Environmental Lobbying on International Trade in Waste: Theory and Evidence

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Significant Growth of Waste Trade

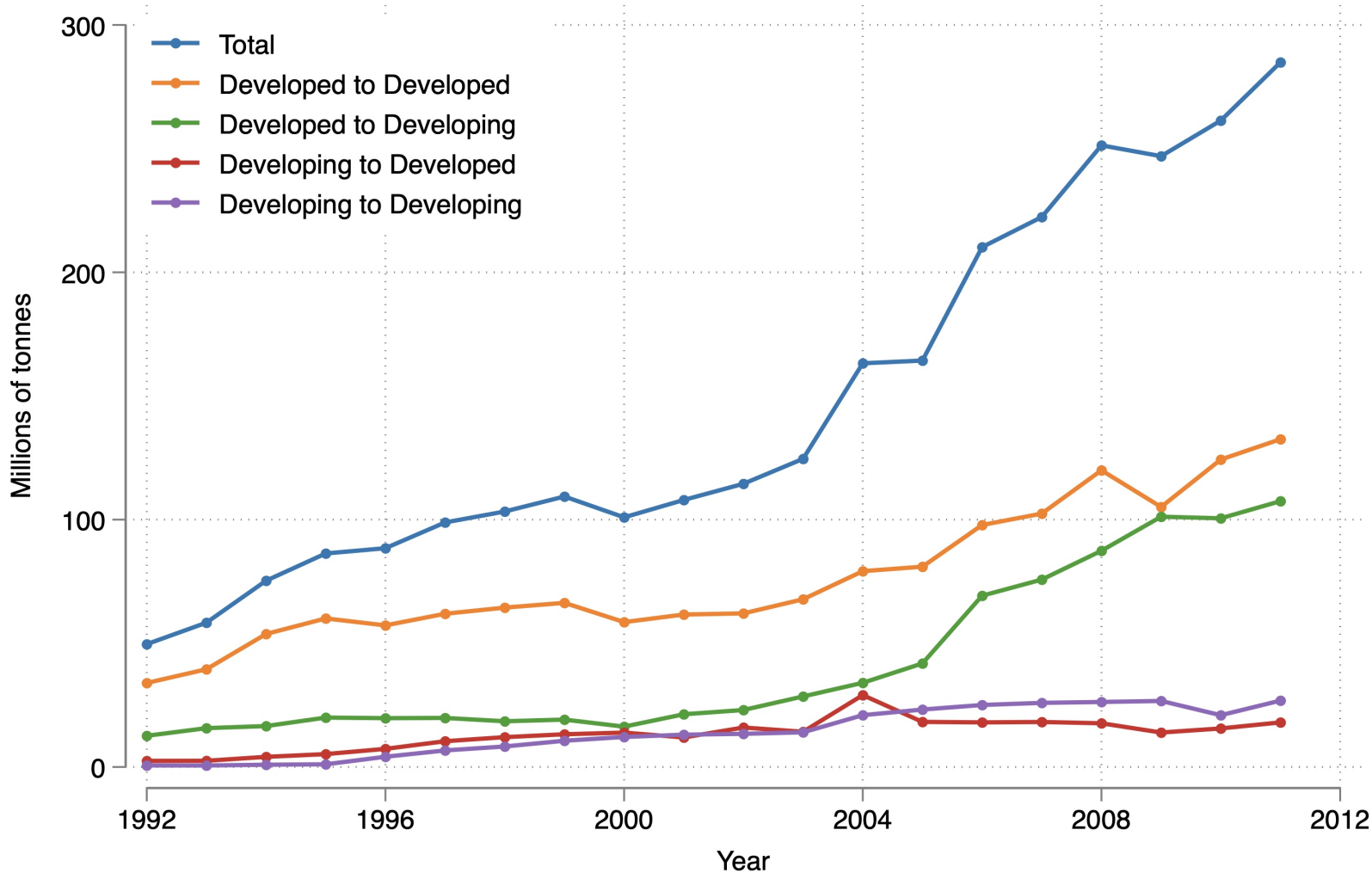

Figure 1: Total annual waste shipments in million tonnes

Shocking Scenes

Figure 2: Piled trash in Indonesia

Figure 3: Giant pacific garbage patch

- Extensive documentation of adverse environmental and public health problems caused by waste. ▸ Cases

Future Increase Expected

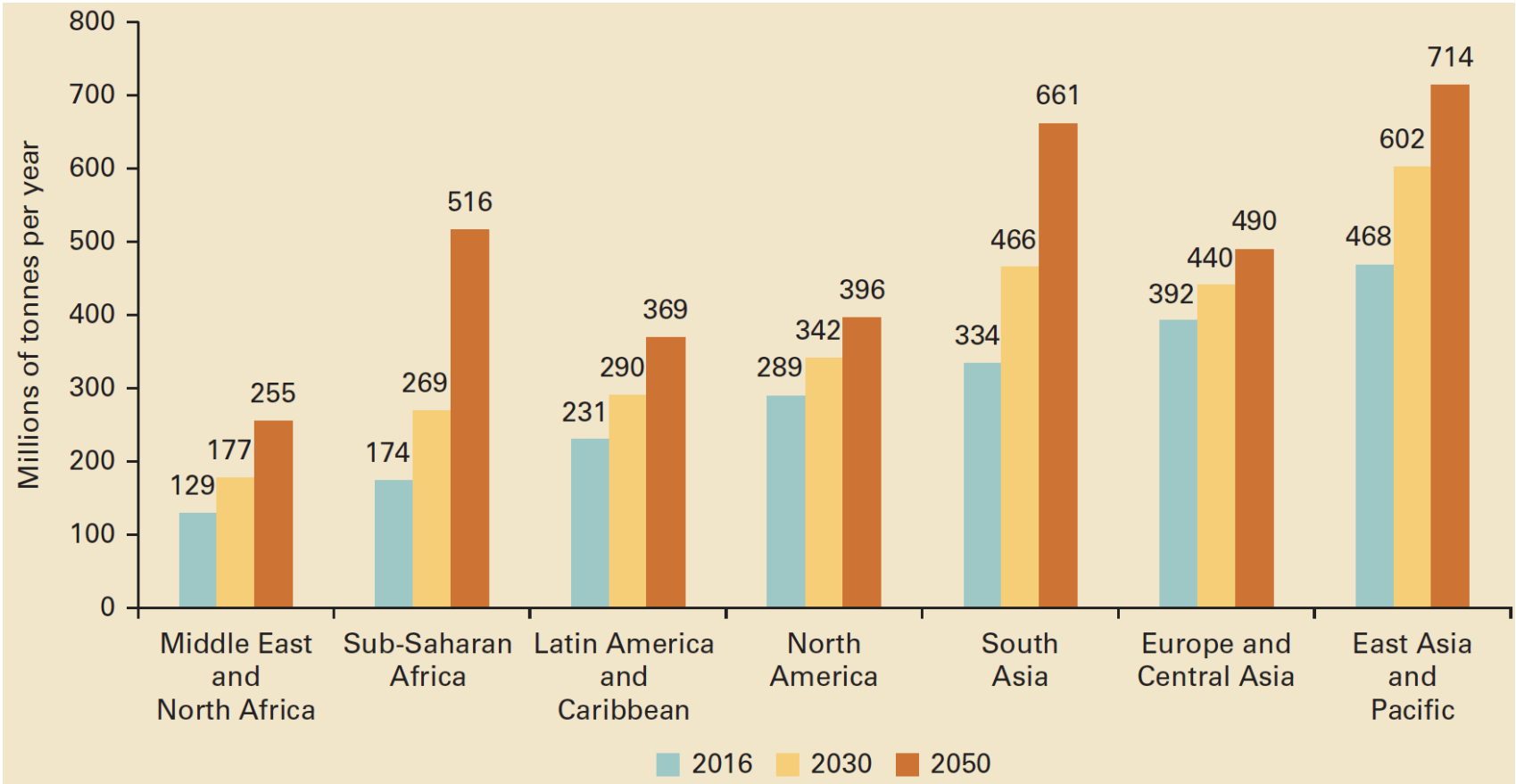

Figure 4: Waste generation estimated by World Bank (2020)

- Waste problem: intentionally and consciously packed and shipped anywhere in the world that is willing to accept it.

Role of Environmental Lobbying

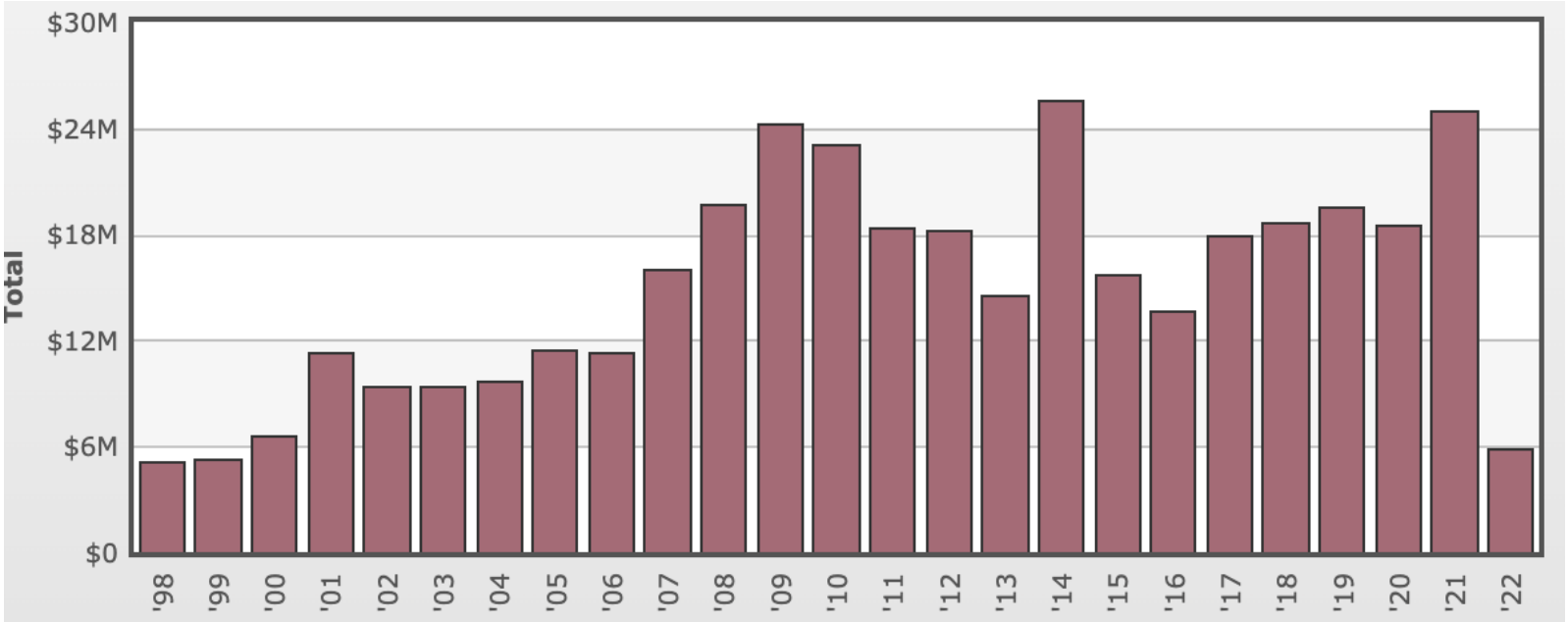

Figure 5: Annual lobbying on environment in US

- Emergence of various green lobbies and their rising impacts in shaping the political landscape;
- Environmental lobby groups steer policies towards better environmental outcomes(Cropper et al., 1992; Riddel, 2003; Binder and Neumayer, 2005; Fredriksson et al., 2005).

This Paper

Research Question: Can strengthening environmental lobby groups help reduce North-to-South waste trade?

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1. Develop a theoretical model:
   - Link waste trade from North to South;
   - Emphasize the potential impact of environmental lobbies on environmental and trade policies;
   - Investigate how waste trade flows are affected through these policy channels.
2. Test empirically with panel data on waste trade and strength of environmental lobbying.

Preview of Main Results

1. The politically chosen policy (tax/tariff) is ambiguous relative to the socially optimal one, depending on the heterogeneity of environmental preferences and degree of pollution damages from waste.
2. The model generates ambiguous theoretical predictions on the effects of environmental lobbying.
3. Empirical evidence suggests that strengthening green lobbies can reduce North-to-South waste exports.

Contribution to Existing Literature

1. Political economy of endogenous trade and environmental policy: Grossman and Helpman(1994), Aidt(1998), etc.
   - All individuals have identical preferences for environmental quality or only environmentalists are concerned about it;
   - People with the same income may also have heterogeneous environmental preferences (Cassings and Long, 2021).

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2. Empirical studies of trade in waste: Baggs(2009), Kellenberg(2012)
   - Governments are benevolent in maximizing welfare;
   - Ignore other factors such as lobby groups, political contributions: Goldberg and Maggi(1999), Pacca et al(2021), etc.

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   - Governments are benevolent in maximizing welfare;
   - Ignore other factors such as lobby groups, political contributions: Goldberg and Maggi(1999), Pacca et al(2021), etc.
3. Policies to reduce waste trade: Kellenberg and Levinson(2014)
   - IEAs(e.g.,Basel Convention) are falling short;
   - Provide first evidence of environmental lobbying on waste trade.

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The Model: Producers

- Two representative small open economies: North + South
- North: waste supply
  - clean sector: produces a numeraire good X using L only;
  - polluting sector: $Y = F(K, L)$ and generates waste: $E = Y$;
  - ship $Q \leq Y$ waste to South at price μ, but incurs cost $\eta(Q)$.
- South: Y is **not traded** and **cannot be produced**
  - clean sector: produces the same X but **less productive**;
  - waste-disposal sector: offers waste disposal service at unit price μ, but incurs treatment cost $C(I)$ for I waste imported.
- International Trade: North exports the numeraire good, and imports South's waste disposal service.

The Model: Consumers and Lobbies

- Consumers with heterogeneous environmental preference:

$$\text{North}: \quad W_i = x_i + u(y_i) - \beta_i D(Z), \text{ where } Z = Y - Q;$$
$$\text{South}: \quad W_i = x_i - \beta_i D(I).$$

- In each country, n consumers can be grouped into three:
  1. m_1 **capitalists** (capital owners in North and waste-disposal factory owners in South) with $0 < \beta_C \leq \bar{\beta} = \frac{1}{n}\sum_{i=1}^{n} \beta_i$;
  2. m_2 **environmentalists** with strong preferences for environmental quality such that $\beta_E \geq \bar{\beta}$;
  3. m_3 **workers** with moderate environmental preference, $\beta_W \in [\beta_C, \beta_E]$, but unknown compared to $\bar{\beta}$.
- Organized lobby groups:
  - Overcome the free-riding problem : $h \in \Lambda = \{1, 2\}$;
  - Take collective actions to influence government policies.

The Model: Governments

- Policies: a pollution tax in North; an import tariff in South.
- Two-stage common agency game:
  1. Each of the organized lobby groups offers to the government a policy-contingent campaign contribution $\psi_h(\theta)$, $\theta = t$ or τ;
  2. Government's objective:

$$\max_{\theta>0} G(\theta) = \delta J(\theta) + \sum_{h\in\Lambda} \psi_h(\theta).$$

- Tax revenue:
  1. Firms receive a tax refund t for every unit of waste exported (or cost-savings in administrating these exported waste);
  2. Equally distribute the rest as a lump-sum tax transfer.
- Tariff revenue: equally distribute to all individuals.

Implications: North

- Waste supply: $\hat{Q} = Q(\mu, t)$, with $\frac{d\hat{Q}}{dt} = \frac{1}{\eta''(Q)} > 0$;
- Political economy equilibrium tax t: ▸ North Equilibrium

$$\Omega \equiv \Big[t - \underbrace{n\bar{\beta}D'(\hat{Z})}_{=\text{Pigovian tax } t^*} \Big] + \underbrace{\frac{1 - \frac{m_1+m_2}{n}}{\delta + \frac{m_1+m_2}{n}}}_{>0} \Big\{ (n\beta_W - n\bar{\beta})D'(\hat{Z}) + \underbrace{\frac{d\hat{\Pi}}{d\hat{Z}}}_{=\frac{d\hat{\Pi}/dt}{d\hat{Z}/dt}>0} \Big\} = 0.$$

Proposition 1:

1. If $\beta_W \geq \bar{\beta}$, or $\beta_W < \bar{\beta}$ but $D'(\hat{Z})$ is small enough, then $t < t^*$;
2. If $\beta_W < \bar{\beta}$ and $D'(\hat{Z})$ is large enough, then $t \geq t^*$.

The Effects of Environmental Lobbying

- More m_3 becomes m_2 and associated β_W increases to β_E:

$$\frac{dt}{dm_2} = \frac{\frac{1+\delta}{\delta+\lambda_0}\frac{1}{m_3}\left[m_3(\beta_E-\beta_W)D'(\hat{Z}) - \left(t - n\bar{\beta}D'(\hat{Z})\right)\right]}{\frac{d\Omega}{dt} \quad (>0)}$$

1. If $t < t^* = n\bar{\beta}D'(\hat{Z})$ (Case 1), then "**waste green paradox**"

$$\frac{dt}{dm_2} > 0, \quad \frac{d\hat{Q}}{dm_2} = \frac{d\hat{Q}}{dt}\frac{dt}{dm_2} > 0$$

2. If $t > t^*$(Case 2) and $m_3(\beta_E - \beta_W)D'(\hat{Z}) < t - n\bar{\beta}D'(\hat{Z})$, then

$$\frac{dt}{dm_2} < 0, \quad \frac{d\hat{Q}}{dm_2} = \frac{d\hat{Q}}{dt}\frac{dt}{dm_2} < 0$$

- **Intuition**: (i)savings from environmental damage vs loss of utility; (ii) political internalization (Aidt, 1998)

Implications: South

- Waste demand: $\hat{I} = I(\mu, \tau)$, with $\frac{\partial \hat{I}}{\partial \tau} = -\frac{\mu}{C''(I)} < 0$;
- Political economy equilibrium tariff rate τ: ▸ South Equilibrium

$$\Omega \equiv \left[\mu\tau - n\bar{\beta}D'(\hat{I})\right] + \frac{1-\lambda_0}{\delta+\lambda_0}\left[(n\beta_W - n\bar{\beta})D'(\hat{I}) + \frac{d\hat{\Pi}}{d\hat{I}}\right] = 0$$

Proposition 2:

1. τ is ambiguous relative to social optimum $\tau^* = \frac{n\bar{\beta}D'(\hat{I})}{\mu}$;
2. The effects of environmental lobbying on tariff rate and waste imports are ambiguous.

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Main objective

- Understand the role of environmental lobby groups in waste trade;
- From the policy-lobbying theoretical perspective, the effects of environmental lobbying on waste trade are unambiguous:

$$\frac{d\hat{Q}}{dm_2} = \frac{d\hat{Q}}{dt}\frac{dt}{dm_2} \overset{?}{<} 0, \qquad \frac{d\hat{I}}{dm_2} = \frac{d\hat{I}}{d\tau}\frac{d\tau}{dm_2} \overset{?}{<} 0$$

$$\Downarrow$$

- Require empirical work to provide some clarity!

Question: Do strong environmental lobby groups lead less waste to be shipped from North to South?

Data

- Waste exports: UN Comtrade database
  - Key words: "waste", "scrap", "slag", "residue" and "ash" in the six-digit HS codes, obtain 87 waste categories
  - Sum up total weight of waste traded between country-pairs across all 87 HS categories, yielding aggregate waste exports
- Environmental lobbying strength: proxyed by the number of ENGOs
  - *The Directory*: organizations with environmental concerns
  - *The Encyclopedia* from Gale Group: use keywords to identify groups with an environmental focus
- Other data: WDI, IMF, CEPII, etc

Some Facts on Waste Trade

- Country status: IMF classification
  - Developed: an advanced economy (GDP per capita, export diversification, and integration into global financial system);
  - Developing: an emerging economy or developing economy.
- Table 1: Share of GDP, waste trade, and ENGOs by country status from 1992 to 2011

Country status	Share of world GDP(%)	Share of world waste exports(%)	Share of world waste imports(%)	Average number of ENGOs
Developed	75.28	81.39	61.32	1,165
Developing	24.72	18.61	38.68	741

Notes: Based on 35 developed countries and 87 developing countries in the sample for the years 1992-2001.

Descriptive Statistics

Table 2: Summary Statistics

Variables	Mean	SD	Min	Max
Waste exports (tonnes)	48,431.26	459,515.06	0.00	23,698,532.00
ENGO exporter	33.29	40.21	0.00	196.00
ENGO importer	8.52	6.29	0.00	29.00
Bilateral trade observations	17,525			
Number of exporters	35			
Number of importers	87			

Notes: The first row shows summary statistics for the main dependent variable: the volume of North-to-South waste exports in tonnes between 1992 and 2011. The second and third rows describe summary statistics for the number of ENGOs in the developed and developing countries between 1992 and 2011, respectively. Row four reports the number of positive bilateral waste trade observations. The last two rows document the number of developed and developing countries in the sample, respectively.

Gravity Specification

North-to-South waste regression specifications:

$$\ln Y_{ijt} = \alpha + \beta_1 \ln \text{ENGO}_{it} + \beta_2 \ln \text{ENGO}_{jt} + \beta_3 X_{ijt} + \beta_t + e_{ijt}$$

- Y_{ijt}: aggregate waste exports in tonnes from a developed country i to a developing j in year t;
- ENGO_{it} and ENGO_{jt}: environmental lobbying strength ;
- X_{ijt}: a set of control variables (X_{it}, X_{jt}, X_{ij})
  1. Industry lobbying strength and population;
  2. GDP that captures the scale effect; Capital-labor ratios that captures capital abundance (Baggs,2009);
  3. Geographic, cultural and trade facilitation factors; Basel Convention (Kellenberg and Levinson, 2014).

Regression Results

Table 3: North-to-South waste trade regression specifications

	Dependent variable: ln (North-to-South waste exports)					
	Exporter only		Importer only		Gravity	
Variables	(1)	(2)	(3)	(4)	(5)	(6)
ln (ENGO exporter)	-0.657***	-0.627***			-0.385**	-0.352***
	(0.179)	(0.168)			(0.155)	(0.133)
ln (ENGO importer)			-0.318**	-0.837***	-0.231*	-0.874***
			(0.131)	(0.124)	(0.128)	(0.117)
Exporter-specific Controls	Yes	Yes	No	No	Yes	Yes
Importer-specific Controls	No	No	Yes	Yes	Yes	Yes
Bilateral Controls	No	Yes	No	Yes	No	Yes
Observations	17512	17512	17322	17322	17309	17309
R-squared	0.044	0.088	0.153	0.221	0.208	0.289

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors clustered at country-pairs are in parentheses. All regressions include a constant term and year fixed effects. Exporter and importer-specific controls include industry lobbying strength, population, GDP and capital-labour ratio. Bilateral controls include bilateral distance and dummy variables that indicating whether countries share a common border, common language, had colonial ties, are both members of WTO and Basel Convention, or in some regional trade agreements.

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EU-WSR

- In 2006, EU approved Waste Shipment Regulation (WSR): prohibit export of hazardous waste to developing countries

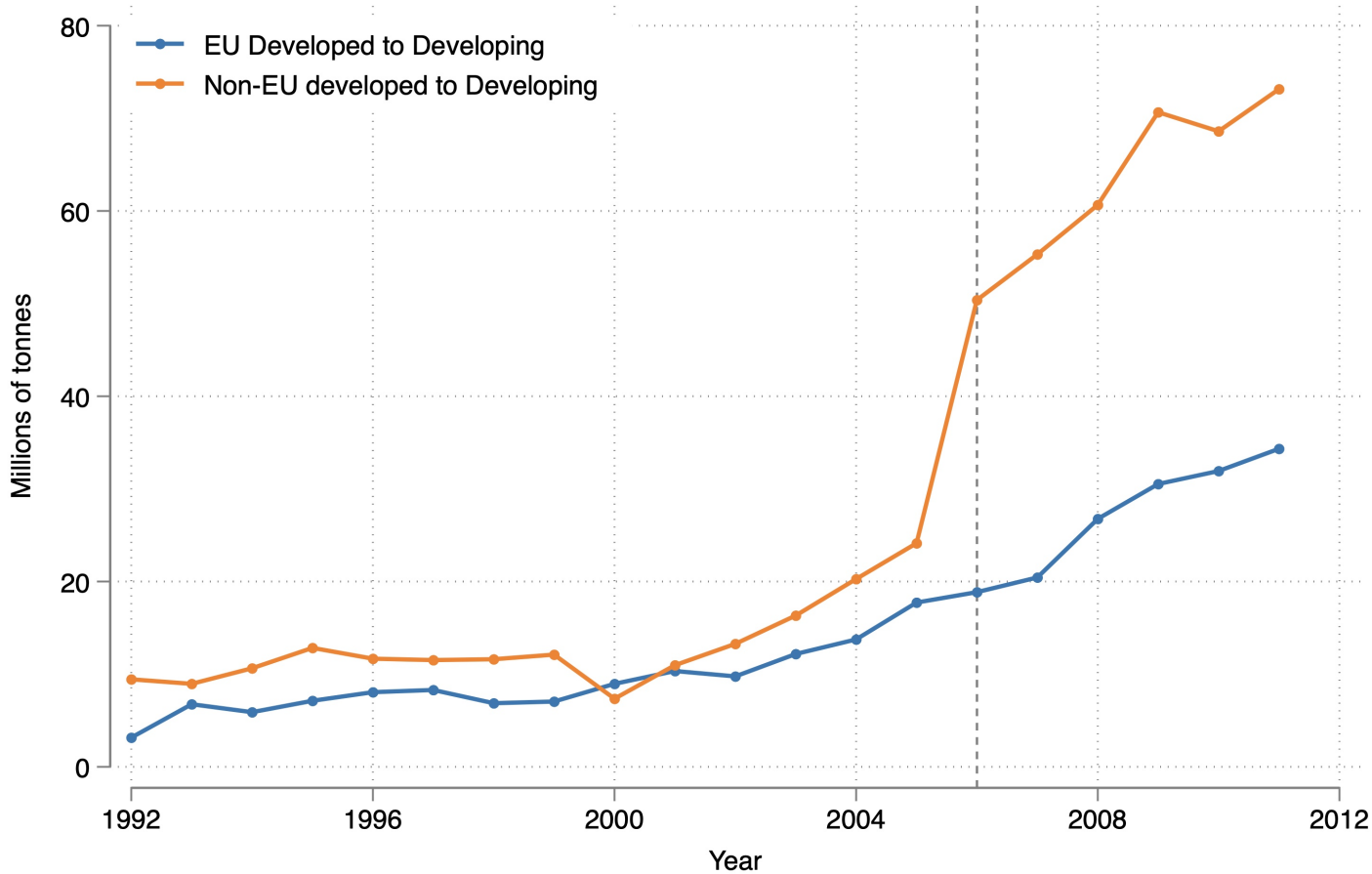

Figure 5: Total annual waste exports to developing countries

Where does EU waste go?

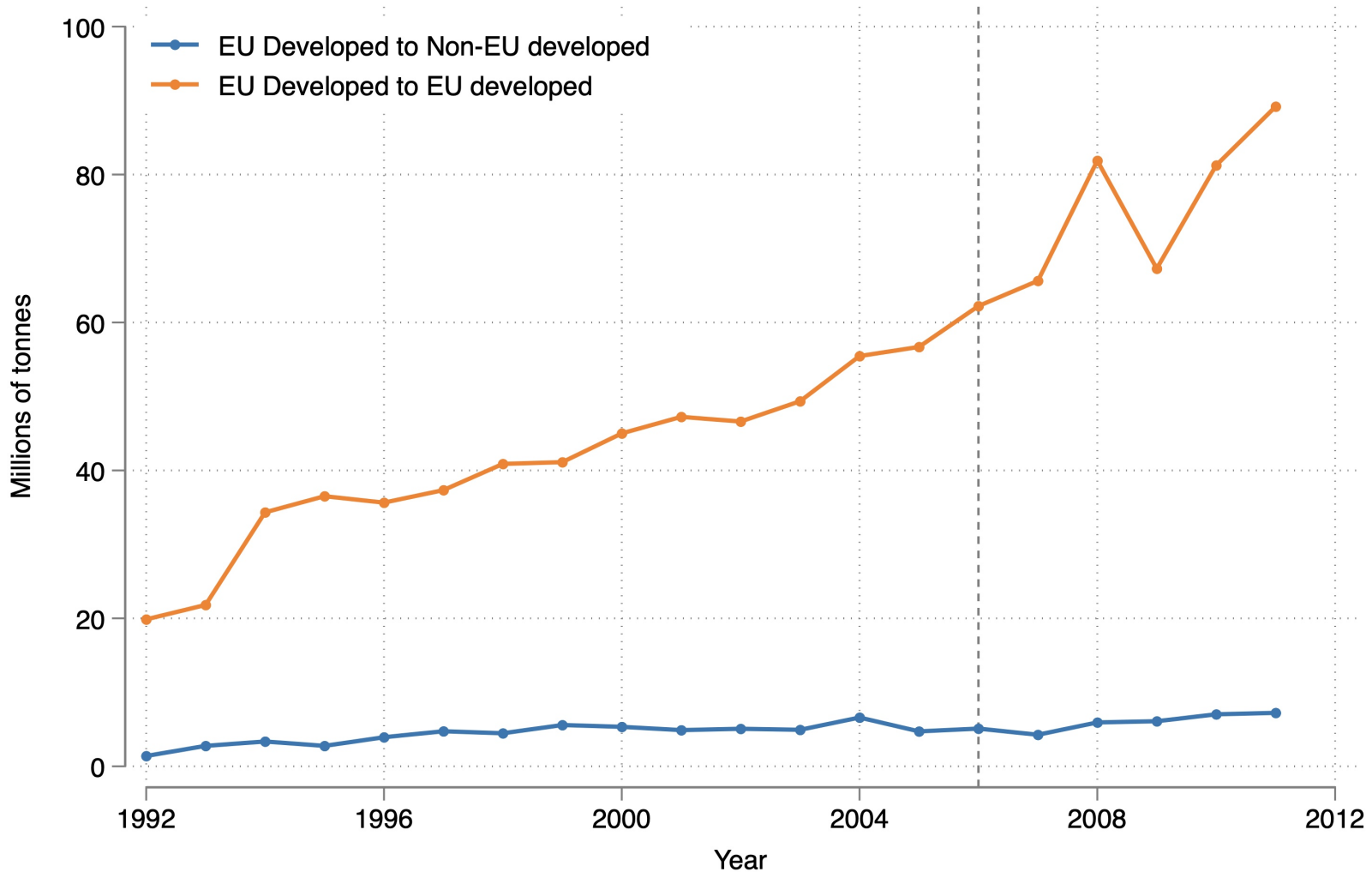

Figure 6: Total annual waste exports from EU developed countries

Triple-Difference Estimation

$$\begin{aligned}\ln Y_{ijt} = {} & \alpha + \beta_1 * \text{Treatment}_i + \beta_2 * \text{Post}_t + \beta_3 * \ln \text{ENGO}_{it} \\ & + \beta_4 * \text{Treatment}_i * \text{Post}_t + \beta_5 * \text{Treatment}_i * \ln \text{ENGO}_{it} \\ & + \beta_6 * \text{Post}_t * \ln \text{ENGO}_{it} + \beta_7 * \text{Treatment}_i * \text{Post}_t * \ln \text{ENGO}_{it} \\ & + \gamma X_{ijt} + \varepsilon_{ijt};\end{aligned}$$

- Y_{ijt}: aggregate waste exports from a developed country i to a developing country j in year t;
- $\text{Treatment}_i = \begin{cases} 1 & \text{if} \quad i \in \text{an EU developed country} \\ 0 & \text{if} \quad i \in \text{non-EU developed country} \end{cases}$;
- $\text{Post}_t = \begin{cases} 1 & \text{if} \quad t \geq 2006 \\ 0 & \text{if} \quad t < 2006 \end{cases}$; ENGO: use 2005 as baseline
- X_{ijt}: a vector of control variables; ε_{ijt}: unobserved error term.

Estimation Results

Table 4: Triple-difference regression specifications

	Dependent variable: ln (North-to-South waste exports)				
	Baseline	Exporter only		Gravity	
Variables	(1)	(2)	(3)	(4)	(5)
Treatment* Post* ln (ENGO exporter)	-0.811***	-0.874***	-0.916***	-0.952***	-0.936***
	(0.152)	(0.158)	(0.156)	(0.159)	(0.157)
Exporter-specific Controls	No	Yes	Yes	Yes	Yes
Importer-specific Controls	No	No	No	Yes	Yes
Bilateral Controls	No	No	Yes	No	Yes
Observations	17525	17512	17512	17309	17309
R-squared	0.015	0.046	0.083	0.213	0.290

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors clustered at country-pairs are in parentheses. Treatment equals one if the country belongs to an EU developed country. Post equals one if year is equal to or greater than 2006. ENGO uses the number of environmental NGOs in 2005 as the baseline. Exporter and importer-specific controls include industry lobbying strength, population, GDP and capital-labour ratio. Bilateral controls include bilateral distance and dummy variables that indicating whether countries share a common border, common language, had colonial ties, are both members of WTO and Basel Convention, or in some regional trade agreements.

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Conclusion

- The politically chosen policy will be distorted from the socially optimal level;
- The effects of environmental lobbying on waste trade are ambiguous, but empirical evidence suggests a positive impact on North-to-South waste exports reduction;
- Policy implication: worthwhile for international donor organizations to provide support for the development of environmental NGOs all over the world. (Binder and Neumayer, 2005; Fredriksson et al., 2005)

Limitations and Future Extensions

1. Green lobbies may affect waste trade via other channels.
   - Yu (2005): greater effectiveness in pubic persuasion;
   - Connelly et al (2012): producing scientific research and reports, organizing protests, staging public stunts;
   - Bentata and Faure (2015): environmental litigation.

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   - Poor tariff data on waste, dominated by the use of nontariff barriers (Gawande and Krishna, 2003);

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   - Data availability and challenges on tax regulation;
   - Poor tariff data on waste, dominated by the use of nontariff barriers (Gawande and Krishna, 2003);
3. Small open economy assumption: price exogenous given.
   - Large countries: China and US;
   - Significant impact of Chinese waste ban in 2017.

THANK YOU!

Waste Disputes

- 2006: Dutch firm Trafigura – Ivory Coast toxic waste dump;
- 2013-2019: Canada – Philippines waste dispute;
- 2019-2020: Malaysia and Indonesia sent back millions of tons of waste back to their original countries.

◂ Scenes

North: Firms' Problem

- Each firm:

$$\max_{K_j, L_j, Q_j} \pi_j = (p_c - t)F(K_j, L_j) - wL_j - rK_j + (t - \mu)Q_j - \eta(Q_j),$$

- For the competitive manufacturing industry as the whole,

$$\max_{L,Q} \Pi = (p_c - t)F(\bar{K}, L) - L + (t - \mu)Q - \eta(Q)$$

- FOC:

$$(p_c - t)F_L(\bar{K}, L) = 1 \Rightarrow \hat{L} = L(t, p_c)$$

$$t - \mu = \eta'(Q) \Rightarrow \hat{Q} = Q(t, \mu), \quad \text{and} \quad \frac{d\hat{Q}}{dt} = \frac{1}{\eta''(Q)} > 0$$

- The maximized aggregate return to capital is

$$\hat{\Pi} = (p_c - t)\hat{Y} - \hat{L} + (t - \mu)\hat{Q} - \eta(\hat{Q}), \quad \text{where } \hat{Y} = F(\bar{K}, \hat{L})$$

North: Consumers' Problem

- For each consumer:

$$\max_{x_k, y_k} [x_k + u(y_k)]$$
$$s.t. \quad x_k + p_c y_k = M_k$$

- Demand is

$$\hat{y}_k = (u')^{-1}(p_c) \equiv y^D(p_c), \quad \hat{x}_k = M_k - p_c \hat{y}_k$$

- Indirect utility function of a consumer is

$$V_k = M_k - p_c y^D(p_c) + u(y^D(p_c)) = M_k + CS(y^D(p_c))$$

- The resulting welfare level of consumer k is

$$W_k = M_k + CS(y^D(p_c)) - \beta_k D(\hat{Z})$$

North: Welfare

- Income of a representative capitalist and non-capitalist:

$$M_i = \hat{\Pi}/m_1 + \bar{l} + t(\hat{Y} - \hat{Q})/n, \quad M_j = \bar{l} + t(\hat{Y} - \hat{Q})/n$$

- Gross welfare of each group is

$$J_1(t) = m_1 \left[M_i + CS(p_c(t)) - \beta_C D(\hat{Y}(t) - \hat{Q}(t)) \right]$$

$$J_2(t) = m_2 \left[M_j + CS(p_c(t)) - \beta_E D(\hat{Y}(t) - \hat{Q}(t)) \right]$$

$$J_3(t) = m_3 \left[M_j + CS(p_c(t)) - \beta_W D(\hat{Y}(t) - \hat{Q}(t)) \right]$$

- Social welfare: $J(t) =$
$n \left[\bar{l} + t(\hat{Y}(t) - \hat{Q}(t))/n + CS(\hat{y}(t)) \right] + \hat{\Pi}(t) - n\bar{\beta} D(\hat{Y}(t) - \hat{Q}(t))$

North: Equilibrium Tax

- Subgame perfect Nash equilibrium:

  1. Following Bernheim and Whinston (1986), focus on interior equilibrium contribution schedules that truthfully reflects gains expected by lobbies

$$\psi_h(t) = J_h(t) - B_h, \quad \text{for } h \in \Lambda, \quad \text{where } B_h > 0$$

  2. The political economy equilibrium tax t^{**} must be the solution of the problem

$$\max_t \hat{G}(t) = (1+\delta)\Big[J_1(t) - B_1 + J_2(t) - B_2\Big] + \delta J_3(t).$$

- FOC that characterizes political economy tax is given by

$$\Omega \equiv \Big[t - n\bar{\beta}D'(\hat{Z})\Big] + \frac{1-\lambda_0}{\delta+\lambda_0}\left\{(n\beta_W - n\bar{\beta})D'(\hat{Z}) + \frac{d\hat{\Pi}}{d\hat{Z}}\right\} = 0,$$

◂ North

South: Firms' Problem

- Competitive firms' problem:

$$\max_{I} \Pi = (1-\tau)\mu I - C(I)$$

- FOC:

$$(1-\tau)\mu = C'(I) \quad \Rightarrow \hat{I} = I(\mu,\tau), \quad \text{with } \frac{\partial \hat{I}}{\partial \tau} < 0$$

- The aggregate profit of waste-disposing firms is

$$\hat{\Pi} = (1-\tau)\mu\hat{I} - C(\hat{I})$$

- Income of a capitalist and non-capitalist:

$$M_i = \hat{\Pi}/m_1 + \bar{l} + \tau\mu\hat{I}/n, \quad M_j = \bar{l} + \tau\mu\hat{I}/n$$

South: Welfare

- Given the linearity of the utility function, the gross welfare of each group is

$$J_1(\tau) = m_1(\hat{\Pi}(\tau)/m_1 + \bar{l} + \tau\mu\hat{I}(\tau)/n) - m_1\beta_C D(\hat{I}(\tau))$$
$$J_2(\tau) = m_2(\bar{l} + \tau\mu\hat{I}(\tau)/n) - m_2\beta_E D(\hat{I}(\tau))$$
$$J_3(\tau) = m_3(\bar{l} + \tau\mu\hat{I}(\tau)/n) - m_3\beta_W D(\hat{I}(\tau))$$

- Social welfare:

$$J(\tau) = \sum_{i=1}^{3} J_i(\tau) = \bar{L} + \tau\mu\hat{I}(\tau) + \hat{\Pi}(\tau) - n\bar{\beta}D(\hat{I}(\tau))$$

- Social optimal tariff rate:

$$\tau^* = \frac{n\bar{\beta}D'(\hat{I})}{\mu}$$

South: Political Economy Equilibrium

- Follwing Bernheim and Whinston (1986), focus on interior equilibrium contribution schedules that truthfully reflects gains expected by lobbies

$$\psi_h(\tau) = J_h(\tau) - B_h, \quad \text{for } h \in \Lambda, \quad \text{where } B_h > 0$$

- Government's problem becomes

$$\max_{\tau} (1+\delta)\Big[J_1(\tau) - B_1 + J_2(\tau) - B_2\Big] + \delta J_3(\tau)$$

- The government's choice of τ must satisfy the following FOC:

$$\Big[\mu\tau - n\bar{\beta}D'(\hat{I})\Big] + \frac{1-\lambda_0}{\delta+\lambda_0}\Big[(n\beta_W - n\bar{\beta})D'(\hat{I}) + \frac{d\hat{\Pi}}{d\hat{I}}\Big] = 0$$

where $\lambda_0 = \frac{m_1+m_2}{n}$, $\frac{d\hat{\Pi}}{d\hat{I}} = \frac{\frac{d\hat{\Pi}(\tau)}{d\tau}}{\frac{d\hat{I}(\tau)}{d\tau}} = \frac{-\mu\hat{I}(\tau)}{\frac{d\hat{I}(\tau)}{d\tau}} > 0.$

◂ South