Exercise MX-201

Removing a cross subsidy that is creating a deficit

The Economic Skills Project

1 Problem

Problem

A government agency serves two markets, U and R, and is subject to a cross subsidy policy that requires it to charge the same $100 price in both markets. It has a $WTA_U = \$80$ but its $WTA_R > \$100$. It is currently selling $Q_U = 10,000$ and $Q_R = 4,000$ and running a $100,000 deficit on the policy. The demand elasticities in the two markets are $\eta_U = -1$ and $\eta_R = -0.5$.

Determine the value of WTA_R. Then calculate what would happen to Q_U and Q_R if the cross subsidy were removed. What would the ΔCS be in each market? What would the overall ΔSS be?

2 Answer

Answer

Here's the solution:

- $WTA_R = \$175$
- $Q_U = 12,000$
- $Q_R = 2,500$
- $\Delta CS_U = +\$220,000$
- $\Delta CS_R = -\$243,750$
- $\Delta SS = +\$76,250$

3 Method

Solution method

Here's one approach:

1. Draw diagrams of the two markets.
2. Calculate the tax revenue raised in the U market.
3. Calculate the subsidy expenditure in the R market.
4. Calculate the value of WTA_R.
5. Use the elasticities to find the new quantities.
6. Calculate ΔCS_U and ΔCS_R.
7. Calculate ΔSS.

4 Solution

4.1 Step 1

Draw diagrams of the two markets

Here's how they look:
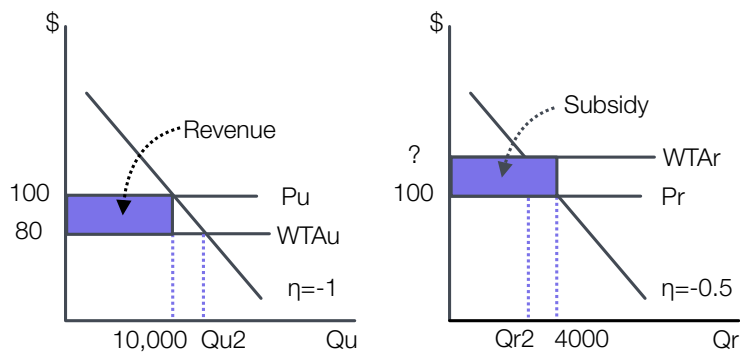
4.2 Step 2

Calculate the tax revenue raised in the U market

The revenue, shown in blue in the previous graph of the U market, is the effective tax rate, $P_U - WTA_U$, times the number of units traded:

$$Rev_U = (\$100 - \$80) * 10,000 = \$200,000$$

4.3 Step 3

Calculate the subsidy expenditure in the R market

The expenditure on the subsidy in R, Exp_R, is equal to Rev_U adjusted by the deficit the agency is incurring on the policy. The accounting equation below links the revenue, subsidy expenditure, and deficit Def:

$$Exp_R - Rev_U = Def$$

Thus:

$$Exp_R = Rev_U + Def$$

So:

$$Exp_R = \$200,000 + \$100,000 = \$300,000$$

4.4 Step 4

Calculate the value of WTA_R

Since Exp_R is $300k and $Q_R = 4000$ units are being subsidized, the subsidy per unit, S, is:

$$S = Exp_R/Q_R = \$300k/4000 = \$75$$

The producer price, P_R^S, is thus:

$$P_R^S = P_R^D + S = \$100 + \$75 = \$175$$

Since supply requires $P_R^S = WTA_R$:

$$WTA_R = \$175$$

4.5 Step 5

Use the elasticities to find the new quantities, p. 1

Removing the cross subsidy would change each market's price to the corresponding WTA. For U the new P_u and the percentage change from the initial value are:

$$P_u = \$80$$

$$\%\Delta P_u = (\$80 - \$100)/\$100 = -20\%$$

Use the demand elasticity, η_u, to calculate the percent change in Q_u:

$$\%\Delta Q_u = \eta_u * \%\Delta P_u = -1 * (-20\%) = +20\%$$

The new value of Q_u will be:

$$Q_{u2} = 10,000 + 0.2 * 10,000 = 12,000$$

Use the elasticities to find the new quantities, p. 2

Calculating the new P_R and the corresponding percentage change:

$$P_R = WTA_R = \$175$$

$$\%\Delta P_R = (\$175 - \$100)/\$100 = +75\%$$

Using the demand elasticity, η_R, to calculate the percent change in Q_R:

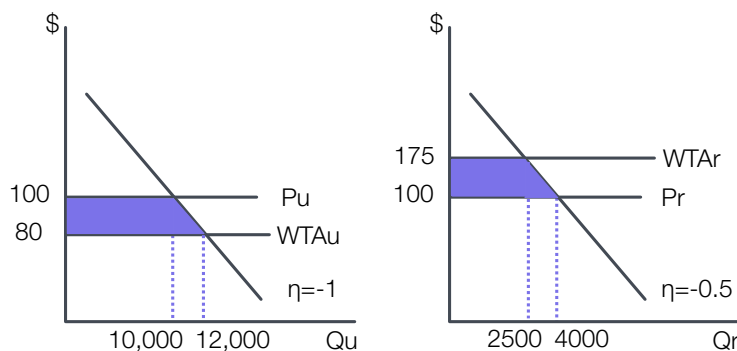$$\%\Delta Q_R = \eta_R * \%\Delta P_R = -0.5 * (+75\%) = -37.5\%$$

The new Q_R is thus:

$$Q_{R2} = 4000 - 0.375 * 4000 = 2500$$

4.6 Step 6

Calculate the changes in CS, p. 1

A good first step is to draw each diagram.Here's how they look:

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Calculate the changes in CS, p. 2

Each ΔCS can be calculated using the formula for the area of a trapezoid:

$$A = (\frac{b_1 + b_2}{2}) * h$$

For U:

$$\Delta CS_U = (\frac{10,000 + 12,000}{2}) * \$20 = +\$220,000$$

For R:

$$\Delta CS_R = -(\frac{4000 + 2500}{2}) * \$75 = -\$243,750$$

4.7 Step 7

Calculate the change in SS, p. 1

The change in social surplus is given by:

$$\Delta SS = \Delta CS_U + \Delta CS_R + \Delta Rev$$

where ΔRev is the difference between the new and old net revenue (revenue less expenditure on the subsidy). The old net revenue was:

$$Rev_1 = \$200,000 - \$300,000 = -\$100,000$$

The new net revenue is $Rev_2 = \$0$ since there's no tax revenue collected in U nor any subsidy paid in R. Thus:

$$\Delta Rev = Rev_2 - Rev_1 = \$0 - (-\$100,000) = \$100,000$$

That is, the agency has eliminated its deficit.

Calculate the change in SS, p. 2

Finally, the change is social surplus is:

$$\Delta SS = \$220,000 - \$243,750 + \$100,000 = \$76,250$$

 Done!