

## Problem Set - ECON4910 (for March 27, 2019)

### 1. Supply-side policies.

Consider the model of Hoel '94 discussed in class, and also the extension by Golombek, Hagem and Hoel (1995), also briefly mentioned, where emission from country  $i$  was given by some function  $E_i(x_i)$ .

In class, we discussed the optimal extraction tax in a coalition/country  $M$ .

(i) Derive instead the optimal emission tax in  $M$  if the supply industry in  $M$  must pay an emission tax that is proportional to the quantity it extracts,  $x_M$ . You can assume that  $E_M''(x_M) \geq 0$ , if you find this necessary to assume.

(ii) How does this tax depend on  $E_M'(x_M)$ ?

(iii) How does it depend on  $E_i'(x_i)$ ,  $i \neq M$ ? Explain the intuition.

### 2. Deforestation (based on online lecture notes to be discussed March 25, 2019)

Use the model presented in class of illegal logging (set  $b = 0$ ), but suppose there is a single country ( $n = 1$ ) and no donor. Also, suppose the government cannot have a different expected penalty in one part of the forest than in another: The expected penalty must be  $\theta$  everywhere.

(i) How does the uniform (!) level of  $\theta$  influence  $x$ ?

(ii) What is the optimal  $\theta$ ? What utility will the country  $C$  then get?

(iii) Suppose the country has two distinct forests of equal size, A and B, and that  $\theta_A$  and  $\theta_B$  can be different, but the expected penalty must be the same within each of these two forests.

When it is optimal that they differ, and what should they be?

(vi) Suppose the country's forest can be divided up in any way you want, and that in unit  $j$  of the forest,  $\theta_j$  can be set different than in any other unit.

Derive the optimal  $\theta_j$ , explain why (if) they may differ in  $j$ , and derive the country's utility. Compare that utility to the utility in (ii) and (iii) and explain why it is higher: