

Econ 102
Spring 2013
Homework 2
Due February 26, 2014

1. Market Demand and Supply

(Hint: this question is a review of material you should have seen and learned in Economics 101.) Suppose the market for snowshoes in Wisconsin is perfectly competitive. The market supply of snowshoes in the market is given by the equation $P = Q$ where P is the price per pair of snowshoes and Q is the quantity of pairs of snowshoes. The demand for snowshoes by consumers in Madison is given by the equation $P = 12 - Q$, and the demand by consumers in Milwaukee is given by the equation $P = 4 - \frac{1}{2}Q$.

- (a) If the only consumers for snowshoes in Wisconsin live in Madison or Milwaukee, what is the market demand for snowshoes in Wisconsin?

At a price above $P = 4$ and below $P = 12$, consumers in Milwaukee will demand 0 snowshoes, so the market demand in the price range from \$4 to \$12 consists only of demand from consumers in Madison. In other words, the market demand is $P = 12 - Q$. This can be written in terms of Q as $Q = P - 12$. At prices above $P = 12$, no one demands a positive quantity of snowshoes.

At prices below $P = 4$, consumers in both Milwaukee and Madison will demand a positive quantity of snowshoes. Therefore, the market demand is given by horizontally summing demand in Madison and Milwaukee. To do so, we must first put both demand equations in terms of Q :

$$\begin{aligned} P = 12 - Q &\Rightarrow Q = 12 - P \\ P = 4 - \frac{1}{2}Q &\Rightarrow Q = 8 - 2P \end{aligned}$$

Now we sum these equations to yield $Q = 20 - 3P$.

Market demand is therefore given by the following equation:

$$Q = \begin{cases} 20 - 3P & \text{if } P \leq 4 \\ 12 - P & \text{if } 4 < P \leq 12 \end{cases}$$

- (b) What is the equilibrium price and quantity in the market for snowshoes?

To find the equilibrium price, we must set each segment of the demand equation equal to the supply equation, $Q = P$. For the first segment, we get

$$P = 20 - 3P \Rightarrow 4P = 20 \Rightarrow P = 5$$

However, $Q = 20 - 3P$ only defines the demand equation for $P \leq 4$. Therefore, this cannot be the equilibrium point.

Now we do the same with the second segment of the demand equation:

$$P = 12 - P \Rightarrow 2P = 12 \Rightarrow P = 6$$

$P = 6$ is in the range for which $12 - P$ defines the demand equation ($4 < P \leq 12$), so this is the equilibrium price. Plug this back into the demand equation to get the equilibrium quantity $Q = 6$. When the snowshoe market in Wisconsin is in equilibrium, only the consumers in Madison buy snowshoes.

2. Graphing lines from points and using models to evaluate a policy

In the real world, firms and the government often do not know consumer demand. So, say a monopolist firm has experimented with different prices and recorded the quantities sold. Assume that all of these are points on the same demand curve. And that, after this experimentation, the monopolist learns the true demand curve, but the government does not know the true demand curve. You can assume in this problem that the government does have access to the information in the table below.

Price	Quantity
24	1
21	2

The government would like to implement a unit or excise tax of T dollars per unit of output (possibly, a negative tax, or subsidy) so that the firm produces 3 units of output.

- (a) Based on this information, the government wants to guess a linear demand curve that goes through both of these points. What is the equation of the guessed demand curve written in y-intercept form (this form of the equation is the inverse demand curve): $P = a + bQ$ (find: a and b)?

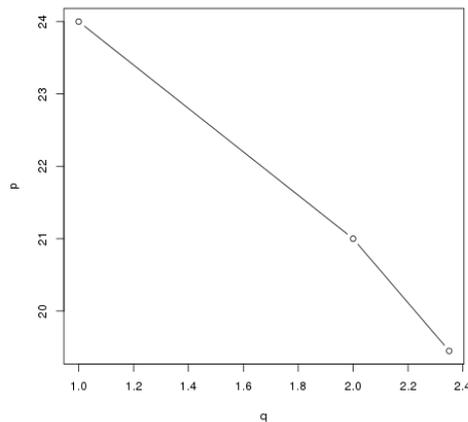
We know two points of the inverse demand curve (1,24) and (2, 21). So, if we want to find the line that goes through these two points, we first need to find the slope, b .

$$b = \text{rise} / \text{run} = (24-21) / (1-2) = -3.$$

Then, we find the intercept so that (1,24) lies on a line with a slope of -3.

$$24 = a + (-3)(1) \Rightarrow 27 = a.$$

So, the guessed inverse demand equation based on this information is: $P = 27 - 3Q$.



- (b) Say, the monopolist has marginal cost: $MC = Q$ (and the government knows this). Recall that for a linear demand curve in the form $P = a + bQ$, a monopolist's marginal revenue is $MR = a + 2bQ$. A profit-maximizing firm produces where $MR = MC + T$. So, say the government believes the demand is given by the line you found in part (a), and wants the firm to produce 3 units of output. What tax does the government decide to charge given this information?

Since the demand curve in slope-intercept form is $P = 27 - 3Q$, the marginal revenue line is $MR = 27 - 6Q$. Then, the profit-maximizing condition is:

$$27 - 6Q = Q + T \Rightarrow \text{for } Q = 3, \text{ we need: } 27 - 18 = 3 + T \Rightarrow T = 6.$$

So, the government should impose a tax of \$6 per unit in order to get the firm to produce 3 units of output.

- (c) When it implements this tax, to the government's surprise, the firm sells 2.3 units and charges a price of \$19.45 (what the consumer pays). Is this what the experimental linear demand predicted? Plot the three points you now have for the demand function and connect each point with a line segment (you do not have to be that precise with the graph). What is the rough shape of the function you have drawn?

No, the linear demand predicted that the firm would produce 3 units, but instead the firm produced far less. The demand curve looks roughly concave or, in other words, bowed out a bit from the origin.

- (d) Suppose the true demand curve in slope intercept form is given by the equation: $P = (5 - Q)(5 + Q)$. Find the true tax T needed to ensure an output of 3 units. **Hint: the optimal output for the firm as a function of the tax T solves the following quadratic equation: $(25 - T) - Q - 3Q^2 = 0$. Also, since the demand equation is different, the MR equation will also be different: $MR = 25 - 3Q^2$.**

The profit maximizing condition requires that $MC + T = MR$. So, $Q + T = 25 - 3Q^2$. Or, $25 - T = Q + 3Q^2$. Plug-in $Q = 3$ into the profit-maximizing condition, and we get: $25 - T = 3 + 27 = 30 \Rightarrow T = -5$.

So, the government should have provided a *subsidy* of \$5 per unit if it wanted to ensure an output of three units, but when using the linear demand model the government decided to impose a *tax* of \$6 per unit.

The purpose of this exercise is to show that choosing the best policy is a difficult problem and relies crucially on the assumptions made in the model.

3. International Trade

Consider the market for ice skates in Icebergland. Domestic demand and supply are given by the following equations:

$$P = 20 - \frac{1}{10}Q^D$$

and

$$P = 2 + \frac{1}{20}Q^S,$$

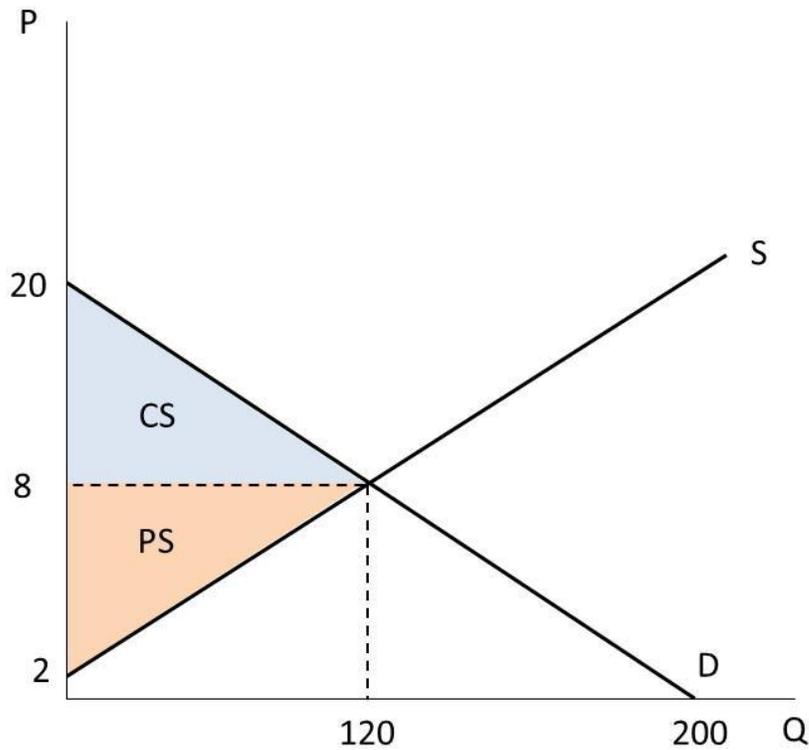
where P is the price of ice skates in dollars and Q is the quantity of ice skates in pairs.

- (a) Suppose Icebergland is in autarky (that is, Icebergland is a closed economy). Find the equilibrium price and quantity in the market for ice skates. What are the values of producer and consumer surplus in the market for ice skates? Show your answers on a graph.

To find the equilibrium set the demand equation equal to the supply equation: $20 - (1/10)Q = 2 + (1/20)Q$ or $400 - 2Q = 40 + Q$ or $Q^* = 120$ and $P^* = \$8$.

$$CS = \frac{1}{2} * (20 - 8) * (120) = \$720$$

$$PS = \frac{1}{2} * (8 - 2) * (120) = \$360$$

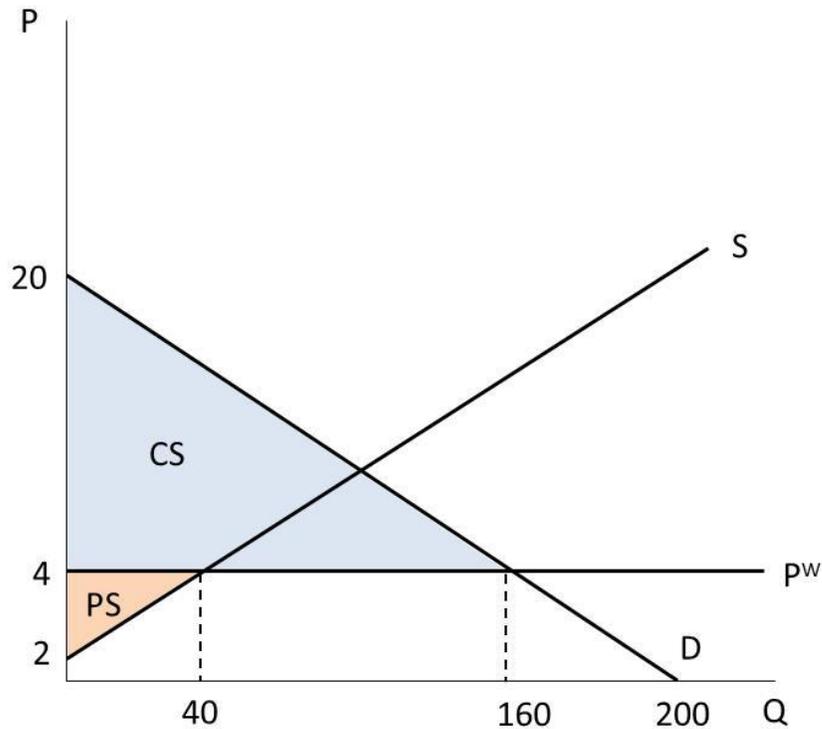


(b) Suppose the world price for ice skates is \$4 per pair. Suppose that Icebergland opens its market for ice skates to world trade. How many pairs of ice skates do domestic firms produce and how many pairs do domestic consumers consume? How many pairs are exported or imported? What are the values of domestic consumer and producer surplus in the ice skates market once this market is open to trade? Show your answers on a graph.

$$P^* = \$4, Q^{S^*} = 40, Q^{D^*} = 160, \text{ and } Q^{IM} = 120$$

$$CS = \frac{1}{2} * (20 - 4) * (160) = \$1,280$$

$$PS = \frac{1}{2} * (4 - 2) * (40) = \$40$$



- (c) Now suppose that the government of Icebergland imposes a tariff of \$1 for each pair of ice skates that is imported. Now how many pairs of ice skates are produced and consumed domestically? How many are imported or exported? What are the consumer and producer surpluses, deadweight loss, and government revenue from the tariff? Show your answers on a graph.

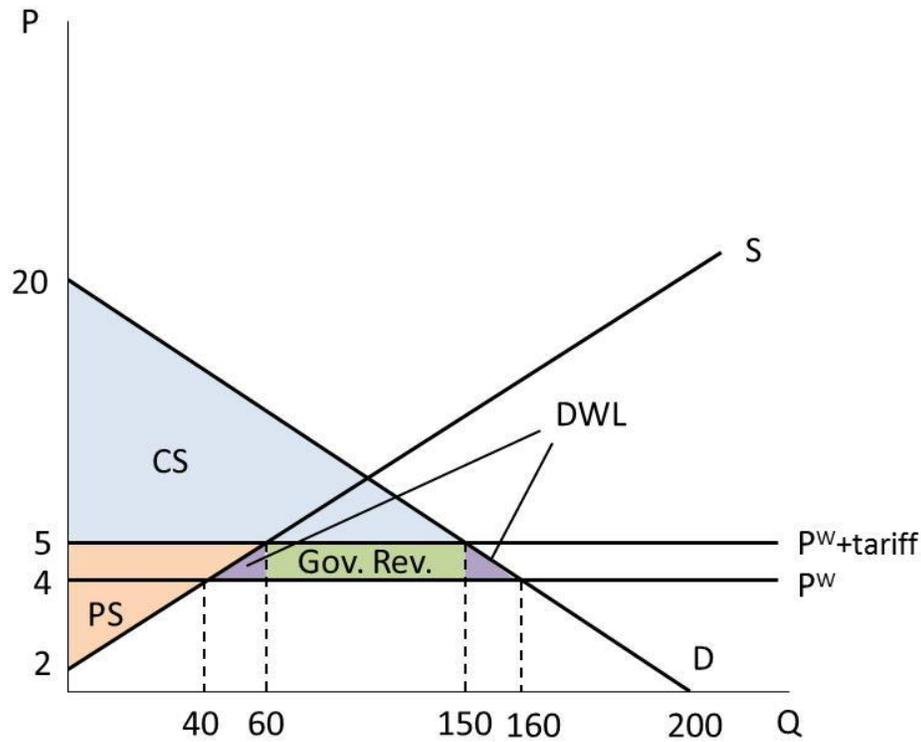
$$P^* = \$5, Q^{D^*} = 150, Q^{S^*} = 60, \text{ and } Q^{IM} = 90$$

$$CS = \frac{1}{2} * (20 - 5) * (150) = \$1,125$$

$$PS = \frac{1}{2} * (5 - 2) * (60) = \$90$$

$$\text{Gov. Revenue} = \$1 * (150 - 60) = \$90$$

$$DWL = \frac{1}{2} * (5 - 4) * (60 - 40) + \frac{1}{2} * (5 - 4) * (160 - 150) = \$15$$



- (d) Suppose that instead of a tariff, the government of Icebergland imposes an import quota of 60 pairs of ice skates. Now how many pairs of ice skates are produced and consumed domestically? How many are imported? What are the domestic producer and consumer surpluses, deadweight loss, and government revenue from the tariff? Show your answers on a graph.

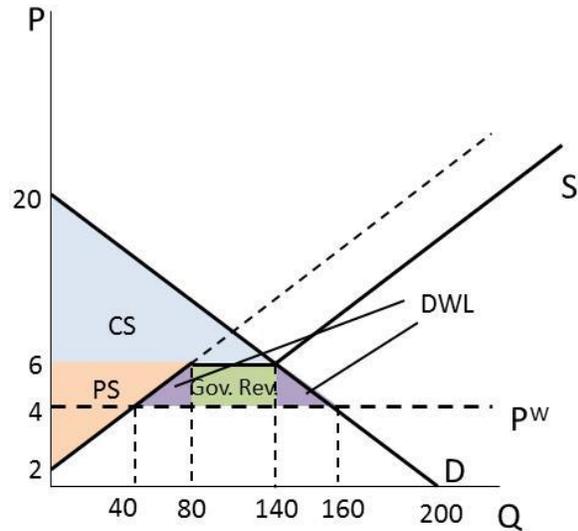
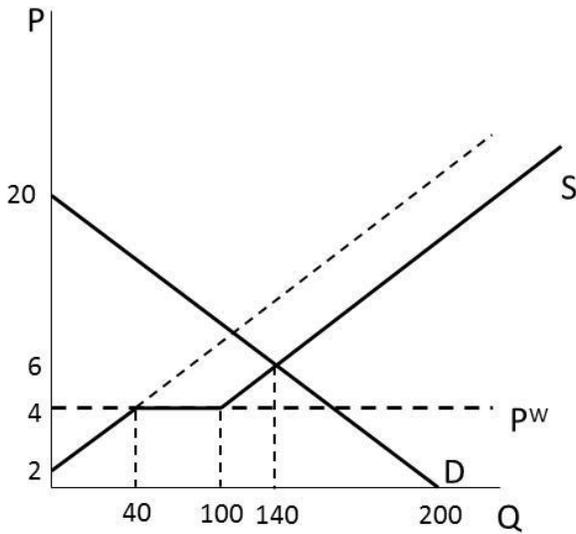
$$P = \$6, Q^{D*} = 140, Q^{S*} = 80, \text{ and } Q^{IM} = 60$$

$$CS = \frac{1}{2} * (20 - 6) * (140) = \$980$$

$$PS = \frac{1}{2} * (6 - 2) * (80) = \$160$$

$$\text{Gov. Revenue} = (6 - 4) * (140 - 80) = \$120$$

$$DWL = \frac{1}{2} * (6 - 4) * (80 - 40) + \frac{1}{2} * (6 - 4) * (160 - 140) = \$60$$



4. Computing GDP

In Catan, to build a road you need 1 unit of wood and 1 unit of brick. All objects are valued in terms of ore. Their prices are given in the table below for the years 2011 and 2012.

	Wood	Brick	Road
2011	1 ore	5 ore	10 ore
2012	1 ore	1 ore	4 ore

Say 1 road was purchased in 2011 and 2 roads were purchased in 2012.

- (a) Compute GDP in 2011 using the expenditure approach, then using the factor payments approach, and, lastly, the value-added approach.

Expenditure approach: $C = 10. \Rightarrow Y = C + I + G + (X-M) = 10$, since there is no investment, trade, or government spending here.

Factor payments: 1 (cost of wood) $+ 5$ (cost of brick) $+ 4$ (profits) $= 10$.

Value-added: 1 (value-added by wood producer) $+ 5$ (value-added by brick producer) $+ (10-5-1)$ (value-added by road producer) $= 10$.

- (b) Compute GDP in 2012 using the expenditure approach, then using the factor payments approach, and, lastly, the value-added approach.

Expenditure approach: $C = 2 \times 4 = 8$.

Factor payments: 2×1 (wood) + 2×1 (brick) + $(4-2) \times 2$ (profits) = 8

Value-added: 2×1 (value-added by wood producer) + 2×1 (value-added by brick producer) + $2 \times (4 - 1 - 1)$ (value-added by road producer) = 8.

(c) What is the growth rate of nominal GDP from 2011 to 2012?

Growth rates are calculated by: $(\text{Current} - \text{Past}) / \text{Past}$. Or:
 $(8 - 10) / 10 = -20\%$.

(d) Is there more output in Catan in the year 2011 or in 2012? Explain your answer in light of part (c).

There is more output in the year of 2012. Remember: two roads were built in 2012 and only one was built in 2011, so the economy produced more roads in 2012. This is true even though nominal GDP decreased from 2011 levels. Why? In this problem we calculated nominal GDP—not real GDP. The goods in this problem have different prices in 2011 and 2012. This decrease in (nominal) GDP is not due to a decrease in output, but a decrease in price.

5. Unemployment

(a) There are 150,000 citizens in Palmville who are age 16 and older. Of these citizens, 120,000 participate in the labor force and 90,000 are employed. What are Palmville's unemployment and labor force participation rates?

$$LFPR = \frac{120,000 \text{ people}}{150,000 \text{ people}} \times 100 = 80$$

$$\text{UnemploymentRate} = \frac{30,000 \text{ people}}{120,000 \text{ people}} \times 100 = 25$$

(b) In Gnomesburg, labor supply and demand are given by the following equations:

$$W = 2 + 2Q^S$$

and

$$W = 20 - Q^D$$

where W is the wage and Q is quantity of labor in thousands of workers.

What minimum wage would give structural unemployment of 6,000 workers?

Structural unemployment of 6,000 workers means that the labor supply is greater than labor demand by 6,000 workers at the wage that prevails in the market. In other words,

$$Q^D + 6 = Q^S.$$

Since Q^D does not equal Q^S , we cannot set $Q^D = Q^S = Q$ and set the supply and demand equations equal. However, we can plug the equation we just wrote above into the supply or demand equation and then solve. Let's plug it into the supply equation:

$$W = 2 + 2(Q^D + 6) = 2Q^D + 14$$

Now setting this equal to the demand equation yields $Q^D = 2$. We plug this back into the demand equation to solve for the wage and find that $W = \$18$. Therefore, it must be the case that $W^{\text{MIN}} = \$18$