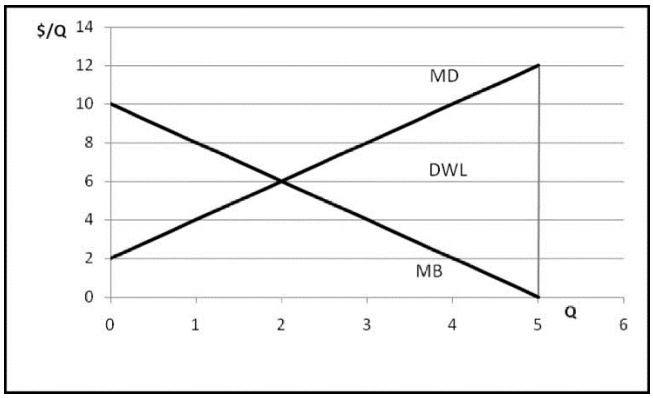
Exercise B

1. Should the value of a statistical life be adjusted for a person's age or health status? For instance, in the early years of George W. Bush's presidency, the Office of Management and Budget proposed using a lower VSL for senior citizens than for younger people. Other proposals suggested using a lower VSL for people with serious or chronic illnesses. What are the implications of using different values for different groups of people? What justifications might exist for having different VSLs? What reasons are there for using the same VSL for all people?

   Open question, no formal solution

2. Buchanan Industries receives profits from polluting according to the formula $\text{Profits} = \pi = 10\text{Q} - Q^2$, where Q=pollution emitted (in tons), and profits are measured in dollars. Marginal benefits (MB) of polluting, derived from this function, are $\text{MB} = 10 - 2\text{Q}$. The damages associated with pollution from this facility are estimated as $\text{Damages} = \text{D} = Q^2 + 2Q$, where damages are measured in dollars. The marginal damages (costs) associated with that function are $\text{MD} = 2\text{Q} + 2$.
   (a) Draw a graph with the marginal benefits and marginal damage curves. Be sure to label the axes.
   (b) If Buchanan Industries could ignore the damages it caused, how much Q would it produce? How much profit would it earn at this level of production? How much would total damages be? What would be the net benefits, the difference between profits and damages?
   (c) What is the efficient Q for this industry? How much profit would Buchanan Industries earn at this level of production? How much would total damages be? What would be the net benefits, the difference between profits and damages?
   (d) Deadweight loss is the difference between the net benefits with the efficient level of pollution and net benefits with another level of pollution. What is the deadweight loss associated with Buchanan Industries ignoring damages that its production causes? Show the deadweight loss on your diagram. If Buchanan Industries would not on its own produce at the efficient Q, is it acting contrary to its own best interests by producing at the level in (c)?
   (e) Those who live near Buchanan Industries propose that Buchanan Industries produce no more than Q=1. What is the deadweight loss associated with this level of production? If Q=1 is an inefficient level of production, are those who live near the factory acting contrary to their own best interests by pushing for Q=1?
   (f) Who benefits from reducing Q from the initial level in (a) to the efficient level in (b)? Who bears the costs? Is this change Pareto improving?
   (g)

   (a) See below.



(b)

If it could ignore the damages, it would produce up to where marginal benefits go to zero, at 5 units.

(h) $D = Q^2 + 2Q = 35$

(i) $\pi = 10Q - Q^2 = 25$

(j) $NB = \pi - D = -10$

(c)

Efficient Q occurs when $MB = MD$, or $10 - 2Q = 2Q + 2$, or $Q = 2$ (notice this is the quantity where MB intersects MD in the figure).

(k) $D = Q^2 + 2Q = 8$

(l) $\pi = 10Q - Q^2 = 16$

(m) $NB = \pi - D = 8$

(d)

$DWL = NB(2) - NB(5) = 8 - (-10) = 18$. On the figure, DWL is the triangle bounded by the point where $MB = MC$ at $Q = 2$ and the vertical line at $Q = 5$. This area represents the net cost to society if Buchanan pollutes at the unregulated level. Note that the area of this triangle is
$(5 - 2) * 12/2 = 18$, which is the same value as was calculated from the net benefits values.

(e)

The DWL triangle for $Q = 1$ is $(8 - 4) * (1)/2 = 2$. Alternatively, $NB(1) = \pi(1) - D(1) = 9 - 3$
$= 6$; $DWL = NB(2) - NB(1) = 8 - 6 = 2$. Wow, once again the answers coincide!

The neighbors are not acting contrary to their own best interests, unless they own Buchanan Industries. They are more likely to bear the costs, while Buchanan gets the benefits. They are very sensible in wanting to reduce the costs they face.

(f)

Those who bear the pollution damages benefit, while those who own Buchanan Industries bear the costs. This change is not Pareto improving unless the same people both own the company and bear the damages.

3. A pollution control agency is considering the following regulatory policies:
   (i) Taxing the use of one input that increases pollution. (Other inputs affect pollution too, both increasing and decreasing it.)
   (ii) Taxing the final goods that firms produce and sell on the market.
   (iii) Taxing pollution.

   For each of the following questions, explain why you have answered with the policy that you have, and explain why you have chosen that policy over the other two.

   (a) Which of these policies is most likely to reduce pollution?

   (b) Which of these policies might actually lead to an increase in pollution?

   (c) Which of these policies is most likely to be financially damaging to firms?

   (d) Which of these policies is most likely to encourage innovative methods of pollution reduction?

   (a)

   Taxing pollution is the most direct way to reduce pollution. Taxing a polluting input would reduce use of that input, but another, perhaps worse, input might be substituted for it. Taxing output would reduce output, but its effect on pollution is indirect.

   (b)

   As noted for (a), taxing a polluting input might lead to substitution to something worse. It is unlikely, but not impossible, that taxing output would increase pollution, if one of the other inputs reduced pollution and its use were decreased more than use of the polluting input.

   (c)

   Since firms get revenue from output, taxing output is likely to be the most financially damaging.

   (d)

   Taxing pollution is more likely to encourage innovative ways of reducing pollution than the other two, which do not target pollution directly.

4. Two pollution sources are located in the same town, immediately next to each other. For every quantity of abatement, marginal costs of abatement for the first source are higher than marginal costs of abatement for the second source.
   (a) If both the tax and standard achieve the same level of total emissions, is a uniform pollution tax more efficient than a uniform pollution standard (that is, a tax or a standard that is the same for both sources), less efficient than a uniform standard, or are you unable to tell? Why?

   (b) Would the sources prefer to face a pollution subsidy or a marketable permit scheme, if permits are distributed at no cost based on the standard in (a), and both the subsidy and the permit scheme achieve the same level of total emissions? Why?

(a) A uniform pollution tax is more efficient than a standard because pollution from one source is a perfect substitute for pollution from the other source. In this case, there are gains to be had by allowing the source with higher abatement costs to abate less, while the source with lower abatement costs abates more. The tax will lead to each firm equating its marginal abatement costs with the tax, which will lead to the equimarginal condition. In contrast, a standard that requires both firms to abate the same amount will lead to different marginal abatement costs for the firms.

(b) The firms will prefer the subsidy, since they will be paid for any abatement that they conduct. Under the permit scheme, they will get some free pollution, but they will not get paid for their abatement.

5. An activity to improve the well-being of some impoverished people will provide benefits of $1 million right now, but it will obliterate the earth in 200 years. The world's value in 200 years is projected at $\$10^{12}$. There are no costs or benefits between these two dates.

   (a) Is it worth avoiding the world's destruction in 200 years at a 10 percent discount rate?

   (b) Is it worth avoiding the world's destruction in 200 years at a 6 percent discount rate?

   (c) If 10percent is the interest rate in the private sector, what are some of the arguments for using a 10 percent discount rate?

   (d) What are some of the arguments for a lower discount rate?

   (e) Do you think discounting and benefit-cost analysis are appropriate ways to handle this problem? Why or why not?

(a)

$PV = 10^{12}/(1.1)^{200} = \$5265.78$. No, it's not worth saving: We're better off using the money now for projects that will benefit us in the meantime.

(b)

$PV = 10^{12}/(1.06)^{200} = \$8{,}686{,}142.44$. Yes, it's worth saving now: Saving the world is more valuable than whatever we might do with the money in the meantime.

(c)

Ten percent represents the opportunity cost of the money. The public sector may want to use the market interest rate to discount, because it reflects the opportunity cost of money in the private sector. If the public sector took money that could be privately invested and instead spent it on a project yielding a lower interest rate, then more valuable private projects could not be funded, and the net wealth of the world would not increase as quickly as if it were all invested at the higher rate.

(d)

The public sector may want to use a rate lower than the private market rate because it cares more about future generations. Lower discount rates mean that the future is relatively important. The private sector may be myopic (nearsighted), in that it may focus unduly on short-term results rather than the long-term good; the public sector does not (and perhaps should not) have to take the same short-sighted view.

(e)

This question is designed to make you think about the implications of discounting in an extreme situation. To prevent the world's destruction in 200 years, we would not help some impoverished people now. If we help the desperate group now, we doom the world in the future.

Some of the problems with using benefit-cost analysis and discounting in this context include the projections of the worth of the planet in the future are uncertain at best, if not purely speculative; what is considered the appropriate rate of discount may easily change over time; and, perhaps most importantly, we are acting on behalf of future generations and not giving them their own say in the matter. Unfortunately, it is impossible to ask future generations what they think about our present decisions. When we are faced with making an irreversible change, there is a value (known as option value) to keeping future options open. The future generations can always decide to destroy the world; in this case, we are the ones with the ability to give them that choice, or to deny them that choice and to declare that they are all going to be wiped out.