Green Collusion, Sustainability and Welfare

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Introduction: Pollution and Collusion

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- So collusion is enviromentally friendly but the consumer pays the (very high) price

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  - higher profits for both firms AND less pollution

The Research Question

Given that horizontal agreements are in general forbidden, under which circumstances should competition authorities allow green collusion to foster sustainable production and consumption?

The Legal Framework in Europe

- June 2023, Guidelines to Horizontal Cooperation Agreements (2023/c 259/01), Chapter 9 "**Sustainability Agreements**"

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The Legal Framework in Europe (cont'd)

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- "521...the term '**sustainability agreement**' refers to any horizontal cooperation agreement that pursues a sustainability objective, irrespective of the form of the cooperation.
- "Agreements that restrict competition cannot escape the prohibition laid down in Article 101(1) simply by referring to a sustainability objective" (can serve as a pretext for collusion)

The Legal Framework (cont'd)

- "522...Where sustainability agreements restrict competition within the meaning of Article 101(1), they may still be compatible with Article 101 if they fulfil the **four conditions** of the exception provided by Article 101(3), ...(OJ C 101, 27.4.2004, p. 97) (efficiency, consumer benefit, indispensability, preservation of competiton) Agreements that restrict competition may at the same time have pro-competitive effects by way of efficiency gains...**When the pro-competitive effects of an agreement outweigh its anti-competitive effects the agreement is on balance pro-competitive and compatible with the objectives of the Community competition rules**."

Examples of green collusion (i.e Sustainability Agreements)

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- July 2019, the **State of California** and **four car manufacturers** entered into a California Air Resources Board framework agreement to lower the average fuel consumption and average emissions. DoJ opened investigation for cartel but did not press charges.

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- We develop a model of oligopoly to address the question
- Our model comprises both public intervention in the form of taxation of pollution, but also product market collusion and green collusion (cooperation on sustainability issues).
- We provide theoretical support for allowing sustainability agreements and derive simple conditions on their desirability that depend on the cost of green investment and the severity of enviromental damage of production.

Related Literature (imcomplete)

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- Firms may compete or collude on how much to invest in green technology or the product market (semi-collusion) or both (full-collusion)

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  - $\gamma > 0$ is a coefficient of abatement cost
  - $\frac{1}{2}\gamma(z_i)^2$ is the total cost of investing z_i units in green technology.

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- RA is interested in total welfare

$$W = CS + PS + T - ED$$

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- **Stage 1:** Each firm i chooses its investment in green technology, z_i, taking as given the investment level of the rival firm z_j so as to maximize π_i.
- **Stage 2:** The RA chooses the per unit emissions fee t to maximize total welfare W.
- **Stage 3:** Each firm i observes z_j and t and chooses its quantity, q_i taking as given q_j (Cournot) so as to maximize π_i.
- Let's call the above "**Cournot-Cournot**" for Cournot in stage 1 and Cournot in stage 3.
- If Cartel means "choose as if you maximize joint profits with rival", then consider:
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Equilibrium in the Basic Model (competition in 1 and 3)

We use SPNE to solve the model with backward induction

- **Stage 3:** Each firm i observes z_j and t and chooses its quantity, q_i taking as given q_j (Cournot) so as to maximize π_i.

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- From the reactions functions $z_i(z_j)$ we deduce that z_i and z_j are strategic substitutes, i.e $dz_i/dz_j < 0$.

0. Equilibrium Values in Cournot-Cournot (CC)

- **Profits**

$$\pi_1^{CC}(\gamma, d) = \pi_2^{CC}(\gamma, d) = \frac{2d(1+3d)[3+8d(3+4d)]+A}{8[\gamma+d(9+14d+4(1+d)\gamma)]^2}(a-c)^2$$

where $A = \gamma + 8d[3+d(9+4d(3+2d))]\gamma + 2(\gamma+2d\gamma)^2$

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- **Welfare**

$$W^{CC}(\gamma, d) = \frac{2d(5d(1+2d)(13+16d)-2)+B}{4[\gamma+d(9+14d+4(1+d)\gamma)]^2}(a-c)^2$$

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- **Consumer Surplus**

$$CS^{CC}(\gamma, d) = \frac{[\gamma+d(7+8d+2\gamma)]^2}{2[\gamma+d(9+14d+4(1+d)\gamma)]^2}(a-c)^2$$

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$$\begin{aligned}\max_{z_1,z_2} \Pi(z_1,z_2) \quad = \quad & [p(z_1,z_2)-c](q_1(z_1,z_2)+q_2(z_1,z_2)) \\ & -t[q_1(z_1,z_2)+q_2(z_1,z_2)-z_1-z_2] \\ & -\frac{1}{2}\gamma[(z_1)^2+(z_2)^2]\end{aligned}$$

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- As before we use backward induction to calculate equilibrium values at the SPNE for **Cartel-Cournot (KC)**

$$\pi_i^{KC}(\gamma, d), W^{KC}(\gamma, d), ED^{KC}(\gamma, d), CS^{KC}(\gamma, d)$$

2.Green Competition and Product Market Collusion (Cournot-Cartel)

- In **Stage 3** firms collude (product market Cartel) and choose q_1, q_2 so as to maximize joint profits $\Pi = \pi_1 + \pi_2$

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- In **stage 2 and 1** same as the basic model. With backward induction we obtain the values at the SPNE for Cournot-Cartel (CK)

$$\pi_i^{CK}(\gamma, d), W^{CK}(\gamma, d), ED^{CK}(\gamma, d), CS^{CK}(\gamma, d)$$

3.Green Collusion and Product Market Collusion (Cartel-Cartel)

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- In **stage 2** same as the basic model. In **stage 1**, firms collude and choose z_1, z_2 so that they maximize joint profits $\Pi = \pi_1 + \pi_2$

$$\max_{z_1,z_2} \Pi(z_1, z_2) = ...$$

  With backward induction we obtain the values at the SPNE for Cartel-Cartel (KK)

$$\pi_i^{KK}(\gamma, d), W^{KK}(\gamma, d), ED^{KK}(\gamma, d), CS^{KK}(\gamma, d)$$

Rankings, K = Cartel C = Competition

$$
\begin{aligned}
W^{KC} &\gtrless W^{CC} > W^{KK} > W^{CK} \\
Z^{KC} &\gtrless Z^{CC} > Z^{KK} > Z^{CK} \\
Q^{KC} &\gtrless Q^{CC} > Q^{KK} > Q^{CK} \ (CS) \\
t^{KC} &\gtrless t^{CC} > t^{CK} > t^{KK} \\
EM^{CK} &> EM^{KK} > EM^{CC} \gtrless EM^{KC} \\
T^{CK} &> T^{KK} > T^{CC} \gtrless T^{KC} \\
ED^{CK} &> ED^{KK} > ED^{CC} \gtrless ED^{KC} \\
PS^{KK} &> PS^{CK} > PS^{KC} > PS^{CC} \\
\pi^{iKK} &> \pi^{iCK} > \pi^{iKC} > \pi^{iCC}
\end{aligned}
$$

Lemma

Green collusion may be Pareto superior to competition. Coordination in green investment can be welfare improving, lead to more green investment, less enviromental damage, more profit and higher consumer surplus.

Results

Lemma

Let $0 < \gamma < d < \frac{3+2\gamma}{4}$, *then* $W^{KC} > W^{CC}$. *Horizontal green agreements (semi-collusion) are welfare improving compared to full competition.*

- **Intuition**: The lower the abatement cost coefficient, the higher the investment in green technology, the lower the pollution tax burden, the higher output (more but cleaner production) and hence consumer surplus. Profits and total welfare increase

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- When abatement cost coefficient is low, semi-collusion outperforms full competition: the level of investment in green technology is higher with semi-collusion
- A low (high) abatement cost relaxes (intensifies) the degree of strategic subsitutability of green investment.

Results

Lemma

Previous lemma holds also with Stackelberg Competition in the first stage (Going green first)

Extension 1 : Partial Cross-Ownership

Suppose each firm has a non controlling share ($< 1/2$) in the other firm (cross-ownership). Then the managers problem is

$$\begin{aligned} V_1 &= (1-s)\pi_1 + s\pi_2 \propto \pi_1 + \lambda\pi_2 \\ V_2 &= (1-s)\pi_2 + s\pi_1 \propto \pi_2 + \lambda\pi_1 \end{aligned}$$

where $\lambda = s/(1-s)$ is the "degree of sympathy" to the rival firm.

Lemma

Partial cross-ownership increases the welfare improving effects of green collusion when $0 < \gamma < d < \frac{3+2\gamma}{4}$.

Extension 2: Product differentiation with WTP

- No RA, but consumers value green/substainable products, green premium is gz_1 which is proportional to the abatement cost coefficient γ

$$\begin{aligned} p_1 &= a + gz_1 - q_1 - \delta q_2 \\ p_2 &= a + gz_2 - q_2 - \delta q_1 \end{aligned}$$

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- A two stage game where firms choose the sustainability levels of their products either independently (competition) or jointly (collusion) and in the second stage they choose output competing Cournot style.

Extension 2: Product differentiation with WTP (cont'd)

Lemma

When consumers value sustainanble products more, coordination in sustainability can be welfare improving, lead to more green investment, more profit and higher consumer surplus, if

$$\frac{2g^2}{(2+\delta)^2} < \gamma < \frac{g^2(\delta-4)}{(\delta-2)(2+\delta)^2}$$

The above lemma is true when for instance $g > \gamma > 3$.

Extension 3 : Reverse timing of investment on green technology

RA sets taxation t on pollution, then firms invest on green technology, then cooperation may not be welfare improving.

Extension 4 : N firms

with or without spillovers

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- We have provided a simple rule for approving green collusion that relies on two variables that can be observed or estimated, the degree of enviromental damage and the abatement cost coefficient.
- When the enviromental damage of production is higher compared to the abatement cost, but not too high, green collusion should be allowed.

Thank you!