (40,000, 50,000) for the tax case and (50,000, $50,000 - 10,000(1+r)$) [note that the government must also pay interest r on the debt]. So in the tax case: $C(\text{next year}) = 40,000 \times (1+r) + 50,000 - (1+r)C(\text{this year})$. In the debt case: $C(\text{next year}) = 50,000(1+r) + 50,000 - 10,000(1+r) - (1+r)C(\text{this year}) = 40,000(1+r) + 50,000 - (1+r)C(\text{this year})$.

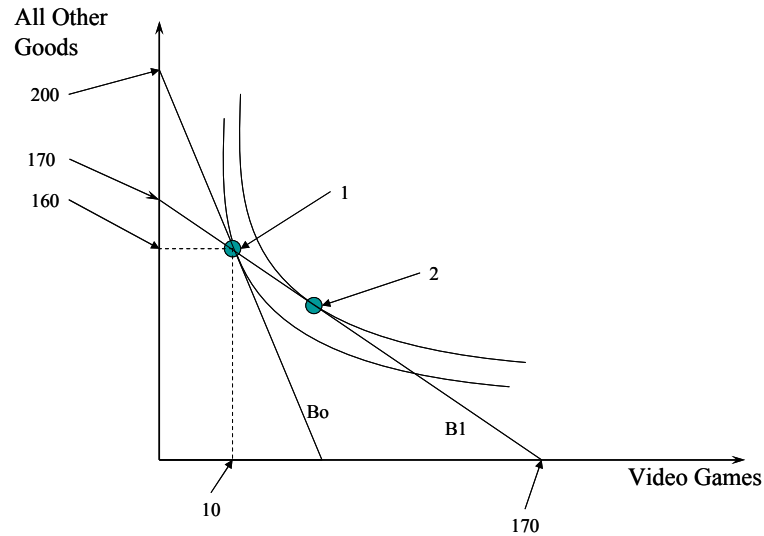
What if the debt was sold to taxpayers? In this two-period model this is exactly equivalent to taxing (including the timing): I give the government \$10,000 today, and tomorrow I get back 10,000 plus interest, but I get taxed exactly by the same amount and so my endowment is (\$40,000, \$50,000).

iv. (optional) Why might debt or tax finance make a real difference?

Debt may be used to constrain future spending, since at some point future administrations will have to cut spending or raise taxes to pay for the public debt. In addition, the government seems to be able to borrow at lower rates than individuals, and therefore it may be efficient for governments to borrow to smooth consumption.

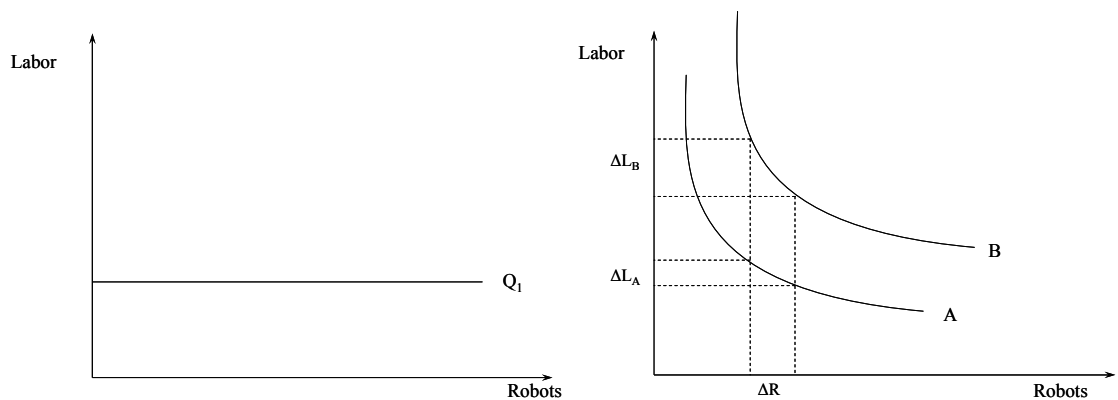
6. (optional) KR 4.11.

Arnold has revealed his preference for bundle 1 over all other bundles on budget constraint B_0 . The new budget constraint under the membership policy is line B_1 . We know that the MRS between video games and other goods must fall, since the price of video games is now lower. We see that Arnold finds that point at 2, where he rents more videos, and consumes less of all other goods.



7. KR 8.5 (p. 257)

The original isoquant map is on the left. With robots of no use at all, the isoquants are horizontal lines. Adding robots does not increase output. When robots start being productive, the isoquants allow substitution between labor and robots (right graph, line A). As robots become more productive, the isoquants show the same number of additional robots (ΔR) replacing more labor (ΔL_B) than before (ΔL_A).

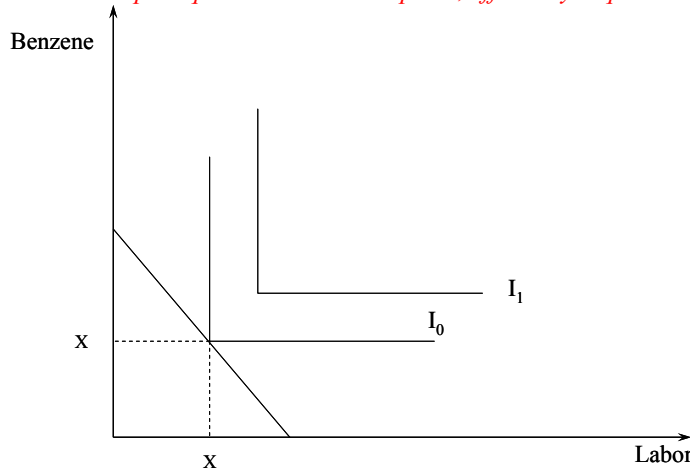


8. KR 8.6 (p.257)

The marginal product of labor increases until the 170th unit of labor, after which MP declines. Since labor is the only variable factor and capital is fixed for next year, it is a short-run analysis.

9. KR 9.2 (p. 286)

- a) *The slope of the isocost line is the negative of the price ratios, $-10/2$ or -5 . That is, if the firm reduces the amount of benzene used by five gallons, and increases labor hours by one, its costs remain constant. The isoquant is a right angle where $B=L$. If $B<L$, then output equals B . If $B>L$, then output equals L . For an output X , efficiency requires that $L=B=X$.*



- b) *$TC = B \times \$2 + L \times \10 . Since efficiency requires that $B=L=X$, we can write this as $TC = \$12 \times X$, where X is the amount produced.*
- c) *Two options here: the production function can be viewed as $X = \min(B, L, M)$, or the cost of L becomes $\$12$. I find the second option more intuitive.*
- d) *$TC = B \times \$2 + L \times \12 . Since $B=L=X$ (efficiency condition), we have $TC = \$14 \times X$.*
- e) *It says the value placed on health risks by workers is less than $\$2$. Suppose workers valued the health risks at $\$3$. Then firms could offer workers wages of $\$7$ instead of $\$10$, plus the masks, which cost $\$2$. Workers would take the deal because the package is worth $\$7 + \$3 = \$10$ to them, while the firm would naturally rather pay $\$7 + \$2 = \$9$ instead of $\$10$.*

10. KR 10.6 (p. 325)

The results for the first firm:

<i>Worker Weeks</i>	0	1	2	3	4	5	6	7
<i>Tons of Cherries</i>	0	12	19	23	24	24.9	25.6	26
<i>MRP (\$)</i>	--	4,800	2,800	1,600	400	360	280	160

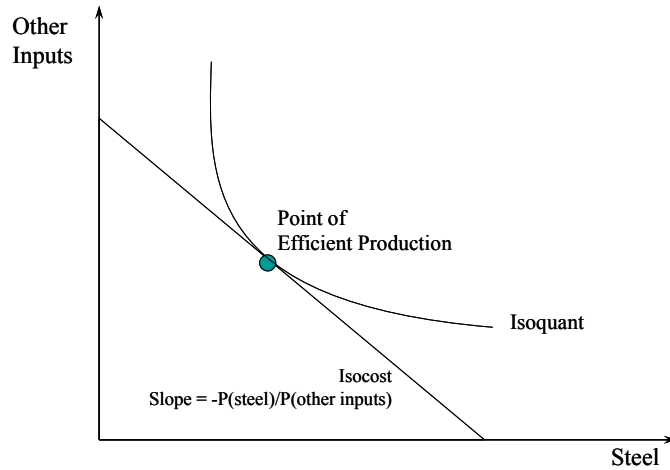
Therefore, the firm will want to hire 6 worker weeks. ($MRP < MFC$ for 7th week). The total variable cost is $6 \times \$270 = \$1,620$ and the total revenue is $\$10,240$, a difference of $\$8,620$. The results for the second firm:

<i>Worker Weeks</i>	0	1	2	3	4	5	6	7
<i>Tons of Cherries</i>	0	14	22	27	28.2	29.2	30.1	30.5
<i>MRP (\$)</i>	--	5,600	2,800	2,000	480	400	360	160

In this case, the firm will also want to hire 6 worker weeks. The total variable cost is also $\$1,620$, but total revenue is now $\$12,040$, a difference of $\$10,420$. When comparing the two firms, we see that the second firm will make $\$1,800$ more profit. The answer could be different in the long run because the relationship between labor and cherries can change when the amount of other factors used changes.

11. Read Doron Levin's article and answer the following:

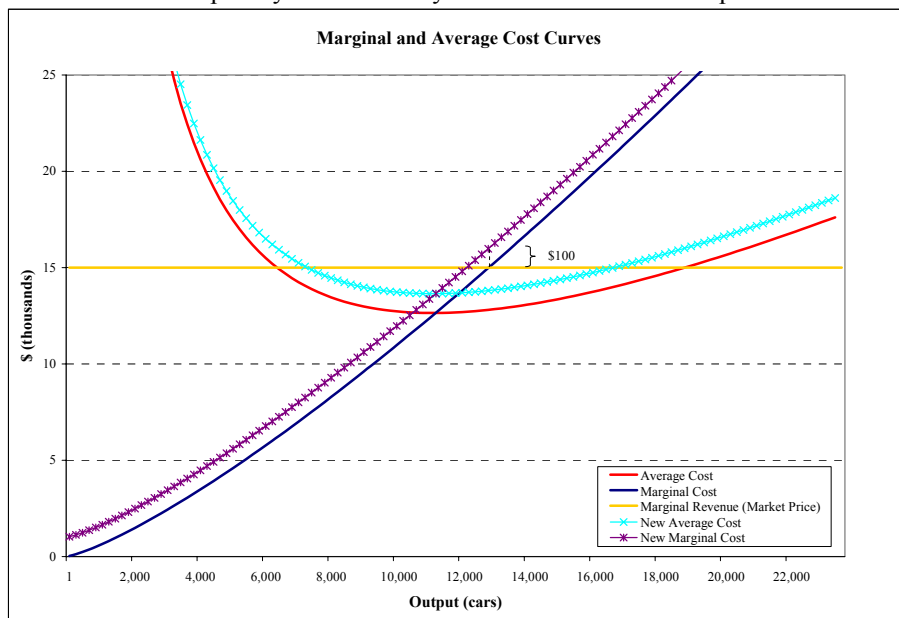
- a. What are the fixed and variable costs for a car company?
Fixed Costs: plant, property (including land) and equipment, labor (if there are long-term contracts that preclude layoffs), patents.
Variable Costs: Steel, autoparts, etc, labor (if the firm can lay off workers at any time), electricity, water.
- b. Draw an isoquant/isocost map with steel on one axis and other inputs on the other.



c. What is the effect of the increase in steel prices in the short run?

In the short run, capital is fixed. Moreover, Levin suggests car makers (and auto parts producers) are finding it hard to pass on steel increases to consumers. Therefore, in the short-run, car companies and auto parts companies will either see profits decrease or incur losses as they cannot shift their input mix in the short run.

d. Draw the firm's marginal and average cost curves before and after the tariffs were imposed. Levin states explicitly the amount by which those costs went up. What was it?



Levin states costs went up by \$100 per car.

e. What are the long-run effects? (draw from the article)

In the long run, by the income and substitution effects we know car companies will use less US steel. This is reflected in the article by Levin's suggestion that car companies will either be moving abroad or will switch to using plastics or other alternative materials. Clearly, for things like foreign steel and plastics Levin suggests that the substitution effect will dominate the income effect. However, the effect on the demand for labor is unclear: it may go up if the substitution effect dominates, or down if the income effect dominates. Levin suggests that US labor demand is likely to go down as companies have to relocate overseas to acquire cheaper steel.

- f. What is the effect of the tariffs in the quantity supplied? How does that depend on the elasticity? What does the article suggest about the elasticity of supply of cars?

There are two possibilities: 1) the increase pushed average cost above price everywhere. In that case, the firms shut down and the tariffs lead quantity demanded to be reduced to zero; 2) the increase did not push average cost above the price everywhere, but the MC curve shifted to the left, thus quantities supplied were reduced for any given price. If supply is highly inelastic (as it may be in the short-run), the quantity supplied will not change much, while if supply is highly elastic, quantity supplied will decrease sharply for a given demand curve. The article suggests that the elasticity of demand for cars is high, since producers appear unable to pass on cost increases to consumers. It is difficult to infer about the elasticity of supply because we don't know whether quantities supplied have increased or decreased, only that apparently prices have not increased.

12. (optional) The following passage is from William Grimes' article on snacks:

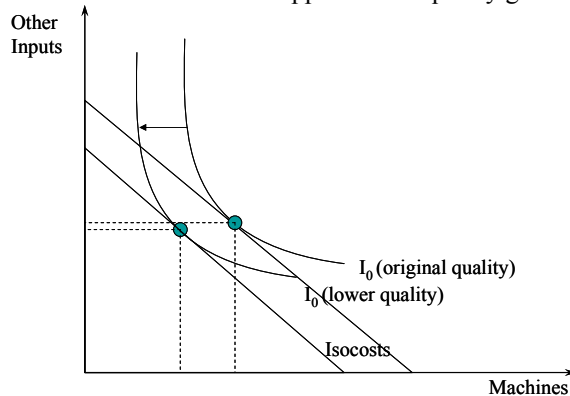
“A laboratory test revealed the following. A one-ounce serving of Pirate's Booty, listed on the amazingly ugly Pirate's Booty bag as containing 2.5 grams of fat and 120 calories, actually contained 8.5 grams of fat and 147 calories — putting it in the same range as the ordinary cheese snack. Whoops. Or, to quote the cartoon pirate on the amazingly ugly booty bag, "Shiver me timbers."

The company's president explained this small difference as a manufacturing slip-up. Demand for the product was so strong that the company had to install new machines to do whatever it is that machines do in order to translate rice, oil, cornmeal, cheddar cheese, whey and buttermilk into a puffy, crunchy snack. The new machines created oversize puffs, and the company, as its operations manager obscurely put it, "had to change the recipe a little bit." It was all an unfortunate error and I, for one, find the company's explanation totally convincing.”

- a. What are the inputs in the production of Pirate's Booty?

Rice, oil, cornmeal, cheddar cheese, whey, buttermilk, machines, workers.

- b. The output has a number of characteristics. It's a “puffy, crunchy snack,” but we can also assume that many consumers assigned value to the product's (relatively) low fat content. Draw a graph with “machines” on one axis and other inputs on the other axis and show isoquant and isocost lines. What happens when quality goes down? (hint, see KR p. 280)



With lower quality, for a given amount of output, the firm needs fewer machines (or the same number of machines of lower quality). Thus it can now produce more snacks with the new, lower quality machines that can be provided in the short run.

- c. Relate the Pirate's Booty story with our discussion of long-run vs. short-run.

In the short run, the company was unable to purchase new machines similar to the old ones. Instead, it had to purchase different machines. The new machines allowed increased production, but of a lower quality product. In other words, the ability of the firm to replicate its production process was constrained in the short run and something had to give, in this case the quality of the snack. Normally, if capital is constrained in the short run, the quantity of output is limited. Here output increases, but output in “quality units” is limited.