

# Awards vs. Labels - Incentivizing Investments in Environmental Quality

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# Introduction

- Consumers have preferences for environmental quality, e.g., Ward et al. (2011), Löschel et al. (2013), Kuhn & Uler (2019), Hulshof & Mulder (2020), Morone et al. (2021), Bartling et al. (2022), Gomes et al. (2023), European Commission (2024), Liu et al. (2024), Ruggeri et al. (2024).
- Consumers have limited attention, e.g., Allcott & Taubinsky (2015), Sexton (2015), Tiefenbeck et al. (2018), Wang et al. (2018), Andor et al. (2020), Boogen et al. (2022), Sejas-Portillo et al. (2025).
- Firms need to draw consumers' attention to the environmental quality of their goods.  
⇒ Labels and awards

# Awards vs. Labels



<https://bergbauernmilch.de/de/information/presse/molkeerei-bgl-crosspromo-dnp2024-1.html>  
<https://www.smeg.com/us/refrigerators>

# Research question

Under which circumstances should a regulator implement

- ❓ an environmental award?
- ❓ an environmental label?

How do environmental awards and environmental labels affect

- ❓ firms' investment in environmental quality?
- ❓ social welfare?

# Preview of results

## Result 1:

With an award, both firms invest in environmental quality.

With a label, at most one firm invests in environmental quality.

## Result 2:

Whether an environmental award or a label results in higher social welfare depends on the salience that the award and the label generate as well as on marginal environmental damage.

# Related literature

## ■ Environmental labels

e.g., Dosi & Moretto (2001), Amacher et al. (2004), Hamilton & Zilberman (2006), Ben Youssef & Lahmandi-Ayed (2008), Ibanez & Grolleau (2008), Harbaugh et al. (2011), Mason (2011), Li & van't Veld (2015), Fischer & Lyon (2019), Heyes et al. (2020).

## ■ Environmental awards

e.g., Morgan (2000), Bos et al. (2016), Osorio & Zhang (2022), Heidelmeier & Sahn (2025).

## ■ Limited attention

e.g., DellaVigna (2009), Bordalo et al. (2012, 2013, 2016), Köszegi & Szeidl (2013), Manzini & Mariotti (2018), Gabaix (2019), Carroni et al. (2023), Schmitt (2025).

# Outline

- 1 Model setup
- 2 Environmental investment
- 3 Social welfare
- 4 Discussion
- 5 Conclusion

# Current section

- 1 Model setup
- 2 Environmental investment
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# The consumer side

## Consumers' experience utility

$$u_{\theta}(i) = v + \theta q_i - p_i \quad \text{for } i \in \{1, 2\}$$

$v$ : base value of consumption

$q_i$ : environmental quality of good  $i$

$\theta$ : marginal willingness to pay for environmental quality with  
 $\theta \sim U(0, 1)$

$p_i$ : price of good  $i$

# The consumer side - Limited attention

## Consumers' decision utility

$$\hat{q}_i = \begin{cases} \sigma q_i & \text{if good } i \text{ has received an award / a label,} \\ 0 & \text{otherwise.} \end{cases}$$

with  $\sigma > 0$ : salience generated by award / label

Decision utility for consumers:

$$\hat{u}_\theta(i) = v + \theta \hat{q}_i - p_i \quad \text{for } i \in \{h, l\}$$

# Demand

$$\begin{array}{l} 1 \\ \left. \vphantom{1} \right\} x_h^D(p_h, p_l, \hat{q}_h, \hat{q}_l) = 1 - \bar{\theta} \\ \bar{\theta} \\ \left. \vphantom{\bar{\theta}} \right\} x_l^D(p_h, p_l, \hat{q}_h, \hat{q}_l) = \bar{\theta} \\ 0 \end{array}$$

# Model

## (1) Regulator implements an award:

CSF for a lottery contest with  $i, j \in \{1, 2\}$  (Tullock 1980):

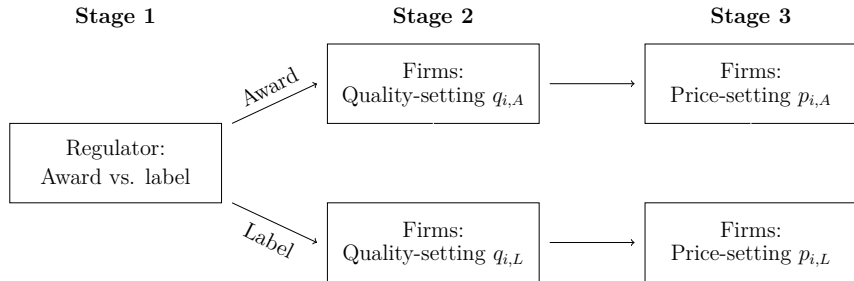
$$\alpha_i(q_i, q_j) = \begin{cases} \frac{1}{2} & \text{if } q_i = q_j, \\ \frac{q_i}{q_i + q_j} & \text{otherwise.} \end{cases}$$

## (2) Regulator implements a label:

labeling threshold  $\bar{q}$

- If  $q_i \geq \bar{q}$ : Good  $i$  receives the label.
- If  $q_i < \bar{q}$ : Good  $i$  does not receive the label.

# Timeline



# Social welfare

Social welfare  $W = CS + PS - D(E)$  with

$$CS = \int_0^{\bar{\theta}} (v + \theta q_l - p_l) d\theta + \int_{\bar{\theta}}^1 (v + \theta q_h - p_h) d\theta$$

$$PS = \pi_l + \pi_h = p_l \cdot x_l^D - cq_l^2 + p_h \cdot x_h^D - cq_h^2$$

$$D(E) = \delta E = \delta \left( (e - q_l)x_l^D + (e - q_h)x_h^D \right)$$

$\delta$ : marginal environmental damage of production

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# Scope for policy intervention

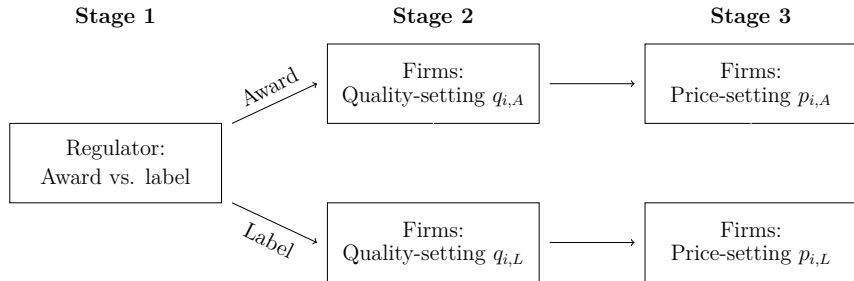
## No intervention:

$$\hat{q}_{i,NI} = 0 \text{ for } i \in \{1, 2\}$$

$$\rightarrow p_{i,NI} = MC = 0$$

$$\rightarrow q_{i,NI} = 0$$

# Timeline



# The producer side

## Stage 3: Price-setting stage

$$\max_{p_i} \quad \pi_i = p_i \cdot x_i^D - cq_i^2 \quad \text{for } i \in \{h, l\}$$

$$\rightarrow p_h = \frac{2}{3}(\hat{q}_h - \hat{q}_l)$$

$$\rightarrow p_l = \frac{1}{3}(\hat{q}_h - \hat{q}_l)$$

# Environmental award

## Stage 2: Quality-setting stage

$$\begin{aligned} \max_{q_i} \quad \mathbb{E}[\pi_i] &= \pi_i^w \cdot \frac{q_i}{q_i + q_j} + \pi_i^l \cdot \left(1 - \frac{q_i}{q_i + q_j}\right) \\ \rightarrow \quad q_{i,A}^* &= \frac{11\sigma}{72c} \end{aligned}$$

where  $\pi_i^w \equiv \pi_h(\hat{q}_i, \hat{q}_j)$  with  $\hat{q}_i = \sigma q_i$  and  $\hat{q}_j = 0$  and

where  $\pi_i^l \equiv \pi_l(\hat{q}_i, \hat{q}_j)$  with  $\hat{q}_i = 0$  and  $\hat{q}_j = \sigma q_j$ .

$$p_{h,A}^* = \frac{2}{3}\sigma q_{i,A}^* \quad \text{and} \quad p_{l,A}^* = \frac{1}{3}\sigma q_{i,A}^*$$

# Environmental award

## Proposition 1: Award equilibrium

Let  $i \in \{l, h\}$  and denote by  $h$  ( $l$ ) the firm that wins (loses) the the contest and thus has a higher (lower) perceived environmental quality.

If the regulator has implemented an award, in the subgame-perfect equilibrium, environmental qualities and prices are  $q_{i,A}^* = (11\sigma)/(72c)$ ,  $p_{h,A}^* = 2\sigma q_{i,A}^*/3$ , and  $p_{l,A}^* = \sigma q_{i,A}^*/3$ .

# Environmental label

## Stage 2: Quality-setting stage

Profit of firm  $i$  if  $q_j \geq \bar{q}$ :

$$\pi_i(q_i, q_j) = \begin{cases} \frac{4}{9}(\sigma q_i - \sigma q_j) - cq_i^2 & \text{if } q_i \geq q_j \\ \frac{1}{9}(\sigma q_j - \sigma q_i) - cq_i^2 & \text{if } \bar{q} \leq q_i < q_j \\ \frac{1}{9}\sigma q_j - cq_i^2 & \text{if } q_i < \bar{q}. \end{cases}$$

Profit of firm  $i$  if  $q_j < \bar{q}$ :

$$\pi_i(q_i, q_j) = \begin{cases} \frac{4}{9}\sigma q_i - cq_i^2 & \text{if } q_i \geq \bar{q} \\ -cq_i^2 & \text{if } q_i < \bar{q}. \end{cases}$$

# Label - Nash equilibria

The subgame-perfect equilibria depend on the label threshold:

(i) If  $\bar{q} \leq (4\sigma)/(9c)$ , then

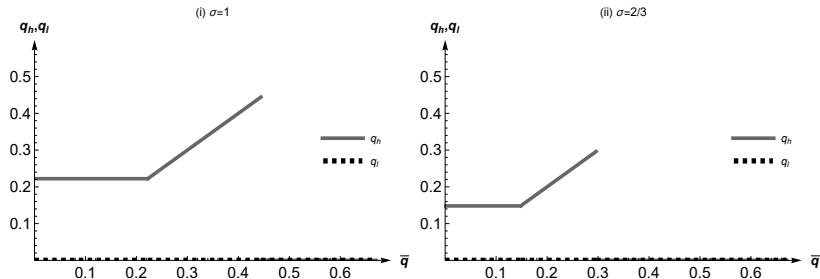
$$q_{i,L}^* = \max \{ (2\sigma)/(9c), \bar{q} \}, \quad q_{j,L}^* = 0,$$

$$p_{i,L}^* = 2\sigma q_{i,L}^*/3, \quad \text{and} \quad p_{j,L}^* = \sigma q_{i,L}^*/3.$$

(ii) If  $\bar{q} > (4\sigma)/(9c)$ , then

$$q_{i,L}^* = q_{j,L}^* = 0, \quad p_{i,L}^* = p_{j,L}^* = 0.$$

# Label - Quality investment



**Figure:** Investments in environmental quality of the firm with higher ( $h$ ) and of the firm with the lower ( $l$ ) environmental quality with  $c = 1$  and (i)  $\sigma = 1$  and (ii)  $\sigma = 2/3$ .

# Optimal labeling threshold

## Proposition 2: Label equilibria

Let  $i, j \in \{1, 2\}$  with  $i \neq j$ . If the regulator implements a label, the optimal labeling threshold depends on salience  $\sigma$ :

- (i) If  $\sigma \leq (2 + 3\delta)/4$ , then  
 $\bar{q}^* = (4\sigma)/(9c)$  with  $q_{i,L}^* = \bar{q}$  and  $q_{j,L}^* = 0$ .
- (ii) If  $(2 + 3\delta)/4 < \sigma < (2 + 3\delta)/2$ , then  
 $\bar{q}^* = (2 + 3\delta)/(9c)$  with  $q_{i,L}^* = \bar{q}$  and  $q_{j,L}^* = 0$ .
- (iii) If  $(2 + 3\delta)/2 \leq \sigma \leq 2 + 3\delta$ , then  
 $\bar{q}^* \in [0, 2\sigma/(9c)]$  with  $q_{i,L}^* = (2\sigma)/(9c)$  and  $q_{j,L}^* = 0$ .
- (iv) If  $\sigma > 2 + 3\delta$ , then  
 $\bar{q}^* \in ((4\sigma)/(9c), \infty)$  with  $q_{i,L}^* = q_{j,L}^* = 0$ .

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# Comparing total welfare: Award vs. Label

## Social welfare

$$W_k = CS_k + PS_k - D(E_k) \quad \text{for } k \in \{A, L\},$$

$$W_A = v + \frac{11(18 - 11\sigma)\sigma}{2592c} - \delta \left( e - \frac{11\sigma}{72c} \right)$$

$$W_L(\bar{q}^*) = \begin{cases} v + \frac{16(\sigma - \sigma^2)}{81c} - \delta \left( e - \frac{8\sigma}{27c} \right) & \text{if } \sigma \leq \frac{2+3\delta}{4} \\ v + \frac{4+9\delta^2}{81c} - \delta \left( e - \frac{4}{27c} \right) & \text{if } \frac{2+3\delta}{4} < \sigma < \frac{2+3\delta}{2} \\ v + \frac{8\sigma - 4\sigma^2}{81c} - \delta \left( e - \frac{4\sigma}{27c} \right) & \text{if } \frac{2+3\delta}{2} \leq \sigma \leq 2 + 3\delta \\ v - \delta e & \text{if } 2 + 3\delta < \sigma \end{cases}$$

# Stage 1: Regulator: Award or label?

## Proposition 3 (Award vs. Label)

The regulator implements an award if and only if

$48/11 < \sigma \leq 22/5$  with

$$(33\sigma - 32)/48 - \sqrt{121\sigma^2 - 528\sigma}/48 < \delta < (33\sigma - 32)/48 + \sqrt{121\sigma^2 - 528\sigma}/48$$

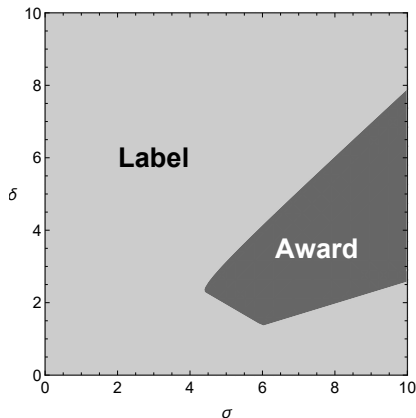
or

$\sigma > 22/5$  with

$$\max\{(58 - 7\sigma)/12, (11\sigma - 18)/36\} < \delta < (33\sigma - 32)/48 + \sqrt{121\sigma^2 - 528\sigma}/48.$$

The regulator implements a label otherwise.

# Stage 1: Regulator: Award or label?



**Figure:** Policy decision dependent on salience  $\sigma$  and marginal damages  $\delta$ . In the dark gray area, the regulator implements the award. In the light gray area, the regulator implements the label.

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# Extensions

- 1 NGO: Minimizing total environmental damage ▶ Analysis
- 2 Award with different levels of salience ▶ Analysis
- 3 Distinguishing award salience and label salience ▶ Analysis
- 4 Award with monetary prize ▶ Analysis

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# Conclusion

## Research question:

To incentivize investment in environmental quality, is it preferable to implement an environmental award or an environmental label?

- ⇒ If consumers underweight or perfectly perceive the environmental quality of the labeled/award-winning goods, the label results in higher social welfare.
- ⇒ If consumers overweight the environmental quality of the labeled/award-winning goods and marginal damages are sufficiently high, the award results in higher social welfare.

Thank you for listening ! Further ideas?

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## Ext2: Environmental award with different levels of salience

Assumption:  $\delta = 1$

Perceived environmental quality of good  $i$ :

$$\hat{q}_i = \begin{cases} \sigma q_i & \text{if good } i \text{ has received an award} \\ s\sigma q_i & \text{otherwise,} \end{cases}$$

where  $s \in [0, 3/5]$ .

## Ext2: Environmental award with different levels of salience

**Stage 3:** As in the baseline model.

**Stage 2: Quality-setting stage**

$$\begin{aligned} \max_{q_i} \quad \mathbb{E}[\pi_i] &= \pi_i^w \cdot \frac{q_i}{q_i + q_j} + \pi_i^l \cdot \left(1 - \frac{q_i}{q_i + q_j}\right) \\ \rightarrow \quad q_{i,A2}^* &= \frac{(11 - 5s)\sigma}{72c} \end{aligned}$$

where  $\pi_i^w \equiv \pi_h(\hat{q}_i, \hat{q}_j)$  with  $\hat{q}_i = \sigma q_i$  and  $\hat{q}_j = s\sigma q_j$  and

where  $\pi_i^l \equiv \pi_l(\hat{q}_i, \hat{q}_j)$  with  $\hat{q}_i = s\sigma q_i$  and  $\hat{q}_j = \sigma q_j$ .

$$p_{h,A2}^* = \frac{(1-s)(11-5s)\sigma^2}{108c} \quad \text{and} \quad p_{l,A2}^* = \frac{(1-s)(11-5s)\sigma^2}{216c}$$

# Ext2: Environmental award with different levels of salience

## Stage 1: Regulator: Award with two prizes or label?

### Proposition 5 (Award with two prizes vs Label)

Let the salience of an awarded good be  $\sigma$  and the salience of a non-awarded good be  $s\sigma$  with  $s \in [0, 3/5]$ .

Then, the regulator implements the award with two prizes if and only if  $1/25 \leq s \leq 3/5$  and  $(46 + 270s)/(7 + 110s - 25s^2) \leq \sigma \leq (54)/(11 - 5s)$ .

Otherwise, the regulator implements the label.



## Ext2: Environmental award with different levels of salience

### Single Prize vs. Two Prizes

Comparing the single prize design and the two prize design, the single prize design yields

- (i) lower environmental damage,
- (ii) higher consumer surplus for  $\sigma < 9/26$  and  $\max\{0, (32\sigma - 9)/(10\sigma)\} < s \leq 3/5$ ,
- (iii) higher producer surplus and
- (iv) higher social welfare for  $0 < \sigma < (54)/(22 - 5s)$ .

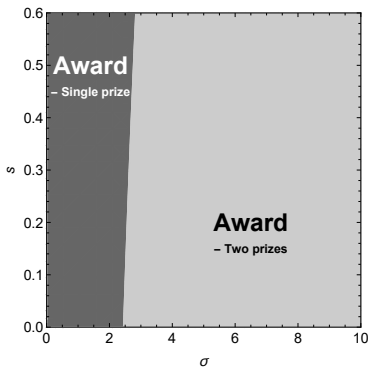
## Ext2: Environmental award with different levels of salience

$$\begin{aligned}CS_{A2} &= \int_0^{\bar{\theta}} (v + \theta q_l - p_l) d\theta + \int_{\bar{\theta}}^1 (v + \theta q_h - p_h) d\theta \\ &= v + \frac{(11 - 5s)[9 + 10(s - 1)\sigma]\sigma}{1296c}\end{aligned}$$

$$PS_{A2} = \pi_l + \pi_h = \frac{(11 - 5s)(3 - 5s)\sigma^2}{864c}$$

$$W_{A2} = v + \frac{(11 - 5s)(18 - (11 - 5s)\sigma)\sigma}{2592c} - \left(e - \frac{(11 - 5s)\sigma}{72c}\right)$$

## Ext2: Environmental award with different levels of salience



**Figure:** Policy decision dependent on the salience  $\sigma$  and  $s$  for  $\delta = 1$ . In the dark gray area, the single prize design yields higher welfare. In the light gray area, the two prize design yields higher welfare.

## Ext3: Award salience $\sigma_A$ and label salience $\sigma_L$

Assumption:  $\delta = 1$

**Stage 3 and 2:** As in the baseline model.

**Stage 1: Regulator: Award or label?**

### Proposition 6

Let the salience of the award be  $\sigma_A$  and the salience of the label be  $\sigma_L$ .

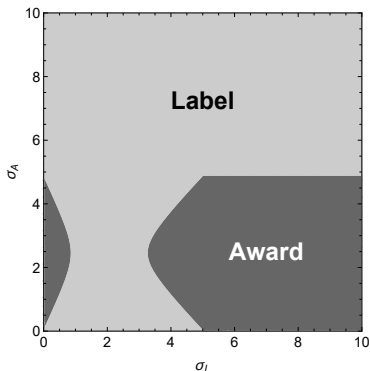
Then, the regulator implements the award if and only if

$\sigma_A \leq 54/11$  and

$\sigma_L \in [0, 5/4 - \sqrt{121\sigma_A^2 - 594\sigma_A + 800}/(16\sqrt{2})] \cup$

$[5/2 + \sqrt{121\sigma_A^2 - 594\sigma_A + 800}/(8\sqrt{2}), \infty)$ .

The regulator implements the label otherwise.

Ext3: Award salience  $\sigma_A$  and label salience  $\sigma_L$ 

**Figure:** Policy decision dependent on the salience of the label  $\sigma_L$  and the salience of the award  $\sigma_A$  for  $\delta = 1$ . In the dark gray area, the regulator implements the award. In the light gray area, the regulator implements the label.

# Ext4: Award with monetary prize and $\sigma \leq 1$

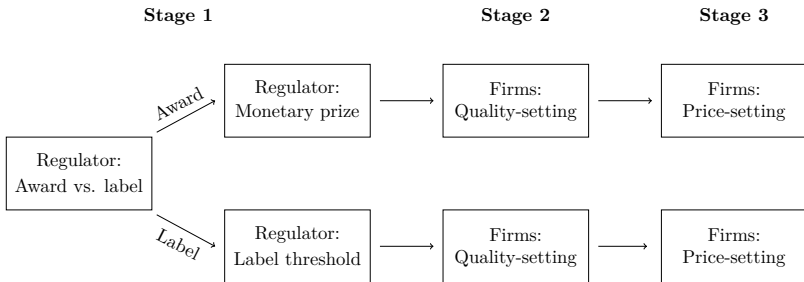


Figure: Timeline

# The producer side

## Stage 3: Price-setting stage

$$\begin{aligned} \max_{p_h} \quad \pi_h(p_h, p_l, \hat{q}_h, \hat{q}_l) &= p_h \cdot x_h^D(p_h, p_l, \hat{q}_h, \hat{q}_l) + \mathbb{I}_A \phi - cq_h^2 \\ &= p_h(1 - \bar{\theta}) - cq_h^2 \end{aligned}$$

$$\max_{p_l} \quad \pi_l(p_h, p_l, \hat{q}_h, \hat{q}_l) = p_l \cdot x_l^D(p_h, p_l, \hat{q}_h, \hat{q}_l) - cq_l^2 = p_l \bar{\theta} - cq_l^2$$

$$\rightarrow p_h = \frac{2}{3}(\hat{q}_h - \hat{q}_l)$$

$$\rightarrow p_l = \frac{1}{3}(\hat{q}_h - \hat{q}_l)$$

# Environmental award

## Stage 2: Quality-setting stage

$$\begin{aligned} \max_{q_i} \quad \mathbb{E}[\pi_i] &= \pi_i^w \cdot \frac{q_i}{q_i + q_j} + \pi_i^l \cdot \left(1 - \frac{q_i}{q_i + q_j}\right) \\ \rightarrow \quad q_{i,A}^* &= \frac{11\sigma + \sqrt{121\sigma^2 + 2592c\phi}}{144c} \end{aligned}$$

where  $\pi_i^w \equiv \pi_h(\hat{q}_i, \hat{q}_j)$  with  $\hat{q}_i = \sigma q_i$  and  $\hat{q}_j = 0$  and

where  $\pi_i^l \equiv \pi_l(\hat{q}_i, \hat{q}_j)$  with  $\hat{q}_i = 0$  and  $\hat{q}_j = \sigma q_j$ .

$$p_{h,A}^* = \frac{2}{3}\sigma q_{i,A}^* \quad \text{and} \quad p_{l,A}^* = \frac{1}{3}\sigma q_{i,A}^*$$

# Environmental award

## Lemma 1: Award equilibrium

Let  $i \in \{1, 2\}$  and denote by  $h$  ( $l$ ) the firm that wins (loses) the contest and thus has a higher (lower) perceived environmental quality.

If the regulator implements an award, in the subgame-perfect equilibrium, the monetary prize is

$$\phi^* = \max\{0, (1 + 2\delta)(9 + 18\delta - 11\sigma)/(72c)\}$$
 and

environmental qualities and prices are

$$q_{i,A}^* = \max\{(11\sigma)/(72c), (1 + 2\delta)/(8c)\}, p_{h,A}^* = 2\sigma q_{i,A}^*/3, \text{ and } p_{l,A}^* = \sigma q_{i,A}^*/3.$$

# Environmental label

## Lemma 2: Label equilibria

Let  $i, j \in \{1, 2\}$  with  $i \neq j$ . If the regulator implements a label, the optimal labeling threshold depends on the salience  $\sigma$ :

(i) If  $\sigma \leq (2 + 3\delta)/4$ :

$\bar{q}^* = (4\sigma)/(9c)$  with  $q_{i,L}^* = \bar{q}$ ,  $q_{j,L}^* = 0$ ,  $p_{i,L}^* = 2\sigma q_{i,L}^*/3$ ,  
and  $p_{j,L}^* = \sigma q_{i,L}^*/3$ .

(ii) If  $\sigma > (2 + 3\delta)/4$ :

$\bar{q}^* = (2 + 3\delta)/(9c)$  with  $q_{i,L}^* = \bar{q}$ ,  $q_{j,L}^* = 0$ ,  
 $p_{i,L}^* = 2\sigma q_{i,L}^*/3$ , and  $p_{j,L}^* = \sigma q_{i,L}^*/3$ .

# Award vs. Label

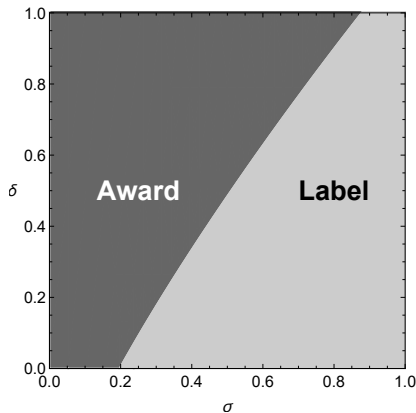
## Proposition 7: Award vs. Label

Whether the regulator implements an environmental award or an environmental label depends on the marginal damage  $\delta$  and the salience  $\sigma$  that awards and labels generate:

The regulator implements the label if and only if the salience is sufficiently high relative to the marginal damage, i.e., if and only if  $(2 + 3\delta)/4 - \sqrt{47 + 60\delta - 36\delta^2}/(16\sqrt{2}) \leq \sigma \leq 1$ .

Otherwise, the regulator implements the award.

# Award vs. Label



**Figure:** Policy decision dependent on salience  $\sigma$  and marginal damage  $\delta$ . In the dark gray area, the regulator implements the award. In the light gray area, the regulator implements the label.

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