Trade and Environment in Indonesia: An Input-output Approach

(Perdagangan dan Lingkungan di Indonesia: Pendekatan Input-output*)*

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ABSTRACT

This study explores the trade and environment in Indonesia. This article aims to examine whether Indonesia is a pollution haven for its trade partners using an input-output framework from 2010 to 2014. The pollution haven can be examined by calculating how much carbon emissions will increase if exports increase by 1 million dollars and how much pollution would decline because of importing products that are not produced in Indonesia. The findings reveal mixed evidence during the period of the study. The evidence from 2012 to 2014 display that Indonesia was not a pollution haven, whereas the findings from 2010 and 2011 show that the pollution haven hypothesis was most likely to hold in Indonesia. Environmental regulations should emphasize the direct and indirect emissions which are generated during the production process of traded goods.

Keywords: international trade, carbon emissions, input-output

ABSTRAK

Studi ini menganalisis mengenai perdagangan dan lingkungan di Indonesia. Artikel ini menelaah apakah Indonesia adalah pollution haven *bagi partner dagangnya dengan menggunakan kerangka input output dari tahun 2010 hingga 2014.* Pollution haven hypothesis *dapat dianalisis dengan menghitung berapa banyak emisi karbon yang akan meningkat apabila ekspor meningkat sebesar satu juta US dolar, dan berapa banyak polusi yang akan berkurang jika mengimpor produk yang tidak lagi diproduksi di Indonesia. Hasil studi menunjukkan bukti yang beragam selama periode penelitian. Pada tahun 2012 hingga 2014, Indonesia bukanlah* pollution haven*, sedangkan hasil pada tahun 2010 dan 2011 menunjukkan bahwa* pollution haven hypothesis *kemungkinan besar terjadi di Indonesia. Regulasi lingkungan perlu ditekankan pada emisi langsung dan tidak langsung yang dihasilkan selama proses produksi barang-barang yang diperdagangkan.*

Kata kunci: pollution haven hypothesis, *perdagangan internasional, analisis* input-output

I. Introduction

1.1. Background

Some concerning problems that pose a challenge to global society are climate change and global warming. Human-produced greenhouse gases, such as carbon emissions, are one of the factors contributing to these problems. Conforming to the Intergovernmental Panel on Climate Change (IPCC), anthropogenic emissions increase the number of such gases in the atmosphere, which results in climate change on Earth (Stocker et al., 2013). Additionally, industrial processes and fuel combustion carbon emissions contributed to around 78% of the increase in greenhouse gas emissions between 1970 and 2010. These emissions of anthropogenic greenhouse gases reached 49 gigatons of CO2-eq/year in 2010 (IPCC, 2014).

Another phenomenon that currently happens is globalization. OECD defines globalization as an increase of markets internationalization of goods and services, the production inputs, competition, corporations, financial systems, technology, and also industries. Globalization induces an increase to raise capital mobility, rapid proliferation of innovation in technology and a rising interdependence and national markets uniformity (OECD, 2013). However, as global production becomes more fragmented, countries specialize in specific stages and connect worldwide through diverse trade links. The pollution haven theory is an essential discussion on the environmental effects of global trade. It has grown more complex as global industrial fragmentation alters the pattern of international trade (Zhang et al., 2017). According to the pollution haven theory, the disparity in environmental policies between developing and developed nations may cause a shift in production from developed countries and a specialization in industries that produce large amounts of pollution in emerging nations (Cole, 2004).

Heckscher-Ohlin's (H-O) theory predicts that developing nations will have a comparative advantage in emission-intensive commodities due to their stringent environmental regulations compared to advanced countries, which results in the production of 'dirty' products will be shifted to emerging economies through international trade. Thus, the trade will have an impact on environmental challenges that already exist in developing countries with laxer environmental regulations. Hence, developing countries become a haven for pollution for other countries by exporting 'dirty' goods and importing 'clean' products (Dietzenbacher & Mukhopadhyay, 2007).

1.2. The problems

The largest economy in the Southeast Asia region is Indonesia, but its economy depends heavily on natural resources as a significant producer and exporter of minerals, energy sources, and agricultural goods. In addition, the manufacturing sector of Indonesia, which contributes nearly 20% of the GDP, is crucial as well (Statistics Indonesia, 2022). Furthermore, Indonesia's electricity supply continues to be dominated by fossil fuels, particularly coal. The majority of Indonesia's power capacity in 2019 stemmed from coal (OECD, 2021).

Indonesia has pledged to reduce emissions by 29 percent by 2030 and up to 41 percent, conditional on international support according to the ratification of the Paris Agreement to The United Nations Framework Convention on Climate Change. However, Indonesia is one of the main greenhouse gasses emitters (WRI, 2020).

Several countries have already implemented emission reduction measures. The European Union (EU), for instance, has already imposed environmental regulations to cut emissions, such as the European Green Deal. Japan, one of Indonesia's principal trading partners, has also been enforcing a carbon tax system since 2012. However, it has a lower rate than other developed nations (Gokhale, 2021). Meanwhile, China, another significant trading partner of Indonesia, is one of the major greenhouse gas emitters. Such carbon instruments are relatively new in Indonesia, where emissions will be taxed starting in 2022, albeit limited to power plants. The pollution haven theory predicts that in terms of pollution, a developing country to lose from increased trade while its trading partner gains. Hence, this study examines whether Indonesia acts as a pollution haven for its trade partners.

1.3. Logical Framework

There has been an increase in globalization, structural changes in the industry, and international trade flows, which has led to the rise in the amount of research studying the role of trade in determining CO2 emissions. In terms of the production and consumption sides, international trade plays an essential role in the changes of emissions (Peters, 2011). According to Copeland and Taylor (2003), a region or country that concentrates on polluting industry and has laxer pollution control regulations than its trading partners is a pollution haven. This is because the 'dirty' industries will locate in nations with less rigorous environmental regulations, highlighting one factor affecting where dirty industries are situated globally. Reduced trade barriers will cause sectors that produce a lot of pollution to move from nations with strict regulations to those with laxer ones. The pollution haven hypothesis from the standpoint of trade, advanced countries have more stringent environmental standards than developing countries; the latter will export 'dirty' goods and import 'clean' products (Dietzenbacher and Mukhopadhyay, 2007). As a result, trade may contribute to environmental issues.

Several studies examine the existence of the pollution haven hypothesis using FDI. The pollution-intensive industries of advanced countries are shifted towards developing countries through FDI; hence the former is clean as they transferred their polluting industries (Gill et al., 2018). However, firms consider various factors, including market potential, institutional quality, and production costs, when determining the destinations for outward FDI. Furthermore, FDI and trade are interdependent since FDI patterns influence trade patterns, and the profitability of trade choice affects the profitability of different types of FDI (Helpman, 2011). This would imply that increased FDI can lead to establishing a pollution haven if FDI occurs because firms seek to minimize production costs. On the contrary, FDI would not affect the pollution haven theory, for instance, if a firm's primary motivation for doing so is to be close its consumers or market potential.

However, other factors that affect production costs, such as the cost of capital and labor, might be more significant (Antweiler et al., 2001). In addition, products which pollution-intensive are typically capital-intensive, and developed nations are more likely to have strict environmental regulations and large capital endowments (Kim et al., 2019).

Given that capital and pollution tend to be related to each other, the various capital costs may have a substantially more significant impact. The pollution haven theory might not be confirmed as a result. The Factor Endowment Hypothesis is the alternative explanation to the pollution hypothesis. This Factor Endowment Hypothesis, according to Antweiler et al. (2001), predicts that dirty capital-intensive industries will move to advanced countries with capital abundance.

Substantial evidence is shown by Kim et al. (2019) that trade benefits developed economies but could have a detrimental effect on emerging economies in terms of emissions when it involves high-income trading partners. They applied a panel analysis on data from 131 developing and developed countries and confirmed predictions of a race to the bottom and the emergence of pollution havens. It is likely because trade has not permitted the proliferation of cleaner technology or rewarded more efficient resource usage for counterweighting the development of the pollution haven.

Dietzenbacher and Mukhopadhyay (2007) examine the pollution haven hypothesis in India using commodity input-output tables. They determine whether India is a pollution haven when the additional pollution caused by exports exceeds the additional pollution caused by an increase in imports. The result is that in spite of significant trade expansion, India has moved even further away from being a pollution haven. The findings appear to be consistent with the Factor Endowment Hypothesis, according to which capital-intensive industries are closely related to those that have high pollution levels.

Using a multi-region input-output framework from 1995 and 2009, Zhang et al. (2017) investigate whether a nation's participation in global value chains causes an increase or decrease in worldwide emissions. The results suggest that the pollution haven hypothesis does not hold, as international production fragmentation generates emissions savings. From a country's perspective, there are significant differences between the emissions produced by various economic activities in each nation, which is linked to each country's share in global value chains. Meanwhile, López et al. (2013) observe the trade relationship between Spain and China using a bi-regional input–output framework. They found that the specialization of countries in various production stages and the trading of final goods affects changes in global emissions.

II. Methods

2.1. Data

This study aims to explore to what extent Indonesia acts as a pollution haven for its trade partners using input-output analysis from 2009 to 2014. The national input-output table (NIOT) of Indonesia, which highlights the interdependencies within the industries, was obtained from the World Input-Output Database of the 2016 release version (Timmer et al., 2015). This World Input-Output Database (WIOD) of 2016 release utilizes the International Standard Industrial Classification Revision 4 (ISIC Rev. 4) to classify data for 56 industries. The National Input-Output Tables from WIOD are defined in millions of US dollars. However, it is expressed in current prices. The satellite account for carbon emissions data in this study is retrieved from The Joint Research Centre of the European Commission (Corsatea et al., 2019), which is in concordance with the sector classification of the WIOD-2016 release.

2.2. Input-output analysis

Consider an input-output model followed Miller and Blair (2009), which can be expressed as

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{f} \qquad (1)$$

where the **A** matrix denotes direct input coefficient matrix with the size of *n x n*, and *n x 1* vector **x** denote the production value or gross output in each sector. Input coefficients calculated from $a_{ij} = z_{ij}/x_j$ which reflect the input from sector *i* which are required for output in sector *j*. Vector **f** gives the *n x 1* total final demands vector, obtained by summing over columns of matrix final demands (**F**). Rewriting the equation (1) as **(I-A) x = f**, where matrix **I** is $n \times n$ identity matrix infers that the solution for the equation (1) as

$$\mathbf{x} = (\mathbf{I}-\mathbf{A})^{-1}\,\mathbf{f} \qquad (2)$$

The matrix $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$ denotes the Leontief inverse matrix and each element represents the extra gross output in sector *i* required (directly and indirectly) for one extra USD of final demand (export or domestic) for product *j*.

Given a new final demand vector $\tilde{\mathbf{f}}$, with the assumption of fixed input coefficients, then the gross outputs vector of gross outputs is $\tilde{\mathbf{x}} = (\mathbf{I} - \mathbf{A})^{-1}\tilde{\mathbf{f}} = \mathbf{L}\tilde{\mathbf{f}}$. As this model is linear, then it can be written in terms of change as $\Delta\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}(\Delta\mathbf{f}) = \mathbf{L}(\Delta\mathbf{f})$ which indicates the extra output (in monetary terms) corresponds to vector $\Delta\mathbf{f}$ of extra final demands.

Furthermore, we can calculate the emissions coefficients and emissions multipliers by using satellite account. The emissions coefficients reflect the carbon emissions that are generated per million USD of output of sector *j*. While the emissions multipliers indicate the amount of carbon emissions are embodied to meet the final demand for sector *j*. Supposed that vector **c** represents the vector of carbon emissions,

$$\boldsymbol{c_i} = \begin{pmatrix} c_1 \\ \vdots \\ c_n \end{pmatrix} \quad (3)$$

$where\ i = 1, 2, \dots, n$

Then emissions coefficient $(\mathbf{ec})$ is obtained from

$$ec_i = c_i / x_i \quad (4)$$

$\mathbf{ec}$ are expressed in kilotons/million USD as carbon emissions are in kilotons (kt).

By multiplying the emissions coefficient (**ec**) with the Leontief inverse matrix (**L**), we obtain $\mathbf{ec}'\mathbf{L}$, that is the emissions due to production required for final demand for the product *j*. This $\mathbf{ec}'\mathbf{L}$ denotes carbon multipliers. Any arbitrary change of final demand $(\Delta\mathbf{f})$ would yields the extra total carbon emission as

$$\mathbf{ec}'\mathbf{L}\Delta\mathbf{f} \quad (5)$$

The *j*th element of vector $\mathbf{ec}'\mathbf{L}\Delta\mathbf{f}$ implies the extra carbon emissions which directly and indirectly embodied in the extra final demand $\Delta\mathbf{f}_{\mathrm{j}}$.

To examine the existence of the pollution haven hypothesis, this study follows the methodology utilized by Dietzenbacher and Mukhopadhyay (2007). Assuming that the world consists of two regions: Indonesia and the rest of the world (RoW), we compute how much emissions would increase in Indonesia if exports were increased by 1 million USD, based on the actual share of each industry in total exports. In a similar manner, we estimate how much emissions in Indonesia would decrease if its imports were increased by $1 million. The underlying idea is that because the imported products are not produced in the country anymore, resulting emissions will be reduced.

Supposed that export vector is defined as $\mathbf{e}_{\mathrm{IDN}}$, and the vector of import is defined as $\mathbf{m}_{\mathrm{IDN}}$. Matrix **W** contains matrix imports, and splits out based on sectors, but we solely focus on import rows, and do not take into account wages and salaries rows. By computing the sums of each row of import matrix from matrix **W**, we obtain the import vector $(\mathbf{m}_{\mathrm{IDN}})$.

Furthermore, suppose that the vector of $\mathbf{exps}_{\mathrm{IDN}}$ and $\mathbf{imps}_{\mathrm{IDN}}$ describe the export and import shares of Indonesia that sum to one million US dollars. However, later on results section, these will be expressed in percentage in table 1 (multiplying the vector shares $\mathbf{exps}_{\mathrm{IDN}}$ and $\mathbf{imps}_{\mathrm{IDN}}$ by 100%). To estimate how much emissions are embodied in one million USD of Indonesia exports and imports, we multiply carbon multipliers by the export and import shares, hence written as $\mathbf{ec}'\mathbf{L}(\mathbf{exps}_{\mathrm{IDN}})$ and $\mathbf{ec}'\mathbf{L}(\mathbf{imps}_{\mathrm{IDN}})$ respectively.

Thus, the increase in the export of Indonesia indicates that the emissions are increased by $\mathbf{ec}'\mathbf{L}(\mathbf{exps}_{\mathrm{IDN}})$, while the increase in Indonesia's import implies that the emissions are decreased by $\mathbf{ec}'\mathbf{L}(\mathbf{imps}_{\mathrm{IDN}})$ since the products are not produced at Indonesia anymore. Furthermore, summing the columns of the emission embodied generates the total carbon emissions embodied in 1 million USD of Indonesian exports and imports. Then, the ratio of carbon emissions embodied in export to carbon emissions embodied in import can be calculated using the total pollution embodied in replacement imports and exports.

III. Results and Discussions

Table 1 shows the extra emissions attributable to 1 million USD of additional Indonesia's exports and imports in 2014. Notable differences in pollution caused by export and pollution generated by import correspond with a significant difference in export and import shares or a large multiplier. From table 1, it can be seen that the most significant carbon emission multipliers in 2014 are Electricity, gas, steam, and air conditioning supply (6.23), Manufacture of other non-metallic mineral products (2.83), and air transport (2.15). The industry of the Electricity, gas, steam, and air conditioning supply had the highest multiplier, but there was no export, and its import was relatively small. Hence the import pollution of this industry was not exceptionally significant. Furthermore, the sector of Manufacturing coke and refined petroleum products distinguishes out due to its third-largest export share, second-largest percentage of imports, and quite substantial multipliers (0.82).

Closer inspection of table 1, the most prominent sector in the export of Indonesia are Mining and quarrying, Manufacture of food products, beverages and tobacco products, Manufacture of textiles, wearing apparel and leather products, Manufacture of coke and refined petroleum products, and Manufacture of rubber and plastic products. Meanwhile, the three most essential sectors in import of Indonesia are the Manufacture of coke and refined petroleum products, the Manufacture of chemicals and chemical products, the Manufacture of computer, electronic and optical products, the Manufacture of machinery and equipment n.e.c, and Mining and quarrying sector. These demonstrate that manufacture and mining industries are important in Indonesian trade.

How much would carbon emissions have been involved if domestic production had taken the place of one million USD in imports? The underlying idea is that increased trade entails more pollution due to an increase in exports but less pollution because of an increase in imports. Hence, for a pollution haven, the first effect is larger than the latter, resulting in a net increase in pollution (Dietzenbacher and Mukhopadhyay, 2007). It should be noted that when importing, the products imported are no longer produced at home. We can observe from Table 1 on the bottom row that export pollution is slightly lower than import-related pollution in Indonesia during this period. Therefore, we can say that in 2014, Indonesia gained from trade in terms of pollution.

Table 1. Emissions generated from an increase in trade of 1 million of USD in Indonesia, 2014

Sectors	Trade		CO2 (kt)		
	Export share (%)	Import Share (%)	Multiplier	Export Pollution	Import Pollution
(1)	(2)	(3)	(4)	(5)	(6)
Crop and animal production, hunting and related service activities	1.15	4.22	0.17	0.0020	0.0073
Forestry and logging	0.07	0.03	0.33	0.0002	0.0001
Fishing and aquaculture	0.57	0.01	0.13	0.0007	0.0000
Mining and quarrying	21.68	6.33	0.63	0.1362	0.0398
Manufacture of food products, beverages and tobacco products	15.65	5.83	0.18	0.0278	0.0103
Manufacture of textiles, wearing apparel and leather products	9.47	4.14	0.41	0.0390	0.0170
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	2.18	0.23	0.35	0.0076	0.0008
Manufacture of paper and paper products	2.78	1.60	0.61	0.0168	0.0097
Printing and reproduction of recorded media	0.01	0.06	0.46	0.0000	0.0003
Manufacture of coke and refined petroleum products	6.75	15.21	0.44	0.0299	0.0674
Manufacture of chemicals and chemical products	5.68	10.85	1.00	0.0567	0.1082
Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.86	0.98	0.24	0.0021	0.0023
Manufacture of rubber and plastic products	6.43	2.24	0.38	0.0247	0.0086
Manufacture of other non-metallic mineral products	0.47	0.75	2.83	0.0133	0.0212
Manufacture of basic metals	4.41	6.21	0.94	0.0416	0.0585
Manufacture of fabricated metal products, except machinery and equipment	1.09	3.06	0.59	0.0065	0.0181
Manufacture of computer, electronic and optical products	4.68	9.97	0.34	0.0159	0.0338
Manufacture of electrical equipment	2.91	3.76	0.47	0.0138	0.0178
Manufacture of machinery and equipment n.e.c.	1.04	8.84	0.21	0.0022	0.0186
Manufacture of motor vehicles, trailers and semi-trailers	2.66	4.11	0.19	0.0050	0.0077
Manufacture of other transport equipment	0.62	1.35	0.25	0.0015	0.0033
Manufacture of furniture; other manufacturing	3.02	0.62	0.50	0.0152	0.0031
Repair and installation of machinery and equipment	0.00	0.03	0.00	0.0000	0.0000
Electricity, gas, steam and air conditioning supply	0.00	0.08	6.23	0.0000	0.0051
Water collection, treatment and supply	0.02	0.18	0.16	0.0000	0.0003
Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services	0.00	0.03	0.00	0.0000	0.0000
Construction	0.14	0.27	0.44	0.0006	0.0012
Wholesale and retail trade and repair of motor vehicles and motorcycles	0.00	0.06	0.19	0.0000	0.0001

Cont. **Table 1**

Sectors	Trade		CO2 (kt)		
	Export share (%)	Import Share (%)	Multiplier	Export Pollution	Import Pollution
(1)	(2)	(3)	(4)	(5)	(6)
Retail trade, except of motor vehicles and motorcycles	0.00	0.33	0.20	0.0000	0.0007
Land transport and transport via pipelines	0.08	0.52	0.44	0.0004	0.0023
Water transport	0.25	0.08	1.83	0.0046	0.0014
Air transport	0.59	0.86	2.15	0.0128	0.0186
Warehousing and support activities for transportation	0.16	0.22	0.56	0.0009	0.0013
Postal and courier activities	0.06	0.00	0.35	0.0002	0.0000
Accommodation and food service activities	1.66	1.70	0.17	0.0028	0.0029
Publishing activities	0.21	0.25	0.30	0.0006	0.0008
Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities	0.15	0.35	0.11	0.0002	0.0004
Telecommunications	0.43	0.30	0.10	0.0004	0.0003
Computer programming, consultancy and related activities; information service activities	0.10	0.24	0.20	0.0002	0.0005
Financial service activities, except insurance and pension funding	0.04	0.21	0.11	0.0000	0.0002
Insurance, reinsurance and pension funding, except compulsory social security	0.01	0.26	0.08	0.0000	0.0002
Activities auxiliary to financial services and insurance activities	0.00	0.00	0.00	0.0000	0.0000
Real estate activities	0.10	0.13	0.08	0.0001	0.0001
Legal and accounting activities; activities of head offices; management consultancy activities	0.82	1.17	0.18	0.0015	0.0021
Architectural and engineering activities; technical testing and analysis	0.00	0.01	0.00	0.0000	0.0000
Scientific research and development	0.00	0.01	0.00	0.0000	0.0000
Advertising and market research	0.00	0.02	0.00	0.0000	0.0000
Other professional, scientific and technical activities; veterinary activities	0.00	0.00	0.00	0.0000	0.0000
Administrative and support service activities	0.40	0.12	0.20	0.0008	0.0003
Public administration and defence; compulsory social security	0.20	0.35	0.23	0.0005	0.0008
Education	0.04	0.17	0.23	0.0001	0.0004
Human health and social work activities	0.11	0.28	0.26	0.0003	0.0007
Other service activities	0.25	0.23	0.80	0.0020	0.0018
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.00	0.00	0.0000	0.0000
Activities of extraterritorial organizations and bodies	0.00	0.00	0.00	0.0000	0.0000
Sum	100.00	100.00		0.4876	0.4988

Source: Author’s calculation

Scrutinize in the industry levels, the Mining and quarrying sector had the most significant export pollution in 2014, with approximately 136 tons of carbon emissions involved both directly and indirectly in an increase of 1 million USD of export. Remarkably, its multiplier is 0.63, but its export share is the highest; thereby, the emissions embodied in the export of the mining industry is the most noteworthy. The Manufacturing of chemicals and chemical products, accounting for about 56 tons of carbon emissions for $1 million in exports from Indonesia, is the second-largest polluter of exports. This industry's carbon emissions multiplier is the fifth highest (1.00), surpassing that of the mining sector, indicating that it is more polluting. The emissions required to meet the (additional) one million USD of export in the Manufacturing of chemicals and chemical products industry are significant because of its remarkable multiplier, despite the fact that its export share is not the highest.

Table 2. Export to import emissions ratio of Indonesia

Year	Export to import ratios of emissions	Values of (in million USD)	
		Exports	Imports
(1)	(2)	(3)	(4)
2010	1.038	183,521	157,932
2011	1.014	235,218	199,796
2012	0.995	225,860	214,770
2013	0.976	219,714	211,524
2014	0.977	210,599	203,017

Source: Author's calculation

Table 2 reveals the export-to-import pollution ratio of Indonesia and the total values of exports and imports from 2010 to 2014. The ratio values shown in column (2) of table 2 are obtained in the same way as the sums at the bottom of table 1. Changes in relative prices might have been accountable for the export and import value increases between 2010 and 2014. These increases may also be somewhat attributable to the overall inflation rate.

The export-to-import ratios of pollution should be greater than one for a pollution haven. As we can see in table 2, from 2010 to 2011 Indonesia lose from trade in terms of pollution as the increase in emissions generated from the extra exports is higher than the pollution reductions due to extra imports, while its trading partners will benefit in terms of emission. Furthermore, from 2012 to 2014, Indonesia was not a pollution haven as the emissions reduction because of the increased imports was larger than the increase in emissions because of extra imports, although the ratio values were merely slightly below one.

A plausible explanation is that Indonesia has a comparative advantage in emission-intensive sectors, consequently exporting those products. In this circumstance, the Mining and quarrying industry is crucial to

Indonesia's trade. Scrutinizing the findings for all periods of the study, the discrepancy between the ratio of export pollution and import pollution was merely minor, revealing that Indonesia was likely to had a tendency as a pollution haven. Therefore, rather than supporting the factor endowment hypothesis, the findings are more likely to support the theory of the pollution haven hypothesis.

IV. Conclusion and Recommendation

This study aims to examine whether Indonesia act as a pollution haven for its trade partner from 2010 to 2014 using input-output analysis. Calculating how much emissions will increase if exports rise by 1 million USD and how much emissions will decrease because of importing products not produced in Indonesia allows for examining the pollution haven hypothesis. The results reveal mixed evidence during the study period, from 2012 until 2014, that Indonesia was likely not a pollution haven. Meanwhile, in 2010 and 2011, the finding revealed the opposite. Therefore, it was likely that the pollution haven hypothesis holds in Indonesia.

Examining the findings for all research periods, the difference in the ratio of export pollution to import pollution was merely minor, indicating that Indonesia was likely to be a pollution haven. As a result, the findings are more likely to corroborate the notion of the pollution haven hypothesis than the factor endowment hypothesis. In contrast, Dietzenbacher and Mukhopadhyay (2007) found that along with the trade expansion, India has moved even further away from being a pollution haven, supporting the Factor Endowment Hypothesis.

Several policy recommendations can be drawn from the above analysis. Given that CO2 emissions have increased in Indonesia over the past few years, more environmental regulations should be taken into account. Regulations need to focus on the direct and indirect emissions which are generated during the production process of traded goods, particularly in emission-intensive sectors. Additionally, balancing environmental protection and economic development is necessary.

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