

4. Demand and supply in a market for coal are given by:

$$Q_D = 20 - P$$

$$Q_S = 4P$$

where Q is the quantity of coal and P is the price per unit of coal.

- (a) Calculate the market equilibrium price and quantity in this market
- (b) Show the market equilibrium in Supply/Demand diagram. Label all axes and curves.
- (c) Calculate consumer surplus, producer surplus at market equilibrium and identify each in the diagram.
- (d) Recent research has found that surface mining of coal causes adverse health impacts in women and children living near coal mines. In the presence of these problems, will the equilibrium found in part (a) be efficient? Why or why not?
- (e) If costs of hospital admissions and forgone wages among those affected by surface mining is estimated to be \$2 per unit of coal, what is the total welfare under the market equilibrium from part (b)? To find this, add consumer surplus and producer surplus from the market equilibrium and subtract the total external cost.
- (f) If costs of hospital admissions and forgone wages among those affected by surface mining is estimated to be \$2 per pound of coal. With this new information, calculate the efficient quantity, Q^* , of coal to be supplied.
- (g) If the government were to pass a Pigouvian Tax to address the health effects of mining, what would the efficient tax be? How much revenue would the government collect in equilibrium?
- (h) Calculate total welfare under the Pigouvian Tax (consumer surplus plus producer surplus plus tax revenue minus total external cost). Is the welfare found under the Pigouvian Tax greater than or less than the welfare calculated in part (e)?
- (i) Would coal producers prefer the tax from (f) or rather the government limit the quantity of coal mining to the quantity in part (e)? Why or why not? You may find it helpful to use a diagram to explain your answer.

1. In a (very) small community, there are 4 residents who all value access to open space. There is a local plan to develop the open space land. Residents can buy individual parcels of land at a price of \$15,000 each. The *total willingness to pay* by individual resident is as follows:

Number of Parcels	Ashley	Brad	Clementine	Deryl
1	\$ 30,000	\$ 45,000	\$ 20,000	\$ 40,000
2	\$ 55,000	\$ 75,000	\$ 30,000	\$ 50,000
3	\$ 65,000	\$ 95,000	\$ 35,000	\$ 55,000
4	\$ 70,000	\$ 105,000	\$ 35,000	\$ 60,000
5	\$ 70,000	\$ 110,000	\$ 35,000	\$ 60,000

- (a) What is Ashley's *marginal willingness to pay* for the 3rd parcel of open space? (*Hint*: This is his willingness to pay to go from 2 to 3 parcels of open space.)
- (b) If open space parcels were excludable, so that the residents could only enjoy their own open space and not that of their neighbors, how many parcels would Ashley, Brad, Clementine and Deryl purchase respectively?
- (c) Under the assumption open space parcels are excludable, draw the each individual's demand function for open space for the community. Keep in mind parcels can only be sold as a whole (i.e. no one can buy 1.5 parcels, only 1 or 2). Find each individual's consumer surplus.
- (d) If open space parcels are not excludable (such that all users can enjoy a parcel purchased by their neighbor for free), but can only be purchased privately (with no coordination among residents) how many total parcels will be purchased?

- (e) Draw the aggregate willingness to pay curve for open space as a public good. What is the aggregate consumer surplus from the private provision of public goods in this case? If the residents could coordinate to purchase the efficient amount of open space (i.e. the amount that maximizes total benefits minus total costs) how much would they purchase? What would be the aggregate consumer surplus from this quantity of open space?