

| | | <i>EU</i> | |
|----|---------|---------------------|---------------------|
| | | ABATE | POLLUTE |
| US | ABATE | 4 , 4 | <u>2</u> , <u>8</u> |
| | POLLUTE | <u>8</u> , <u>2</u> | -2 , -2 |

Cost to Abate: 6 for each country that invests

Gains from Abatement: if only one country abates: 8 for each
if both countries abate: 10 for each

Extra cost if everyone pollutes: -2 loss for each country

1. Fill in the box with the correct values: **see above**
2. Solve the game: **best strategy for each player in each case underlined**
3. what are the equilibria if the game is simultaneous? **(P,A) and (A,P) giving (8,2) and (2,8)**
4. What kind of a game is it? **Chicken**
5. What is the unique equilibrium in the sequential game if US moves first? **US pollutes, EU abates (8, 2)**
6. What is the unique equilibrium in the sequential game if EU moves first? **EU pollutes, US abates (2, 8)**
7. What is the outcome if EU and US manage to Cooperate? Is there a side-payment needed? If yes, what is the minimum side-payment required? **They would want to reach (A,P) or (P,A) because total is 8+2=10. These are already equilibria so in principle there is no side payment needed. But this is an open question, and a side payment is possible, anything between 0 and 4 depending on the bargaining power and the alternative situation.**

Repeat the exercise (all 7 steps) with the following information:

Cost to Abate: 4 for each country that invests

Gains from Abatement: if only one country abates: 2
if both countries abate: 8

NOTE: Gains are much larger in this case if BOTH abate.

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|-----------|---------------------------------|---------------------|---------------------|
| | | ABATE | POLLUTE |
| <i>US</i> | A B A T E | <u>4</u> , <u>4</u> | -2 , 2 |
| | P O L L U T E | 2 , -2 | <u>0</u> , <u>0</u> |

8. Fill in the box with the correct values: **see above**
9. Solve the game: **best strategy for each player in each case underlined**
10. what are the equilibria if the game is simultaneous? **(A,A) and (P,P) giving (4,4) and (0,0)**
11. What kind of a game is it? **Coordination game**
12. What is the unique equilibrium in the sequential game if US moves first? **US abates, EU abates (4, 4)**
13. What is the unique equilibrium in the sequential game if EU moves first? **EU abates, US abates (4, 4)**
14. What is the outcome if EU and US manage to Cooperate? Is there a side-payment needed? If yes, what is the minimum side-payment required? **They would want to reach (A,A) because total is 4+4=8. This is already an equilibrium. No side payment needed.**

In the following Prisoner's Dilemma game, what is the minimum penalty that must be paid by the country that does not respect the treaty (pollutes) to the one that abates to solve the dilemma and make the treaty self-enforcing? **41 (in principle anything >40) to make abate dominate strategy for both and change the equilibrium from pollute,pollute (0,0) to abate,abate (1,1).**

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|-----------|---------------------------------|--|--|
| | | ABATE | POLLUTE |
| <i>US</i> | A B A T E | 1 , 1 Equilibrium after | -40 , 30 -40+41=1, 30-41=-11 |
| | P O L L U T E | 30 , -40 30-41=-11, -40+41=1 | 0 , 0 Equilibrium after |