Economics 2
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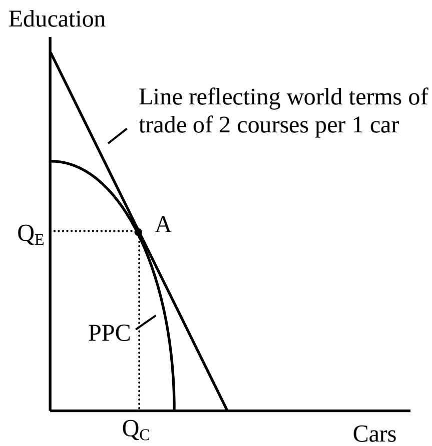
Professor Christina Romer
Professor David Romer

SUGGESTED ANSWERS TO PROBLEM SET 3

1.a. When workers in a country differ in ability, we cannot draw the PPC for a typical worker. Instead, we need to draw the PPC for the whole country. The PPC will be curved to reflect the fact that the opportunity cost of an output rises as more is produced. The opportunity cost of producing an output rises because we will organize production so that the lowest-opportunity-cost resources are used first, the next lowest second, and so on.



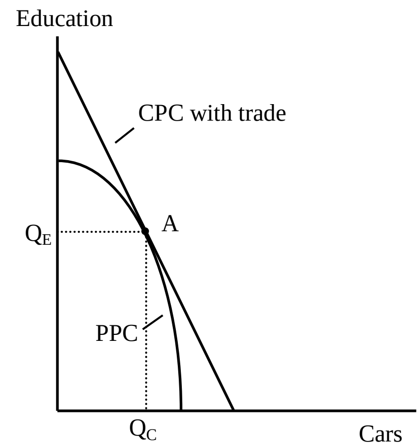
There is nothing in the problem that tells us the precise shape of the curved PPC. If we make the realistic assumption that the U.S. is on average relatively better at producing education than cars, the curved PPC for the U.S. (with cars on the horizontal axis and education on the vertical axis) will have a somewhat tall, thin shape. But the PPC could be fairly symmetric (if the U.S. is roughly equally good at producing courses and cars) or have a somewhat short, fat shape (if the U.S. is on average relatively better at producing cars than higher education).

If the world price of a car is $20,000 and the world price of a course is $10,000, the terms of trade in world markets is 2 courses for 1 car. A country with rising opportunity costs wants to produce an output up to the point where its domestic opportunity cost is equal to its opportunity cost in world markets. At levels of production where the domestic opportunity cost is less than the world opportunity cost, the country can have more of the output by producing it domestically than by producing something else and trading for the output. Only when the domestic opportunity cost is equal to the opportunity cost in world markets can the country reap no more gains from specialization. In our diagram, the U.S. wants to produce where a line reflecting the world terms of trade of 2 courses for 1 car is just tangent to the PPC. This occurs at point A. This is the point where the domestic opportunity cost of a car is equal to the terms of trade in world markets. At point A, the U.S. is producing quantity Q_E of education and quantity Q_C of cars.

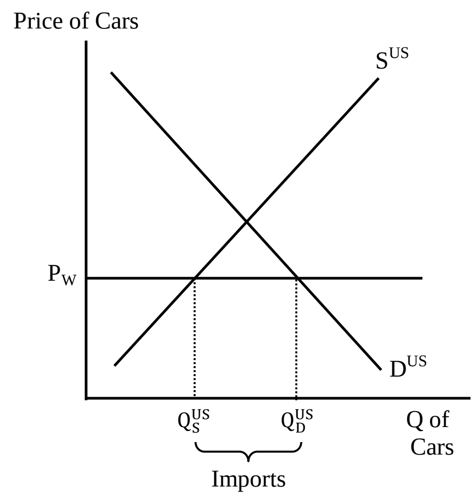
Notice that with a somewhat tall, thin shape of the curved PPC, the U.S. wants to produce relatively few cars and relatively many courses. This is because the U.S. has an opportunity cost for courses that is lower than the world terms of trade up to a high level of course production. In this sense the U.S. has a comparative advantage in course production: up to quite high levels of production, it is the low-opportunity-cost producer.

b. The consumption possibilities curve with trade (CPC) shows the combinations of courses and cars that the U.S. can purchase on world markets when it trades its domestic production at the prevailing terms of trade. Since it shows how the U.S. can trade on world markets, its slope is determined by the world terms of trade. In our example, the world terms of trade is 2 courses for 1 car, and so the CPC has a slope of -2. And since one combination of cars and courses we can have is the combination we produce, it goes through that combination—that is, it goes through point A of the diagram in the answer to part (a). Thus, the CPC with trade is the same as the line drawn in the answer to part (a): it is a line with a slope that reflects the world terms of trade and that is just tangent to the PPC. The trade-off in the world market does not vary with production (so the CPC has a constant slope) because we assume that any one country is small relative to the rest of the world. Therefore, changes in the quantity of a good either supplied or demanded by a country will not affect the world terms of trade.

We know the value of the cars and higher education at point A: it is $\$20{,}000 \cdot Q_C + \$10{,}000 \cdot Q_E$. Along the CPC, the U.S. is trading 2 courses, which together have a value of $20,000, for each car, which also has a value of $20,000. Thus, the total value of every combination of cars and courses along the CPC is the same as at point A, which is $\$20{,}000 \cdot Q_C + \$10{,}000 \cdot Q_E$. One way to think about point A is that it shows the feasible combination of domestic production of the two outputs with the highest value on the world market. This domestic production combination is the endowment that the country brings to the world market to trade at the world terms of trade. The country can then trade for any other combination of the two outputs with the same value in the world market.



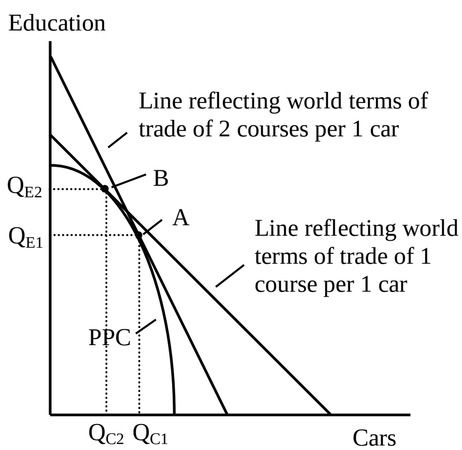
c. A supply and demand diagram with the world price can capture the same decision reflected by the point of tangency between the curved PPC and the line showing the world terms of trade. Consider the market for cars in the U.S. There is an upward sloping domestic supply curve (S^{US}). Its upward slope reflects the fact that the opportunity cost of producing cars rises in the U.S. as more are produced because workers within the country differ in ability. There is a downward sloping domestic demand curve (D^{US}) that shows that American consumers want more cars (from all sources) when the price of cars is lower than when the price is higher. When there is a large world market, we can think of there being an infinitely elastic world supply of cars at the prevailing world price (P_W). This just means that we can buy as many cars as we could plausibly want from other countries without changing the world price.

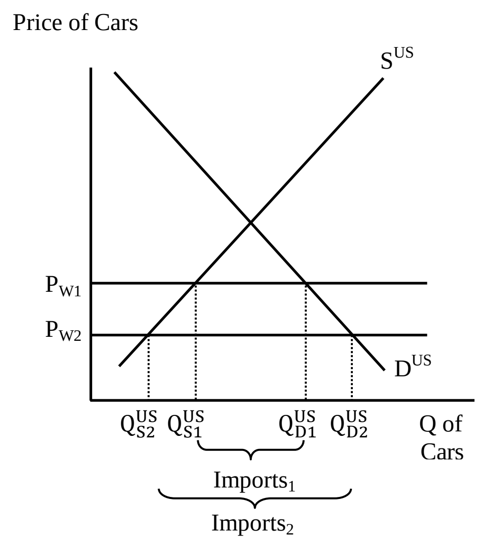


The point of intersection between the line showing the world price and the American supply curve shows the quantity of cars the U.S. wants produces domestically (Q_S^{US}). This is the quantity of cars that corresponds to the quantity at point A in part (a). It is the quantity of cars where the domestic opportunity cost of a car is equal to the opportunity cost of a car in world markets. American consumers want to consume where the world price line intersects the domestic demand curve (Q_D^{US}). At this point, the marginal benefit of another car is just equal to the world price. We have drawn the diagram so that the quantity of cars American consumers demand at the world price is greater than the quantity of cars American firms supply at that price. This reflects the assumption in the problem that the U.S. is an importer of cars.

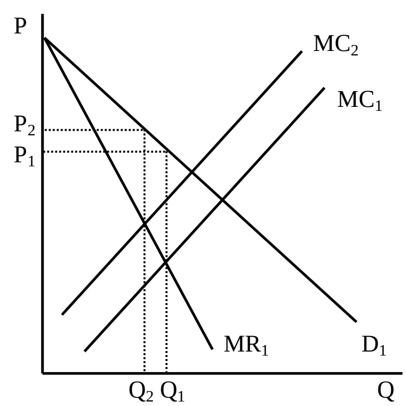
d. If the world price of a car falls to \$10,000, while the world price of courses remains at \$10,000, this implies that the terms of trade between courses and cars has changed from 2 courses for 1 car to 1 course for 1 car. The fall in the opportunity cost of cars in world markets will make the U.S. produce fewer cars. This fact can be seen both in the diagram with the PPC and a line showing the world terms of trade and in the supply and demand diagram with trade. In the PPC diagram (the left-hand diagram below), the fall in the price of cars implies that the line showing the world terms of trade has gotten flatter. It now has a slope of −1 instead of −2. The U.S. wants to produce any cars for which the domestic opportunity cost is lower than the trade-off in the world market. Because the trade-off in the world market has fallen, the level of car production where domestic opportunity cost is equal to the trade-off in the world market is now smaller than before. The new terms of trade line is now tangent to the PPC at point B, which has a smaller quantity of cars than before (and a larger amount of education).

In the supply and demand diagram with trade (the right-hand diagram), the fall in the world price of cars is represented by a shift down in the world price line (from P_{w1} to P_{w2}). The U.S. produces where the new world price line intersects U.S. the supply curve. This occurs at quantity Q_{S2}^{US}. The fall in the world price decreases domestic production and increases domestic consumption. The result is an increase in U.S. car imports (from Imports_1 to Imports_2).

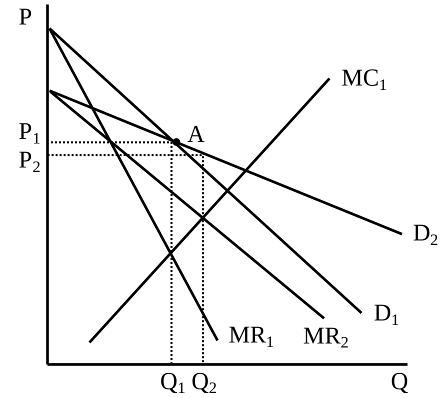




2.a. The rise in the price of an input increases the monopolist's cost of producing each additional unit of output. As the result, the monopolist's marginal cost curve shifts up (from MC_1 to MC_2 in the diagram). As a result, at the old profit-maximizing level of output (Q_1 in the diagram), marginal revenue is now less than marginal cost. The monopolist can therefore increase its profits by reducing output. To put it another way, the level of output where MR = MC is lower than before. The monopolist therefore reduces the amount it produces (from Q_1 to Q_2 in the diagram.)



We can also tell what happens to price: because the quantity falls and the demand curve has not shifted, the price charged by the monopolist rises (from P_1 to P_2).



b. The problem says that the demand curve becomes flatter but still goes through the point on the original demand curve where the monopolist was initially producing. The initial demand curve is D_1. Marginal revenue and marginal cost were equal at Q_1, and so the monopolist was charging P_1. Thus, the monopolist was producing at point A. The new demand curve is flatter but still goes through A. This is curve D_2 in the diagram.

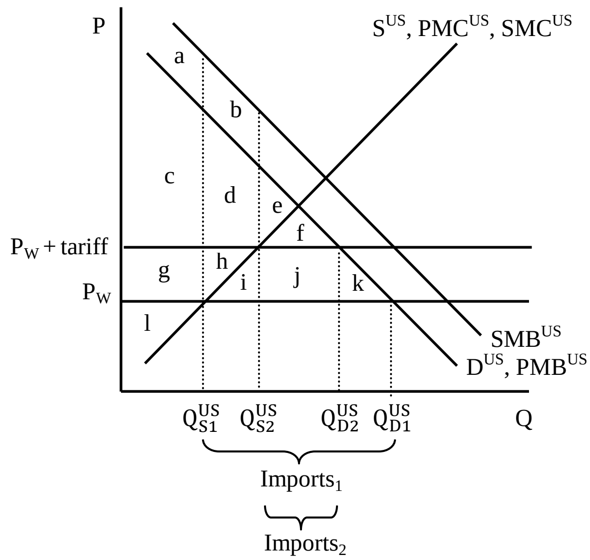
The change in the slope of the demand curve has the effect that at the old level of output, marginal revenue is higher than before. There are several ways to see this. One is to consider both the positive and the negative component of marginal revenue at the old level of output. When the monopolist sells one more unit, it receives the price of that unit, which contributes positively to marginal revenue. But in order to sell that unit, the monopolist has to charge slightly less on all the units it was previously selling; that is, to sell one more unit, the monopolist has to move down its downward sloping demand curve.

Since the new demand curve crosses the old demand curve at the point where the monopolist was initially producing, at that level of output the first component of marginal revenue—the price the monopolist charges for one more unit—is the same with the old and new demand curves. But when demand is more elastic, the amount the monopolist needs to cut its price to sell that additional unit is less than before. That is, the negative component of marginal revenue is smaller than before. With the positive component unchanged and the negative component smaller, overall marginal revenue (the positive component minus the negative component) is larger than before. (Another way to see the change in marginal revenue at the old level of output is to draw the diagram carefully.)

Since marginal revenue now exceeds marginal cost at the old level of output, the monopolist wants to produce more than before. The profit-maximizing level of output is now Q_2, which is larger than Q_1, and the monopolist now charges P_2, which is less than P_1. Intuitively, when demand becomes more elastic, the monopolist gains less by producing below the amount that would be produced in a competitive market, and so it raises its output.

3.a. To answer this question we need to draw the supply and demand diagram for tablet PCs in the United States. There is a normal upward-sloping supply curve for U.S. producers, which is also both the private and social marginal cost curves (S^{US}, PMC^{US}, SMC^{US}). There is a normal downward-sloping demand curve for U.S. consumers, which is also the private marginal benefit curve (D^{US}, PMB^{US}). Because there is a positive externality, there is a social marginal benefit curve in the U.S. (SMB^{US}), which is above the private marginal benefit curve. On any tablets that we ***produce*** in the U.S., we get some extra marginal benefit, such as knowledge spillovers and induced technological progress.

The problem states that there is free international trade and that the world price of tablets is below the equilibrium level that would prevail if the U.S. were a closed economy. American consumers choose to consume where the U.S. demand curve intersects the world price line (Q_{D1}^{US}). American producers choose to produce where the U.S. supply curve intersects the world price line (Q_{S1}^{US}). We import the difference between Q_{D1}^{US} and Q_{S1}^{US}. This is shown in the diagram on the next page.



American consumer surplus is the area between the U.S. demand curve and the world price, up to the level consumed in the U.S. American producer surplus is the area between the world price and American marginal cost, up to the level produced in the U.S. The external benefits are the area between the U.S. social marginal benefit curve and the U.S. private marginal benefit curve, up to the level produced in the U.S. The welfare accounting for the United States at the initial level of U.S. supply and demand (Q_{S1}^{US} and Q_{D1}^{US}) is given below.

	At Q_{S1}^{US} and Q_{D1}^{US}	At Q_{S2}^{US} and Q_{D2}^{US}
Consumer Surplus	c+d+e+f+g+h+i+j+k	c+d+e+f
Producer Surplus	l	g+h+l
External Benefits	a	a+b
Tariff Revenue		j
Total Social Surplus	a+c+d+e+f+g+h+i+j+k+l	a+b+c+d+e+f+g+h+j+l

b. When we draw in the horizontal world price line, we are assuming that foreign suppliers will supply us with all the tablet PCs we want at the prevailing world relative price (world supply is perfectly elastic at P_W). If we put on a tariff, foreign suppliers will still be willing to supply us with all the tablets we want, but they now will insist on a price that is higher by the amount of the tariff. That is, the imposition of the tariff will have the effect of raising the effective world price of tablets to P_W + tariff. (The effects of the tariff are shown in the diagram at the top of this page.) At this new higher world price, American consumers will demand fewer tablets than before. They now want to consume where the American demand curve intersects the new, higher effective world price, which is occurs at quantity Q_{D2}^{US}. American producers will now want to produce where the American supply curve intersects the horizontal line at P_W + tariff, which occurs at quantity Q_{S2}^{US}. Since the quantity supplied by American producers rises as a result of the tariff and the quantity demanded by American consumers falls, American imports fall.

The accounting above shows the components of the total U.S. social surplus at the new American quantities supplied and demanded as a result of the tariff (Q_{S2}^{US} and Q_{D2}^{US}). American consumer surplus is now the smaller area under the demand curve and above the higher effective world price. American producer surplus is now the larger area above the supply curve and below P_W + tariff. There is tariff revenue which is the area between P_W and P_W + tariff times the amount of imports (Imports$_2$). Because there is more domestic production than before, the U.S. gets additional external benefits equal to the distance between the social marginal benefit curve and the private marginal benefit curve times the increase in U.S. production.

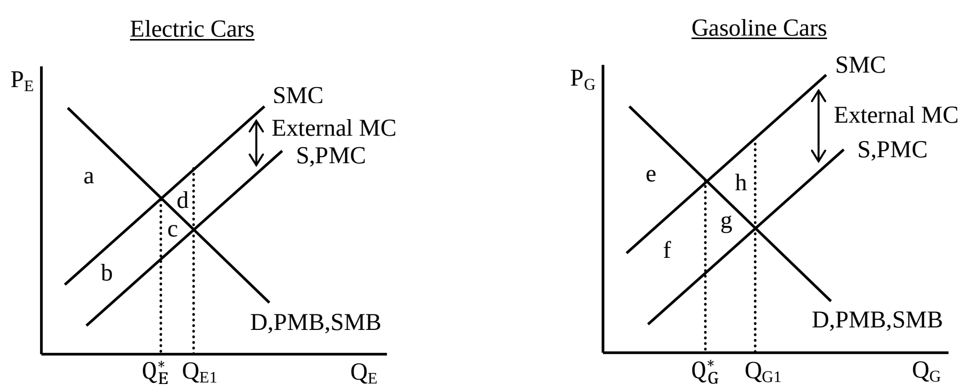
c. The change in the total social surplus when the tariff is imposed is area b minus areas i and k. Because the tariff encourages domestic production, the U.S. gets more external benefits as a result of the tariff (area b). But, because the tariff raises the price of the good, there is some reduction in consumer surplus that is not transferred to either producers or the government (areas i and k). This is the usual welfare loss of a tariff. Whether the tariff increases total U.S. social welfare depends on the relative sizes of areas b and i+k.

What kinds of factors will affect the relative sizes of these areas? One thing that obviously matters is the size of the external marginal benefit (that is, the how far the SMB is above the PMB). The larger the external marginal benefit, the larger the size of area b and the more likely the tariff is to increase social welfare.

Another thing that matters is the price elasticity of demand. The less elastic the demand curve, the less the tariff will reduce consumption. As a result, the smaller area k will be. Clearly the size of the tariff also affects how much consumption actually declines.

The price elasticity of supply also matters, but the effects are complicated. The more elastic supply is, the more domestic production will rise and so the more the external benefit will rise. However, the more elastic supply is, the more change there will be in American behavior and so the larger area i will be. Again, the size of the tariff will also affect the amount of distortion there will be in the behavior of American producers.

4.a. To answer this question we need to draw the supply and demand diagram for each market. In both markets, there is a normal downward sloping demand curve for the good, which is also both the private and social marginal benefit curve (D, PMB, SMB). There is a normal upward sloping supply curve in each market, which is also the private marginal cost curve (S, PMC). However, both goods involve negative externalities. Thus, for each good there is a social marginal cost curve (SMC) that is above the private marginal cost curve. Finally, the problem states that the negative externalities associated with electric cars are smaller than those associated with gasoline-powered cars. Thus, the distance between the PMC and SMC curves is smaller for electric cars than for gasoline-powered cars.



The welfare accounting is given in the table on the next page. Here we walk through it for the electric car market; it is completely analogous for the gasoline car market. The private surplus is the area between the PMB and PMC curves, up to the quantity produced. Thus, it is area a+b+c if the amount produced is the free market quantity, Q_{E1}, and it is area a+b if electric cars are produced to the point where PMB and SMC are equal, Q_E^*. The external costs are the area between the PMC and SMC curves up to the quantity produced. This is b+c+d if the amount produced is Q_{E1}, and b if the amount produced is Q_E^*. Total social surplus is total private surplus minus external costs. Thus, it is (a+b+c) – (b+c+d) = a – d at Q_{E1}, and (a+b) – b = a at Q_E^*. The deadweight loss is the shortfall of total social surplus from its maximum possible level. If there are no taxes or subsidies, output is Q_{E1} and total social surplus is less than its maximum possible by amount d. Thus, the deadweight loss is area d.

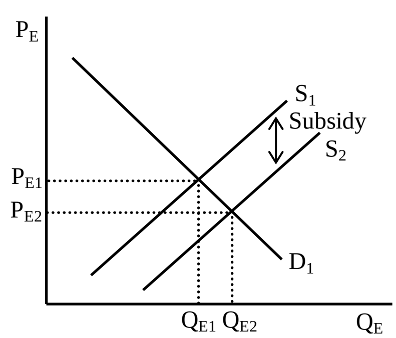
By exactly parallel reasoning, deadweight loss in the market for gasoline powered cars in the absence of taxes or subsidies is area h.

	Electric Cars		Gasoline Cars	
	Q_{E1}	Q_E^*	Q_{E1}	Q_E^*
Total Private Surplus	a+b+c	a+b	e+f+g	e+f
External Costs	–(b+c+d)	–b	–(f+g+h)	–f
Total Social Surplus	a – d	a	e – h	e
Deadweight Loss	d		h	

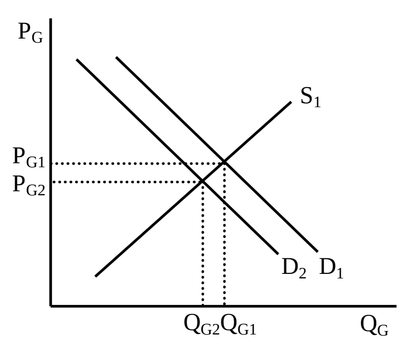
b. A subsidy paid to the seller will shift the supply curve down by the amount of the subsidy. Suppliers are willing to supply more at a given price because for each electric car they sell, they will receive a payment from the government. As the left-hand diagram below shows, the subsidy increases the quantity of electric cars (from Q_{E1} to Q_{E2}) and reduces their price (from P_{E1} to P_{E2}). (Notice that because the problem does not ask about externalities or social welfare, we have simplified the diagram by taking out the SMC curve and the labeling of the various areas.)

The fact that gasoline-powered cars and electric cars are substitutes means that the fall in the price of electric cars shifts the demand curve for gasoline-powered cars to the left. As a result, as the right-hand diagram shows, both the price and quantity of gasoline cars fall (from P_{G1} to P_{G2} and from Q_{G1} to Q_{G2}).

Electric Cars

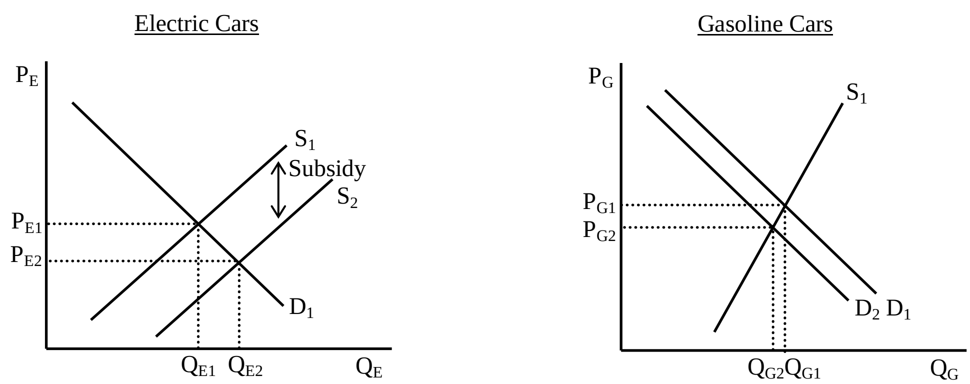


Gasoline Cars



c. The change in carbon emissions will depend on the quantity of emissions associated with each type of car and the changes in their quantities. One factor that would tend to make emissions go up is if the rise in the quantity of electric cars is much larger than the fall in the quantity of gasoline-powered cars. This could arise if the two types of cars are not very good substitutes; for example, perhaps the main effect of the subsidy would be to cause some environmentally-conscious consumers to switch from taking public transportation to driving an electric car, rather than mainly causing consumers to switch from gasoline cars to electric cars. The fall in the quantity of gasoline cars would also tend to be small relative to the rise in the quantity of electric cars if the supply curve of gasoline cars if relatively inelastic, so that the shift back in the demand curve for gasoline cars leads mainly to a fall in their price. Finally, if the emissions associated with electric cars are only slightly less than those associated with gasoline cars, this would work in the direction of causing the subsidy to raise rather than lower emissions.

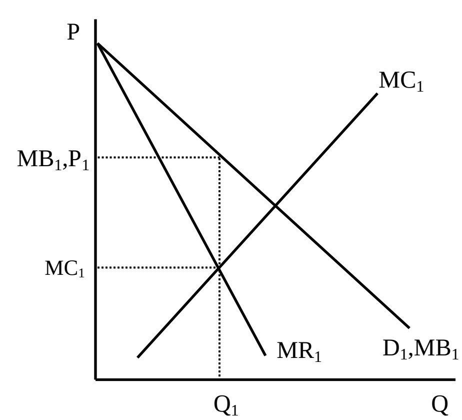
The diagram below shows a case where the fall in the price of electric cars causes only a small shift in the demand curve for gasoline-powered curves (as would occur if the two types of cars are not close substitutes), and where the shift in the demand for gasoline cars leads to only a small fall in the quantity of gas cars (because the supply curve is relatively inelastic). As a result, the rise in the quantity of electric cars caused by the subsidy is much larger than the fall in the quantity of gasoline cars. In such a case, unless emissions associated with electric cars are vastly lower than those associated with gasoline cars, total emissions will rise. In fact, however, because of the emissions from manufacturing electric cars, and, especially, from generating the electricity they run on, electric cars involve nontrivial carbon emissions.



Because of complications like this, many economists' preferred solution to the negative externalities from carbon emissions is to levy a "carbon tax"—that is, a tax on all carbon emissions. In the context of electric and gasoline-powered cars, such a tax, if set at the right level, not only aligns private marginal cost and social marginal cost for individuals' choices between the two types of cars; it also aligns them for choices about whether to have a car at all.

An economic case for subsidizing electric cars requires that they have a positive externality associated with them, not just a smaller negative externality than a substitute. For example, because electric cars are a new industry, perhaps their production involves technological progress whose benefits are not fully captured by the firms making them.

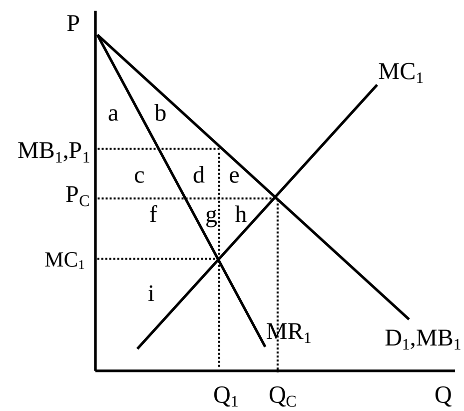
5.a. False. The first part of the statement is true: monopoly leads to production below the level where MB = MC. A monopolist, like a competitive firm, produces at the point where marginal revenue (MR) equals marginal cost (MC). But for a monopolist, unlike a competitive firm, marginal revenue is less than price. Thus at the point where MR = MC, MC is less than the price. And we know that the price shows the marginal benefit of the good to consumers (to see this, think about the vertical interpretation of the demand curve). Thus,



at the level of output where the monopolist produces, MC and MR are equal, but both are less than MB. This is shown in the diagram: at the profit-maximizing level of output, MC = MR, but MC < P = MB.

The second part of the statement is false, however: monopoly does not lead to misallocation of the good across consumers. Recall that misallocation occurs when the units of the good that are produced are not allocated to the consumers with the highest MB. That occurs in cases (such as a binding price ceiling) when the units that are produced are not allocated by price. With a monopoly, however, the units that are produced ***are*** allocated by price: anyone who wants to buy the good at the price charged by the monopolist, P_1, can do so. Thus, consumers for whom the marginal benefit exceeds P_1 buy the good; those for whom it is less than P_1 do not. That is, the units that are produced go to the consumers who value it the most, and so there is not misallocation among consumers.

The diagram to the right shows the full welfare accounting. With competition, the price is P_C and the quantity is Q_c. Consumer surplus is a+b+c+d+e and producer surplus is f+g+h+i. Thus total surplus is a+b+c+d+e+f+g+h+i. With monopoly, the price is P_1 and the quantity is Q_1. Because the price is P_1 and there is no misallocation, consumer surplus is a+b. Producer surplus is c+d+f+g+i, and total surplus is a+b+c+d+f+g+i. The deadweight loss—the shortfall of total surplus form its maximum possible level—is e+h, reflecting the fact that some units for which MB > MC are not produced.



b. True. First consider moral hazard. Just as with fire insurance, there are choices a buyer of health insurance can make that the insurer cannot observe and that harm the insurer. Examples include decisions about participating in risky sports and about diet and exercise. Thus there is moral hazard in health insurance. As described in lecture in the context of fire insurance, moral hazard tends to make the equilibrium quantity of insurance less that the allocatively efficient amount. To achieve allocative efficiency, consumers should do things (such as exercising and wearing protective gear when playing sports) that lower their healthcare costs up to the point where the marginal benefit and marginal cost of those things are equal, and they should be insured up to the point where the marginal benefit and the marginal cost of insurance are equal. But if a consumer is even partly insured, the benefit to him or her alone of doing things that keep their healthcare costs down are less than the total benefits to them and the insurer together. Since insurers know that consumers will devote less effort to protecting their health when they are more insured, they will charge a higher amount (per unit of insurance) for more insurance coverage. Consumers will respond by choosing to purchase less than the allocatively efficient amount of insurance. Thus, moral hazard acts to make the equilibrium quantity of health insurance less than the allocatively efficient amount.

Now consider adverse selection. At a given price of health insurance, the individuals who choose to buy insurance are the ones who have information (about such things as their health histories and their lifestyles) that their healthcare costs are likely to be particularly high. This raises costs for insurance companies, which leads them to charge high prices (relative to the cost of insuring an average member of the population as a whole). As a result, healthy individuals face a price of insurance that is above the marginal cost of insuring them. If the marginal benefit of insurance to some of these individuals is greater than the marginal cost of insuring them but less than the price they would have to pay, they will not buy insurance (because MB < P) even though it would be allocatively efficient for them to do so (because MB > MC). Thus, adverse selection also acts to make the equilibrium quantity of health insurance less than the allocatively efficient amount.