Is India becoming a waste haven of metal scrap?

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12. October 2015

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Abstract

India is one of the largest importers of waste in the world with metallic scrap constituting the bulk of the waste imports. While relatively weak environmental standards in developing countries is often seen to be a key factor in the emergence of *waste havens* in cross-country studies, little attention has been given to examine the pattern of waste trade in a developing country over time. This paper analyzes factors determining metallic waste import in India from different source countries during 1996 through 2012. We empirically test the presence of *waste haven effect* in metallic scrap import by India after controlling for technology and home market demand. We find that the escalating domestic demand for metal and use of relatively labour-intensive technology are significant factors behind India's import of metallic wastes from different source countries. We find no empirical evidence of *waste haven effect*.

Keywords: waste-haven effect, recyclable metallic wastes and scrap, factor-intensity, home- market effect.

JEL classification: F18, Q56

1. *Introduction*

The rapid growth in the international movement of wastes has given rise to many controversies and concerns of safety for the environment.[1] Globalisation has scaled up economic activities (in terms of both production and consumption) leading to a rapid increase in waste generation[2] all over the world. Increasing innovation of new technologies has led to piling up of the old ones that further add to the volume of the debris. With traditional methods of disposing of wastes (within its area of origin) getting superseded owing to rapid urbanisation, and tightening of environmental laws in industrialised countries[3] , the cost of waste management and disposal has escalated in the developed economies. Therefore shipping their wastes to countries characterised by lower disposal costs is a profitable option for the developed nation- leading to transboundary movement of wastes. Although movement of waste also takes place between developing countries and between developed nations, the movement of wastes from developed to developing countries accounts for the majority (approximately 51 %) of the total waste import taking place in the world[4].

Over the last few years transboundary movement of wastes from developed to developing countries has increased remarkably. In the year 2012 approximately 586million tons[5] of wastes were imported by developing countries from developed nations –a five-fold increase from 1996. This indicates that developing countries have emerged as attractive dumping grounds for wastes by the developed nations. Developing countries like China, India, Pakistan, Indonesia, Malaysia, Nigeria, Ghana etc. are some of the major wastes recipients of the wastes generated in the world.

Emerging literature on waste movement indicates that less stringent environmental regulations ensuing cheaper waste disposal costs is one of the important factors that has made developing countries the "*waste haven*" for the developed nations [Kellenberg (2012)]. Similar to the concept of Pollution Haven effect, transboundary movement of waste has given rise to an environmental problem; termed as *"Waste Haven Effect".* The only difference is that the former involves movement of pollution-intensive industries across borders whereas the later involves direct movement of wastes across borders due to difference in environmental regulations. Difference in relative factor endowment [Baggs (2009), Copeland (1991), and Rauscher (1999)], and asymmetric transport costs [Kellenberg (2010)] are some of the other relevant factors behind international movement of wastes across borders.

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[1] The waste traded across borders contain hazardous substances. If they are not handled in an environmentally sound manner they can alter the environmental quality of the importing country and can cause serious health hazards. Multilateral environmental agreements related to transboundary movement of wastes, like the Basel Convention on Transboundary Movements of Hazardous Waste (1989), aim to reduce the ill effects of the negative externalities and incidence of waste dumping from developed to developing countries.

[2] Global municipal solid waste generation are estimated to be approximately "1.3 billion tonnes per year and it is expected to increase to approximately 2.2billion tonnes per year by 2025." (Hoorweg and Bhada-Tata 2012: 8)

[3] In the year 1976 the US Environmental Protection Agency passed the Resource Conservation and Recovery Act (RCRA). It aimed at reducing the problem of increasing volume of municipal and industrial waste in the country. It banned the dumping of any kind of wastes openly and encouraged recycling of wastes to promote safe disposal of waste.

[4] Based on authors's calculation using UN Comtrade database.

[5] Authors's calculation is based on different waste and scrap categories at six digit level HS code classification as available in the UN Comtrade database.

The export of wastes from developed to developing countries occur mainly for the purpose of reprocessing i.e. recycling or re-use. Recycling is a labour-intensive process. Developing countries characterised by abundant labour supply enjoys a comparative advantage in the process. In particular, reprocessing and treatment of metallic wastes yields valuable metals like aluminium, copper, gold and silver. Secondary metals[6] crafted out from scraps are cheap alternative to virgin metals. Metal scrap serves as an important alternative source of raw materials in the metal manufacturing and other large scale manufacturing sectors like machinery equipments etc. Indeed metallic waste and scrap is the most widely traded category of wastes in the world. Our analysis in this paper focuses on this category of waste import in India.

Developing countries, focused on basic and heavy industries experiences high demand for metal [Johnstone (1998)]. The depletion of natural mineral reserves have escalated the price of virgin metals thus producers are now increasingly shifting to the alternative source of metallic waste and scrap for the production of metals. Hence there is a high market demand for these metallic scraps in developing countries [Johnstone (1998), Higashida and Managi (2013)]. A part of this demand is satisfied through import of metallic wastes and scraps [Johnstone (1998)]. This market demand may also form the basis of trade in wastes from developed to developing countries.

Among the developing countries, India is one of the largest importers of metallic waste, after China. In the year 2012, India imported more than 59 million tonnes of metal waste from high- income countries. During our period of analysis 1996-2012 considered here, more than 60% of this waste was sourced from the European Union (EU) United States of America (US), and the United Arab Emirates (UAE). Since India’s environmental regulations and enforcement is relatively lax, it raises the question whether the rapid increase in metal scrap import is an indication of a *waste haven effect,* or is it the escalating domestic demand for metal.

In this paper we examine determinants of India's metallic waste from different source countries for the period 1996-2012. The data on metal waste and scrap categories is defined at the 6-digit classification (following 1996 Harmonized codes). We find that escalating domestic demand for metal and relatively labour-intensive technology are significant factors behind India’s import of metallic wastes from different source countries. There is no evidence of waste haven.

The next section gives a review of the existing literature on economic factors driving movement of wastes across countries. Section 3 elaborates the existing waste regulation rules in India and discusses some of the salient features of the pattern of metallic waste import by India. In Section 4 we present an empirical model to analyse factors behind India’s metallic waste import, and in Section 5 we provide the methodology and data sources used. Section 6 discusses the empirical results, and Section 7 concludes the study.

2. Literature Review

While trade in waste occurs through both legal and illegal channels, the former is more tractable and

[6] The metals crafted from recycled metallic wastes are known as secondary metals (primary being the ones obtained directly from mineral ores).

open to deeper economic analyses. Waste trade through legal channels is well recorded and hence most of the researchers have examined this area of waste trade [Johnstone (1998), Rauscher (1999), Beukering and Bouman (2001), Cassing and Kuhn (2003), Baggs (2009), Kellenberg (2010), Kellenberg (2012), Higashida and Managi (2013)]. Few papers in the literature, like Copeland (1991), Ivanova (2007) discussed waste trade through illegal channels. However our analysis is restricted to legal channels of waste trade only[7] .

Economists have broadly considered two hypotheses while explaining essential factors behind trade-environment linkages. The *"pollution haven*" hypothesis predicts that pollution intensive industries migrate to low-income countries due to difference in the stringency of environmental regulations. There is an extensive literature on the theoretical and empirical validation of "pollution haven hypothesis[8]". Conversely the *factor endowment hypothesis* indicate that pollution-intensive or 'footloose' industries follow a capital intensive production process hence are generally located in high-income countries. Similar to the pollution haven hypothesis, Copeland (1991) suggested that the international movement of waste across borders may give rise to an environmental problem of "waste haven effect"- countries with less stringent environmental laws are targeted as the dumping ground of waste (or Waste haven) by the developed countries where environmental regulations are stricter. This is an emerging literature.

From the definition of "waste haven affect", it is apparent that difference in environmental stringency is a significant factor that can explain trade in waste. Among a few other papers, Cassing and Kuhn (2003), and Kellenberg (2012) established that the difference in disposal costs determined by the degree of environmental regulation stringency plays a decisive role in explaining the comparative advantage of a country in waste trade. The degree of environmental stringency of a country is determined by the difference in income-levels. High income countries will have higher ability to pay for maintaining the natural quality of the environment (higher demand for good quality of the environment) compared to low- income countries. Thus we can expect high-income countries will have stricter environmental laws than low income countries.

Cassing and Kuhn (2003) theoretically examined strategic environmental policy issues between developed and developing countries. In a game theoretic approach they showed that developing countries always end up having less stringent environmental regulations compared to the developed nations. This indicates possibility of developing countries in becoming "waste haven" by the developed nations.

Cassing and Kuhn (2003) and Copeland (1991) indicate that in order to achieve a global optimum level of pollution (in the form of waste here) international coordination of environmental and trade policies are necessary. Multilateral Environmental Agreements[9] with trade measures are designed to

[7] It is difficult to trace out the illegal waste trade channel. No data is available hence our analysis addresses only the legal channel of waste trade.

[8] Copeland (2000) Copeland and Taylor (2001), Cole and Elliot (2003), Ederington, Levinson and Minier (2005) and many others have examined the validation of Pollution Haven Hypothesis. The results are mixed regarding the presence of pollution haven hypothesis.

[9] A legally binding but voluntary instrument between two or more nation states that deals with the aspect of the

address this issue. In this context one of the important multilateral environmental agreements is the Basel Convention on Transboundary Movement of Hazardous Wastes. It was signed in the year 1989 with the objective to regulate and monitor trade so that its member countries (170 member countries till date) can control the adverse environmental consequences of the hazardous waste more efficiently. It prohibited trade in toxic wastes from developed countries to low-income countries. However, participation and adherence to the rules of the Convention is discretionary. Therefore if the environmental laws in the domestic country are not made strong enough Basel Convention becomes ineffective.

Some analysts have questioned the principal role of regulatory cost differential in determining the trade in waste. They postulate that apart from differences in regulatory costs, factors like factor endowment difference, asymmetric transport costs may be more crucial in explaining waste trade taking place between two countries. Copeland (1991) and Rauscher (1999) explained that the basis of international trade in waste lies in the famous Hecksher-Ohlin theory of trade. The process of waste disposal is a land-intensive method and it also requires abundant supply of labour for management and processing. Copeland (1991) theoretically showed that a small open economy abundantly supplied with land has comparative advantage in the process of waste disposal, hence may become an exporter of waste disposal service. Following, Copeland (1991), Rauscher (1999) theoretically showed that waste trade is mainly taking place from developed to developing countries. The factor endowment difference is one of the crucial components which form the basis of this trade. Unlike Copeland (1991), Rauscher (1999) restricted his analysis only to the legal channels of waste trade.

Baggs (2009) empirically validated Copeland (1991) and Rauscher (1999) arguments. Baggs (2009) posited that inclusion of factor abundance as a variable in explaining waste trade between two countries can outweigh the effect of environmental leniency. However her approach of explaining factor abundance was different from Copeland (1991). She assumed that waste disposal service and recycling activities require high investment and are capitalintensive. Thus large economies characterised by high-income and capital abundance will have a comparative advantage in waste disposal services compared to the low-income countries. Baggs argued that a large economy will produce more waste and will also have greater waste disposal capacity due to scale effect[10]. "a *1%* increase in GDP leads to a 0.5% increase in hazardous waste production, a 1.4% increase in treatment plant capacity and a 0.9% increase in total disposal capacity". This result implies that in developed countries increase in income level results in more waste thus they should export more waste for disposal than developing countries. But the rate of growth of disposal capacity outweighs the rate of waste production, effectively making the developed country exporter of waste disposal service.

However, income effect is likely to act as a deterrent to import wastes in developed countries .Baggs

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environment. Multilateral environmental agreements have evolved over the years as a cooperative means to protect and conserve environmental resources & control trans-boundary or global pollution. In order to achieve sustainable development environmental & trade policy must be mutually supportive. With the aim to reduce environmental damage associated with free trade & to reduce free-riding problems (trade with non-parties are restricted) trade measures are included in the Multilateral Environmental Agreements.

[10] Scale effect is the impact on pollution of simply scaling up current economic activity given production techniques and the mix of goods produced. In this context, higher the size of the economy more will be the production of waste but at the same time disposal capacity will also increase.

also showed keeping all other things (i.e. difference in factor abundance) constant difference in income levels (which is used as proxy to measure environmental stringency) will result in, high income countries becoming exporter of wastes. High income countries will have higher willingness to pay for good quality of environment. Hence they will be reluctant to accept waste from abroad. As an extension to the main model Baggs (2009) pointed out that with the fall in distance cost (trade barrier) trade between developed and developing country increases more than two times. Thus distance cost can be used as an important policy instrument to regulate trade in waste.

Later Kellenberg (2010) explicitly explained that this difference in distance cost (which is usually proxied by transportation cost) may be an important factor in shaping the comparative advantage of a country in waste trade. In a two country (north- south) two good framework Kellenberg showed that difference in transport cost (proxy shipping freight rates) across countries play a role in influencing the decision of a country to export waste(his discussion mainly considered e-wastes) to other countries. The change in shipping freight rates was found to be positively correlated (0.81) with the volume of waste transported from US to Asia. One of the reasons for the increase in the waste flow from North to South is an improvement in efficiency of the shipping industry in the North which decreases the backhaul rate (export from Asia to US) and improves the North’s comparative advantage (environmental arbitrage condition) to ship waste to the South.

The majority of the wastes, especially the re-usable category imported by the South typically used for the purpose of recycling [Johnstone (1998), Beukering and Bouman (2001), Higashida and et al (2013)]. Beukering and Bouman (2001) showed that developing countries specializes in the utilisation of wastes mainly for the production of secondary materials out of it. Their analysis considered two types of wastes- lead wastes and paper wastes. Unlike Beukering and Bouman (2001), Johnstone (1998) focused only on metalbearing wastes: non-ferrous wastes and scrap (copper, lead and zinc scrap). The metal processing industries and other manufacturing industries (e.g.: Steel manufacturing industries, foundries) in developing countries like China, India have high demand for metal-bearing waste and scrap. They process the metal-bearing wastes and scrap in order to craft out precious metals like gold, aluminium, copper -termed as secondary metals which are much cheaper than the virgin metals. The high price of virgin metals has further escalated the demand for metal-bearing waste and scrap. Domestic supply of metal scrap may not be adequate enough to meet the increasing demand of the metal processing industries. Thus a part of the demand is satisfied through import of metal bearing waste and scrap in the developing countries. Johnstone (1998) empirically showed that imported non-ferrous metallic scrap significantly affects the secondary non-ferrous metal production. He separately examined the determinants of secondary production for three metals, copper, lead and zinc.

Higashida and Managi (2013) also empirically showed that increased industrial activities in developing countries have escalated the demand for raw materials including recyclable materials from other countries. They showed higher labour productivity and domestic demand for metallic scraps significantly drives trade in wastes from developed and developing counties. In their analysis no empirical evidence was found for *waste haven effect* in developing countries.

In the waste haven literature Kellenberg (2012) is the first paper that empirically validated the presence “waste haven effect” in a cross-country analysis (92 countries for the year 2004). He considered bilateral waste trade to be function of difference in the degree of environmental stringency, difference in the productivity of the recycling industries between two countries and other country-specific characteristics (it includes common official language, distance, member of any trade agreements, etc.). Under gravity model setting he found that import of waste by home country increases by 0.32% for every 1% deterioration in its environmental stringency compared to the foreign country's standard. Hence difference in degree of environmental stringency was found to be one of the significant factors behind waste trade. He constructed a proxy for environmental stringency based on a survey[11].

There is much debate on the appropriate proxy to measure the degree of environmental stringency of a country. The main practical obstacle is unavailability of data and comparison of data across countries because the definition or the scale of stringency is subjective. Four major problems in measuring the degree of environmental stringency are multi-dimensionality[12], simultaneity[13], industrial composition[14], capital vintage[15]. To address the problem of multi-dimensionality [Levinson (1999a), Smarzynska and Wei (2004), Cole and Elliot (2003), Kellenberg (2012)] have constructed composite indices. However, Levinson and Brunel (2013) argued that these indices give ordinal measure of environmental stringency but not a cardinal measure. Researchers [Ederington and Minier (2003), Kellenberg (2009)] have used instrumental variable technique in order to avoid the problem of simultaneity. Due to unavailability of data on different dimensions sometimes it is difficult to construct an index. Cole and Elliot (2003), Grether De Melo (2003), Jug and Mirza (2005) Santis (2012) have used gross domestic product per capita (GDP per capita) as a proxy to measure the environmental stringency. In this paper, we used four different proxies to capture the difference in degree of environmental stringency between India and its trading partner- relative cleanliness of energy used, relative income, rule of law and government effectiveness rank rather than using an index.

In the Indian context no studies so far have empirically examined metallic waste import pattern and the underlying factors behind it. This paper empirically analyses factors behind India's metallic waste import from different source countries over a period of 1996-2012.

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[11] In his survey, company executives in each country were asked to rank the stringency of the country's air, water, chemical, and toxic waste regulations relative to other countries in the world based on a 1-7 scale.

[12] Environment is a multi-dimensional concept, so a single measure of stringency cannot capture the different dimensions. A particular regulation based on certain policy target will be specific only to that pollutant.

[13] The consequence of environmental regulation is assessed by observing its effect on certain dimensions like economic growth, pollution level etc. The problem of simultaneity arises from the fact that these factors may have influenced the formation of the regulations. So it is tautological.

[14] From the classical theory of trade we know that a country produces that commodity in which it has comparative advantage. Comparative advantage arises due to natural resources, skill of labor, transportation costs etc. difference in environmental stringency may alter the composition of the products produced by the industry. So, there may be a simultaneity problem.

[15] Capital vintage is the problem similar to "grandfathering" i.e. the existing pollution sources are subject to more lenient environmental stringency compared to the new sources of pollution. This also gives rise to the problem of simultaneity.

3. Waste import and regulatory environment of India

3.1 Metallic- waste import pattern (1996-2012)

The major exporters of metallic waste to India are United States, United Arab Emirates and European Union. Figure 1 below depicts an upward trend in metallic waste import by India from high-income countries[16] over the period 1996-2012. We can see India also import metallic wastes from low and middle income countries[17] but it is much lower than the quantity of waste imported from the high income countries. Thus it is evident that bulk of the metallic wastes in India comes from high-income countries, and its growth has been rather sharp since 2000. This indicates a possibility of waste haven effect.

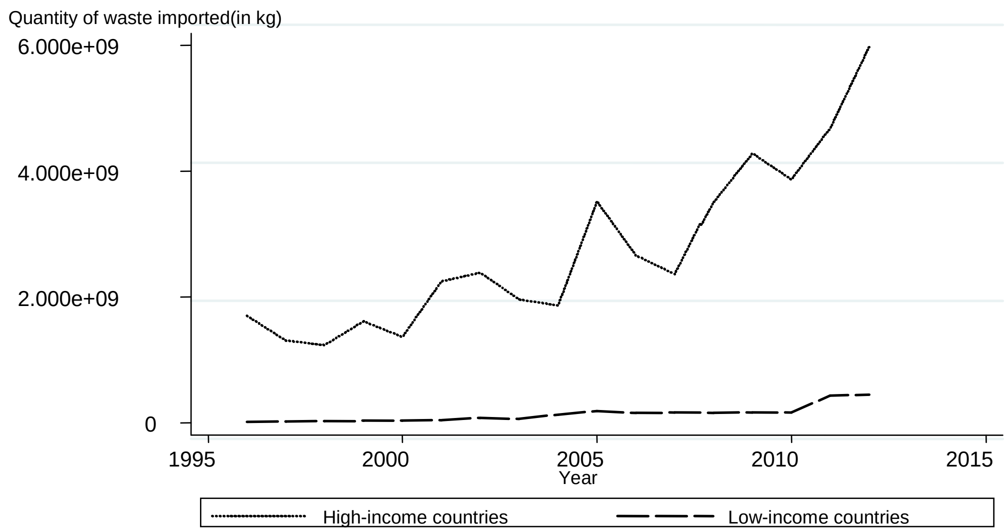

Fig1: Import of metallic waste and scrap by India from High income and low and middle income countries

Metallic wastes and scrap constitute the bulk of India's waste import bundle (78%-80% of the total quantity of waste import each year). Metallic wastes are highly recyclable[18] because of their homogeneous nature i.e. these are less contaminated with non-metallic substances and can be easily segregated due to their magnetic properties. These are cheap sources of raw materials in metal manufacturing and fabricated metal product manufacturing industries in India[19]. Ferrous wastes and scraps [which include iron and steel scraps] constitute a large share (approximately 89.9%) of the metallic wastes import bundle of India. Annual growth rate in the import of ferrous wastes and scrap

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[16] The definition of high income country is as given in UN Comtrade database. It includes OECD as well as non-OECD high income countries like Australia, Austria, Canada, Cyprus, Denmark, France, Italy, Japan, Korea etc.

[17] The definition is as given in the UN Comtrade database. It includes China, Mongolia, Indonesia, Philippines etc.

[18] Among the obsolete discarded goods which are dumped as wastes there are some products which can retain their chemical properties even after the end of their useful product-life. The categories of wastes are potential sources of valuable resources and are termed as recyclable wastes. Metallic wastes and scraps is one of the major recyclable waste categories and have high economic value attach to it.

[19] From the plant level data of Annual Survey of Industries in India (1998-99 to 2009-10) we observed that these metallic wastes and scrap are used as a one of the major basic raw materials in metal and fabricated metal product producing plants.

is about 23.1%. In the year 2012-13 the import of steel scraps has increased 25% [Metal recycling Association of India (2012-13 annual report)].

3.2 Waste import regulations in India

Following the Basel Convention norms, the Directorate General of Foreign Trade(DGFT) of India has formulated certain rules related to import of metallic wastes and scrap. According to the DGFT rules, import of metallic wastes and scrap are allowed only if they are not contaminated with hazardous materials like radioactive wastes or any other explosive materials like cartridges, shells etc. It has been made mandatory to submit certain documents to the custom officials at the port during the clearance of the goods: "i) Pre-shipment inspection certificate (PSIC) as per the format mentioned in annexure in appendix 5 of the DGFT Handbook. ii) Documents assuring that the consignment are not contaminated with explosive materials and free of any radiations (gamma rays or neutrons) and iii) Copy of the contract between the importers and exporters declaring that the consignment is free of radioactive elements and explosive materials." Import of metallic wastes and scrap in India is allowed only through some selected ports, listed in the DGFT Handbook[20].

Metallic waste and scrap is listed under hazardous material category in Annex-IX list B of the Basel Convention. Import of certain metallic scrap like ferrous scrap, aluminium scrap, zirconium scrap, tungsten scrap, copper scrap etc. do not requires license from DGFT. Import of antimony scrap, cadmium and lead scrap is strictly restricted. The licence for import of these scrap are given by DGFT only for the purpose of re-processing and re-use. Import of beryllium waste and scrap is strictly prohibited in India.

Following the Basel Conevention norms, the import of certain hazardous metallic wastes in India requires prior informed certificate and license from both the Directorate General of Foreign Trade (DGFT) in India and Ministry of Environment and Forests(MOEF).From the year 2008, with the amendment in the Hazardous Waste Management Rules (1989) of India, the Ministry of Environment and Forests (MOEF) also regulates trade in hazardous wastes by India. It permits import of wastes only for the purpose of recycling and re-use. Waste imported solely for the purpose of the disposal is not allowed by the MOEF. Proper management and treatment of imported wastes within the economy are to be done as per the Hazardous Waste Management Rules (1989).The MOEF also monitors the rate of indigenous waste generation and treatment facilities within the economy. Import of lead and cadmium scraps are allowed only for the purpose of recycling to the licence-holders. However import of iron and steel scrap, copper scrap, nickel scrap, aluminium scrap etc. are allowed freely.

There seems to be a dichotomy in India's approach towards hazardous wastes. While the Hazardous Waste Management Rule 2008 in India acknowledges production of secondary aluminium, copper, zinc etc. from its wastes and scrap as hazardous processes of secondary aluminium, copper, zinc etc. from its wastes and scrap as hazardous processes yet the DGFT and MOEF allows the import of these metallic scraps into India freely. It seems economic consideration[21]outweighed the environmental

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[20] Twenty-six ports are given permission through which metallic wastes may enter India. It is mentioned in detail in page-27 and 28 of the Handbook on procedure of export-import policy of India.

[21] Minimizing cost of production by using the more metallic wastes and scraps as raw materials in different manufacturing sectors can be defined as economic consideration.

aspect in formulation of India's legislation regarding the transboundary movement of hazardous waste.

It may be noted here that most of the toxic wastes like e-wastes, wastes contaminated with lead, mercury and beryllium exported from developed countries to developing countries are under reported or misreported because they are strictly restricted by the Basel Convention. It is rather difficult to trace the illegal channel of waste as it is often observed that the toxic e- wastes, labelled as "metal waste and scrap" (there is no separate industrial code for e-waste) are shipped to developing countries for the purpose of recycling. Recycling industries in developing countries have high demand for these "metal waste and scrap" as already discussed earlier. Ivanova (2007) showed that countries exporting these toxic wastes, bribe the government officials (especially custom officials at the port) of importing country to hide these illegal activities which further increases the problem of tracing the illegal channel of waste trade. As noted earlier, our paper analyzes only the legal waste import in India.

4. Determinants of metallic waste import by India and model specification

We model India's metallic waste import (M_{it}) from country i as a function of environmental stringency ($Envstr_{it}$) of country i compared to India, relative factor endowment (K/L_{it}) of country i, compared to India , home market demand for metal in India ($Mktdd_t$) and the size ($size_{it}$) ofr country i:

$$LogM_{it} = aEnvstr_{it} + b(K/L)_{it} + c(Mktdd)_t + d(size)_{it} + \alpha_i + \lambda_t + \varepsilon_{it} \qquad (1)$$

t=year
α_i *=country fixed effect*
λ_t *=year dummies (1996-2012)*
ε_{it} *=error*

There are two implicit assumptions in this model. We assumed that waste imported by India is solely used for the purpose of re-processing (rather than dumping) and it is a labour-intensive process.

As discussed earlier in section 2, construction of a proxy to capture the relative difference in the degree of environmental stringency was a major challenge in this analysis. We used four proxies. Relative GDP per capita ratio of partner country to India [Grether De Melo (2003), Jug and Mirza (2005) Santis (2012)], is used as one of the proxies in this study. Countries with higher per capita income tend to have higher ability to pay for maintaining the natural quality of the environment (income effect). To ensure good quality of environment stricter rules are implemented. This escalates price of waste disposal within the country. India characterised by lower GDP per capita will enjoy comparative advantage in terms of lower waste disposal costs. Hence high income countries in order to take advantage of this lower disposal costs will send their wastes to India. Positive sign of the coefficient *a*, in equation (1) will indicate presence of *waste haven effect* i.e. due to difference in the degree of environmental stringency the quantity of metallic wastes imported by India from its trading partner get positively affected.

Alternative to GDP per capita we used difference of two perception rankings between partner country and India; namely Government Effectiveness percentile ranking and Rule of law percentile ranking as a proxy. Government effectiveness captures the perception of the quality of services provided by the government, formulation and implementation of polices and government's accountability towards these polices. Rule of law captures the degree of agent's confidence in government policies and the extent to which they adhere to these rules. It also captures the crime and violence. These two proxies indicate effectiveness of regulations /rules and it's degree of adherence in a country. Thus the rank difference may reflect relative difference in degree of stringency of environmental rules between partner country and India. Higher the difference higher the degree of environmental stringency, higher will be the waste disposal costs in the partner country hence higher will be India's import of wastes from that country.

We also used relative ratio of carbon dioxide emission intensity per kg of energy used by India to its trading partner as an alternative proxy. It indicates the cleanliness of energy used in the country. Higher the degree of environmental stringency, lower will be the carbon-dioxide emission intensity per kg of the oil used under the assumption that stringent laws will induce use of cleaner alternative sources of energy in the country. This implies that if the ratio rises it implies that India has less stricter environmental laws hence waste imported by India from its trading partner must also rise.

Apart from the environmental stringency difference, relative factor-endowment difference between countries also forms the basis of waste trade [Copeland (1991), Rauscher (1999) and Baggs (2009)]. To capture this we used relative capital-labour ratio of trading partner to India at time t. The sorting of metallic wastes from other non-metallic substances requires huge amount of unskilled labour. India being a labour-abundant country is likely to have comparative advantage[22] in the process. Thus, as the ratio increases it implies that India is more labour-intensive compare to its partner country and hence it will import more wastes from its partner country. Positive sign of the coefficient *b* in equation (1) indicates relative labour abundance positively affect the quantity of waste imported by India.

There is an inverted U-hypothesis[23] related to the metal consumption and the per capita income of a country [Johnstone (1998)]. Accordingly, India being a developing country metal use is relatively high in its production processes. Hence market demand for metal as a raw material is high in different manufacturing sectors in India. Metallic wastes and scrap is a cheap alternative raw material to virgin metallic ores manufacturing industries. To capture the home market demand we used the annual growth in value added by the manufacturing sector in India. We expect that as the sector grows the demand for raw materials will also increase. A positive coefficient favours the argument that growth in manufacturing sector increases demand for metal and a part of this demand is met by the scrap import from different countries.

[22] The basis of comparative advantage follows from the price-definition of factor-abundance i.e. price of the abundant factor will be less.

[23] The metal consumption of a country in its production process increases with the increase in income. After reaching a certain limit with further increase in income the usages of metal in the production process decreases. Countries with high per capita income uses non-metallic substances like plastics, man-made fibres etc. in larger proportion compare to metal in their production process. The basic intuition is they become more environmentally concerned and uses products which are bio-degradable.

We also controlled for the relative size (land labour ratio of partner country to India) between India and its trading partner.

4. *Data*[24]

India's import of waste trade data is obtained from the UN Comtrade database[25] for the period1996-2012 for different metal waste and scrap categories at six digit HS codes(defined at 1996 harmonised system) The list of trading partners used in the empirical analysis is reported in the appendix in table A.2. The selection of the countries and the time-period of analysis are subject to data availability constraint. The UN Comtrade database reports both trade value and quantity for each metal-waste categories. We considered the quantity of metallic wastes, aggregated across different metal categories imported by India as the dependent variable.

The data on all the explanatory variables are obtained from the World Development Indicators. The data on Government indicators which are used as proxies for degree of environmental stringency are obtained from the World Government Indicators. The detail of all the explanatory variables is reported in the appendix in table A.3.

The empirical analysis involves panel regression. We separately used within or fixed effect estimation and between effect estimation techniques.

6. *Results*

The regression results are reported in staggered manner in Table 1 and 2 below.

Table1 below reports the within regression results. In our first specification R (1) we test the significance of home market demand while controlling for the relative labour intensity of India, and relative size. We find that India's home market demand and the size of the source country had a positive and statistically significant effect on the quantum of metal waste imported into India. The home market effect in particular is robust and remains highly in the staggered regressions.

The coefficient of environmental stringency is statistically insignificant irrespective of the proxy used to measure it in different specifications (R2-R5 in Table 1) government effectiveness, rule of law, Relative income per capita and cleanliness of energy used in the source country relative to India. In these specifications we test for the presence of *waste haven effect* for a trading partner after controlling for the relative factory intensity, relative size and home market demand effect. Only the home market demand remains highly significant in all these specifications. This indicates that in case of metal import there is no empirical evidence of waste haven effect in India and home market demand is the main factor in the growth of metallic waste and scraps import into the country.

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[24] We would like to thank the reviewers and participants of Young Scholar's Seminar, 2015 (CESP, JNU) and International Workshop on Economics,2015(University of Calcutta)

[25] The United Nation's Statistical Division (UNSD) maintains the UN Comtrade database. It provides merchandise trade (export and import) data by detailed commodity and partner countries (around 272 partner

Table 1: Within Regression (fixed-effect) results *Dependent variable: Log (Quantity of waste imported)*

	R1	R2	R3	R4#	R5##
Home Market Demand	2.648	2.602	2.487	3.028	2.537
	(0.339)***	(0.397)***	(0.418)***	(0.415)***	(0.355)***
Relative Factor Intensity	0.01	0.01	0.009	0.004	0.008
	(0.011)	(0.011)	(0.011)	(0.01)	(0.01)
Size	0.129	0.126	0.114	0.06	0.116
	(0.062)*	(0.059)*	(0.063)*	(0.065)	(0.068)*
Government Effectiveness		0.006			
		(0.025)			
Rule of Law			0.024		
			(0.029)		
Relative Income per capita				0.022	
				(0.014)	
Cleanliness of energy used					-0.046
					(1.001)
Time dummies	Yes	Yes	Yes	Yes	Yes
Observations	608	608	608	600	570
Number of country	38	38	38	38	38
R-squared	0.379	0.379	0.382	0.373	0.313

#For some of the year's data on relative GDP per capita data on Lithuania is not reported.
##Data on carbon dioxide emission intensity per kg of oil equivalent for each country included in our analysis is not reported for 2012.
*significant at 10%, **significant at 5%, ***significant at 1% .Robust standard errors are reported in the parentheses.

The between effect estimation results are reported in Table 2 below. In case of between-effect estimation we dropped the home market demand for metal as it does not vary between the cross-section units.

In R(1) specification we test for the significance of labour abundance of India in affecting its import from trading partners after controlling for the size. We find that the relative labour-intensive nature of India compared to its partner country is a highly significant factor that affected India's import of metallic wastes.

In R(2) - R(5) we include different proxies for environmental stringency, namely government effectiveness, rule of law, relative income per capita and cleanliness of energy used in the partner country to India. In these specifications we test for the presence of *waste haven effect* across India's trading partners after controlling for their relative factor abundance and size. As evident from the Table 2 below, the proxies for difference in degree of environmental stringency are all statistically insignificant. But relative labour abundance of India remains significant throughout. Hence there is no empirical evidence of waste haven effect in metallic waste import in India. But abundant labour supply and home market demand effect are the two significant factors behind India's metallic waste import.

Table 2: **Between-effect Regression results** *Dependent variable: Log (Quantity of waste imported)*

	R1	R2	R3	R4#	R5##
Relative Factor Intensity	0.103	0.093	0.095	0.079	0.1
	(0.036)****	(0.037)*	(0.037)*	(0.031)*	(0.035)*
Size	0.021	0.018	0.019	0.016	0.022
	(0.015)	(0.015)	(0.015)	(0.012)	(0.016)
Government Effectiveness		0.021			
		(0.02)			
Rule of Law			0.014		
			(0.016)		
GDP per capita				0.027*	
				(0.015)	
Cleanliness of energy used					-0.752
					(0.672)
Time Dummies	Yes	Yes	Yes	Yes	Yes
Observations	608	608	608	600	570
Number of country	38	38	38	38	38
R-squared	0.528	0.549	0.542	0.716	0.534

#For some of the years data on relative GDP per capita data on Lithuania is not reported.
Data on carbon dioxide emission intensity per kg of oil equivalent for each country included in our analysis is not reported for 2012.
*significant at 10%, **significant at 5%, ***significant at 1% Robust standard errors are reported in the parentheses.

Conclusion

This paper analysed different factors determining the import of metallic wastes in India from different source countries. Preliminary study of data suggests a possibility of waste haven effect in India. Using four proxies to capture the difference in the degree of environmental stringency between India and her partner countries, we find no empirical support for *waste haven effect* in India.

We find that relative labour abundance and high home market demand for metal in India appeared to be the most significant factors driving the import of metallic wastes and scrap through the period 1996-2012.

The results obtained in this paper support the argument of Copeland (1991), Rauscher (1999), Baggs (2009) that apart from environmental stringency difference there may be some other factors that may drive waste movement across countries(as discussed in Section 2). In this paper, factor endowment difference forms the basis of India's metallic waste import from different source countries. India being a labour-abundant country relative to the partner country enjoys a comparative advantage in metallic scrap sorting and processing. This indicates a Hecksher-Ohlin pattern of trade. Similar to Higashida and Managi (2013), we got no empirical evidence of *waste haven effect.* Our analysis also shows that home market demand effect plays an important role behind India's metallic waste import. As Johnstone (1998) also discussed that a part of the increased demand for metal in developing countries is satisfied through imports of scraps and wastes which are cheap alternative to virgin metallic ores.

In this entire analysis we assumed that metallic wastes that are imported by India and are solely used for the purpose of recycling (rather than dumping in illegal sites). The secondary metals produced from the recycled scraps are cheaper alternative to virgin metals. While this may have helped India in lowering the cost of production of different manufacturing sectors that use these secondary metals as their inputs, it does not capture the environmental and social costs arising from the processing of imported metallic wastes and scrap in the country. The production of secondary metals from metallic wastes is an economically viable option only if, *net benefits* from metal recycling activities is positive. This requires cost-benefit analysis of the entire process of crafting secondary metals from the metallic wastes. In Indian context not much is discussed on this. Hence, it remains an important area of future research work.

Recently, the tariff rate on metallic waste and scrap was increased from 2.5% to 5% [Jha (2013)]. The metallic scrap processing industries are affected by this move and are requesting the government to reduce the tariff rate. While the imposition of import tariff may seem to be an attempt to incorporate social and environmental cost of processing/ recycling these wastes, it is rather *ad hoc* since such decisions are not based on “optimal tariff” calculations to ensure that the final import price reflects the *true* marginal cost (internalizing the negative environmental externality) of an unit of metallic waste imported. Practice of producing secondary metals from metallic scraps definitely leads to conservation of natural resources but India needs to adopt policies to ensure safe handling of the scrap with adequate environmental protection to the surrounding ecosystem and the people involved in these activities.

Appendix

Table A.1 Metallic wastes and scrap categories with their HS codes included in the analysis

Category	***HS code (1996)***	***Commodity description***
Ferrous-metallic wastes and Scraps	711210	Waste and scrap of metal clad with gold but excluding sweepings containing other precious metals
	711220	Waste and scrap of platinum, including metal clad with platinum excluding sweepings containing other precious metals
	711290	Other (waste and scrap of precious metals excluding the above two category)
	720410	Waste and scrap of cast iron
	720421	Waste and scrap of alloy steel (stainless steel)
	720429	Waste and scrap of alloy steel other than the stainless steel
	720430	Waste and scrap of tinned iron or steel
	720441	Other waste and scrap:- turnings , shavings, chips milling waste, saw dust
	720449	Other ferrous waste and scrap
Non-ferrous Metallic scraps	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
	810191	Tungsten waste and scrap
	810291	Molybdenum waste and scrap
	810310	Tantalum waste and scrap
	810420	Magnesium waste and scrap
	810600	Bismuth waste and scrap
	810710	Cadmium waste and scrap
	810810	Titanium waste and scrap
	810910	Zirconium waste and scrap
	811000	Antimony waste and scrap
	811100	Manganese waste and scrap
	811211	Beryllium waste and scrap
	811291	Beryllium; other waste and scrap

Table A.2 Countries included in the empirical analysis

European Union	Austria, Belgium , Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece ,Hungary, Ireland, Italy, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom
North America	Canada , United States of America
Latin America	Brazil, Mexico
Asia and Pacific	China, Australia, Turkey, Russian Federation, Japan, Korea, Indonesia, United Arab Emirates

Table A.3: Data sources of different explanatory variables

Variables	***Units***	***Data Source***
Quantity of waste imported	KG	UN Comtrade database: https://wits.worldbank.org
GDP per capita	Constant US dollar(2005=100)	World development Indicators:data.**world**bank.org/data-catalog/**world-development-indicators**
Government Effectiveness Percentile Rank		World Government Indicators:data.worldbank.org › Data Catalog
Rule of Law Percentile Rank		World Government Indicators : data.worldbank.org › Data Catalog
Market Capitalisation[26]	Current US dollar	World Development Indicators: data.**world**bank.org/data-catalog/**world-**
Total labor force	Units	World Development Indicators:data.**world**bank.org/data-catalog/**world-**
Total land area	Square kilometre	World Development Indicators: data.**world**bank.org/data-catalog/**world-development-indicators**
Carbon-dioxide intensity	in Kg per kg of oil equivalent energy	World Development Indicators:data.**world**bank.org/data-catalog/**world-development-indicators**

References

Baggs, Jen (2009), "International Trade in Hazardous Waste", *Review of International Economics*, 17(1): 1-16.

Bouman, Mathijs N. and Pieter J.H. Beukering (2009), "Empirical Evidence on recycling and Trade of paper and lead in Developed and Developing countries", *World Development* 29:1717-1737

Cassing, James and Thomas Kuhn (2003), "Strategic Environmental Policies when waste Products are tradable", *Review of international Economics* 3(11):445-511 16

Cole, Mathew and Elliot J.R. Robert (2003), "Determining the trade-environment composition effect: the role of capital, labor and environmental regulations", *Journal of Environmental Economic and Management*, Vol. (46):363-383

Copeland, Brain R (1991), "International trade in Waste products in the Presence of illegal Disposal", *Journal of Environmental Economics and Management*, 20(2) 143-162

Dwivedy, Maheshwar and R.K Mittal (2010), "Estimation of future outflows of e-waste in India" *Waste Management*, 30:483-491

Government of India (2007), Ministry of Environment and Forests Hazardous Wastes (Management and Handling) Rules (2007), published in the Gazette of India, Extraordinary, Part-II, section 3, subsection (ii), New Delhi

Grether, Jean-Marie and Jaime Melo (2003), "Globalization and dirty industries: do pollution havens matter?", *National Bureau of Economic Research(NBER) working paper series, 9776*

Higashida, Keisaku and Shunsuke Managi (2013), "Determinants of trade in recyclable wastes: evidence from commodity-based trade of waste and scrap", Environment and

[26] Market Capitalisation (also known as market value) is defined as share price times the number of share outstanding. This is used as a proxy for capital in our analysis.

Development Economics, Vol. (1): 1-21

Jha, Kumar Dilip (2013), "India to lose Rs, 11,000 cr. metal castings export market on levy", Business Standard, Mumbai, 28.05.2013

Johnstone, Nick (1998), "The implications of Basel Convention for developing countries: the case of trade in non-ferrous metal-bearing waste", *Resources, conservation and recycling*, 23: 1-28

Kellenberg, Derek (2010), "Consumer Waste, Backhauling & Pollution Haven" *Journal of Applied Economics;* 13:283-304

Kellenberg, Derek (2012), "Trading Wastes", *Journal of Environmental Economics and Management* 64:68-87

Khetriwal- Sinha, Deepali Philipp Kraeuchi and Markus Schwaninge (2005), "A comparison of electronic waste recycling in Switzerland and in India", *Environmental Impact Assessment Review,* 25: 492-504

Tata-Bhada, Perinaz and Daniel Hoorweg (2012), What a Waste: global review of solid Waste Management Working paper of urban development & local government unit of World Bank, 15

Thakker, Nisha (2006), "India's Toxic Landfills: A dumping ground for the World's Electronic waste", Sustainable Development Law and Policy, Vol. (6):58-61

Rauscher, Michael (1999), "International Trade in Waste", ECONSTOR working paper No.19, www.econstor.eu/bitstream/10419/78285/1/wp019thuenen.pdf