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Trade for the Environment: Transboundary Hazardous Waste Movements After the Basel Convention

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Abstract

International institutions are important regulators of the trade–environment relationship. Many of them deploy trade measures for environmental purposes, with mixed results. The Basel Convention is one case where trade restrictions have not succeeded in curbing movements of hazardous waste or protecting vulnerable countries from waste dumping. Current literature emphasizes North–South conflict under the Basel Convention as a main reason for these shortcomings. This paper returns to the fundamental question as to why countries engage in this trade. It contends that hazardous wastes are not only characterized by their environmental impacts, but are also distinct in the ways they are generated, distributed, and managed. I argue that global economic integration has commodified these wastes, and countries are increasingly diverging on their views of hazardous materials. This paper draws from the under-utilized Basel Convention Database and other sources to piece together a holistic picture of the global hazardous waste movements. It identifies three types of countries with distinct trade orientations: industrialized countries trading the largest amounts of hazardous wastes and with considerable specialization; newly industrializing countries as influential players in hazardous waste generation and management; and least developed countries, which oppose waste trade yet suffer from waste dumping. As globalization deepens, management of hazardous wastes may require extensive trade of hazardous materials between countries of varying capabilities and interests. Contrary to its current trade minimization approach based on a crude North–South dichotomy, the Basel Convention may benefit from an approach that motivates capable countries to import wastes and one that builds capacity for intended waste importers.

KEY WORDS: Basel Convention, hazardous waste, developing countries, trade and environment, globalization

国际机构是贸易与环境关系的重要监管者。许多机构出于环境目的采用贸易措施，取得的结果喜忧参半。《巴塞尔公约》一例中，贸易限制还未成功控制危险废物转移，或保护脆弱国家免受废物倾倒的危害。现有文献强调《巴塞尔公约》下的北-南冲突是造成这些缺点的一个主要原因。本文回到最基本的问题，即为何各国会参与这次贸易。本文认为，危险废物的特征不仅是环境影响，它的生产、分配和管理方式也很独特。我论证认为，全球经济一体化已将这些废物商品化，并且各国正越来越多地就其对危险材料的看法产生分歧。基于现行的巴塞尔公约数据库及其他来源，本文综合描述了全球危险废物转移。本文识别了三种具备独特贸易导向的国家：已完成工业化的国家，它们进行最大量的危险废物交易且废物伴随大量特殊化；正在进行工业化的新兴国家，它们是危险废物生产与管理中具有影响力的参与者；最不发达国家，它们反对废物贸易然却遭受废物倾倒的影响。随着全球化继续深化，危险废物管理可能要求具备不同能力和兴趣的国家之间进行广泛的危害材料交易。与当前基于一个粗略的北-南二分法的贸易最小化方法相反的是，《巴塞尔公约》可能获益于一个激励有能力的国家进口废物的方法，且该方法为预期的废物进口国创造能力

关键词: 环境, 发展中国家, 国际治理, 污染

Las instituciones internacionales son importantes reguladores de la relación comercio medio ambiente. Muchos de ellos implementan medidas comerciales con fines ambientales, con resultados mixtos. El Convenio de Basilea es un caso en el que las restricciones comerciales no han logrado frenar los movimientos de desechos peligrosos ni proteger a los países vulnerables del vertido de desechos. La literatura actual enfatiza el conflicto Norte Sur bajo el Convenio de Basilea como la razón principal de estas deficiencias. Este documento vuelve a la pregunta fundamental de por qué los países participan en este comercio. Sostiene que los

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desechos peligrosos no solo se caracterizan por sus impactos ambientales, sino que también son distintos en la forma en que se generan, distribuyen y gestionan. Sostengo que la integración económica global ha mercantilizado estos desechos, y los países están divergiendo cada vez más en sus puntos de vista sobre los materiales peligrosos. Este documento se basa en la Base de Datos del Convenio de Basilea infrautilizada y otras fuentes para armar una imagen holística de los movimientos globales de residuos peligrosos. Identifica tres tipos de países con distintas orientaciones comerciales: países industrializados que comercializan las mayores cantidades de desechos peligrosos y con una especialización considerable; nuevos países industrializados como actores influyentes en la generación y gestión de residuos peligrosos; y los países menos adelantados, que se oponen al comercio de residuos y sufren el vertido de residuos. A medida que se profundiza la globalización, el manejo de los desechos peligrosos puede requerir un amplio comercio de materiales peligrosos entre países de capacidades e intereses variables. Contrariamente a su enfoque actual de minimización del comercio basado en una cruda dicotomía Norte Sur, el Convenio de Basilea puede beneficiarse de un enfoque que motive a los países capaces de importar desechos y que desarrolle capacidad para los importadores de desechos previstos.

PALABRAS CLAVE: medio ambiente, países en desarrollo, gobernanza internacional, contaminación

ABBREVIATIONS: EEA, European environment agency; EU, European Union; GDP, gross domestic product; LDC, least developed countries; MEA, multilateral environmental agreements; NIC, newly industrializing countries; OECD, organization of economic cooperation and development; UNEP, United Nations environmental programme; UNIDO, United Nations industrial development organization; WEEE, waste of electronic and electric equipment; WTO, world trade organization.

Introduction

The relationship between trade and the environment continues to be hotly debated. National governments, transnational businesses, and international institutions hold divergent views on this topic, and this influences their respective practices concerning trade and environmental regulation. Even more controversial than the trade of normal goods is the trade of wastes, considered by many as blatant exploitation of waste-importing developing countries. In July 2017, an “import ban” from China again brought the issue of waste trade to the forefront. The largest importer of recyclable wastes, in its recent campaign against “foreign garbage (洋垃圾),” China forbade the import of 24 kinds of solid waste and tightened regulations on the levels of impurities permissible in other recyclables (WTO, 2017a, 2017b). This has panicked major industrialized countries, including the United States, Canada, Australia, and the Western European countries, which have been exporting billions of tons of scrap commodities and other recyclables to China and now see these wastes piling up in their own warehouses (Freytas-Tamura, 2018; Profita & Burns, 2017). China’s foreign waste ban has forced foreign garbage dealers to find alternative destinations for their wastes, which has triggered a ripple effect in other Asian countries. In 2018, Thailand banned imports of 432 types of e-wastes and plastic waste (Thepgumpanat, 2018). In March 2019, India amended its hazardous waste rules to prohibit the import of solid plastic waste (Cockburn, 2019). Malaysia, the Philippines, and Vietnam also took measures to restrict waste imports and clamped down on waste trafficking (CBS News, 2019). The expanding trade disputes between emerging economies and Western countries has revived fundamental questions regarding waste trade: Why are countries of different developmental levels increasingly participating in waste trade? What is the role of trade in global waste management? And, what can international institutions do to protect public and environmental health from the adverse effects of waste trade?

This paper aims to answer these questions by analyzing the trade of hazardous wastes, the wastes that pose great risk to human and environmental health, and those international institutions that govern this trade. Volume wise, hazardous wastes account for a moderate part of all types of wastes traded. Indeed, a large part of household wastes, solid wastes, e-wastes, or plastic wastes is not hazardous, although it can contain or mix with hazardous materials. Hazardous wastes are wastes with properties that make them dangerous or capable of having harmful effects on human health or the environment (USEPA, 2019). Hazardous wastes are generated as byproducts of industrial production and post-consumption disposal, and they can impose significant damage on public and environmental health if handled improperly. While some hazardous materials can be recycled, management of hazardous wastes tends to be technology and capital intensive. Several alarming incidents occurred in the 1980s, whereby companies from industrialized countries dumped large amounts of hazardous wastes on the lands of less developed countries and caused significant casualties. Public outcry within developing countries, with the help of environmental nongovernmental organizations, brought this issue to the international stage and led to the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. The Convention fully recognizes:

... that any State has the sovereign right to ban the entry or disposal of foreign hazardous wastes and other wastes in its territory, recognizing also the increasing desire for the prohibition of transboundary movements of hazardous wastes and their disposal in other States, especially developing countries ... considering that enhanced control of transboundary movement of hazardous wastes and other wastes will act as an incentive for their environmentally sound management and for the reduction of the volume of such transboundary movement. (UNEP, 2011b)

The Basel Convention is the main international treaty that regulates transboundary movements of hazardous wastes and other wastes requiring special consideration.¹ With the entry into force of the Ban Amendment and recent decisions that control transboundary movements of contaminated plastic wastes and require prior informed consent (PIC) for other plastic wastes,² the Basel Convention has become ever more relevant as the major international institution that oversees global waste management. Affected by the dumping incidents, however, many developing countries view hazardous waste trade as pollution transfer, and reducing such trade could incentivize the waste-generating industrialized countries to manage hazardous wastes properly among themselves. The Convention decided on a trade minimization approach and has sought to ban hazardous waste movements from member countries of the Organization for Economic Cooperation and Development (OECD) and European Union (EU) to non-members. This paper questions the rationale of this trade minimization approach, arguing that a regulated trade of hazardous wastes has potential to facilitate the environmentally sound management of hazardous wastes. Globalization has changed the ways in which hazardous wastes are generated and distributed, creating conditions for their proper management through controlled movements of hazardous materials. These new developments make the Basel Convention's approach to trade restrictions based on a simplified North–South bifurcation outdated.

This study draws from the under-utilized Basel Convention Database and other sources to piece together a holistic picture of global hazardous waste movements. It

re-categorizes countries into industrialized, newly industrializing, and less developed ones based on their factor endowments and levels of trade openness. Among these three country groups, industrialized countries have become highly specialized in treating a variety of hazardous wastes and in large amounts. The hazardous waste management business prospers in these countries and has expanded its network beyond the global North. Newly industrializing countries (NICs), characterized by high economic growth and intermediate trade openness, have become important actors in recycling metallic hazardous materials to supply their manufacturing industries. Although some of this waste treatment is considered to be “dirty recycling,” these countries capture some value from hazardous waste management and may be climbing up the technology ladder into more sophisticated segments along the chain. Least developed countries (LDCs), which are in general less open to trade and specifically to hazardous waste trade, are most vulnerable to toxic dumping due to limited institutional oversight and low technological capacity. The three groups of importers represent three markets for hazardous wastes and to a certain extent, three approaches to the hazardous waste problem. An analysis of these countries’ participation in hazardous waste trade, then, makes it possible to compare the different potential trajectories of global hazardous waste management.

With an examination of which hazardous materials are traded and by what countries, this study sheds light on several interrelated questions that have yet to be fully answered. For example, if hazardous wastes are pollution, why do some industrialized countries import them in ever-larger amounts, sometimes from developing countries? Why have some newly industrializing countries yet to ratify the Basel Ban Amendment, despite domestic societal pressure? Moreover, why are some developing countries, who portend opposition to hazardous waste trade, importing hazardous wastes and thereby violating the treaties they signed onto? By answering these questions, this paper offers an updated look at the Basel Convention’s efficacy amid changing trade patterns.

How effective is it in curbing transboundary movements of hazardous wastes, and in enhancing proper waste management practices? How can its institutions be improved to better protect humans and the environment from ever-growing amounts of hazardous wastes? The findings of the paper suggest that the Basel Convention is essential in creating the three markets we see today, but to better protect developing countries from the danger of hazardous wastes, the Convention needs to re-evaluate its advocacy of trade-restricting measures and the binary categorization of countries based on OECD and EU memberships. The governance of hazardous wastes warrants a more nuanced categorization of countries, greater incentives for capable handlers to treat hazardous wastes, and capacity building for vulnerable countries to regulate hazardous wastes in general.

The Commodification of Hazardous Wastes

This article challenges the widely held view that hazardous wastes are pollution and their trade should be minimized to foster proper waste management in the countries of origin. I argue that hazardous wastes are endogenous to industrial production and therefore possess certain characteristics of industrial goods that are currently traded

globally. Hazardous wastes are distinct both in their impact on the environmental and public health and in the ways they are generated, distributed, and managed. This article contextualizes hazardous materials according to the industries where they are generated and disposed to better understand the reasons a number of countries are trading hazardous wastes and the implications of this emerging phenomenon.

Hazardous wastes are defined as wastes that are explosive, flammable, toxic, corrosive, and infective. These wastes comprise a vastly heterogeneous group of materials that source from 48 different waste streams.³ With respect to their generation, these wastes can be nonhazardous materials contaminated by hazardous ones, or process wastes from industrial manufacturing and post-consumption wastes. Waste electrical and electronic equipment, also called e-wastes, are post-consumption wastes and one of the biggest sources of hazardous wastes. E-wastes are not all hazardous, but a majority of them contains hazardous metals (e.g., used lead batteries). Some e-wastes may not meet the “intrinsic hazard” criterion but can release toxic substances when improperly recycled (e.g., circuit boards). Although hazardous wastes are known for their adverse ecological effects, some, such as metal-containing wastes, are of high economic value if recycled, and others can be recycled to generate energy and heat. Because hazardous wastes are endogenous to industrial production, their generation, flow, and management are likely to follow the same pattern as those of industrial goods.

Since the 1960s, the industrial economies have been shaped by rapid economic integration. Technological advances have lowered transportation and communication costs, thus enabling countries to participate more vigorously in world trade and to capitalize on their comparative advantages. Under the auspices of economic globalization, two trends have emerged with important implications for hazardous wastes. First, globalization has facilitated the relocation of industrial production and consumption, and as a result, of hazardous waste generation. Many industrial facilities in developed countries have been relocating to developing countries, particularly those endowed with labor and infrastructure. The de-industrialization of developed countries has accelerated the industrialization of emerging economies, at the same time transforming them into waste generators. Lowering transport costs have facilitated trade in industrial goods, many of which become hazardous wastes post-use. This includes paints, special-use glasses, and virtually all electronic products. The upshot is that developing countries generate hazardous wastes not only from relocated industrial production, but also from the consumption of goods produced elsewhere in the world.

Second, economic globalization has bolstered specialization. It usually means that a country focuses on manufacturing certain goods or parts of those goods (with imported inputs) as a way to increase efficiency gains. An important aspect of industrial relocation is the transfer of segments of the same industry across countries with different comparative advantages. This leads to intra-industry trade in intermediate goods. Countries specialize through intra-industry and inter-industry trade according to their technology, capital, and labor endowments. This means that the management of hazardous wastes, like their generation, is unlikely to exclude trans-border movement.

When we view hazardous wastes as derivatives of industrial goods, the participation of a given country in hazardous waste management can be explained within a comparative advantage framework. That is, countries import hazardous wastes to capture value from corresponding industrial processes, that is, renewing, recycling, or

disposal. Technology, economies of scale, and the convenience of accessing input and output markets all influence profit margins of these treatments. That means the pollution haven effect (rising income vs. waste import) can be outweighed by the factor endowments of high-income countries, because rising GDP increases disposal capacity more than waste production (Baggs, 2009). Because hazardous wastes encompass a diversity of materials and industries, a country might have comparative advantages in certain materials and treatments, which are not directly associated with its overall trading position on hazardous wastes.

Based on this understanding, countries at different levels of industrialization may engage in the trade of various hazardous materials. Industrialized countries with high treatment capacity are likely to trade in large volumes and specialize in technology-intensive treatments. In these countries, waste management thrives as an environmental service dominated by multinational corporations. NICs, less endowed in capital but abundant in labor, may engage in less technology-intensive recycling treatments and those that directly fuel domestic industrial production. The LDCs neither supply nor demand hazardous wastes. They are more resistant to waste trade yet also vulnerable to illegal dumping. This paper, by sketching the three decades of evolution after the Basel Convention was established, offers new knowledge as well as a fresh perspective on hazardous waste management and how international institutions can facilitate it.

Literature Review

This paper engages with key debates concerning the trade–environment relationship and the use of trade measures in multilateral environmental agreements (MEAs). For instance, is the trade in environmentally sensitive goods invariably bad? What is the relationship between the transboundary movements of these goods and their proper management? In an ever-globalizing world economy, is it possible for MEAs to take trade measures to protect humans and the environment from risks posed by hazardous materials? Global economic integration has greatly complicated the relationship between trade and the environment. Scholars continue to debate whether trade liberalization is compatible with environmental protection, whether environmentally sensitive goods should be traded, and what type of policies could facilitate win–win solutions in this realm. In this section I review the literature on the trade–environment nexus and the usage of trade measures in multilateral trade and environmental regimes, with the Basel Convention on Transboundary Movements of Hazardous Wastes as the case in point.

The extensive literature on the trade–environment relationship focuses on two questions: how trade affects environmental quality, and how environmental regulation influences trade flows. The pollution haven theory and its variations argue that environmental regulations discourage industrial investments, because polluting industries tend to relocate in countries with lax environmental regulations and low compliance costs for the regulations that do exist. This resonates with the “race to the bottom” argument, in which countries lower their environmental regulations to attract foreign investment in polluting industries (Taylor, 2005). Some find that hazardous wastes can be easier to relocate than industrial production, therefore developing countries are even more subject to the pollution haven syndrome (Kellenburg,

2009). Under globalization, then, countries with lax environmental regulations may be more likely to become waste havens (Adeola, 2000; Clapp, 2001; Grether, Mathys, & de Melo, 2012; Kellenburg, 2009).

Other theories hold that environmental regulation is just one of many variables that affect the flow of pollution or waste. The Factor-Endowment Hypothesis argues that capital, labor, and resource endowments collectively determine the flow of waste. From this viewpoint, processes intrinsic to a given industry, rather than the stringency of environmental regulation, may shape industrial production and trade of goods. Another growing literature studies the positive interactions between environmental regulation and economic integration (Vogel, 2000). Strict domestic industrial regulations may give industries first-mover advantage on the international market, evidenced by the strong correlation between environmental policy and a country's competitiveness (Esty & Porter, 2002; Porter & van de Linde, 1995). Similarly, trade policy can affect environmental protection. In 1979, the United States made a "can ban" prohibiting the trade of chlorofluorocarbon-containing propellants between the states, with the purpose of phasing out their usage. Credible threats to impose trade sanctions could help sustain full cooperation in the provision of public goods (Barrett, 1997).

Trade measures are widely used in multilateral trade and environmental regimes. The dominant multinational trading regime, the GATT/WTO, has Article XX on General Exceptions that restricts free trade when doing so is "necessary for the protection of human, animal or plant life or health (b), or relating to the conservation of exhaustible natural resources (g)." The WTO also established the Committee on Trade and Environment to enhance the positive interaction between trade liberalization and environmental protection. Following the WTO, a number of regional and bilateral agreements have incorporated environmental exemptions. Still, the liberalization mandate of the WTO has raised debates on the conflict between trade and environmental regimes. In addition to studies on the trade-environment relationship discussed above, scholars are also debating whether the WTO enhances or undermines the work of MEAs, and which should prevail when conflict arises (Axelrod, 2011; Conca, 2000; Eckersley, 2004; Horn & Mavroidis, 2014). Indeed, from the *Tuna-Dolphin* and *Shrimp-Turtle* cases of earlier days to the recent *Raw Materials* and the *Rare Earths* cases, the necessity and sufficiency of Article XX are constantly contested (Howse, 2002; Liu, 2014).

Unlike the trade regimes that make environmental exceptions within trade rules, MEAs restrict trade for environmental protection. The WTO lists 31 MEAs containing trade measures for the purpose of environmental welfare. Trade measures in MEAs serve a variety of purposes, including: regulating trade in endangered species or products derived from those species; regulating trade in environmentally hazardous goods; supporting the phase-out of hazardous substances; enhancing informed decision making; encouraging standardized information systems; avoiding "free-riding," and creating a level playing field (UNEP, 2007). The match between trade measures and the purposes they serve has significant impact on the effect of trade measures. The strongest among all trade measures are trade restrictions and bans.

The Basel Convention is a global MEA that uses trade restrictions as the main policy tool for environmental protection. The Convention was established in response to a series of publicized incidents in which toxic wastes were dumped from industrialized countries onto lands in developing countries or into the ocean to avoid increasing the

domestic disposal costs. Eighteen months of negotiations witnessed polarized debates between industrialized countries, who supported a PIC approach, and developing countries (especially African countries), who called for a global-wide ban of hazardous waste trade (Kummer, 1998). The Convention, adopted in 1989 and went in force in 1992, declared its mission to “protect human health and the environment against adverse effects of hazardous wastes.” To the disappointment of African countries and some environmental groups, the Convention adopted the PIC procedures and only banned the waste trade between Parties and non-Parties. The trade ban continued to be a central agenda item after the convention text was adopted, and Parties eventually reached a compromise on one issue, which is a ban on hazardous wastes movements from industrialized to developing countries instead of a global ban on waste trade (Kummer, 1998). Building on the notion that developing countries are unwilling and incapable to engage in hazardous waste trade, the Convention established the proximity principle, the self-sufficiency principle, the least transboundary-movement principle, and eventually the Ban Amendment to protect the developing countries from waste dumping (UNEP and ISWA, 2002). The trade restrictions of the Basel Convention and their potential conflicts with the WTO rules have sparked significant controversy, arguably even deterring certain countries from ratifying the Basel Convention and the Ban Amendment (O’Neill & Burns, 2005; Wirth, 1998).⁴

Despite the extensive use of trade restrictions within MEAs, the effectiveness of these measures demands further scrutiny. As Brack and Grey (2003) have noted, MEAs usually have many provisions that it is hard to gauge the impact of trade-related ones in isolation from the rest. This may explain the lack of consensus within the existing literature with regard to the trade–environment relationship and the ability of MEAs to promote harmony between trade and environment. This paper contributes to this debate by introducing nuances. I argue that trade of a certain good can be environmentally beneficial under some conditions while harmful in others, depending on the nature of the good and the context that governs its movements. Countries may have different perceptions of the same goods, and bridging of this perception gap can potentially open up new ways to think about the role of trade in hazardous waste management.

Methodology and Data

Trade data on hazardous wastes are limited compared to those on other commodities. The definition and reporting of hazardous wastes differ widely from country to country (Krueger, 1999; Kummer, 1995). Until the Basel Convention categorized hazardous wastes with Y codes in 1998, there was no single source that reliably monitored the transport of hazardous wastes around the world. This was added by the undetectable nature of hazardous waste trafficking. For these reasons, I use the Basel Convention National Reporting Database as the primary data source. This database contains information on waste streams, disposal, and recovery methods for all transactions reported by Basel Parties between 1998 and 2017 at different aggregation levels.⁵ It is the only global database that uses the Basel Convention definition of hazardous wastes. This database was created under the mandate of paragraph 3, Article 13 of the Basel Convention, which requests Parties to submit annual reports regarding the

generation, transport, and management of hazardous wastes. These national reports contain information on all export and import shipments of the reporting country, including the materials (Y-codes); the hazardous characteristics of the materials (H-codes); treatments (R-codes for recycling and D codes for disposal); and countries of origin, transit, and destination. The data between 1998 and 2011 were compiled into an online reporting database. This paper uses these aggregated data (based on import) for the country group analysis (Figures 1–4) and individual national reports for country-specific analyses.

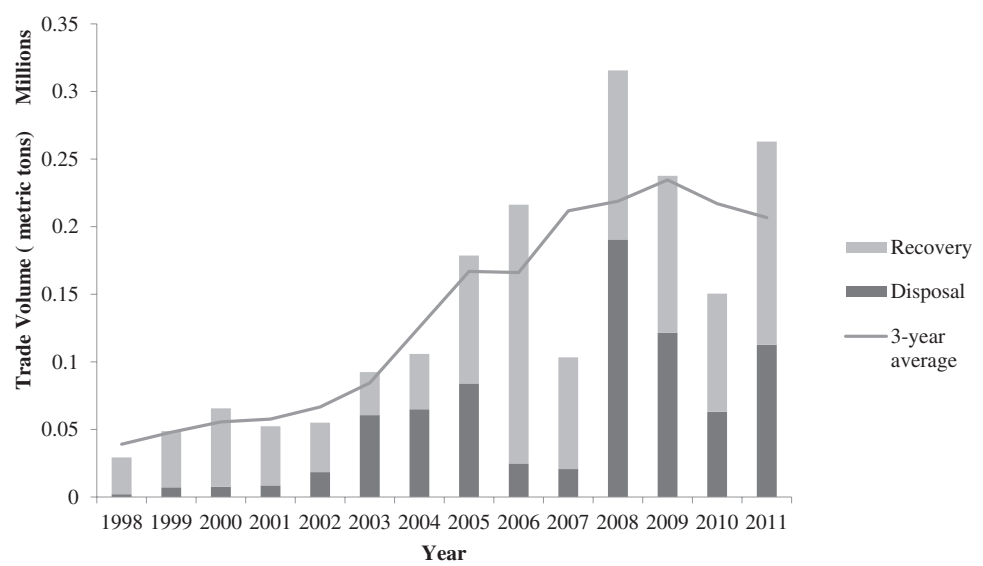


Figure 1. Industrialized Countries Imports from Developing Countries (1998–2011). *Source:* the Basel Convention Database. Based on import data.

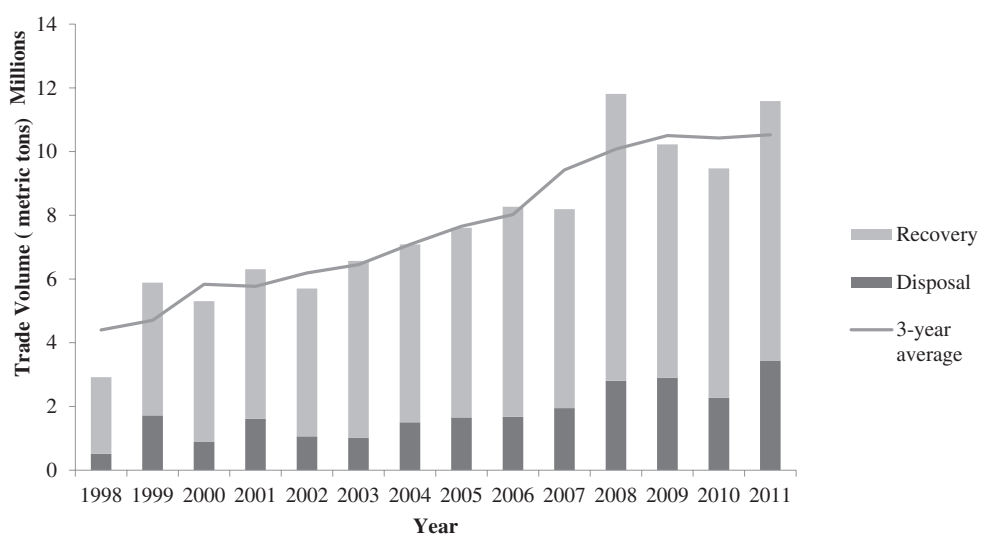


Figure 2. Industrialized Countries Imports from Industrialized Countries (1998–2011). *Source:* The Basel Convention Database. Based on import data.

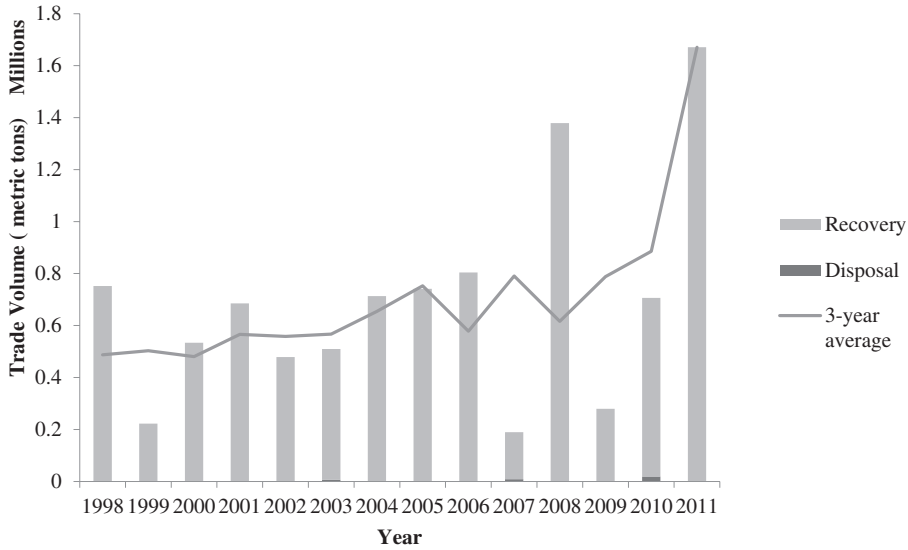


Figure 3. NIC Import from NICs 1998–2011. *Source:* The Basel Convention Database. Based on import data.

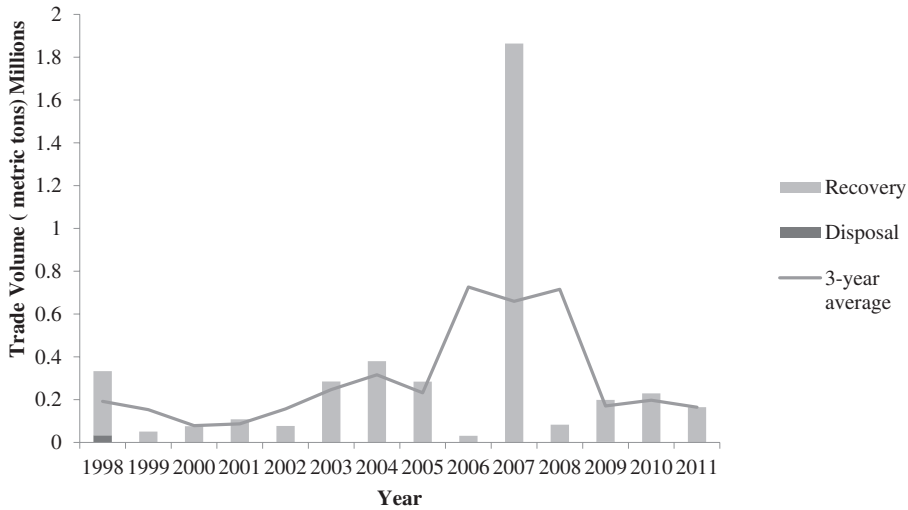


Figure 4. NIC Import from Industrialized Countries 1998–2011. *Source:* The Basel Convention Database. Based on import data.

The main limitation of the Basel Convention Database is the uneven national reporting practice across countries and years. Industrialized countries, particularly EU countries, generally comply with the national reporting requirement, but the United States, the biggest industrialized country, is not a Party to the Basel Convention and does not submit national reports. Many developing countries submit national reports at various frequencies, but some large ones, such as India and China, often only report waste generation instead of traded volumes. Most LDCs have no capacity to inspect the movements of hazardous wastes across their borders, and the few shipments that involve them are usually exports from these countries to industrialized

countries (reported by the latter). To compensate for the limitations of the Basel Convention Database, I draw from databases and reports from the EU (Eurostat and European Environmental Agency), OECD, governmental environmental agencies of individual countries, and academic studies. These databases and studies generally share the Basel categorization of hazardous wastes. Because the Basel Convention Database does not have a category for e-wastes and it is difficult to identify all e-wastes from shipment material descriptions, the analyses of e-wastes and specific hazardous materials also draw from UN reports, environmental agencies of individual countries, and academic studies, some of which use UN COMTRADE to estimate generation and trade of e-wastes and metal scraps.

There are several ways to categorize countries by stage of development, such as income-level, human development index, and OECD membership. Since the Basel Database uses OECD membership to separate industrialized and developing countries, I categorize industrialized countries by OECD membership (Annex-IIV countries), keeping in mind that some industrialized economies are not OECD members and the OECD expanded its membership during this period.⁶ I identify the LDCs from the UN official list of the LDCs.⁷ I classify the countries that are on neither list as NICs. The NICs tend to have higher growth rates and trade openness than the LDCs. According to this grouping, there are 57 industrialized economies, 115 NICs, and 48 LDCs. This categorization largely coincides with UNIDO's three-tier country categorization that measures levels of industrialization as a percent of GDP and per capita Manufactured Value-Added. Given the strong correlation between trade openness and income (Cerdeiro & Komaromi, 2017), levels of trade openness do indeed decline from industrialized economies to NICs to LDCs.

Country Participation in Hazardous Waste Trade

This section analyzes why and how countries from the three groups trade hazardous wastes. I look at different types of countries' participation in hazardous waste trade through the lens of their memberships in multilateral/bilateral agreements, substantive trade (import) volumes, and the nature of the materials being traded. In each country group, I also examine countries that are representative to demonstrate the government-industry dynamics behind their trading of hazardous wastes.

Industrialized Countries

From the Basel Convention Database, the industrialized countries are by far the biggest importers of hazardous wastes. About 87% of global hazardous waste trade occurs between industrialized countries, and industrialized countries import some hazardous materials from developing countries—albeit in smaller amounts (Figures 1 and 2). From 1998 to 2011, the import of hazardous wastes by industrialized countries quadrupled from 2.95 to 11.8 million tons (Basel Convention, 2019). The OECD countries as a whole were net importers of 4.11 million tons of hazardous wastes during this period (OECD, 2013). About 70% of hazardous wastes imported annually were for recycling, and the rest were for disposal. The three most-used disposal treatments are landfill, incineration, and physical/chemical treatments.

The waste trade of the industrialized countries is governed by OECD and EU regulations. These regulations aim to protect vulnerable developing countries and foster a regional market. The OECD Decision C(92)39/FINAL of 1992 provided an enforceable framework to control transboundary movements of wastes destined for recovery operations. It consisted of a two-tiered regulation system for amber-list (hazardous) and green-list (nonhazardous) wastes. Transboundary movements of amber-list materials required written contracts, financial guarantees, and duty to return or re-export wastes under certain conditions. The OECD amended this decision in 2001 with Decision C (2001)107/FINAL to address the growing Basel membership and new hazardous materials. In the EU, the Council Directive 91/789/EEC on hazardous wastes establishes a similar framework. It adopted the Basel Ban Amendment of 1995 into the European Waste Shipment Regulation in 2006, and initiated the Hazardous Waste Directive (91/689/EEC) and the Directive on Incineration of Waste (2000/76/EC) to minimize hazardous waste generation and maximize recycling.

Article 11 of the Basel Convention states that,

Parties may enter into bilateral, multilateral, or regional agreements or arrangements regarding transboundary movement of hazardous wastes or other wastes with Parties or non-Parties provided that such agreements or arrangements do not derogate from the environmentally sound management of hazardous wastes and other wastes as required by this Convention.

Article 11 has been used to enable trade between Parties and non-Parties. Industrialized countries have used this provision to import hazardous wastes from developing countries in small amounts. The United States, a non-Party, signed bilateral agreements with Costa Rica, Malaysia, and the Philippines to import hazardous wastes from the overseas facilities of U.S. multinationals. Industrialized countries also sign agreements with small non-Party developing countries, such as East Timor and San Marino, to help them manage their hazardous wastes. The Waigaini Convention bans the South Pacific island developing countries from importing hazardous and radioactive wastes. It also bans Australia and New Zealand to export hazardous and radioactive wastes to South Pacific island countries, thereby enabling Australia and New Zealand to import hazardous wastes from South Pacific island developing countries who are not Basel parties. Table A1 shows a list of agreements that govern hazardous waste import of the industrialized countries.

For most industrialized countries, the rate at which hazardous wastes are traded has outpaced the rate at which they are generated. Taking the EU as an example, from 2000 to 2009, hazardous wastes generation grew by 28%, while its exports increased by 131% and imports by 197% (European Environment Agency, 2012). Calculated from all reported shipments of EU countries, hazardous waste trade between EU countries grew from 7.28 in 2001 to 25.8 million tons in 2016, whereas the generation of hazardous wastes within the EU totaled 100.7 million tons (Eurostat, 2019). This is a visible shift from the late 1980s, when 2.2 out of 20–30 million tons of hazardous wastes generated were traded between the EU-12 countries (Kummer, 1995). Intensified trading implies cross-country specialization. This specialization has been facilitated by EU's adoption of the Ban Amendment and other EU policies on regional integration, which have motivated countries to develop comparative advantages based on their industrial profile, domestic market, and geography.

The specialization of hazardous waste management in the industrialized world manifests at two levels. At the national level, some industrialized countries are increasingly specializing in exporting or importing activities with regard to hazardous wastes. Germany, France, Spain, and South Korea have become net hazardous waste importers, while Japan, the Netherlands, and the United Kingdom have become net exporters (Basel Convention, 2019). The harmonized EU hazardous waste regulation has facilitated free movements of hazardous wastes within the common market. Many top hazardous waste importers, such as Germany, France, and the Netherlands, are also major exporters. In this market, countries may specialize in specific materials or treatments.

The shift of Germany from a net hazardous waste exporter to Europe's biggest importer and the opposite turn for the United Kingdom show how a country's trading position on hazardous wastes evolves with its domestic waste management. Like other industrialized countries, Germany had a shortage of landfills in the 1980s, and it was among the countries that were caught illegally dumping hazardous wastes onto the lands of developing countries. Since the 1990s, Germany has increased its waste minimization and recycling practices, including Waste-to-Energy (WTE) facilities, with the goal to turn the waste disposal to a resource management system. The 1990s saw the recycling rates of nonhazardous wastes, such as various packaging wastes and graphic paper, leaped from 0%–56% to 61%–89%. Into the 2000s, recycling rates of nonhazardous wastes stabilized but those for hazardous wastes increased from 20% in 2000 to 65% in 2006. With the help of domestic legislation and regulation, Germany developed a chain of industries along the waste management sector, including sorting, re-packaging, biological/physical/chemical treatments and WTE facilities, which have combined to turn Germany into a net importer. Germany's trading position on hazardous wastes contrasts with that of nonhazardous wastes, the management of which is generally less technology and capital intensive. From 2004 to 2016, Germany annually net-imported 3.6–5.4 million tons of hazardous wastes, while its net export of nonhazardous wastes⁸ increased from 4.5 to 5.8 million tons (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2018).

The United Kingdom was a major net hazardous waste importer in the 1990s, with nearly half of its imports coming from Germany (O'Neill, 2000).⁹ Hazardous waste exports of the United Kingdom grew in the 2000s and accelerated after 2011. From 2011 to 2015, its export increased ten-fold to 4.46 million tons, while its import stabilized at the 2001 level around 0.18 million tons. Roughly 80% of its exports were refuse-derived fuel (RDF), the vast majority of which flowed to Germany, the Netherlands, Belgium, and Spain for WTE treatments (Basel Convention, 2019).¹⁰ The Brexit vote in 2016 negatively affected the United Kingdom's RDF exports. In response, the RDF Industry Group (2018) published a Brexit Briefing Note that asked the U.K. government to ensure the RDF export to the European continent unhindered after Brexit. It argues that the United Kingdom has limited RDF treatment capacity that, if not exported, RDF is likely end up in landfills, the capacity of which is also of short supply. On the other hand, the continental Europe has spare WTF capacity and, as the energy networks between the United Kingdom and continental Europe develop, the United Kingdom will benefit from the energy and heat generated from RDF from continental Europe.

The Netherlands is Germany's biggest trade partner on hazardous wastes. It had been the largest hazardous waste exporter in Europe before recently being surpassed by the United Kingdom. As Germany becomes specialized in disposal treatments,¹¹ the Netherlands has become specialized in the "exchange of waste for recovery operations" and "repackaging for disposal operations" (Basel Convention, 2019). Germany's waste disposal capacity provided a cheaper option to dispose the Netherlands's toxic waste across the border (Ludwig & Schmid, 2007). After 2011, the Netherlands' imports started to catch up with its exports, and by 2018 it had become the biggest importer of the United Kingdom's RDF. The changing positions of the Netherlands, Germany, and the United Kingdom since the 1990s illustrate how the market and industrial capacity of a single type of hazardous material can influence the waste flow and trading position of European countries.

The evolving EU regional market has also incentivized its waste management facilities to relocate across borders. Within the EU, waste treatment has decreased in Luxemburg, Austria, Greece, Ireland, and the United Kingdom, while the hazardous waste generation of these countries has been stable or increasing (Eurostat, 2018). Waste management has been concentrating in other EU countries. From 2004 to 2014, the volume of hazardous wastes treated in the five biggest EU countries has increased from 69% to 85% as a percentage of the EU-28 total (Eurostat, 2018).¹² This trend toward relocation is more pronounced with regard to certain hazardous materials. For example, industrial effluent sludge treatment capacity shifted from Poland, Estonia, and Finland to France and the Netherlands between 2004 and 2012, while France and the Netherlands' generation of industrial effluent sludge decreased over the same period (Eurostat, 2018). Shifting waste treatment capacity across countries might also result from industrial relocation, as is the case of wood wastes (Eurostat, 2018).

This specialization also takes place at the firm level in waste generation and management industries. Multinational corporations with home offices in the industrialized countries play a notable role in importing hazardous wastes. Take the United States as an example. Prior to establishing production facilities in Costa Rica, the Intel Corporation asked the U.S. Environmental Protection Agency to broker a bilateral agreement that would enable the transport of Intel's hazardous waste back to the United States, leading to a U.S.-Costa Rica Agreement to this effect (Cotsworth, 1997). Intel sought to back-transport scrap materials, high-value materials, and materials containing Intel intellectual property to the United States and Canada to recycle metals and protect its intellectual property and market.¹³ Given the size of Intel's production in Malaysia and the Philippines, bilateral agreements with the United States over the disposal of hazardous wastes might have similar origins. Possibly for the convenience of German mining multinationals, Germany also signed bilateral agreements with Kazakhstan and Zimbabwe to "recover secondary materials."¹⁴

Japanese multinationals transport hazardous wastes for affordable and reliable waste management. Since the late 1980s, Japanese multinationals have set up industrial facilities in Duty-Free Zones and Export Processing Zones in Asian developing countries. Hazardous wastes generated in these zones can be treated either in their host countries or back in Japan, but the first option requires multinationals to pay additional fees/taxes to send process wastes to the domestic market of host countries,

which may have less reliable waste management capacity than Japan.¹⁵ In contrast, hazardous wastes exported back to Japan are exempt from taxes/fees and are guaranteed reliable management. This explains why Japan received 95% of hazardous waste imports from Asian countries from 1999 to 2008, most of which came from Japanese companies based in Asian developing countries (Kojima & Michida, 2013).

Waste management multinationals can influence a country's trading pattern and sometimes trading position on hazardous wastes. A recent paper shows that the United States imports several thousands of shipments from Canada and Mexico each year and in some years it is a net hazardous waste importer in North America (Moore, Rosenfeld, Nost, Vincent, & Roth, 2018). In the case of mercury waste, the numerous shipments from Canada and Mexico into the United States are concentrated in ten facilities (out of 1965 facilities in the country). Moreover, a corporate network analysis shows that three firms dominate the hazardous waste trade the United States engages in, meaning that a large portion of these shipments within North America are intra-firm transport (Moore et al., 2018). Between countries and facilities, specialization based on hazardous materials appears to dominate trade patterns in North America.

To summarize, the hazardous waste market among the OECD countries is characterized by high levels of horizontal and vertical specialization. Traded hazardous wastes are growing in volume for most industrialized countries, and the whole supply chain of hazardous wastes, ranging from waste generation to waste management companies, is deeply involved in this trade. This is so even though the former is mainly concerned with materials they produced, while the latter operates somewhat like a waste broker that channels wastes from different sources. Countries are building specialized capacity for specific hazardous materials as well as operations, leading to a large and growing market with a diversity of materials for disposal as well as recovery treatments. Since the 1990s, the global waste management industry has been significantly privatized, globalized, and concentrated in OECD multinational corporations, which have increased their influence over policy making. Tightening domestic environmental regulations, reduced waste generation, and regional common-market policies have encouraged waste management industries to expand business to other industrialized countries and to developing countries (Ma, 2004; Rosengren, 2019; SUEZ, 2019). As will be discussed in the next section, a number of recycling multinationals, some originally from the mining industry, have started to import grinded scraps (that contains hazardous metals to recycle) from developing countries through brokers and their own facilities established in those countries (Grant & Oteng-Ababio, 2016). A positive correlation exists between the outward FDI position of OECD countries and the number of non-OECD countries that export hazardous wastes back to the OECD bloc.¹⁶

Newly Industrializing Countries

Newly industrializing countries are developing countries that experience rapid economic growth led by manufacturing industries. These countries are characterized by market liberalization, increasing levels of investment in manufacturing and infrastructure. These NICs are diverse in geography and developmental paths. East and Southeast Asian NICs, such as China, India, Indonesia, the Philippines, and Thailand,

opted for export-oriented industrialization, while many Latin American NICs, including Argentina and Brazil, chose to industrialize through import substitution—although they have become more export-oriented in recent decades. NICs are more open to trade and foreign investment and are more integrated into global supply chains than are the LDCs. This has led to their increased participation in global hazardous waste trade.

Due to a lack of regulatory institutions and national reporting to the Basel Convention, many NICs do not report trade of hazardous wastes to the Basel Convention. I subtracted shipments involving the LDCs to sift out the data on NICs from the Basel Convention database on non-OECD countries. Similar to industrialized countries, NICs have more than doubled their hazardous waste imports from 1998 to 2011, from 1.09 to 1.84 million tons (Figures 3 and 4). The Basel Convention does not restrict the trade of hazardous wastes between NICs, but some NICs are parties to regional agreements that ban hazardous waste imports, including the Bamako Convention and the Central American Agreement on Transboundary Movements of the Hazardous Wastes.

Compared to the industrialized countries, NICs focus more on recycling treatments. Hazardous wastes containing lead, mercury, and copper are common recyclables NICs import, owing to the high price of these primary sources. Lead compounds, for example, comprise one-third to one-half of NIC imports, contrary to 6% for the industrialized countries.¹⁷ Lead-containing waste trade (e.g., used automobile batteries) has been prospering within the NICs (Asante-Duah & Nagy, 1998). Costa Rica, South Africa, and Venezuela are major importers, each importing from a number of neighboring countries.

Asian NICs have become active traders in hazardous wastes since their economic take-off. According to the Basel Convention Database, Asian NICs have been trading predominantly recyclable and metallic hazardous wastes, with certain levels of horizontal specialization. India, for example, has been importing 80% of its consumed asbestos, a large part of which comes from industrialized countries (Broughton, 2005). Meanwhile, hazardous wastes requiring special treatments (e.g., mercury and PCB-containing wastes) are usually exported to industrialized countries in the region (Japan, South Korea, and Singapore). The Philippines and Thailand, two countries that have not ratified the Ban Amendment, have become major traders of metallic wastes. From 2002 to 2017, Thailand's total trade of hazardous materials increased 100-fold to 73,546 metric tons, and the Philippines' traded volume stabilized at around 50,000 metric tons per year (Basel Convention, 2019). Increasing participation of Asian NIC importers is driven by a demand for recyclable resources, as well as a growing recycling capacity (UNEP, 2014).

Other regional hubs are emerging outside Asia. South Africa, for example, has become the biggest destination for hazardous materials in Africa. In 2017 alone, it imported 31,658 tons from seven African countries and exported another 29,883 tons to South Korea, Japan, France, and Belgium (Basel Convention, 2019).¹⁸ Half of its imports consisted of diverse waste streams for disposal, while virtually all of its exports were metallic wastes for recovery. Facility overcapacity may have played a role in South Africa's lead imports (Joseph & Verwey, 2001). It is likely that South Africa helps neighboring countries that are incapable of handling certain hazardous materials, and it

sorts and processes recyclable waste streams as a regional transfer point. Another example is Costa Rica, which has also failed to ratify the Ban Amendment. Despite being a party to the Central American Regional Agreement on the Transboundary Movements of Hazardous Wastes that bans import into the region, Costa Rica has imported hazardous wastes since 2014, and its imported volume had doubled to 21,584 tons by 2017. Costa Rica sources from other parties to Central America Agreement and other countries, including the Bahamas, El Salvador, Nicaragua, and Jamaica. Like South Africa, Costa Rica mainly imports metallic wastes for recovery and exports various hazardous wastes to industrialized countries for disposal and recovery. Similarly, although Nigeria ratified the Ban Amendment in 2004, it has been importing small amounts of hazardous wastes from the United States and Belgium since 2012 (Basel Convention, 2019).

Given the predominance of e-wastes in the NIC's trade of hazardous materials, a more detailed analysis is warranted. NICs' capability to handle e-wastes has long been questioned. Many countries have been reported to conduct "sham recycling" (improper disposal by dumping or burning) and "dirty recycling" (metal recovery using fire or acid). Greenpeace reports that improper recycling occurs in the coastal areas of some NICs, including China, India, and Pakistan (Greenpeace, 2009). The Basel Action Network claims that waste trade for recycling in developing countries falls either into sham recycling or dirty recycling (Basel Action Network, 2015). However, just like the trade of other hazardous wastes, the trade of e-wastes is more complicated than is the case of rich countries dumping e-wastes on the shores of poorer ones (Grant & Oteng-Ababio, 2016; Lepawsky, 2018; Lepawsky & McNabb, 2009).

Two factors are behind the booming trade of hazardous e-wastes. The first is the rise of NICs as the manufacturers of the world, especially for electronic products. As underground mining resources are becoming more scarce compared to the "above-ground ores," end-of-life metal-bearing wastes are becoming the major secondary resources for metals such as gold, silver, and copper (Grant & Oteng-Ababio, 2016; Knapp, 2016; UNU, 2012). Recovering these heavy metals is of both industrial and environmental necessity. As a result, industrializing countries with large manufacturing sectors, such as China, India, the Philippines, and South Africa, are importing e-wastes that contain certain metals in ever-larger amounts to feed their manufacturing sector. This suggests some level of horizontal specialization for certain heavy-metallic wastes across the NICs in recycling as well as renewal treatments. A study of e-waste circulation among China, Vietnam, and Cambodia found that many e-wastes imported from industrialized countries are renewed in the border regions of these countries and shipped to LDCs for reuse. Although their governments have banned e-waste trade to varying degrees, a soaring demand for regional e-waste recycling and renewal has gained at least partial acquiescence from these governments. Specific second-hand e-products flow to countries with corresponding market demand. In this case, China mainly imports computer e-wastes and Vietnam TV e-wastes (Shinkuma & Huong, 2009).

The second factor is the integration of NICs in the global supply chain of electronic goods. The differing levels of industrialization across the NICs have led some to engage in segments of the recovery chain for specific metallic hazardous wastes. Not dissimilar to the industrialized countries, the net importers and exporters arise among the NICs, but many countries trade both ways. Increasing vertical specialization

is emerging, breaking the recycling of e-wastes into at least three segments: sorting, processing, and recycling. Take Ghana as an example. Since 2004 it started to trade e-wastes and refurbished electronic devices, importing large amounts of nonferrous scrap from the United States, Europe, China, South Africa and the Middle East, and exporting to China, India, Southeast Asia, and Europe. Accra's e-waste sector consists of a handful of formal recyclers that monopolize the export market, domestic scrap firms that seek to export through formal recyclers or scrap brokers, and local scavengers that sort and grind motherboards. Each group seeks to expand its business into other segments of this lucrative metal recovery chain. Due to limited local capability, most heavy metals are exported for recycling, while steel and aluminum scraps are recycled locally. Here, we see not only signs of vertical specialization in the surging trade between NICs, but also the active engagement of multinational metallic waste recyclers. The biggest formal exporters are mainly Indian companies, some of which import scraps from Ghana and other facilities located in the free zones and elsewhere and then back to India to supply its secondary metal producers (Grant & Oteng-Ababio, 2016). China is the largest importer of Ghana's scraps, followed by India, European countries, and recycling multinationals. In other words, a West Africa regional and international e-waste management network is taking shape, and countries of all industrialization levels are taking part in it.

In tandem with this heightened demand are the NICs' growing capacity and levels of specialization in manufacturing and recycling processes. Geographical proximity makes NICs competitive handlers of recyclable wastes that can be put into manufacturing production on site. Available labor and technology make it economically feasible to recycle certain materials. Many countries are advantaged in recycling specific post-use hazardous wastes because they manufacture and export those products, such as Malaysia's recycling of CRT glass. Low costs, feasible technology, economies of scale, and convenience combine to generate comparative advantages in treating certain recyclable hazardous wastes in NICs.

Least Developed Countries

The LDCs, compared to industrialized countries and NICs, are less engaged in hazardous waste trade yet more vulnerable to hazardous waste trafficking. Among the 47 LDCs, 33 are in Africa, nine in Asia, four in Oceania, and one in Latin America and the Caribbean. These countries are not big hazardous waste generators and most of them support a trade ban on hazardous wastes. In response to the Basel Convention's failure to prohibit hazardous waste flows into LDCs, the African and Oceanic LDCs made agreements to ban hazardous waste import in their regions. The Bamako Convention has 25 parties, 16 of which are LDCs. The Waigaini Convention includes three out of four Oceanic LDCs. Enforcement of these agreements has been uneven. Due to limited institutional capacity of African countries, implementation of the Bamako Convention has been weak and the region as a whole suffers from the illegal dumping of hazardous wastes.

Data on LDCs' participation in hazardous waste trade are anecdotal. In Africa, where over half of the countries are LDCs, few government reports are available on e-waste management (Baldé, Forti, Gray, Kuehr, & Stegmann, 2017). LDCs generally

have limited infrastructure to inspect waste shipments, enforce strict trade restrictions, or handle hazardous wastes that have already entered the country. Many LDCs have not adopted a national definition of hazardous wastes or domestic regulations to control them. They might also intentionally avoid reporting hazardous waste imports in order to hide violations of the trade bans that they signed onto.¹⁹ The Basel Convention Database records four countries that occasionally traded (mostly exporting) hazardous wastes from 2001 to 2012: Lesotho, Senegal, Togo, and Zambia. Among their shipments, all but 1 of the 15 export shipments were destined for industrialized countries for disposal. Only Zambia recorded 82,939 tons of imports in 2007. About 80% of imported wastes, mostly metallic wastes, were for recovery. Among those, one shipment of metallic wastes for recovery came from Mexico, an OECD member country.

An unknown yet larger amount of hazardous wastes is likely to cross borders of these African and Asian LDCs than is reported in the Basel Convention Database. West Africa's proximity to Europe and to the United States makes it vulnerable to hazardous waste trafficking since the 1980s, including the infamous Koko case in 1988. In 2006, a ship registered in Panama sailed from Amsterdam and offloaded toxic chemical wastes (generated by a British oil trader while on the high seas) at Port Abidjan, Côte d'Ivoire.²⁰ There, a local contractor disposed of these wastes improperly, causing 17 deaths and over 30,000 injuries. Other African LDCs also suffer from illegal hazardous waste dumping, including Benin, Somalia, and Zambia (Africa Faith & Justice Network, 2016; VOA News, 2009; Webster-Main, 2002). Some European countries have been illicitly exporting e-wastes to West Africa, where those wastes were reused or improperly recycled (UNEP, 2011a). Notwithstanding the recycling opportunities forwent by the Bamako Convention and arguably the Basel Convention, neither of them has fulfilled their goals of protecting vulnerable countries from environmental disasters (Widawsky, 2008).

Low levels of trade openness and official disinterest in hazardous waste trade have not protected LDCs from the adverse effects of hazardous wastes. Limited technical, financial, and institutional capabilities have locked these countries into an enforcement deficit on this front. Despite the fact that the bulk of e-wastes goes to industrialized countries and the NICs, the remainder that flows into or through LDCs may increase environmental and health risks of those countries considerably.

Summary

An examination of industrialized countries, NICs, and LDCs shows how their participation in hazardous waste trade differs according to their integration into the world economy. Lowering trade barriers and transaction costs in industrial production have facilitated horizontal and vertical specialization in goods and services. Hazardous wastes, generated by industrial production and consumption, are a byproduct of economic integration. As world imports tripled between 2001 and 2011, hazardous waste imports doubled over this same period from 7 to 14 million tons. Global economic integration reduces the costs of hazardous waste transport and facilitates the growth of waste management multinationals.

Empirical analysis suggests that a country's inclination to participate in hazardous waste trade does not necessarily decline as it industrializes. Judging from the Basel Convention Database, industrialized countries import the largest amounts of hazardous wastes and with the greatest diversity. Vertical and horizontal specialization dominates these countries' trading patterns. The NICs import hazardous wastes of smaller volumes and diversity, as they focus on the recycling of metallic hazardous wastes that can fuel their manufacturing industries. Their comparative advantage in treating those wastes lies in the low treatment costs and geographical proximity to the market. The LDCs are less open to hazardous waste trade, yet they are most vulnerable to illegal trafficking. In each group, countries exhibit a wide variation in their participation in terms of trading positions, volumes, materials, and treatments. Indeed, the lines between the three groups are fine ones, and the three markets are not isolated from one another.

The hazardous waste trade practice of the NICs deserves special attention. Due to poor national reporting from developing countries, the Basel Convention Database may severely underestimate the actual volumes of hazardous materials crossing borders of the NICs. Analysis of the NICs suggests that most hazardous wastes are traded as secondary goods in these countries, whose production and distribution structures have been undergoing rapid changes. This might explain why some NICs, including Brazil, India, Thailand, and Russia, have not ratified the Ban Amendment. As the industrial structure of these countries evolves, their profile of hazardous wastes trade will continue to change in terms of material, amount, and treatment.

Conclusion

Given the potential risks of hazardous wastes, should their trade be discouraged or encouraged? The Basel Convention favors the former option. While it does not explicitly ban hazardous waste trade between all parties, the objectives, principles, and actions that it has taken thus far confirm that it discourages their transboundary movements. If hazardous wastes were indeed nothing more than pollution, the two overarching goals of the Convention—trade minimization and the proper management of hazardous wastes—can be compatible. However, as this article suggests, hazardous wastes are byproducts of an increasingly sophisticated and globalized industrial supply chain. Hazardous wastes differ fundamentally from municipal solid wastes in their environmental impact, recyclable values, and the technology involved. Environmentally sound and efficient management of hazardous wastes may require transboundary movements between countries of different capabilities. The market for hazardous wastes is expanding, and countries of all developmental levels are already taking their positions in different segments of their global supply chains.

The main contribution of this paper lies in linking the mandate and approach of the Basel Convention in light of the new data, which offer a holistic picture on the trade of hazardous wastes. This paper finds no evidence that the majority of hazardous wastes are transported cross-border for "dumping" in less developed countries. In contrast, it finds that countries of different developmental stages trade hazardous wastes in three markets, interconnected to one another, of different sizes and levels of specialization. Countries with higher levels of industrialization and openness tend

to import hazardous wastes in higher volumes and various treatments. Globalization has made hazardous wastes more mobile, but it also offers opportunities to handle them efficiently. It by no means denies the existence of hazardous waste trafficking and the potential risks of poor recycling practices, especially in the LDCs. Rather, it suggests that transboundary movements of hazardous wastes can be used to facilitate waste management, given proper international and domestic regulations. There is no doubt that industrialized countries, who trade the most, also have the most stringent regulations of waste management. It is also important to see that the gaps in trade and regulations between the industrialized and the NIC markets have narrowed drastically over the last twenty years.

Appropriate institutions can greatly expedite capacity building of developing countries on hazardous waste management. The dichotomous categorization of countries and their obligations may have been justified during the early years of the Basel Convention, given that many developing countries were not fully integrated into the global economy, and our understanding of hazardous waste trade was limited. But as globalization deepens and the gaps between developing countries have widened, the binary framework based on OECD membership is falling short in explaining patterns of hazardous waste trade. The NICs have become major hazardous waste generators and recyclers. They may need to import recyclable hazardous materials from industrialized countries, and they can also dump hazardous wastes to other developing countries without being held accountable by the Convention (Sonak, Sonak, & Giriyan, 2008). Actually, China's recent import ban targets mostly the no/low-value recyclables (textile wastes), unsorted wastes (mixed paper wastes), and wastes where its own domestic supply is in excess. This "trade ban" supports my point that China, as a NIC, is upgrading from low-value, labor-intensive industries into higher value and more efficient ones, not dissimilar from Germany 20 years ago. Moreover, its growing institutional capacity and market clout have forced industrialized countries that used to export those wastes, legally or illegally, to come up with domestic policies to reduce waste generation. Lack of distinction between the NICs and LDCs also hinders the Convention's mission to protect vulnerable countries from waste dumping. Compared to the NICs, the LDCs have limited capability to manage hazardous materials, and their exposure to the hazardous waste market should be closely monitored to make sure their capacity building does not come at the cost of environmental and health risks.

The recent entry into force of the Basel Ban Amendment brings new changes to the global trade and management of hazardous wastes. With Croatia's ratification on September 6, the Ban Amendment gained 97 ratifications from its signatories and came into force on December 5, 2019. This, along with the decisions that now bring plastic wastes under the Convention's control, considerably expands the Convention's jurisdiction and strengthens its regulations of controlled substances. On the one hand, the Ban Amendment has limited legal impact on the existing North-South trade, because the EU has already adopted the Amendment and the United States remains a non-party to the Basel Convention. On the other hand, the Ban Amendment does not solve the two issues raised in this paper: that a country's ability to fend off illegal waste import requires more capacity building than a trade ban; and that current transboundary movements of hazardous wastes occur as much between South and South as between North and South. Proper hazardous waste management in developing

countries can rarely be achieved with a blanket ban on waste exports rather than international regulations that make it transparent and controllable (Montgomery, 1995). The Ban Amendment may allow unilateral restrictive policies that result in “unjustifiable discrimination” (Lat, 2009), while the globalizing world economy calls for more sophisticated trade rules rather than a blanket ban between the North and South (Brack & Gray, 2003). As the main international treaty on hazardous wastes, it is imperative that the Basel Convention adopts a capacity-building approach and develops regulations for a global market of hazardous wastes, where capable countries in the global North and South are willing to handle hazardous materials and assist other countries in developing the much needed industrial capacity on hazardous waste management.

Notes

- 1 The Basel Convention designates two types of wastes that require special consideration (Annex II): wastes collected from households (Y46); and residues arising from the incineration of household wastes (Y47).
- 2 Basel Decision 14/12 and 14/13.
- 3 Wastes to be controlled can be found in Annex I to the Basel Convention and are categorized into 48 distinct types with Y codes.
- 4 For the United States and the Philippines, among other countries, restricting the trade of recyclable hazardous wastes is among the reasons for their non-ratifications of the Basel Convention and the Ban Amendment.
- 5 From 1998 to 2000, there are aggregated data based on OECD/non-OECD countries but not national reports. From 2001 to 2011, data are available for country groups as well as cleaned individual transactions. From 2012 onward, there are no aggregated data but only uncleaned transaction data reported in each country's national reports. All data points drawn from the aggregated data and individual national reports have the same citation “Basel Convention (2019).”
- 6 Singapore as an industrialized country is not an OECD member. Slovenia, Estonia, and Israel joined the OECD in 2010. Because Slovenia and Estonia joined the EU in 2004 and adopted EU waste restrictions in 2003, I treat them as industrialized countries in this paper. However, the Basel Convention Database did not specify if these three countries were treated as OECD countries in the aggregated data (Figures 1-4) for years 2010 and 2011.
- 7 Two countries (Timor-Leste and Senegal) were added to the LDC list, and two countries (Cabo Verde and Maldives) were removed from the list. None of those countries reported on any volumes of hazardous wastes between 2001 and 2011.
- 8 Nonhazardous wastes mean wastes that do not require consent in cross-border transport, for any kind of wastes containing hazardous substances require consent.
- 9 The figure comes from the traded volumes of the 1993–94 period. It only covers England and Wales, which consists of 98%–100% of traded hazardous wastes of the United Kingdom.
- 10 These wastes are traded for R1 treatment, which is defined by the Basel Convention “use as a fuel (other than in direct incineration) or other means to generate energy.”
- 11 With the most efficient incinerators in the world. James E. Girard, P565. Principles of Environmental Chemistry.
- 12 The biggest five countries (2014) are Germany, Serbia, Bulgaria, France, and Estonia.
- 13 According to email correspondence with Intel.
- 14 See Agreement text. Despite the agreements, no waste has been imported from Zimbabwe to Germany since then (Germany BMUB). The Kazakhstan-Germany agreement expired as Kazakhstan became a Basel Party in 2003.
- 15 China, the Philippines, Indonesia, and Thailand.
- 16 (To all countries) Spearman's $r = 0.53$, significant at the 0.01 level. (To non-OECD countries) Spearman's $r = 0.43$, significant at the 0.05 level.
- 17 Taking 2009 as a snapshot. The Basel Convention Database.

- 18 The seven countries are Botswana, Gabon, Lesotho (LDC), Mozambique (LDC), Namibia, Swaziland, and Zambia (LDC).
- 19 This might be the case for some NICs too. China and India trade huge amounts of hazardous wastes but barely report them, even though India has not ratified the Ban Amendment.
- 20 It should be noted that not all countries in West Africa are LDCs. Côte d'Ivoire, for instance, is not a LDC, although its GDP per capita is lower than some LDCs like Angola and Zambia. Ghana and Nigeria are also not LDCs.

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Appendix

Table A1. Agreements Concerning Hazardous Wastes Imports of Industrialized Countries^a

Agreement	Parties	Adoption	Enforcement
OECD Council Decision C(2001) 107/Final on the Control of Transboundary Movements of Wastes Destined for Recovery Operations	OECD members		2001
European Waste Shipment Regulation	EU members		2006
Costa Rica Exports hazardous wastes to the United States for Management	Costa Rica, United States		1997
Malaysia exports hazardous wastes to the United States for Management	Malaysia, United States		1995
Philippines exports hazardous wastes to the United States Management	Philippines, United States		2001
Transboundary movements of hazardous wastes for recovery and/or final disposal	Canada, United States		1986
Export of wastes generated in Kosovo (Serbia and Montenegro) during the deployment of KFOR/NATO troops to Germany environmentally sound management ^b	KFOR/NATO, Federal Republic of Germany		2000
Import of hazardous wastes from Afghanistan for the purpose of disposal according to environmental requirements	Afghanistan, Germany		2002
Import of hazardous wastes from Zimbabwe into Germany	Zimbabwe, Germany		1994 ^c
Import of hazardous wastes from San Marino for the purpose of disposal according to environmental requirements	San Marino, Italy	2000	2001
Import of hazardous wastes from Andorra to Spain for management	Andorra, Spain		2006
Import of hazardous wastes from the Netherlands Antilles to the Netherlands for management	the Netherlands, the Netherlands Antilles		2005

^aThis table only includes agreements that directly regulate transboundary hazardous waste flow.

^bThis treaty was concluded without prejudice.

^cAlthough the state of the treaty is not updated on the Basel Convention website, the treaty is supposed to be concluded without prejudice when Zimbabwe became a Basel Party in 2012.

Source: <http://www.basel.int/Countries/Agreements/tabid/1482/Default.aspx>