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Solution to Exam 1

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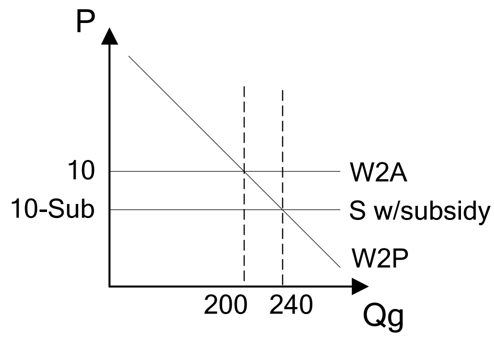
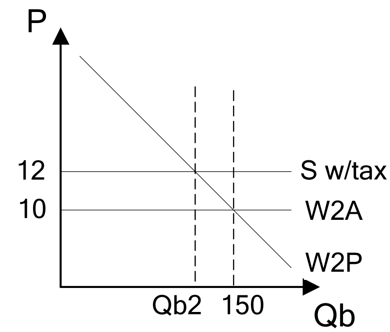
Here are notes on the solution. Some of the graphs may be omitted and the explanations are a bit terse. If you have any questions, please don't hesitate to stop by during office hours or the lab session to talk over things in detail.

Part 1

1(a) Finding the new equilibria

The initial and target equilibria in each market are shown below (G on the left):





The first step is to calculate the subsidy needed in market G. Using the demand elasticity to find the price change needed to increase Q to the target level:

$\eta = \%\Delta Q / \%\Delta P$

$\%\Delta P = \%\Delta Q / \eta$

$\%\Delta P = ((240-200)/200)/(-2)$

$\%\Delta P = (20\%)/(-2)$

$\%\Delta P = -10\%$

$\Delta P = -0.1 * \$10 = -\$1$

P with subsidy = \$10 – \$1 = \$9

The subsidy per unit of good G must be \$1 and the price must be \$9. The cost of the subsidy will be \$1*240 = \$240.

The next step is to calculate the effect of the tax on Qb. Using the elasticity:

$\eta = \%\Delta Q/\%\Delta P$

$\%\Delta Qb = \eta * \%\Delta Pb$

$\%\Delta Qb = (-1)*((12-10)/10) = -1*20\% = -20\%$

$\Delta Qb = -0.2*150 = -30$

$Qb2 = 150 – 30 = 120$

Revenue from the tax will be $2*120 = $240. Since the expenditure on the subsidy exactly matches the revenue raised by the tax, the cross-subsidy will work without creating a budget surplus or deficit.

1(b) Changes in surplus

The change in CS in each market can be calculated as follows:

$\Delta CSg = \$1*200 + 0.5*\$1*40 = \$220$

$\Delta CSb = -(\$2*120 + 0.5*\$2*30) = -\$270$

Deadweight loss is just the sum (difference between lost CS in market B and gained CS in market A):

$DWL = \$220 - \$270 = -\$50$

Checking by calculating the DWL triangles in the two markets separately:

$DWLg = 0.5*\$1*40 = \$20$

$DWLb = 0.5*\$2*30 = \$30$

$DWL = DWLg + DWLb$

Part 2

2(a) Market equilibrium

The first step is to rearrange each W2P equation to find the quantity demanded by a given individual of each type:

$$W2Pa = 500 - Qa$$

$$W2Pa = P = 500 - Qa$$

$$Qa = 500 - P$$

$$W2Pb = 500 - 5*Qb$$

$$W2Pb = P = 500 - 5*Qb$$

$$Qb = (500 - P)/5$$

The market demand is the sum of the individual demands. Since there are 10 type-A buyers and 20 type-B buyers, the total Qd demanded will be:

$$Qd = 10*Qa + 20*Qb$$

$$Qd = 10*(500 - P) + 20*(500 - P)/5$$

$$Qd = 5000 - 10*P + 2000 - 4*P$$

$$Qd = 7000 - 14*P$$

The supply curve is:

$$W2A = P = Qs/6$$

$$Qs = 6*P$$

Finding the equilibrium:

$$Qd = Qs$$

$$7000 - 14*P = 6*P$$

$$7000 = 20*P$$

$$P = 350$$

$$Qd = 7000 - 14*350 = 7000 - 4900 = 2100$$

Checking: $Qs = 6*350 = 2100$

The question does not ask for the individual Q's but they are straightforward to calculate and are a useful check:

$$Qa = 500 – 350 = 150$$

$$Qb = (500 – 350)/5 = 30$$

$$Qd = 10*150 + 20*30 = 1500 + 600 = 2100$$

2(b) Effect of a \$200 tax

With the tax, the seller will only supply the good when the buyers pay P = W2A+\$200. Using that to find the supply curve with the tax:

$$P = W2A + \$200$$

$$P = Qs/6 + \$200$$

$$Qs = 6*P - \$1200$$

Finding the equilibrium:

$$Qd = Qs$$

$$7000 – 14*P = 6*P - 1200$$

$$8200 = 20*P$$

$$P = \$410$$

$$Qd = 7000 – 14*410 = 1260$$

$$\text{Check: } Qs = 6*410 - \$1200 = 1260$$

Part 3

Policy 1 would raise the price of good X by \$20 and have no effect on good Y. Using the elasticity to find the change in the quantity of good X:

$$\eta = \%\Delta Q/\%\Delta P$$

$$\%\Delta Qx = \eta*\%\Delta Px$$

$$\%\Delta Qx = (-1)*((120-100)/100) = (-1)*(20\%) = -20\%$$

$\Delta Qx = -0.2*1000 = -200$

$Qx = 1000 – 200 = 800$

Revenue raised: $20*800 = $16,000. Deadweight loss: 0.5*$20*(1,000-800) = $2,000.

Policy 2 would raise the price of each good by $10. Since each good originally sells for $100, that's an increase of 10%. Using the elasticity formula to find the changes in Qx and Qy (both will be the same):

$\%\Delta Qx = \eta*\%\Delta Px = (-1)*(10\%) = -10\%$

$\%\Delta Qy = \eta*\%\Delta Py = (-1)*(10\%) = -10\%$

$\Delta Qx = -0.1*1000 = -100$

$\Delta Qy = -0.1*1000 = -100$

$Qx = 1000 – 100 = 900$

$Qy = 1000 – 100 = 900$

Revenue raised: $10*900 + $10*900 = $18,000. Deadweight loss: 0.5*$10*(1,000-900) + 0.5*$10*(1,000-900) = $500 + $500 = $1,000.

Policy 2 is unambiguously better: it raises $2,000 more revenue and has $1,000 less deadweight loss. That turns out to be true in general, by the way: several small taxes are almost always better than one big one.