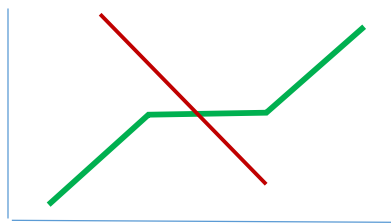


Possible Solutions for Homework 1

Economics of Sustainability

K Foster, Colin Powell School CCNY, Spring 2016

1. What are the names of people in your study group?
2. Consider demand elasticities:
 - a. What goods do you personally demand (be creative!), which have a low price elasticity?
 - b. Which have a high price elasticity?
 - c. If we narrow the range to just phone apps (if you don't have a smartphone, then imagine), which ones would be highest/lowest elasticity?
 - d. What about environmental goods? Give an example of high and low elasticity.
3. Consider the supply and demand for gasoline. Sketch the changes (if any) for each contingency.
 - a. What would be the effect of a slowdown in Chinese economic growth? Would price increase or decrease? Would quantity increase or decrease?
An inward shift of the demand curve would lower price and quantity.
 - b. What would be the effect, on supply and demand for gasoline, of the end of Iran sanctions? Would gas prices increase or decrease? Would quantity of gas sold increase or decrease?
An outward shift in the supply curve would lower prices while increasing quantity sold. While the income increase might shift overall demand as well, this effect would be orders of magnitude smaller.
 - c. What would be the effect of new battery technology lowering the cost of hybrid or electric vehicles? Would gas prices increase or decrease? Would quantity of gas sold increase or decrease?
An inward shift in demand, as people wanted less fuel for their cars, would (just as with the Chinese slowdown) lower price and quantity.
 - d. Suppose the Saudis kept enough reserve production capacity to be able to increase or decrease production by 3%, with the aim of steadying prices?
If supply could be shifted up or down then this could be represented as a flat spot on the supply curve so small shifts in demand or supply would not change price only quantity.



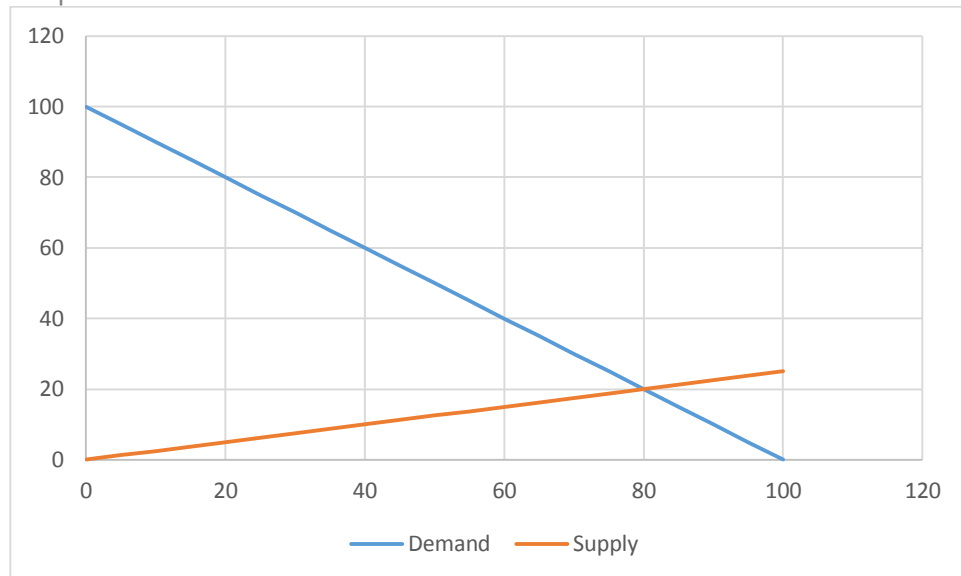
- e. What would be the effect, in the gasoline market, of completing the Keystone pipeline? Would price increase or decrease? Would quantity increase or decrease?
The Keystone would shift the supply curve outward by lowering the cost of getting Canadian product to market, so a similar effect as ending Iran sanctions.
- f. How does fracking and enhanced recovery of 'tight oil' react to gasoline prices? What is that effect in the gasoline market?
As gasoline prices fall it becomes less profitable to extract tight oil and vice versa for price rises. This is supposed to have the effect of making the supply curve more elastic (flatter) over some time horizon. However it hasn't worked out quite that way – when oil prices fell, it was

thought that many frackers would stop pumping but they haven't. There are a number of theories about why...

- g. (extra) How does the gasoline price affect employment in the Detroit area?
Lower gas prices mean more demand for SUVs which is good for Detroit. With the fall in gas prices, US sales of automobiles have not risen by as much as sales of light trucks.

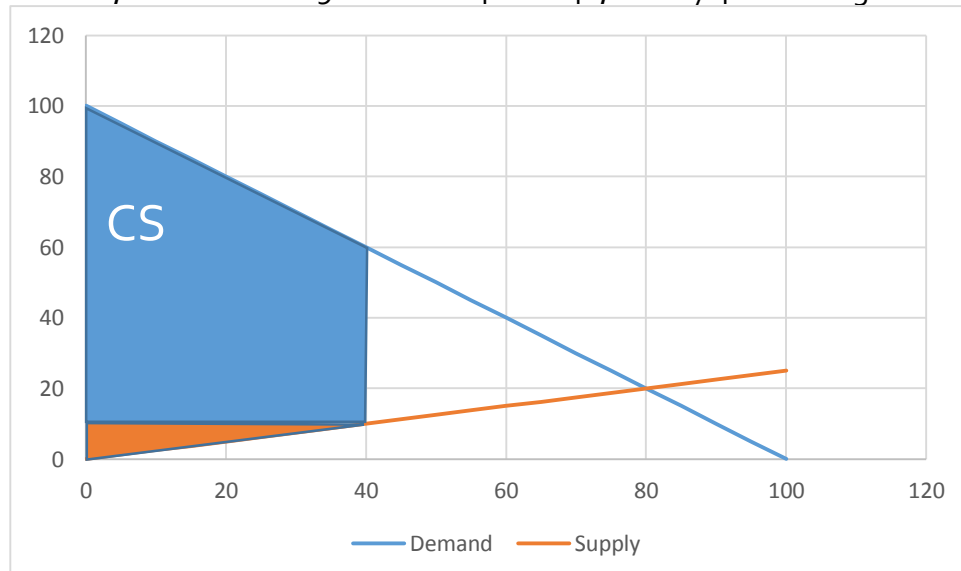
4. Consider a market that can be represented by a linear demand curve, $Q_D = 100 - P_D$, (where Q_D is the quantity demanded and P_D is the price that demanders pay) and a linear supply curve that $Q_S = 4P_S$ (where Q_S is the quantity supplied and P_S is the price that suppliers get).

- a. Graph the two functions with P on the vertical axis.



- b. At a price of 10, how many units are demanded? How many are supplied? What would be Consumer and Producer Surplus at this price? (Remember that short side rules – can't buy something not produced nor sell something not bought!) *(Recall that the area of a triangle is half the base times the height.)*

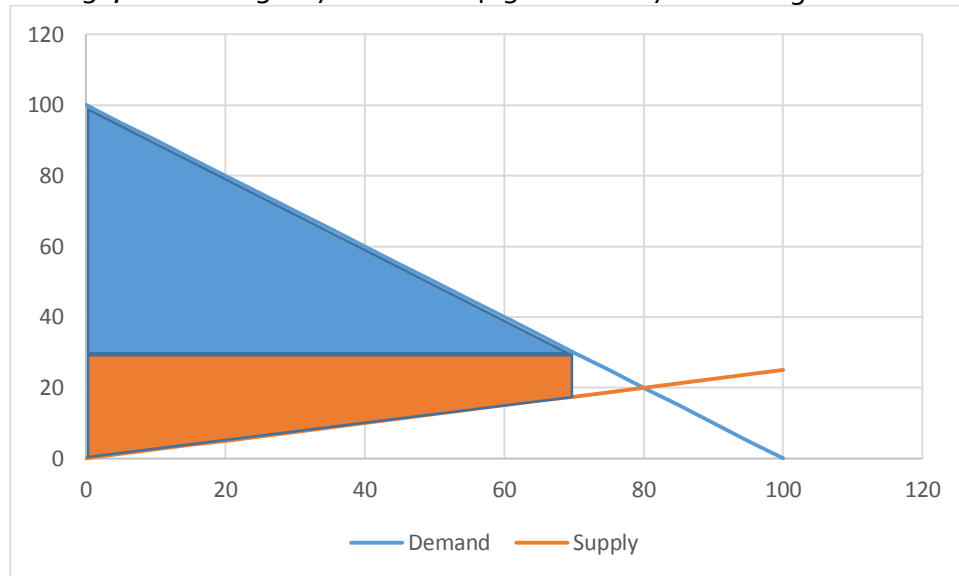
At $P=10$, $Q_d = 100 - 10 = 90$ but $Q_s = 4 \cdot 10 = 40$, so only 40 are bought & sold.



So CS is the big blue trapezoid while PS is the small brown triangle. Area of triangle is $.5 \cdot 10 \cdot 40 = 200$. Area of trapezoid is a bit tougher, need to note that the upper-right point is at $Q=40$, $P=60$; so it's a box with triangle on top with area $[40 \cdot (60 - 10)] + .5 \cdot (100 - 60) \cdot 40 = 2800$. Total surplus for $CS + PS = TS = 3000$.

- c. At a price of 30, how many units are demanded and supplied? What would be Consumer and Producer Surplus at this price?

At $P=30$, $Q_D = 100 - 30 = 70$ but $Q_S = 4 \cdot 30 = 120$ so 70 are bought & sold.



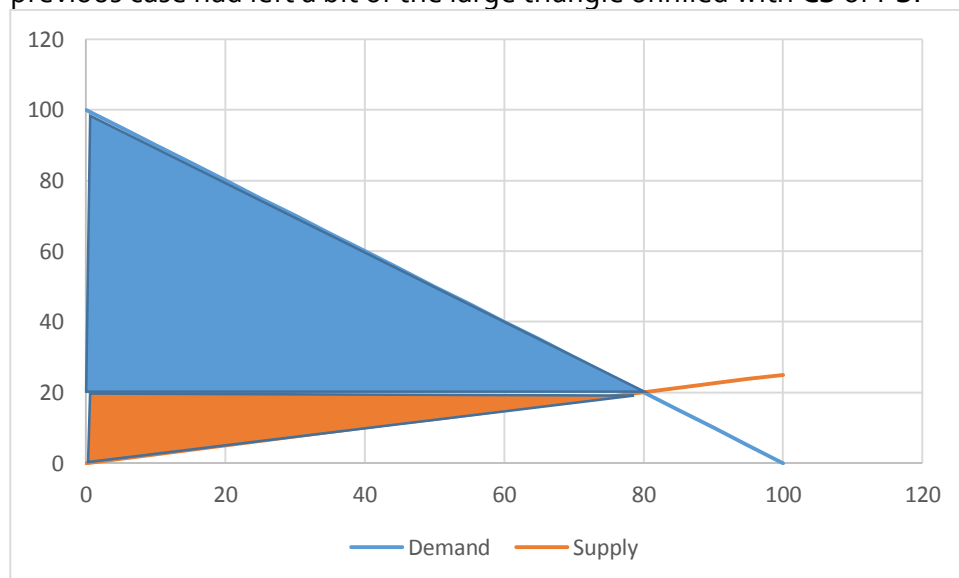
Now CS is the blue triangle with area $.5 \cdot (100 - 30) \cdot 70 = 2450$, so consumers are worse off – more people get to buy the product but they have to pay more. The PS trapezoid is 1487.5 so producers are definitely better off. Total Surplus = TS = CS + PS = 3937.5.

- d. Set $P_D = P_S$ and $Q_D = Q_S$ and solve the system of equations to find the equilibrium (find the intersection of the lines). Show on the graph.

To solve the equations set $100 - P = 4P$ so $P^* = 20$ and $Q^* = 80$.

- e. What are CS & PS now? Show on the graph. Compare Total Surplus for the 3 cases.

CS is triangle in blue; PS is triangle in brown; CS has area $.5 \cdot (100 - 20) \cdot 80 = 3200$; PS has area $.5 \cdot (20) \cdot 80 = 800$. Total Surplus is 4000 which is greater than either previous case – each previous case had left a bit of the large triangle unfilled with CS or PS.



- f. Suppose the government sets a tax of \$2 per unit. This means that $P_D = P_S + 2$. What is now the quantity demanded & supplied? (You can rewrite the equations, that currently show Q as a function of P , to instead get P as a function of Q . Then substitute in the algebraic expressions

for P_D and P_S to solve.) What are CS & PS now? What is government revenue (which adds to total surplus)? What is DWL (deadweight loss)?

$$P_D = P_S + 2$$

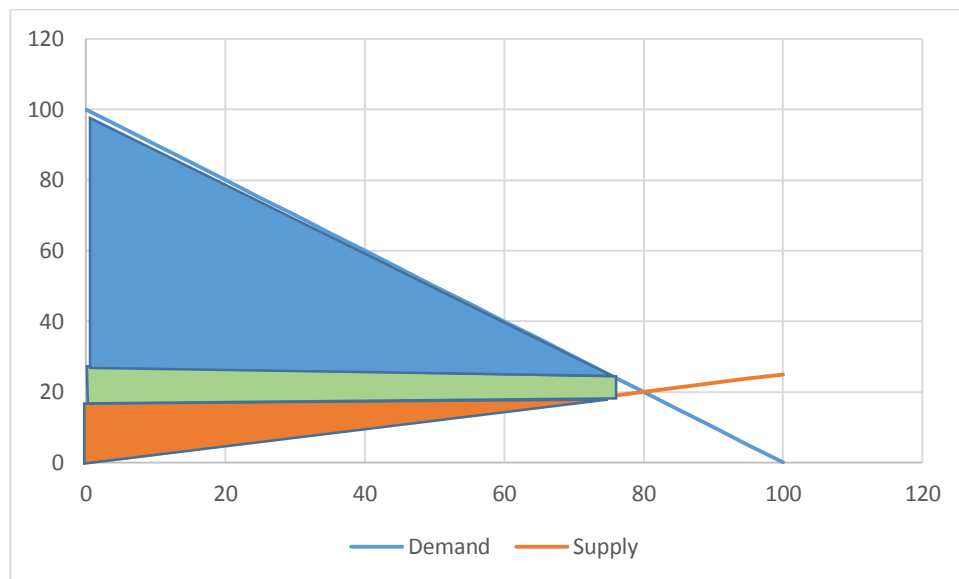
$$[100 - Q] = \left[\frac{1}{4}Q\right] + 2$$

$$98 = \frac{5}{4}Q$$

$$Q = 78.4$$

So $P_D = 100 - 78.4 = 21.6$ and $P_S = 78.4/4 = 19.6$. The tax means that demanders pay more than suppliers get.

Tax revenue is $2 \times 78.4 = 156.8$. CS is $.5(100 - 21.6)(78.4) = 3073$; PS is $.5(19.6)(78.4) = 768$. Total surplus is 3988.4, which is 1.6 smaller than total surplus without the tax – so that is the DWL, the area of the tiny leftover triangle.



- g. Suppose that production of this good has a marginal external cost of \$3 per item. What is the DWL of the free market equilibrium? What is the DWL of the tax case?

If the social cost (private cost plus external cost) is \$3 higher then producing more than 77.6 is inefficient. The free market creates a DWL of $.5 \times 3 \times (80 - 77.6) = 3.6$. The tax case produces a smaller DWL since only 78.4 units are made, just $(78.4 - 77.6) = .8$ too many and at only \$1 more than paid, so DWL is 0.4.

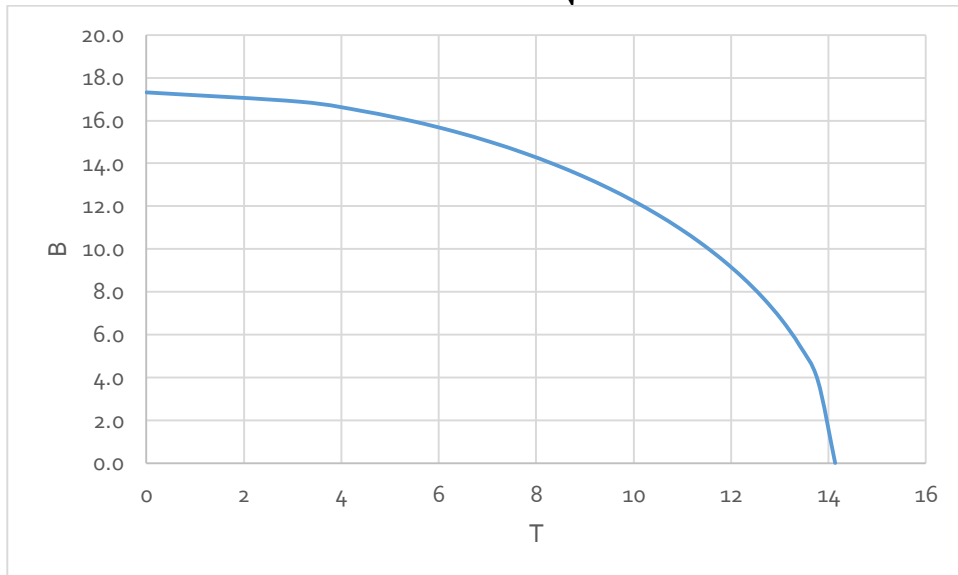
5. A locality can use its coast for tourism (people are attracted to pristine coastline) or business/industry (which destroys the tourist appeal). It wants to choose what percent of coast should be preserved for tourism and how much should be kept for industry. Assume that the two industries can be modeled as follows. The coast (C) can be used for tourism, T, or business, B, where each is a percentage so $C_T + C_B = 100$. The jobs from businesses (in hundreds) can be modeled as $B = \sqrt{3C_B}$ and the number of tourists (in thousands) is $T = \sqrt{2C_T}$. From combining the first two equations we can write $B = \sqrt{3(100 - C_T)}$; from the third equation we can write $C_T = \frac{T^2}{2}$.

- a. If 100% of the coast is used for tourism, what is the maximum number of tourists? If 100% were used for business, what is the maximum number of jobs? If there were a 50/50 split, how many tourists and how many jobs?

If all the coast is tourism then $C_T = 100$, $C_B = 0$, $T = 14.1$ and $B = 0$. If instead $C_T = 0$ and $C_B = 100$ then $T = 0$, $B = 17.3$. If $C_T = 50$ and $C_B = 50$ then $T = 10$, $B = 12.2$.

- b. Write the equation giving B as a function of T. Graph it. (You can use Excel to plot points if it's easier.)

$$B = \sqrt{3 \left(100 - \frac{T^2}{2} \right)}$$

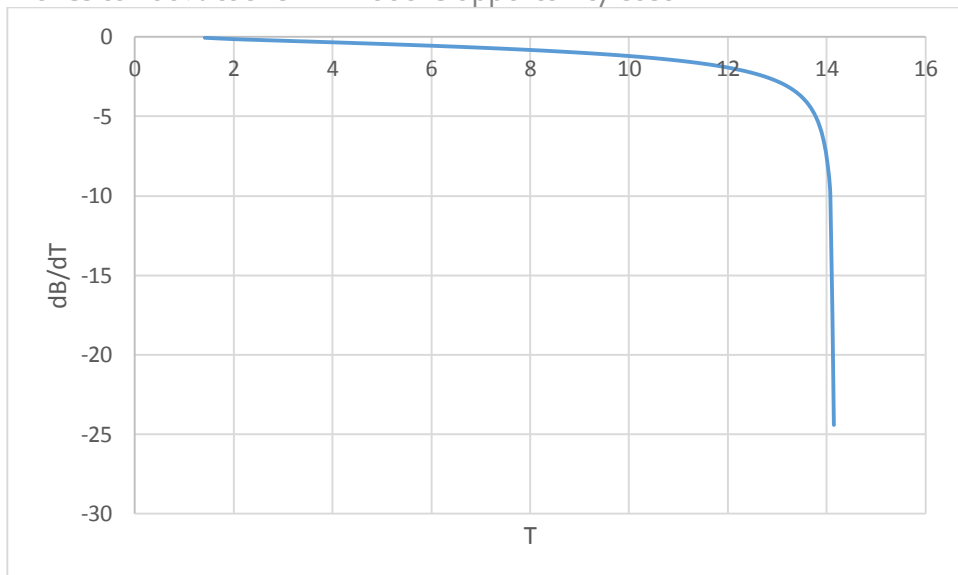


- c. What is the opportunity cost, of business given up, if the island moves from zero to one tourist unit? (You can use calculus or find the change between values.)

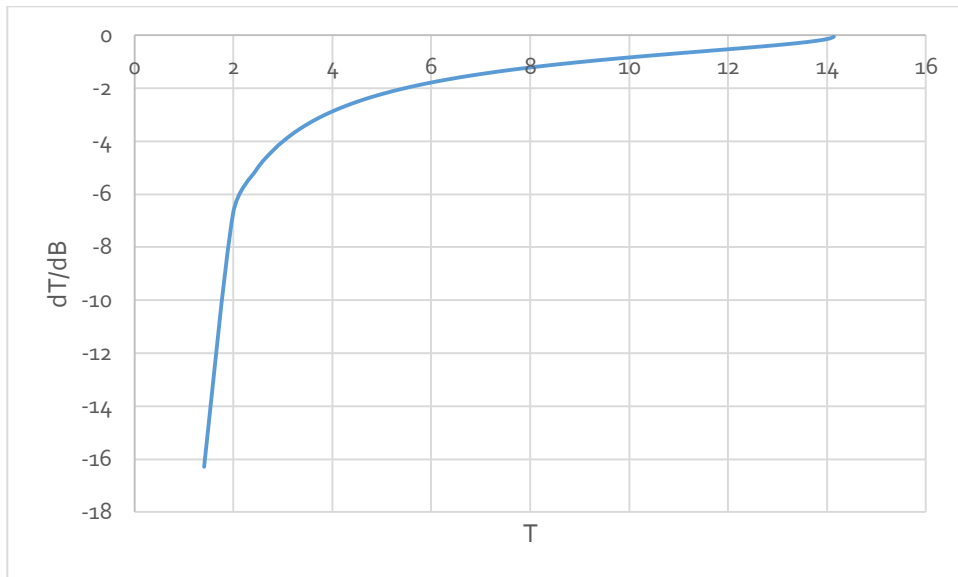
With calculus, find $\frac{\Delta B}{\Delta T} = \frac{3T}{\sqrt{300 - \frac{3T^2}{2}}}$. Or find from CT=0 to CT=1 is a change in T from 0 to 1.41;

while from CB=100 to CB=99 is a change in B from 17.32 to 17.23; so $\frac{\Delta B}{\Delta T} = -.06$.

- d. What is the opportunity cost, of business jobs given up, for each unit of tourism, if the island moves to 100% tourism? Plot the opportunity cost.



- e. Do the same exercise (find opportunity cost and plot), but find opportunity cost in terms of tourists, for integer units of business jobs.



- f. What is the best combination? What additional information is needed, to answer this? Would need some way of comparing jobs; there might not be a single measure that is satisfactory to everyone.