Environmental Lobbying on International Trade in Waste: Theory and Evidence

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Abstract

This paper investigates the effects of environmental lobbying on international trade in waste. I develop a theoretical framework that emphasizes the potential impact of green lobbies on environmental and trade policies and how North-to-South waste flows are affected through these policy channels. I show that the politically chosen policies are ambiguous relative to the socially optimal levels, depending on the heterogeneity of environmental preferences and the degree of pollution damages from waste. This in turn leads to ambiguous effects of environmental lobbying on the North-to-South waste trade. Further, I take the theory to the empirics using panel data on the bilateral waste trade and the number of environmental NGOs (ENGOs) as a proxy for the environmental lobbying strength. I employ two different empirical strategies. The first one is a gravity specification that exploits within-country and cross-country variations. The results show that a 10% increase in the number of ENGOs in the North will lower North-to-South waste exports by 3.52%, whereas a similar increase in the South can reduce waste exports by 8.74%. The second approach uses a triple-difference estimation strategy that exploits plausibly exogenous variation created by waste exports restriction following the introduction of the EU Waste Shipment Regulation in 2006. I find that countries with 10% more ENGOs tend to decrease their waste exports by 6.7% more after the implementation of the regulation. These findings thus suggest that strengthening ENGOs can represent an important strategy to reduce the international waste trade.

Keywords: Trade in waste; Environmental lobbying; Political economy; Externality;

JEL Codes: D72, F14, F18, Q53, Q56, Q58

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1 Introduction

Growing waste generation coupled with a highly globalized economy has led to increased volumes of waste being shipped across borders. The global South, in need of the employment and foreign exchange offered by waste trade, has often been targeted by the North as a dumping haven to absorb their excessive waste. However, developing countries are typically ill-equipped to handle the recycling and recovery of material that is often highly toxic. Consequently, much of the waste is dumped or discarded directly into the environment, causing a further escalation of environmental degradation (Kellenberg, 2012). With the shocking sight of towering waste piles in the neighbourhoods of developing countries and giant garbage patches floating on the ocean, there is widely documented evidence of adverse environmental and public health problems caused by waste.[1]

Galvanized by the growing pace and scale of climate change, environmental lobby groups have increased significantly both in size and strength over the past few decades.[2] Their rising impacts are shaping the political landscape (Wapner, 1995; Fredriksson et al., 2005; Longhofer and Schofer, 2010) and steering government policies towards better environmental outcomes (Kalt and Zupan, 1984; Cropper et al., 1992; Riddel, 2003; Binder and Neumayer, 2005; Fredriksson et al., 2005).

This paper investigates the role of green lobbies in the international waste trade and seeks to understand whether strengthening environmental lobby groups can represent an important strategy to reduce the North-to-South waste trade. To address this question, I first develop a political economy model of the kind introduced by Grossman and Helpman (1994). Using this model, I investigate how green lobbies affect the determination of environmental and trade policies and how waste trade flows are affected through these policy channels. I focus on two representative small open economies that are linked by trade in waste, where waste is modelled as an environmentally harmful byproduct generated during the production process in a developed-country market. This byproduct is tolerated at some level and subjected to a pollution tax and can be exported to a developing country for disposal but with a fee. The developing country may want to restrict some waste imports and thus imposes a tariff rate

[1]For example, Trafigura, a Dutch oil trading company with additional offices in Great Britain, dumped hundreds of tons of waste at Abidjan, Côte dIvoire (Ivory Coast) in 2006, and caused nausea, headaches, vomiting, violent rashes, and even death among thousands of people living near the dump sites. See https://www.business-humanrights.org/en/latest-news/trafigura-lawsuit-re-hazardous-waste-disposal-in-côte-divoire-filed-in-the-netherlands/. More recently in 2019, the dragging Canada-Philippines garbage dispute finally came to an end after Canada agreed to take back its trash sent to the Philippines 6 years ago, which was falsely labelled as recyclable scrap but instead contained household waste. Tonnes of rotting refuse have sat festering on the docks of Manila, causing port congestion and posing a health hazard risk. See https://www.nytimes.com/2019/05/23/world/asia/philippines-canada-trash.html.

[2]For instance, up to date, the Environmental Defense Fund has an active membership of 2.5 million with operations in 28 countries and operating expenses reaching a record $216 million in 2020. See https://www.edf.org/about. The other leading environmental NGO, Greenpeace, has also expanded massively with national and regional organizations across the world.

to prevent the country from becoming a garbage dump. In each country, an organized environmental and industry lobby group with heterogeneous environmental preferences confronts the incumbent government with contribution schedules contingent on its waste policies. The respective governments then try to balance the competing interests of various lobby groups and choose the policy to maximize a weighted sum of the social welfare and campaign contributions received from lobby groups.

I show that the politically chosen policy (i.e., tax in the North and tariff in the South) is ambiguous relative to the socially optimal level, depending on the heterogeneity of environmental preferences and the degree of pollution damages from waste. This political distortion arises from two facts: one is that lobby groups offer campaign contributions to an electorally motivated government in exchange for particular political favours (Aidt, 1998); the other is that lobby groups with heterogeneous environmental attitudes respond differently to various degrees of waste-induced environmental damages. Because of the relatively lower environmental valuations and the additional incentive to reduce the negative policy effect on profits that do not accrue to environmentalists, capitalists will typically lobby more aggressively for a less stringent policy, which eventually dominates any countervailing efforts from environmentalists. The resulting equilibrium policy level will be lower than the socially optimal one. However, if environmental damage caused by waste is significant enough, it will play an increasing role in both lobby groups' welfare calculations, inducing capitalists to diminish their lobbying efforts while triggering a more aggressive response from environmentalists. Consequently, the political equilibrium policy may equal or even overshoot the social optimum.

I then investigate how strengthening green lobbies – as measured by an increase in the number of environmentalists and the joining members' environmental valuation – might affect the policy stringency and by extension firms' decision on waste trade. This can be interpreted as an environmental movement in which growing environmental awareness has arguably enabled environmentalists to mobilize more ordinary people to join forces and exert pressure on governments to take more action. My theoretical model generates ambiguous predictions about the effects of environmental lobbying on trade in waste.

I show that when capitalists have a dominating lobbying power, which leads to a downward distorted policy that is inefficiently weak, strengthening environmental lobbies in the North will lead to a higher tax and therefore result in more waste being exported, while doing so in the South will increase the tariff rate but lead to less North-to-South waste exports. Indeed, as more people become environmentally concerned and join the green lobbying while the number of capitalists is fixed, this translates into more power exercised by the environmental lobby group. As a result, the government will respond to this boosted political pressure by increasing regulations on the externality. This in turn leads to a higher tax in the North and a higher tariff in the South, where the former increases the cost of disposing waste domestically and thereby induces firms to export more waste out of the country for disposal, and the latter effectively deters more waste from being imported. Using a different model, McAusland (2008) draws a similar conclusion, demonstrating that when facing increased political pressure from lobby groups, regulators have an incentive to increase regulation on pollution that is a by-product of consumption activities and thereby induce firms to export waste to locations with lower environmental regulations. This result resembles the so-called "Green Paradox" (Sinn, 2008; Jensen et al., 2015; Van der Ploeg and Withagen, 2015). Within the waste trade context, a well-intended movement to strengthen environmental protection leads to increased domestic environmental stringency and more waste – often highly toxic – to be shipped to countries that are less equipped to deal with it, possibly exacerbating the environmental damages.

However, in the case of environmentalists lobbying more aggressively while capitalists diminish their lobbying efforts, which leads to an upward distorted policy that is inefficiently strict, strengthening green lobbies may unexpectedly lead to a lower tax (tariff) and result in less (more) North-to-South waste exports. While environmentalists endeavour to save the country from suffering too much waste-induced environmental damage, they also derive utility from consumption. When the extra savings from environmental damages cannot compensate for their utility loss from consumption, they would like to exchange some environmental protection for more consumption, which relaxes the policy stringency. As the number of environmental lobbyists increases, the desire for the tradeoff also increases, which further reduces the tax or tariff. As the pollution tax in the North decreases, the cost of disposing of waste domestically goes down and therefore less waste will be exported abroad, while a lower tariff rate in the South will induce firms to import more waste. Eventually, when all workers become environmentalists, the equilibrium will equal the socially optimal level, leading to a political internalization of the environmental externality (Aidt, 1998).

The model provides us with some insights into the relationship between environmental lobbying strength, policy stringency, and firms' decisions on waste trade. However, the theory does not yield unambiguous predictions without making further assumptions. Thus, it becomes an empirical question as to whether environmental lobby groups can play a role in reducing the waste trade. To address this question, I build a comprehensive dataset that combines two decades of bilateral waste trade data at the aggregate country level with the number of environmental NGOs (ENGOs) as a proxy for environmental lobbying strength. My analysis leverages data across 35 developed and 87 developing countries in the period from 1992 to 2011. I then employ two different empirical strategies to identify the effects of environmental lobbying on North-to-South waste exports. The first strategy is a gravity specification that explores within-country and cross-country variations; the second approach uses a triple-difference estimation strategy that exploits plausibly exogenous variation created by waste exports restriction following the introduction of the EU Waste Shipment Regulation (WSR) in 2006.

The gravity estimation results suggest that strong environmental lobby groups in either developed or developing countries will result in less North-to-South waste exports. More specifically, a 10% increase in the number of ENGOs in developed countries will lower waste exports by 3.52%, whereas a similar increase in developing countries can reduce waste exports by 8.74%. Exploring differences in waste exports between EU developed countries and non-EU developed countries, before and after the EU-WSR as well as in environmental lobbying strength across countries, I find compelling evidence that environmental lobby groups exert a statistically significant impact on waste export reduction by EU developed countries. More precisely, countries with 10% more ENGOs tend to decrease 6.7% more of their waste exports after the implementation of the regulation. These empirical results provide robust evidence that strengthening ENGOs can represent an important strategy to reduce the international waste trade. Therefore, it may be worthwhile for international donor organizations to provide support for the development of ENGOs all over the world (Binder and Neumayer, 2005; Fredriksson et al., 2005).

My paper contributes to several strands of literature. The first is to the large literature on the political economy approach of endogenous trade policy[3] that has been later extended to endogenous environmental policy-making (Fredriksson, 1997; Aidt, 1998; Schleich, 1999; Conconi, 2003; Fredriksson et al., 2005; Fünfgelt and Schulze, 2016). However, these studies generally assume that only environmentalists are concerned about the environment or that all individuals have identical environmental preferences while neglecting the fact that people with the same income may also have heterogeneous preferences for environmental quality. The strength of such feelings toward the environment is not correlated with income levels and the diversity of such attitudes is largely considered as a source of social conflict (Cassing and Long, 2021). I add to the literature by incorporating heterogeneous environmental preferences and providing some new insights into the politically distorted equilibrium.

My paper is closely related to Cassing and Long (2021), but extends their work in a number of dimensions. First, I supplement their model by including a waste-receiving country, whose optimal choice of the tariff rate on imported waste is also governed by a politically determined process. Second, I relax some of their restrictive assumptions on the ranking of environmental attitudes among lobby groups, which allows me to provide some new findings about the political economy equilibrium. That is, the politically chosen policy can be even tighter than the socially optimal one if waste-induced environmental damages are large enough. Third, my model enables me to investigate and demonstrate explicitly how lobby groups might affect waste trade through the mechanism of a politically determined tax and tariff.[4] Finally, I take the theory to the

[3] See Grossman and Helpman (2020) for a review of the literature.

[4] While Cassing and Long (2021) assume that individuals have heterogeneous environmental preferences within and across different groups, I consider the situation where environmental preference only differs across groups but remains the same within the group. One reason for doing so is that it allows me to analytically investigate the effect of the environmental movement.

data to empirically clarify the effects of environmental lobbying on trade in waste.

My research also contributes to the empirical trade literature that examines factors affecting international trade in waste.[5] Previous studies have estimated the effects of various economic factors on transboundary waste shipments, including income and capital-labour ratio (Baggs, 2009), recycling cost (Kellenberg, 2012), environmental regulation (Baggs, 2009; Kellenberg, 2012), wage and population (Higashida and Managi, 2014) and Basel Convention (Kellenberg and Levinson, 2014). However, these econometric analyses are built upon the conventional economic line that governments are benevolent in always maximizing social welfare while ignoring other factors such as lobby groups and political contributions (Goldberg and Maggi, 1999; Gawande and Bandyopadhyay, 2000; Pacca et al., 2021). I contribute to this literature by taking the political economy approach and investigating the role of environmental lobby groups in the international waste trade.

Finally, my findings contribute to the policy discussions that aim to reduce transboundary waste shipments. The existing policy approach includes international treaties such as the Basel Convention, Rotterdam Convention and Stockholm Convention as well as individual countries' own restrictions and environmental regulations.[6] However, ample evidence suggests that these approaches are falling short. Like any other international environmental agreements (IEAs), the above-mentioned treaties also suffer the free-riding problem and some of them are merely seen as an attempt by countries to bolster their international image without active ratification or enforcement. The US, one of the largest waste exporters, has yet to sign any of the agreements. Even though many jurisdictions such as Australia, Canada, the UK and the European Union have ratified them, millions of tonnes of waste are still heading their way to developing countries each year. Using annual bilateral waste shipments among countries before and after one of the trading partners ratifies the Basel Convention, Kellenberg and Levinson (2014) find no evidence that the Convention has resulted in less waste being traded. Note that unlike most of the other transboundary pollution problems such as climate change that need global cooperation, the waste problem arises from the fact that the externality is intentionally and consciously packed and shipped anywhere in the world that is willing to accept it. The deliberate and voluntary nature of these actions raises hope for a possible solution. My paper contributes to the literature by providing the first such evidence of environmental lobbying and highlighting its positive effects on reducing the waste trade.

The remainder of the paper is structured as follows. Section 2 presents the theoretical framework. Section 3 describes the data and summary statistics. Section 4 illustrates the empirical strategies and main results. Finally, Section 5 concludes.

[5]For an overview of this literature, see Kellenberg (2015).

[6]For example, both Canada and the European Union have introduced the extended producer responsibility program, which makes producers accountable for waste disposal costs and responsible for establishing recycling and reuse objectives (Bernard, 2015).

2 The theoretical framework

In this section, I present a political economy model with the simplest possible structure that captures much of the essential elements of international trade in waste. I analyze two representative small open economies in the highly-integrated world markets, which thus do not affect the market prices of waste, e.g. consider Canada and the Philippines.[7] This is a sensible assumption that I consider true for most economies in terms of waste trade. Indeed, on the waste supply side, suppliers are fairly competitive in taking the price of waste treatment as given; on the waste demand side, there is considerably more competition as many firms in the developing countries vie for those waste-disposal contracts. I model waste as a production externality generated in the global North that can be exported to the South for disposal but with a fee. In both North and South, there is an organized environmental lobby group and industry lobby group that seek to influence the governments' environmental and trade policies. The governments do not simply maximize social welfare, but balance competing interests in their support-maximizing calculus according to the political influence of different lobby groups (Grossman and Helpman, 1994). I then characterize the political economy equilibrium in each country and compare it with the socially optimal level. Finally, I investigate the effects of environmental lobbying on policy stringency and how the waste trade is affected through these policy channels.

2.1 The North: waste supply

A small open competitive economy in the North has 2 sectors. The first one is a clean sector, which produces a numeraire good using labor only with constant returns to scale and a one-to-one input-output ratio. The other one is a polluting sector that uses capital and labor to produce a manufacturing output according to the neoclassical production function $Y = F(K, L)$ that exhibits constant returns to scale with positive and diminishing marginal products and convex isoquants. During the manufacturing process, a negative externality or by-product called waste is generated. For simplicity, each unit of output is accompanied by a unit of waste, denoted by $E = Y$. The North can ship $Q \leq Y$ units of its waste to the South for disposal at a constant unit price $\mu > 0$. For Q units of waste exported, firms incur a cost $\eta(Q)$ in collecting, sorting as well as packaging and transportation of waste, where η is strictly convex with $\eta(0) = 0, \eta(Q) > 0$ and $\eta''(Q) > 0$.[8] Suppose that the North is endowed with a fixed supply of capital and labor, denoted by $\bar{K}$ and $\bar{L}$, respectively, and that labour is perfectly mobile across sectors and full employment prevails. The domestic and world prices of the numeraire good are set equal to one, then the economy-wide wage rate is fixed at

[7] See Cassing and Kuhn (2003) for the case of market power when both waste-importing and waste-exporting countries act strategically to utilize national environmental policies to attach rents arising from trade in waste.

[8] One can also interpret $\eta(Q)$ as the amount of labor that is required for these activities.

$w = 1$.

The economy is populated by a large number of individuals n, each endowed with $\bar{l}$ units of labor, where $\bar{L} = n\bar{l}$. Each individual i derives utility from the consumption of both goods, denoted by a quasi-linear and additively separable utility function: $U_i = x_i + u(y_i)$, where x_i, y_i denotes the consumption of numeraire and manufactured good, respectively, and $u' > 0, u'' < 0$. However, discomfort arises from seeing the pollution caused by waste in the country, so the welfare of individual i is given by

$$W_i(x_i, y_i, Z) = x_i + u(y_i) - \beta_i D(Z),$$

where $D(Z)$ is a positive and convex damage function with $D(0) = 0, D(Z) > 0, D''(Z) > 0$, $Z = Y - Q$ is the amount of waste or pollution that remains in the country, and β_i denotes individual i's preference for environmental quality. Let $\bar{\beta} = \frac{1}{n}\sum_{i=1}^{n} \beta_i$ represent the society's average environmental preference, then it follows that the social marginal cost of a unit of waste is $\frac{\partial \sum_{i=1}^{n} W_i}{\partial Z} = n\bar{\beta}D'(Z)$.

Suppose that the n individuals in this economy can be categorized into 3 groups. Among them, group 1 consists of $m_1 < n$ individuals who own capital, referred to as capitalists. For simplicity, all the capitalists are assumed to have the same environmental preference, denoted by $\beta_C \in (0, \bar{\beta}]$, and each of them has an equal endowment of capital, $\bar{K}/m_1$. Group 2 consists of m_2 non-capitalists who share the same strong preference for environmental quality, referred to as environmentalists, with $\beta_E \geq \bar{\beta}$. In the model, environmentalists are assumed to be those who only care about local pollution and do not have global concerns – referred to as NIMBYs (not in my backyard). Finally, the remaining m_3 non-capitalists, referred to as workers, constitute Group 3 with the same moderate preference for environmental quality at $\beta_W \in [\beta_C, \beta_E]$, but whether β_W is greater than $\bar{\beta}$ or not remains unknown.

Suppose individuals with similar interests can overcome the free-riding problem (Olson, 1965), and are formed as organized lobby groups to further their interest by taking collective action to influence government policies. I adopt the structure of the two-stage common agency game developed by Bernheim and Whinston (1986) and later employed by Grossman and Helpman (1994) on endogenous trade policies. In the first stage of the game, each of the organized groups simultaneously and non-cooperatively offers to the incumbent government a campaign contribution contingent on the pollution tax selected by the government to correct for the externality. While a group that prefers low taxes will always make more political donations the lower the announced tax, a group that stands to gain in terms of its own welfare with respect to a higher tax will always increase its contributions. Within the context, the not-in-my-back-yard environmentalists will typically push for a higher environmental tax to avoid too much pollution in the country, while capitalists will only lobby for a lower tax if doing so increases their welfare. By definition, individuals in an unorganized group do not have enough stake in the policy outcome and thus make no campaign contributions. In the second stage of the game, the government takes the “announced contribution schedules" as given and chooses an environmental tax t on the manufacturing output to maximize a weighted sum of social welfare and its receipt of campaign contributions:

$$\max_{t} G(t) = \delta J(t) + \sum_{h \in \Lambda} \psi_h(t),$$

where $J(t) = \sum_{i=1}^{n} J_i(t)$ is the aggregate social welfare, $\psi_h(t)$ is the campaign contribution made by organized lobby group $h \in \Lambda$ and $\delta > 0$ is an exogenously given weight that the government attributes social welfare relative to political contributions.

Finally, the domestic firms will receive a tax refund t for every unit of waste that is being exported, i.e., the government will only tax the pollution that remains within the country. This can be seen as a form of border tax adjustment (Keen and Kotsogiannis, 2014; Cosbey et al., 2020). Another way to interpret this tax refund is that firms will save an equivalent per unit cost of t in administrating those exported waste. As for the remaining tax revenue, the government will distribute it as a lump-sum tax transfer to all the individuals in the economy. Refunding environmental charges back to the polluting industry and consumers are quite often and typically reduces resistance from the polluters, making the policy more politically acceptable than a standard tax. See, for example, the refunded emission payment scheme in Sweden (Sterner and Isaksson, 2006), the carbon tax rebate programs in Canada, and other examples in Aidt (2010).

In the following, I solve the problems of firms, consumers, lobby groups and the government, respectively. First, taking as given the consumer price of the manufactured good p_c, the unit waste absorption fee μ, and the environmental tax t on manufacturing output, which is also the refund per unit of waste exported, each competitive manufacturing firm chooses the input levels (K_j, L_j) and waste export level (Q_j) to maximize its profit:

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

where $w = 1$ is the wage rate and r is the rental rate. With the constant returns to scale assumption and $\sum_j K_j = \bar{K}$, we know that for the manufacturing industry as a whole, the industry’s employment of labor L and waste exports Q must be determined by maximizing the aggregate return to the capital stock. Thus, the firms’ problem can be reformulated as

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

Assuming an interior solution, the first order conditions with respect to Q and L are respectively

$$t - \mu = \eta'(Q), \tag{1}$$

and

$$(p_c(t) - t)F_L(\bar{K}, L) = 1, \tag{2}$$

where F_L denotes the marginal product of labor in manufacturing. Equation (1) says that at the optimal waste export level $\hat{Q}$, the marginal benefit must be equal to the marginal cost of exporting waste. As long as $t > \mu$, firms would want to export waste abroad. Equation (2) says that at the optimal labor allocation $\hat{L}$, the value of the marginal product of labor is equated to the wage rate. Given $\hat{Q}$ and $\hat{L}$, the maximized aggregate return to capital is

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

After solving the firms' problem, I now turn to the consumer's problem. Each consumer i is maximizing the utility subject to her budget constraint:

$$\max_{x_i, y_i} [x_i + u(y_i)], \quad s.t. \quad x_i + p_c y_i = M_i,$$

where M_i is the income of consumer i. Every consumer in the economy receives income from two sources: first, she supplies her endowment of labour inelastically to the competitive labour market and thus earns the wage income $w\bar{l}$; second, she receives $1/n$ of the government's net tax revenue $t(\hat{Y} - \hat{Q})$ as a lump sum transfer. However, a capitalist has one additional income source from her endowment of capital, which claims $\frac{\hat{\Pi}}{m_1}$. Therefore, the income of a representative non-capitalist, i.e., environmentalist or worker, is given by

$$M_j = \bar{l} + t(\hat{Y} - \hat{Q})/n, \tag{3}$$

while that of a representative capitalist is

$$M_k = \hat{\Pi}/m_1 + \bar{l} + t(\hat{Y} - \hat{Q})/n. \tag{4}$$

Utility maximization yields the first order condition:

$$u'(y_i) = p_c. \tag{5}$$

Thus, the demand for the manufactured good and numeraire good are respectively:

$$\hat{y}_i = (u')^{-1}(p_c) \equiv \hat{y}(p_c), \quad \hat{x}_i = M_i - p_c \hat{y}_i,$$

and the indirect utility function of consumer i is

$$V_i = M_i - p_c \hat{y}(p_c) + u(\hat{y}(p_c)) = M_i + CS(\hat{y}(p_c)),$$

where $CS(\hat{y}(p_c)) = u(\hat{y}(p_c)) - p_c \hat{y}(p_c)$ is the consumer surplus with $\frac{dCS(\hat{y}(p_c))}{dp_c} =$

$-\hat{y}(p_c)$. The resulting welfare level of consumer i is

$$W_i = M_i + CS(\hat{y}(p_c)) - \beta_i D(\hat{Z}),$$

where $\hat{Z} = \hat{Y} - \hat{Q}$ and M_i is given by equation (3) for a non-capitalist and equation (4) for a capitalist. Therefore, the gross welfare of each group can be expressed as

$$J_1(t) = m_1 \left[\hat{\Pi}(t)/m_1 + \bar{l} + t(\hat{Y}(t) - \hat{Q}(t))/n + CS(p_c(t)) \right] - m_1 \beta_C D(\hat{Y}(t) - \hat{Q}(t)),$$

$$J_2(t) = m_2 \left[\bar{l} + t(\hat{Y}(t) - \hat{Q}(t))/n + CS(p_c(t)) \right] - m_2 \beta_E D(\hat{Y}(t) - \hat{Q}(t)),$$

$$J_3(t) = m_3 \left[\bar{l} + t(\hat{Y}(t) - \hat{Q}(t))/n + CS(p_c(t)) \right] - m_3 \beta_W D(\hat{Y}(t) - \hat{Q}(t)).$$

and the aggregate social welfare is

$$J(t) = n \left[\bar{l} + t(\hat{Y}(t) - \hat{Q}(t))/n + CS(\hat{y}(t)) \right] + \hat{\Pi}(t) - n\bar{\beta} D(\hat{Y}(t) - \hat{Q}(t)), \tag{6}$$

where by definition, $n\bar{\beta} = m_1\beta_C + m_2\beta_E + m_3\beta_W$.

Before we proceed to characterize the two-stage subgame perfect equilibrium, it will be useful to derive the socially optimal environmental tax so that we have a benchmark to compare to. Also, it will be helpful to compute the comparative statics of $\hat{L}, \hat{Y}, \hat{Q}, \hat{Z}, \hat{\Pi}$ with respect to t, which constitute a building block to analyze the effects of environmental lobbying on tax and by extension trade in waste. But first note that in equilibrium, the total consumption of the manufactured good must be equal to that sector's total output, i.e.,

$$n\hat{y} = \hat{Y} = F(\bar{K}, \hat{L}) \iff \hat{y} = \frac{\hat{Y}}{n}. \tag{7}$$

2.1.1 Pigovian tax

Without any political considerations, a benevolent government only cares about the aggregate welfare level of its country and thus welfare maximization is the main force that drives environmental policy decisions. Maximizing (6) with respect to t yields the socially optimal environmental tax, i.e.,

$$\frac{dJ}{dt} = \left(t - n\bar{\beta} D'(\hat{Z}) \right) \left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt} \right) = 0 \Rightarrow t^* = n\bar{\beta} D'(\hat{Z}).$$

Proof. See Appendix A.1. □

That is, the socially optimal or Pigovian tax is equal to the social marginal cost of waste.

2.1.2 Comparative statics with respect to tax

The equilibrium demand for labour in the manufacturing sector, $\hat{L}$, is implicitly given by equation (2): $(p_c(t) - t)F_L(\bar{K}, L) = 1$. This, combined with equation (5): $u'(y_i) = p_c$ and equation (7): $\hat{y} = \frac{\hat{Y}}{n} = \frac{F(\bar{K},\hat{L})}{n}$, yields a unique equation that determines $\hat{L}$ as a function of t:

$$\left[u'\left(\frac{F(\bar{K},\hat{L})}{n}\right) - t\right] F_L(\bar{K},\hat{L}) - 1 = 0. \tag{8}$$

Applying the implicit function theorem to equation (8) yields

$$\frac{d\hat{L}}{dt} = \frac{F_L}{u'' F_L^2/n + F_{LL}/F_L} < 0.$$

Then, it follows that

$$\frac{d\hat{Y}}{dt} = F_L \frac{d\hat{L}}{dt} = \frac{F_L^2}{u'' F_L^2/n + F_{LL}/F_L} = \frac{1}{u''/n + F_{LL}/F_L^3} < 0,$$

with

$$\frac{dp_c}{dt} = \frac{u''}{n}\frac{d\hat{Y}}{dt} = \frac{u'' F_L^2/n}{u'' F_L^2/n + F_{LL}/F_L} < 0, \quad \frac{dp_c}{dt} - 1 = -\frac{F_{LL}}{F_L^3}\frac{d\hat{Y}}{dt} < 0.$$

The equilibrium waste exports, $\hat{Q}$, can be implicitly obtained from equation (1): $t - \mu = \eta'(Q)$ as a function of t. Totally differentiate (1) with respect to $\hat{Q}$ and t yields

$$\frac{d\hat{Q}}{dt} = \frac{1}{\eta''(Q)} > 0.$$

Therefore, the equilibrium pollution level is $\hat{Z}(t) = \hat{Y}(t) - \hat{Q}(t)$ with $\frac{d\hat{Z}}{dt} = \frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt} < 0$. Finally, using the envelope theorem, we can get

$$\frac{d\hat{\Pi}}{dt} = \left[\frac{dp_c}{dt} - 1\right]\hat{Y} + \hat{Q} = \hat{Q} - \hat{Y}\frac{F_{LL}}{F_L^3}\frac{d\hat{Y}}{dt},$$

which can be rearranged as

$$\frac{dp_c}{dt} - 1 = \frac{\frac{d\hat{\Pi}}{dt} - \hat{Q}}{\hat{Y}} < 0. \tag{9}$$

A higher pollution tax increases firms' burden and would typically lead to lower aggregate industry profits or producer surplus. Thus, by construction,

$$\frac{d\hat{\Pi}}{dt} < 0 \Longleftrightarrow \hat{Q} < \hat{Y}\frac{F_{LL}}{F_L^3}\frac{d\hat{Y}}{dt}.$$

2.1.3 Political economy tax

In this paper, I only consider two organized lobby groups – capitalists and environmentalists, while workers are not organized.[9] I now investigate how the pressure exercised by an environmental and industry lobby group could result in a political economy equilibrium and characterize the government's optimal choice of environmental tax.

The incumbent governments action is the unit pollution tax and the lobby groups' actions are contribution schedules that map each tax policy into a contribution level. The political equilibrium thus consists of a set of feasible contribution functions $(\{\psi_h(t^{**})\}_{h\in\Lambda})$ and the environmental tax policy (t^{**}). Following Bernheim and Whinston (1986), I focus on the interior equilibrium contribution schedules that truthfully reflect the gains expected by the pressure groups such that $\psi_h(t) = J_h(t) - B_h$, where $B_h > 0$ is a constant.[10] Then, t^{**} must be the solution to the problem

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

Thus, when both environmentalists and capitalists are organized, the political economy equilibrium tax t^{**} is characterized by the following equation:

$$\frac{\frac{d\hat{G}(t)}{dt}}{(\lambda_0+\delta)\frac{d\hat{Z}}{dt}} = \Omega \equiv \Big[t - n\bar{\beta}D'(\hat{Z})\Big] + \frac{1-\lambda_0}{\delta+\lambda_0}\Big\{(n\beta_W - n\bar{\beta})D'(\hat{Z}) + \frac{d\hat{\Pi}}{d\hat{Z}}\Big\} = 0, \quad (10)$$

where

$$\lambda_0 = \frac{m_1+m_2}{n}, \quad \frac{d\hat{Z}}{dt} = \frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt} < 0, \quad \frac{d\hat{\Pi}}{d\hat{Z}} = \frac{d\hat{\Pi}/dt}{d\hat{Z}/dt} > 0.$$

Proof. See Appendix A.2. □

Note that for t^{**} to be a maximum, we need to ensure that the second order condition of the government's maximization with respect to t is negative, i.e.,

$$\frac{d^2\hat{G}(t)}{dt^2} = (\lambda_0+\delta)\frac{d^2\hat{Z}}{dt^2}\Omega + (\lambda_0+\delta)\frac{d\hat{Z}}{dt}\frac{d\Omega}{dt} < 0.$$

Since $\Omega = 0$ and $\frac{d\hat{Z}}{dt} < 0$, we must have

$$\frac{d\Omega}{dt} = 1 - n\bar{\beta}D''(\hat{Z})\frac{d\hat{Z}}{dt} + \frac{1-\lambda_0}{\delta+\lambda_0}\left((n\beta_W - n\bar{\beta})D''(\hat{Z})\frac{d\hat{Z}}{dt} + \frac{\frac{d^2\hat{\Pi}}{dt}\frac{d\hat{Z}}{dt} - \frac{d\hat{\Pi}}{dt}\frac{d^2\hat{Z}}{dt^2}}{(\frac{d\hat{Z}}{dt})^2}\right) > 0.$$

Now, we are ready to compare the outcome of this political equilibrium with the

[9] When all groups are organized, the political economy equilibrium tax is efficient and identical to the Pigovian tax, see e.g., Aidt (1998) or Cassing and Long (2021).

[10] I do not derive the equilibrium condition here. For a detailed description of the common-agency game, please refer to Bernheim and Whinston (1986) and see Proposition 1 in Grossman and Helpman (1994) for the necessary and sufficient conditions of the subgame-perfect Nash equilibrium.

benchmark outcome under a benevolent social planner. From equation (10), we can observe that the political equilibrium tax is ambiguous relative to the Pigovian one. Suppose $\beta_W \geq \bar{\beta}$ (i.e., $\beta_C \leq \bar{\beta} \leq \beta_W \leq \beta_E$), this means that the society has a disproportionally large number of capitalists or capitalists have an extremely low environmental valuation. Since $D'(\hat{Z}) > 0$ and $\frac{d\hat{\Pi}}{d\hat{Z}} > 0$, we must have $t^{**} < t^* = n\bar{\beta}D'(\hat{Z})$. That is, the pressure exercised by the lobby groups creates a politically downward distortion of environmental policy that is inefficiently weak. While environmentalists always push for a higher environmental tax, capitalists typically lobby in the opposite direction for a less stringent one. Because of the additional incentive to reduce the negative effect of a higher tax on its profits that do not accrue to environmentalists and the relatively lower valuation of environmental damages, the capitalists will lobby more aggressively for the tax that moves in favor of its direction. As a result, the politically determined tax when balancing the opposing effects of an organized environmental lobby group and industry lobby group will be lower than the Pigovian one.

However, if instead $\beta_C \leq \beta_W < \bar{\beta} \leq \beta_E$ (i.e., the society has a disproportionally large number of environmentalists or environmentalists have an extremely high preference for a clean environment), then $(n\beta_W - n\bar{\beta})D'(\hat{Z}) < 0$ and we may have different cases where the political equilibrium tax is above, equal or less than the Pigovian level. Denote $A \equiv (n\beta_W - n\bar{\beta})D'(\hat{Z}) + \frac{d\hat{\Pi}}{d\hat{Z}}$, then we can rewrite A as

$$\underbrace{(n\beta_W - n\bar{\beta})D'(\hat{Z})\frac{d\hat{Z}}{dt}}_{>0} + \underbrace{\frac{d\hat{\Pi}}{dt}}_{<0},$$

where the first term captures the positive effect of tax on social environmental valuations (i.e., savings from environmental damages), and the second term is the negative effect of tax on industry profits. If $D'(\hat{Z})$ is small enough, then $A < 0$ and thus $t^{**} < t^* = n\bar{\beta}D'(\hat{Z})$. The same intuition as earlier applies here. However, if $D'(\hat{Z})$ is large enough, then we may have a situation where the two effects are cancelled out or even the former effect dominates, i.e., $A \leq 0$. In this case, we would have $t^{**} \geq t^* = n\bar{\beta}D'(\hat{Z})$. This is because the significant environmental damage caused by waste plays an increasing role in both lobby groups' welfare calculations. From the capitalists' perspective, the loss from environmental damages caused by waste can be so severe as to dominate any profit gains due to a lower tax. As a result, capitalists will diminish their lobbying efforts for a lower tax. Meanwhile, in response to the significant environmental damages, environmentalists will lobby more aggressively for a higher tax. Consequently, the political tax may overshoot the Pigovian level. These findings can be summarized in Proposition 1:

Proposition 1. *If group 3 is not organized, when $\beta_W \geq \bar{\beta}$, or $\beta_W < \bar{\beta}$ but $D'(\hat{Z})$ is small enough, the political economy equilibrium tax on the externality is below the Pigovian one. However, when $\beta_W < \bar{\beta}$ and $D'(\hat{Z})$ is large enough, the political tax can be equal to or above the Pigovian level.*

It will prove helpful to demonstrate the model and the findings of the above proposition with some specific functional forms and numerical examples. I provide several examples in Appendix B.1 for illustration.

2.1.4 The effects of environmental lobbying on tax and waste exports

In this section, I analyze how strengthening green lobbies – measured by an increase in the number of environmentalists and the joining members' associated environmental valuation – might impact the environmental tax and by extension firms' decision to export waste. This can be interpreted as an environmental movement in which increased environmental awareness has arguably enabled environmentalists to mobilize more ordinary people to join forces and exert pressure on governments to take more action.

Assume that the number of capitalists (m_1) and the total population (n) are fixed. As more workers (m_3) become environmentalists (m_2) and their associated environmental preference (β_W) also increases to β_E, it follows that the effect of strengthening environmental lobbying on tax is given by

$$\frac{dt}{dm_2} = \frac{\frac{1+\delta}{\delta+\lambda_0}\frac{1}{m_3}\left[m_3(\beta_E - \beta_W)D'(\hat{Z}) - \left(t - n\bar{\beta}D'(\hat{Z})\right)\right]}{\frac{d\Omega}{dt}}. \tag{11}$$

Proof. See Appendix A.3. □

Since $\frac{d\Omega}{dt} > 0$, the sign of $\frac{dt}{dm_2}$ is determined by the two terms in the square bracket: $m_3(\beta_E - \beta_W)D'(\hat{Z}(t))$ and $\left(t - n\bar{\beta}D'(\hat{Z})\right)$. Note that $(\beta_E - \beta_W)$ measures how much environmental valuation increases when one worker becomes an environmentalist, so the first term $m_3(\beta_E - \beta_W)D'(\hat{Z}(t)) > 0$ captures the social marginal benefit of this environmental movement, whereas the second term $\left(t - n\bar{\beta}D'(\hat{Z})\right)$ captures the political distortion from the socially optimal level, therefore representing the social marginal loss from lobbying.

Suppose we are starting with a situation where $t < n\bar{\beta}D'(\hat{Z})$. This corresponds to the above-mentioned case where the capitalists have a dominating lobby power (i.e., when $\beta_W \geq \bar{\beta}$, or $\beta_W < \bar{\beta}$ but $D'(\hat{Z})$ is small enough), which creates a downward distortion of environmental policy that is inefficiently weak. Since $t - n\bar{\beta}D'(\hat{Z}) < 0$, then the numerator must be positive, so we have $\frac{dt}{dm_2} > 0$, and by extension, $\frac{d\hat{Q}}{dm_2} = \frac{d\hat{Q}}{dt}\frac{dt}{dm_2} > 0$. This result is highly intuitive. As more people become environmentally concerned and join the environmental lobbying while the number of capitalists is fixed, this translates into more power exercised by the environmental lobby group. As a result, the government will respond to this boosted political pressure by increasing the stringency of environmental policy. This ultimately pushes up the cost of disposing of waste domestically, thereby resulting in more waste being exported to other countries. This conclusion is similar to McAusland (2008), which demonstrates that when facing increased political pressure exercised by the organized interest groups, regulators have an incentive to increase regulation on pollution that is a by-product of consumption activities and thereby induce firms to export waste to lower environmental regulation locations. Eventually, when environmentalists are able to mobilize all the workers to join forces, the resulting equilibrium tax will equate to the social optimum.

This finding resembles the so-called "Green Paradox" (Sinn, 2008; Jensen et al., 2015; Van der Ploeg and Withagen, 2015), in which increased environmental stringency leads to accelerated fossil fuel extraction and therefore greater pollution. Similarly, within the waste trade context, a well-intended movement to strengthen environmental protection leads to increased domestic environmental stringency and more waste – often highly toxic– to be shipped to countries that are less equipped to deal with it, possibly exacerbating the environmental damages.

However, if $t > n\bar{\beta}D'(\hat{Z})$, this corresponds to the situation where the environmentalists lobby more aggressively while the capitalists diminish their lobbying efforts (i.e., when $\beta_W < \bar{\beta}$ and $D'(\hat{Z})$ is large enough), creating an upward distorted environmental policy that is inefficiently strict. Now both the terms $m_3(\beta_E - \beta_W)D'(\hat{Z}(t))$ and $t - n\bar{\beta}D'(\hat{Z})$ are positive. If the former exceeds the latter, then still we have $\frac{dt}{dm_2} > 0$, $\frac{d\hat{Q}}{dm_2} = \frac{d\hat{Q}}{dt}\frac{dt}{dm_2} > 0$. However, if the former is less than the latter, i.e., $m_3(\bar{\beta}_E - \bar{\beta}_M)D'(\hat{Z}(t)) < \big(t - n\bar{\beta}D'(\hat{Z})\big)$, then we would have

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

This is quite surprising as one would expect that strengthening environmental lobby groups should always lead to a higher tax. While this result may seem counterintuitive, the main intuition behind it is that we are starting with a situation where the tax is already set very high, meaning that the marginal benefit for any extra efforts to increase the environmental stringency would be very small, but the marginal loss of doing so could be significant. While environmentalists enjoy saving the country from suffering too much environmental damage caused by waste, they also derive utility from the consumption of manufacturing goods. When the extra savings from environmental damages cannot exceed their loss from the happiness of consumption, they would like to trade off the two and exchange some environmental protection for more consumption, which drives down the tax. As the number of environmental lobbyists increases, the desire for the tradeoff also increases, which further reduces the tax. As the pollution tax decreases, the cost of disposing of waste domestically goes down and thereby less waste will be exported to other countries. Eventually, when all workers become environmentalists, the equilibrium tax will equate to the socially optimum level. This result is similar to Aidt (1998), which demonstrates that the competitive political process and the fact that some lobby groups adjust their economic objectives to reflect environmental concerns will lead to the political internalization of environmental externalities. These results can be summarized in the following proposition:

Proposition 2. *In the political economy equilibrium, if the pollution tax is inefficiently weak, then strengthening green lobbies will lead to a higher tax and more waste to be exported, resulting in a "waste green paradox". However, if the pollution tax is inefficiently strict and the marginal benefit of the environmental movement is less than the marginal loss from lobbying, then strengthening environmental lobbying may result in a lower tax and less waste to be exported.*

Proposition 2 shows that the effects of environmental movement depend on the political equilibrium pollution tax relative to the efficient Pigovian level, which in turn crucially depends on the environmental lobbying strength and the degree of environmental damages caused by waste. In the following, I will present the waste demand side – a small open economy in the South that imports the waste from the North.

2.2 The South: waste demand

Consider a corresponding small open economy in the South with a very similar structure to that in the North. For notational convenience, the superscript argument, S, is omitted throughout this entire section, but it should be understood that all the variables are denoting the South to be distinguished from the North.[11] To focus on trade in waste, I assume that the manufactured good is non-traded and cannot be produced in the South.

The South also has two sectors: a clean sector and a waste-disposal sector. Both sectors use labor as the only inputs. The clean sector produces the same numeraire good as the North with constant returns to scale but is less productive. The competitive waste-disposal sector offers the North a "waste absorption" service at a constant price $\mu > 0$ per unit of waste imported, but incurs an increasing treatment cost at $C(I)$, where I is the amount of waste imported, with $C'(I) > 0$ and $C''(I) > 0$. Therefore, in the global equilibrium, the total waste exported from the North must be equal to the total waste imports from the South, i.e., $\sum_{i \in N} Q_i = \sum_{j \in S} I_j$. Suppose that the South is endowed with a fixed supply of labor $\bar{L}$ and labor is perfectly mobile across sectors, and that full employment prevails. Thus, labour becomes irrelevant to firms' problems, and in terms of the conventional trade model, North exports the numeraire good and imports the South's waste disposal service.

The economy is also populated by a large number of individuals n, each endowed with $\bar{l}$ units of labor, where $\bar{L} = n\bar{l}$. Each individual i derives utility from the consumption of the numeraire good x_i, but the imported waste itself or the waste treatment process causes environmental damages $D(I)$, so the welfare of individual i is given by

$$W_i(x_i, I) = U(x_i) - \beta_i D(I) = x_i - \beta_i D(I),$$

where for simplicity $U(x_i)$ is assumed to be linear in x_i, and $D(0) = 0, D(I) > 0, D''(I) >$

[11] For example, the number of population n should be interpreted as n^S, and the environmental preference β_i should be understood as β_i^S, etc.

0, and β_i denotes individual i's preference for a clean environment. Denote $\bar{\beta} = \frac{1}{n}\sum_{i=1}^{n}\beta_i$, then it follows that the social marginal cost of waste is given by $\frac{d\sum_{i=1}^{n}W_i}{dI} = n\bar{\beta}D'(I)$.

Among the n individuals in the economy, $m_1 < n$ capitalists own the waste-disposal factories and for simplicity, each capitalist is assumed to own only one waste-disposal factory; m_2 environmentalists have strong preferences for environmental quality, with the remaining m_3 workers having moderate preferences for environmental quality. Let β_C, β_E and β_W denote the environmental preference for each capitalist, environmentalist and worker, respectively, with $\beta_C \leq \bar{\beta} \leq \beta_E$ and $\beta_W \in [\beta_C, \beta_E]$, but whether β_W is larger than $\bar{\beta}$ remains unknown. Suppose capitalists and environmentalists can overcome the free-riding problem and are formed as organized lobby groups to further their interests by taking collective actions to influence the government's policies. Within this context, the government imposes an ad valorem tariff rate τ on the imported waste to avoid the country from becoming a garbage dump and distributes all the tariff revenue to its citizens as a lump sum transfer. Following Grossman and Helpman (1994), I adopt the structure of a two-stage common agency game between the lobbies and the government. In the first stage, each of the organized lobby groups confronts the incumbent government with contribution schedules, $\psi_h(\tau)$, that are contingent on the governments choice of tariff rate on waste, while ordinary workers are not organized and do not take any actions. In the second stage, the government takes the announced contribution schedules as given and chooses τ to maximize a weighted sum of social welfare $J(\tau)$ and its receipt of campaign contributions:

$$\max_{\tau} G(\tau) = \delta J(\tau) + \sum_{h\in\Lambda}\psi_h(\tau),$$

where $\delta > 0$ is an exogenously given weight that the government places on the aggregate social welfare relative to total campaign contributions.

Taking as given the per unit waste disposal fee μ and the tariff rate τ on the imported waste, the waste-disposal firms must decide on how much waste to be imported, so firms solve the following profit maximization problem

$$\max_{I>0} \Pi = (1-\tau)\mu I - C(I).$$

The first order condition with respect to I yields

$$(1-\tau)\mu = C'(I), \tag{12}$$

which says that at the optimal waste import level $\hat{I}(\tau)$, the marginal benefit must be equal to the marginal cost of importing waste. The equilibrium waste demand, $\hat{I}$, can thus be implicitly expressed as a function of τ. Totally differentiate (12) with respect to $\hat{I}$ and τ yields $\frac{d\hat{I}}{d\tau} = -\frac{\mu}{C''(I)} < 0$. Given $\hat{I}(\tau)$, the maximized aggregate profit of waste-disposing firms is

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

Each consumer derives income from working at either sector and receives an equally distributed lump-sum government transfer of the tariff revenue, but a capitalist earns an extra income from the ownership of the waste-disposal factories. Therefore, the income of a representative capitalist is $M_k = \hat{\Pi}/m_1 + \bar{l} + \tau\mu\hat{I}/n$, and the income of a representative non-capitalist is $M_j = \bar{l} + \tau\mu\hat{I}/n$. Given the linearity of the utility function, the welfare of each group is thus

$$J_1(\tau) = m_1\left[\hat{\Pi}(\tau)/m_1 + \bar{l} + \tau\mu\hat{I}(\tau)/n\right] - m_1\beta_C D(\hat{I}(\tau)),$$

$$J_2(\tau) = m_2\left[\bar{l} + \tau\mu\hat{I}(\tau)/n\right] - m_2\beta_E D(\hat{I}(\tau)),$$

$$J_3(\tau) = m_3\left[\bar{l} + \tau\mu\hat{I}(\tau)/n\right] - m_3\beta_W D(\hat{I}(\tau)),$$

and social welfare is the sum of the three groups:

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

where by definition, $n\bar{\beta} = m_1\beta_C + m_2\beta_E + m_3\beta_W$.

2.2.1 Socially optimal tariff rate

Without any political distortion, a benevolent government chooses the tariff rate to maximize the aggregate social welfare, i.e.,

$$\frac{dJ(\tau)}{d\tau} = \left(\mu\tau - n\bar{\beta}D'(\hat{I}(\tau))\right)\frac{d\hat{I}(\tau)}{d\tau} = 0 \Rightarrow \tau^* = \frac{n\bar{\beta}D'(\hat{I})}{\mu}$$

Proof. See Appendix A.4. □

Note that μ is the unit waste disposal price the North has to pay to the South and $n\bar{\beta}D'(\hat{I})$ is the social marginal cost of waste. That is, the social optimal tariff rate is equal to the ratio of the marginal social cost of waste over the private marginal cost of waste.

2.2.2 Political economy tariff rate

In this section, I investigate how the pressure exercised by an organized environmental and industry lobby group could result in a political economy equilibrium and characterize the government's optimal choice of the tariff rate on waste. Following Bernheim and Whinston (1986), I focus on the interior equilibrium contribution schedules that truthfully reflect the gains expected by the pressure groups such that $\psi_h(\tau) = J_h(\tau) - B_h$, where $B_h > 0$ is a constant. Then, τ^{**} must be the solution to the problem

$$\max_{\tau} \hat{G}(\tau) = \delta J(\tau) + \Big[J_1(\tau) - B_1 + J_2(\tau) - B_2\Big].$$

Therefore, when both environmentalists and capitalists are organized, the political economy equilibrium tariff rate τ^{**} is characterized by the following equation:

$$\frac{\frac{d\hat{G}(\tau)}{d\tau}}{(\lambda_0+\delta)\frac{d\hat{I}}{d\tau}} = \Omega \equiv \Big[\mu\tau - n\bar{\beta}D'(\hat{I})\Big] + \frac{1-\lambda_0}{\delta+\lambda_0}\Big[(n\beta_W - n\bar{\beta})D'(\hat{I}) + \frac{d\hat{\Pi}}{d\hat{I}}\Big] = 0, \quad (13)$$

where

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

Proof. See Appendix A.5. □

Note that for τ^{**} to be a maximum, we need to ensure that the second order condition of the government's maximization with respect to τ is negative, i.e.,

$$\frac{d^2\hat{G}(\tau)}{d\tau^2} = (\lambda_0+\delta)\frac{d^2\hat{I}}{d\tau^2}\Omega + (\lambda_0+\delta)\frac{d\hat{I}}{d\tau}\frac{d\Omega}{d\tau} < 0.$$

Since $\Omega = 0$ and $\frac{d\hat{I}}{d\tau} < 0$, we must have

$$\frac{d\Omega}{d\tau} = \mu - n\bar{\beta}D''(\hat{I})\frac{d\hat{I}}{d\tau} + \frac{1-\lambda_0}{\delta+\lambda_0}\left((n\beta_W - n\bar{\beta})D''(\hat{I})\frac{d\hat{I}}{d\tau} + \frac{\frac{d^2\hat{\Pi}}{d\tau}\frac{d\hat{I}}{d\tau} - \frac{d\hat{\Pi}}{d\tau}\frac{d^2\hat{I}}{d\tau^2}}{(\frac{d\hat{I}}{d\tau})^2}\right) < 0.$$

Up to now, equation (13) should look very familiar. Clearly, the politically chosen tariff rate is ambiguous relative to the socially optimal tariff rate. Following our earlier discussion on the tax in the North, the relationship between the political economy equilibrium tariff and the socially optimal one can be directly summarized in the following proposition.

Proposition 3. *If group 3 is not organized, when $\beta_W \geq \bar{\beta}$, or $\beta_W < \bar{\beta}$ but $D'(\hat{I})$ is small enough, the political economy equilibrium tariff rate on the imported externality is below the social optimal one. However, when $\beta_W < \bar{\beta}$ and $D'(\hat{I})$ is large enough, the political tariff rate can be equal to or above the social optimum.*

In the former case, because of the relatively lower valuations for environmental damages and the additional incentive to counter the negative impact of a higher tariff rate on profits that are missing in environmentalists' welfare calculation, the capitalists will launch a massive lobbying blitz for a lower tariff, which eventually dominates any countervailing efforts from environmentalists. In the latter case, the significant environmental damages caused by imported waste play a much bigger role in both groups' welfare considerations, inducing capitalists to diminish their lobbying efforts for a lower tariff, while triggering a more aggressive lobbying response by environmentalists for a higher tariff. The resulting tariff rate can thus be equal to or higher than the social optimum. I illustrate the above findings with some specific functional forms and numerical examples in Appendix B.2.

2.2.3 The effects of environmental lobbying on tariff and waste imports

In this section, I analyze how the environmental movement might impact the import tariff and by extension firms' decision to import waste. Following our conclusion from the North, it is not hard to obtain the effects of environmental lobbying on the tariff as

$$\frac{d\tau}{dm_2} = \frac{\frac{1+\delta}{\delta+\lambda_0}\frac{1}{m_3}\left[m_3(\beta_E - \beta_W)D'(\hat{I}) - \left(\mu\tau - n\bar{\beta}D'(\hat{I})\right)\right]}{\frac{d\Omega}{d\tau}},$$

and we can observe the following:

Proposition 4. *In the political economy equilibrium, if the import tariff is inefficiently weak, then a strengthening of the environmental lobby group will lead to a higher tariff and result in less waste being imported. However, if the import tariff is inefficiently strict and the marginal benefit of the environmental movement is less than the marginal loss from lobbying, then strengthening environmental lobbying may result in a lower tariff and more waste to be imported.*

In the former case, as more people become environmentally concerned and join the environmental lobbying while the number of capitalists is fixed, this translates into more power exercised by the environmental lobby group. As a result, the government will respond to this boosted political pressure by increasing the tariff rate, which effectively deters more waste to be imported. In the latter case, we are starting with a situation where the tariff is already set very high, which means that the marginal benefit for any extra efforts to increase the tariff would be very small, but the marginal loss of doing so could be significant. When the extra savings from environmental damages cannot exceed their loss of income (or utility from consumption), environmentalists would like to sacrifice some environmental protection for more income, which pushes down the tariff rate. As the number of members increases, the desire for the tradeoff also increases, which further reduces the tariff. As the tariff decreases, more waste will be imported. Eventually, when all workers become environmentalists, the equilibrium tariff rate will be equal to the social optimum, leading to a political internalization of environmental externality (Aidt, 1998).

3 Data and descriptive statistics

The model presented above illuminates how the strength of environmental lobbies might affect policy stringency and corporate decisions to export/import waste. However, the theory does not yield unambiguous predictions without making any further assumptions. Depending on the waste-induced environmental damages and heterogeneity of group environmental preferences, the effects of environmental lobbying on the North-to-South waste exports can be either positive or negative. To better understand the role played by environmental lobby groups, I empirically test the effects of environmental lobbying on the North-to-South waste trade. However, I face several empirical challenges in doing so: (i) measuring waste trade and environmental lobbying strength; (ii) identifying the causal effects of environmental lobbying on trade in waste.

3.1 Waste trade

The challenge in measuring waste trade arises partly from the question of what constitutes waste. Things can alternate during their lifespan from waste to treasure, from useless to useful, or move in the opposite direction. I share the same viewpoint as Moore (2011) that whether or not something is considered a waste depends on time and place more than any inherent characteristics of the object itself.

In this paper, I consider waste as all the waste products under the UN six-digit Harmonized System (HS) Codes for commodity classification. Specifically, I retrieve the information on waste exports between country pairs from the UN Comtrade database for the periods 1992-2019. The bilateral waste data can date back to 1962 from this database. However, the HS Codes for commodity classification were not uniformly adopted until 1992. Even though several countries retrospectively reported trade data from prior years using the 1992 HS codes, I believe many countries did not and this may yield inconsistencies in the description of the product traded and result in measurement errors. Thus, I choose to start with the year 1992.

An alternative source of waste trade data is the Basel Convention, whose goal was to reduce shipments of hazardous waste to countries that were unable to safely and adequately dispose of it. Under the rules of the Convention, member countries are required to self-report data on their shipments of hazardous waste to the Basel Convention Secretariat each year. This self-reported hazardous waste trade data has been used by Baggs (2009) to explore the role that differences in the size of the economy (measured by GDP), capital/labor ratios, and GDP per capita (a proxy for regulatory stringency) across countries play in determining bilateral trade in hazardous waste. But as Kellenberg (2012) has pointed out, including only hazardous waste defined under the classification of the Basel Convention may miss a large proportion of other waste categories that may seem harmless but pose severe environmental and health consequences when disposed of improperly. Also, as mentioned earlier, countries such as the US have not signed the Convention and are thus not obligated to report their waste shipments. In addition, countries may have an incentive to under-report the true extent of hazardous waste shipments, particularly when being shipped to low environmental regulation countries (Kellenberg, 2012).

Following Kellenberg (2012) and Kellenberg and Levinson (2014), I define waste exports as all six-digit HS categories where waste and/or scrap are the only categorization of a product in the UN Comtrade database. Upon searching the keywords "waste", "scrap", "slag", "residue", and "ash" as the primary descriptors of the product in the six-digit HS codes, I obtain the waste exports for a total of 87 categories, which can be found in Table C1 of Appendix C. For each of the 87 waste products, there are two measures of trade between country pairs – the total weight (in kg) and the total value (in US dollars). I use the size of waste as the main observation suggested by the model, and then sum up the total weight of waste traded between country pairs across all 87 HS categories, yielding the aggregate waste exports between country pairs for each year. This comprises my original waste trade dataset of 196 countries for 28 years.

3.2 Environmental lobbying strength

The challenge in measuring the environmental lobbying strength arises largely because of the difficulties in collecting information on the active membership base and financial resources of various environmental lobby groups within a country. Often, data is not readily available for the budget and membership numbers of many environmental lobby groups, and attempting to collect this information for a cross-country time-series study is prohibitively difficult.

In this paper, I choose to use the number of environmental NGOs (ENGOs) as a proxy, as in Binder and Neumayer (2005) and Fredriksson et al. (2005). However, unlike the cross-country approach taken by Fredriksson et al. (2005) that focuses on a specific year and the panel study of Binder and Neumayer (2005) that focuses on a limited set of countries with a time dimension covering 1977-1988 for which environmental protectionism has not become pronounced, I use a comprehensive dataset that covers a large number of countries with more recent time periods that better capture the growing trend of global environmental awareness. More specifically, I derive information on the number of ENGOs in a given country from two independent sources – the World Directory of Environmental Organizations (*the Directory*) and the Encyclopedia of Associations: International Organizations (*the Encyclopedia*).[12] These two sources are believed to be the most comprehensive cross-national data sources available for ENGOs (Longhofer and Schofer, 2010).

The Directory, first released by the Sierra Club in 1973 and published regularly

[12] I am deeply indebted to Professor Wesley Longhofer from Emory University for sharing his Environmental NGO data with me. For a more detailed description on the data construction and limitations, please refer to Longhofer and Schofer (2010), Schofer and Longhofer (2011) and Longhofer et al. (2016).

thereafter, provides basic information such as name, address, contact information and founding date on governmental and nongovernmental environmental organizations across the world (Longhofer and Schofer, 2010; Trzyna and Didion, 2013). Organizations listed in *the Directory* such as citizens environmental groups, environmentally oriented development organizations, and academic research centers involved in either environmental policy work or information dissemination, are then categorized as ENGOs. The measure from *the Encyclopedia* is obtained from the Gale Group's Associations Unlimited database, which contains detailed information on more than 30,000 domestic organizations worldwide (Longhofer et al., 2016). This measure documents all formal, private, noncommercial, self-governing, and voluntary organizations in each country over time, including development NGOs, human rights organizations, arts and recreational clubs, and so on (Schofer and Longhofer, 2011). Then Gale's keywords are used to identify groups that have an environmental focus, yielding another dataset of ENGOs. These two sources of ENGOs are then combined to reduce idiosyncratic source-level biases, filling in any missing information from either source and correcting for any mismatch between the two sources. This yields a final coverage of 213 countries from 1971 to 2011 on ENGOs.

For this analysis, I assume that this proxy measure captures the overall environmental lobbying strength in a country. However, there may be some concerns. ENGOs are heterogeneous in terms of their sizes, main focuses, and so on. Typically, ENGOs differ significantly in their environmental focus. Some care about waste issues very much while others focus on other emerging environmental problems such as climate change, biodiversity loss, and so on. Also, ENGOs differ in their compositions and objectives, which gives rise to different viewpoints on worldwide environmental issues. For example, Greenpeace has branches in many countries, which may lead to a coordinated effort to reduce global waste rather than caring about a single country's domestic waste issue. Unfortunately, I do not observe this information in the data, so I can not improve upon this proxy measure.

3.3 Control variables

Finally, the challenge I face in identifying the causal effects of environmental lobbying on the waste trade arises due to the potential for both reverse causality and omitted variable bias. The reverse causality issue is typically observed in estimating policy effects on international trade (Baier and Bergstrand, 2007; Yotov et al., 2016). As governments often alter trade policy in response to changes in environmental quality (Copeland, Shapiro and Taylor, 2021) and alter environmental policy in response to trade (Cherniwchan and Najjar, 2021), it is likely that increasing waste flows may incentivize governments to tighten environmental/trade policies, thereby reducing the need for environmental lobbies. However, it will be less of a concern here. As shown later in Figure 3, the number of ENGOs increases steadily over time and thus it is highly unlikely that ENGOs are endogenously determined by waste trade.

Another concern is the omitted variable bias. There may exist a set of time-varying country-specific characteristics and time-invariant bilateral trade characteristics that are all potentially correlated with both waste trade flows among country pairs and the probability that more people become environmentalists. I control for these possible factors, which include: (i) the industry lobbying strength and population; (ii) the traditional gravity variable – GDP that captures the scale effect – as larger countries typically generate larger volumes of waste and have more available disposal capacity, and thus more waste should be traded; (iii) geographic and cultural factors such as bilateral distance between country pairs, whether countries share a common border, a common official language, and have ever had colonial ties, to proxy trade costs; (iv) trade facilitation factors such as whether both countries are members of the WTO or in some regional trade agreements; (v) capital-labor ratios in Baggs (2009) that reflect the technological capabilities of the recycling sectors across countries; (vi) whether both countries ratified the Basel Convention (Kellenberg and Levinson, 2014), which is aimed at reducing hazardous waste trade to countries that were unable to safely and adequately recycle or dispose of it.

There is no direct measure for the countervailing effects of the industry lobby group within a country. Similar to Binder and Neumayer (2005), I choose to employ commercial energy use (kg of oil equivalent per capita) as a proxy. This data along with other country-specific characteristics including GDP, population and labour force are obtained from the World Bank's World Development Indicators Database, which covers 264 countries from 1960 to 2021. The capital stock data is sourced from the International Monetary Fund (IMF), which provides three types of capital stock – general government capital stock, private capital stock and public-private partnership capital stock – over the period of 1960-2019 for 170 countries.[13] I then derive the aggregate country-level capital stock by summing up these three types and divide it by the labour force to get the capital-labour ratio across countries.

Bilateral variables such as geographical distance between country pairs, and dummy variables indicating whether country pairs share a common border, a common official language, or have ever had colonial ties are directly obtained from the CEPII website, which consists of 224 unique bilateral country pairs.[14] Data on Basel Convention ratification status comes from the Basel Convention website, which includes 188 signatories with only Haiti and the USA as the two exceptions.[15] Data on WTO membership is directly taken from the WTO website, which covers information on 164 members and 25 observers.[16] Data on whether a bilateral country-pair was in one of the regional trade agreements was obtained from Prof. Mario Larch's website, which covers all mul-

[13]See https://data.imf.org/?sk=1CE8A55F-CFA7-4BC0-BCE2-256EE65AC0E4.

[14]See the dist-cepii.dta data file, http://www.cepii.fr/anglaisgraph/bdd/distances.htm.

[15]See http://www.basel.int/Countries/StatusofRatifications/PartiesSignatories/tabid/4499/Default.aspx.

[16]See https://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm.

tilateral and bilateral regional trade agreements (RTA) as notified to the World Trade Organization for the last 70 years from 1950 to 2019 between 280 country-pairs.[17] Then, three respective dummy variables are constructed to indicate whether both countries were ratified members of the Basel Convention, members of the WTO, and in some regional trade agreements in year t. The definition of all the variables used in this paper and their sources can be found in Table C3 of Appendix C.

3.4 Waste trade trend and evolution of ENGOs

My final sample includes 122 countries that had at least some positive quantity of waste trade for the period from 1992 to 2011.[18] To identify a country's development status, I follow the IMF's definition and categorize a developed country based on its advanced economy while considering the nation a developing country if it possesses an emerging or developing economy.[19] I end up with 35 developed countries and 87 developing countries in the sample, documented in Table C2 of Appendix C.[20]

The complex annual data on waste volumes shipped in each direction between each pair of countries reveal a number of stark facts about international trade in waste. There are two types of exporters and importers (developed versus developing), yielding 4 different types of annual waste shipments. As described in Table 1, a total of 2.9 billion tonnes of waste were shipped between countries over the 20-year period from 1992 to 2011. More than half of this waste trade was among developed countries themselves, whereas developed to developing waste shipments constituted the second largest component with more than one-quarter of the trade volume. As for the shipments from developing countries (Columns 4 and 5), they only made up a small proportion of the total waste trade. In fact, international trade in waste has been growing so much that these cross-section differences in Table 1 may be obscured by the overall growth. Figure 1 plots the total annual waste exports between country pairs, which shows that the global waste trade has grown substantially from 1992 to 2011. Although waste trade among developed countries has been steadily increasing over the years, it is not hard to observe that much of the world growth should be attributed to the increasing shipments from developed to developing countries – the ones that are most concerning and the main focus of this paper.

[17]See https://www.ewf.uni-bayreuth.de/en/research/RTA-data/index.html.

[18]These 122 countries comprise more than 92% of the total waste trade.

[19]IMF takes several different factors into account when determining whether a nation is an advanced economy, an emerging market and developing economy, or a low-income developing country. The main three criteria are: (1) per capita income level, (2) export diversification – so oil exporters that have high per capita GDP would not make the advanced classification because around 70% of their exports are oil, and (3) degree of integration into the global financial system. For details, please see https://www.imf.org/external/pubs/ft/weo/faq.htm.

[20]In many other classifications, EU member countries such as Poland and Hungary will be typically considered as developed, but this is not the case according to the IMF standard. Nevertheless, I conduct several robustness checks with the inclusion of these two countries as developed countries and the regression results remain very robust.

Table 1: Waste shipments among country pairs

	All	Developed to Developed	Developed to Developing	Developing to Developed	Developing to Developing
Total (million tonnes)	2922.18	1,529.75	848.76	262.15	281.53
Annual average (tonnes)	44,212.55	100,873.52	48,431.26	16,712.59	15,889.25
	(335,885.19)	(456,040.49)	(459,515.06)	(127,250.20)	(124,249.84)
Observations	66,094	15,165	17,525	15,686	17,718

Notes: Based on 35 developed countries and 87 developing countries in the sample for the years 1992-2011. Standard deviation in parentheses.

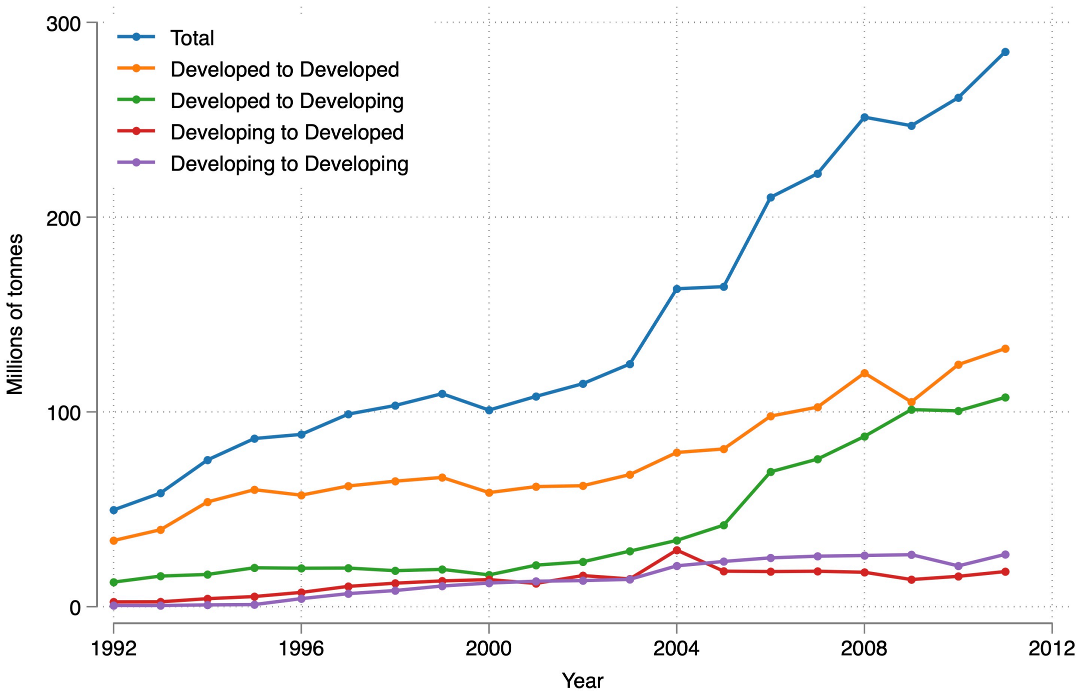

Figure 1: Total annual waste exports in million tonnes

These stylized facts have highlighted the increasing role of North-to-South shipments in the global waste trade. To get a better idea of where waste has been shipped, I follow Kellenberg (2012) and document in Table 2 the largest waste exporters and importers by aggregate volume from 1992 to 2011. Table 2a shows that the top 10 waste exporters make up more than 70% of all waste exported worldwide. Among them, 9 are developed countries with Russia, a developing country, being the only exception. Perhaps more surprisingly is a similar trend observed in Table 2b. With the exception of China and Turkey, all of the top 10 waste importers are also developed countries, which account for a total of 42.5% of global waste imported. Contrary to the common but somewhat misleading belief that developing countries are the main waste recipients, developed countries do import a large proportion of worldwide waste. This begs the question: where does the rest of the waste go and do developing countries play an important role in the waste trade? Table 2c answers this question by reporting the top 10 developing country waste importers, which shows that they collectively import more than 32% of global traded waste – a significant share.

Table 2: Largest waste exporters, importers and number of ENGOs

(a) Top 10 waste exporters

Ranking	Country	Exports (million tonnes)	World share (%)	Annual average ENGOs
1	Germany	438.52	15.01	40.95
2	United States	437.68	14.98	170.15
3	Japan	218.67	7.48	34.30
4	France	189.97	6.50	40.55
5	United Kingdom	164.47	5.63	182.90
6	Netherlands	161.68	5.53	36.95
7	Belgium	136.14	4.66	31.50
8	Russia	127.86	4.38	20.30
9	Canada	113.45	3.88	94.30
10	Hong Kong SAR	74.03	2.53	5.75
	Sum	2062.48	70.58	657.65

(b) Top 10 waste importers

Ranking	Country	Imports (million tonnes)	World share (%)	Annual average ENGOs
1	China	431.72	14.77	13.85
2	Turkey	208.66	7.14	11.70
3	Germany	182.03	6.23	40.95
4	Netherlands	177.94	6.09	36.95
5	South Korea	166.14	5.69	9.80
6	Italy	152.71	5.23	33.60
7	United States	150.07	5.14	170.15
8	France	142.51	4.88	40.55
9	Spain	137.39	4.70	24.65
10	Belgium	137.02	4.69	31.50
	Sum	1886.19	64.55	413.70

(c) Top 10 developing country waste importers

Ranking	Country	Imports (million tonnes)	World share (%)	Annual average ENGOs
1	China	431.72	14.77	13.85
2	Turkey	208.66	7.14	11.70
3	India	83.60	2.86	19.65
4	Indonesia	49.68	1.70	12.00
5	Mexico	43.77	1.50	19.75
6	Malaysia	40.75	1.39	12.10
7	Thailand	33.54	1.15	14.50
8	United Arab Emirates	23.74	0.81	4.55
9	Egypt	20.65	0.71	13.35
10	Vietnam	18.76	0.64	5.30
	Sum	954.87	32.68	126.75

Notes: The ranking is based on the aggregate waste trade volume from 1992 to 2011 for a total of 122 countries, including 35 developed and 87 developing countries.

A similar story emerges if we look at all of the countries in the sample. Table 3 presents the share of world GDP, world waste exports and imports, and the yearly average number of ENGOs for developed and developing countries, respectively. Whereas developed countries produce 75% of the world's income (measured by GDP) and supply approximately 82% of world waste exports, developing countries only make up 18% of global waste exports with around 25% of the world income share. That is, countries with a larger capacity to produce and consume also tend to supply more waste to international markets (Kellenberg, 2015). Indeed, both Baggs (2009) and Higashida and Managi (2014) have found positive and significant effects of GDP on bilateral trading pairs for waste. However, if we compare the income with import share, the evidence seems to confirm that developing countries import a disproportionately larger share of world waste (38.68%) relative to their income share (24.72%).

One possible explanation for this disparity could be the differences in terms of environmental lobbying strength (proxied by ENGOs) between developed and developing countries. A closer look at the last columns of Table 2 and Table 3 indicates that developed countries, in general, have a substantially higher number of ENGOs than developing countries. For example, the UK and US have the largest average number of ENGOs with 183 and 170 respectively, nearly 15 times more than the ones in Turkey, Indonesia and many other developing countries. Moreover, the average number of ENGOs in developed countries is nearly 4 times larger than that in developing countries. Therefore, one reason for developing countries to import a larger share of waste could be their lack of ENGOs who typically lobby aggressively for environmental protection. My analysis aims to explore whether strengthening ENGOs in those developing countries may result in less waste being imported.

Table 3: GDP, waste trade, and ENGOs by country status

Country status	Share of world GDP(%)	Share of world waste exports(%)	Share of world waste imports(%)	Annual average number of ENGOs
Developed	75.28	81.39	61.32	33.29
Developing	24.72	18.61	38.68	8.52

Notes: Based on 35 developed countries and 87 developing countries in the sample for the years 1992-2011.

Before I address this question, I explore further the evolution of ENGOs over time and across countries. Figure 2 plots the aggregate number of ENGOs over the 20-year period, which shows that there has been a steady increase of ENGOs for both developed and developing countries. This fact is consistent with the growing environmental awareness worldwide. Figure 3 describes the number of ENGOs for a selected sample of developed and developing countries over the period from 1992 to 2011. Whereas large differences exist between countries, most countries experience only a slight increase in the number of ENGOs over time. That is, there is much cross-country variation but little within-country variation in ENGOs.

Finally, Table 4 summarizes the descriptive statistics for the main dependent variable of interest – North-to-South waste exports, and the main independent variables – environmental lobbying strength proxied by ENGOs in developed and developing countries, respectively.[21] As Table 4 shows, there are 17,525 observed waste shipments from developed countries to developing countries in my sample, among which an average of 48,431 tonnes are traded each year. However, bilateral country pairs differ substantially in terms of their waste trade volume, which ranges from 1 kg to 23.7 mil-

[21] For a full description of summary statistics of all variables, please refer to Table C4 in Appendix C.

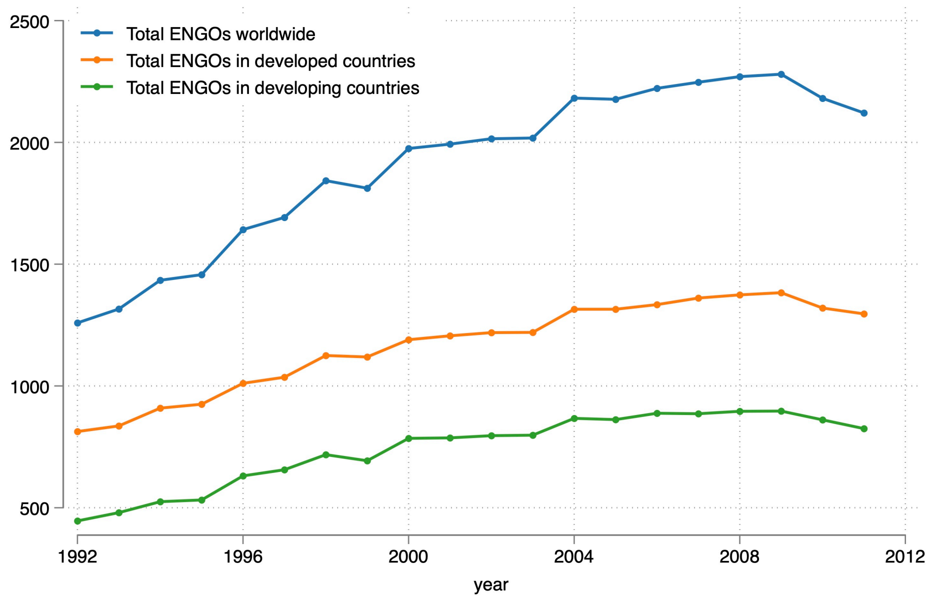

Figure 2: Annual total number of ENGOs from 1992 to 2011

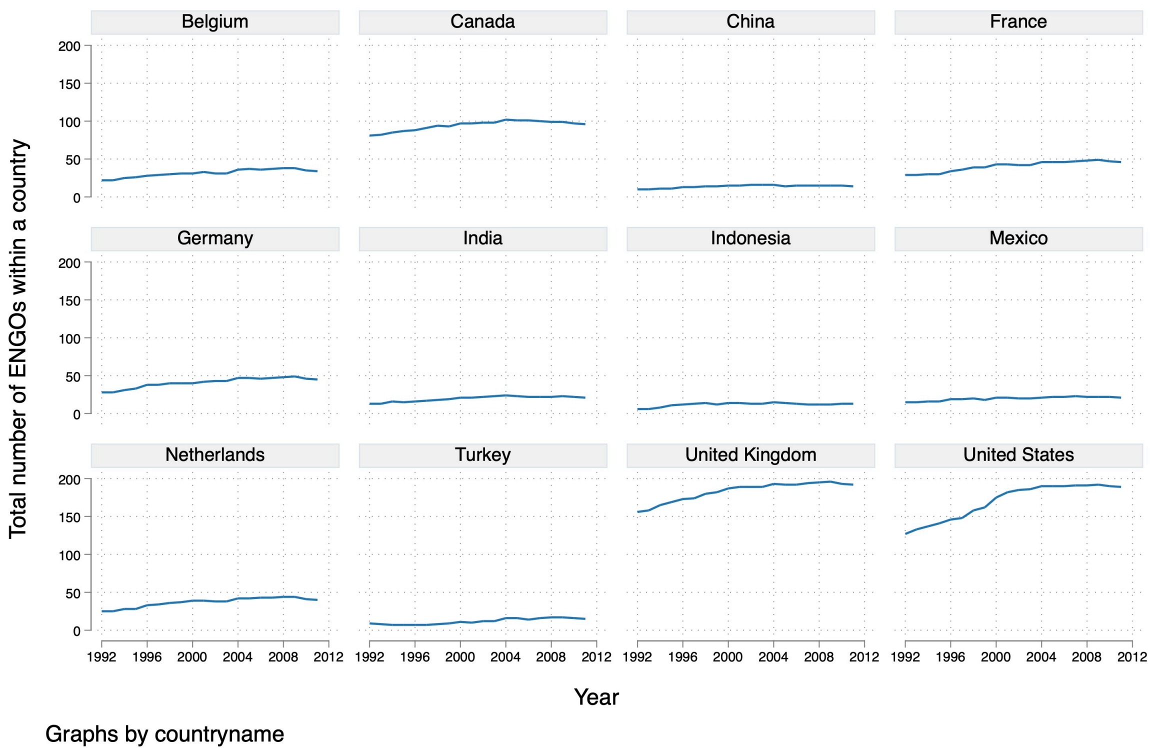

Figure 3: Number of ENGOs by country from 1992 to 2011

lion tonnes. Moreover, there are substantial variations in the number of ENGOs for both exporters and importers. The average number of ENGOs in developed countries is 33.3 with a range from 0 to 196, while that in developing countries is nearly 4 times less (8.5), ranging from 0 to 29. In the following analysis, I exploit these variations to estimate the effects of environmental lobbying on the North-to-South waste trade.

Table 4: Summary Statistics

	Mean	S.D.	Min	Max
North-to-South waste exports (tonnes)	48,431.264	459,515.061	0.001	23698532.000
ENGO exporter	33.292	40.213	0.000	196.000
ENGO importer	8.516	6.289	0.000	29.000
Bilateral trade observations	17,525			

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 ENGOs among the 35 developed and 87 developing countries between 1992 and 2011, respectively. Row four reports the number of positive bilateral waste trade observations in the sample.

4 Empirical strategies and results

Does strengthening environmental lobby groups in the North/South lead to less waste being shipped from developed to developing countries? The theoretical framework does not provide a clear answer. To provide some clarity on this question, I employ two empirical strategies to test the effects of environmental lobbying in this section. I discuss them in detail in what follows.

4.1 Gravity specification

In the first strategy, I explore both cross-country and within-country variations in ENGOs and implement the following gravity regression specifications:

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

where $\ln Y_{ijt}$ is the natural log of aggregate waste exports in tonnes from a developed country i to a developing country j in year t, ENGO_{it} and ENGO_{jt} are the main variables of interest – the strength of environmental lobby groups at country i and country j respectively in year t, $\boldsymbol{X}_{ijt}$ is a vector of control variables that include country-specific characteristics and bilateral characteristics as defined earlier, β_t is the year fixed effect to control for any global changes,[22] and ε_{ijt} is the unobserved error term.

Table 5 reports the main estimation results for the exporter side, importer side, and gravity specifications, respectively, using ordinary least squares (OLS) with robust standard errors clustered by country pairs.[23] While columns 1, 3 and 5 present results based on the simplest specifications with country-specific control variables, columns 2, 4 and 6 include additional bilateral control variables in the specifications. The coeffi-

[22]It would be ideal to include additional country fixed effects to capture and net out average differences across countries. But the inclusion of country fixed effects seems to take away much of the variation across countries – the main source of variation in the sample, causing most of the estimated coefficients to be either in unexpected signs or insignificant. Results are available from the author on request.

[23]A more detailed description of the results can be found in Appendix D.

cients on the main variables of interest – environmental lobbying strength, proxied by the number of ENGOs – are all negative and statistically significant for both exporter and importer in all the specifications. This suggests that strong environmental lobby groups in either developed or developing countries will result in less North-to-South waste exports. More specifically, a 10% increase in the number of ENGOs in developed countries will reduce waste exports by 3.52%, whereas a similar increase in developing countries can lower waste exports by 8.74%, according to the most preferred gravity specification – model 6. Recall that the average numbers of ENGOs in developed and developing countries are 33.3 and 8.5, respectively and the annual average waste shipments are 48,431 tonnes. These estimates thus imply that on average, an increase of ENGOs by 3.3 and 0.85 in developed and developing countries reduces annual North-to-South waste exports by 1,705 tonnes and 4,233 tonnes, respectively. This sums up to an aggregate amount by 118,760 tonnes [24] – a significant waste export reduction in volume.

Table 5: 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	X	X			X	X
Importer-specific Controls			X	X	X	X
Bilateral Controls		X		X		X
Observations	17512	17512	17322	17322	17309	17309
R^2	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 indicate whether country pairs share a common border, common language, had colonial ties, are both members of WTO and Basel Convention, or in some regional trade agreements.

Despite our endeavour to include as many control variables as possible to account for the omitted variable bias, there may still exist some unobserved time-varying country-specific characteristics that might confound our results. For example, the time-varying country-specific multilateral resistance terms in Anderson and Van Wincoop (2003) and the firm-level heterogeneity in Helpman, Melitz and Rubinstein (2008) are found to be important factors in determining trade flows,[25] and may also be correlated with the strength of environmental lobbying, but both are theoretical constructs

[24] $(1,705 + 4,233) * 20 = 118,760$ tonnes.

[25] Anderson and Van Wincoop (2003) show that bilateral trade flows depend on trade costs across all possible bilateral routes. Therefore, ignoring the fact that regions operate in a multilateral world and failing to account for this multilateral resistance will lead to overstating the importance of changes

that can not be directly observed by the researcher. One possible approach to address this endogeneity concern is to use country-year fixed effects (i.e., exporter-year and importer-year fixed effects – β_{it} and β_{jt}). However, I would be unable to do so, because all the time-varying country-specific characteristics can be captured by β_{it} and β_{jt}, and as a result, the main variables of interest would drop out because they are collinear with the country-year fixed effects.

These endogenous concerns may bias the above estimates and lead one to question a causal interpretation of the coefficients. In order to provide further evidence of the effects of environmental lobbying on the North-to-South waste exports, I exploit an EU policy on waste shipments and use a triple-difference estimation strategy.

4.2 Triple-difference estimation strategy

The increasing transboundary waste trade has called for an urgent need to regulate waste shipments and their inherent risks. In accordance with the Basel Convention and OECD decision on the control of hazardous waste, the European Union (EU) approved a main legislative act called Waste Shipment Regulation (WSR) in 2006 to regulate transboundary movements of waste. One of the main objectives of the regulation is to ensure that waste exported outside the EU does not create adverse effects on the environment or public health in the countries of destination, by prohibiting the export of hazardous waste to developing countries that are typically unable to manage the waste in an environmentally sound manner.

The regulation is a formalization of the Basel Convention and the EU's commitment to the Ban Amendment on hazardous waste. Using this policy information in a quasi-natural experiment setting, I exploit plausibly exogenous variation created by waste exports restriction following the introduction of the WSR. The idea is that firms inside the EU market will be limited in their ability to ship their waste to developing countries due to the WSR, while firms in other non-EU developed countries should not be affected by this EU policy. Consequently, this regulation creates large cross-country or group discrepancies between EU developed countries and non-EU developed countries in terms of their aggregate waste exports to the developing world.

4.2.1 Difference-in-differences specification

Exploring differences in waste exports between EU developed countries (defined as the treatment group) and non-EU developed countries (defined as the control group), before and after the EU-WSR, I start with a simple difference-in-differences research

in trade barriers on bilateral trade flows (Behar and Nelson, 2014). Meanwhile, Helpman, Melitz and Rubinstein (2008) demonstrate that firms are heterogeneous within a country, meaning that not all firms are productive enough to cover the fixed costs of exporting. Therefore, in the case of high enough fixed costs, firms in a given country may find it unprofitable to export to a given destination, thereby resulting in zero trade between country pairs. Failing to account for this firm heterogeneity represents a country selection bias and thus misrepresents bilateral trade elasticities.

design by implementing the following regression specification:

$$\ln Y_{ijt} = \alpha + \beta_1 * \text{Treatment}_i + \beta_2 * \text{Post}_t + \beta_3 * \text{Treatment}_i * \text{Post}_t + \varepsilon_{ijt},$$

where $\ln Y_{ijt}$ denotes the natural log of aggregate waste exports from a developed country i to a developing country j in year t. The dummy variable Treatment_i equals one if the country i belongs to an EU developed country, and equals zero otherwise. The dummy variable Post_t equals one if year t is equal to or greater than 2006,[26] and equals zero otherwise. ε_{ijt} is the unobserved error term.

I begin my analysis with a simple exercise by dividing the exporters into EU and non-EU groups and plotting the aggregate annual waste exports from each group to developing countries over the 20-year period. The purpose of doing so is to provide a simple test of my research design or check the underlying parallel trend assumption. That is, after controlling for observable differences, the trend of treatment and control groups' aggregate waste exports to developing countries should be similar to each other and thus differences in the volume of trade after the policy between the two groups are purely due to the implementation of the EU-WSR. So if WSR did, in fact, affect EU waste exports, then I should observe trade volume changes across these two groups after the regulation went into effect in 2006.

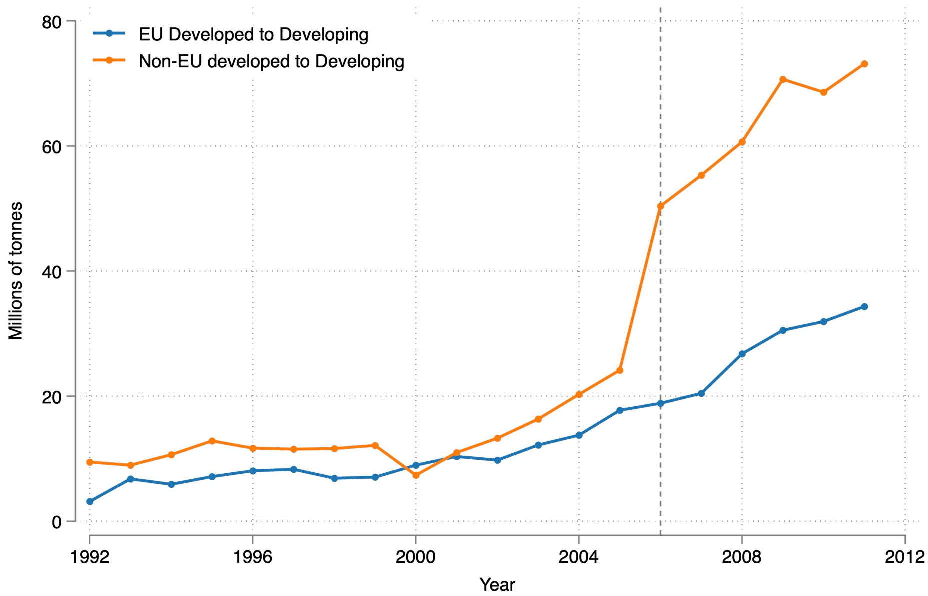

Figure 4: Total annual waste exports to developing countries

Figure 4 provides such suggestive evidence by illustrating the annual aggregate waste exports from EU developed and non-EU developed countries to the developing world from 1992 to 2011. While there were small level differences in the trade volumes between these two groups, the waste export trends followed a very similar pattern

[26] The EU-WSR was approved in 2006, but actually went into force in 2007. However, firms may have already known about this regulation earlier and anticipated its potential impacts on their waste disposal. Therefore, firms had already taken some actions such as building more waste disposal factories, increasing disposal capacities, and so on before 2007.

prior to 2006. However, after the implementation of WSR in 2006, the trends seem to diverge substantially. While the waste shipments from non-EU developed countries increased considerably, the increasing trend for EU developed countries remained relatively steady. One possible explanation for this post-policy difference may be that the EU waste regulation effectively deters more domestic firms from shipping their waste to the developing world, as it would be considered as a violation of the law. But as Bernard (2015) has pointed out, firms can undertake both legal and illegal waste shipments that take different forms to bypass the regulation, including transporting waste on the black market, mixing different types of waste, declaring hazardous waste as non-hazardous, or classifying waste as second-hand goods. Nonetheless, waste exports from EU developed countries do not present the same substantial increase trend as those non-EU ones.

However, it is possible that this markedly divergent trend is due to some other reasons rather than the EU-WSR. Though the regulation strictly bans the export of hazardous waste to developing countries, it does allow waste trade between developed countries themselves. Thus, one explanation for the nonparallel waste trend between EU and non-EU developed countries could be trade diversion. That is, EU developed countries may have shipped a large part of their waste to other non-EU developed countries, or simply there is more waste trade within the EU block. Figure 5 clarifies

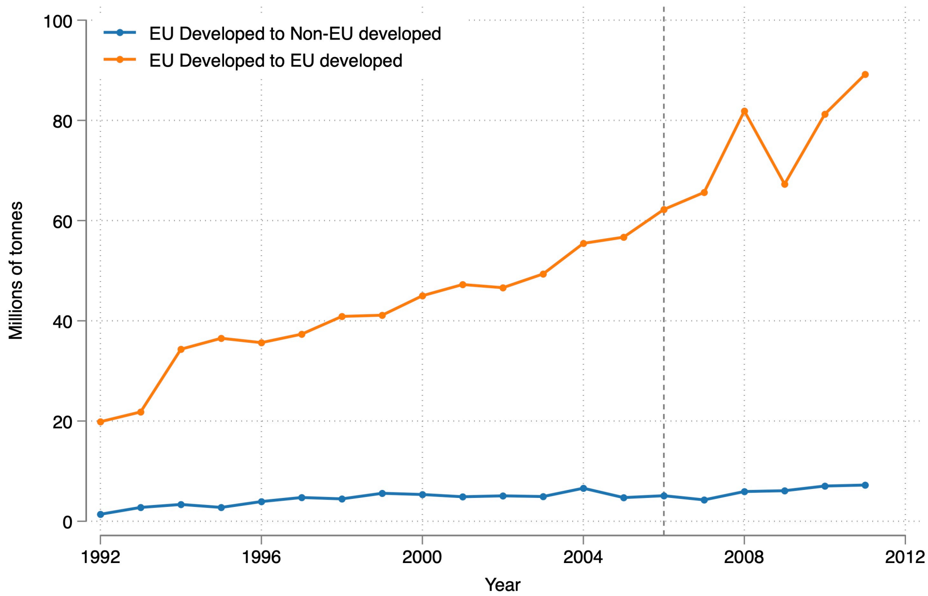

Figure 5: Total annual waste exports from EU developed countries

this concern by plotting the total annual waste exports from EU developed countries to other non-EU developed countries and to themselves, respectively. Clearly, there was substantial within-EU trade after the implementation of the WSR, while the waste shipments from EU developed to non-EU developed countries remained relatively stable.[27] That is, in the absence of the WSR, waste exports from EU developed countries

[27] This evidence is further confirmed in the subsequent EU reports on the implementation

would have followed a similar trend to those from non-EU developed countries.

While these figures are suggestive of the policy effects, they do not fully exploit the variation in waste exports created by EU-WSR. As my next step, I present estimates of the average effects on waste export reduction in Table 6 using the above-outlined specification. Column 1 reports estimates from the simplest specification. In columns 2-4, I include year fixed effects, exporter fixed effects and importer fixed effects to capture and net out average differences across years, exporters and importers, respectively. Finally, column 5 includes both year and exporter fixed effects, and column 6 includes all of the three fixed effects. The coefficients on the double-difference estimator presented in Table 6 are all negative, indicating that EU developed countries decreased their waste exports to developing countries after the implementation of the WSR. More specifically, according to the estimate in column 6, the WSR reduced the waste exports of EU developed countries by 31.9%.[28]

Table 6: Simple difference-in-differences regression specifications

	Dependent variable: ln (North-to-South waste exports)					
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Treatment* Post	-0.192	-0.208	-0.187	-0.376**	-0.200	-0.384***
	(0.153)	(0.153)	(0.151)	(0.148)	(0.151)	(0.143)
Year FE		X			X	X
Exporter FE			X		X	X
Importer FE				X		X
Observations	17525	17525	17525	17525	17525	17525
R^2	0.010	0.013	0.113	0.255	0.115	0.401

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 the year is from 2006 onwards.

4.2.2 Mechanism: the role of ENGOs

The results from the simple difference-in-differences specification lend confidence to my research design and provide evidence about the policy effects on waste export reduction by EU developed countries. I now turn to the main focus of the paper and identify the mechanism through which environmental lobbies can play a role in reducing the waste trade. That is, how much of the waste export reduction brought by EU-WSR can be explained by the variation in environmental lobbying strength? Do countries with more ENGOs tend to experience a larger effect?

of the Waste Shipment Regulation. Please refer to https://environment.ec.europa.eu/topics/waste-and-recycling/waste-shipments_en for more details.

[28] $(exp(-0.384) - 1) * 100\% = 31.9\%$.

To better answer these questions, I explore the differences in environmental lobbying strength (proxied by the number of ENGOs) across countries, in addition to the double differences discussed earlier, and thus use a triple-difference estimation strategy. I implement the following regression specification for the triple-difference estimation:

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

where Y_{ijt} denotes the size of aggregate waste exports from a developed country i to a developing country j in year t. The dummy variable Treatment_i equals one if country i belongs to an EU developed country, and equals zero otherwise. The dummy variable Post_t equals one if year t is equal to or greater than 2006, and equals zero otherwise. As for ENGO_{it}, I use the variation in the number of ENGOs in 2005, which is prior to the policy implementation. X_{ijt} is a vector of control variables defined as earlier, and ε_{ijt} is the unobserved error term. β_7 is the triple-difference estimator – my main coefficient of interest. Identifying β_7 requires some assumptions. That is, countries with different baseline ENGOs react similarly to changes in unobservable differences between EU developed and non-EU developed countries.

It is possible that the number of ENGOs and waste exports are simultaneously determined. Thus, if I use the yearly number of ENGOs in the regression, the variable may be endogenous. To address this issue, I use the baseline variation in the number of ENGOs. Another concern is that the EU-WSR may be the result of stronger pressure from ENGOs. But the interaction term $(\text{Treatment}_i * \ln \text{ENGO}_{it})$ in the regression should capture any baseline differences in environmental lobbying strength between EU developed countries. Finally, there are some concerns that the EU waste export reduction was driven by some other waste policies than the WSR.[29] For example, the EU's directives on End of Life Vehicle (ELV) in 2000 and Waste Electrical and Electronic Equipment (WEEE) in 2000 (amended in 2006), may have helped reduce some waste production and improve waste reuse, possibly reducing the amount of waste being exported and thereby reducing the need for environmental lobbies. However, as shown in Figure 3, the number of ENGOs increases steadily over time and thus it is highly unlikely that ENGOs are endogenously determined by these policies. Nonetheless, I conduct a robustness check using the variation of ENGOs in 1999, but the results remain very similar.[30]

Table 7 reports the coefficient estimates from the triple-difference specification on the exporter side; a more detailed description of the results can be found in Appendix

[29] For a full list of all EU waste policies, please see https://www.municipalwasteeurope.eu/summary-current-eu-waste-legislation.

[30] Results are available from the author on request.

E.1. While column 1 describes the estimates from the simplest specification, column 2 includes additional exporter-specific controls and column 3 adds extra bilateral control variables in the specifications. In columns 4-6, I include additional year fixed effects, exporter fixed effects and importer fixed effects to capture and net out average differences across years, exporters and importers, respectively. Finally, column 7 controls for all of these additional factors simultaneously.

Table 7: Triple-difference exporter side regression specifications

	Dependent variable: ln (North-to-South waste exports)						
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment* Post* ln (ENGO exporter)	-0.811***	-0.874***	-0.916***	-0.883***	-0.889***	-0.778***	-0.670***
	(0.152)	(0.158)	(0.156)	(0.157)	(0.158)	(0.152)	(0.154)
Exporter-specific Controls		X	X	X	X	X	X
Bilateral Controls			X	X	X	X	X
Year FE				X			X
Exporter FE					X		X
Importer FE						X	X
Observations	17525	17512	17512	17512	17512	17512	17512
R^2	0.015	0.046	0.083	0.093	0.158	0.413	0.483

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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. Exporter-specific controls include industry lobbying strength, population, GDP and capital-labour ratio. Bilateral controls include bilateral distance and dummy variables that indicate 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.

Throughout all the specifications, the coefficients on the triple-difference estimator are all negative and statistically significant at the 1% level. This means that the more ENGOs in 2005, the more pronounced is the decrease in waste exports triggered by the policy for the EU developed countries. More specifically, according to the estimate in column 7, EU developed countries with 10% more ENGOs in 2005 are estimated to decrease their waste exports by 6.7% more than their EU counterparts after the implementation of the WSR.

As shown earlier, the importer-specific factors can also affect the waste trade. I thus implement the triple-difference estimation with the gravity specification as a robustness check. The results from this analysis are reported in Table 8 with more details in Appendix E.2. Column 1 again describes the estimates from the simplest specification, whereas column 2 includes additional exporter-specific and import-specific controls, and column 3 adds extra bilateral control variables in the specifications. In columns 4-5, I include additional year fixed effects, both exporter fixed effects and importer fixed effects to capture and net out average differences across years, and exporters and importers, respectively. Finally, column 6 includes all of these additional factors simultaneously. The triple-difference coefficient estimates presented in Table 8 prove to be quite robust – still negative and statistically significant at the 1% level, with only the magnitudes increasing slightly. Therefore, I can conclude that environmental lobby groups exert a statistically significant impact on North-to-South waste export reduction.

Table 8: Triple-difference gravity regression specifications

	Dependent variable: ln (North-to-South waste exports)					
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment* Post* ln (ENGO exporter)	-0.811***	-0.952***	-0.936***	-0.898***	-0.700***	-0.704***
	(0.152)	(0.159)	(0.157)	(0.157)	(0.153)	(0.154)
Exporter-specific Controls		X	X	X	X	X
Importer-specific Controls		X	X	X	X	X
Bilateral Controls			X	X	X	X
Year FE				X		X
Exporter FE					X	X
Importer FE					X	X
Observations	17525	17309	17309	17309	17309	17309
R^2	0.015	0.213	0.290	0.296	0.489	0.490

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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. Exporter and importer-specific controls include industry lobbying strength, population, GDP and capital-labour ratio. Bilateral controls include bilateral distance and dummy variables that indicate 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.

4.3 Robustness check with zero waste trade

In the previous sections, I have focused only on the positive waste trade and estimated the regressions by OLS, while leaving out a significant proportion of zero waste trade.[31] One clear drawback of using OLS is that it can not take into account the information contained in the zero trade flows, since these observations are simply dropped out when transformed into a logarithmic form. This may constitute a selection bias because the sample is not drawn randomly from all trade flows, but only consists of those trade flows which are strictly positive. Several researchers (Eaton and Tamura, 1994; Silva and Tenreyro, 2006; Helpman, Melitz and Rubinstein, 2008; Martin and Pham, 2020) have proposed different approaches to address this zero trade issue.[32] I follow Silva and Tenreyro (2006) and employ the Poisson Pseudo Maximum Likelihood (PPML) estimation technique for a robustness check.

Similar to Table 5, Table 9 reports the main estimation results for the exporter side, importer side, and gravity specifications, respectively, but now estimated by PPML with the tonnes of North-to-South waste exports as the dependent variable. Though the coefficients for ENGO on the exporter side become statistically insignificant, the ones on the importer side remain quite robust – negative and statistically significant

[31] In fact, there should be $35 \times 87 \times 20 = 60,900$ total observations, in which the zero trade makes up 71.2% of the total trade if counted.

[32] See Head and Mayer (2014) for a review.

at 1% level in all the specifications. This further validates my previous finding that strong environmental lobby groups in developing countries will result in less waste being shipped from North to South.

Table 9: North-to-South waste trade regression specifications using PPML

	Dependent variable: North-to-South waste exports					
	Exporter only		Importer only		Gravity	
Variables	(1)	(2)	(3)	(4)	(5)	(6)
ln (ENGO exporter)	-0.045	-0.056			-0.045	0.280
	(0.380)	(0.385)			(0.289)	(0.216)
ln (ENGO importer)			-0.899***	-0.892***	-0.899***	-1.135***
			(0.257)	(0.168)	(0.198)	(0.167)
Exporter-specific Controls	X	X			X	X
Importer-specific Controls			X	X	X	X
Bilateral Controls		X		X		X
Observations	60117	60117	59325	59325	58646	58646
Pseudo R^2	0.244	0.353	0.492	0.657	0.679	0.767

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 indicate 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.

Two similar exercises are performed for the triple-difference estimations using PPML with the North-to-South waste exports in tonnes as the dependent variable. The results on the triple-difference estimator for the exporter-side specification and gravity specification are reported in Table 10 and Table 11, respectively. Though only very weak evidence is observed in the exporter side specifications from Table 10, the triple-difference coefficient estimates reported in Table 11 show that the results are highly robust – all negative and statistically significant at the 1% level, except for the second one at 5% level. This further confirms my previous claim that EU developed countries with more ENGOs tend to reduce their waste exports by more after the implementation of the regulation. These additional empirical exercises take into consideration the "missing" zero waste trade and provide robust evidence of my previous findings that strengthening ENGOs can reduce the international waste trade.

5 Conclusion

In this paper, I develop a political economy model to investigate the role played by lobby groups on international trade in waste, an externality generated by production

Table 10: Triple-difference exporter side regression specifications using PPML

Variables	Dependent variable: North-to-South waste exports						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment* Post* ln (ENGO exporter)	-0.522**	-0.327	-0.289	-0.311*	-0.206	-0.211	-0.259*
	(0.238)	(0.231)	(0.189)	(0.185)	(0.172)	(0.148)	(0.150)
Exporter-specific Controls		X	X	X	X	X	X
Bilateral Controls			X	X	X	X	X
Year FE				X			X
Exporter FE					X		X
Importer FE						X	X
Observations	60900	60291	60291	60291	60291	60291	60291
Pseudo R^2	0.190	0.256	0.369	0.377	0.440	0.851	0.902

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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. Exporter-specific controls include industry lobbying strength, population, GDP and capital-labour ratio. Bilateral controls include bilateral distance and dummy variables that indicate 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.

Table 11: Triple-difference gravity regression specifications using PPML

	Dependent variable: North-to-South waste exports					
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment* Post* ln (ENGO exporter)	-0.522**	-0.336**	-0.405***	-0.422***	-0.335***	-0.371***
	(0.238)	(0.148)	(0.106)	(0.102)	(0.100)	(0.105)
Exporter-specific Controls		X	X	X	X	X
Importer-specific Controls		X	X	X	X	X
Bilateral Controls			X	X	X	X
Year FE				X		X
Exporter FE					X	X
Importer FE					X	X
Observations	60900	58792	58792	58792	58792	58792
Pseudo R^2	0.190	0.695	0.775	0.779	0.902	0.905

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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. Exporter and importer-specific controls include industry lobbying strength, population, GDP and capital-labour ratio. Bilateral controls include bilateral distance and dummy variables that indicate 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.

activities in a developed-country market that can be exported to a developing country for disposal but with a fee. The model assumes that groups have heterogeneous preferences for environmental quality and that the environmental and trade policy on the externality is endogenously determined by balancing the competing interests of an organized environmental and industry lobby group. I show that the politically chosen policy is ambiguous relative to the socially optimal level, depending on the heterogeneity of environmental attitudes and the degree of pollution damages from waste. Further, taking theory to data to provide some empirical clarity on the effects of environmental lobbying, I find compelling evidence that environmental lobby groups exert a statistically significant impact on North-to-South waste export reduction. Therefore, strengthening ENGOs can represent an important strategy to reduce the international waste trade. Thus, it may be worthwhile for international donor organizations to provide support for the development of ENGOs all over the world (Binder and Neumayer, 2005; Fredriksson et al., 2005).

The paper has some limitations. First, I have only explored the policy channels through which environmental lobby groups affect the waste trade. However, as demonstrated in Yu (2005), the amount of political contributions observed from environmental lobby groups is typically very small compared to industrial ones, and thus the success of environmental lobbying is largely due to their greater effectiveness in public persuasion and the growing public environmental awareness. In addition, as identified in Connelly et al. (2012), ENGOs can engage in many other activities to affect policymakers' perceived political support, such as producing scientific research and reports, organizing protests, staging public stunts, and so on. They can also use environmental litigation and courts to fulfil their goals (Bentata and Faure, 2015). Therefore, it would be interesting to extend the analysis to explore other possible mechanisms of environmental lobbying on the waste trade.

Second, I do not seek to test the relationship between the strength of environmental lobby groups and policy stringency, due to data availability and challenges. There is no explicit measurement of the environmental tax on waste, and attempting to collect this information for a cross-country time-series study is prohibitively difficult. Though tariff data on waste is largely available,[33] it turns out to be very poor and information on many waste categories is missing. Also, as argued by Gawande and Krishna (2003), the trade barriers used in practice are a complicated combination of tariff and nontariff barriers, and trade protection has been heavily dominated in recent decades by the use of nontariff barriers. Given the particular nature of waste, it is not difficult to imagine that most of the waste categories will be subject to nontariff barriers. Therefore, the use of available average or aggregate data to proxy for the country's overall ad valorem import tariff on waste will be unreliable.

Third, I have made the small open economy assumption and thus the price of waste is exogenously given. However, as noted in the data, China has played a significant role in the waste trade, and the Chinese waste ban in 2017 has undoubtedly affected the worldwide waste industry (Guo, Walls and Zheng, 2023). It would be worthwhile

[33]The tariff data on waste can be directly obtained from the WTO Tariff Download Facility, which contains comprehensive information on Most-Favoured-Nation (MFN) applied and bound tariffs at the standard codes of the Harmonized System (HS) for all WTO members. This information is sourced from submissions made to the WTO Integrated Data Base (IDB) for applied tariffs and imports and from the Consolidated Tariff Schedules (CTS) database for the bound duties of all WTO members. See more at https://www.wto.org/english/tratop_e/tariffs_e/tariff_data_e.htm.

to investigate how the results will change when the price of waste is endogenously determined. Finally, I have assumed that environmentalists are those not-in-my-backyard ones that only care about domestic environmental protection. A natural extension will be modelling the case when they also care about other countries' environments. These are all relevant and promising extensions for future research.

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Appendices

A Proofs

A.1 FOC for socially optimal tax

Proof. Note that

$$\begin{aligned}\frac{dJ_1}{dt} &= \frac{d\hat{\Pi}}{dt} + \frac{m_1}{n}\left[\hat{Y} - \hat{Q} + t\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right)\right] + m_1\frac{dCS(p_c)}{dp_c}\frac{dp_c}{dt} - m_1\beta_C D'(\hat{Z})\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right) \\ &= \left[\frac{dp_c}{dt} - 1\right]\hat{Y} + \hat{Q} + \frac{m_1}{n}\left[\hat{Y} - \hat{Q} + t\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right)\right] - m_1\frac{\hat{Y}}{n}\frac{dp_c}{dt} - m_1\beta_C D'(\hat{Z})\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right),\end{aligned}$$

$$\begin{aligned}\frac{dJ_2}{dt} &= \frac{m_2}{n}\left[\hat{Y} - \hat{Q} + t\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right)\right] - m_2\frac{\hat{Y}}{n}\frac{dp_c}{dt} - m_2\beta_E D'(\hat{Z})\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right), \\ \frac{dJ_3}{dt} &= \frac{m_3}{n}\left[\hat{Y} - \hat{Q} + t\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right)\right] - m_3\frac{\hat{Y}}{n}\frac{dp_c}{dt} - m_3\beta_W D'(\hat{Z})\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right),\end{aligned}$$

and thus

$$\begin{aligned}\frac{dJ}{dt} &= \left[\frac{dp_c}{dt} - 1\right]\hat{Y} + \hat{Q} + \left[\hat{Y} - \hat{Q} + t\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right)\right] - \hat{Y}\frac{dp_c}{dt} - n\bar{\beta}D'(\hat{Z})\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right) \\ &= \left(t - n\bar{\beta}D'(\hat{Z})\right)\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right).\end{aligned}$$

□

A.2 FOC for political equilibrium tax

Proof. The first-order condition yields

$$\frac{d\hat{G}(t)}{dt} = (1+\delta)\left(\frac{dJ_1}{dt} + \frac{dJ_2}{dt}\right) + \delta\frac{dJ_3}{dt} = 0,$$

or

$$\frac{dJ_1}{dt} + \frac{dJ_2}{dt} + \delta\frac{dJ}{dt} = 0.$$

That is,

$$\left[\frac{dp_c}{dt} - 1\right]\hat{Y} + \hat{Q} + \frac{m_1+m_2}{n}\left[\hat{Y} - \hat{Q} + t\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right)\right] - \frac{m_1+m_2}{n}\hat{Y}\frac{dp_c}{dt}$$

$$-(m_1\beta_C + m_2\beta_E)D'(\hat{Z})\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right) + \delta\left(t - n\bar{\beta}D'(\hat{Z})\right)\left(\frac{d\hat{Y}}{dt} - \frac{d\hat{Q}}{dt}\right) = 0.$$

This equation reduces to

$$\frac{m_3}{n}\hat{Y}\left[\frac{dp_c}{dt}-1\right]+\frac{m_3}{n}\hat{Q}+\left(\frac{m_1+m_2}{n}t-(m_1\beta_C+m_2\beta_E)D'(\hat{Z})\right)\left(\frac{d\hat{Y}}{dt}-\frac{d\hat{Q}}{dt}\right)$$

$$+\delta\left(t-n\bar{\beta}D'(\hat{Z})\right)\left(\frac{d\hat{Y}}{dt}-\frac{d\hat{Q}}{dt}\right)=0.$$

Substitute with equation (9):

$$\frac{dp_c}{dt}-1=\frac{\frac{d\hat{\Pi}}{dt}-\hat{Q}}{\hat{Y}},$$

and use the result

$$m_1\beta_C+m_2\beta_E=n\bar{\beta}-m_3\beta_W=\frac{m_1+m_2+m_3}{n}n\bar{\beta}-m_3\beta_W=\frac{m_1+m_2}{n}n\bar{\beta}-\frac{m_3}{n}(n\beta_W-n\bar{\beta}),$$

the equation becomes

$$\frac{m_3}{n}\frac{d\hat{\Pi}}{dt}+\left[\frac{m_1+m_2}{n}t-\left(\frac{m_1+m_2}{n}n\bar{\beta}-\frac{m_3}{n}(n\beta_W-n\bar{\beta})\right)D'(\hat{Z})\right]\left(\frac{d\hat{Y}}{dt}-\frac{d\hat{Q}}{dt}\right)$$

$$+\delta\left(t-n\bar{\beta}D'(\hat{Z})\right)\left(\frac{d\hat{Y}}{dt}-\frac{d\hat{Q}}{dt}\right)=0.$$

Define $\lambda_0=\frac{m_1+m_2}{n}$ as the fraction of the population that belong to the organized group, then

$$(1-\lambda_0)\frac{d\hat{\Pi}}{dt}+\left[\lambda_0\left(t-n\bar{\beta}D'(\hat{Z})\right)+(1-\lambda_0)(n\beta_W-n\bar{\beta})D'(\hat{Z})\right]\left(\frac{d\hat{Y}}{dt}-\frac{d\hat{Q}}{dt}\right)$$

$$+\delta\left(t-n\bar{\beta}D'(\hat{Z})\right)\left(\frac{d\hat{Y}}{dt}-\frac{d\hat{Q}}{dt}\right)=0.$$

Combine terms, we have

$$\frac{d\hat{G}(t)}{dt}=(\lambda_0+\delta)\left(t-n\bar{\beta}D'(\hat{Z})\right)\left(\frac{d\hat{Y}}{dt}-\frac{d\hat{Q}}{dt}\right)+(1-\lambda_0)\left[\frac{d\hat{\Pi}}{dt}+(n\beta_W-n\bar{\beta})D'(\hat{Z})\left(\frac{d\hat{Y}}{dt}-\frac{d\hat{Q}}{dt}\right)\right]=0.$$

□

A.3 Effects of environmental movement

Proof. Given $n=m_1+m_2+m_3$, we must have

$$\frac{dm_1}{dm_2}=\frac{dn}{dm_2}=0,\quad \frac{dm_3}{dm_2}=-1,\quad \frac{d\lambda_0}{dm_2}=\frac{1}{n},$$

$$\frac{d\frac{1-\lambda_0}{\delta+\lambda_0}}{dm_2}=\frac{-\frac{1}{n}(\delta+\lambda_0)-\frac{1}{n}(1-\lambda_0)}{(\delta+\lambda_0)^2}=\frac{-\frac{1}{n}(\delta+1)}{(\delta+\lambda_0)^2}<0,$$

$$\frac{d\beta_C}{dm_2} = \frac{d\beta_W}{dm_2} = \frac{d\beta_E}{dm_2} = 0, \quad \frac{dn\bar{\beta}}{dm_2} = \frac{d(m_1\beta_C + m_2\beta_E + m_3\beta_W)}{dm_2} = \beta_E - \beta_M > 0.$$

Rewrite equation (10) as

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

then

$$\frac{dt}{dm_2} = (\beta_E - \beta_W)D'(\hat{Z}(t)) + n\bar{\beta}D''(\hat{Z}(t))\frac{d\hat{Z}}{dt}\frac{dt}{dm_2} + \frac{\frac{1}{n}(\delta+1)}{(\delta+\lambda_0)^2}\left[(n\beta_W - n\bar{\beta})D'(\hat{Z}(t)) + \frac{d\hat{\Pi}/dt}{d\hat{Z}/dt}\right]$$

$$-\frac{1-\lambda_0}{\delta+\lambda_0}\left[-(\beta_E - \beta_W)D'(\hat{Z}(t)) + (n\beta_W - n\bar{\beta})D''(\hat{Z}(t))\frac{d\hat{Z}}{dt}\frac{dt}{dm_2} + \frac{\frac{d^2\hat{\Pi}}{dt}\frac{dt}{dm_2}\frac{d\hat{Z}}{dt} - \frac{d\hat{\Pi}}{dt}\frac{dt}{dm_2}\frac{d^2\hat{Z}}{dt^2}}{(\frac{d\hat{Z}}{dt})^2}\right].$$

Combine terms on the right hand, we have

$$\frac{dt}{dm_2} = \frac{1+\delta}{\delta+\lambda_0}(\beta_E - \beta_W)D'(\hat{Z}(t)) + \frac{(1+\delta)n\bar{\beta} - (1-\lambda_0)n\beta_W}{\delta+\lambda_0}D''(\hat{Z}(t))\frac{d\hat{Z}}{dt}\frac{dt}{dm_2}$$

$$+\frac{\frac{1}{n}(\delta+1)}{(\delta+\lambda_0)^2}\left[(n\beta_W - n\bar{\beta})D'(\hat{Z}(t)) + \frac{d\hat{\Pi}/dt}{d\hat{Z}/dt}\right] - \frac{1-\lambda_0}{\delta+\lambda_0}\frac{\frac{d^2\hat{\Pi}}{dt}\frac{d\hat{Z}}{dt} - \frac{d\hat{\Pi}}{dt}\frac{d^2\hat{Z}}{dt^2}}{(\frac{d\hat{Z}}{dt})^2}\frac{dt}{dm_2}.$$

Now, combine the term dt/dm_2, then

$$\left[1 - \frac{(1+\delta)n\bar{\beta} - (1-\lambda_0)n\beta_W}{\delta+\lambda_0}D''(\hat{Z}(t))\frac{d\hat{Z}}{dt} + \frac{1-\lambda_0}{\delta+\lambda_0}\frac{\frac{d^2\hat{\Pi}}{dt}\frac{d\hat{Z}}{dt} - \frac{d\hat{\Pi}}{dt}\frac{d^2\hat{Z}}{dt^2}}{(\frac{d\hat{Z}}{dt})^2}\right]\frac{dt}{dm_2}$$

$$= \frac{1+\delta}{\delta+\lambda_0}(\beta_E - \beta_W)D'(\hat{Z}(t)) + \frac{\frac{1}{n}(\delta+1)}{(\delta+\lambda_0)^2}\left[(n\beta_W - n\bar{\beta})D'(\hat{Z}(t)) + \frac{d\hat{\Pi}/dt}{d\hat{Z}/dt}\right].$$

That is,

$$\frac{dt}{dm_2} = \frac{\frac{1+\delta}{\delta+\lambda_0}(\beta_E - \beta_W)D'(\hat{Z}(t)) + \frac{\frac{1}{n}(\delta+1)}{(\delta+\lambda_0)^2}\left[(n\beta_W - n\bar{\beta})D'(\hat{Z}(t)) + \frac{d\hat{\Pi}/dt}{d\hat{Z}/dt}\right]}{1 - \frac{(1+\delta)n\bar{\beta} - (1-\lambda_0)n\beta_W}{\delta+\lambda_0}D''(\hat{Z}(t))\frac{d\hat{Z}}{dt} + \frac{1-\lambda_0}{\delta+\lambda_0}\frac{\frac{d^2\hat{\Pi}}{dt}\frac{d\hat{Z}}{dt} - \frac{d\hat{\Pi}}{dt}\frac{d^2\hat{Z}}{dt^2}}{(\frac{d\hat{Z}}{dt})^2}}.$$

Note that the denominator is exactly $\frac{d\Omega}{dt}$ as we derived earlier:

$$\frac{d\Omega}{dt} \equiv 1 - n\bar{\beta}D''(\hat{Z})\frac{d\hat{Z}}{dt} + \frac{1-\lambda_0}{\delta+\lambda_0}\left((n\beta_W - n\bar{\beta})D''(\hat{Z})\frac{d\hat{Z}}{dt} + \frac{\frac{d^2\hat{\Pi}}{dt}\frac{d\hat{Z}}{dt} - \frac{d\hat{\Pi}}{dt}\frac{d^2\hat{Z}}{dt^2}}{(\frac{d\hat{Z}}{dt})^2}\right) > 0,$$

and the second term in the numerator can be rewritten from equation (10) as

$$\left[(n\beta_W - n\bar{\beta})D'(\hat{Z}) + \frac{d\hat{\Pi}}{d\hat{Z}}\right] = -\frac{\delta+\lambda_0}{1-\lambda_0}\left[t - n\bar{\beta}D'(\hat{Z})\right] = -\frac{n}{m_3}(\delta+\lambda_0)\left[t - n\bar{\beta}D'(\hat{Z})\right].$$

Therefore,

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

or

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

□

A.4 FOC for socially optimal tariff rate

Proof. Note that

$$\frac{dJ_1}{d\tau} = \frac{d\hat{\Pi}(\tau)}{d\tau} + \frac{m_1\mu}{n}\left(\hat{I}(\tau) + \tau\frac{d\hat{I}(\tau)}{d\tau}\right) - m_1\beta_C D'(\hat{I}(\tau))\frac{d\hat{I}(\tau)}{d\tau},$$

$$\frac{dJ_2}{d\tau} = \frac{m_2\mu}{n}\left(\hat{I}(\tau) + \tau\frac{d\hat{I}(\tau)}{d\tau}\right) - m_2\beta_E D'(\hat{I}(\tau))\frac{d\hat{I}(\tau)}{d\tau},$$

$$\frac{dJ_3}{d\tau} = \frac{m_3\mu}{n}\left(\hat{I}(\tau) + \tau\frac{d\hat{I}(\tau)}{d\tau}\right) - m_3\beta_W D'(\hat{I}(\tau))\frac{d\hat{I}(\tau)}{d\tau},$$

$$\frac{d\hat{\Pi}(\tau)}{d\tau} = -\mu\hat{I}(\tau) + \left[(1-\tau)\mu - C'(\hat{I}(\tau))\right]\frac{d\hat{I}(\tau)}{d\tau} = -\mu\hat{I}(\tau) < 0,$$

and thus

$$\frac{dJ}{d\tau} = \frac{d\hat{\Pi}(\tau)}{d\tau} + \mu\left(\hat{I}(\tau) + \tau\frac{d\hat{I}(\tau)}{d\tau}\right) - n\bar{\beta}D'(\hat{I}(\tau))\frac{d\hat{I}(\tau)}{d\tau} = \left(\mu\tau - n\bar{\beta}D'(\hat{I}(\tau))\right)\frac{d\hat{I}(\tau)}{d\tau}.$$

□

A.5 FOC for political equilibrium tariff rate

Proof. The first-order condition yields

$$\frac{d\hat{G}(\tau)}{d\tau} = \frac{dJ_1}{d\tau} + \frac{dJ_2}{d\tau} + \delta\frac{dJ}{d\tau} = 0.$$

That is,

$$-\mu\hat{I}(\tau) + \frac{(m_1+m_2)\mu}{n}\left(\hat{I}(\tau) + \tau\frac{d\hat{I}(\tau)}{d\tau}\right) - (m_1\beta_C + m_2\beta_E)D'(\hat{I}(\tau))\frac{d\hat{I}(\tau)}{d\tau}$$

$$+\delta\left(\mu\tau - n\bar{\beta}D'(\hat{I}(\tau))\right)\frac{d\hat{I}(\tau)}{d\tau} = 0.$$

Use the result of

$$m_1\beta_C + m_2\beta_E = n\bar{\beta} - m_3\beta_W = \frac{m_1+m_2+m_3}{n} n\bar{\beta} - m_3\beta_W = \frac{m_1+m_2}{n} n\bar{\beta} - \frac{m_3}{n}(n\beta_W - n\bar{\beta}),$$

the equation reduces to

$$-\frac{m_3}{n}\mu\hat{I}(\tau) + \left[\frac{m_1+m_2}{n}\mu\tau - \left(\frac{m_1+m_2}{n}n\bar{\beta} - \frac{m_3}{n}(n\beta_W - n\bar{\beta})\right)D'(\hat{I}(\tau))\right]\frac{d\hat{I}(\tau)}{d\tau}$$

$$+\delta\Big(\mu\tau - n\bar{\beta}D'(\hat{I}(\tau))\Big)\frac{d\hat{I}(\tau)}{d\tau} = 0.$$

Define

$$\lambda_0 = \frac{m_1+m_2}{n}, \quad 1-\lambda_0 = \frac{m_3}{n},$$

then we have

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

$$+\delta\Big(\mu\tau - n\bar{\beta}D'(\hat{I}(\tau))\Big)\frac{d\hat{I}(\tau)}{d\tau} = 0.$$

Combine terms, then

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

□

B Examples

B.1 Examples for political equilibrium tax

Suppose the production function, utility function, cost function and damage function take the following forms respectively:

$$Y = F(K,L) = 2K^{\frac{1}{2}}L^{\frac{1}{2}}, \quad u(y) = Ay - \frac{1}{2}y^2, \quad \eta(Q) = \frac{1}{2}Q^2, \quad D(Z) = \frac{\gamma}{2}Z^2,$$

which will allow us to obtain an analytical solution. For simplicity, let $\bar{K} = 1$, then

$$Y = F(\bar{K},L) = 2L^{\frac{1}{2}}, \quad F_L(\bar{K},L) = L^{-\frac{1}{2}}, \quad F_{LL}(\bar{K},L) = -\frac{1}{2}L^{-\frac{3}{2}}, \quad \frac{F_{LL}}{F_L^3} = -\frac{1}{2},$$

and we have

$$u'(y) = A - y, \quad \eta'(Q) = Q, \quad D'(Z) = \gamma Z.$$

From equation (8):

$$\left[u'\left(\frac{F(\bar{K},\hat{L})}{n}\right)-t\right]F_L(\bar{K},\hat{L})-1=0,$$

we can obtain the optimal labour and thereby output in the manufacturing sector as

$$\hat{L}(t)=\left(\frac{n(A-t)}{n+2}\right)^2,\quad \hat{Y}(t)=2\hat{L}^{\frac{1}{2}}=\frac{2n(A-t)}{n+2}.$$

From equation (1), the optimal exported waste can be expressed as

$$\hat{Q}(t)=t-\mu.$$

Therefore, the optimal pollution is given by

$$\hat{Z}(t)=\hat{Y}(t)-\hat{Q}(t)=\frac{2n(A-t)}{n+2}-t+\mu.$$

To ensure $\hat{Y},\hat{Q},\hat{Z}>0$, we would need

$$\mu<t<\frac{2nA+\mu(n+2)}{3n+2}<A.$$

Clearly,

$$\frac{d\hat{Y}(t)}{dt}=-\frac{2n}{n+2}<0,\quad \frac{d\hat{Q}(t)}{dt}=1>0,\quad \frac{d\hat{Z}(t)}{dt}=-\frac{2n}{n+2}-1<0,$$

Then, we have

$$\frac{d\hat{\Pi}}{dt}=\hat{Q}-\hat{Y}\frac{F_{LL}}{F_L^3}\frac{d\hat{Y}}{dt}=t-\mu-\frac{2n(A-t)}{n+2}(-\frac{1}{2})(-\frac{2n}{n+2})=t-\mu-\frac{2n^2(A-t)}{(n+2)^2},$$

and

$$\frac{d\hat{\Pi}}{d\hat{Z}}=\frac{\frac{d\hat{\Pi}}{dt}}{\frac{d\hat{Z}}{dt}}=\frac{t-\mu-\frac{2n^2(A-t)}{(n+2)^2}}{-\frac{2n}{n+2}-1}=\frac{2n^2(A-t)-(t-\mu)(n+2)^2}{(3n+2)(n+2)}$$

To ensure $\frac{d\hat{\Pi}}{dt}<0$ or $\frac{d\hat{\Pi}}{d\hat{Z}}>0$, we need

$$t<\frac{2n^2A+\mu(n+2)^2}{3n^2+4n+4}.$$

It can be easily verified that

$$\frac{2n^2A+\mu(n+2)^2}{3n^2+4n+4}<\frac{2nA+\mu(n+2)}{3n+2}.$$

Therefore, the resulting political equilibrium tax must satisfy the condition:

$$\mu < t < \frac{2n^2A + \mu(n+2)^2}{3n^2+4n+4}.$$

Finally, from equation (10), we have

$$t - n\bar{\beta}\gamma\hat{Z} + \frac{1-\lambda_0}{\delta+\lambda_0}\left[(n\beta_W - n\bar{\beta})\gamma\hat{Z} + \frac{d\hat{\Pi}}{d\hat{Z}}\right] = 0.$$

That is,

$$t + \gamma\frac{m_3\bar{\beta}_M - (\delta+1)n\bar{\beta}}{\delta + \frac{m_1+m_2}{n}}\left[\frac{2n(A-t)}{n+2} - t + \mu\right] + \frac{\frac{m_3}{n}}{\delta + \frac{m_1+m_2}{n}}\left[\frac{2n^2(A-t) - (t-\mu)(n+2)^2}{(3n+2)(n+2)}\right] = 0$$

For numerical illustrations, we use the following parameter values:

$$n = 10, \quad \mu = 2.5, \quad A = 5, \quad \bar{L} = 10, \quad m_1 = 3, \quad m_2 = 2, \quad m_3 = 5, \quad \delta = 0.5.$$

Thus,

$$\lambda_0 = \frac{m_1+m_2}{n} = 0.5, \quad \frac{1-\lambda_0}{\delta+\lambda_0} = \frac{0.5}{0.5+0.5} = 0.5$$

Example 1. Suppose the average environmental preference for each group is such that

$$\beta_C = 0.01 < \bar{\beta} = 0.2 < \beta_W = 0.25 < \beta_E = 0.36,$$

with

$$m_1\beta_C + m_2\beta_E + m_3\beta_W = 3 \times 0.01 + 2 \times 0.36 + 5 \times 0.25 = 2 = 10 \times 0.2 = n\bar{\beta}$$

and $\gamma = 3$, then the political economy equilibrium tax can be solved as

$$t^{**} = 3.7867 \in \left(\mu = 2.5, \frac{2n^2A + \mu(n+2)^2}{3n^2+4n+4} = 3.9535\right).$$

Thus, we have

$$\hat{L}(t^{**}) = 1.0223, \quad \hat{Y}(t^{**}) = 2.0222, \quad \hat{Q}(t^{**}) = 1.2867, \quad \hat{Z}(t^{**}) = 0.7355,$$

and the Pigovian tax is

$$t^* = n\bar{\beta}\gamma\hat{Z} = 4.4130 > t^{**} = 3.7867.$$

Example 1 shows that when $\beta_W \geq \beta$, the political economy equilibrium tax on the externality is below the Pigovian level.

Example 2. Suppose the average environmental preference for each group is such that

$$\beta_C = 0.02 < \beta_W = 0.18 < \bar{\beta} = 0.2 < \beta_E = 0.52,$$

with

$$m_1\beta_C + m_2\beta_E + m_3\beta_W = 3 \times 0.02 + 2 \times 0.52 + 5 \times 0.18 = 2 = 10 \times 0.2 = n\bar{\beta}$$

and $\gamma = 1$, then the political economy equilibrium tax can be solved as

$$t^{**} = 3.4101 \in \left(\mu = 2.5, \frac{2n^2A + \mu(n+2)^2}{3n^2 + 4n + 4} = 3.9535\right).$$

Thus, we have

$$\hat{L}(t^{**}) = 1.7554, \quad \hat{Y}(t^{**}) = 2.6498, \quad \hat{Q}(t^{**}) = 0.9101, \quad \hat{Z}(t^{**}) = 1.7398,$$

and the Pigovian tax is

$$t^* = n\bar{\beta}\gamma\hat{Z} = 3.4795 > t^{**} = 3.4101.$$

Example 2 shows that when $\beta_W < \bar{\beta}$ but $D'(\hat{Z})$ is small enough (i.e., $\gamma = 1$), the political economy equilibrium tax on the externality is below the Pigovian level.

Example 3. We retain the same average environmental preference for each group as in Example 2:

$$\beta_C = 0.02 < \beta_W = 0.18 < \bar{\beta} = 0.2 < \beta_E = 0.52,$$

but now $\gamma = 5$, then the political economy equilibrium tax is

$$t^{**} = 3.9219 \in \left(\mu = 2.5, \frac{2n^2A + \mu(n+2)^2}{3n^2 + 4n + 4} = 3.9535\right).$$

Thus, we have

$$\hat{L}(t^{**}) = 0.8071, \quad \hat{Y}(t^{**}) = 1.7968, \quad \hat{Q}(t^{**}) = 1.4219, \quad \hat{Z}(t^{**}) = 0.3749,$$

and the Pigovian tax is

$$t^* = n\bar{\beta}\gamma\hat{Z} = 3.7486 < t^{**} = 3.9219.$$

Example 3 shows that when $\beta_W < \bar{\beta}$ and $D'(\hat{Z})$ is large enough (i.e., $\gamma = 5$), the political economy equilibrium tax on the externality is above Pigovian level.

B.2 Examples for political economy tariff rate

Suppose the cost function and damage function both take the quadratic forms:

$$C(I) = \frac{1}{2}I^2, \quad D(I) = \frac{\alpha}{2}I^2,$$

which will allow us to obtain an analytical solution. Then, we have

$$C'(I) = I, \quad D'(I) = \alpha I.$$

From equation (12), we can obtain the optimal imported waste as

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

and thus

$$\frac{d\hat{I}}{d\tau} = -\mu, \quad \frac{d\hat{\Pi}}{d\tau} = -\mu\hat{I}, \quad \frac{d\hat{\Pi}}{d\hat{I}} = \frac{\frac{d\hat{\Pi}(\tau)}{d\tau}}{\frac{d\hat{I}(\tau)}{d\tau}} = \hat{I}.$$

Therefore, equation (13) becomes

$$\left[\mu\tau - n\bar{\beta}\alpha\hat{I}\right] + \frac{1-\lambda_0}{\delta+\lambda_0}\left[(n\beta_W - n\bar{\beta})\alpha\hat{I} + \hat{I}\right] = 0.$$

For numerical illustrations, we retain some of the same parameter values used in the North:

$$n = 10, \quad \mu = 2.5, \quad m_1 = 3, \quad m_2 = 2, \quad m_3 = 5, \quad \delta = 0.5.$$

Thus,

$$\lambda_0 = \frac{m_1 + m_2}{n} = 0.5, \quad \frac{1-\lambda_0}{\delta+\lambda_0} = \frac{0.5}{0.5+0.5} = 0.5$$

Example 4. Suppose the average environmental preference for each group is such that

$$\beta_C = 0.01 < \bar{\beta} = 0.2 < \beta_W = 0.25 < \beta_E = 0.36,$$

and $\alpha = 3$, then the political economy equilibrium tariff rate can be solved as

$$\tau^{**} = 0.8261 \in [0, 1].$$

Thus, the optimal imported waste is

$$\hat{I} = 0.4348,$$

and the social optimal tariff rate is

$$\tau^* = \frac{n\bar{\beta}\alpha\hat{I}}{\mu} = 1.0435 > \tau^{**} = 0.8261.$$

Example 4 shows that when $\beta_W \geq \bar{\beta}$, the political economy equilibrium tariff rate on the imported externality is below the socially optimal one.

Example 5. Suppose the average environmental preference for each group is such that

$$\beta_C = 0.02 < \beta_W = 0.18 < \bar{\beta} = 0.2 < \beta_E = 0.52,$$

and $\alpha = 1$, then the political economy equilibrium tariff rate can be solved as

$$\tau^{**} = 0.6154 \in [0, 1].$$

Thus, the optimal imported waste is

$$\hat{I} = 0.9615,$$

and the social optimal tariff rate is

$$\tau^* = \frac{n\bar{\beta}\alpha\hat{I}}{\mu} = 0.7692 > \tau^{**} = 0.6154.$$

Example 5 shows that when $\beta_W < \bar{\beta}$ but $D'(\hat{I})$ is small enough (i.e., $\alpha = 1$), the political economy equilibrium tariff rate on the imported externality is below the socially optimal one.

Example 6. We retain the same average environmental preference for each group as in Example 5:

$$\beta_C = 0.02 < \beta_W = 0.18 < \bar{\beta} = 0.2 < \beta_E = 0.52,$$

but now $\alpha = 5$, then the political economy equilibrium tariff rate is

$$\tau^{**} = 0.9091 \in [0, 1].$$

Thus, the optimal imported waste is

$$\hat{I} = 0.2273,$$

and the social optimal tariff rate is

$$\tau^* = \frac{n\bar{\beta}\alpha\hat{I}}{\mu} = 0.9091 = \tau^{**}.$$

Example 6 shows that when $\beta_W < \bar{\beta}$ and $D'(\hat{I})$ is large enough (i.e., $\alpha = 5$), the political economy equilibrium tariff rate on the imported externality is identical to the socially optimal one.

C Additional tables for data

Table C1: 87 categories of internationally traded waste by HS code

HS Code	Commodity Description
180200	Cocoa; shells, husks, skins and other cocoa waste
230320	Beet-pulp, bagasse and other waste of sugar manufacture; whether or not in the form of pellets
230330	Brewing or distilling dregs and waste; whether or not in the form of pellets
230800	Vegetable materials and vegetable waste, vegetable residues and by-products; whether or not in the form of pellets, of a kind used in animal feeding, not elsewhere specified or included
251720	Macadam of slag, dross or similar industrial waste; whether or not incorporating the materials in item no. 2517.10
252530	Mica; waste
261800	Slag, granulated (slag sand); from the manufacture or iron or steel
261900	Slag, dross; (other than granulated slag), scalings and other waste from the manufacture of iron or steel
262011	Slag, ash and residues; (not from the manufacture of iron or steel), containing mainly zinc, hard zinc spelter
262019	Slag, ash and residues; (not from the manufacture of iron or steel), containing mainly zinc, other than hard zinc spelter
262021	Slag, ash and residues; (not from the manufacture of iron or steel), containing mainly lead; leaded gasoline sludges and leaded anti-knock compound sludges
262029	Slag, ash and residues; (not from the manufacture of iron or steel), containing mainly lead; excluding leaded gasoline sludges and leaded anti-knock compound sludges
262020	Ash and residues; (not from the manufacture of iron or steel), containing mainly lead
262030	Slag, ash and residues; (not from the manufacture of iron or steel), containing mainly copper
262040	Slag, ash and residues; (not from the manufacture of iron or steel), containing mainly aluminium
262050	Ash and residues; (not from the manufacture of iron or steel), containing mainly vanadium
262060	Slag, ash and residues; (not from the manufacture of iron or steel), containing arsenic, mercury, thallium or their mixtures, of a kind used for the extraction of arsenic or those metals or for the manufacture of their chemical compounds
262091	Slag, ash and residues; (not from the manufacture of iron or steel), containing antimony, beryllium, cadmium, chromium or their mixtures
262099	Slag, ash and residues; (not from the manufacture of iron or steel), containing mainly metals or their compounds, n.e.c. in heading no. 2620
262100	Slag and ash nes, including seaweed ash (kelp)
262110	Slag and ash; ash and residues from the incineration of municipal waste

(To be continued)

HS Code	Commodity Description
262190	Slag and ash n.e.c. in chapter 26; including seaweed ash (kelp) but excluding ash and residues from the incineration of municipal waste
300680	Pharmaceutical goods; waste pharmaceuticals
300692	Pharmaceutical goods; waste pharmaceuticals
382510	Residual products of the chemical or allied industries, not elsewhere specified or included; municipal waste
382520	Residual products of the chemical or allied industries, not elsewhere specified or included; sewage sludge
382530	Residual products of the chemical or allied industries, not elsewhere specified or included; clinical waste
382541	Residual products of the chemical or allied industries, not elsewhere specified or included; halogenated waste organic solvents
382549	Residual products of the chemical or allied industries, not elsewhere specified or included; waste organic solvents, other than halogenated
382550	Residual products of chemical or allied industries, not elsewhere specified or included; wastes of metal pickling liquors, hydraulic fluids, brake fluids and anti-freeze fluids
382561	Residual products of the chemical or allied industries, not elsewhere specified or included; (other than sewage sludge, municipal waste or waste covered in 27.10); other wastes n.e.c. in 3825; those mainly containing organic constituents
382569	Residual products of the chemical or allied industries, not elsewhere specified or included; (other than sewage sludge, municipal waste or waste covered by 27.10); other wastes n.e.c. in 3825; except those mainly containing organic constituents
391510	Ethylene polymers; waste, parings and scrap
391520	Styrene polymers; waste, parings and scrap
391530	Vinyl chloride polymers; waste, parings and scrap
391590	Plastics n.e.c. in heading no. 3915; waste, parings and scrap
400400	Rubber; waste, parings and scrap of rubber (other than hard rubber) and powders and granules obtained therefrom
411520	Leather; parings and other waste, of leather or composition leather; not suitable for the manufacture of leather articles; leather dust, powder and flour
450190	Cork; waste cork, crushed, granulated or ground cork
470710	Paper or paperboard; waste and scrap, of unbleached kraft paper or paperboard or corrugated paper or paperboard
470720	Paper or paperboard; waste and scrap, paper or paperboard made mainly of bleached chemical pulp, not coloured in the mass
470730	Paper or paperboard; waste and scrap, paper or paperboard made mainly of mechanical pulp (e.g. newspapers, journals and similar printed matter)
470790	Paper or paperboard; waste and scrap, of paper or paperboard n.e.c. in heading no. 4707 and of unsorted waste and scrap
500300	Silk waste (including cocoons unsuitable for reeling, yarn waste and garnetted stock)
510320	Wool and hair; waste of wool or of fine animal hair, including yarn waste, but excluding garnetted stock and noils of wool or of fine animal hair

(To be continued)

HS Code	Commodity Description
520210	Cotton; yarn waste (including thread waste)
520291	Cotton; garnetted stock waste
520299	Cotton; waste other than garnetted stock and yarn (including thread) waste
530130	Flax; tow and waste, including yarn waste and garnetted stock
550510	Fibres; waste (including noils, yarn waste and garnetted stock), of synthetic fibres
550520	Fibres; waste (including noils, yarn waste and garnetted stock), of artificial fibres
700100	Glass; cullet and other waste and scrap of glass, glass in the mass
711230	Waste and scrap of precious metal or of metal clad with precious metal; ash containing precious metal or precious metal compounds
711291	Waste and scrap of precious metals; of gold, including metal clad with gold but excluding sweepings containing other precious metals
711292	Waste and scrap of precious metals; of platinum, including metal clad with platinum but excluding sweepings containing other precious metals
711299	Waste and scrap of precious metals; waste and scrap of precious metals including metal clad with precious metals, other than that of gold and platinum and excluding ash which contains precious metal or precious metal compounds
720410	Ferrous waste and scrap; of cast iron
720421	Ferrous waste and scrap; of stainless steel
720429	Ferrous waste and scrap; of alloy steel (excluding stainless)
720430	Ferrous waste and scrap; of tinned iron or steel
720441	Ferrous waste and scrap; turnings, shavings, chips, milling waste, sawdust, fillings, trimmings and stampings, whether or not in bundles
720449	Ferrous waste and scrap; n.e.c. in heading no. 7204
740400	Copper; waste and scrap
750300	Nickel; waste and scrap
760200	Aluminium; waste and scrap
780200	Lead; waste and scrap
790200	Zinc; waste and scrap
800200	Tin; waste and scrap
810197	Tungsten (wolfram); waste and scrap
810297	Molybdenum; waste and scrap
810330	Tantalum; waste and scrap
810420	Magnesium; waste and scrap
810530	Cobalt; waste and scrap
810730	Cadmium; waste and scrap
810830	Titanium; waste and scrap
810930	Zirconium; waste and scrap
811020	Antimony; waste and scrap
811213	Beryllium; waste and scrap
811222	Chromium; waste and scrap
811252	Thallium; waste and scrap
854810	Waste and scrap of primary cells, primary batteries and electric accumulators; spent primary cells, spent primary batteries and spent electric accumulators

Table C2: Country list

35 developed countries				
Australia	Austria	Belgium	Canada	Cyprus
Czechia	Denmark	Estonia	Finland	France
Hong Kong SAR, China	Germany	Greece	Iceland	Ireland
Israel	Italy	Japan	Latvia	Lithuania
Luxembourg	Malta	Netherlands	New Zealand	Norway
Portugal	Singapore	Slovakia	Slovenia	South Korea
Spain	Sweden	Switzerland	United Kingdom	United States
87 developing countries				
Albania	Algeria	Argentina	Armenia	Azerbaijan
Bahrain	Bangladesh	Belarus	Benin	Bolivia
Bosnia and Herzegovina	Botswana	Brazil	Bulgaria	Cambodia
Cameroon	Chile	China	Colombia	Congo
Costa Rica	Croatia	Côte dIvoire	Dominican Republic	Ecuador
Egypt	El Salvador	Ethiopia	Gabon	Georgia
Ghana	Guatemala	Haiti	Honduras	Hungary
India	Indonesia	Iran	Jamaica	Jordan
Kazakhstan	Kenya	Kuwait	Kyrgyzstan	Lebanon
Malaysia	Mauritius	Mexico	Moldova	Mongolia
Morocco	Mozambique	Namibia	Nepal	Nicaragua
Nigeria	North Macedonia	Oman	Pakistan	Panama
Paraguay	Peru	Philippines	Poland	Qatar
Romania	Russia	Saudi Arabia	Senegal	South Africa
Sri Lanka	Sudan	Syria	Tanzania	Thailand
Togo	Trinidad and Tobago	Tunisia	Turkey	Ukraine
United Arab Emirates	Uruguay	Venezuela	Vietnam	Yemen
Zambia	Zimbabwe			

Notes: There is no commonly agreed-upon definition of what constitutes a developed and developing country in the literature. IMF's definition is used to identify a country's status, in which an advanced economy is categorized as a developed country while a nation is designated as a developing country if it possesses an emerging or developing economy. IMF takes several different factors into account when determining whether a nation is an advanced economy, an emerging market and developing economy, or a low-income developing economy. The main three criteria are: (1) per capita income level, (2) export diversification – so oil exporters that have high per capita GDP would not make the advanced classification because around 70% of their exports are oil, and (3) degree of integration into the global financial system. For details, please refer to https://www.imf.org/external/pubs/ft/weo/faq.htm.

Table C3: Definition of variables and data source

Variable	Definition	Source
Waste trade	Aggregate waste exports in tonnes between bilateral country pairs	UN Comtrade database
ENGO	Environmental lobbying strength, proxied by the total number of ENGOs	World Directory of Environmental Organizations; Encyclopedia of Associations: International Organizations
Industry	Industry lobbying strength, proxied by the commercial energy use (kg of oil equivalent per capita)	World Bank's World Development Indicators(WDI) database
GDP	Gross domestic product in billion dollars	WDI
Population	Population in millions	WDI
Capital/labour	Capital per worker in dollars	WDI; International Monetary Fund (IMF)
Distance	Bilateral distance between country pairs	Centre d'Études Prospectives et d'Informations Internationales (CEPII)
Common border	Dummy variable indicating whether both countries share a common border	CEPII
Common language	Dummy variable indicating whether both countries share a common language	CEPII
Colonial ties	Dummy variable indicating whether both countries had colonial ties	CEPII
Basel	Dummy variable indicating whether both countries had ratified the Basel Convention	Basel Convention website
WTO	Dummy variable indicating whether both countries had joined the WTO	WTO website
RTA	Dummy variable indicating whether both countries were in regional trade agreements	Prof. Mario Larch's website

Table C4: Descriptive statistics for North-to-South waste trade

	Obs.	Mean	S.D.	Min	Max
North-to-South waste exports	17,525	48,431.264	459,515.061	0.001	23698532.000
ENGO exporter	60,761	33.292	40.213	0.000	196.000
ENGO importer	60,761	8.516	6.289	0.000	29.000
Industry exporter	60,761	4,313.295	2,154.642	1,546.682	18,157.598
Industry importer	60,551	1,743.814	2,793.187	122.727	22,120.430
GDP exporter	60,152	894.863	2,060.840	2.709	15,542.600
GDP importer	60,271	117.990	381.699	0.652	7,551.500
Population exporter	60,761	27.210	52.266	0.261	311.557
Population importer	60,656	55.414	177.876	0.495	1,344.130
Capital/labour exporter	60,761	162,247.940	68,528.565	25,831.807	408,884.688
Capital/labour importer	60,656	51,887.886	66,419.309	0.000	647,583.312
Distance	60,761	7,122.088	3,982.239	111.093	19,747.404
Common border	60,761	0.009	0.093	0.000	1.000
Common language	60,761	0.084	0.278	0.000	1.000
Colonial ties	60,761	0.024	0.152	0.000	1.000
WTO	60,761	0.650	0.477	0.000	1.000
RTA	60,761	0.139	0.346	0.000	1.000
Basel	60,761	0.737	0.440	0.000	1.000

Notes: The table shows summary statistics for all the variables in the sample. For a detailed description of how each variable is defined and sourced, please refer to Table C3.

D Additional gravity specification results

Table D1: Exporter side only waste regression specifications

	Dependent variable: ln (North-to-South waste exports)						
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln (ENGO exporter)	0.240**	0.002	-0.453***	-0.328*	-0.657***	-0.660***	-0.627***
	(0.109)	(0.124)	(0.158)	(0.172)	(0.179)	(0.168)	(0.168)
ln (Industry exporter)		1.198***	1.211***	1.470***	1.433***	1.546***	1.688***
		(0.266)	(0.265)	(0.284)	(0.282)	(0.275)	(0.272)
ln (Population exporter)			0.430***	1.042***	-0.516	-0.745**	-0.642*
			(0.086)	(0.212)	(0.342)	(0.334)	(0.330)
ln (GDP exporter)				-0.627***	1.026***	1.303***	1.228***
				(0.210)	(0.359)	(0.348)	(0.346)
ln (Capital/labour exporter)					-2.347***	-2.319***	-2.372***
					(0.429)	(0.431)	(0.428)
ln (Distance)						-0.329***	-0.389***
						(0.106)	(0.120)
Common border						3.194***	3.194***
						(0.679)	(0.657)
Common language						0.114	0.051
						(0.313)	(0.309)
Colonial ties						0.336	0.313
						(0.447)	(0.432)
WTO							1.146***
							(0.153)
RTA							0.236
							(0.194)
Basel							0.472**
							(0.214)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17525	17525	17525	17512	17512	17512	17512
R^2	0.007	0.017	0.030	0.033	0.044	0.073	0.088

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors clustered at country pairs are in parentheses. The variables *ENGO*, *Industry*, *Population*, *GDP* and *Capital/labour* represent the environmental lobbying strength (proxied by the total number of ENGOs), industry lobbying strength (proxied by the commercial energy use, kg of oil equivalent per capita), population (in millions), gross domestic product (in billion dollars), and capital per worker (in dollars), respectively. The variable *Distance* represents the bilateral distance between country pairs in km, and *Common border*, *Common language* , *Colonial ties*, *WTO*, *RTA* and *Basel* are dummy variables indicating whether both countries share a common border, a common language, had colonial ties, had joined the WTO, were in some regional trade agreements, and had ratified the Basel Convention, respectively.

Table D2: Importer side only waste regression specifications

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable: ln (North-to-South waste exports)						
ln (ENGO importer)	1.215***	1.200***	-0.068	-0.320**	-0.318**	-0.608***	-0.837***
	(0.102)	(0.102)	(0.125)	(0.130)	(0.131)	(0.123)	(0.124)
ln (Industry importer)		-0.139*	0.331***	-0.256*	-0.312**	-0.577***	-0.312**
		(0.079)	(0.082)	(0.139)	(0.143)	(0.141)	(0.136)
ln (Population importer)			0.910***	0.369***	0.531***	0.456***	0.748***
			(0.063)	(0.119)	(0.148)	(0.143)	(0.133)
ln (GDP importer)				0.689***	0.519***	0.730***	0.571***
				(0.130)	(0.157)	(0.153)	(0.144)
ln (Capital/labour importer)					0.252*	0.278**	0.320***
					(0.135)	(0.127)	(0.114)
ln (Distance)						-0.528***	-0.668***
						(0.102)	(0.109)
Common border						2.542***	2.307***
						(0.611)	(0.546)
Common language						0.422*	0.187
						(0.249)	(0.234)
Colonial ties						0.531	0.751**
						(0.378)	(0.356)
WTO							1.457***
							(0.163)
RTA							0.303*
							(0.181)
Basel							-1.617***
							(0.201)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17437	17417	17417	17332	17322	17322	17322
R^2	0.051	0.052	0.142	0.151	0.153	0.188	0.221

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors clustered at country pairs are in parentheses. The variables *ENGO*, *Industry*, *Population*, *GDP* and *Capital/labour* represent the environmental lobbying strength (proxied by the total number of ENGOs), industry lobbying strength (proxied by the commercial energy use, kg of oil equivalent per capita), population (in millions), gross domestic product (in billion dollars), and capital per worker (in dollars), respectively. The variable *Distance* represents the bilateral distance between country pairs in km, and *Common border*, *Common language* , *Colonial ties*, *WTO*, *RTA* and *Basel* are dummy variables indicating whether both countries share a common border, a common language, had colonial ties, had joined the WTO, were in some regional trade agreements, and had ratified the Basel Convention, respectively.

Table D3: Gravity waste regression specifications

Variables	Dependent variable: ln (North-to-South waste exports)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln (ENGO exporter)	0.365***	0.112	-0.270**	-0.150	-0.385**	-0.373***	-0.352***
	(0.106)	(0.120)	(0.136)	(0.146)	(0.155)	(0.137)	(0.133)
ln (ENGO importer)	1.272***	1.273***	0.001	-0.257**	-0.231*	-0.631***	-0.874***
	(0.105)	(0.103)	(0.122)	(0.127)	(0.128)	(0.114)	(0.117)
ln (Industry exporter)		1.248***	1.134***	1.385***	1.375***	1.709***	1.723***
		(0.257)	(0.231)	(0.247)	(0.246)	(0.228)	(0.221)
ln (Industry importer)		-0.117	0.434***	-0.161	-0.231*	-0.589***	-0.297**
		(0.077)	(0.079)	(0.136)	(0.138)	(0.132)	(0.129)
ln (Population exporter)			0.574***	1.163***	0.083	-0.282	-0.211
			(0.075)	(0.198)	(0.306)	(0.289)	(0.283)
ln (Population importer)			0.984***	0.447***	0.634***	0.548***	0.849***
			(0.060)	(0.115)	(0.137)	(0.125)	(0.124)
ln (GDP exporter)				-0.608***	0.538*	1.006***	0.922***
				(0.197)	(0.319)	(0.297)	(0.292)
ln (GDP importer)				0.681***	0.465***	0.795***	0.566***
				(0.127)	(0.146)	(0.135)	(0.132)
ln (Capital/labour exporter)					-1.648***	-1.895***	-1.857***
					(0.381)	(0.370)	(0.365)
ln (Capital/labour importer)					0.313***	0.323***	0.338***
					(0.120)	(0.104)	(0.101)
ln (Distance)						-0.995***	-1.144***
						(0.099)	(0.111)
Common border						2.156***	2.055***
						(0.594)	(0.559)
Common language						0.404*	0.265
						(0.227)	(0.221)
Colonial ties						0.611*	0.685**
						(0.358)	(0.339)
WTO							1.577***
							(0.161)
RTA							0.027
							(0.179)
Basel							-0.234
							(0.166)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17437	17417	17417	17319	17309	17309	17309
R^2	0.058	0.070	0.189	0.202	0.208	0.271	0.289

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors clustered at country pairs are in parentheses. The variables *ENGO*, *Industry*, *Population*, *GDP* and *Capital/labour* represent the environmental lobbying strength (proxied by the total number of ENGOs), industry lobbying strength (proxied by the commercial energy use, kg of oil equivalent per capita), population (in millions), gross domestic product (in billion dollars), and capital per worker (in dollars), respectively. The variable *Distance* represents the bilateral distance between country pairs in km, and *Common border*, *Common language* , *Colonial ties*, *WTO*, *RTA* and *Basel* are dummy variables indicating whether both countries share a common border, a common language, had colonial ties, had joined the WTO, were in some regional trade agreements, and had ratified the Basel Convention, respectively.

E Additional triple-difference estimation results

E.1 Exporter side specification

Table E1: Triple-difference exporter side regression specifications

	Dependent variable: ln (North-to-South waste exports)						
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment	-2.356***	-2.431***	-1.788**	-2.832***	-2.149**	-2.586***	-2.817***
	(0.805)	(0.799)	(0.827)	(0.866)	(0.868)	(0.835)	(0.833)
Post	-1.379***	-1.461***	-1.586***	-1.241***	-1.793***	-1.825***	-1.888***
	(0.364)	(0.359)	(0.363)	(0.374)	(0.391)	(0.383)	(0.377)
ln (ENGO exporter)	-0.013	-0.233	-0.639***	-0.611***	-0.931***	-0.895***	-0.841***
	(0.142)	(0.155)	(0.175)	(0.174)	(0.176)	(0.164)	(0.163)
Treatment* Post	2.802***	2.805***	3.161***	3.395***	3.076***	3.284***	3.280***
	(0.575)	(0.573)	(0.583)	(0.586)	(0.597)	(0.595)	(0.591)
Treatment* ln (ENGO exporter)	0.443**	0.539**	0.420*	0.689***	0.620***	0.698***	0.744***
	(0.215)	(0.213)	(0.219)	(0.229)	(0.230)	(0.224)	(0.223)
Post* ln (ENGO exporter)	0.468***	0.487***	0.515***	0.513***	0.542***	0.540***	0.535***
	(0.090)	(0.090)	(0.090)	(0.091)	(0.094)	(0.093)	(0.091)
Treatment* Post* ln (ENGO exporter)	-0.811***	-0.799***	-0.885***	-0.928***	-0.874***	-0.927***	-0.916***
	(0.152)	(0.153)	(0.155)	(0.155)	(0.158)	(0.158)	(0.156)
ln (Industry exporter)		0.948***	1.053***	1.447***	1.671***	1.715***	1.718***
		(0.285)	(0.285)	(0.303)	(0.299)	(0.289)	(0.284)
ln (Population exporter)			0.413***	1.143***	-0.090	-0.152	0.052
			(0.088)	(0.191)	(0.241)	(0.234)	(0.239)
ln (GDP exporter)				-0.754***	0.598**	0.691***	0.462*
				(0.185)	(0.245)	(0.236)	(0.242)
ln (Capital/labour exporter)					-2.156***	-1.925***	-1.771***
					(0.349)	(0.352)	(0.350)
ln (Distance)						-0.331***	-0.346***
						(0.108)	(0.121)
Common border						3.263***	3.237***
						(0.671)	(0.652)
Common language						0.053	-0.036
						(0.311)	(0.310)
Colonial ties						0.216	0.229
						(0.453)	(0.445)
WTO							0.762***
							(0.129)
RTA							0.219
							(0.192)
Basel							-0.098
							(0.183)
Observations	17525	17525	17525	17512	17512	17512	17512
R^2	0.015	0.020	0.031	0.037	0.046	0.075	0.083

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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. The variables *Industry*, *Population*, *GDP* and *Capital/labour* represent the industry lobbying strength (proxied by the commercial energy use, kg of oil equivalent per capita), population (in millions), gross domestic product (in billion dollars), and capital per worker (in dollars), respectively. The variable *Distance* represents the bilateral distance between country pairs in km, and *Common border*, *Common language* , *Colonial ties*, *WTO*, *RTA* and *Basel* are dummy variables indicating whether both countries share a common border, common language, had colonial ties, had joined the WTO, were in some regional trade agreements, and had ratified the Basel Convention, respectively.

Table E2: Triple-difference exporter side regression specifications with year FE

	Dependent variable: ln (North-to-South waste exports)						
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment	-2.310***	-2.376***	-1.742**	-2.980***	-1.785*	-2.159**	-1.999**
	(0.804)	(0.798)	(0.826)	(0.890)	(0.918)	(0.886)	(0.879)
ln (ENGO exporter)	-0.016	-0.248	-0.650***	-0.610***	-1.000***	-0.974***	-0.931***
	(0.141)	(0.154)	(0.174)	(0.175)	(0.182)	(0.170)	(0.168)
Treatment* Post	2.745***	2.735***	3.092***	3.414***	2.880***	3.065***	3.067***
	(0.572)	(0.571)	(0.580)	(0.586)	(0.601)	(0.598)	(0.593)
Treatment* ln (ENGO exporter)	0.434**	0.532**	0.415*	0.731***	0.549**	0.615***	0.557**
	(0.214)	(0.213)	(0.219)	(0.235)	(0.239)	(0.232)	(0.231)
Post* ln (ENGO exporter)	0.470***	0.491***	0.519***	0.513***	0.552***	0.551***	0.585***
	(0.090)	(0.090)	(0.090)	(0.091)	(0.096)	(0.094)	(0.093)
Treatment* Post* ln (ENGO exporter)	-0.800***	-0.784***	-0.870***	-0.934***	-0.833***	-0.882***	-0.883***
	(0.152)	(0.152)	(0.154)	(0.155)	(0.158)	(0.158)	(0.157)
ln (Industry exporter)		0.994***	1.096***	1.514***	1.699***	1.748***	1.841***
		(0.289)	(0.288)	(0.306)	(0.300)	(0.289)	(0.286)
ln (Population exporter)			0.410***	1.250***	-0.419	-0.534	-0.442
			(0.088)	(0.219)	(0.356)	(0.346)	(0.339)
ln (GDP exporter)				-0.865***	0.945**	1.094***	1.028***
				(0.218)	(0.375)	(0.363)	(0.358)
ln (Capital/labour exporter)					-2.484***	-2.307***	-2.328***
					(0.442)	(0.443)	(0.437)
ln (Distance)						-0.336***	-0.423***
						(0.108)	(0.122)
Common border						3.256***	3.210***
						(0.668)	(0.649)
Common language						0.066	-0.018
						(0.309)	(0.306)
Colonial ties						0.250	0.270
						(0.451)	(0.437)
WTO							1.178***
							(0.153)
RTA							0.151
							(0.192)
Basel							0.425**
							(0.210)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17525	17525	17525	17512	17512	17512	17512
R^2	0.017	0.023	0.034	0.040	0.050	0.079	0.093

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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. The variables *Industry*, *Population*, *GDP* and *Capital/labour* represent the industry lobbying strength (proxied by the commercial energy use, kg of oil equivalent per capita), population (in millions), gross domestic product (in billion dollars), and capital per worker (in dollars), respectively. The variable *Distance* represents the bilateral distance between country pairs in km, and *Common border*, *Common language* , *Colonial ties*, *WTO*, *RTA* and *Basel* are dummy variables indicating whether both countries share a common border, common language, had colonial ties, had joined the WTO, were in some regional trade agreements, and had ratified the Basel Convention, respectively.

Table E3: Triple-difference exporter side regression specifications with exporter FE

Variables	Dependent variable: ln (North-to-South waste exports)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post	-1.538***	-1.587***	-1.320***	-1.316***	-1.315***	-1.219***	-0.973***
	(0.361)	(0.363)	(0.364)	(0.364)	(0.363)	(0.356)	(0.353)
ln (ENGO exporter)	0.516	-0.303	0.432	3.935**	3.927**	5.678***	5.687***
	(0.325)	(0.415)	(0.518)	(1.718)	(1.727)	(1.695)	(1.054)
Treatment* Post	2.701***	2.623***	2.336***	2.323***	2.332***	2.437***	2.834***
	(0.576)	(0.575)	(0.571)	(0.584)	(0.596)	(0.588)	(0.591)
Treatment* ln (ENGO exporter)	-0.220	-0.034	0.245	-0.357*	-0.352	-0.604***	-1.975***
	(0.174)	(0.203)	(0.240)	(0.210)	(0.215)	(0.214)	(0.319)
Post* ln (ENGO exporter)	0.516***	0.529***	0.505***	0.504***	0.504***	0.475***	0.457***
	(0.091)	(0.091)	(0.090)	(0.091)	(0.091)	(0.089)	(0.088)
Treatment* Post* ln (ENGO exporter)	-0.785***	-0.759***	-0.709***	-0.707***	-0.710***	-0.744***	-0.889***
	(0.154)	(0.154)	(0.152)	(0.155)	(0.159)	(0.157)	(0.158)
ln (Industry exporter)		0.506	0.609	0.595	0.613	0.409	-0.399
		(0.434)	(0.437)	(0.457)	(0.463)	(0.459)	(0.480)
ln (Population exporter)			-1.905**	-2.052**	-2.058**	-3.121***	-4.705***
			(0.849)	(1.028)	(1.022)	(1.004)	(1.037)
ln (GDP exporter)				0.028	0.036	0.192	-0.239
				(0.169)	(0.176)	(0.173)	(0.178)
ln (Capital/labour exporter)					-0.058	0.350	-0.258
					(0.488)	(0.479)	(0.495)
ln (Distance)						-0.460***	-0.435***
						(0.109)	(0.119)
Common border						2.846***	2.831***
						(0.697)	(0.657)
Common language						-0.048	-0.088
						(0.300)	(0.296)
Colonial ties						0.597	0.634
						(0.460)	(0.444)
WTO							0.807***
							(0.123)
RTA							0.413**
							(0.178)
Basel							0.659***
							(0.131)
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17525	17525	17525	17512	17512	17512	17512
R^2	0.115	0.115	0.116	0.116	0.116	0.145	0.158

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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. The variables *Industry*, *Population*, *GDP* and *Capital/labour* represent the industry lobbying strength (proxied by the commercial energy use, kg of oil equivalent per capita), population (in millions), gross domestic product (in billion dollars), and capital per worker (in dollars), respectively. The variable *Distance* represents the bilateral distance between country pairs in km, and *Common border*, *Common language* , *Colonial ties*, *WTO*, *RTA* and *Basel* are dummy variables indicating whether both countries share a common border, common language, had colonial ties, had joined the WTO, were in some regional trade agreements, and had ratified the Basel Convention, respectively.

Table E4: Triple-difference exporter side regression specifications with importer FE

	Dependent variable: ln (North-to-South waste exports)						
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment	-2.659***	-2.791***	-1.732***	-2.539***	-2.029***	-1.833***	-2.147***
	(0.648)	(0.626)	(0.631)	(0.642)	(0.653)	(0.566)	(0.562)
Post	-1.169***	-1.276***	-1.479***	-1.213***	-1.629***	-1.449***	-1.318***
	(0.374)	(0.368)	(0.369)	(0.372)	(0.386)	(0.391)	(0.383)
ln (ENGO exporter)	0.368***	0.093	-0.586***	-0.565***	-0.808***	-0.532***	-0.635***
	(0.116)	(0.125)	(0.135)	(0.134)	(0.140)	(0.124)	(0.122)
Treatment* Post	2.252***	2.263***	2.872***	3.071***	2.839***	2.774***	2.504***
	(0.578)	(0.576)	(0.583)	(0.582)	(0.593)	(0.597)	(0.584)
Treatment* ln (ENGO exporter)	0.627***	0.755***	0.567***	0.775***	0.723***	0.626***	0.751***
	(0.169)	(0.167)	(0.167)	(0.170)	(0.173)	(0.147)	(0.148)
Post* ln (ENGO exporter)	0.466***	0.492***	0.541***	0.539***	0.562***	0.536***	0.507***
	(0.091)	(0.090)	(0.090)	(0.089)	(0.093)	(0.094)	(0.092)
Treatment* Post* ln (ENGO exporter)	-0.702***	-0.689***	-0.838***	-0.876***	-0.837***	-0.852***	-0.778***
	(0.151)	(0.151)	(0.152)	(0.152)	(0.154)	(0.155)	(0.152)
ln (Industry exporter)		1.170***	1.362***	1.675***	1.848***	2.176***	2.141***
		(0.236)	(0.224)	(0.238)	(0.240)	(0.214)	(0.212)
ln (Population exporter)			0.717***	1.283***	0.353*	0.239	0.084
			(0.065)	(0.164)	(0.199)	(0.184)	(0.189)
ln (GDP exporter)				-0.587***	0.432**	0.620***	0.724***
				(0.158)	(0.198)	(0.181)	(0.187)
ln (Capital/labour exporter)					-1.636***	-1.611***	-1.698***
					(0.289)	(0.274)	(0.276)
ln (Distance)						-1.804***	-1.803***
						(0.132)	(0.134)
Common border						2.030***	1.970***
						(0.497)	(0.491)
Common language						0.370*	0.353*
						(0.200)	(0.198)
Colonial ties						0.444	0.480*
						(0.283)	(0.281)
WTO							0.300***
							(0.103)
RTA							-0.065
							(0.182)
Basel							-0.859***
							(0.121)
Importer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17525	17525	17525	17512	17512	17512	17512
R^2	0.281	0.289	0.321	0.325	0.331	0.409	0.413

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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. The variables *Industry*, *Population*, *GDP* and *Capital/labour* represent the industry lobbying strength (proxied by the commercial energy use, kg of oil equivalent per capita), population (in millions), gross domestic product (in billion dollars), and capital per worker (in dollars), respectively. The variable *Distance* represents the bilateral distance between country pairs in km, and *Common border*, *Common language* , *Colonial ties*, *WTO*, *RTA* and *Basel* are dummy variables indicating whether both countries share a common border, common language, had colonial ties, had joined the WTO, were in some regional trade agreements, and had ratified the Basel Convention, respectively.

Table E5: Triple-difference exporter side regression specifications with all FE

	Dependent variable: ln (North-to-South waste exports)						
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln (ENGO exporter)	1.449***	-0.599*	-0.756	0.194	0.138	2.034	1.254
	(0.203)	(0.308)	(0.660)	(2.142)	(2.135)	(2.100)	(1.261)
Treatment* Post	2.356***	2.033***	2.081***	2.302***	2.275***	2.246***	2.097***
	(0.565)	(0.556)	(0.560)	(0.572)	(0.582)	(0.579)	(0.575)
Treatment* ln (ENGO exporter)	-0.126	0.389***	0.333*	0.573***	0.565***	0.241	-0.554***
	(0.098)	(0.132)	(0.171)	(0.171)	(0.172)	(0.167)	(0.149)
Post* ln (ENGO exporter)	0.519***	0.570***	0.577***	0.571***	0.570***	0.500***	0.469***
	(0.085)	(0.086)	(0.086)	(0.086)	(0.086)	(0.086)	(0.086)
Treatment* Post* ln (ENGO exporter)	-0.743***	-0.640***	-0.647***	-0.702***	-0.692***	-0.719***	-0.670***
	(0.150)	(0.148)	(0.148)	(0.151)	(0.155)	(0.155)	(0.154)
ln (Industry exporter)		1.933***	1.971***	2.157***	2.101***	1.960***	1.983***
		(0.497)	(0.504)	(0.514)	(0.515)	(0.510)	(0.508)
ln (Population exporter)			0.412	0.485	0.548	-0.425	-0.424
			(1.165)	(1.199)	(1.189)	(1.169)	(1.163)
ln (GDP exporter)				-0.366	-0.397	-0.285	-0.328
				(0.280)	(0.282)	(0.276)	(0.273)
ln (Capital/labour exporter)					0.198	0.650	0.672
					(0.519)	(0.511)	(0.508)
ln (Distance)						-1.953***	-1.933***
						(0.117)	(0.124)
Common border						1.533***	1.530***
						(0.534)	(0.532)
Common language						0.156	0.158
						(0.195)	(0.194)
Colonial ties						0.956***	0.959***
						(0.286)	(0.287)
WTO							0.340**
							(0.141)
RTA							0.124
							(0.162)
Basel							-0.444***
							(0.115)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17525	17525	17525	17512	17512	17512	17512
R^2	0.403	0.404	0.404	0.405	0.405	0.482	0.483

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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. The variables *Industry*, *Population*, *GDP* and *Capital/labour* represent the industry lobbying strength (proxied by the commercial energy use, kg of oil equivalent per capita), population (in millions), gross domestic product (in billion dollars), and capital per worker (in dollars), respectively. The variable *Distance* represents the bilateral distance between country pairs in km, and *Common border*, *Common language* , *Colonial ties*, *WTO*, *RTA* and *Basel* are dummy variables indicating whether both countries share a common border, common language, had colonial ties, had joined the WTO, were in some regional trade agreements, and had ratified the Basel Convention, respectively.

E.2 Gravity specification

Table E6: Triple-difference gravity regression specifications

	Dependent variable: ln (North-to-South waste exports)							
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	-2.356***	-2.867***	-2.869***	-1.659**	-2.900***	-2.324***	-2.822***	-3.341***
	(0.805)	(0.786)	(0.774)	(0.733)	(0.747)	(0.760)	(0.687)	(0.669)
Post	-1.379***	-1.450***	-1.517***	-1.799***	-1.915***	-2.198***	-2.333***	-2.280***
	(0.364)	(0.374)	(0.368)	(0.375)	(0.392)	(0.400)	(0.395)	(0.383)
ln (ENGO exporter)	-0.013	0.079	-0.146	-0.528***	-0.517***	-0.775***	-0.676***	-0.739***
	(0.142)	(0.139)	(0.151)	(0.158)	(0.157)	(0.161)	(0.138)	(0.132)
Treatment* Post	2.802***	2.988***	2.973***	3.349***	3.654***	3.389***	3.553***	3.323***
	(0.575)	(0.586)	(0.584)	(0.591)	(0.598)	(0.608)	(0.615)	(0.598)
Treatment* ln (ENGO exporter)	0.443**	0.573***	0.655***	0.476**	0.807***	0.741***	0.816***	0.978***
	(0.215)	(0.207)	(0.205)	(0.193)	(0.196)	(0.199)	(0.182)	(0.179)
Post* ln (ENGO exporter)	0.468***	0.433***	0.453***	0.532***	0.543***	0.575***	0.570***	0.558***
	(0.090)	(0.092)	(0.091)	(0.091)	(0.092)	(0.094)	(0.094)	(0.091)
Treatment* Post* ln (ENGO exporter)	-0.811***	-0.859***	-0.842***	-0.927***	-0.997***	-0.952***	-1.009***	-0.936***
	(0.152)	(0.155)	(0.155)	(0.155)	(0.157)	(0.159)	(0.162)	(0.157)
ln (ENGO importer)		1.189***	1.183***	-0.065	-0.297**	-0.293**	-0.676***	-0.866***
		(0.100)	(0.099)	(0.113)	(0.120)	(0.120)	(0.108)	(0.114)
ln (Industry exporter)			0.972***	1.194***	1.650***	1.823***	2.024***	2.032***
			(0.280)	(0.253)	(0.275)	(0.274)	(0.249)	(0.241)
ln (Industry importer)			-0.119	0.442***	-0.178	-0.243*	-0.589***	-0.402***
			(0.076)	(0.079)	(0.133)	(0.137)	(0.131)	(0.128)
ln (Population exporter)				0.585***	1.394***	0.406*	0.324	0.383*
				(0.077)	(0.185)	(0.236)	(0.219)	(0.218)
ln (Population importer)				1.003***	0.433***	0.690***	0.622***	0.846***
				(0.059)	(0.111)	(0.131)	(0.121)	(0.119)
ln (GDP exporter)					-0.840***	0.243	0.393*	0.282
					(0.178)	(0.237)	(0.219)	(0.216)
ln (GDP importer)					0.710***	0.429***	0.728***	0.583***
					(0.121)	(0.139)	(0.129)	(0.126)
ln (Capital/labour exporter)						-1.672***	-1.548***	-1.502***
						(0.331)	(0.313)	(0.308)
ln (Capital/labour importer)						0.370***	0.393***	0.439***
						(0.121)	(0.105)	(0.102)
ln (Distance)							-0.981***	-1.119***
							(0.101)	(0.112)
Common border							2.295***	2.153***
							(0.590)	(0.561)
Common language							0.396*	0.247
							(0.229)	(0.221)
Colonial ties							0.408	0.466
							(0.363)	(0.346)
WTO								1.255***
								(0.133)
RTA								-0.072
								(0.175)
Basel								-0.813***
								(0.154)
Observations	17525	17437	17417	17417	17319	17309	17309	17309
R^2	0.015	0.062	0.068	0.190	0.206	0.213	0.274	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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. The variables *Industry*, *Population*, *GDP* and *Capital/labour* represent the industry lobbying strength (proxied by the commercial energy use, kg of oil equivalent per capita), population (in millions), gross domestic product (in billion dollars), and capital per worker (in dollars), respectively. The variable *Distance* represents the bilateral distance between country pairs in km, and *Common border*, *Common language* , *Colonial ties*, *WTO*, *RTA* and *Basel* are dummy variables indicating whether both countries share a common border, common language, had colonial ties, had joined the WTO, were in some regional trade agreements, and had ratified the Basel Convention, respectively.

Table E7: Triple-difference gravity regression specifications with year FE

	Dependent variable: ln (North-to-South waste exports)							
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	-2.310***	-2.789***	-2.811***	-1.635**	-2.857***	-1.907**	-2.278***	-2.576***
	(0.804)	(0.779)	(0.767)	(0.730)	(0.759)	(0.794)	(0.720)	(0.705)
ln (ENGO exporter)	-0.016	0.074	-0.179	-0.545***	-0.527***	-0.859***	-0.782***	-0.829***
	(0.141)	(0.137)	(0.148)	(0.157)	(0.157)	(0.165)	(0.144)	(0.137)
Treatment* Post	2.745***	2.871***	2.850***	3.282***	3.608***	3.181***	3.305***	3.104***
	(0.572)	(0.582)	(0.580)	(0.588)	(0.595)	(0.609)	(0.618)	(0.602)
Treatment* ln (ENGO exporter)	0.434**	0.559***	0.655***	0.475**	0.800***	0.660***	0.708***	0.804***
	(0.214)	(0.205)	(0.203)	(0.192)	(0.199)	(0.205)	(0.187)	(0.185)
Post* ln (ENGO exporter)	0.470***	0.443***	0.466***	0.537***	0.547***	0.585***	0.582***	0.594***
	(0.090)	(0.092)	(0.091)	(0.091)	(0.092)	(0.096)	(0.096)	(0.093)
Treatment* Post* ln (ENGO exporter)	-0.800***	-0.836***	-0.816***	-0.912***	-0.988***	-0.909***	-0.958***	-0.898***
	(0.152)	(0.154)	(0.154)	(0.154)	(0.156)	(0.159)	(0.162)	(0.157)
ln (ENGO importer)		1.284***	1.288***	0.009	-0.246*	-0.233*	-0.628***	-0.849***
		(0.104)	(0.104)	(0.121)	(0.126)	(0.126)	(0.112)	(0.115)
ln (Industry exporter)			1.085***	1.247***	1.668***	1.838***	2.038***	2.103***
			(0.283)	(0.256)	(0.277)	(0.275)	(0.250)	(0.242)
ln (Industry importer)			-0.095	0.443***	-0.166	-0.244*	-0.601***	-0.336***
			(0.076)	(0.079)	(0.136)	(0.137)	(0.131)	(0.129)
ln (Population exporter)				0.582***	1.373***	-0.000	-0.204	-0.136
				(0.077)	(0.208)	(0.324)	(0.302)	(0.295)
ln (Population importer)				0.985***	0.431***	0.627***	0.537***	0.816***
				(0.060)	(0.115)	(0.139)	(0.126)	(0.124)
ln (GDP exporter)					-0.819***	0.672**	0.954***	0.864***
					(0.205)	(0.337)	(0.313)	(0.307)
ln (GDP importer)					0.697***	0.481***	0.809***	0.607***
					(0.127)	(0.147)	(0.135)	(0.132)
ln (Capital/labour exporter)						-2.072***	-2.084***	-2.067***
						(0.403)	(0.384)	(0.377)
ln (Capital/labour importer)						0.322***	0.332***	0.357***
						(0.123)	(0.106)	(0.102)
ln (Distance)							-0.989***	-1.176***
							(0.100)	(0.113)
Common border							2.252***	2.110***
							(0.586)	(0.554)
Common language							0.422*	0.272
							(0.228)	(0.220)
Colonial ties							0.441	0.497
							(0.361)	(0.340)
WTO								1.599***
								(0.161)
RTA								-0.116
								(0.176)
Basel								-0.429**
								(0.173)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17525	17437	17417	17417	17319	17309	17309	17309
R^2	0.017	0.070	0.077	0.193	0.208	0.216	0.277	0.296

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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. The variables *Industry*, *Population*, *GDP* and *Capital/labour* represent the industry lobbying strength (proxied by the commercial energy use, kg of oil equivalent per capita), population (in millions), gross domestic product (in billion dollars), and capital per worker (in dollars), respectively. The variable *Distance* represents the bilateral distance between country pairs in km, and *Common border*, *Common language* , *Colonial ties*, *WTO*, *RTA* and *Basel* are dummy variables indicating whether both countries share a common border, common language, had colonial ties, had joined the WTO, were in some regional trade agreements, and had ratified the Basel Convention, respectively.

Table E8: Triple-difference gravity regression specifications with country FE

Variables	Dependent variable: ln (North-to-South waste exports)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post	-1.277***	-1.188***	-1.547***	-1.561***	-1.597***	-1.645***	-1.321***	-1.271***
	(0.344)	(0.347)	(0.339)	(0.344)	(0.347)	(0.345)	(0.341)	(0.340)
ln (ENGO exporter)	1.442***	1.455***	-0.399	-0.505	3.046	2.251	4.066**	1.859*
	(0.202)	(0.203)	(0.289)	(0.523)	(2.487)	(1.932)	(1.878)	(1.101)
Treatment* Post	2.358***	2.339***	2.167***	2.181***	2.299***	2.333***	2.319***	2.156***
	(0.566)	(0.570)	(0.553)	(0.553)	(0.567)	(0.579)	(0.577)	(0.573)
Treatment* ln (ENGO exporter)	-0.124	-0.119	0.321**	0.293	0.189	0.011	-0.381**	-0.512
	(0.098)	(0.098)	(0.127)	(0.191)	(0.209)	(0.173)	(0.154)	(0.321)
Post* ln (ENGO exporter)	0.521***	0.500***	0.551***	0.554***	0.547***	0.560***	0.493***	0.465***
	(0.085)	(0.086)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)
Treatment* Post* ln (ENGO exporter)	-0.744***	-0.741***	-0.677***	-0.678***	-0.712***	-0.726***	-0.755***	-0.700***
	(0.150)	(0.151)	(0.147)	(0.146)	(0.149)	(0.154)	(0.153)	(0.153)
ln (ENGO importer)		-0.030	-0.288***	-0.291**	-0.264**	-0.250**	-0.260**	-0.148
		(0.106)	(0.111)	(0.119)	(0.124)	(0.125)	(0.127)	(0.134)
ln (Industry exporter)			1.427***	1.455***	1.602***	1.520***	1.452***	1.596***
			(0.431)	(0.436)	(0.446)	(0.445)	(0.439)	(0.446)
ln (Industry importer)			1.431***	1.410***	1.255***	0.827***	0.941***	0.920***
			(0.251)	(0.257)	(0.282)	(0.291)	(0.290)	(0.287)
ln (Population exporter)				0.232	0.077	-0.469	-1.371	-1.191
				(1.040)	(1.138)	(1.104)	(1.076)	(1.068)
ln (Population importer)				-0.099	-0.320	0.367	0.466	0.511
				(0.337)	(0.367)	(0.386)	(0.384)	(0.387)
ln (GDP exporter)					-0.264	-0.203	-0.082	-0.103
					(0.197)	(0.195)	(0.191)	(0.192)
ln (GDP importer)					0.283**	0.115	0.110	0.146
					(0.129)	(0.130)	(0.130)	(0.130)
ln (Capital/labour exporter)						-0.133	0.312	0.407
						(0.481)	(0.470)	(0.465)
ln (Capital/labour importer)						0.919***	1.073***	1.070***
						(0.206)	(0.207)	(0.208)
ln (Distance)							-1.989***	-1.974***
							(0.118)	(0.125)
Common border							1.519***	1.516***
							(0.537)	(0.535)
Common language							0.154	0.155
							(0.194)	(0.193)
Colonial ties							0.987***	0.988***
							(0.284)	(0.284)
WTO								0.104
								(0.103)
RTA								0.090
								(0.164)
Basel								-0.478***
								(0.108)
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17525	17437	17417	17417	17319	17309	17309	17309
R^2	0.402	0.402	0.406	0.406	0.407	0.409	0.488	0.489

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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. The variables *Industry*, *Population*, *GDP* and *Capital/labour* represent the industry lobbying strength (proxied by the commercial energy use, kg of oil equivalent per capita), population (in millions), gross domestic product (in billion dollars), and capital per worker (in dollars), respectively. The variable *Distance* represents the bilateral distance between country pairs in km, and *Common border*, *Common language* , *Colonial ties*, *WTO*, *RTA* and *Basel* are dummy variables indicating whether both countries share a common border, common language, had colonial ties, had joined the WTO, were in some regional trade agreements, and had ratified the Basel Convention, respectively.

Table E9: Triple-difference gravity regression specifications with all FE

	Dependent variable: ln (North-to-South waste exports)							
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln (ENGO exporter)	1.449***	1.464***	-0.574*	-0.734	0.319	0.779	2.686	1.679
	(0.203)	(0.204)	(0.307)	(0.660)	(2.164)	(2.101)	(2.060)	(1.240)
Treatment* Post	2.356***	2.347***	2.057***	2.100***	2.321***	2.370***	2.373***	2.214***
	(0.565)	(0.568)	(0.550)	(0.555)	(0.571)	(0.580)	(0.579)	(0.576)
Treatment* ln (ENGO exporter)	-0.126	-0.121	0.385***	0.325*	0.568***	0.524***	0.194	-0.425
	(0.098)	(0.098)	(0.132)	(0.172)	(0.170)	(0.168)	(0.163)	(0.351)
Post* ln (ENGO exporter)	0.519***	0.501***	0.561***	0.567***	0.559***	0.577***	0.506***	0.472***
	(0.085)	(0.086)	(0.085)	(0.085)	(0.085)	(0.085)	(0.085)	(0.085)
Treatment* Post* ln (ENGO exporter)	-0.743***	-0.742***	-0.645***	-0.651***	-0.708***	-0.719***	-0.754***	-0.704***
	(0.150)	(0.151)	(0.146)	(0.146)	(0.150)	(0.154)	(0.154)	(0.154)
ln (ENGO importer)		-0.194	-0.182	-0.187	-0.146	-0.077	-0.117	-0.075
		(0.145)	(0.146)	(0.150)	(0.151)	(0.152)	(0.154)	(0.154)
ln (Industry exporter)			1.877***	1.914***	2.119***	2.022***	1.875***	1.894***
			(0.488)	(0.495)	(0.506)	(0.502)	(0.493)	(0.493)
ln (Industry importer)			1.396***	1.378***	1.279***	0.849***	0.950***	0.909***
			(0.269)	(0.282)	(0.289)	(0.293)	(0.291)	(0.289)
ln (Population exporter)				0.433	0.479	0.240	-0.723	-0.809
				(1.167)	(1.215)	(1.171)	(1.149)	(1.143)
ln (Population importer)				-0.067	-0.219	0.610	0.683	0.634
				(0.387)	(0.395)	(0.423)	(0.422)	(0.421)
ln (GDP exporter)					-0.400	-0.398	-0.291	-0.314
					(0.279)	(0.277)	(0.270)	(0.268)
ln (GDP importer)					0.193	0.027	0.012	0.036
					(0.155)	(0.152)	(0.152)	(0.151)
ln (Capital/labour exporter)						0.088	0.529	0.578
						(0.499)	(0.488)	(0.484)
ln (Capital/labour importer)						0.997***	1.151***	1.124***
						(0.211)	(0.212)	(0.212)
ln (Distance)							-1.989***	-1.972***
							(0.118)	(0.125)
Common border							1.511***	1.510***
							(0.537)	(0.535)
Common language							0.153	0.155
							(0.194)	(0.193)
Colonial ties							0.987***	0.988***
							(0.284)	(0.284)
WTO								0.111
								(0.135)
RTA								0.096
								(0.164)
Basel								-0.455***
								(0.118)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17525	17437	17417	17417	17319	17309	17309	17309
R^2	0.403	0.404	0.407	0.407	0.409	0.410	0.489	0.490

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 the year is equal to or greater than 2006. ENGO uses the number of ENGOs in 2005. The variables *Industry*, *Population*, *GDP* and *Capital/labour* represent the industry lobbying strength (proxied by the commercial energy use, kg of oil equivalent per capita), population (in millions), gross domestic product (in billion dollars), and capital per worker (in dollars), respectively. The variable *Distance* represents the bilateral distance between country pairs in km, and *Common border*, *Common language* , *Colonial ties*, *WTO*, *RTA* and *Basel* are dummy variables indicating whether both countries share a common border, common language, had colonial ties, had joined the WTO, were in some regional trade agreements, and had ratified the Basel Convention, respectively.

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