Environmental Risk and Uncertainty: Implications for policy

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Canada’s Ecofiscal Commission
December 2018
Focus:

- Risks to the environment from economic activity
- Policy solutions, esp. “financial assurance”
- Analytical framework for environmental risk
Environmental risk: Oil by rail

Risk of environmental cost (EC)
(e.g., derailment leading to an oil spill)

- No environmental cost (EC = $\emptyset$)
  \[ P(\text{EC} = \emptyset) = 99\% \]

- Moderate environmental cost (EC = $50M$)
  \[ P(\text{EC} = 50M) = 0.99\% \]

- Severe environmental cost (EC = $1B$)
  \[ P(\text{EC} = 1B) = 0.01\% \]
Oil by rail: Environmental risk

Reality:

- *Continuous* probability distribution
- Combination of several probability distributions:
  - Derailment
  - Spill size
  - Environmental sensitivity
Oil by rail: Environmental risk

Oil by rail: A second risk

Risk of public liability (PL)
(e.g., taxpayers paying for clean-up)

Why? Liability gaps

- Firms’ liability for environmental damage might be defined, capped, or scoped in a way that makes it possible they won’t be held fully accountable
- Or – even where a firm is fully liable – it may not be held accountable if it is bankrupt

...The risk of public liability is therefore a legal risk, a financial risk, or both
Oil by rail: A second, *conditional* risk

Risk of public liability (PL)
(e.g., taxpayers paying for clean-up)

No environmental cost
$P(\text{EC} = \emptyset) = 99\%$

Moderate environmental cost
$P(\text{EC} = 50\text{M}) = 0.99\%$

- **Public absorbs no cost**
  $P(\text{PL} = 0 \mid \text{EC} = 300\text{M}, A) = 80\%$

- **Public absorbs half the cost**
  $P(\text{PL} = 25\text{M} \mid \text{EC} = 50\text{M}, A) = 20\%$

- **Public absorbs majority of cost**
  $P(\text{PL} \approx 50\text{M} \mid \text{EC} = 50\text{M}, A) = 0\%$

Severe environmental cost
$P(\text{EC} = 1\text{B}) = 0.01\%$

- **Public absorbs half the cost**
  $P(\text{PL} = 500\text{M} \mid \text{EC} = 1\text{B}, A) = 70\%$

- **Public absorbs majority of cost**
  $P(\text{PL} \approx 1\text{B} \mid \text{EC} = 1\text{B}, A) = 20\%$

Public absorbs no cost
$P(\text{PL} = 0 \mid \text{EC} = 1\text{B}, A) = 10\%$
Risk externalities

A “risk externality” exists when two risks are present:

- Risk of environmental harm occurring
- Risk that – should harm occur – at least some of its costs will be borne by the public

...So what?
The problem with risk externalities: moral hazard

Severe environmental cost
P(EC = $1B) = 0.01%

Public absorbs no cost
P(PL = $0 | EC = $300M) = 80%

Public absorbs half the cost
P(PL = $500M | EC = $1B) = 70%

Public absorbs majority of cost
P(PL = ~$1B | EC = $1B) = 20%

Moderate environmental cost
P(EC = $50M) = 0.99%

Public absorbs half the cost
P(PL = $25M | EC = $50M) = 20%

Public absorbs majority of cost
P(PL = ~$50M | EC = $50M) = 0%

Public absorbs no cost
P(PL = $0 | EC = $1B) = 10%

Severe environmental cost
P(EC = $1B) = 0.01%

Public absorbs half the cost
P(PL = $500M | EC = $1B) = 70%

Public absorbs majority of cost
P(PL = ~$1B | EC = $1B) = 20%
Addressing risks with policy

**Status quo (A):** Commercial liability insurance requirement of $25M

**New policy (B):** Liability insurance requirement plus an industry fund

**Policy choice**

- **No environmental cost**
  - Status quo (A): $P(EC = \emptyset | A) = 99\%$
  - New policy (B): $P(EC = \emptyset | B) = 99.5\%$

- **Moderate environmental cost**
  - Status quo (A): $P(EC = \text{\$50M} | A) = 0.99\%$
  - New policy (B): $P(EC = \text{\$50M} | B) = 0.495\%$

- **Severe environmental cost**
  - Status quo (A): $P(EC = \text{\$1B} | A) = 0.01\%$
  - New policy (B): $P(EC = \text{\$1B} | B) = 0.005\%$

Public absorbs:

- **No cost**
  - Status quo (A): $P(PL = \$0 | EC = \text{\$50M}, A) = 80\%$
  - New policy (B): $P(PL = \$0 | EC = \text{\$50M}, B) = 100\%$

- **Half the cost**
  - Status quo (A): $P(PL = \text{\$25M} | EC = \text{\$50M}, A) = 20\%$
  - New policy (B): $P(PL = \text{\$25M} | EC = \text{\$50M}, B) = 0\%$

- **Majority of cost**
  - Status quo (A): $P(PL = \text{\~\$50M} | EC = \text{\$50M}, A) = 20\%$
  - New policy (B): $P(PL = \text{\~\$50M} | EC = \text{\$50M}, B) = 0\%$

- **Owes no cost**
  - Status quo (A): $P(PL = \$0 | EC = \text{\$1B}, A) = 10\%$
  - New policy (B): $P(PL = \$0 | EC = \text{\$1B}, B) = 20\%$

- **Owes half the cost**
  - Status quo (A): $P(PL = \$500M | EC = \text{\$1B}, A) = 70\%$
  - New policy (B): $P(PL = \$500M | EC = \text{\$1B}, B) = 80\%$

- **Majority of cost**
  - Status quo (A): $P(PL = \text{\~\$1B} | EC = \text{\$1B}, A) = 20\%$
  - New policy (B): $P(PL = \text{\~\$1B} | EC = \text{\$1B}, B) = 0\%$
Status quo (A): Commercial liability insurance requirement of $25M

New policy (B): Liability insurance requirement plus an industry fund

**Policy choice**

### No environmental cost
- **Probability**: $P(\text{EC} = \emptyset \mid A) = 99\%$
- **Cost of environmental harm**
  - Private: $\emptyset$
  - Social: $\emptyset$
  - Probability: 99\%

### Moderate environmental cost
- **Probability**: $P(\text{EC} = \$50M \mid A) = 0.99\%$
- **Cost of environmental harm**
  - Private: $\emptyset$
  - Social: $\emptyset$
  - Probability: 99\%

### Severe environmental cost
- **Probability**: $P(\text{EC} = \$1B \mid A) = 0.01\%$
- **Cost of environmental harm**
  - Private: $\emptyset$
  - Social: $\emptyset$
  - Probability: 0.001\%

New policy (B): Liability insurance requirement plus an industry fund

### No environmental cost
- **Probability**: $P(\text{EC} = \emptyset \mid B) = 99.5\%$
- **Cost of environmental harm**
  - Private: $\emptyset$
  - Social: $\emptyset$
  - Probability: 99.5\%

### Moderate environmental cost
- **Probability**: $P(\text{EC} = \$50M \mid B) = 0.495\%$
- **Cost of environmental harm**
  - Private: $\emptyset$
  - Social: $\emptyset$
  - Probability: 0.004\%

### Severe environmental cost
- **Probability**: $P(\text{EC} = \$1B \mid A) = 0.005\%$
- **Cost of environmental harm**
  - Private: $\emptyset$
  - Social: $\emptyset$
  - Probability: 0.001\%
Three (competing) goals

• You might ask: why not go even harder with policy? (e.g., requiring liability insurance of $1B or *closing* all liability gaps)

• Because policy-makers have *three* goals
  – Deterrence
  – Compensation
  – Economic activity

• These goals can be in competition
  – Deterrence and compensation can be at odds
  – And *both* can affect economic activity

• Policy-makers have to strike a balance
### Goals in the framework

<table>
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<th>Probability</th>
<th>Private cost</th>
<th>Social cost</th>
<th>Cost of environmental harm</th>
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<tr>
<td>0%</td>
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<td>$1B</td>
<td>$1B</td>
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**EV for total costs (A): $1.7M**

**EV for total costs (B): $1.82M**

There is no objective way to weight goals; must be based on local context & priorities

Jurisdictions will vary in the balance that makes sense for them
Other policy options

- Regulations
  - Require more frequent monitoring or inspection
  - Require adoption of certain technologies
  - Bar high-risk activities or tech.'s (e.g., rail cars)

- Liability rules
  - Clarify or broaden firms’ legal liability for env. damages

- Financial assurance
  - Require firms to commit funds against their env. risks (e.g., dedicated monitoring, reserves, etc.)
Status quo (A): Commercial liability insurance requirement of $25M

New policy (B): Liability insurance requirement plus an industry fund

### Regulations

- **Status quo (A):** Commercial liability insurance requirement of $25M
- **New policy (B):** Liability insurance requirement plus an industry fund

### Liability rules

- **No environmental cost**
  - **Moderate environmental cost**
    - **Severe environmental cost**

### Financial assurance

- **No environmental cost**
  - **Moderate environmental cost**
    - **Severe environmental cost**

### Policy choice

#### Probability
- **99%**
- **99%**
- **99.5%**
- **99%**
- **99%**
- **99%**
- **99.5%**
- **99%**

#### Cost of environmental harm
- **Private cost**
- **Social cost**

- **$50M**
- **$0**
- **$25M**
- **$25M**
- **$0**
- **$500M**
- **$500M**
- **$0**
- **$1B**
- **$0**
- **$500M**
- **$500M**
- **$1B**
- **$0**
Putting the tools into action

• Policy-makers can calibrate the policy tools to strike their desired balance across policy goals

• Balance they achieve will depend on:
  – The types of tools put into action
  – The specific instruments used
  – How they are implemented
  – Their stringency
A focus on financial assurance

• A powerful tool:

1. *Reinforces* liability rules, to narrow or plug liability gaps like bankruptcy (and thereby, addresses moral hazard)

2. *Flexible*: can emphasize different goals, depending on priorities (e.g., “soft” vs. “hard” assurance)

3. *Market-based*: puts a *price* on imposing risk to the environment (e.g., paying a regular premium for a surety bond)

• Low-risk operations get a competitive advantage

• Screening function

• Useful information for investors
Zooming out

- Multiple policy options, multiple decision trees

...By pricing risk using FA, we could better reconcile them
The final piece

• Probability of environmental harm
• Potential magnitude
• Risk of harm leading to public costs

???

???
How can we deal with uncertainty?

- Risk that cannot be reliably estimated
- Could be legal, financial, environmental, or technological
- Often, uncertainty is the rule, not the exception

Solutions:
- Pursue desired balance across policy goals (as before) (some will focus on economic activity, others on risk reduction)
- Greater reliance on scenario analysis
- Assess risk qualitatively (e.g., L/M/H)
- Solicit input from the public and from experts

Uncertainty is not cause to ignore risk (the opposite, in fact)
- Policy makers ignore *fat tailed* uncertain risks at their
Questions?