

Please complete these problems to the best of your ability and submit your solutions on Gradescope by 11:59pm on Friday, September 24. When drawing any graphs, please use the appropriate labels on axes and specialization points.

1. Consider the following market supply and demand curves for college educations:

$$P = 90 - Q_d$$
$$P = 10 + \frac{7Q_s}{9}$$

Prices are in thousands of U.S. dollars and quantity is in thousands of degrees.

- (a) Sketch the supply and demand curves, labeling the axes and the equilibrium point.
- (b) Compute consumer and producer surplus at the market equilibrium.

Suppose also that pursuing a college education results in a positive consumption externality of 15 (in thousands of dollars) per graduate.

- (c) Now include the marginal social benefit curve into your sketch. Label the socially optimal point in your sketch. What is the socially optimal quantity of college degrees?
- (d) Is the equilibrium quantity lower or higher than the socially optimal quantity of college degrees?
- (e) What is the deadweight loss associated with the market equilibrium compared to the socially optimal level?
- (f) Suppose that, in order to incentivize consumers to pursue higher education, the government offers a subsidy for attending college. Suppose that each consumer receives a subsidy of 20 (in thousands of U.S. dollars). On a separate graph, sketch the new relationship between the market price and the quantity demanded. Add in the supply curve and compute the market equilibrium.
- (g) At the market equilibrium with the subsidy in place, what is the total amount transferred to consumers by the government?
- (h) Now include the marginal social benefit curve into your new sketch. Has the subsidy from part (f) succeeded in achieving the socially optimal level of college degrees? If not, compute the deadweight loss associated with the new market outcome as compared to the socially optimal level and suggest a new subsidy which would achieve the desired outcome.
- (i) Suppose that the starting wage for entry-level jobs which require a college degree increases, but that the positive externality associated with each degree remains the same. How would you expect this to affect the government's optimal subsidy?
- (j) Suppose that a recent study demonstrates that the expansion of college campuses leads to a greater influx of activity for local businesses. Do you expect the socially optimal quantity of college degrees to be higher or lower than initially believed after learning of this change? Explain.

1. (a) A sketch of the market is given in the following figure:

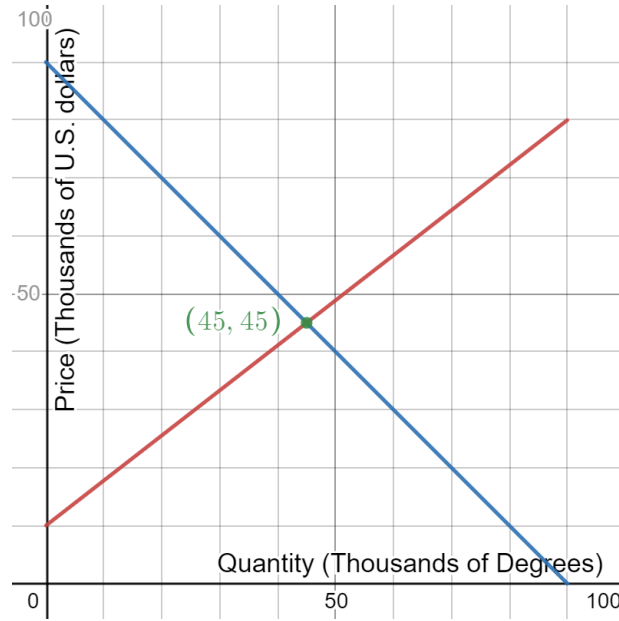


Figure 1: Supply and Demand for college degrees. Equilibrium price and quantity are 45.

- (b) Consumer and producer surplus are given in the following figure:

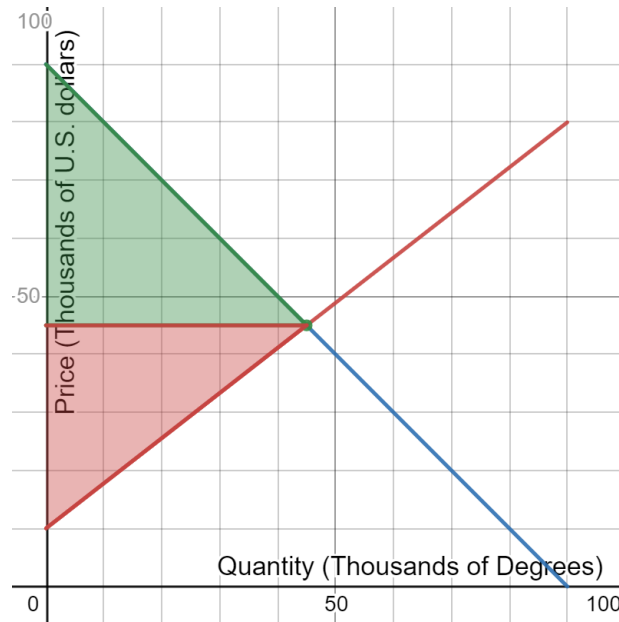


Figure 2: Consumer surplus (green), producer surplus (red)

Consumer surplus: $\frac{2025}{2}$ (in millions of U.S. dollars)
 Producer surplus: $\frac{1575}{2}$ (in millions of U.S. dollars)

(c) A sketch with the marginal social benefit curve is given below:

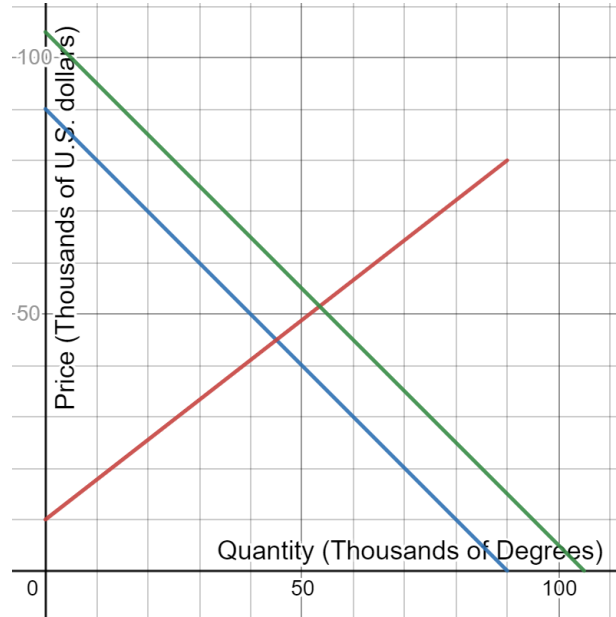


Figure 3: Marginal social benefit (green)

The socially optimal quantity is $Q = \frac{855}{16}$ (in thousands of degrees)

(d) We see from the sketch that the equilibrium quantity is lower than the socially optimal quantity.

(e) Deadweight loss is sketched in the following figure:

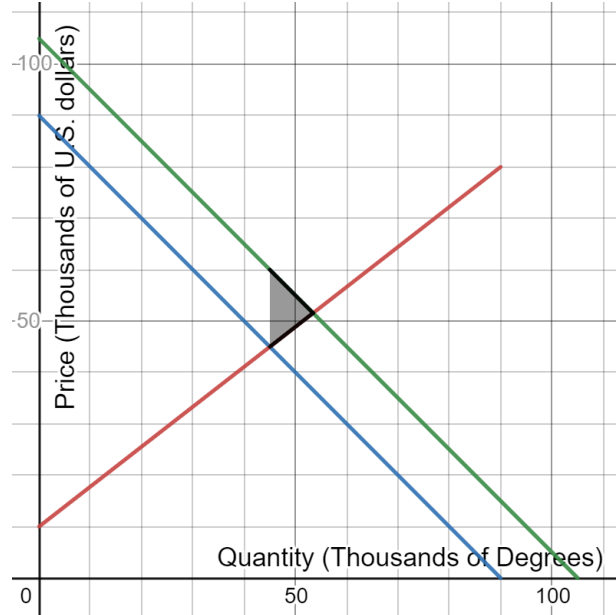


Figure 4: Deadweight loss (gray)

Deadweight loss is given by: $\frac{2025}{32}$ (in millions of U.S. dollars)

(f) The new relationship between market price and the new equilibrium is given in the following figure:

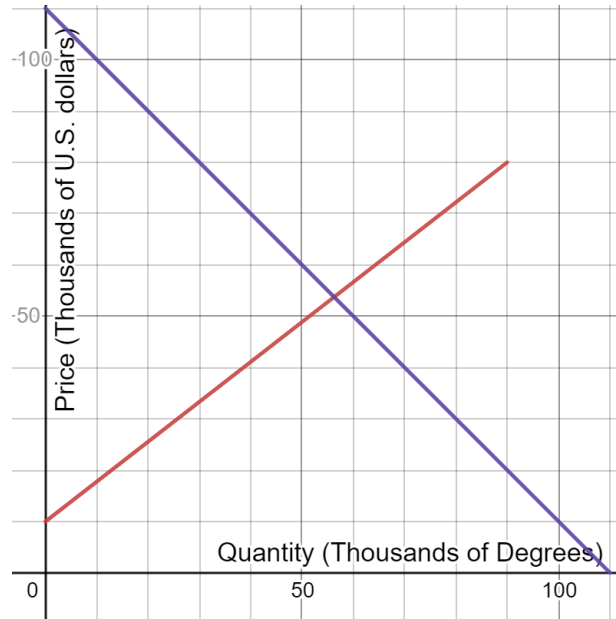


Figure 5: New relationship between pre-tax price and quantity demanded (purple)

The new equilibrium quantity is $\frac{225}{4}$ (in thousands of degrees) and the new equilibrium (total price) is $\frac{215}{4}$ (in thousands of dollars).

(g) Transfer to consumers are sketched in the following figure:



Figure 6: Total subsidy to consumers (purple shaded) and the original demand curve (blue)

The total transfer to consumers is: $\frac{4500}{4}$ (in millions of U.S. dollars)

(h) The sketch is given in the following figure:



Figure 7: Marginal social benefit (green), deadweight loss (grey)

Deadweight loss in this case is given by: $\frac{225}{32}$ (in millions of U.S. dollars). The correct subsidy in this case is the Pigouvian subsidy equal to the marginal externality. That is, the subsidy should be \$15 (in thousands of U.S. dollars).

- (i) We expect this change to result in a shift in the demand for college degrees. This change affects the marginal private benefit, which also shifts the marginal social benefit by the same amount. The crux of the problem is the fact that the marginal externality is unchanged. This implies that the optimal subsidy of \$15 (in thousands of U.S. dollars) is unchanged. So the answer is that this change does not affect the optimal subsidy.
- (j) The study indicates that the positive externalities associated with college degrees may be higher than initially thought. This suggests that the optimal quantity of degrees is even larger than the one found in part (c).