Technical Appendix

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1. Marginal Cost of Abatement by Sector

Sector A

$Marginal\ Cost\ Abatement\ Sector\ A = 0.5768419 * q + -8.6444767$

Sector B

$Marginal\ Cost\ Abatement\ Sector\ B = 0.1987443 * q + 9.3176977$

Sector C

$Marginal\ Cost\ Abatement\ Sector\ C = 0.7838266 * q + -11.6550307$

Sector D

$Marginal\ Cost\ Abatement\ Sector\ D = -0.0437836 * q + 0.0020247 * q^2 + 16.774099$

2. Demand for Carbon Emissions

Demand Curves

Plugging in O for q will result in the willingness to pay for the right to pollute the first unit.

Sector A: $Price\ of\ Emissions = 0.5768419 * (180 - q) + -8.6444767$
- Willingness to Pay for First Unit = $95.2

Sector B:

$Price\ of\ Emissions = 0.1987443 * (200 - q) + 9.3176977$

- Willingness to Pay for First Unit = $49.12

Sector C:

$Price\ of\ Emissions = 0.7838266 * (220 - q) + -11.6550307$

- Willingness to Pay for First Unit = $160.78

Sector D:

$Price\ of\ Emissions = -0.0437836 * (300 - q) + 0.0020247 * (300 - q)^2 + 16.774099$‘

- Willingness to Pay for First Unit = $185.46

$Price\ of\ Emissions = 0.2599275 * (300 - q) + 9.6875061$‘

- Willingness to Pay with Linear Function: $87.69

Note: The rest of the anlaysis will use the linear demand equations for each sector.

3. Country X

Suppose to meet the Paris Accord commitments, Country X (which contains sectors A, B, and C) needs to cut all carbon emissions in half. For each policy option derive the following:
1. The total cost of meeting the target in Country X
2. The cost (or benefit) to each sector
3. The tax revenue generated

a. Cap on Carbon

```
# Each sector cuts emissions by 100 - abates 100
################ Part 1 Write abatement curve functions for each sector and plug in 100 for Q

#### Abatement function Sector A

abate_a <- function(q){
  (slope_a*q) + int_a
}

costa_100 <- abate_a(100)

#### Abatement function Sector B

abate_b <- function(q){
  (slope_b*q) + int_b
}

costb_100 <- abate_b(100)

#### Abatement function Sector C

abate_c <- function(q){
  (slope_c*q) + int_c
}

costc_100 <- abate_c(100)

#### Abatement function Sector D - NOT used in this question

abate_d <- function(q){
  (slope_d*q) + int_lineard
}

################# Part 2 Integrate to find the area under the curve (the cost of abatement from 0-100)

areaa_100 <- integrate(abate_a, lower = 0, upper = 100)$value

areab_100 <- integrate(abate_b, lower = 0, upper = 100)$value

areac_100 <- integrate(abate_c, lower = 0, upper = 100)$value

################# Part 3 Add all areas together to find the total cost of abating 100 units from each s

totalcost_100 <- areaa_100 + areab_100 + areac_100
```

1. Total Cost of Carbon Cap
   $Total\ Cost = 6698.882897$

2. Cost/Benefits to each Sector
   $Cost\ to\ Sector\ A = 2019.761768$

$Cost\ to\ Sector\ B = 1925.491278$

$Cost\ to\ Sector\ C = 2753.629851$

3. Tax Revenue
   There is no tax revenue with a carbon cap

b. Tax on Carbon

1. Total Cost of Carbon Cap
2. Cost/Benefits to each Sector
3. Tax Revenue

c. Cap and Trade

1. Total Cost of Carbon Cap
2. Cost/Benefits to each Sector
3. Tax Revenue

4. Country Y

Country Y contains only Sector D and is not obligated to reduce its emissions. To enter into Country X's carbon market Country Y would need to cap its emissions at its current level (300 tons) but allows them to sell credits to Sectors A, B, and C in Country X.

Incentives for Country Y to enter the carbon market:

Incentives for Country X to attract Country Y to the carbon market:

5. Local Air Pollution

Now assume every ton of carbon emissions creates one ton of local air pollution. Local air pollution only causes economic damages in the country where it is emitted. Neither Country X nor Country Y have local air pollution regulations.

a. Carbon Cap and Trade Market only Covering Country X

How much local air pollution would you expect in Country X and Country Y?

b. Country Y enters the Carbon Market of Country X

How much local air pollution would you expect in Country X and Country Y?

c. Advice on International Trade of Carbon Emission Credits