

## Econ4925 – Seminar 4

### Hydropower

Consider a two period model of an exhaustible resource. The initial resource stock is  $S$  and the use of the resource in the two periods is  $x_1$  and  $x_2$ , hence  $x_1 + x_2 = S$ . Interpret the resource as representing a water reservoir and the use as hydropower production during two half-year periods.

The utility function of the representative household is  $u_t(x_t) + y_t$ , for  $t = 1, 2$ , where  $y_t$  is exogenous. The discount factor is  $b \in (0; 1]$ .<sup>1</sup> We here specify the utility function as  $u_t(x_t) = \ln(\alpha_t + x_t)$ , where  $\alpha_1$  and  $\alpha_2$  are exogenous, positive parameters.

1. Interpret  $\alpha_1$  and  $\alpha_2$  when the resource is the water in a reservoir to be used up during one year.
2. Derive the socially optimal use of water in period 1,  $x_1^*$ .
3. Denote the optimal use of water in period 1 by a profit maximizing monopolist as  $x_1^M$ . What can you say about the sign of  $x_1^* - x_1^M$ ?
4. Assume  $S$  is not known when  $x_1$  is determined. The expected value of  $S$  is the same as before. How are  $x_1^*$  and  $x_1^M$  affected by such uncertainty?
5. Assume now that  $\alpha_2$  is unknown when  $x_1$  is chosen (the expected value of  $\alpha_2$  is unchanged). How is  $x_1^*$  affected by that type of uncertainty?
6. Consider (5.) once again. What will the competitive outcome  $x_1^C$  be if producers are risk averse?

---

<sup>1</sup> $b = \frac{1}{1+r}$