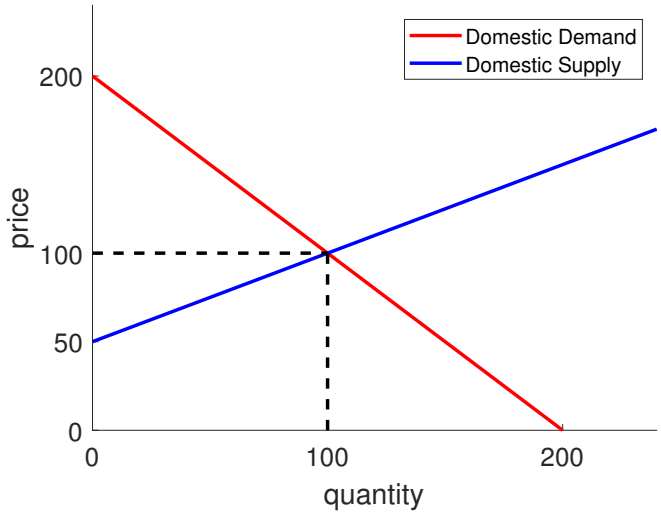
Problem 1. Suppose US demand for steel is given by $P = 200 - Q$, US supply for steel is given by $P = 50 + Q/2$, and international firms can supply as much or as little steel as they want at a price of $P_w = 80$.

(a) Draw the supply and demand diagrams without international trade, and determine the equilibrium price and quantity.

Solution. In the absence of international trade, just look at the intersection of supply and demand. You get $P^* = 100$ and $Q^* = 100$.

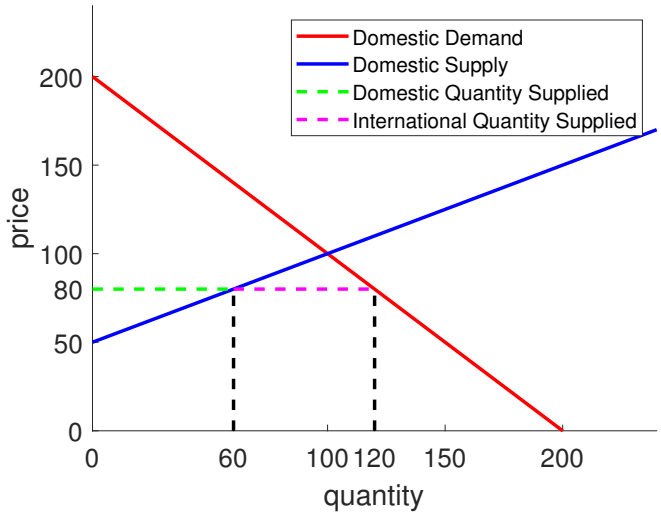


Note that consumer surplus is $\text{CS} = 0.5(200 - 100)100 = 5000$ and producer surplus is $\text{PS} = 0.5(100 - 50)100 = 2500$, so total surplus is $\text{TS} = 5000 + 2500 = 7500$.

(b) Draw the supply and demand diagrams with international trade, and determine the equilibrium domestic price, domestic quantity supplied, and imported quantity.

Solution. Draw the international price of $P_w = 80$. Domestic firms can't have a price higher than 80 because otherwise all consumers would just buy from international firms. Therefore firms will charge a price of at most 80. And at a price of 80, domestic firms are willing to produce 60 units. However, at a price of 80 domestic consumers want 120 units. Ergo domestic firms will produce 60 units and domestic consumers will import the remaining quantity demanded $120 - 60 = 60$ from internationally-produced units.

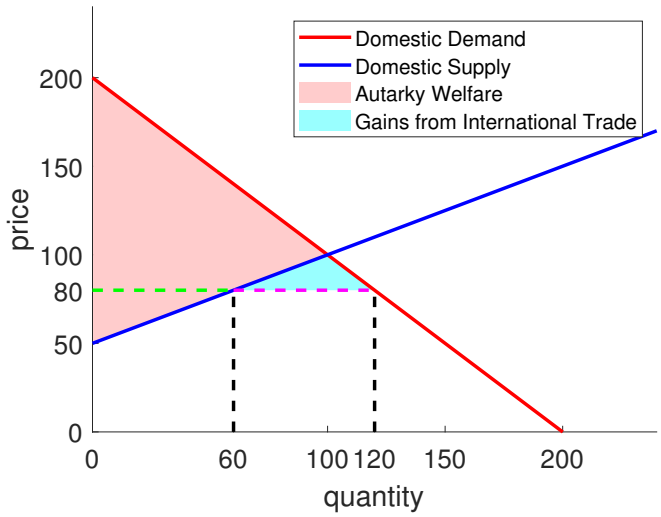
In the diagram below, the green dashed line is the quantity of domestic production and the magenta dashed line is the quantity of imports.



(c) In terms of US welfare, is society better with or without international sales?

Solution. Society is better off with international sales. Without international trade, the welfare area is between demand and supply up to their intersection. With international trade, there's an additional welfare area.

Specifically, consumer surplus is now $\text{CS} = 0.5(200-80)120 = 7200$, domestic producer surplus is now $\text{PS} = 0.5(80-50)60 = 900$, and therefore total surplus is now $\text{TS} = 8100$. International trade helps domestic consumers, hurts domestic producers, and overall welfare is higher by 600. The increase in total surplus is shown by the blue triangle below.



Also note that international firms are better off with trade as well, since they can trade things and therefore earn additional producer surplus. Overall the US is better off with trade, as is the rest of the world; but domestic firms have an incentive to prevent trade.

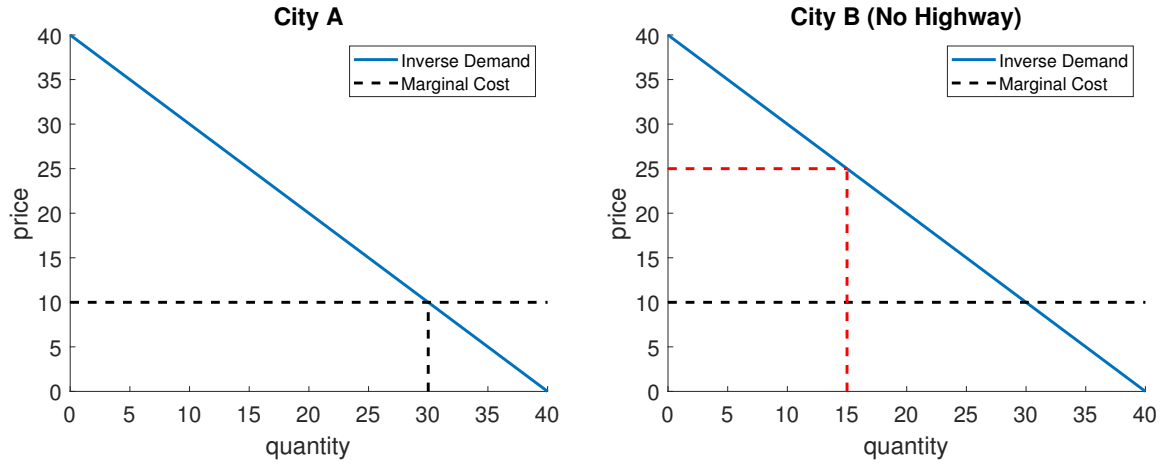
Problem 2. Little Debbie Honey Buns are sold by grocery stores in City A and City B. The inverse demand curve in City A is $P_A = 40 - Q_A$, and in City B is $P_B = 40 - Q_B$. City A is served by a group of perfectly competitive grocery stores, whereas City B is served by a single grocery store. Grocery stores can purchase as many Honey Buns from Little Debbie as they want at wholesale price $P_w = 10$.

(a) What will be the market price and quantity of Honey Buns in each location? Calculate consumer surplus and producer surplus.

Solution. First note that the marginal cost for a grocery store to acquire one more Honey Bun is the price it has to pay the upstream firm Little Debbie, $P_w = 10$.

For City A with perfect competition, it follows that $P_A^* = \text{MC} = 10$, which implies $Q_A^* = 30$. Consumer surplus is $\text{CS}_A = 0.5(40-10)30 = 450$ and producer surplus is $\text{PS}_A = 0$.

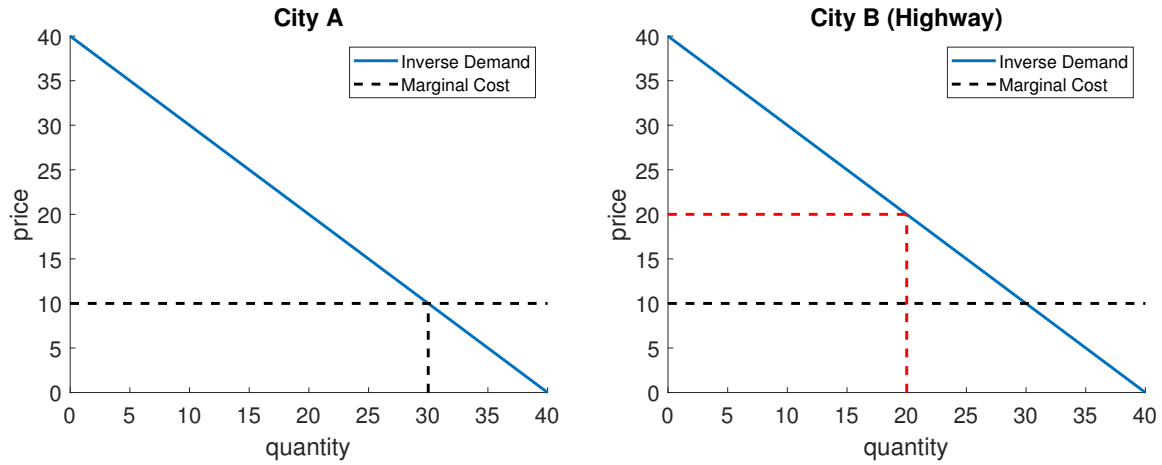
For the City B monopoly grocery store, we'll have MR = MC. Marginal revenue is given by $\text{MR} = 40 - 2Q_B$. Therefore $40 - 2Q_B := 10$ implies $Q_B^* = 15$ and $P_B^* = 25$. Consumer surplus is $\text{CS}_B = 0.5(40-25)15 = 112.5$ and producer surplus is $\text{PS}_B = (25-10)15 = 225$.



(b) A large highway is built between City A and City B. Individuals can drive between the two locations at a cost of 5 in each direction, so a total transportation cost of 10. Would the new highway affect the prices of Honey Buns sold in the two cities?

Solution. City A prices are entirely determined by $P = \text{MC} = 10$ because of perfect competition, so a highway isn't going to make a difference; it's not like you can have more than perfect competition.

City B however is now facing competition that it wasn't before: consumers in City B can go to City A and buy for a total of \$20, that is, \$10 for the good and \$10 for the cost of travel. It follows that if the City B firm charges any higher than \$20, then all City B consumers would rather just go buy in City A. Therefore City B will charge the highest price it can, $P_B = \$20$.



(c) Calculate the gain and/or loss in producer and consumer surplus in both City A and City B that would result from the construction of the highway.

Solution. Nothing would change in City A because it was perfect competition before and perfect competition after: same demand curve, same price, same quantity, same surpluses.

After the highway, City B's consumer surplus is $CS'_B = 0.5(40-20)(20) = 200$ and its producer surplus is $PS'_B = (20-10)20 = 200$. Therefore CS changes by $200 - 112.5 = 87.5$ and PS changes by $200 - 225 = -25$. The highway, because it in a sense forces the monopolist in City B to face some competition, helps City B consumers but hurts the City B grocery store. Overall City B welfare increases from the highway.

(d) Briefly explain what the Economic Theory of Regulation would say about whether or not we should expect the highway to be constructed.

Solution. The Economic Theory of Regulation states three things:

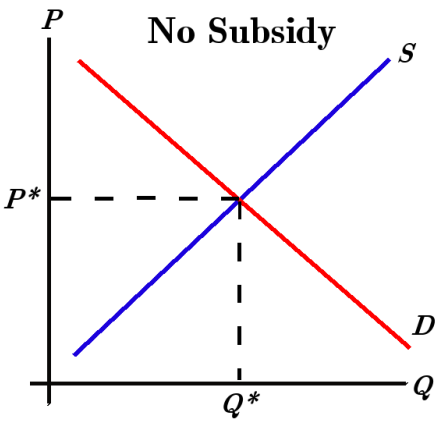
- Interest groups will lobby the government to get the government to impose favorable policies;
- Interest groups that benefit more from lobbying will lobby more;
- Interest groups that are concentrated should have better incentives to lobby the government (e.g. residual claimancy).

The City B monopolist suffers from the construction of the highway, so it has an incentive to lobby against highway construction; and because a monopoly is very concentrated, it will likely lobby harder than anyone else and will quite possibly succeed in preventing highway construction.

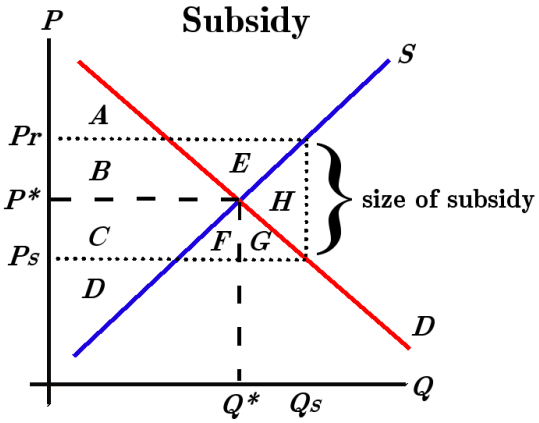
Problem 3. Here, have some true/false questions.

(a) Since subsidies increase producer and consumer surplus, subsidies increase welfare.

False. Subsidies require government spending (which must be taxed from someone), and that government spending is larger than the combined increase in producer and consumer surplus. Therefore welfare falls, as crudely illustrated in my MS Paint diagrams below. P^* and Q^* are the free-market equilibria; P_s and Q_s are the market prices with the subsidy; P_r is the (subsidized) price received by the firm. The deadweight loss with a subsidy is the area H, entering TS with a negative sign.



$CS = A+B$
$PS = C+D$
$TS = A+B+C+D$



$CS = A+B+C+F+G$
$PS = B+C+D+E$
$GS = B+C+E+F+G+H$ (subtract)
$TS = A+B+C+D-H$

(b) A city wants to increase tax revenue by taxing local firms. All else equal, it should tax firms that sell goods that are hard to import rather than firms that sell goods that are easy to import.

True. Taxing easily imported goods is more prone to *leakage*: if local firms are taxed, then they can just move production elsewhere, not have to pay a tax, and export the goods back to the city. In this scenario, the city generates no tax revenue because the firm left the city and therefore the city does not actually tax the firm.

(c) Leakage is likely to be a bigger problem if firms in two neighboring jurisdictions are Bertrand rather than Cournot competitors.

True. Suppose Firm A is located in City A and Firm B is located in City B, but othrewise the firms are identical. Each firm charges $P_A^* = P_B^* = \text{MC}$ and splits demand as a consequence of Bertrand competition.

Later on, City A imposes a per-unit pollution tax t on Firm A. This means Firm A's (after-tax) marginal costs have increased, so it has no choice but to increase its price to at least $P_A = \text{MC} + t$, otherwise it will earn negative profit. But when Firm A increases its price above MC, it loses *all* of its demand to Firm B because Firm B can

still charge $P_B < \text{MC} + t$. Therefore leakage is complete: all production winds up in unregulated City B.

Cournot competition is not all-or-nothing in the way that Bertrand competition is. So when Firm A raises its price to account for the tax, it loses only some business, and therefore leakage is only partial.

(d) Neighboring states setting environmental regulations can be modeled as a prisoner's dilemma.

True. If both states tried to do regulation, then one state could benefit by repealing their regulation, thereby stealing businesses away from the state that does do regulation. As long as the benefit of stealing the other state's business exceeds the cost of having unregulated pollution, then the Nash equilibrium will be no regulation, even if both states would be better off if they both regulated pollution relative to both not regulating.

Consider the following situation.

- If both City A and City B choose to have no pollution tax, then they both get social welfare of 100.
- If both choose to have a pollution tax, then they both gain 20 social welfare, bringing their total welfare 120.
- If City A chooses to tax and City B chooses no tax, then City A gains 20 welfare from cleaning up pollution, but loses 40 business to City B, thereby receiving total welfare of $100 + 20 - 40 = 80$. City B receives total welfare $100 + 40 = 140$ from stealing business away from City A.
- If City B chooses to tax and City A chooses no tax, the outcome is symmetric.

The corresponding payoff matrix is shown below with best responses underlined.

		City B	
		no tax	tax
City A	**no tax**	**<u>100</u>, <u>100</u>**	<u>140</u>, 80
	tax	80 , <u>140</u>	120, 120

The only Nash equilibrium is the outcome in which both cities choose no tax, even though both would benefit if they were to both have a tax: classic prisoner's dilemma.

(e) The government is regulating an economy-wide externality and chooses the point where its estimate of the MCA and MBA curves cross. If the true MCA is below the MCA curve used by the government to set policy, then we will get too little abatement using either a tax or tradeable permits.

False. This is similar to what you did on problem set 6, but backwards. If the true MCA curve is lower than the one the policymakers use, then a tax would be set too high and there would be over-abatement as consequence; or too many permits would be issued and there would be under-abatement as consequence.