Resource & Environmental Economics Field Examination

**January 2021**

Instructions:

You have 4 hours to complete the exam. This time commences at the end of a 15-minute reading period during which no writing is allowed.

Please place your assigned "alpha letter" on every page so we can identify your exam. Do not add your name or social security number or UIN. Write on only one side of the page leaving at least one-inch margins. Number each page, and make sure the pages are in order.

You have four questions to answer.

1. In a recent online forum, the environmental economist Robert Stavins asked the following question:

   Many, perhaps most economists would say that carbon pricing, at least in large complex industrial economies, will be necessary in order to achieve significant or really meaningful reductions in fossil fuel emissions. However, they might also say that pricing will be necessary, but not sufficient because of [1] other market failures, [2] principal agent problems, and [3] the public good nature of information. What's your take on the role of carbon pricing, at least in these large more advanced economies?

   Answer Stavins' question. Specifically:
   a) Why do other market failures potentially compromise the ability of a carbon price to efficiently reduce carbon emissions?
   b) How might principal-agent problems affect the efficiency of a carbon pricing policy?
   c) How does the public good nature of information affect the efficiency of a carbon pricing policy?

   There are no "right" answers to these questions. We are looking for some understanding of the underlined concepts and an ability to apply them to the problem of carbon reduction policies.

2. Consider a city managing its waste problem. There are *N* homogeneous citizens in the city, each of whom makes two main choices in each period *t* that affect the waste stream:
    a) how much stuff to buy, which eventually must be disposed of, $g_t$, and
    b) what portion of the waste to recycle $r_t$.

    Hence, each citizen recycles $r_t \cdot g_t$ waste and the remainder, $(1-r_t)g_t$ goes to the landfill. Assume each citizen's utility function is of the form
    $U = u(g_t, r_t) - \gamma_R r_t g_t - \gamma_L (1-r_t) g_t$,
    where $u(g_t, r_t)$ is monotonically increasing and concave in both arguments because the consumer likes stuff, and also feels good about recycling. The parameters $\gamma_R$ and $\gamma_L$ capture the utility cost (hassle) of recycling and putting trash in the trash can, respectively. Assume that *u*, $\gamma_R$ and $\gamma_L$ are all money-metric in nature, i.e. they are measured in dollars.

    From the city's perspective, collecting trash and taking it to the landfill costs $c_L$ per unit. The unit cost of collecting and processing recyclable material is $c_R(r_t)$, which is negative for low levels of $r_t$, but is increasing in $r_t$ and eventually becomes positive since the more people recycle, the messier it gets and the costlier it is to separate.

    a) Develop the static problem that would be solved by the city that is concerned with both the welfare of its citizens and the costs to the city.

        *i.* Under what conditions would citizen independent behavior lead to the social optimum?

        *ii.* If private behavior does not lead to the social optimum, can the optimal level of $g_t$ and $r_t$ be achieved with fees (or subsidies if <0) for recycled and non-recycled garbage, $t_R$ and $t_L$ respectively?

    b) Now assume that the city owns a landfill with remaining capacity of $G \cdot N$, i.e. *G* per person. The city will have a large (effectively unlimited) landfill that will open in period *T*, but it must manage its existing landfill until that time.

        *i.* Assuming that the city discounts future welfare at the rate $\delta$, specify the city's modified trash management problem.

        *ii.* How would the optimal city fees differ from those identified in question a)?

3. In recent years there has been a lot of talk about the food-energy-water nexus. IN a water context the basic concept is that social gains arise when parties in the food and energy industries collaborate with other water users, compared to if each party acted independently when making decisions about water usage.

    a) Why would such a collaborative setting be better than the marketplace?

    b) Suppose agriculture could reduce (conserve) its water use in the interest of higher-valued-municipal interests. What intersectoral arrangements might make water conservation attractive for agriculture firms?

4. Climate change mitigation sounds like it will soon be strongly on the US policy agenda. One important issue that is being discussed is how to implement carbon pricing policy. Some economists are arguing that this is best implemented as a tax, while others argue that we should have cap and trade.

    a) What arguments would you use relative to the advantages and disadvantages of each in an agricultural setting?

    b) How would you approach setting the level of tax or cap?

    c) Should agricultural emission/sequestration be valued or traded on an equal per ton basis with emission reduction/sequestration in other sectors?

    d) We face a situation where some agricultural sources are widely dispersed across the landscape while others are concentrated at specific locations. What are the challenges of implementing emissions reduction policy in each setting and how might these challenges be resolved?

5. You've been given the task of estimating the value of the COVID-19 vaccine. The two versions of the vaccine that are being distributed across the U.S. are being administered for free, so you cannot use market prices in your estimation.

    a) Name two ways in which you might be able to estimate the value of the vaccine.

    b) Describe the process of valuation for each of these two methods. Be sure to specify what kind of data you would collect, how you would collect it, and how you would then carry out the estimation.

c) The realized social benefits of a vaccine ultimately depend on what share of the population gets vaccinated. Policy makers are considering implementing a fine for skipping the COVID-19 vaccine (except for a legitimate medical reason). The fine would be equal to the value of the vaccine you estimated (the per-capita value). Discuss whether such a fine would be effective at internalizing the negative externalities associated with skipping the vaccine.